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Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Project No. 101076277

Deliverable 3.3 – Training material

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About this document

This document presents the training program (definitions, trainees' groups, purpose and proposition of the training program an indicative agenda and training modules). The document sets out a framework for training of the personnel of One Stop Shops (OSSs) and REVERTER Ambassadors (RAs) in the four REVERTER pilots.

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Executive summary

The EU-funded project REVERTER aims to contribute to the reduction of energy poverty and improvement of quality of life of people in Europe by providing homeowners, tenants and landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which aim at capacity building and knowledge sharing by developing dedicated training programs and materials for different target groups, i.e., One-stop shop (OSS) personnel, REVERTER Ambassadors (RAs) and vulnerable households.

REVERTER will implement community engagement campaigns, trainings and will advise the identified households on improvement of their levels of comfort or reduction of energy consumption by low-cost measures.

More specifically, the objective of *Task 3.4. Setting up REVERTER Ambassadors and OSS personnel training program* is to establish training programs and relative materials for the RAs and the personnel of the pilot OSSs. The training will focus on issues such as:

- social inclusion;
- no- or low-cost measures to cope with EP;
- simple technical issues of energy saving in households;
- retrofitting practices;
- benefits of retrofitting;
- energy financing mechanisms and innovative tools, etc.;
- establishment and operation of OSS.

This deliverable summarises the basis for the establishment of the training program by identifying relevant training materials for the aforementioned topics, identifies and analyses the different groups of trainees, discusses appropriate topics to be specifically targeted at the different trainees' groups, develops the educational curriculum and lays out an indicative training agenda.

The detailed training modules are presented in Annexes I and II of the deliverable. It is noted that for some training topics (e.g., national legislation), the English version provides only summary information; the detailed text will be available in REVERTER pilot's national languages. Finally, Annex III presents the first leaflet that has been created to provide vulnerable households with practical tips on how to reduce their energy bills and improve their well-being.

Table of Contents

List of Tables

Glossary

Abbreviation / acronym	Description
EP	Energy Poverty
OSS	One-stop shop
RAs	REVERTER Ambassadors
HHs	Households
GDPR	General Data Protection Regulation

1 Recipients of training

1.1 OSSs personnel

The OSSs personnel will consist of staff members of the partners of the project, especially those who are responsible for the pilot implementation of the roadmaps. At least 25 OSSs providers will be trained on how to operate the OSS. The OSSs providers can be permanent or fixed-term members of the staff. In case one or more stakeholders are interested in operating their own OSSs, local partners will train the stakeholders' staff and provide all the information material.

As described in D3.1 Global Methodology, the OSSs personnel will be trained on how to approach energy vulnerable households and to increase renovation demand through marketing and communication measures for specific target groups (e.g. low income, specific city districts, etc.), to raise awareness of the benefits resulting from energy retrofits, to promote existing services offered by other stakeholders (local authority, suppliers, etc.), to communicate with local actors (e.g. local authorities, real estate agents, banks, etc.), to recommend customised energy-saving measures, technologies and materials adapted to a specific life situation and provide list of existing suppliers, to conduct a preliminary building analysis / energy audit, to provide assistance on existing financing options for which the homeowner is eligible (subsidies, tax credits, energy efficiency certificates, etc.) and help to develop a tailor-made financing plan and to prepare all documents necessary for accessing financial instruments, to develop a certification scheme for quality' suppliers, etc.

Besides project staff, municipal staff can also be trained by the project. Based on outcomes from pilot sites, at least 5 interested municipalities in developing OSSs will be trained in each country on how to identify vulnerable groups, how to communicate with them and how to raise their awareness and build their skill for improved behaviour and for available retrofit options. This will stimulate uptake of the practical recommendations resulting from the project as widely as possible, to audiences beyond the target groups and individuals /organisations engaged directly in the project.

1.2 REVERTER Ambassadors

REVERTER pilots will recruit from the local community at least 65 REVERTER Ambassadors (RAs), as follows:

Bulgaria: 15

Greece: 30

Latvia: 10

Portugal: 10

The RAs could be:

- building managers;
- social workers for the municipalities;
- community members;
- frontline staff of energy suppliers;
- university students;
- staff from organisations assisting vulnerable households;

- ➢ elders of multi-family buildings;
- ➢ other.

Training programmes of recruited RAs will focus on issues such as: social inclusion, no- or low-cost measures to cope with EP, simple technical issues of energy saving in households, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc. Besides training, RAs will be supported by tools and step by step guidelines by the project partners related to the scope of the visits to be conducted. Particular attention will be given to avoid any issues of stigmatisation and all legal (i.e., GDPR) and ethical requirements will be fulfilled. Besides training, RAs will be supported by tools and step by step guidelines by the project partners related to the scope of the visits to be conducted.

The RAs will be responsible to spread knowledge to the local community through 1,500 visits, namely:

Bulgaria 500	Greece 600
Latvia 200	Portugal 200

During household visits, data on manifestations of EP and energy efficiency potential will be gathered including:

- ➢ demographic data;
- ➢ gender data;
- ➢ level of energy efficiency;
- ➢ simple energy audit data including specificities of the external/internal envelope and heating systems;
- ➢ level of energy literacy;
- ➢ energy consumption;
- ➢ level of knowledge of available incentive programmes and financial tools;
- ➢ health and wellbeing data;
- ➢ social inclusion, etc.

1.3 Vulnerable households

The project aims to create a positive impact on more than 3,000 vulnerable people through the implementation of 1,500 visits by more than 60 RAs to vulnerable households and the organisation of 16 social engagement events. This will help to address residents' buy-in from the early stages of the process and adapt their post-intervention energy use behaviour, through community engagement campaigns, advice, and training. Moreover, the project will demonstrate the effectiveness and replicability of the proposed solutions among 20,000 energy vulnerable households through 9 awareness campaigns and the preparation and distribution of information material. This will facilitate the market uptake of renovation approaches for the large-scale rollout of building-related interventions for vulnerable districts, clusters of buildings, or groups of such buildings.

This specific target group is not directly related to the training program, but it will benefit from the advice at an individual level. The RAs will help vulnerable groups to improve their energy use behaviour and will provide advice on both low-cost measures that can be quickly applied and energy renovation works that can reduce households' energy consumption significantly.

The facilitation of a bi-directional communication channel using RAs as an intermediate link, between the EP households and the OSSs, will help to couple local needs and beliefs with renovation opportunities. Moreover, the knowledge to be gained from the two-way communication and information activities and the shelf-training material that will be disseminated in a large number of households and will create a stronger outreach program.

2 REVERTER training program suggestion

The following table presents the training topics for the three target groups.

Table 1. Proposed training topics

Training topic	Short description/sub-topics	OSS personnel	RAs	HHs	Responsible partner
I. National legislation	National legislation and requirements in terms of minimal energy performances for buildings, thermal comfort conditions, etc.	✓			All partners – to be adapted for the national context
II. Energy consumption in households	1. Basic energy concepts and units 2. Building envelope 3. Building installations 4. RES in households - Solar systems for DHW - PVs - Geothermal energy	✓	✓		GSC
III. Step-by-Step Deep Renovation	1. Introduction to Deep Renovation 2. Building Assessment and Energy Auditing 3. Planning and Designing Deep Renovation Projects 4. Project Implementation and Management 5. Monitoring, Measurement, and Verification 6. Certification and Assessment	✓	✓		GSC
IV. Energy saving in households - best practices	1. Low-cost EE measures 2. Energy management systems and energy behavior tips - Smart meters, energy monitoring and control - energy behavior change 3. Energy labelling 4. Benefits of retrofitting 5. Energy saving tools	✓	✓	✓ leaflets	GSC
V. Existing financial schemes and mechanisms at national/local level	1. Deep renovation measures 2. RES 3. Social grants	✓	✓	✓ leaflets	All partners at national level
VI. Communication and advising of vulnerable households	1. Who is energy poor and energy vulnerable 2. How to approach energy vulnerable households 3. Communication with energy vulnerable households 4. How to advise and support energy vulnerable households	✓	✓		EUROPACE
VII. Establishment and operation of OSSs	1. Design 2. Set-up 3. Deployment 4. Marketing and communication 5. Management and monitoring	✓			EUROPACE

3 Training tools

3.1 Training modules

The training materials by topic and training group have been developed as separated documents. The English version of the training modules, which is included in the Annexes of this deliverable, lays out the framework under which each partner will adapt and translate the modules in the national language to suit the local conditions. On this basis, each partner will create Powerpoint presentations and additional training tools listed in Section 3.2.

3.2 Training tools

The tools to be used during the training of the OSS personnel and the RAs may include:

- Training materials as text documents;
- Training materials in ppt;
- Videos;
- Web-based, software tools or applications (if applicable);
- Leaflets;
- Questionnaire;
- Step-by-step guidelines for visits (for the RAs).

4 Training program agenda

The training for RAs depends on their professional background and could be simplified and conducted in 2-3 hours to provide an introduction to the project objectives, the organisation of the visits and must-have communication skills. If needed, partners may decide to carry out detailed training (around 7 hours, including breaks) to familiarise the RAs with all the topics of the training program, so as to ensure accountability in the execution of the tasks and reliable results of the household visits. Specific topics could be recorded as video for self-training.

An indicative training agenda for RAs is presented in the following table.

Table 2. Indicative agenda for the training of RAs

Time	Topic	Training hours
9:30	Introduction	10min
9:40-10:00	About the project	20min
10:00-11:00	**II. Energy consumption in households** 1. Basic energy concepts and units 2. Building envelope 3. Building installations 4. RES in households - Solar systems for DHW - PVs - Geothermal energy	1h
11:00-12:00	**III. Step-by-Step Deep Renovation** 1. Introduction to Deep Renovation 2. Building Assessment and Energy Auditing 3. Planning and Designing Deep Renovation Projects 4. Project Implementation and Management 5. Monitoring, Measurement, and Verification 6. Certification and Assessment	1h
12:00-13:30	**Lunch**	1h30’
13:30-14:30	**IV. Energy saving in households - best practices** 1. Low-cost EE measures 2. Energy management systems and energy behaviour tips - Smart meters, energy monitoring and control - energy behaviour change 3. Energy labelling 4. Benefits of retrofitting 5. Energy saving tools	1h
14:30-15:30	**V. Existing financial schemes and mechanisms at national/local level** 1. Who is energy poor and energy vulnerable 2. How to approach energy vulnerable households 3. Communication with energy vulnerable households 4. How to advise and support energy vulnerable households	1h
15:30-16:30	**VI. Communication and advising of vulnerable households** 1. Who is energy poverty and energy vulnerable 2. How to approach energy vulnerable households 3. Communication with energy vulnerable households 4. How to advise and support energy vulnerable households	1h
	Certificates	

The training program for the OSS staff will be more comprehensive and will include specialised subjects to enable them to cope with the demands of the OSS’s operation. The training can be organised in 3 days of 5 training hours. The indicative training agenda is presented in the following table.

Table 3. Indicative agenda for the training of OSS personnel

Time	Topic	Training hours
	Day 1	
9:30	Introduction	10min
9:40	About the project	20min
10:00-10:45	**I. National legislation**	45’
10:45-12:00	**II. Energy consumption in households** 1. Basic energy concepts and units 2. Building envelope 3. Building installations 4. RES in households - Solar systems for DHW - PVs - Geothermal energy	1h15’
12:00-13:30	**Break**	1h30’
13:30-15:30	**III. Step by step deep renovation** 1. Introduction to Deep Renovation 2. Building Assessment and Energy Auditing 3. Planning and Designing Deep Renovation Projects 4. Project Implementation and Management 5. Monitoring, Measurement, and Verification 6. Certification and Assessment	2h
15:30-16:00	**Discussions**	
	Day 2	
09:00-12:00	**IV. Energy saving in households – best practices** 1. Low-cost measures 2. Energy management systems and energy behaviour tip - Smart meters, energy monitoring and control - energy behaviour change 3. Energy labelling 4. Energy saving tools	3 hours
12:00-13:30	**Break**	1h30’
13:30-15:30	**V. Financial schemes and mechanisms** 1. Deep renovation measures 2. RES 3. Social measures	2 hours
15:30-16:00	**Discussions**	
	Day 3	
9:00-12:00	**VI. Communication and advising of vulnerable households** 1. Who is energy poor and energy vulnerable 2. How to approach energy vulnerable households 3. Psychological methods of communication with energy vulnerable households 4. How to advise and support energy vulnerable households	3 hours

12:00-13:15	**Break**	1h15’
13:15-16:15	**VII. Establishment and operation of OSSs** • Design • Set-up • Deployment • Marketing • Management and monitoring	3 hours
16:15-16:45	**Discussions**	
	Certificates	

At the end of the training, certificates and badges will be awarded to the RAs, so that they can verify that they have the knowledge and skills required to carry out the visits and thus guarantee trust of the households. Certificates of completed training will be issued to the OSS personnel, as well.

Annex I: OSS personnel training material

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC I

National legislation

Co-funded by the European Union

Executive Summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel. It aims to provide a summary of the regulatory measures in the countries of the REVERTER pilots regarding the requirements for the energy performance of existing buildings based on the implementation of the EPBD.

A detailed list and description of the existing national legislation in terms of energy efficiency, deep renovation and renewable energy sources will be provided in the national translated training program for each pilot.

Annex I includes a table that will be provided to OSS personnel, with description of the specific requirements for energy efficiency and deep renovation measures in buildings.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
NZEB	Nearly Zero Energy Building
RES	Renewable Energy Sources
LTRS	Long Term Renovation Strategy

1 Energy performance requirements in Bulgaria

While the Ministry of Energy oversees the state's energy efficiency policy in final energy consumption, the Ministry of Regional Development and Public Works takes on the responsibility of formulating and enforcing technical rules and regulations governing the energy performance of both new and existing buildings, as well as renovation projects. Simultaneously, the Sustainable Energy Development Agency (SEDA) plays a crucial role in executing the national policy aimed at enhancing energy efficiency in both energy end-use and energy services.

The legislative framework, consisting of the Energy Efficiency Act, the Law on Spatial Planning, and accompanying regulations, prescribes the mandatory measures applicable to existing buildings.

Energy Efficiency Law - This law regulates public relations related to the implementation of the state policy to increase energy efficiency in the final energy consumption and the provision of energy services. The law aims to increase energy efficiency as a main factor for increasing the competitiveness of the economy, the security of energy supplies and the protection of the environment by: using a system of activities and measures to increase energy efficiency among end users of energy; development of the energy services market and implementation of activities and measures to increase energy efficiency among end users.

Activities to increase energy efficiency are activities related to: energy efficiency certification of new buildings; survey and certification for energy efficiency of buildings in operation; checking for energy efficiency of heating installations with water boilers and of air conditioning installations in buildings; energy efficiency management; improving the energy characteristics of outdoor lighting - street, park and others.

Regarding Energy Efficiency Survey and Certification of Buildings, the law provides:

The certification for energy efficiency of buildings in operation aims to certify the current state of energy consumption in buildings, energy characteristics and their compliance with the scale of energy consumption classes from the regulation under Art. 15, para. 3.

(2) Energy efficiency certification of buildings in operation is carried out on the basis of an energy efficiency survey of the building.

(3) The owners of public service buildings with a built-up area of more than 500 sq.m., and from July 9, 2015 - with a built-up area of more than 250 sq.m., for which an energy performance certificate has been issued, are obliged to place the certificate in a prominent place in the building.

The energy performance of a new building before commissioning is certified with a design energy performance certificate.

When selling a new building in its entirety, the seller provides the buyer with the original certificate of design energy characteristics.

(2) When selling independent objects in a new building, the seller provides the buyer with a notarized copy of the certificate for the design energy characteristics of the building.

(3) When renting out a new building or independent objects in it, the landlord provides the tenant with a copy of the certificate for the design energy characteristics of the building.

(4) When a new building, for which a certificate of design energy characteristics has been issued, or a separate object in it is announced for sale or for rent, the indicator specific annual consumption of primary energy - kWh/m2, specified in the certificate, is noted in all ads.

Any building in operation may be certified, except:

1. buildings and cultural values included in the scope of the Cultural Heritage Act and the Protected Areas Act, to the extent that the fulfilment of certain minimum requirements for energy performance would lead to a violation of the architectural and/or artistic characteristics of the building;

2. houses of prayer of the legally registered religious denominations in the country;

3. temporary buildings with a planned use time of up to two years;

4. farm buildings of agricultural producers used for agricultural activity;

5. production buildings;

6. residential buildings that are used for their intended purpose up to 4 months a year;

7. individual buildings with a built-up area of up to 50 sq.m.

The measures to increase energy efficiency, which are recommended for any reconstruction, major renovation, major repair of a building or parts of a building in operation, are evaluated in terms of the technical and economic feasibility of using alternative systems.

After the implementation of reconstruction, major renovation, major repair of a building, its energy characteristics must be improved so that they correspond to the minimum regulatory requirements defined in the regulation No. RD-02-20-3 of November 9, 2022 on the technical requirements for the energy performance of buildings.

The newly developed and adopted ***REGULATION No. RD-02-20-3 of November 9, 2022 on the technical requirements for the energy performance of buildings*** defines:

1. the indicators of the energy characteristics (EPB indicators) and the requirements for the energy characteristics of the buildings;

2. the national calculation methodology for assessing the energy characteristics of buildings;

3. the scale of energy consumption classes with numerical limits for different categories of buildings and the minimum requirements for energy efficiency in accordance with the scale for the corresponding category of buildings. The Ordinance applies to: design of new residential buildings and new public service buildings; design related to the achievement of energy efficiency requirements for deep renovations, major repairs, alterations, reconstructions, upgrades and additions to existing buildings; assessing the compliance of investment projects with the requirements for energy efficiency of buildings; survey and certification for energy efficiency of buildings according to the requirements defined in the Law on Energy Efficiency; calculation of the energy characteristics of production buildings; design and survey for energy efficiency of buildings - cultural values included in the scope of the Cultural Heritage Act, insofar as the improvement of the energy characteristics of the enclosing elements and/or of the technical systems in these buildings does not lead to a violation of the architectural and/or artistic characteristics of the buildings. The energy characteristics of buildings in Bulgaria are assessed according to a uniform national calculation methodology according to Annex No. 1 of the Regulation.

The belonging of the building to the relevant class of energy consumption is established by comparing the value of the general (integrated) energy characteristic of the building with the numerical values of the class limits according to the condition: EPmin ≤ EP < EPmax,

where: EPmin and EPmax are, respectively, the minimum and maximum numerical value of the limits for the corresponding class of energy consumption; EP - general (integrated) energy characteristic - "specific annual energy consumption" (kWh/m2.year) of the building.

The scale of energy consumption classes for types of building categories is as follows:

Клас	EP_{min} kWh/m^2	EP kWh/m^2	EP_{max} kWh/m^2	МНОГОФАМИЛНИ ЖИЛИЩНИ СГРАДИ
A	Не се дефинира	EP <	90	A
B	90	≤ EP <	180	B
C	180	≤ EP <	235	C
D	235	≤ EP <	290	D
E	290	≤ EP <	363	E
F	363	≤ EP <	435	F
G	435	≤ EP	Не се дефинира	G

Figure 1 Scale of energy consumption classes for multi-family residential buildings

Клас	EP_{min} kWh/m^2	EP kWh/m^2	EP_{max} kWh/m^2	ЕДНОФАМИЛНИ ЖИЛИЩНИ СГРАДИ
A	Не се дефинира	EP <	83	A
B	83	≤ EP <	166	B
C	166	≤ EP <	203	C
D	203	≤ EP <	240	D
E	240	≤ EP <	300	E
F	300	≤ EP <	360	F
G	360	≤ EP	Не се дефинира	G

Figure 2 Scale of energy consumption classes for single family buildings

Клас	EP_{min} kWh/m^2	EP kWh/m^2	EP_{max} kWh/m^2	АДМИНИСТРАТИВНИ СГРАДИ
A	Не се дефинира	EP <	134	A
B	134	≤ EP <	268	B
C	268	≤ EP <	329	C
D	329	≤ EP <	390	D
E	390	≤ EP <	488	E
F	488	≤ EP <	585	F
G	585	≤ EP	Не се дефинира	G

Figure 3 Scale of energy consumption classes for public service buildings – offices

Клас	EP_{min} kWh/m^2	EP kWh/m^2	EP_{max} kWh/m^2	УЧИЛИЩА
A	Не се дефинира	EP <	35	A
B	35	≤ EP <	70	B
C	70	≤ EP <	110	C
D	110	≤ EP <	150	D
E	150	≤ EP <	188	E
F	188	≤ EP <	225	F
G	225	≤ EP	Не се дефинира	G

Figure 4 Scale of energy consumption classes for schools

Table 1. Verbal expression of achieved energy efficiency

Class	Verbal expression of achieved energy efficiency	Determining the boundaries $EP_{min} \leq EP < EP_{max}$
A	Very good energy efficiency - a building with very good energy characteristics	$EP < 0,5.R_{r,ref}$
B	A building with good energy characteristics - good energy efficiency	$0,5.R_{r,ref} \leq EP < R_{r,ref}$
C	Average (by level) energy efficiency – a building with satisfactory energy characteristics	$R_{r,ref} \leq EP < 0,5.(R_{r,ref} + R_{s,ref})$
D	Improved energy efficiency – a building with unsatisfactory energy efficiency	$0,5.(R_{r,ref} + R_{s,ref}) \leq EP < R_{s,ref}$
E	Poor energy efficiency – a building with poor energy performance	$R_{s,ref} \leq EP < 1,25.R_{s,ref}$
F	Worst energy efficiency - building with the worst energy performance	$1,25.R_{s,ref} \leq EP < 1,5.R_{s,ref}$
G		$1,5.R_{s,ref} \leq EP$

The Ordinance defines the following energy efficiency requirements for buildings:

1. all new buildings of the relevant category in Annex No. 2 are designed with close to zero energy consumption according to the definition in § 1, item 28 of the additional provisions of the Energy and Environmental Protection Act;

2. existing buildings of the relevant category in Appendix No. 2, which are occupied by public bodies, must have primary energy consumption at least in accordance with class "B" according to the requirements of this regulation;

3. all existing buildings of the relevant category in Annex No. 2, which are not occupied by public bodies, must have a primary energy consumption of at least class "B" according to the requirements of this regulation. It is allowed, when the technical and/or functional infeasibility of fulfilling the requirement has been proven by an energy efficiency survey, that the primary energy consumption corresponds to class "C".

During an energy efficiency survey of buildings, a package of energy-saving measures must be offered, after the implementation of which the building reaches compliance with the requirement for near-zero energy consumption.

Regulation No. E-RD-04-3 of 05/04/2016 on the permissible measures for realizing energy savings in the final consumption, the ways of proving the energy savings achieved, the requirements for the methodologies for their evaluation and the ways of their confirmation - This regulation defines: the permissible measures for realizing energy savings in the final energy consumption; the ways to prove the achieved energy savings; the requirements to the methodologies for evaluating energy savings; the ways to confirm the achieved energy savings, the terms, order and format for issuing, transferring and cancelling energy savings certificates.

Eligible measures for realizing energy savings in the final energy consumption are measures to increase energy efficiency that lead to a verifiable, measurable or evaluable increase in energy efficiency for final energy customers.

Allowable measures to implement (realize) energy savings must lead to:

1. saving energy in the final energy consumption;

2. saving energy, including fuels;

3. reduction of greenhouse gas emissions;

4. improving or preserving the quality of the environment;

5. improvement or preservation of sanitary and hygienic standards.

The proof of the achieved energy savings is carried out after the implementation of a measure/measures for energy savings at the end customers through: energy efficiency survey of buildings, enterprises, industrial systems or external artificial lighting systems, inspection of heating installations with water boilers and air conditioning installations, carried out no earlier than one year after the implementation of the energy saving measure(s), or application of methods developed under the conditions and according to the order of chapter four.

REGULATION No. E-RD-04-2 of December 16, 2022 on energy efficiency survey, certification and assessment of energy savings of buildings - This regulation defines the terms and conditions for:

1. issuance of certificates for energy characteristics of new buildings;

2. conducting an energy efficiency survey of buildings or parts of buildings in operation, including the documents that reflect the results of the survey;

3. issuance of certificates for energy characteristics of buildings or parts of buildings in operation;

4. preparing an assessment of the energy savings of buildings***.***

The certificate for energy characteristics of a new building certifies the energy characteristics of a new building before its commissioning, including the level of energy consumption and its corresponding class on the scale of energy consumption classes from the regulation under Art. 31, para. 4 of the Energy Efficiency Act (EEA), in accordance with the requirements for new buildings.

With the energy efficiency survey of a building in operation, the normalized (baseline) energy consumption of a building in its existing condition at the time of the survey is determined, the specific possibilities for reducing the normalized energy consumption are determined while the normative parameters of the microclimate are guaranteed to be maintained, it is carried out is a technical and economic assessment of the measures to increase the energy efficiency of the building.

The subject of the energy efficiency survey of a building in operation is:

1. identification of the building enclosing elements of the structure and the systems for ensuring the microclimate, measurement and calculation of the energy characteristics, analysis and determination of the potential for reducing energy consumption;

2. development of measures to increase energy efficiency and/or measures to utilize energy from renewable sources, applicable to the specific building in the area of its location;

3. technical and economic assessment of measures to increase energy efficiency and the ratio "costs - benefits";

4. assessment of the CO2 emissions that will be saved as a result of the implementation of measures to increase energy efficiency.

The energy efficiency survey of a building in operation is carried out independently by energy efficiency consultants who are included in the composition of a legal entity under Art. 44, para. 1 of

EEL, respectively Art. 44, para. 2 of the EEL, and are entered in the public register under Art. 44, para. 1 of EEL.

The survey of a building in operation covers: 1. the means for measuring and controlling the energy flows in the building; 2. systems for burning fuels and converting energy flows entering the building, including from renewable sources; 3. heat transfer systems - water, vapor condensation, air; 4. power supply systems; 5. lighting systems; 6. systems for ensuring the microclimate; 7. hot water systems for domestic needs; 8. the elements of the building structure (enclosing and internal).

2 Energy performance requirements in Athens Urban Area pilot

In Greece, the Ministry of Environment and Energy (YPEN) holds the responsibility for overseeing the energy performance of buildings. The national building code, known as the 'Regulation on the Energy Performance of Buildings' (KENAK), underwent amendments in July 2017, and the corresponding Technical Guidelines received approval in November 2017. KENAK establishes minimum requirements, specifically maximum U-values for building elements, as well as criteria for energy losses and gains across the entire building envelope. Additionally, it outlines minimum efficiency standards for heating, cooling, and hot water production systems, derived from a cost-optimal study. Consequently, existing buildings or units undergoing major renovations can achieve optimal energy savings with minimal cost impact.

The definition of major renovation is established in Law 4122/2013, subsequently amended by Law 4409/2016. A renovation is categorized as deep when the total cost related to renovating the building envelope or technical building system exceeds 25% of the building's value, excluding the value of the land on which the building is situated. For existing buildings undergoing deep renovation, the minimum energy performance requirements are met when the building: (a) satisfies all minimum criteria for existing buildings, and (b) the calculated annual total primary energy consumption is less than or equal to that of the reference building, while the building is classified at least as Class “B”. Exceptions are permissible only if a technical report demonstrates that meeting these standards is not technically, functionally, and economically feasible.

The definition of Nearly Zero-Energy Buildings (NZEB) for existing buildings is outlined in Law 4122/2013, with its application elucidated in the national NZEB study issued in December 2018. The national plan, released in August 2018, aimed at increasing the number of nearly zero-energy buildings, stipulates that an existing building qualifies as a nearly zero-energy building if it falls under at least energy class B+. However, a decision on the minimum share of Renewable Energy Sources (RES) and its contribution to primary energy consumption is still pending.

Details on the energy performance of a building and recommendations for enhancing its efficiency are incorporated into the Energy Performance Certificate (EPC), which remains valid for a duration of 10 years. The EPC becomes mandatory upon the completion of the construction of a new building, after a comprehensive renovation, during the sale of a building, or when leasing to a new tenant. In accordance with Law 4342/2015, effective from November 9, 2015, all new rentals are required to include the unique protocol number of the EPC in the electronic platform of the General Secretariat of Information Systems of the Ministry of Finance.

Finally, as outlined in the National Energy and Climate Plan (NECP), there is a crucial emphasis on the optimal integration of Renewable Energy Sources (RES) technologies for heating and cooling within the building sector. This emphasis is particularly significant as the mandate stipulates that all new buildings are to achieve nearly zero-energy status from 2021 onward. In a significant development, the Hellenic Parliament passed a comprehensive law in March 2023, encompassing various facets of renewable energy installations. This law includes provisions such as setting the maximum capacity for rooftop photovoltaic systems at 10 kW for households and 100 kW for businesses, an increase from the previous limit of 3 MW. The rationale provided by the government is the limitation of grid space.

3 Energy performance requirements in Riga pilot

In Latvia, the Ministry of Economics holds the overall responsibility for the implementation of the EPBD. The Ministry is tasked with developing and executing the national energy efficiency policy, encompassing the transposition of the EPBD. The requisite laws and regulations for transposing the EPBD were adopted at the conclusion of 2014 and are presently in effect.

The primary legislative act pertaining to the energy performance of buildings in Latvia is the Law on the Energy Performance of Buildings (LEPB), which came into force on January 9, 2013. Complementary to this law, there are specific Cabinet Regulations, such as Regulation No. 222 of April 16, 2021, titled 'Methods for calculating the energy performance of buildings and rules for certification of the energy performance of buildings' and Regulation No. 280 of January 1, 2020, titled 'Regulations of Latvian Building Norm LBN 002-19: Thermal Requirements of the Buildings Envelopes.' These regulations delineate design requirements specifying the minimum permissible level of energy performance for buildings.

The criteria for various components of building envelopes remain consistent for both renovations and new constructions; however, the minimum acceptable energy performance levels differ for existing buildings. According to Cabinet Regulation No.730 dated December 16, 2020 titled 'Minimum requirements for the energy performance of existing buildings' if existing residential buildings surpass the minimum energy performance requirements, the building owner is obliged to implement measures to enhance energy efficiency. The regulation specifies minimal energy efficiency requirements, which need to be ensured for existing buildings. The minimum permissible energy performance levels for reconstructed or renovated buildings are set at 80 kWh/m^2 per year for multi-apartment residential houses and 90 kWh/m^2 per year for one-apartment and two-apartment residential buildings of various types.

For existing buildings aspiring to reach Nearly Zero-Energy Building (NZEB) status, Regulation No. 222 outlines specific criteria. To be classified as NZEB, a building must meet the following conditions:

- The building's energy performance indicator corresponds to at least Class “A”.
- The total primary energy consumption for heating, hot water supply, mechanical ventilation, cooling, and lighting corresponds to at least Class “A”
- High-efficiency systems are employed and correspond to Class “A” in energy rating
- Indoor air temperatures must be set according to ISO 16798-1:2019 “Energy performance of buildings - Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6”. During winter the indoor air should be set to at least category II and during summer the indoor air temperature should reach at least category III
- Indoor air quality must be set according to ISO 16798-1:2019 “Energy performance of buildings - Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6”. The indoor air quality should reach at least category III

In Latvia, Energy Performance Certificates (EPCs) are issued for buildings under construction, reconstruction, or renovation, either for acceptance into service or sale. EPCs are also issued for existing buildings or apartments for sale, rent, or lease, upon request by the purchaser, tenant, lessee, or building owner.

Finally, while Regulation No. 222 mandates the partial use of renewable energy in NZEB, specific requirements regarding the share of renewable energy resources are not explicitly outlined. Moreover, Latvian legislation does not enforce the mandatory installation of on-site renewable energy production, indirectly regulating this aspect through the consumption of non-renewable primary energy.

4 Energy performance requirements in Coimbra pilot

The implementation of the EPBD in Portugal commenced in 2007, guided by three decrees issued in 2006. Subsequently, in 2013, the legislation underwent revision to align with the new stipulations of Directive 2010/31/EU. Between 2019 and 2020, the Portuguese government undertook a comprehensive review of existing legislation to align it with the provisions of Directive (EU) 2018/844. In recent years, the focus of EPBD implementation in Portugal has centred on updates and minor adjustments, building upon the groundwork laid since 2013. However, certain aspects of current regulations require revision to ensure full compliance with the EPBD, including adjustments related to requirements for renovated building elements.

Presently, when a specific building component (such as the building envelope or technical building system) undergoes renovation, minimum requirements are applicable. In such cases, energy efficiency is systematically improved “part-by-part”, ensuring that each new component functions at a level equivalent to that of a new building. In the context of major renovations, an overall assessment is mandated, necessitating the attainment of a minimum performance standard for the entire building. In these instances, it may be imperative to replace or enhance additional elements to meet the stipulated minimum threshold. Notably, technical building systems, without exception, are subject to these enhancements, with the minimum efficiency of equipment currently surpassing the standards set in 2013. Stricter requirements for existing residential buildings come into play exclusively when these buildings undergo renovations. The building component slated for renovation must adhere to the minimum performance levels as defined by prevailing regulations.

Within the framework of the Portuguese Long Term Renovation Strategy (LTRS), a set of cost-effective approaches to building renovations has been identified. The LTRS incorporates four distinct renovation packages, each applied based on the building's needs. These packages are set to be progressively and cumulatively implemented until 2050, prioritising the renovation of the worst-performing segments of the building stock. The strategy encompasses various measures, including:

- The rehabilitation of passive building components (windows, walls, and roofs) to ensure acceptable levels of thermal comfort without increasing energy consumption.
- The replacement of existing electrical equipment, air conditioning (AC) systems, and lighting systems with more efficient alternatives.
- The integration of local Renewable Energy Source (RES) production systems, such as solar thermal and photovoltaic panels, along with storage systems (batteries).
- The installation of highly efficient AC systems in buildings that, despite undergoing rehabilitation, still require such systems to ensure adequate thermal comfort, particularly in more severe climatic zones.

Major renovation is considered when more than 25% of the building's value is spent on building elements. However, the level of Nearly Zero-Energy Buildings (NZEB) for existing buildings is not specifically defined in national legislation.

Since its mandatory introduction in 2009 for rent or sales transactions, the EPC has become widely accessible to the public. The use of EPC has seen a notable increase due to the mandatory advertisement of the EPC label before buildings are rented or sold, a responsibility shared by both building owners and real estate agents. Instances of non-compliance are now more regularly addressed, largely because notaries, in accordance with regulations, are obligated to report transactions that occur without an existing EPC. In such cases, building owners or real estate agents are required to rectify the situation by issuing the EPC and providing it, free of charge, to the new owner.

REVERTER

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC II

Energy consumption in households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to make the trainees aware of the basic principles of energy, building envelope characteristics, energy consumption in households, solutions for renewable energy and energy monitoring. In addition, the training material will provide OSS personnel and the RAs with necessary information to understand the environmental impacts of energy use, making the bridge to renewable energy sources and communities.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
A2A	Air To Air
ASHP	Air Source Heat Pump
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BESS	Battery Energy Storage System
BMS	Building Management System
BTU	British Thermal Unit
COP	Coefficient Of Performance
DC	Direct Current
DHW	Domestic Hot Water
EER	Energy Efficiency Ratio
EPS	Expanded Polystyrene
EU	European Union
GSHP	Ground Source Heat Pump
HVAC	Heating, Ventilation, and Air Conditioning
IEA	International Energy Agency
LED	Light Emitting Diode
LPG	Liquified Petroleum Gas
MEPS	Moulded Expanded Polystyrene
PIR	Polyisocyanurate
PUR	Polyurethane
PV	Photovoltaic
PVC	Polyvinyl Chloride
SCOP	Seasonal Coefficient Of Performance
SEER	Seasonal Energy Efficiency Ratio
SEER	Seasonal Energy Efficiency Ratio
XPS	Extruded Polystyrene

1 Basic energy concepts and units

1.1 Primary and final energy

The primary energy consumption encompasses the utilization and losses incurred during energy transformations within the energy industries, such as power generation and refineries. On the other hand, final energy consumption represents the cumulative energy used in various sectors like industry (excluding the energy sector), transport, buildings (residential and services), and agriculture. This excludes the fuels employed by autoproducers for power generation.

Coal is formed from dead organic plant matter converted into peat. The industrial revolution of the 19th century was possible thanks to coal.

Oil is a liquid carbonaceous rock, composed of organic materials trapped in the rock. Oil provides the majority of liquid energies such as fuel, diesel, petrol or LPG.

Natural gas is an organic gaseous found naturally in porous rocks. Most natural gas is created by two mechanisms: biogenic and thermogenic. Biogenic gas is created by methanogenic organisms in marshes, bogs, landfills, and shallow sediments. Deeper in the earth, at greater temperature and pressure, thermogenic gas is created from buried organic material. The gas comes in third place among the most-used types of energy worldwide.

Uranium is a radioactive metal that lies deep in the earth and in the earth's crust. Much of these stocks, however, are unusable. Recently, it has been increasingly used to produce electricity, although the Fukushima tragedy has slowed down this development. The process is with zero CO_2 emissions, however, it generates radioactive waste, which is problematic. Known resources will be exhausted by 2049. The final energy produced is primary energy, transformed into another suitable type: electric, mechanical, steam, or heat. It also includes the transformation losses.

Primary energy comprises both renewable and non-renewable forms in their natural state, while final energy consumption quantifies the total energy expended to satisfy the needs of end-use applications. Examples include the electricity consumed by a lightbulb or the fuel burned by a truck. Notably, final energy consumption measurements exclude transmission and distribution losses or inefficiencies, which are considered in the assessment of primary energy demand.

Figure 1 describes the difference between primary and final energy.

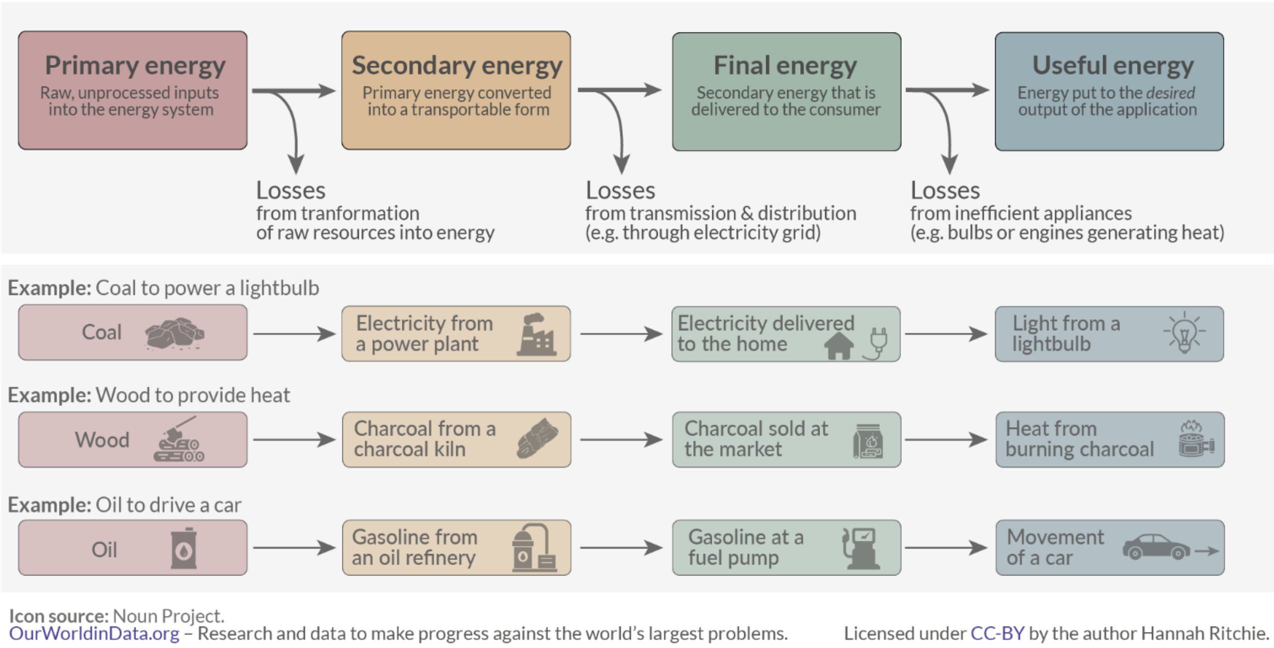


Figure 1. Different types of energy (Source: OurWorldinData.org)

Energy content of different energy sources

Each energy source has a different energy content (calorific value).

Table 1. Energy content of different types of energy sources

Energy source	Energy content (calorific value), Q
Natural gas (kg)	13,1 kWh/kg
Natural gas (m^3)	9,3 kWh/ m^3
Liquefied Natural Gas (kg)	12,55 kWh/kg
Liquefied natural gas (l)	7,3 kWh/l
Oil (kg)	11,75 kWh/kg
Oil (l)	10 kWh/l
Wood (kg)	3,88 kWh/kg
Black coal (kg)	5,83 kWh/kg
Anthracite coal (kg)	8,58 kWh/kg
Brown coal (l)	2,9 kWh/l

Example of calculating the energy content in kilowatt hours of natural gas: 1 000 m^3 of natural gas = 1 000 m^3 * 9,3 kWh / m^3 = 9 300 kWh

CO_2 emissions from different types of energy sources

The environmental impact stemming from energy consumption can be quantified through CO_2 emissions, using emissions factors that indicate the amount of carbon dioxide produced per unit of energy from specific fuels. Below are the emission factors for commonly used fuels. In the case of electricity, emission factors vary annually at both national and European levels due to fluctuations in the energy mix used for electricity generation. To ensure precise conversion, it is essential to identify the appropriate emission factor for each country.

Table 2. Ecological equivalence of the different energy sources

Type of energy source	Ecological equivalence factor fi*
	gCO_2/kWh
Natural Gas	220
LPG	290
Biogas	100
Liquid biofuel	70
Hetiang oil	290
Coal	360
Anthracite	360
Woods	40
Pellets	40
Electricity	486
Heat from district heating	290
Renewable energy supplied by a carrier in place and nearby	0

* the values are at national level. The source of the presented values is Bulgarian National methodology for calculating the energy performance of buildings.

Units of Energy

Table 3: Basic units of energy

Unit	Description
Joule (J)	The SI unit of energy is the **joule (J)** or **newton-meter (N * m)**. The joule is also the SI unit of work. Joule (J) - energy for mass lifting 1 kg per 1 m
Calorie (Cal)	Equivalent to 4 180 J - energy to raise the temperature of 1 g of water from 14°C to 15°C at a pressure of 1 atm.
kilowatt hour (kWh)	Equivalent to $3.6 \times 10_6$ J or 1 GJ = 277.777 kWh energy produced or consumed in kilowatt hours.
Tonne of oil equivalent (toe)	The equivalent quantity of energy produced during the burning of 1 tonne of oil - 41 868 kJ, which is approximately 42 GJ. This unit is useful if different fuels are compared. 1 toe = 11.63 MWh = 41.868 GJ
BTU	The British thermal unit (BTU or Btu) is a measure of heat, which is a form of energy. It was originally defined as the amount of heat required to raise

	the temperature of one pound of water by one degree Fahrenheit. The SI unit for energy is the joule (J); one BTU equals about 1,055 J

1.2 Heat exchange and material properties

Heat exchange is a process whereby heat transfers from a higher to a lower temperature body. Heat exchange takes place through:

- Thermal conductivity (solids);
- Convection (for fluids);
- Heat radiation

Thermal conductivity: heat transfer by direct contact between two physical materials
Some materials transfer heat better than others. Example: If the panhandle on the stove is made of copper, it will be warm to the touch, because copper is a conductor of heat. If the handle is made of plastic, we won't feel the heat because plastic is a poor conductor of heat.

Convection: Convective heat transfer, commonly known as convection, is the **process of transferring heat from one location to another** through the movement of fluids.
In liquids and gases, convection typically stands as the primary mode of heat transfer. Despite being discussed separately, convective heat transfer encompasses the combined mechanisms of conduction (heat diffusion) and advection (heat transfer through bulk fluid flow).
Example: if you hold your hand above a flame, you feel warmth because the air is heated by the flames.

Radiation: Transfer of heat by electromagnetic waves.
Materials reflect more or less the thermal radiation they receive. Wood, for example, reflects more radiation than marble. This is why a wooden interior is warmer than a marble interior Example: The sun emits heat radiation. So, when the sun is shining, you feel the heat on the surface of the skin, but when a cloud hides the sun, you no longer feel the heat.

Heat transmittance: The heat transmittance λ (lambda) expresses the amount of heat that passes through a material – 1 m² area, 1 second, 1 m thick, 1K (one degree) difference between the temperatures on both sides of the material under consideration.
This feature characterizes the ability of each material to transfer thermal energy in the form of heat. Specific heat conductivity is a constant for all types of materials, except heat insulations. The lower the value of λ, the better thermo-insulation properties the corresponding material has. Very often the packaging of building materials is indicated by their thermal conductivity - λ.

1.3 Energy consumption in households

According to *Eurostat* in 2021, households accounted for 27 % of final energy consumption in the EU. Most of the EU's final energy consumption in households was covered by natural gas (33.5%) and electricity (24.6%). Renewables accounted for 21.2%, followed by oil and petroleum products (9.5%) and derived heat (8.6%). A small proportion (2.5%) was still covered by coal products (solid fossil fuels).

- In 2021, households represented 27% of final energy consumption, or 18.6% of gross inland energy consumption, in the EU.
- In 2021, natural gas accounted for 33.5% of the EU final energy consumption in households, electricity for 24.6%, renewables and wastes for 21.2% and oil & petroleum products for 9.5%.
- The main use of energy by households in the EU in 2021 was for heating their homes (64.4% of final energy consumption in the residential sector), with renewables accounting for more than a quarter (27%) of EU household's space heating consumption.
- The biggest share of the household`s energy consumption relies on space heating, especially in the continental climate zone. Therefore, heating is the share of consumption that has the greatest potential for reduction.

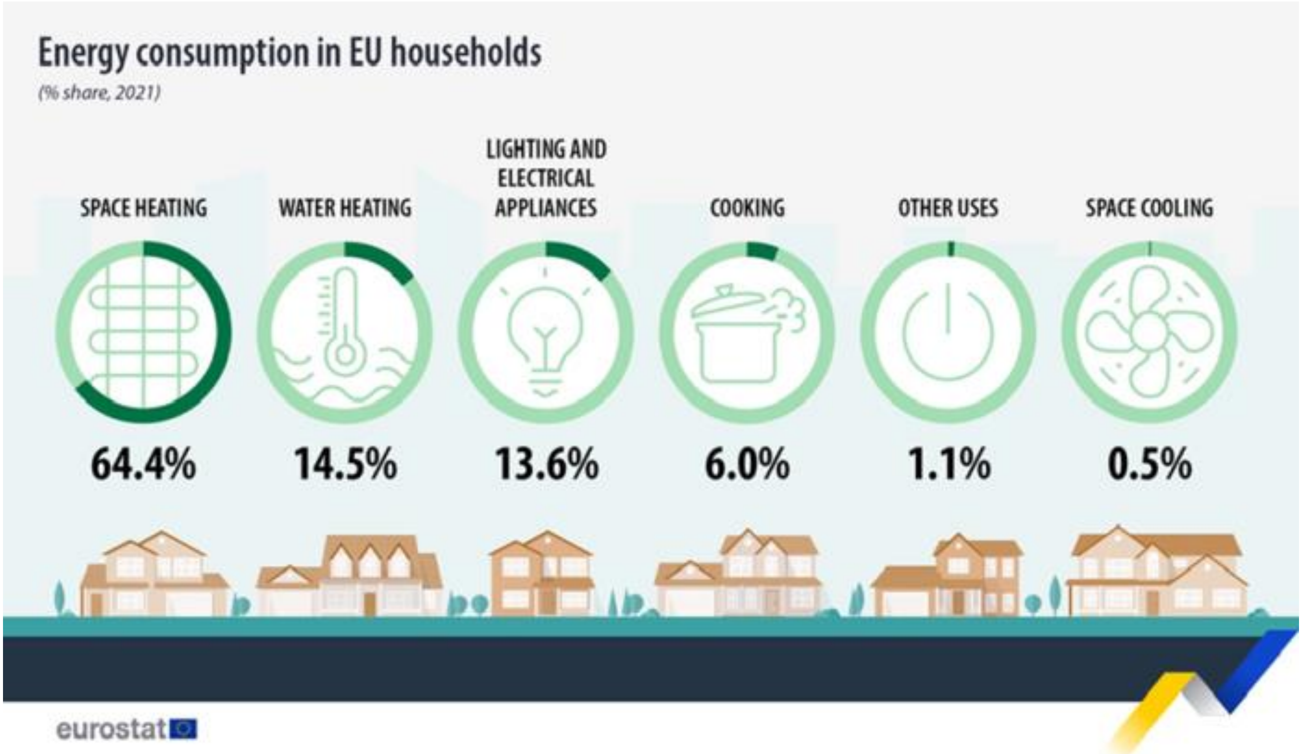


Figure 2. Energy consumption in European households (Source: https://ec.europa.eu/)

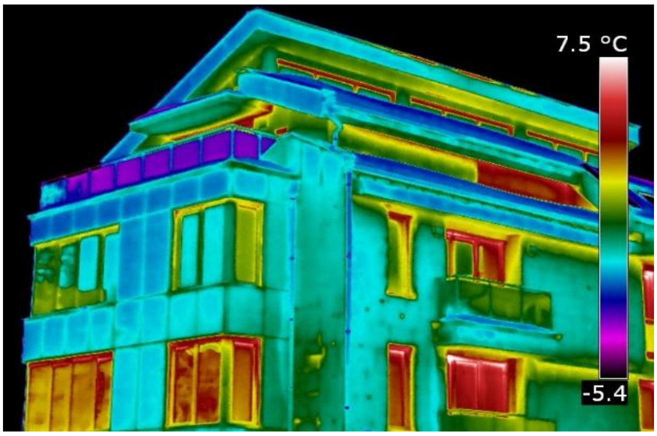
2 Building envelope

The building envelope acts as the physical barrier that separates the exterior and interior environments enclosing a structure. Typically, it consists of a combination of components and systems designed to shield the interior space from external environmental factors such as precipitation, wind, temperature, humidity, and ultraviolet radiation. The internal environment encompasses occupants, furnishings, building materials, lighting, machinery, equipment, and the HVAC (heating, ventilation, and air conditioning) system.

The building envelope performs various functions, which can be categorized into three main areas:

Support	Control	Finish
• it ensures strength and rigidity, providing structural support against both internal and external loads and forces	• it controls the exchange of water, air, condensation, and heat between the interior and exterior of the building.	• it serves aesthetic purposes, enhancing the visual appeal of the structure while still fulfilling its support and control functions

2.1 Heat losses through building envelope



Heat losses in residential buildings are the result of heat exchange through the external enclosing elements, depending on their thermal conductivity and the difference between external and internal temperatures. Heat transfer takes place from the area with higher to the area with lower temperature.

Reducing heat loss through the building envelope depends on the local climate and the local energy needs - certain architectural principles guarantee high energy efficiency and a high standard of visuals, warmth and health comfort in the spaces where different activities are realized.

- Most of the heat losses are through the roof (more than 30%) and through the walls (more than 20%).
- The most effective energy-saving measure is optimizing the thermal insulation of the external walls.
- The combination of insulation solutions on external walls and roofs can lead to a reduction of up to 50% of heat losses.
- Current regulatory requirements in Bulgaria require the laying of 10-12 cm insulation on the external walls and between 12-15 cm on the roof structures

Thermal insulation materials have the following important features:

- **Thermal conductivity (λ)** - characterizes the quality of a material as a conductor of heat. The thermal conductivity coefficient is W/mK and indicates how much heat (W) conducts a 1 m thick element at a temperature difference of 1 Kelvin (K). The lower the thermal conductivity of a material, the better the insulator is.
- **Thermal resistance** is the reciprocal of thermal conductivity (1/K) and is measured in mK/W. This is the temperature resistance for a unit thickness (per meter). Thus determined, this magnitude depends on the nature and thickness of the material, so the value is specific.
- **Heat transmittance** (U-value) - the quantity of thermal losses through the element is determined by the heat transfer coefficient U (U-value). It describes the amount of heat flowing through $1m^2$ of an element when the temperature difference between the inner and outer surfaces is 1K. The unit is W/m^2K.

Table 4 Heat transmittance coefficient of different type of external walls

Types of multilayer elements	Total wall thickness	Heat transmittance coefficient, U $W/(m^2K)$
External wall - concrete, without insulation	25 cm.	3,30
External wall - brick, without insulation	25 cm.	1,26
External wall - brick with 5 cm EPS	30 cm.	0,49
External wall – concrete with 5 cm EPS	30 cm.	0,65
External wall - brick with 8 cm EPS	33 cm.	0,33
External wall - brick with 10 cm EPS	35 cm.	0,28
Wooden frame construction with 22 cm insulation	25 cm.	0,19
Low energy wall with 46 cm insulation	49 cm.	0,09

Major sources of losses in non-insulated buildings (although it depends on the specific conditions):

- Roof: about 25 to 30% of heat losses;
- Walls: about 20 to 25% of heat losses;
- Ventilation and infiltration: about 20 to 25% of heat losses;
- Windows: about 10 to 15% of heat losses;
- Thermal bridges: about 5 to 10% of heat losses

The most intensive heat losses within a building are through the roof (more than 30%) and through the walls (more than 20%).

Reducing heat loss through the building envelope, depending on the local climate and the local energy, needs certain architectural principles:

- external or internal insulation;
- roof insulation
- change of windows and doors
- improving air-tightness.

By implementing them we can achieve high energy efficiency, as well as a high standard of visual, warm and healthy comfort.

2.2 Infiltration and thermal bridges

The presence of a thermal bridge in the building leads to a greater heat transfer from the warmer to the colder surface of the building, therefore thermal bridges can significantly reduce the quality of the insulation. A classic thermal bridge is a balcony slab that passes through an insulated exterior wall. Typical effects of thermal bridging are reduction of internal surface temperature; in the worst case, this can lead to an increase in humidity in parts of the structure. The percentages of heat losses are indicative and depend on the areas of the enclosing elements and their ratios to the total enclosing area of the building, as well as their thermal conductivity.

In the enclosing structure of each building, there are elements with higher thermal conductivity. They are set at the project level or appear in the construction process.

- Thermal bridges occur at: corners and edges, ceiling-to-wall connection, two-wall connection, or wall-to-floor connection;
- Thermostats increase heating costs as well as harmful emissions in the atmosphere;
- increase the risk of condensation, mould and fungi; damage to the structure; aesthetic problems;
- Thermal losses: about 5 to 10% of heat losses. Thermal bridges are formed when materials that are bad insulators are in contact with air and allow the airflow to pass through the created air "Path".

Thermal bridges should be removed by reduced profile cross-section, with materials having better insulating properties or by inserting an additional insulating element.

Infiltration air refers to the inadvertent and uncontrolled entry of outdoor air into an enclosed space. This occurrence results from cracks in the building envelope caused by pressure differentials between the interior and exterior environments. Even when doors or windows are intentionally opened for ventilation, the air entering through them is still considered infiltration. This phenomenon is more prevalent in winter when outside air is colder and denser than the air inside, influenced by factors such as wind velocity, wind direction, and the airtightness of the building envelope.

2.3 Different types of insulation

External wall insulation systems are materials that form the thermal envelope of a building. The primary objective of these insulation materials is to diminish heat transfer through walls, thereby reducing heat losses and, consequently, lowering the energy demand for heating. Thermal insulation, characterized by low thermal conductivity, typically below 0.1 W/mK, plays a crucial role in minimizing energy consumption in buildings by preventing heat loss through the building envelope.

An external wall insulation system involves the use of materials such as expanded polystyrene (extruded - XPS and expanded - EPS), mineral wool, polyurethane foam, or phenolic foam, combined with a reinforced cement-based, mineral, or synthetic plaster. Commonly used insulation materials include EPS, XPS, and mineral wool. Improving insulation, especially in existing buildings, can significantly reduce energy losses in both external walls and roofs. Insulation acts as a barrier against heat loss and gain, with its importance extending to protecting against summer heat in addition to winter cold in various climate zones.

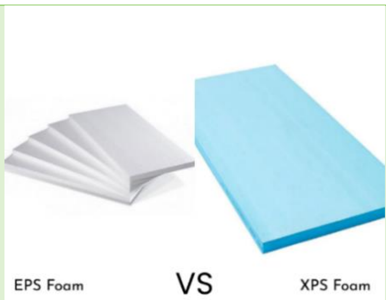
Table 5. Market available insulation materials

Material	Thermal conductivity coefficients (typical values), λ, W/(m*K)
Fiberglass	• **0.046** W/(m*K)
Mineral wool	• **from 0.037 to 0.045** W/(m*K)
Cellulose insulation	• **0.040** W/(m*K)
Polyurethane foam / Polyisocyanurate	• **0.022** W/(m*K)
Polyisocyanurate	• **0.023** W/(m*K)
Expanded polystyrene (EPS)	• **from 0.031 to 0.037** W/(m*K)
Extruded polystyrene (XPS)	• **from 0.031 to 0.037** W/(m*K)

A crucial characteristic of insulation materials is their ability to maintain R-value over time and continue providing insulation even when exposed to water for extended periods. Given that water is an efficient conductor of heat, water-soaked insulation loses its R-value. Additionally, if absorbed water undergoes freezing and thawing cycles, the insulation structure may deteriorate over time, compromising its structural integrity.

Table 6. Different types of insulation materials

Type of insulation material	Description
	**Fiberglass** is a commonly used insulation material in recent times. Fiberglass is a non-flammable insulating material. Moreover, it is an inexpensive insulation and is therefore a recommended option.
	**Mineral wool** refers to several different types of insulation. It can refer to glass wool (made from natural sand and/or recycled glass), rock wool (made from basalt) or slag wool (made from the slag that is generated in steel foundries). Mineral wool can be purchased in the form of plates or rolls. Most forms of mineral wool do not have additives to make them fire-resistant, but it is not flammable by itself.

	**Cellulose insulation** is undoubtedly one of the most environmentally friendly insulations. It is produced from recycled cardboard, paper and other similar materials, and is supplied in bulk form. Some recent research on cellulose has shown that it can be an excellent product for preventing fire damage.
	**Polyisocyanurate** (PIR) is a thermoset type of plastic, a closed-cell foam that contains a low-conductivity gas without hydrochlorofluorocarbon in its cells. Polyisocyanurate insulation is available as a liquid, as a spray foam, and as rigid foam boards. It can also be produced as laminated insulation panels with a variety of surface finishes.
	**Polystyrene** is commonly used to make foam, insulation boards, concrete insulation blocks or loose insulation from small balls. Moulded expanded polystyrene (MEPS) is often used as thermal insulation boards but is also available in bulk. Other polystyrene insulation material similar to MEPS is expanded polystyrene (EPS), graphite polystyrene (graphite EPS) and extruded polystyrene (XPS).
	**Polyurethane** is an insulating material in the form of foam, which contains a gas with low thermal conductivity in its cells. Polyurethane foam for insulation is available in closed and open-cell forms. In closed cell forms, the high-density cells are closed and filled with gas, which helps the foam to expand and fill the spaces around them. Open cell forms are not as dense and filled with air, giving this form of insulation a spongy structure and a lower R-value.

Source: ComAct (2021). Inventory of energy efficiency technical measures for energy-poor households. Available at: https://www.oneplanetnetwork.org/sites/default/files/from-crm/d4.1-identification-and-analysis-of-technical-measures-.pdf

The selection of materials for building construction is influenced by a diverse range of factors. Here are three examples:

1. XPS (Extruded Polystyrene):
    - XPS is produced through a continuous extrusion process, resulting in a consistent closed-cell cross-section.
    - The homogeneous structure of XPS contributes to its thermal and mechanical properties.

2. EPS (Expanded Polystyrene):
   - EPS is manufactured by expanding spherical beads in a mold, using heat and pressure to fuse the beads where they touch. Open spaces between the beads remain.
   - This method creates a structure with both closed and open cells, influencing its insulation characteristics.
3. Composite Insulated Panels (Sandwich Panels) with PIR/PUR Core:
   - Composite insulated panels consist of two rigid metal facings (typically steel or aluminum) with a core made of PIR/PUR foam insulation.
   - Rigid polyurethane (PUR) and polyisocyanurate (PIR) insulation products offer high effectiveness, low weight, excellent thermal conductivity, and a strong strength-to-weight ratio.
   - The closed-cell structure of the foam, with trapped gas having low thermal conductivity, contributes to excellent insulation.
   - During manufacturing, the PIR/PUR core expands, creating a robust semi-structural unit by bonding and laminating with the metal facings.
   - These panels provide superior thermal performance, ensuring continuous insulation and factory-engineered airtight joints.

In summary, the choice of building materials involves considering manufacturing processes, structural characteristics, and insulation properties. Each material, whether XPS, EPS, or composite insulated panels with a PIR/PUR core, has specific attributes that make it suitable for different applications in construction.

ADVANTAGES:

- Efficient Heat Conservation: Substantially decrease heat loss and reduce the energy demand for heating, leading to a decrease in CO_2 emissions.
- Common and Effective Solution: External wall insulation is a widely adopted solution, delivering notable energy savings, particularly in colder climates, with an impressive payback period.
- No Reduction in Floor Area: Implementation of external wall insulation does not diminish the floor area of the building.
- Enhanced Sound Resistance: Improves the building's resistance to sound transmission.
- Extended Wall Longevity: Increases the lifespan of external walls.
- Non-disruptive Application: Application can be carried out without causing disruption to the household.
- Aesthetic Renewal: Revitalizes the appearance of external walls.

- Diverse Design Options: Offers a broad range of renders and decorative finishes, providing nearly limitless options for textures and colors..

ENERGY SAVINGS:

The percentage of energy savings is a function from:

- The thickness of the thermal insulation and the respective U–value;
- The climate zone;
- The size, type and gross floor area of surrounding external walls;
- Other energy-saving measures implemented.

COSTS:

The cost associated with wall insulation can fluctuate based on several factors, including the insulation type and thickness, facade intricacies and finish, labor costs, insulation manufacturer, and the country of origin. Notably, the overall cost is influenced by the building's height due to the expenses related to scaffolding. Typically, insulation costs are computed per square meter of the facade surface. Consequently, providing a comprehensive assessment of the payback period proves challenging, as it hinges on both the initial investment and the resulting savings.

2.4 Glazing

Glazing refers to a sealed construction comprising two or more windows separated by variously sized spacers, creating double (single) or triple glazing (two-chamber) glass configurations. Insulated glass units are produced with glass thickness ranging from 10 mm to 16 mm.

The primary purpose of glazing is to facilitate optimal natural light entry into a room while offering visibility to the outside. It plays a crucial role in preventing bidirectional heat transfer between the interior and exterior of a building, with a focus on retaining heat during winter and excluding heat in summer..

The area of the windows typically reaches about 25% of the area of the dwelling. If these 25% are covered with energy-efficient windows, the average winter temperature in the dwelling can rise by 4-5°C. Thus, windows have a great influence on the heat loss in the dwelling.

The glass area within a window typically ranges between 70% and 90%, significantly impacting the overall thermo-technical parameters of windows. Achieving excellent thermal insulation is a key objective in residential buildings, aiming to substantially reduce energy needs, heating losses, and associated costs.

Various types of double and triple glazing windows with distinctive features and U-values include:

- **White Float Glass**: Widely used in combination with other types, available in varying thicknesses (3 mm up to 10 mm).
- **Low-Emission Glass (K-Glass)**: Enhances overall energy efficiency with a high solar heat gain coefficient and visible transmittance, reducing the U-factor significantly.
- **All-Season Glass**: Offers optimal thermal insulation, sunlight control, and insulation capabilities for a comfortable environment throughout the year without a "greenhouse" effect. Characterized by high selectivity and a low coefficient of thermal conductivity.

- **Laminated Glass**: A multi-layered glass type joined by high-tension film, providing high soundproofing and safety as it does not break into pieces when damaged.
- **Reflective Glass**: Suitable for walls or roofs, increases solar control, and exhibits high resistance to scratching and staining.
- **Tinted Glass**: Available in blue, green, brown, and grey tints, suitable for windows and doors.
- **Argon Gas Windows**: Feature windows filled with argon gas between panes to enhance overall energy efficiency. Argon, being heavier than air, prevents frost at the window's bottom and improves soundproofing. Three-paneled argon-filled windows provide dual insulation layers.

These varied glass options offer solutions tailored to specific needs, combining functionality, energy efficiency, and aesthetic considerations. The heat that passes through 1 m^2 of the window surface is characterized by the U value, while the amount of solar energy that passes through 1 m^2 is represented by "g" (solar energy transmittance). The lower the value of U, the more solar energy passes through it.

Table 7. Characteristics of different glazing types

	Number of spacers	Transmission coefficient W/m²K	Transmittance %	Solar factor
Double glazing with white float glass – 24 mm	1x16mm	2.6	81.1	77.1
Double glazing with white float glass and K-glass – 24 mm	1x16mm	1.1	79.3	61.3
Double glazing with white float and high energy glass– 24 mm	1x16mm	1.1	66.2	42.5
Triple glazing with three white float glasses – 36 mm	2x12mm	1.7	73.6	69.4
Triple glazing with high-energy and two white glasses – 36 mm	2x12mm	0.7	58.9	37.9

Types of glazing based on their efficiency:

- **Inefficient glazing** - single glazing (U-values up to 5.8 W / m²K) is considered **very inefficient for windows glazing**.
- **The energy-efficient glazing consists** of two or three layers of glasses separated by an air layer. (U-values from 1,20 W/m²K to 1,70 W/m²K))
- **The triple glazing is considered high-efficiency** (U-values from 0,4 to 1,1 W/m²K)

Table 8. Different types of joinery

Type	Description
Wooden windows	Excellent insulation characteristics; among the best materials for preserving the comfort of home; the cheapest option - joinery of coniferous trees (white pine or spruce). Of the broad-leaved woods, the most used are oak and ash
Double-glazed wooden windows	Providing twice as good sound and heat insulation compared to traditional woodwork and with no danger of condensation. It is produced from three-layer lamellas and this prevents it from rolling, shrinkage and cracking
Aluminium joinery	Ensures durability and security, maintenance is easy and inexpensive and does not require periodic painting. As a material, aluminium is an excellent conductor of heat and therefore heat loss in this type of window is greater. Quality aluminium windows require thermal insulating bridges in the profiles, which leads to their cost increase;
PVC (PVC) joinery	Very good heat and sound insulation properties. Maintenance is easy. The material is resistant to cold, heat, and chemicals. Greater and better energy performance is achieved with joinery with more internal chambers
Combined joinery	The most expensive option is joinery combining aluminium with wood. The wood is protected from atmospheric influences with an external aluminium lining on the profile. The best qualities of the two materials combine in aesthetic and functional terms

Important!
Regarding windows:
The "g"-values of windows exert a more significant impact on decreasing cooling demand than their U-values.

- For insulation:
  - There is a possibility that insulation may elevate cooling demand due to retained heat gains in the building.
  - The additional benefit of insulation in reducing cooling demand is most prominent in climates where heat reserves are minimized, achieved through external sunshades, efficient applications, and effective ventilation.
- In temperate climates, apart from the roof or top floor, the extra impact of insulation in reducing cooling demand is generally negligible.

3 Building installations

3.1 Heating devices and installations

Different means of heating are used to heat dwellings and buildings. Such systems could be centralized or decentralized, as well as individual or common (common system for the whole building).

- **Individual heating could be a heating stove**, electric heater, air conditioner, another type of heat pump, or individual boiler. Those heating solutions can be based on solid fuels, natural gas, oil or electricity.
- Common **heating systems could be a boiler that can run on biomass, oil, natural gas or a heat pump.**
- **Centralised heating systems** connected to district heating that runs on natural gas, solid or liquid fuels. The decentralized heating systems could be grouped into two different types, depending on the location of the heat source – direct and indirect heating.

3.1.1 Direct heating

When the heat source is in the room that is being heated, the heating unit belongs to the group of direct heating devices. There are different types of direct heating devices:

- fireplaces;
- stoves;
- cast iron heaters;
- combined stoves;
- Electrical heaters;
- individual air-to-air heat pumps (air conditioners).

In this group of heating devices, part of the heat is transmitted directly to the air or water so as to heat the room. The heating source for this type of heating is mainly wood, wooden pellets and coals or electricity.

- Systems (boilers, stoves, burners) with efficiency greater than 88-90 % are considered very efficient.
- Systems with efficiency lower than 88% are considered inefficient.
- Systems with efficiency between up to 70% are considered very inefficient.
- Electrical radiators or other electrical systems with an efficiency of 100 % are also considered inefficient (high energy consuming means of heating).

3.1.2 Indirect heating

The second group of heating systems includes different types of indirect heating. The heat source is outside the heated rooms. Most of the heat is transferred to a heat carrier (water or air) that is transported to the rooms to be heated by pipelines or ducts and heating units such as radiators, convectors/ fan coils. In the premises, the heat transfer medium indirectly or directly transfers part of the heat it transmits and returns it to the heat source. These are the systems with heating boilers, heat pumps, centralized heating.

• **Pellet boilers**

One of the most popular options for heating in houses is the use of wood pellets as a source of heat. They are small granules made from sawdust, agricultural or plant residues. These boilers are the most environmentally friendly appliances for solid fuel heating. Their burning efficiency reaches 90 % or more. In terms of convenience and cleanliness, they are easier to maintain and operate than traditional fireplaces. At the same time, the use of pellets leads to a reduction in greenhouse gas emissions. Their only disadvantage is the higher initial investment.

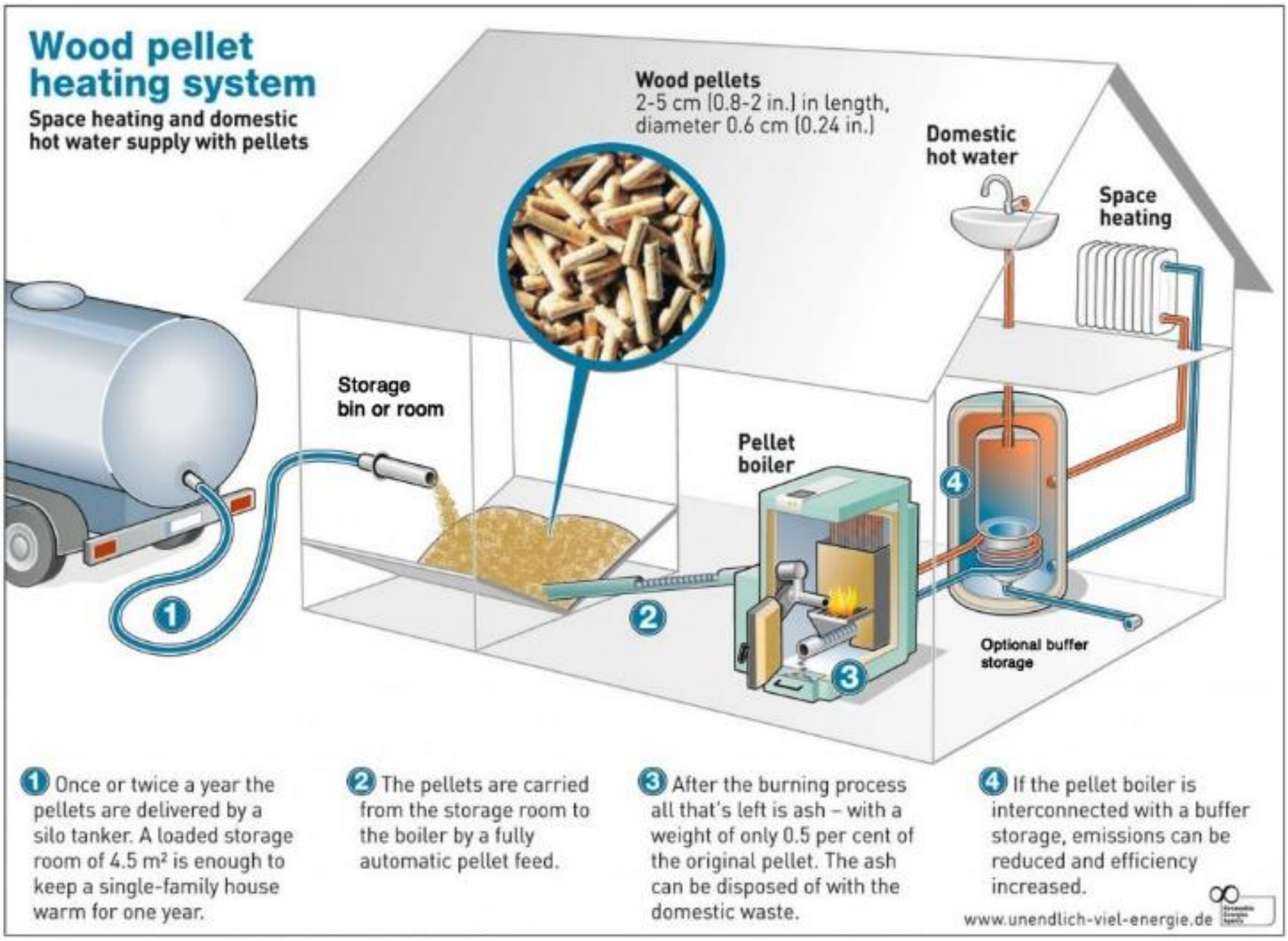


Figure 3. Wood pellet heating system (Source: Biomass Magazine)

As of 1 January 2022, reference Regulation (EC) 2015/1185, specific eco-design requirements are imposed for heating local solid fuel heating sources, namely: the seasonal energy efficiency of heating of local heating hot-fuel sources with a closed combustion chamber using pellets must be at least 79%. Seasonal energy efficiency means the relationship between the heating load covered by a local heating fuel source and the annual energy consumption required to cover this load, expressed as a percentage.

• **Condensing gas boilers**

Condensing boilers, powered by gas or oil, function as water heaters with high efficiency, typically exceeding 90% of the higher heating value. Their efficiency is achieved by condensing water vapor in the exhaust gases, recovering the latent heat of vaporization that would otherwise be wasted. The condensed vapor exits the system as liquid water through a drain.

In a conventional boiler, fuel combustion produces hot gases that pass through a heat exchanger, transferring much of their heat to water and raising its temperature. Water vapor (steam) is a byproduct of burning the hydrogen content of the fuel. A condensing boiler enhances efficiency by extracting additional heat from waste gases through condensation of water vapor to liquid form, recovering its latent heat of vaporization. This process can result in a typical efficiency increase of 10-12%. The effectiveness of condensation varies based on the temperature of the water returning to the boiler but is always at least as efficient as a non-condensing boiler.

Manufacturers of condensing boilers claim potential thermal efficiency of up to 98%, in contrast to 70%-80% with conventional designs (based on the higher heating value of fuels). Typical models achieve efficiencies of about 90%, placing most brands of condensing gas boilers in the highest available categories for energy efficiency

In terms of economy and environmental friendliness, gas heating is one of the most practical solutions for the home. Despite the economy and environmental friendliness, natural gas heating remained a less popular solution due to the poorly developed gas distribution network. The modern market offers a wide range of gas heaters with automatic (using a sensor) and manual control.

Condensing boilers - general characteristics

The condensing gas boiler uses not only the heat from the combustion of the gas, but also the heat released when the water vapor in the fuel condenses

- Burner modulates: in the range from 12.5 to 100 % of the maximum power, which means high efficiency even at lower load
- Automatically adapts to required heat.

Single circuit boilers

- works only in heating mode.
- They have the option of connecting to an external boiler with a coil for heating hot water for DHW

Double-circuit boilers with direct heating of domestic hot water

- hot water is heated according to current consumption
- no heat loss
- water does not stagnate in the boiler.

Double-circuit boilers with built-in water tank

- with larger dimensions, but provide higher comfort of hot water without an additional boiler
- completely eliminate the need to wait for the water to heat up and provide a sufficient amount of hot water at the moment.

- **Oil boilers**

A boiler serves two primary functions: heating the air inside a home and providing hot water. In the case of an oil boiler, the combustion of oil in the combustion chamber warms up cold water through a heat exchanger. The process is similar to that of a gas boiler, and oil boilers can approach the efficiency levels of gas boilers. Building regulations mandate that new oil boilers must have an energy rating of at least 86%, or A+, and a condensing oil-fired boiler typically achieves an efficiency of 90% or higher. Oil is considered a more efficient fuel than gas because oil boilers utilize nearly all the heat generated from burning fuel, minimizing wastage.

The primary distinction between a gas and an oil boiler lies in how they store their fuel. A gas boiler, connected to the mains, has a continuous fuel supply and doesn't require fuel storage. Conversely, an oil boiler necessitates a tank to store oil until needed. Despite their efficiency, oil boilers are often considered less environmentally friendly compared to gas or electric alternatives.

In new buildings, oil heating systems are increasingly rare due to their overall inefficiency and higher annual heating costs, especially when compared to more efficient alternatives like heat pumps. A new condensing oil-fired boiler typically achieves an efficiency rating of 92% to 93%, surpassing non-condensing boilers at 85%, and older systems at 60% to 70%. Replacing an old heating system with a high-tech heat pump can lead to significant savings, with a potential 30% reduction in annual heating costs when utilizing outdoor reset control and proper heat loss calculation, and over 270% compared to a modern heat pump.

3.1.3 Heat pumps

Heat pumps offer exceptional energy efficiency, operating similarly to refrigerators or air conditioners. They extract heat from sources such as the surrounding air, geothermal energy from the ground, water sources, or waste heat from industrial processes, amplifying and transferring the heat to the desired location. This method of transferring heat is more efficient than generating it, making heat pumps more cost-effective than traditional heating technologies like boilers or electric heaters. The coefficient of performance (COP) for a typical household heat pump is around 4, indicating that the energy output is four times greater than the electrical energy used to run it. This makes current models 3-5 times more energy efficient than gas boilers. Heat pumps can also be combined with other heating systems, commonly gas, in hybrid configurations.

There are various types of heat pumps, each with its unique characteristics:

1. **Air-to-Air Heat Pump:**
    - Transfers heat from the outside air to the air inside the home, increasing room temperatures.
    - Efficiency varies with outside temperatures, being less effective at lower temperatures.
    - Quick to install and does not require complex installations.
    - Does not heat water, requiring an alternative method for domestic hot water (DHW).
    - Requires a heat pump for each room needing heating or cooling.
2. **Air Source Heat Pump:**
    - Transfers heat from the outside air to water, which heats rooms through radiators or underfloor heating.
    - Can also heat water stored in a hot water cylinder.

- Absorbs heat into a fluid that passes through a heat exchanger, raising the temperature and transferring heat to water.

3. **Water Source Heat Pump:**
   - Uses heat energy from water for heating and hot water.
   - Two main designs: closed loop systems (lakes, lochs, or large ponds) and open loop systems (boreholes near rivers or suitable geological conditions).
4. **Ground Source Heat Pump (Geothermal):**
   - Transfers heat from the ground to heat the home and hot water.
   - Uses a loop of pipe buried in outdoor space, absorbing heat from the ground into a fluid that is then transferred to water.
   - Retains high efficiency even at low outside temperatures and is not affected by external factors.
5. **Hybrid Heat Pump:**
   - Combines a heat pump with another heat source, often a fossil fuel (gas, oil, or LPG) boiler.
6. **Cascaded Heat Pump System:**
   - Allows multiple heat pump units to work together to meet heating and hot water requirements.
7. **Exhaust Air Heat Pump:**
   - Transfers heat from a ventilation system to warm air that heats the home.
   - Can be used to heat water stored in a hot water cylinder, reducing the need for a wet central heating system.

Each type of heat pump has its advantages and is suitable for specific applications, offering environmentally friendly and energy-efficient solutions for heating and hot water needs.

Choosing a heat pump involves considering various factors, including costs, efficiencies, installation practicality, and available space. Here are key considerations.

Cost of heat pumps

- The installation cost varies between air source and ground source heat pumps.
- Common cost factors include the size of the dwelling, whether it's a new or existing building, preparation work needed for conversion, and potential radiator upgrades for improved efficiency.
- New builds with fulfilled efficiency standards can help keep costs down.

Efficiency

- Heat pump efficiency is influenced by the 'source' temperature (air, water, or ground).
- Air source heat pumps work with air temperatures ranging from -5°C to 25°C for most of the year.

- Ground source heat pumps extract heat from the soil, where temperatures don't reach as high but generally stay above 5°C throughout the year.
- Air source heat pumps can be more efficient in certain periods, but ground source heat pumps tend to be more efficient over the entire year.
- Ground source heat pumps are more efficient during extremely cold temperatures, making them a better option in colder climates.

Climate zones for heating mode

- Climatic conditions and external temperatures significantly impact the coefficient of performance (COP) of heat pumps.
- SCOP (Seasonal Coefficient of Performance), which was launched in 2013, measures energy efficiency throughout winter (heating) and summer (cooling).
- Heat pumps are labeled based on performance in three climate zones: cold, moderate, and warm.
- SCOP is evaluated at different temperatures (-7°C, 2°C, 7°C, and 12°C).
- Unlike air conditioning units, climate zones on heat pump labels are coded in shades of blue.

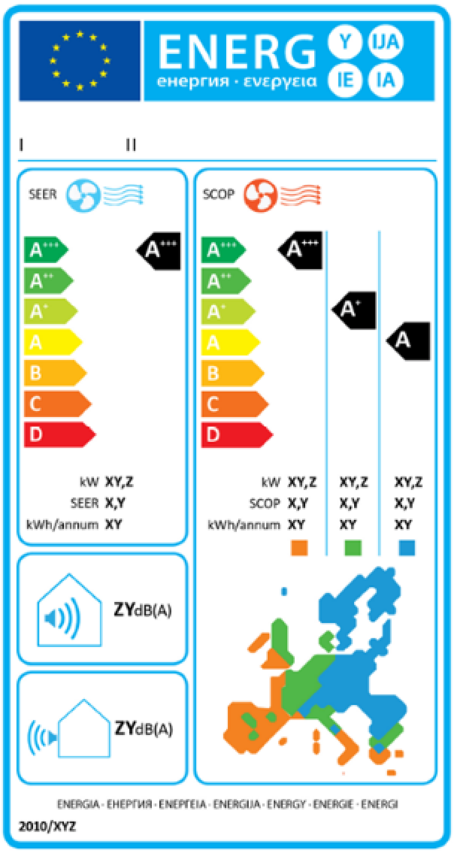


Figure 4. Energy labels for air-to-air heat pumps

A+++	SCOP ≥ 5,10	SEER ≥ 8,50
A++	4,60 ≤ SCOP < 5,10	6,10 ≤ SEER < 8,50
A+	4,00 ≤ SCOP < 4,60	5,60 ≤ SEER < 6,10
A	3,40 ≤ SCOP < 4,00	5,10 ≤ SEER < 5,60
B	3,10 ≤ SCOP < 3,40	4,60 ≤ SEER < 5,10
C	2,80 ≤ SCOP < 3,10	4,10 ≤ SEER < 4,60
D	2,50 ≤ SCOP < 2,80	3,60 ≤ SEER < 4,10
E	2,20 ≤ SCOP < 2,50	3,10 ≤ SEER < 3,60
F	1,90 ≤ SCOP < 2,20	2,60 ≤ SEER < 3,10
G	SCOP < 1,90	SEER < 2,60

Figure 5 Scale for energy labelling of air-to-air heat pumps

A+++	SCOP > 3,75	η_s > 150 %
A++	3,13 ≤ SCOP < 3,75	125 % ≤ η_s < 150 %
A+	2,45 ≤ SCOP < 3,13	98 % ≤ η_s < 125 %
A	2,25 ≤ SCOP < 2,45	90 % ≤ η_s < 98 %
B	2,05 ≤ SCOP < 2,25	82 % ≤ η_s < 90 %
C	1,88 ≤ SCOP < 2,05	75 % ≤ η_s < 82 %
D	0,93 ≤ SCOP < 1,88	37 % ≤ η_s < 75 %
E	0,85 ≤ SCOP < 0,93	34 % ≤ η_s < 37 %
F	0,75 ≤ SCOP < 0,85	30 % ≤ η_s < 34 %
G	SCOP < 0,75	η_s < 30%

Figure 6. Scales for energy labelling of air-to-water heat pumps for 55 ˚C

3.1.4 Individual electric heaters

Traditional electric heating appliances are typically: fan coils; electric radiators: oil, water, dry (air); accumulating stoves; air conditioners. The air conditioners are modern heating systems that consume 3 to 4 times less electricity than the energy they bring into the heated / cooled room. In contrast, electric heaters, accumulator electric heaters, convectors and fan coils consume as much electrical energy as heating energy they provide.

The typical installed power of the electric heaters is shown in the following table.

Table 9 Typical installed power of the most prevalent electric heating appliances

Electric heating appliances	Installed power, Watt
Calorifier	2000
Fan coil	2400
Electric heater	2000
Accumulating electric heater	3000
Air conditioner 9000 BTU	950
Air conditioner 12000 BTU	1250
Air conditioner 18000 BTU	1750
Air conditioner 24000 BTU	2600

3.1.5 State of the art energy efficiency level of different devices

Different types of individual heating devices considered to be efficient include:

Table 10. Efficiency and power of different types of individual heating devices

DIRECT HEATING DEVICES	EFFICIENCY	INSTALLED POWER
PELLET HEATING DEVICES		
• **Hot air pellet fireplace**	88-92 %	6 / 8 / 10 / 12 kW
• **Pellet fireplace with water jacket**	88-92 %	12 / 18 / 25 kW
• **Pellet boiler**	88-92 %	15 / 25 / 35 kW
NATURAL GAS HEATING DEVICES		
Natural gas condensing boilers		
• **Single-circuit natural gas condensing boiler**	90-95 %	16 / 24 / 28/ 35 kW
• **Two-circuit natural gas condensing boiler**	90-95 %	24 / 35 kW
• **Condensing gas boiler with built-in water heater**	90-95 %	24 / 35 kW
Gas convectors		
• **Gas convector**	90-95 %	3 / 5 kW
ELECTRIC HEATING DEVICES		
• **Air Conditioners (A2A heatpump)**	350 to 470 %	9000 / 12 000 / 15 000 / 24 000 / 30 000 BTU

The most important feature of how individual units are characterised is their overall and seasonal efficiency. Nevertheless, the price efficiency is also a function of the price of the energy carrier

3.1.6 Centralized district heating

District heating is a system for producing and distributing heat energy, generated in a centralized location (power plant) through a system of insulated pipes for residential and commercial heating needs such as space heating and domestic hot water. Many fossil-fuel-fired power plants, especially those in settlements, are actually cogeneration power plants. Cogeneration is a technology for centralized simultaneous generation of electricity and heat. In traditional methods of electricity production, a large amount of useful heat is discharged into the environment in the form of condensed heat from the steam. In contrast, cogeneration technology uses this "waste" heat and produces both heat and electricity in a combined process with higher efficiency. The combined production of electric and thermal energy has proven qualities and, in combination with modern best available techniques, is the most efficient and environmentally friendly method.

The facilities that connect the heat transmission network to the domestic installations of residential, administrative and industrial buildings are called substations.

Heating installations with horizontal risers have entered the market during the last twenty-five years after the introduction of polyethylene pipes with metal inserts. This type of installation has its unquestionable advantages: more aesthetic and practical - there are no vertical pipes in the rooms, the bills are simpler - according to the indications of the central and apartment heat meters, and the difference forms the energies for the building installation and for the heating of water. A great advantage is the possibility of interruption of heating individually in case of overdue bills. For horizontal heating installations, residents have the ability to regulate their own heat consumption by themselves.

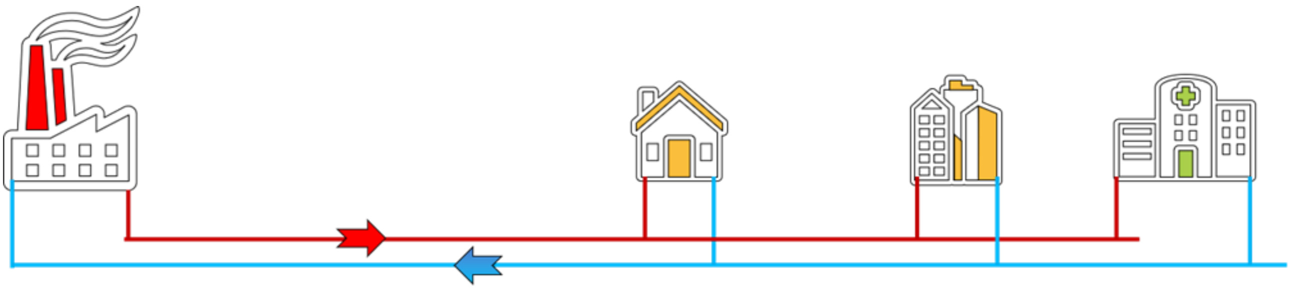


Figure 7 Scheme of centralized heating (Source: community.esri.com)

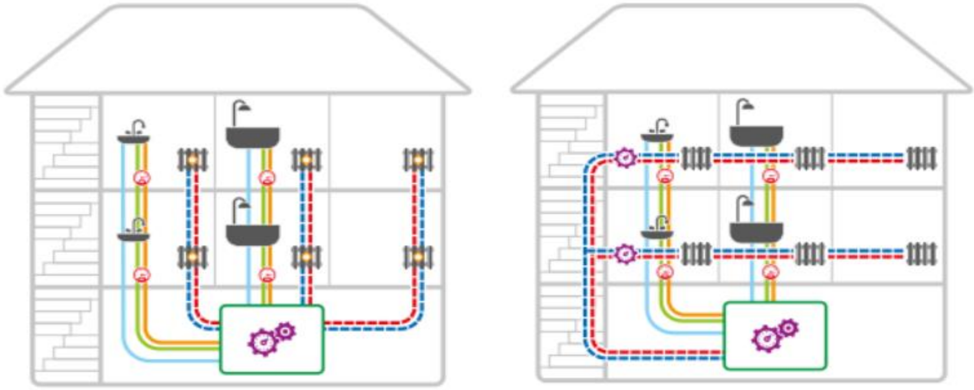


Figure 8 Example of old vertical and new horizontal internal heating building installation (source: EVN Bulgaria)

3.2 Electricity usage within households

3.2.1 General information

The distribution of electricity use can vary significantly based on individual habits, energy efficiency measures, and regional climate differences.

Household`s electricity consumption depends on:

- The number of people in a household
- Whether the household uses electricity as a heating means and the number of heating appliances;
- Whether the water is heated by an electric boiler;
- What type of food preparation is used;
- the energy efficiency of the lighting fixtures;
- Efficiency of appliances.

The distribution of electricity consumption in households depends mainly on the way of heating. As it was already presented above, the highest share of the final energy consumption in households takes the space heating (64,4%), followed by water heating (14,5%) and lighting and appliances (13,5%).

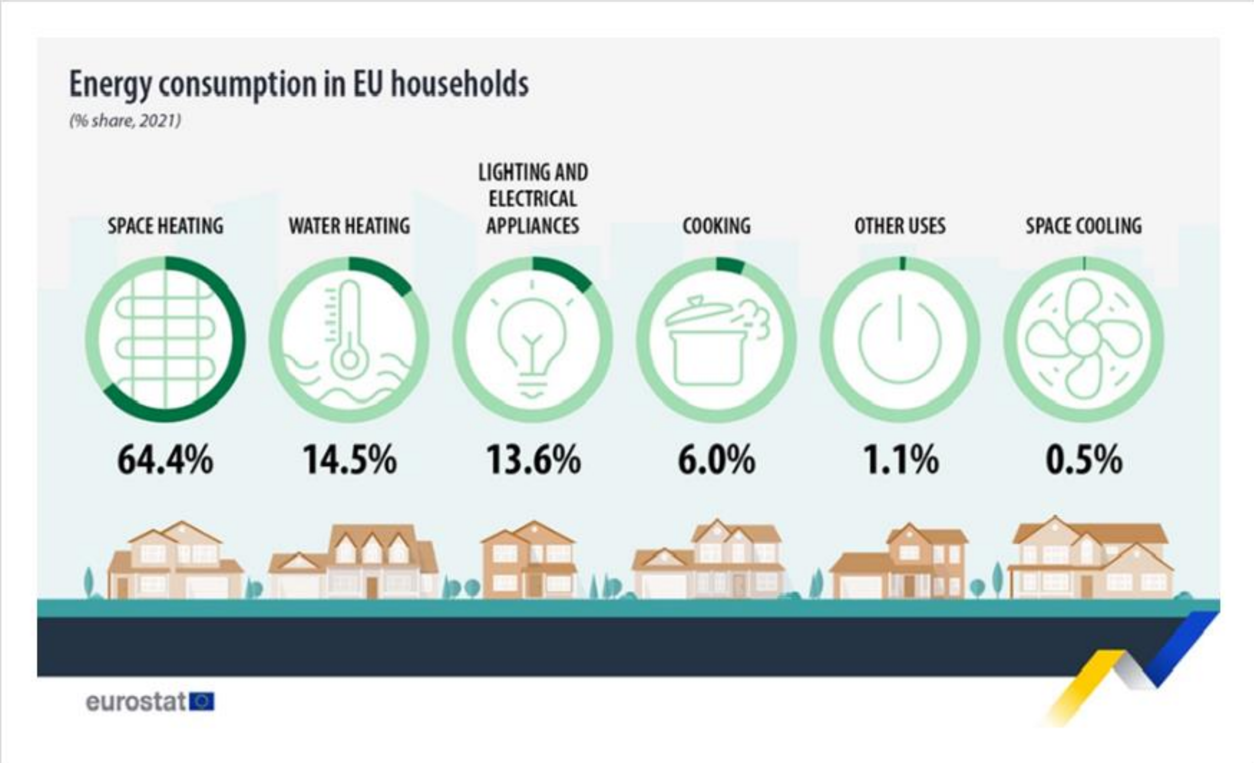


Figure 9. Distribution of energy consumption in EU households

Certainly, in some EU countries with warmer climates, cooling can be a significant portion of electricity use in households.

As it can be seen the fields with the highest potential for energy saving are domestic hot water, cooling, lighting and refrigeration appliances.

Electricity consumption in households in Bulgaria

According to the Institute for Energy Management in Bulgaria, traditionally, the final energy consumption of households is mainly covered by electricity (41%) and renewable sources and biofuels (36.1%). It has been repeatedly noted that behind this high share of RES in households, the main contribution is the use of wood for heating and hot water. Unlike the average values for the EU, the consumption of natural gas by Bulgarian households is extremely low (4%).

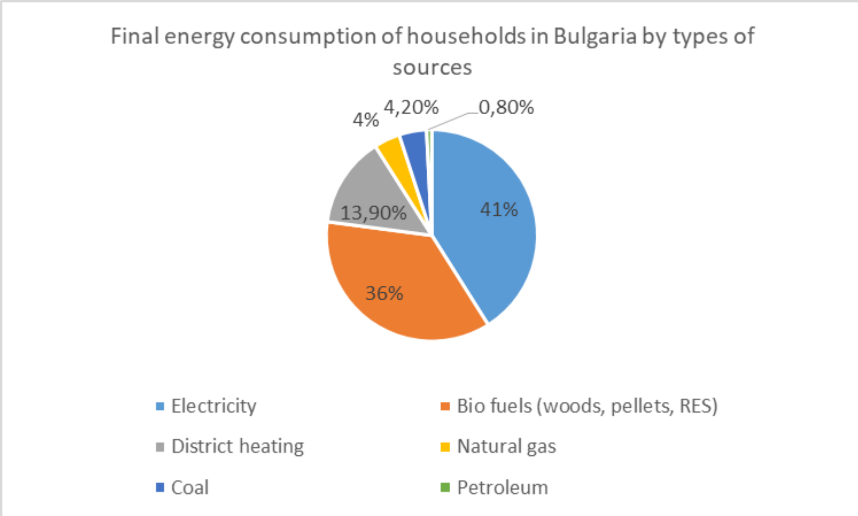


Figure 10. Final energy consumption of households in Bulgaria by types of sources (Source:EMI)

The statistical data of Eurostat for Bulgaria regarding the distribution of energy by satisfied needs and by energy sources is presented in the figure below:

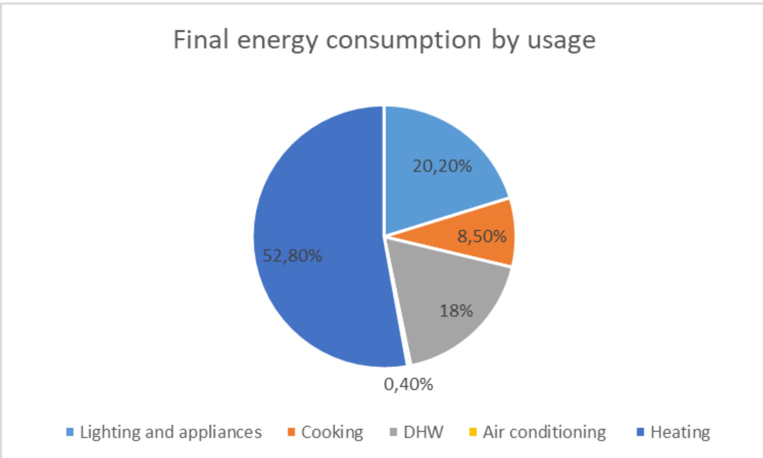


Figure 11. Distribution of energy by usage (Source: Center for Energy Efficiency EnEffect)

Distribution of electricity consumption in households by needs is presented in the figure below:

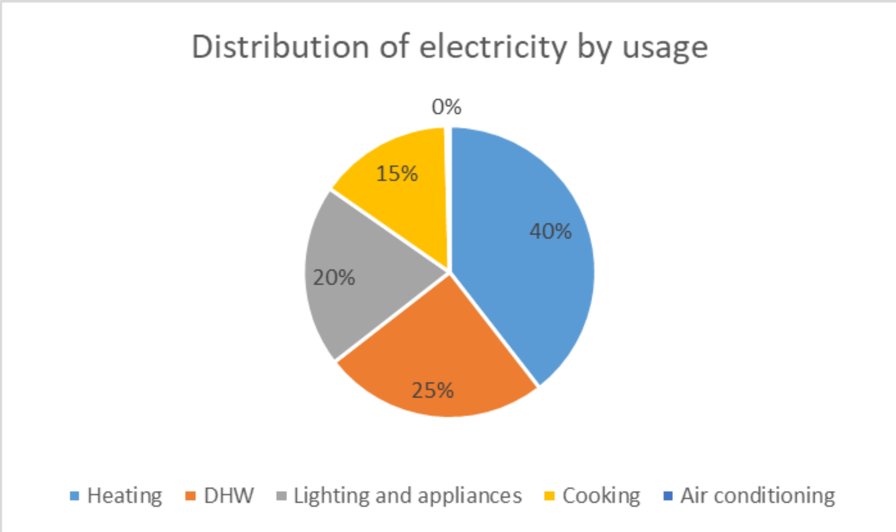


Figure 12. Distribution of electricity consumption in households by needs (Source: Center for Energy Efficiency EnEffect

Electricity consumption in households in Greece

According to the available data of 2021, 53% of the consumed final energy was utilized for space heating in residential buildings, while lighting and electrical appliances had the second highest share (20%). The production of domestic hot water amounted to 14% of the final energy consumption, while cooking and space cooling presented correspondingly lower shares (9% and 4% respectively).

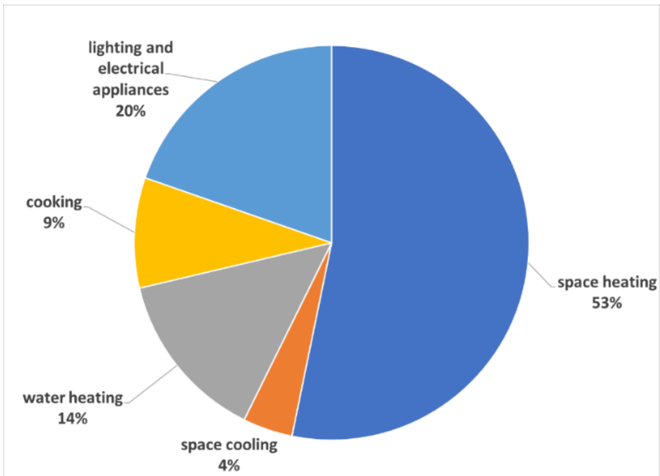


Figure 13. Allocation of the final energy consumption to the various end-uses

Lighting and electrical appliances had more than half of the consumed electricity, while the other end-uses resulted in shares ranging from 8% for the case of space heating to 16% for the case of domestic hot water.

Electricity was the most prevailing energy carrier representing 36% of the total energy consumption. Oil and petroleum products had also a significant share (26%), while the penetration of biofuels and natural gas was also notable with shares equal to 16% and 12% respectively. The shares of the other energy carriers were low ranging from 1% to 7%.

Oil and petroleum products had the highest share in space heating (44%), while the shares of biofuels and natural gas amounted to 23% and 22% highlighting their significant role. The shares of the other energy carriers were low ranging from 2% to 5%.

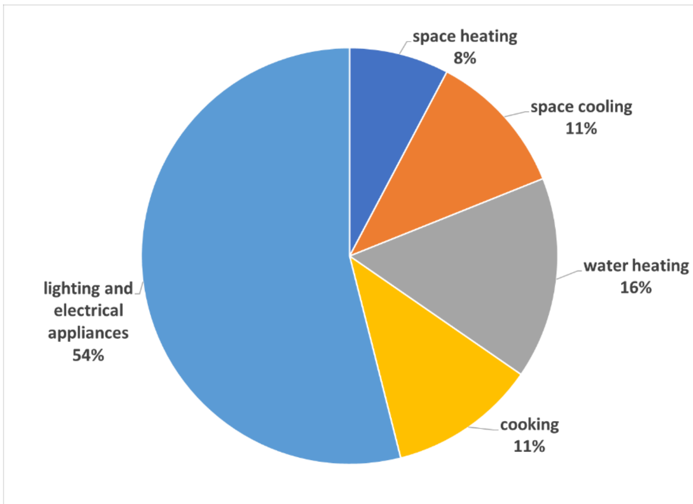


Figure 14. Allocation of the electricity consumption to the various end-uses.

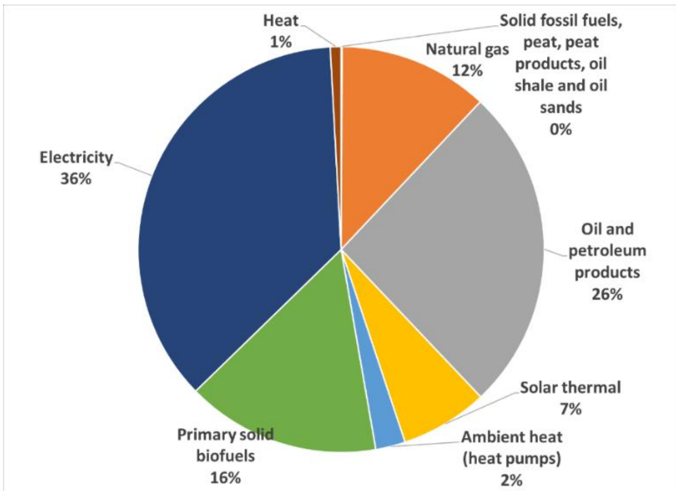


Figure 15. Allocation of the final energy consumption to the various energy carriers.

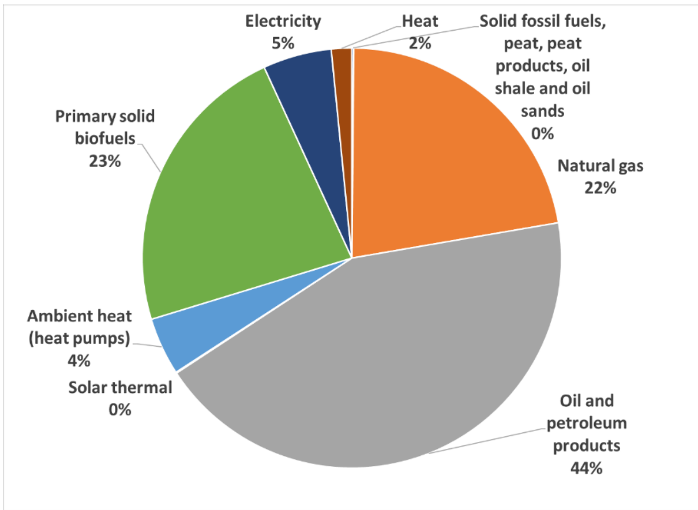


Figure 16. Allocation of the energy consumption for space heating to the energy carriers.

According to following figure, the contribution of solar thermal to the production of domestic hot water was the highest one (49% share), while electricity had also a remarkable penetration (41% share). Oil and petroleum products and natural gas revealed considerably lower shares (9% and 1% respectively).

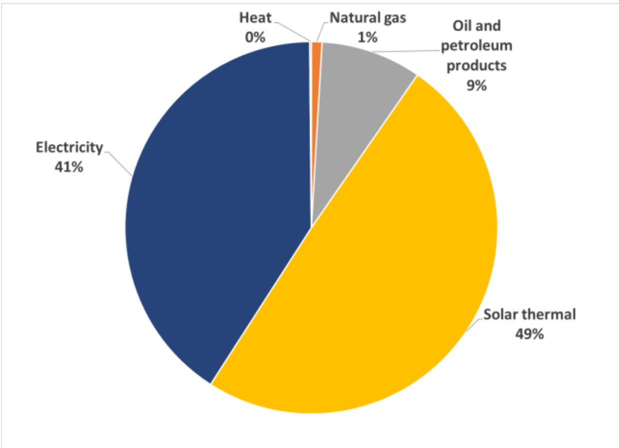


Figure 17. Allocation of the energy consumption for domestic hot water to the various energy carriers

Electricity was the most common energy carrier for cooking (46% share), while biofuels constituted an alternative option representing 37% of the consumed energy. Finally, oil and petroleum products were utilized with a considerably lower share (17% respectively).

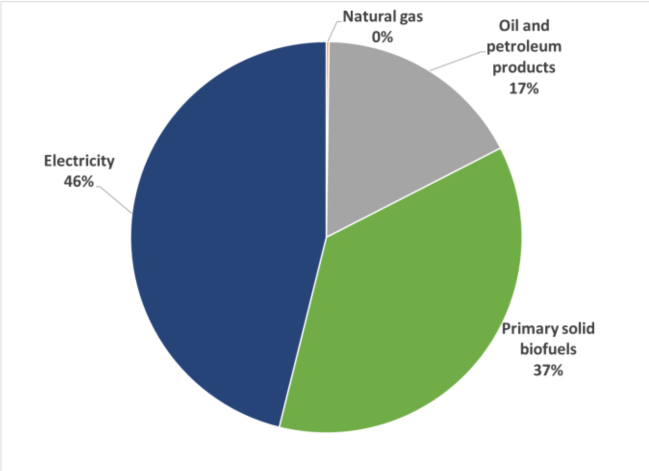


Figure 18. Allocation of the energy consumption for cooking to the various energy carriers.

Electricity consumption in households in Portugal

In Portugal, according to the most recent results available (INE, consumption survey 2020), energy consumption in the domestic sector confirms the trends identified from other sources of information, namely the increase in the relative weight of electricity and natural gas in domestic energy consumption and the existence of efficiency gains, partly associated with the type of equipment used.

With regard to energy consumption (excluding fuels used in vehicles), in 2020 electricity remained the main source of energy consumed in the domestic sector in Portugal, accounting for 46.4% of total energy consumption. Biomass emerged as the second main source of energy consumed in Portuguese households in 2020, accounting for 18.4% of total energy consumption in homes. With regard to gas consumption in the domestic sector, this has been increasing since the expansion of the Natural Gas network in Portugal, being available for about 28% of dwellings in Portugal. Natural gas is the third main source of energy in the domestic sector in terms of consumption. Bottled LPG, despite being used in around 53 per cent of households in Portugal, has dropped to fourth place in terms of energy consumption in the domestic sector, representing 12.2% of total energy used. Piped LPG, Heating Oil and Solar Thermal still have low expression (4.4%, 4.1% and 2.1% of total energy consumption in households in 2020, respectively), despite the fact that Solar Thermal energy consumption almost tripled in the last decade.

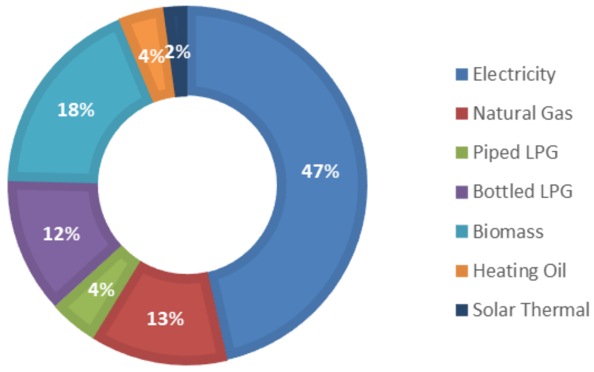


Figure 19. Distribution of energy consumption in the dwelling by type of energy in Portugal (Source: INE 2020)

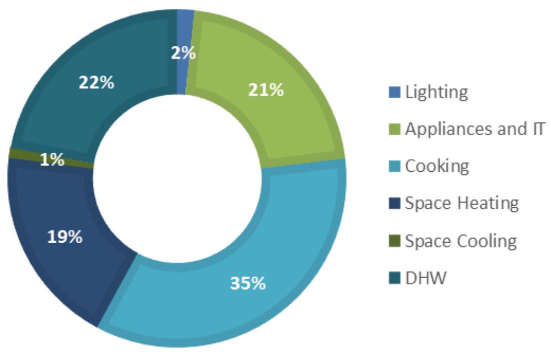


Figure 20. Distribution of energy consumption in the dwelling by type of main end-use (Source: INE 2020)

Electricity consumption holds significant importance in the residential sector, given that a majority of home appliances rely on this energy source, creating a clear dependence on electricity in contemporary society. The consumption of electricity is closely linked to the rising demand for thermal comfort and the increasing prevalence of electrical appliances in households. Additionally, advancements in technology have led to the availability of more energy-efficient equipment.

Analysing the specific end uses of electricity, the highest consumption was observed in the kitchen and electrical equipment categories. In 2020, these segments accounted for 42.7% and 46.0% of the total electricity consumption, respectively. This underscores the central role of electricity in supporting various domestic activities and the need for efficient energy management in residential settings.

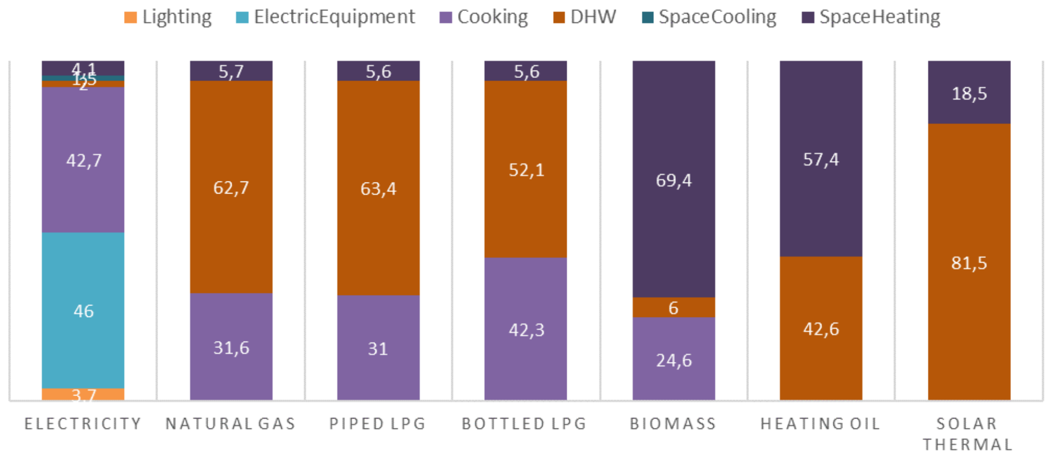


Figure 21. Distribution of energy consumption in the dwelling by energy source and type of use in Portugal (Source: INE 2020)

Based on the above information and taking into account field auditing studies, the typical household electricity consumption, broken down by the main use's in the dwellings, can be estimated with good degree of confidence, as presented below.

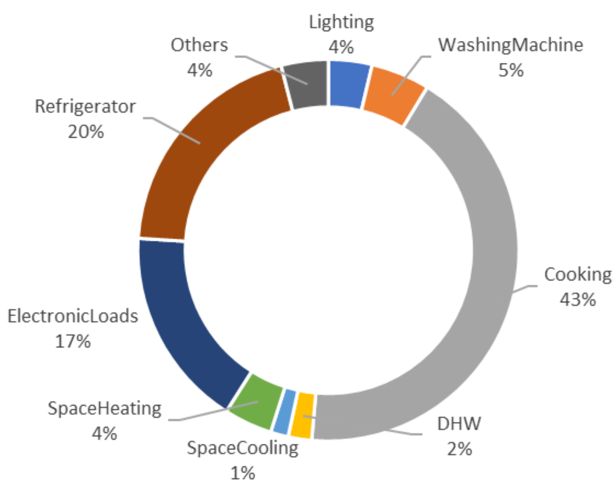


Figure 22. Distribution of electricity consumption in the dwelling by end-use in Portugal (Source: Adapted based on cross references)

Electricity consumption in households in Latvia

By analyzing the electricity consumption of a household, it is possible to discover who the largest consumers are, and often also to discover electrical appliances whose electricity consumption was previously unknown. Understandably, energy consumption is very individual – it depends on the dimensions of the living space (in a larger dwelling it will take more energy to heat it, or vice versa - to cool it), the energy efficiency of the building, the number of household members (the more inhabitants in the household, the higher the energy consumption), the number of electrical appliances, their energy efficiency, frequency of use, as well as the geographical location of the place of residence.

The majority or 64.5% of electricity in Latvia is spent on heating, and then on hot water preparation – 19.2%, approximately 8.7 % is used for lighting and electrical appliances, on average in households about 7.1 % of the total electricity is spent on cooking.

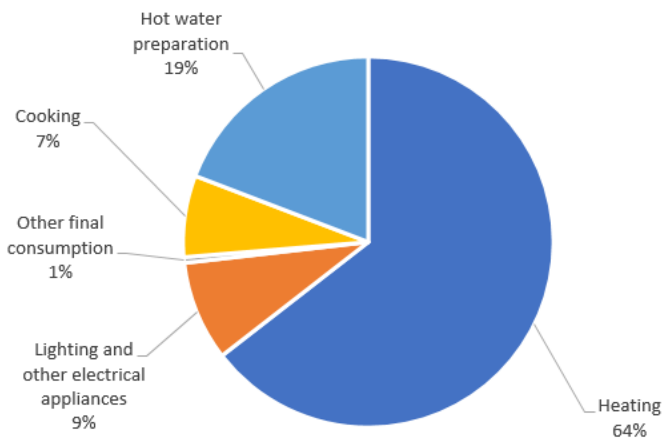


Figure 23. Distribution of energy consumption in the dwelling in Latviaby type of main end-use

3.2.2 Refrigerators

Refrigerators and freezers are some of the biggest energy consumers in a household because of their constant work. The average temperature inside a refrigerator is between 2°C and 8°C.

- **Decreasing the temperature by one degree increases energy consumption by 6%.**
- **Therefore, the internal temperature setting should not be below 7°C. This saves about 30% of electricity compared to an internal temperature setting of 2°C.**

As a rule of thumb, a four-person household with an old refrigerator (12 years of more) or refrigerator-deep freeze chest will consume up to 700 kWh per year. By comparison, a new particularly energy-saving combined refrigerator-deep freeze with a refrigerator volume of more than 190 litres and a freezer section of 92 litres requires only around 200 kWh per year. Deciding in favour of purchasing energy-saving appliances saves around two-thirds of the electricity required.

The main reasons for the high electrical consumption of refrigeration equipment are the following:

Table 11. Main reasons for the high electrical consumption of refrigeration equipment

High electricity consumption due to	Reason
Poor thermal insulation	Old appliance
Unsealed door	Amortisation
High outdoor temperature	Wrong location
Too low temperature	Incorrect setup
Poor heat dissipation	Insufficient ventilation
Ice on the internal wall	Poor support

3.2.3 Domestic hot water

Domestic hot water refers to the heated water used in bathrooms, showers, and kitchens that flows from taps. In apartments, independent conventional water heaters are commonly powered by electricity or gas, with the latter often integrated into the heating system. The standard temperature for domestic hot water heating is typically set at least between 50 to 55°C in the boiler, although some heaters may only heat up to 40°C. Heating systems can be categorized as conventional or unconventional (innovative).

A. Conventional systems

Conventional systems can be flow-through (using electricity or gas) or tank (using electricity only), while unconventional systems are usually tank-based.

- Flow-Through Systems: Activated upon demand, these systems use electrical resistance or combustion (for gas heaters) to heat water. While designed for delivering small amounts of water at a single point, they minimize heat loss as the water is used immediately.
- Tank Systems: Involving volumetric water heaters with capacities of 60 to 100 litres, water is heated and stored in an insulated container. However, this storage can lead to heat loss (2 to 5%). Energy consumption can be adjusted based on factors like water temperature and off-peak tariffs..

B. Efficiency and Innovation systems

They can be distinguished in condensing gas boilers and innovative systems:

- Condensing Gas Boilers: The efficiency of these boilers for hot water, particularly in complex models, can reach up to 95%. Efficiency is influenced by the heater's location, the distance hot water travels, and the desired water temperature. Conventional hot water systems, especially electric water heaters, are considered to have reached their peak efficiency.
- Innovative Systems: Recent water heaters incorporate heat pumps, solar thermal systems, or a combination of both. Despite the presence of a tank leading to some heat loss, these systems are more efficient, providing cheaper hot water.

Regardless of the method used for domestic hot water, be it electric water heaters, centralised heating plants, gas boilers, or other systems, the provision of domestic hot water represents the second-largest expense in the total energy costs for each household. This highlights the importance of exploring innovative and energy-efficient solutions to optimize the cost-effectiveness of hot water provision.

3.2.4 Washing machines and dryers

Energy consumption of washing machines

Around 5% of the electricity consumed in the household is required for washing laundry. The greatest part of this is for heating the water. A washing machine requires a small part of the energy input (10 to 20%, according to the wash program) for the rotation of the washing, while the greatest part serves to heat the soapy water.

The energy requirements for a washing cycle increase with the amount of water and the washing temperature. The amount of water required for a washing cycle depends upon the machine, but also upon the selected wash program. In earlier times more than 100 litres of water flowed through the machine for a standard 60 °C wash program. Today, only somewhat less than 40 to 50 litres are required for five or even six kilogrammes of laundry.

The electricity consumption of a conventional old washing machine does not depend upon the filling level; that is, when only half loaded with the normal washing program, the washing machine requires the same amount of electricity as with a completely filled drum. If washing with only a partially loaded washing machine is unavoidable in your household, the most economical washing machines are those which adapt the amount of water to the amount of laundry. In new washing machines, this so-called automatic capacity regulation is already standard. However, a half-full washing machine still requires considerably more electricity per kilogramme of laundry than a small, but full washing machine.

Washing temperature

The energy consumption per washing cycle depends strongly on the washing temperature, as shown in the following table.

Table 12. Consumption and costs per washing cycle according to washing temperature

Washing temperature	Required electricity for each use
30°C	0.35 kWh
40°C	0.50 kWh
60°C	0.95 kWh
90°C	1.70 kWh

The selection of the best-suited wash program according to the type of textile and the level of soiling determines the consumption. As a rule, even for heavily soiled textiles, no pre-washing is required. At 95 degrees without pre-washing around 40% of the energy consumed can be saved. In view of the washing effectiveness of today's washing machines, the 60° program is sufficient for white laundry (underwear, hand towels). The 95° C program requires nearly double the energy of the 60° program.

Energy-saving programs

The different extra programs, such as the short program, the energy-saving program or the optimisation of the spin speed, can save energy. With energy-saving programs longer soaking times are used in place of high washing temperatures. Examine the times required for the respective wash programs in the user's manual. The so-called energy-saving program sometimes turns out to be more energy-intensive than, for example, the short program for lightly soiled laundry.

Energy consumption of dryers

Electrical laundry dryers require considerable electricity. In any case, drying laundry in fresh air or in the laundry room is less expensive. In winter also, laundry can be dried with little energy consumption in the laundry room, in the cellar or in another suitable room on the laundry stand, if necessary, with a 25 Watt - fan oriented so that the air is blown between the laundry items and causes them to move in the air stream. Laundry dried in fresh air delivers water to the air flowing past. With this trick well spin-dried laundry is dry after one day or even after a few hours. Pleasant side effect: The continuous motion of the laundry renders it soft and smooth, as in a laundry dryer. Laundry driers are available in three basically different designs: Ventilation dryers introduce ambient air, heat the air and blow it through the laundry, so that it takes up moisture. The moist hot air is then expelled to the outside. This requires a well-ventilated room and an exhaust air pipe to the outside in order that the air intake is relatively dry and not moist and no damage occurs to the building structure due to moist air. Gas-heated ventilation dryers have around only half the low primary consumption of electrically heated ventilation driers.

Condensation dryers are more widespread than ventilation dryers and require only a single connection to power. Moist hot air is cooled in a section of the appliance, whereby the moisture condenses and is collected in a reservoir or immediately passed to the wastewater. The air-dried and cooled in this manner is heated again and blown through the laundry. Usually, the room air is pumped in a duct through the hot air of the drier, heated and again expelled to the room in order to heat the drier environment. Alternatively, there are also water-cooling systems. According to design, these appliances require around 10 per cent more energy than ventilation driers to achieve the same effect. Condensation dryers with heat pumps function at low hot air temperatures as standard condensation dryers. The heat from the drying process is recovered. With these dryers, one can save as much as 50% of the electricity consumption, depending upon the appliance. Cabinet dryers, which dry using cold air, have the lowest energy consumption of all but require very long drying times.

A specialised type of dryer is the washer-dryer, which combines the functions of a washing machine and a dryer. These appliances are capable of washing and drying laundry within a single unit. Standard models typically have a capacity to wash around 5 kg of laundry and dry 2.5 kg per wash cycle. In practical terms, this means that after washing, half of the laundry needs to be removed for drying, as the appliance has the capacity to dry only a portion of the washed load. The drying process in these appliances employs a water condensation technique. Heated dry air is directed over a water-cooled surface, causing the water vapor in the air to condense. The condensed water then flows off as liquid water. It's important to note that the drying function in washer-dryers requires access to (cooling) water. These appliances are designed for small households where installing a separate dryer is not feasible, and there's no option to air-dry laundry on a clothesline. This makes washer-dryers a convenient solution for homes with limited space or specific constraints.

3.2.5 Energy and water consumption of dishwashers

Dishwashers require electricity to heat the water. This fraction constitutes around two-thirds of the consumption per washing cycle. Reducing the temperature of the dishwasher from 60°C to 50°C consumes around 30% less electricity.

When fully loaded, large dishwashers with space for 10 to 14-place settings are more economical in terms of electricity consumption than smaller dishwashers with space for seven to nine-place settings. There are usually programs for different degrees of food residues, which differ according to temperature (40 – 70°C), washing time (approximately 30 – 120 minutes) and energy required. However, nearly every dishwasher has special program settings, and the program times can be very different. By using energy-saving programs for these appliances, equally good results are obtained with longer washing times at lower temperatures, with less energy consumption than with shorter washing times at higher temperatures.

3.2.6 Energy consumption for cooking

The average power of an electric stove is 1000 to 1500 Watts (small hot plate), up to 2200 Watts (large hot plate) per hot plate in use. The oven has a power of around 2 kW. Thus, cooking one hour with a large hot plate consumes between 2 and 2.2 kWh of electricity. In terms of energy consumed, gas is more favourable for cooking, as the entire chain leading to the conversion of energy (e.g., coal) to electricity is no longer required.

Table 13. Typical annual electricity consumption for cooking, depending on the household size (Source: VDEW)

Household size	Annual electricity consumption for cooking
1 person	200 kWh
2 persons	390 kWh
3 persons	450 kWh
4 persons	580 kWh

Different efficiencies are found according to the type of cooking hob. The higher the efficiency, the greater the amount of heat directly supplied to the food being cooked in the cooking vessel and not only to the hot plate itself. Heating to the required temperature consumes between 70 and 80% of the electricity consumed, leaving only 20 - 30% for further cooking, particularly when the hot plate step is reduced in due time.

3.2.7 Air-conditioners for cooling

Classified by efficiency, the air conditioners rank:

- Conventional - these air conditioners do not change the power they give
- Inverter - these air conditioners change their power smoothly, allowing them to operate in an optimal mode.
- DC inverters – this is a variation of the inverter air conditioner, whose compressor is very efficient, which is reflected in increasing the efficiency of the whole machine and reducing the consumption of electricity.

The required installed power of the air conditioners for premises with different heated volumes is given in the following table.

Table 14. Required installed power of air conditioners

Space dimensions	Required power
< 50 m³	2,0 kW
50-60 m³	2,7 kW
60-90 m³	3,5 kW
90-120 m³	5,0 kW
120-170 m³	7,0 kW

3.2.8 Lighting in households

Lighting in an average household represents about 10% of all energy consumption. The potential for savings in lighting is very high. Energy-saving lamps (LED lighting) can reduce annual consumption by half – from 200 kWh to 100 kWh without loss of comfort.

The many terms used in connection with lighting can be downright confusing. In the following box, the most important terms for the energy-saving check are briefly introduced and their meaning made clear:

Luminous flux - Luminous flux refers to the amount of light which a lamp produces. Luminous flux is measured in lumens (lm). The higher the number of lumens produced by a lamp, the brighter the lamp. Since 2010 the lumen output of energy-saving lamps must be specified and is now generally found on the packaging.

Illuminance - The basic parameter for the planning of lighting systems is the required illuminance. The illuminance expresses the amount of light falling on a surface. It is measured in lux (lx). Lux = lumen per square meter. For the workplace, different minimum illuminances are specified according to application. These vary from 50 lux in corridors and 200 to 500 lux in typical working areas to 1500 lux in Quality Control. An illuminance between 20,000 and 100,000 lux is required on the surface of an operating room table.

Luminous efficacy - The so-called luminous **efficacy** of a lamp describes the amount of light produced in relation to the required energy input. It is calculated as the ratio of the luminous flux (lumens) to the electrical power input (Watts).
Luminous efficacy = Lumens per Watt

The higher the "lumens per Watt value" (lm/W) of a lamp, the better the energy efficiency. This value is therefore a measure of the lamp's efficiency.

The table below shows the luminous efficacy depending on the lamp type:

Table 15 Luminous efficacy of different types of lamps (Source: Educational Program IDEA Project)

Lamp type	Luminous efficiency (lumens per Watt)
Incandescent lamp	12
Halogen lamp	15-25
High performance LEDs	> 80 to 120
Fluorescent lamp	100

3.3 Intelligent/smart meters and systems for energy management in households

There are some good practices for reducing energy consumption in households as analysis of current energy consumption and calculation of costs by compiling a list of electrical appliances (especially energy-efficient goods) in the home:

- The rising cost of energy is just one of the many reasons why a change in thinking is essential. In general, we consume much more energy than we really need. To address this, there are many useful tools for measuring energy consumption. While awareness of the problems can help the consumer to save energy, the analysis and monitoring of energy consumption is crucial to save energy.
- The lack of information is an obstacle to saving energy for consumers. It is a barrier on two levels: consumers do not have information about the energy consumption of their household appliances, as well as how this consumption can be reduced. **By using intelligent equipment and feedback on the individual consumption patterns of their appliances, consumers will be given a very easy way to learn how much energy their appliances use**. Smart energy meters allow consumers to monitor the level of energy savings by changing their energy habits. Seeing this immediate effect is one of the most motivating ways to change habits.

Figure 24 Programmable thermostat as an application (Source: www.mothlighting.com)

- The **thermostat** is a device that automatically responds to changes in ambient temperature by turning on or off a heating or cooling system to constantly maintain a set desired temperature indoors. The biggest benefit of using the thermostat is the ability to set different temperature regimes and schedules. When the operation of the heating or cooling system or appliances is optimized, significantly less energy is used in the long run.
- **Temperature control** - it is possible to set a lower temperature (heating during the day when you are not at home and at the same time a program) (with digital thermostats) to reach

and maintain a comfortable temperature when you get home, thus saving energy during your absence.

4 Renewable energy sources in households

Renewable energy, often referred to as clean energy, is energy that comes from natural sources or processes that are constantly replenished. For example, sunlight and wind, even if their availability depends on time and weather.

4.1 Solar energy

Solar energy is the most prominent technology for energy self-consumption, in particular solar PV, though solar thermal is also widespread. Solar energy is used both for hot water, as well as for electricity generation. Solar PV generates electricity directly from the sun using solar panels that are integrated into building structures, on the roof, walls or even windows (using transparent panels). Solar PV can be used directly in the building, fed into electricity networks or stored on-site. Today solar energy is also financially competitive.

4.1.1 Solar energy for hot water

Solar thermal energy is formed by the conversion of solar radiation into heat. This energy can be used directly for heating or indirectly for electrical energy by generating steam that drives generators. **However, the main use of solar collectors is for warming up water for domestic purposes.** There are two types of solar collectors: vacuum-pipe and plate panels as the vacuum-pipe collectors have always been the most efficient power generation systems.

Despite the increasing demand for solar collectors, modern manufacturing techniques have led to cost savings, so vacuum technology offers the greatest return on investment compared to any other solar system.

The vacuum-pipe solar collectors consist of two layers of glass with a vacuum between the layers. The outer layer of the solar tube is made of borosilicate glass, which is very low in iron and allows 98% of the light energy to pass through the 2nd inner layer, which is also specially coated. These coatings and advanced technology are what make these solar collectors have even more thermal parameters than any other collector on the market.

These systems are characterized by the fact that they do not directly heat the water you use for bathing, but usually another fluid is used to heat your boiler - most often it is propylene glycol (antifreeze), which does not freeze in winter. It warms up in the collector and, moved by a circulation pump, reaches the water heater, where it passes through a special coil (therefore, in these systems, a water heater with one or more coils is used) and gives off its heat to the drinking water, then again moves to the collector and the same processes are repeated again.

The solar hot water tank can be installed with a reservoir of 80 to 200 litres of solar hot water, depending on the model selected. Typically, it is connected to the existing water supply system of the building. When the hot water in the tank is already hot, the heating elements of the existing tank should not work. They can be used when we want to have hot water early in the morning, for example, when draining the boiler the previous night.

Flat plate collectors represent one of the oldest and well-established solar technologies currently available in the market. This type of solar collector comprises an absorber, a transparent cover, a frame, and insulation. Typically, low iron safety glass is utilized as the transparent cover, allowing a significant portion of solar radiation to pass through. At the same time, it minimizes the escape of heat emitted by the absorber through the greenhouse effect. This cover also serves the purpose of preventing wind from cooling the absorber. The frame, along with the transparent cover, provides protection to the absorber against adverse weather conditions. To further reduce heat loss through conduction, insulation is applied to the back of the absorber and the side walls. In high-quality panels, this insulation commonly consists of mineral fiber materials such as glass wool or rock wool. Overall, flat plate collectors remain a reliable and enduring technology, offering efficient solar energy utilization with the added benefits of weather protection and thermal insulation

How to choose the most suitable solar system?

If you are a single-family house, the calculation is relatively simple. While for a family of four, an 80l electric water heater is completely sufficient, a solar system with an 80l water tank won't be enough for you. There are many reasons and they are all related to the daily sunlight. The electric water heater is on 24/7 and immediately starts heating when you use a little of the hot water and its temperature drops. For its part, the sun shines only during the day and on days when there is sunshine. This means that when you take a shower in the evening, the collector does not have the opportunity to heat the water in the water heater.

The solar collector heats the water more slowly. The electric boiler heats its water to 60ºC in 1.5-2 hours, while the solar panel needs 3-4 hours.

For these reasons, the solar water heater is significantly larger to be able to provide you with a sufficient reserve of hot water for the whole day, even though it only heats water during the day.

As standard, the collectors in the combined cells are sized according to the water heater. To guide you, we will say that a boiler with a capacity of about 120-150 litres is suitable for a single-family house. complete with a collector of about 2.5 m². Different companies offer different models, reaching up to 200l. with collector 2.5-3 m².

In this case, combined solar systems are extremely suitable, which are usually complete with a vacuum tube collector.

If you need a solar system for heating larger quantities of water - for example, a hotel, restaurant, etc., then the system should be sized according to your needs. The starting point is your assumed or expected consumption. If you expect that you will need 500 l of hot water per day, the system should be designed on this basis. For such amounts, the split solar system is most suitable, where the collectors are located on the roof, and the water heater is installed in a suitable room in the building. The two are connected by a pipe system.

4.1.2 Solar energy for electricity production

Photovoltaic solar energy is formed by the transformation of light into electricity through semiconductors. A solar cell, or a photocell, a photoelectric converter, is a semiconductor device that converts light energy into electrical. This is one of the most environmentally friendly ways to extract electrical energy. The generated electricity can be used either at the moment or stored in batteries. A typical photovoltaic system employs solar panels, each comprising a number of solar cells, which generate electrical power. PV installations may be ground-mounted, rooftop or wall-mounted. The mount may be fixed, or use a solar tracker to follow the sun across the sky.

Solar cells can be made from about a dozen different materials. Up to now, the most significant of these is crystalline silicon.

- **Monocrystalline silicon cells** - they are made of a single crystal of high purity silicon crystal, and have a cylindrical shape which is cut into thin plates with a thickness of 0.2-0.3 mm. Circular plates are obtained which, for the purpose of efficient use of the edges are cut out and shaped like an octagon. The most common cell size is 100 mm. Mass-produced monocrystalline cells have an efficiency of about 23% and a modulus of 13-17%. They are the most expensive and most energy-intensive cells for the time being.
- **Polycrystalline (multicrystalline) silicon cells** – they are made by casting, cooled in mould and, when hardened, form irregular poly (multi) crystalline structures. Their surface is brilliant with a characteristic blue colour. Blue colour has the best optical properties: and absorbs the greatest amount of light. The square silicon block is cut into 0.3 mm thick plates. The efficiency of the cell is about 17% and the module is 11-15%. The polycrystalline cells typically have a size of 100x100 mm. They have the largest market share.
- **Thin-Film Solar Cells** – these cells, specifically those incorporating copper-indium coatings of selenide and cadmium tellurite, present a promising departure from traditional silicon-based solar technologies. Despite having lower efficiency, these thin-film technologies offer resistance to high temperatures and shadows, along with the advantage of lower production costs. The film thickness ranges from a few nanometres (nm) to tens of micrometres (μm), which is considerably thinner compared to the conventional first-generation crystalline silicon solar cells (c-Si) that utilize wafers up to 200 μm thick. This thinness allows for flexibility and reduced weight in thin-film cells, setting them apart from their thicker counterparts. Thin-film solar cells find applications in various domains, including building-integrated photovoltaics and as semi-transparent photovoltaic glazing materials that can be laminated onto windows. In addition, rigid thin-film solar panels, sandwiched between two panes of glass, are employed in some of the world's largest photovoltaic power stations. These advancements highlight the versatility and potential cost-effectiveness of thin-film technologies in the solar energy landscape.

Nominal power of the PV installations

The maximum amount of energy a cell can produce (module) is called nominal / peak power (Wp). Generally, the amount of electricity produced is proportional to the amount of light falling on it: the greatest is direct radiation - strong sunlight without clouds. Peak power is defined under standard test conditions: 1000 W / m² sunshine and cell temperature 25 ^{o}C.

The required area to generate 1 kWp for different cell types is usually 2,5 m².

Influence of temperature on cell performance

Cell efficiency decreases with increasing temperature. Energy production declines by 0.5% with each degree Celsius increase in the temperature. At 30 °C, it decreases by 15%. Crystalline cells are more sensitive than thin films. In the amorphous silicon, productivity decreases by 0.2% every degree in the temperature range promotion. In summer, the module's temperature may reach 40-70 °C. Therefore, the modules should be kept as cool as possible. Cooling is very important! In fact, on a sunny winter day, the production peak may be higher than on a hot summer day.

Other factors affecting cell efficiency - *loss of reflection* - part of the radiation is reflected by the surface of the cells - decreases with anti-reflex coating; - *the radiation is not ingested* - part of the radiation does not have enough energy to emit electrons from the atoms; - *the radiation is too strong* - if the radiation has more energy to break off electrons, *excess energy is lost* - the cells are heated; temperature, shading, premature recombination before reaching P / N transition, electrical loss.

The main components of a photovoltaic system are:

1. Photovoltaic panels
2. A supporting structure
3. Inverter
4. Monitoring and control devices
5. Batteries (optional)

<u>Photovoltaic panels</u>

The photovoltaic panel converts the solar radiation into a constant voltage. There are different models and manufacturers of panels. Most manufacturers and importers offer a wide range of power from 50Wp to 670Wp.

The panels should be installed in lighted, unshaded places, with their orientation facing South, East and West. In home systems, the panels are most often installed on the roofs of buildings.

The panels are connected in series by grouping them in strings. The parameters of the string are determined according to the inverter that is used.

It is important during the installation of the panels that there is no shaded panel from tall trees, chimneys or other protruding things, because the shaded panel worsens the performance of the entire string, the entire row.

<u>Construction</u>

An additional construction is used for the installation of the panels. It depends on the place where the panels will be installed, which also determines their type. The most common types of constructions are:

- Tile roof construction
- Flat roof construction with counterweights or anchoring
    - Orientation - East / West
    - Orientation - SOUTH
- Construction for thermal panel or sheet metal
- Ground structure

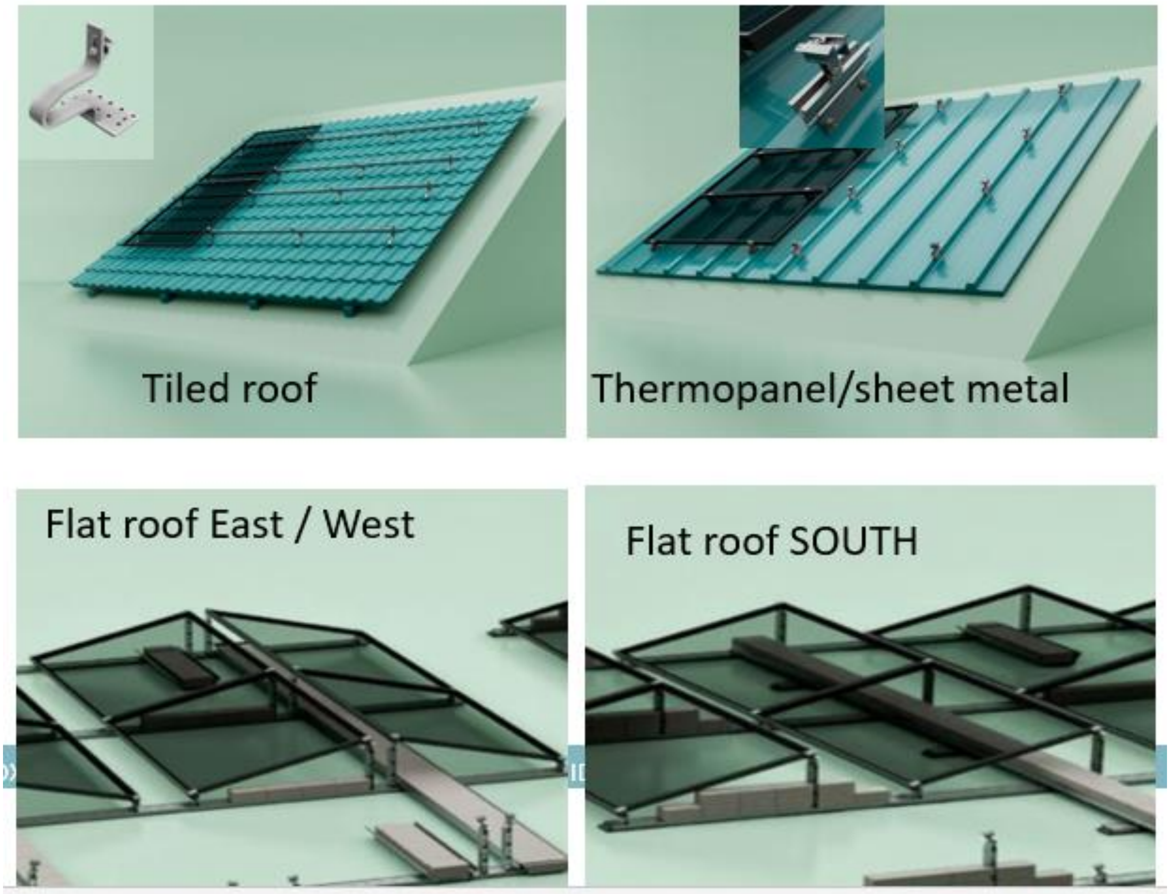


Figure 25. Different types of PV construction (Source: Kukov and Co Ltd.)

<u>Solar panel orientation</u>

The optimal orientation of solar panels significantly influences their power output. To maximize energy production, it is crucial to ensure that PV panels are correctly positioned to receive sunlight at the most effective angle. Some panels are fixed, while others incorporate tracking systems that follow the sun's movement. In building applications, fixed PV panels are generally more suitable.

Direction: In the northern hemisphere, PV panels are ideally oriented to face true south (true north in the southern hemisphere) to receive direct sunlight throughout the day. Any direction between southeast and southwest can be highly productive, and an east-west setup may only lose 10 to 15% of annual production compared to a perfect south-facing system. Rooftop solar panels are typically installed flush to the roof, although exceptions exist.

Angle: The tilt or angle of a solar panel is crucial for optimal energy production and is determined by the geographical latitude of the location. A general rule is to set the PV panel tilt angle equal to the geographical latitude for optimal annual energy production. For example, at 50° latitude, the optimal tilt angle is also 50°. Closer proximity to the equator suggests a more vertical tilt, while closer to the poles implies a tilt towards the equator. South-facing solar panels perform best when tilted between 15° and 40°, with 37° being the optimum angle for photovoltaic panels injecting electricity into the grid.

<u>Inverters</u>

In home systems, inverters convert direct voltage to alternating current, which is widely used in households.

According to the mode of operation, inverters are divided into three types:

- On-grid - They work only in the presence of an external grid, if the power supply to the ERP fails, the inverter turns itself off.
- OFF grid inverters- Operate in island mode. They must have a battery system.
- Hybrid Inverters – These inverters are a combination of the first two types. It can work with an external network (with or without batteries) by synchronizing with it, as well as in island mode using batteries. Hybrid inverters are the most widely used in home systems.

In terms of the number of phases, inverters are divided into:

- single-phase inverters
- three-phase inverters

Whether a single-phase or three-phase inverter will be used is determined by the type of household external power supply. If the power supply is three-phased, a three-phase inverter is used, if it is single-phased, a single-phase inverter is used.

Battery energy storage systems

Battery energy storage systems (BESS) can also be added to home photovoltaic systems since they help to increase the building`s self-sufficiency and self-consumption rates.

SSR is the portion of the electrical demand of the installation that is covered locally by the PV and BESS. It equals the ratio of the consumed PV generation and the total electrical demand for a certain period of time - equation.

$$\text{SSR} = \frac{C+E}{A+C+E+F},$$

where A and F are the grid-consumed electricity, kWh;

C – direct PV consumption, kWh;

D – charged power to the BESS, kWh;

E – discharged power from the BESS, kWh.

The typical daily power curves of a prosumer with a BESS are illustrated in the figure below.

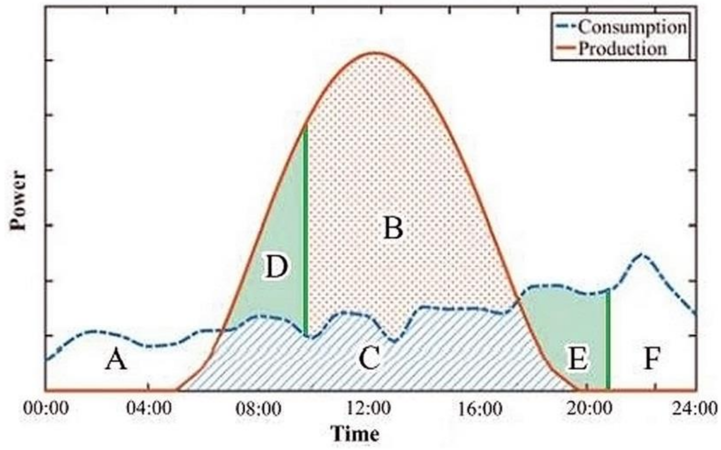


Figure 26. Visualization of the different types of consumption at the user with installed PV installation and BESS

Compression of annual self-sufficiency rates achieved by pilots with and without BESS. The figure below demonstrates the self-sufficiency rates achieved by 5 pilots located in Bulgaria, given the impact generated from using the 2.7 PV + 9.8 kWh BESS hybrids on a monthly basis in a non-power sales mode

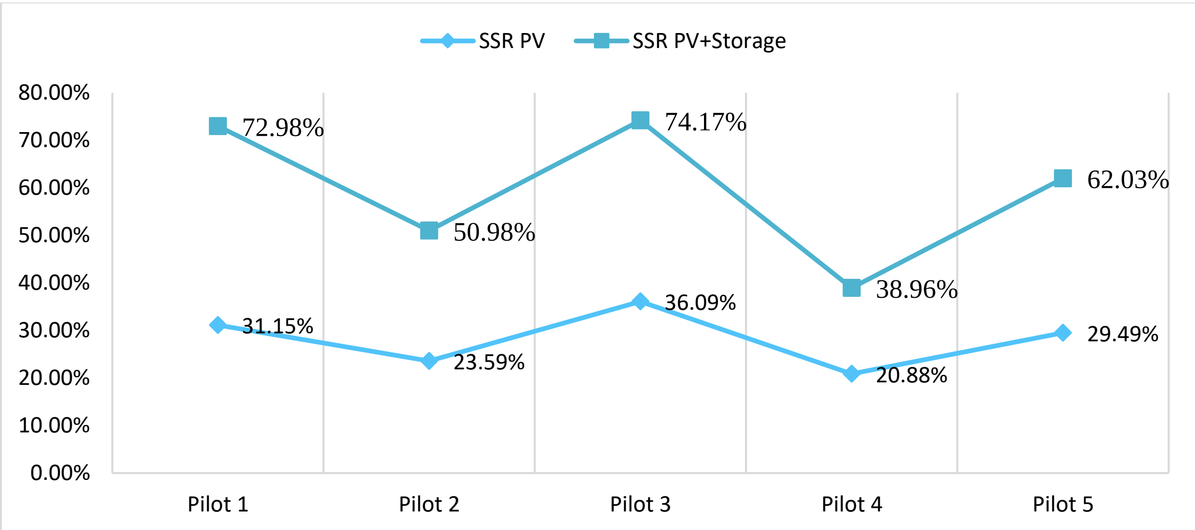


Figure 27. Compression of annual self-sufficiency rates achieved by pilots with and without BESS.

The most used batteries at the moment are of the LiFePO4 type. They are of the modular type, consisting of a charging module (BMS) and battery module of 5 kWh each. The battery systems can be of 5, 10 and 15 kWh or similar, and the 10 kWh system consists of one charging module and two battery modules of 5 kWh each. The 15-kilowatt battery system consists of one charging module and 3 battery modules of 5 kWh.

As standard, one hybrid inverter up to 10 kW can be installed with up to two charging modules and on each charging module up to 3 battery modules of 5 kWh each. Thus, the largest configuration obtained is a 10 kilowatt inverter with 30 kWh battery modules. The battery module, which is 5 kilowatt hours, provides this power for no less than two hours, i.e. its maximum instantaneous power is 2.5 kW.

Devices for monitoring and control

An element of the monitoring system is a smart meter with current transformers. It is installed on the incoming cable of the main panel, monitoring the amount of energy from the external network. It is a mandatory component when we restrict the system from returning electricity to the external grid.

For remote monitoring, a dongle or logger is required to connect the system to the Internet via the home network or a mobile card for a 4G network. Most manufacturers have developed their own software with which the system is managed and monitored almost in real time, showing the production, consumption and state of charge of the battery. The data is sent to servers and the client reads it from the server through a mobile application or browser.

4.2 Geothermal energy

Geothermal, or "warmth on the ground", boreholes are needed to reach the heat. The depth of drilling depends on the temperature. In shallow drilling, the temperature is too low to be used directly for heating. Then a heat pump is needed to raise the temperature. Geothermal heat pumps are used mostly in places that are poor in sunlight and are an alternative to the solar system. The geothermal installation works contrary to the refrigerator principle. It delivers a compressive force to the compressor, which compresses a refrigerant, which in turn absorbs heat by evaporation in the environment.

There are two ways to extract geothermal energy:

- Drilled geothermal heat pump
- Geothermal heat pump with flat collector

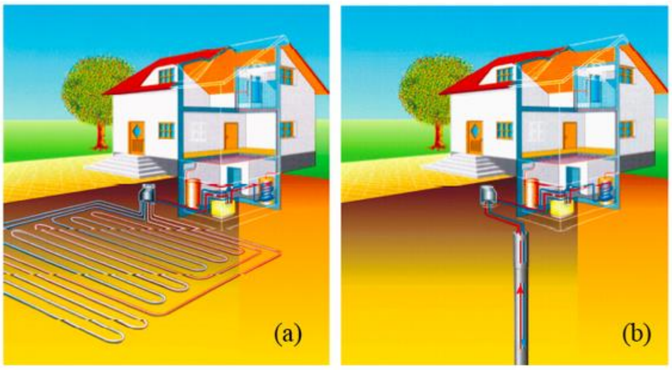


Figure 28. Different types of geothermal installation (Source: avelim.co.il)

A flat collector occupies considerable space, so it is good to plan it right from the start of the project. This system consists of pipes that are laid at no more than a meter and a half depth. For a single-family house, between 200 and 400 square meters of collector area are required in dry, clay soil. By rough estimate, the collector system’s dimensions must be at least twice the area of the house.

For optimal use, moist soil and regular sunlight are most suitable, as most of the energy produced is stored in the ground. Soil and extraction capacity of flat collector:

- Dry, sandy soil: 15W / m

- Wet, sandy soil: 20W / m
- Dry, clay soil: 25W / m
- Wet, loamy soil: 30W / m
- Ground over groundwater: 35W / m

For a meter drilling, the probe generates up to 80 watts of energy. Soil and groundwater play a key role in reducing productivity; in dry areas, it can fall to less than 20 watts per meter. Different soil and thermal yield in watts per meter:

- Dry, sandy: 20W / m
- Wet, sandy: 40W / m
- Wet, rocky: 60W / m
- Groundwater: 80W / m

Advantages of using a geothermal heat pump installation:

- the unit price of a heating system with this type of system is 4-5 times lower than the price of conventional electric heating and about 2-3 times the use of other fuels;
- no fuels used for heating - no dependence on the price of the respective fuels;
- not affected by atmospheric conditions;
- No emissions; - the energy source is always available;
- easy maintenance and operation.

Requirements prior to installation of the geothermal heat pump:

- Studies before installation of the respective installation type are required
- Required water flow – 24-hour sample pumping from the wells;
- water temperature - at a depth of 20m, the temperature is about 10°C. Significant deviations from this value are a sign of permeate surface water in the underground;
- physicochemical composition of water - analysis in an authorized laboratory;
- determining the required number of wells and their location in order to ensure the necessary water flow.

4.3 Biofuels

Biofuels are the oldest source of energy used for heating, cooking or producing electricity. They are considered a renewable resource if the yield of material does not exceed the rate of growth of biomass. Biofuels are all types of liquid, solid and gaseous fuels that are produced from biological raw materials, and include wood from biomass crops, agricultural and forestry residues, bio-diesel, ethanol and methanol, and biogas from anaerobic digestion processes. According to the aggregate state biofuels could be:

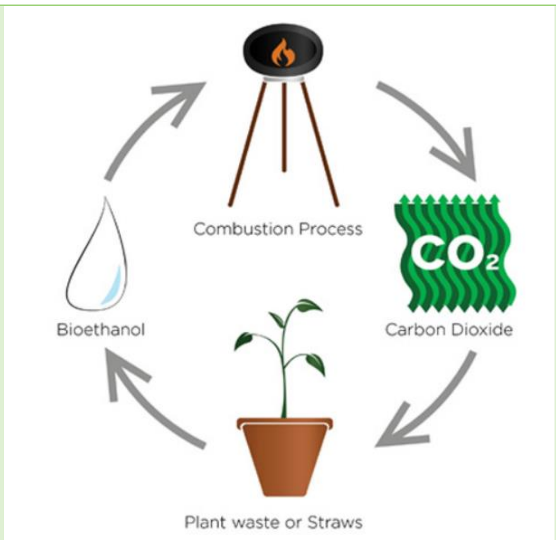
- solid biofuels such as wood, wooden pellets, briquettes, chips, etc.
- liquid biofuels such as bioethanol and biodiesel
- gaseous biofuels - biogas and biomethane; syngas

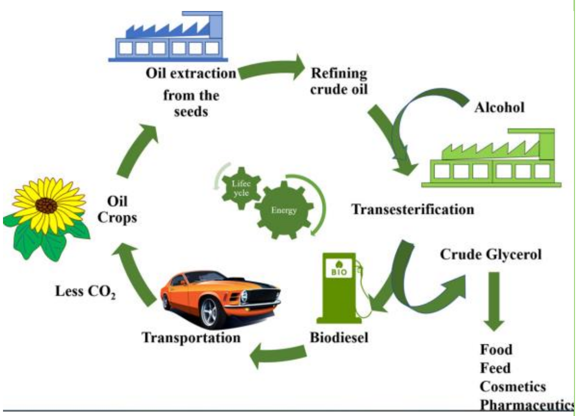
On a global scale, the demand for fossil fuels is increasing, but at the same time, the trend is to reduce their production, due to the limited deposits and the exploitation of increasingly difficult-to-access deposits. The massive use of conventional fuels leads not only to a drastic reduction of the available quantities but also to negative consequences for the environment, which directly reflect on the health of the population and the quality of life. The goals of modern society are aimed at ensuring the security and diversification of energy supplies, developing alternative sources of fuels, improving the technologies for their absorption and processing and, last but not least, reducing emissions of greenhouse gases.

Different types of bioenergy can be used for different purposes, as shown in the following table.

Table 16. Types of bioenergy and uses

Different types of biofuels	
	**Wood pellets** - made from dried and milled waste, pressed under high pressure and at high temperature, in the form of small cylinders. They do not contain adhesive substances. Lignin, which is contained in plant tissues at temperatures above 100 ° C, softens and allows the material to acquire the corresponding shape, as it appears, as a natural glue that supports the shape of the pellets. Basic Parameters of Wood Pellets: • **ash content**: because it is of natural origin, biomass has a certain amount of non-combustible Basic Parameters mineral mass that is naturally absorbed or mechanically encapsulated in the final product. Wood pellets are produced from the core of the wood. When the bark comes into them, the ash content increases and their quality is reduced. The ash content of woody biomass is less than that in cereal crops. • **moisture content -** the moisture content is mainly 8 ÷ 10%, which guarantees the mechanical strength of the fuel; • **mechanical resistance** - this parameter characterizes its resistance to shredding during transport. The high mechanical strength of the pellets guarantees a lower degree of pellet crushing and trouble-free operation of the feeder mechanisms. Different equipment requirements for mechanical resistance are different and should be taken into account when buying fuel.
	**Wood briquettes** - a product similar to pellets (obtained identically to wood pellets) but with a larger diameter (Ø 40-80 mm). Various feedstock can be used to produce them. Depending on this, the briquettes can be of deciduous wood (oak) or of coniferous wood (pine), etc. As with pellets, the production process of wood briquettes involves several stages: crushing the raw material, drying and pressing. Basic Parameters: - Ash content is <1.5%. - Calorific value ~ 4500kcal / kg

	**Wood chips** – a product that is produced by mechanized chipping of wood. Wooden chips are raw materials, which are made from inferior waste wood (wood pulp), pre-cut logging wood and / or wood for felling that is not suitable for woodworking. Wood chips are the main raw material for the production of paper and corrugated cardboard and in the last years, it has been used mainly as an energy raw material. Depending on the type of wood, wood chips can be made from hardwood (beech, oak, hornbeam, etc.) or softwood (pine, fir, poplar, etc.). The difference in chips obtained from different tree species (soft and hard) is mainly in density and, accordingly, inenergy value.
	**Sunflower pellets** - a product made from secondary raw materials. They are harvested from sunflower seeds, which are waste from oil-producing plants and nut-production plants (roasted peeled sunflower seeds). The technology for their pelleting is very similar to that of wood pellets. The difference is that sunflower flakes are of lower humidity (10-15% sunflower is used for the production of sunflower oil or nuts). Basic Parameters: Energy value: 5.1 kW / kg (14.76 MJ / kg, 3525 kcal / kg) Humidity: 10-15% Density: 350 kg / m³ Dimensions: Ø 6 mm x 10-25 mm Ash content: 5% Unit of measure: t (ton) Price: 215 leva / ton (VAT included) Packaging: Bulk or Big Beg (1.2 x 1.2 x 2 m)
	**Bioethanol**– energy from plant and animal matter (often blended with petrol or diesel) used for heating or transport fuel (e.g., bioethanol used in a commercial vehicle). Bioethanol Bioethanol is produced from plant sugar crops, starch or cellulosic raw materials. The main technology for converting biomass into ethanol is fermentation followed by distillation. Ethanol is currently produced in large quantities by fermenting sugar or starch residues from agricultural raw materials. The crops used for ethanol production vary by region and can be: sugar cane, wheat, corn, sugar beet, wine grape residues, etc. The main material for bioethanol is sugar, from which, with the help of enzymes and a yeast fungus, alcohol is obtained. Bioethanol is primarily used as a fuel additive to reduce carbon monoxide and other harmful emissions emitted by vehicles. Statistics show that using a ten percent bioethanol additive to gasoline results in a 30% reduction in carbon monoxide content, up to 50% in exhaust particulate matter, up to 19% in greenhouse gases, and up to 25% in smog.

	Overall, exhaust gas toxicity is reduced by about 21%
 *Source: Recent advances in biodiesel production: Challenges and solutions (https://www.sciencedirect.com/science/article/abs/pii/S0048969721038237#ab0010)*	**Biodiesel** Biodiesel is produced by the esterification of vegetable oil extracted from oilseed crops - rapeseed, soybean and sunflower. Esterification involves the transformation of vegetable oil molecules into molecules similar to diesel hydrocarbons – an expensive process that makes biodiesel more expensive than mineral diesel. Usually, 1t of oil and 110kg of methanol produce 1t of biodiesel and 110kg of glycerin. The characteristics of biodiesel are very close to those of mineral diesel. The bio variant can be used in existing diesel motor vehicles in a mixture with mineral diesel - in any proportion. Its energy content is lower by about 8%, but it has a higher fuel density and better ignition qualities. Biodiesel is absolutely compatible with any type of diesel engine. The only problem that would arise is with older, unmaintained engines - as biodiesel is a good solvent, the old rubber hoses need to be replaced.

5 Thermal comfort in home

Households spend a large part of their budget on providing thermal comfort - in summer for cooling, in winter - for heating. But actually – what does thermal comfort mean? Are there any objective dimensions, apart from our personal feelings - as many people as there are sensations?

In response to this question, the definition given by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) is most often cited: "it is a state of mind that expresses satisfaction with the thermal environment and is assessed by subjective assessment". Simply put – when you feel good, neither cold nor warm, you are in your thermal comfort zone. At a higher temperature, you get tired quickly, if you are cold - you become distracted and restless.

The presence or absence of thermal comfort is essential not only for our psycho-physical balance:

- It determines productivity in each area, as well as occupational accidents and injuries;
- affects the incidence rates of socially significant diseases such as cardiac, respiratory, joint, etc.;
- it costs a lot of energy and financial resources.

This proves to be a sufficient reason for the achievement of optimal thermal comfort to be the object of the searches of investors, architects and designers, manufacturers of building materials and systems for air conditioning and ventilation, and builders.

Thermal comfort depends on the exchange of heat between the human body and its environment. These exchanges depend on six factors that are classified into two categories, namely environmental and individual factors.

There are different factors, which define indoor comfort:

Table 17. Factors determining the indoor comfort

Environmental factors	**Individual factors**
Air temperature	Person’s activity level
Air speed	Clothing thermal resistance
Humidity	
Wall temperature	
Indoor air quality	

Thermal comfort

Human thermal comfort is a crucial aspect of building design and is defined as the state of mind that reflects satisfaction with the surrounding environment. Engineers focus on ensuring thermal comfort in their plans for heating, ventilation, air conditioning (HVAC), and the building envelope. Several factors contribute to determining thermal comfort: indoor and outdoor air temperature, air movement (i.e. the circulation or movement of air within a space - stagnant air can lead to discomfort, while controlled airflow can enhance comfort), relative humidity (that is the amount of moisture in the air), clothing, activity level (e.g. spaces with varying activity levels may require adaptable HVAC systems), and room temperature.

Within an accommodation, to feel comfortable, advised temperatures are the following:

- 17 °C in the bedrooms to sleep well
- 19° C in the living room, the kitchen and the living rooms
- 22 °C in the bathroom

Other health problems

The following health problems are related to unsuitable indoor conditions and are included in the extended assessment of the health benefits of energy renovation:

- unhealthy housing syndrome
- heart attacks
- brain strokes
- respiratory diseases
- flu.

Indoor air quality

Many health problems that lead to poor health and reduced productivity can be attributed to poor indoor environmental quality, where poor air quality plays an important role. A room with good air quality means low odours and pollutants, as well as acceptable levels of CO_2 and humidity. Limiting and controlling the sources of indoor air pollutants, combined with adequate ventilation, are critical to ensuring good indoor air quality. A starting point for assessing indoor air quality can be the monitoring of certain parameters, such as the levels of volatile organic compounds, CO_2, ozone, nitrogen dioxide and particulate matter in a representative sample of public buildings. It should include schools and hospitals where vulnerable groups of the population spend a significant part of their time.

Humidity

Humidity, in the context of building environments, refers to the amount of water vapor present in the air. Various sources contribute to the humidity levels in buildings, including:

1. Exhalation of Occupants:
   - The presence of people within a space contributes to humidity levels. The amount of water vapor released through exhalation is influenced by factors such as the level of physical activity.
2. Utilization of the Room:
   - Different activities conducted within a room, such as cooking, drying clothes, working, or engaging in sports, can release moisture into the air. These activities impact the overall humidity of the indoor environment.
3. “Free Water” from Materials and Construction:
   - New buildings can introduce moisture through “free water”, which comes from the materials used in construction and the manufacturing processes involved in building construction. This can include water present in construction materials and introduced during the building process.

To quantify and describe the amount of water vapor in the air, the concept of "relative humidity" is used. Relative humidity is a measure that expresses the percentage of moisture in the air compared to the maximum amount the air could hold at a given temperature.

Managing humidity levels in buildings is crucial for maintaining indoor air quality, preventing issues such as mold growth, and ensuring the overall comfort of occupants. A comfortable feeling for a human being is at a relative air humidity of around 50% (air temperature of 20°C). The air within an accommodation must be constantly renewed, for several reasons:

- Bring new air and ensure our oxygen needs
- Filter out the excess humidity (water vapour) produced by our activities
- Filter out the air containing odours and pollutants

Ventilation is therefore absolutely necessary to ensure health, security and comfort in any accommodation.

In the past, ventilation was naturally done by opening the windows, or through the walls which were hardly airtight. In more newly built accommodations, where walls are insulated, ventilation is done through mechanical systems, thanks to air intakes located on the doors and the windows, and extraction units, set up in specific rooms, in bathroom and kitchen in particular. In any case, and in order to secure air exchange, it is important to manually ventilate its accommodation every day, both summer and winter, for about five minutes, by opening the windows and turning off the heat.

Air speed

Air motion in the accommodation influences the air temperature felt. Thus, the faster the air motion is, the higher the room temperature is needed to feel comfortable. For example: - For an air motion of 0.15 meters per second (m/ s), the comfortable temperature is 21 ° C - For an air motion of 1 meter per second (m/ s), the comfort temperature is 25 ° C Note: In old houses, generally not insulated, ventilation is more difficult to control. The air motion generates greater feelings of discomfort.

Table 18. Sustainable construction for thermal comfort

How sustainable construction affects thermal comfort in the building				
Orientation and glazing	**Building materials and systems**	**Heating, ventilation and air conditioning**	**Shading systems**	**Fans**
Solar heating can significantly increase the temperature in the building in winter, and its absence - reduce the need for cooling in summer. That is why the orientation of modern buildings in relation to the terrain and world directions is so important when designing. The area of windows and glazing is also important.	Fluctuations in the external temperature also affect the internal temperature. The more massive the building materials used, the more heat they accumulate and the more they give off when the inside of the building cools down. Skilful use of thermal inertia reduces sharp temperature fluctuations and their corresponding impact on thermal comfort.	In older buildings, there is natural air circulation and a constant exchange between the external and internal environments. This optimizes humidity and air currents in the building. Modern insulation and window frames close the home (office) hermetically. Ventilation is difficult, condensation and mold appear. In such cases, the solution that restores the optimal indoor environment is modern heating, ventilation and air conditioning (HVAC) systems.	With their help, you can adjust the strength of the sun's rays and the overheating of the premises in the summer with a minimum of costs.	Although they are probably the most suboptimal way to provide thermal comfort, they are cheap, readily available and portable – they are always where you need them.

Thermal comfort is experienced by each of us individually, however, at the same time, it has a high socio-economic value. Achieving and controlling it is the task of sustainable construction.

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REVERTER

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC III

Step-by-Step Deep Renovation in Households

Co-funded by the
European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to provide OSS personnel and REVERTER ambassadors with the knowledge of how to plan and execute deep renovation projects, enabling them to transform existing buildings into energy-efficient and sustainable spaces. The trainees will gain a comprehensive understanding of the deep renovation process and the techniques involved in achieving significant energy savings, as well as the benefits of deep renovation.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
EE	Energy Efficiency
RA	REVERTER Ambassadors
EPC	Energy Performance Certificate
R&D	Research and
ESCO	Energy Saving Contract Organisation
DHW	Domestic Hot Water
RES	Renewable Energy Sources

1 Introduction to Deep Renovation

Renovating a building can pose challenges in terms of complexity, cost, and time investment. In Europe, the majority of residential building renovations are executed incrementally over several years, introducing the risk of being "locked in" where current renovation decisions may constrain future possibilities. For homeowners, the lack of clarity on which renovation measures to undertake and their sequencing presents a significant hurdle to enhancing energy efficiency and the overall condition of their property. Compounding these challenges is the unique nature of each situation, as buildings differ in construction characteristics, renovation history, current use, and other factors. Homeowners themselves have diverse needs, preferences, and available resources. [1]

Building renovation not only has the potential to enhance energy performance but can also address other objectives, such as reconfiguring spaces or upgrading the facade. These various changes can be unified within a cohesive roadmap, optimizing the combination of interventions and encompassing the numerous benefits that a well-planned renovation can deliver, including enhanced thermal comfort, indoor air quality, sound insulation, and more.

Deep renovation denotes a thorough and comprehensive process aimed at enhancing the energy efficiency, sustainability, and overall performance of a building or structure. It entails significant modifications to the building's systems, components, and materials, bringing it in line with modern standards and reducing its environmental impact.

Key features of deep renovation typically include (Figure 1):

[1] iBRoad. My path towards an energy efficient home. December 2020. Available at: https://ibroad-project.eu/

Energy efficiency

The primary goal of deep renovation is to substantially reduce the energy consumption of a building. This may involve upgrading insulation, windows, doors, and HVAC (heating, ventilation, and air conditioning) systems to improve thermal performance and reduce heating and cooling costs.

Sustainability

Deep renovation often incorporates sustainable building practices and materials to minimize the environmental impact of the building. This may include using renewable energy sources, installing energy-efficient lighting, and incorporating water-saving features.

Structural improvements

Deep renovation may also address structural issues, such as repairing or replacing damaged building components, strengthening the foundation, or improving the overall structural integrity of the building

Indoor environmental quality

Efforts are made to enhance the indoor environmental quality of the building, including better ventilation, air quality, and natural lighting to create a healthier and more comfortable living or working environment.

Accessibility

Renovations often include improvements to make the building more accessible for people with disabilities, ensuring compliance with accessibility standards and codes.

Figure 1. Key features of deep renovation

Deep renovation involves making significant and comprehensive renovations to the building to boost energy efficiency and sustainability. This means going beyond simple renovation and cosmetic changes and focusing on improving the building's performance, which can lead to substantial cost savings and a greener, more comfortable living space.

Deep renovation according to the European Commission refers to those building renovations that achieve more than a 60% reduction in primary energy consumption.

A huge potential for energy savings lies in the renovation of the existing building stock. The deep renovation of these buildings is a necessary condition for the construction sector to be able to reduce its greenhouse gas emissions and meet the targets for reducing energy consumption. The new Target 55-ready package aims to put the EU on the path to climate neutrality. Energy accounts for 75% of greenhouse gas emissions, and the building stock of EU member states - about 43% of energy consumption.

A major renovation can be defined as such renovation that meets the national standard and regulations of a specific country; a major renovation can also be defined as a minimum percentage of energy savings; Energy savings from non-renewable sources over 60%. Other definitions are related to standards for near-zero consumption buildings.

It is important to know that if the goal is to save energy above 60% (primary energy savings), this can be achieved by renovating the entire building, and this can mean a large investment out of reach for most European families.

It is possible a step-by-step basic energy renovation, for example, every 3-4 years, one investment for:

1. Replacement of windows;

2. Wall insulation;

3. Replacement of heating and cooling systems.

A road map with recommendations for reducing the energy consumption of the building or household can be developed with an estimated budget for each step and achieving standards approaching those of a near-zero consumption building in a few years.

1.1 National regulations related to energy renovation of residential buildings

Bulgaria

State policy in the field of energy efficiency and renewable energy sources (RES) is implemented by all national and local authorities through the development and adoption of National and municipal programs for energy efficiency, as well as National and municipal programs to promote the use of energy from RES sources and biofuels, which should both be in accordance with the objectives of the above-mentioned laws and be developed taking into account the strategic goals and priorities of the specific regional development plans of the respective regions.

The policies for sustainable energy development in Bulgaria are defined in the following main energy laws - **Law on Energy Efficiency and Law on Energy from Renewable Sources**, which require the development of a number of national documents that must be complied with by all regional governments, namely:

- **Integrated plan in the field of energy and climate of the Republic of Bulgaria 2021 - 2030** - defines the country's main goals for stimulating low-carbon economic development, developing competitive and secure energy and reducing dependence on fuel and energy imports. To achieve the goals set in the plan, complex actions are needed in all spheres of socio-economic relations. This is particularly the case for economic sectors where the potential of existing industries to take up new technologies must be fully exploited, ensuring a smooth and fair transition to a climate-neutral circular economy, such as the hydrogen economy.

The national priorities in the field of energy laid down in the plan are summarized as follows:

- increasing energy security and diversification of energy resource supplies;
- development of an integrated and competitive energy market;
- use and development of renewable energy, according to the available resource, network capacity and national specifics;
- increasing energy efficiency through the development and application of new technologies to achieve modern and sustainable energy;
- consumer protection by guaranteeing fair, transparent and non-discriminatory conditions for the use of energy services.

➢ Based on the **Bulgarian Integrated Energy and Climate Plan in 2030**, Bulgaria plans to achieve a 27.89% reduction in primary energy consumption and a 31.67% reduction in final energy consumption compared to the PRIMES 2007 benchmark. It also intends to reach a 27.09% share of RES in gross final energy consumption by 2030, a 30.33% share of renewable electricity, and a 42.60% share of renewable energy for heating and cooling.

National Recovery and Resilience Plan - The main objective of the Recovery and Resilience Plan is to facilitate economic and social recovery from the crisis caused by the COVID-19 pandemic. The green transition occupies a leading position in the Recovery and Sustainability Plan of Bulgaria, concentrating 45.8% of the total estimated costs, with a minimum set of 37% of the European Commission regulation. In this way, Bulgaria contributes to the fulfillment of the pan-European goals for gradual decarbonization. In addition, efforts are focused on three main areas:

- Creation of conditions for accelerated introduction of renewable energy sources and hydrogen;
- Enhanced actions to increase the energy efficiency of the economy;
- Sustainable mobility.

➢ **Strategy for sustainable energy development of the Republic of Bulgaria until** 2030 with a horizon until 2050 - clearly reflects the trends, measures and policies in the field of energy security, energy efficiency, the liberalization of the electricity and gas markets and their integration into the common European energy market, the development and the implementation of new energy technologies. These policies are also reflected in the Integrated Energy and Climate Plan.

The Strategy sets out the following main priorities:

• Guaranteeing energy security and sustainable energy development;

• Development of an integrated and competitive energy market and consumer protection by guaranteeing transparent, competitive and non-discriminatory conditions for the use of energy services;

• Increasing energy efficiency in the processes from production to final consumption of energy;

• Sustainable energy development for clean energy and decarbonization of the economy;

• Implementation of innovative technologies for sustainable energy development.

- **National Plan for Near-Zero Energy Buildings** - local authorities are required to deploy the plan under the National Plan for Near-Zero Energy Buildings 2015-2020, which aims to make the concept of near-zero-energy buildings practically viable alternative to the future construction of new buildings in Bulgaria, as well as to deploy a proven approach for cost-effectiveness.

Portugal

Among the overall political factors, the national framework is aligned with European Directives, going further in the reduction targets established in the long term. The Portuguese government aims to achieve carbon neutrality by 2045. There is no definition of deep renovation but the National Energy and Climate Plan and the Long term Renovation Plans, together with the recently approved National Strategy for Energy Poverty, are important drivers to increase building renovation rates, thus creating a favourable framework for the diffusion of the REVERTER roadmaps. Local regulations at the Municipal level often limit the scope of renovation possibilities due to specific requirements for the façades, etc., (e.g. Municipal Masterplan and Municipal Urbanisation and Building Regulations) as well as there are too many formalities (licenses, etc. ...) to start the process. This implies a long process for each individual procedure. Time and bureaucracy are important barriers for renovations to be carried out.

In relation to financing help for building renovations, there are National Incentives and interesting instruments for lending funds for renovation works (IFRRU and 1º Direito), as well as specific financial incentives for low-income families, such as the energy efficiency vouchers, available since November 22, which can amount to 3900€ per household and there is also VAT reduction for energy renovations. The central government has also been promoting the use of RES by low income households, by creating the regulatory framework for the establishment of REC. Transposition of new targets regarding energy savings (new EED recently approved with new yearly reduction targets), and the ongoing revision of the EPBD, setting more ambitious targets and requirements such as the MEPS for existing buildings, will ensure the ongoing efforts to improve the building stock, starting with the most energy inefficient buildings. At the local level, several municipalities already developed the Local Strategy for Housing and the SECAPs.

In terms of regulations, Portugal is well advanced, yet the bureaucracy and complexity behind the processes postpone the household decision to enter into a renovation process by themselves.

Buildings decarbonisation is supported through a range of programmes and measures pushing for improved energy efficiency, higher electrification and use of renewable energy. Under the National Buildings Energy Performance Certification System (SCE), all residential and commercial buildings must be audited to receive an energy certificate when they are built or deeply renovated and each time the building changes ownership or is leased. The SCE has contributed to better insulated buildings, resulting in lower energy demand and emissions.

As of January 2019, all new buildings owned or occupied by a public entity need to satisfy nearly zero-energy buildings (NZEB) requirements. Starting in January 2021, all newly constructed or majorly renovated private buildings with an area greater than 1 000 square metres (m^2) need to satisfy NZEB requirements. Portugal's national building code requires the installation of solar thermal heating systems with a minimum size of 1.0 m^2 per building occupant (or other renewable energy systems providing a similar energy savings). In February 2021, the government published the Portuguese Long-Term Renovation Strategy, which promotes building renovation through indicative objectives of renovations, primary energy savings and a reduction of hours of discomfort for 2030, 2040 and 2050. The strategy also defines measures to support the achievement of these objectives.

Latvia

According to National building code LBN 002-19 “Thermotechnics of Building Envelopes”, all MFBs undergoing renovation should reach energy consumption for heating no higher than 80 kWh/m² a year (energy class C) and for single family buildings the heating energy consumption should not exceed 90 kWh/m² a year (energy class C). Additionally, there are some provisions regarding minimal requirements towards building envelope thermodynamic properties. The maximum allowed thermal transmittance values for building envelope components are given in the table below.

Table 1. Maximum allowed thermal transmittance values for building envelope components in Latvia

No.	Building envelope component	Residential buildings, nursing homes, hospitals and kindergartens	Non-residential buildings	Industrial buildings
		U_{RM} value, W/(m²K)	U_{RM} value, W/(m²K)	U_{RM} value, W/(m²K)
1.	Floor:			
1.1.	floors and walls in contact with the ground	0.2	0.25	0.35
1.2.	floor to non-heated basement or floor with ventilated underfloor	0.3	0.35	0.40
2.	External walls:			
2.1.	external walls	0.23	0.25	0.30
2.2.	walls in traditional log houses without installing a thermal insulation layer in the wall	0.65	0.65	0.65
3.	Roofs and coverings in contact with outdoor air	0.20	0.23	0.25
4.	Exterior doors and gates	1.80	2.00	2.20
5.	Windows and balcony doors	1.10	1.10	1.30
6.	Thermal bridges ψ_{RM}	0.20	0.20	0.35

The total heat transfer coefficient of building envelope H (W/K) should not exceed the maximum normative heat transfer coefficient H_{tr} (W/K).

1.2 National definition for deep renovation

Bulgaria

According to Bulgarian legislation (EE Law), **Major renovation** is defined as: "Major renovation" of a building is a complex of construction and installation works related to the fulfilment of the basic requirements under Art. 169, para. 1 and 3 of the Territorial Planning Law, which is carried out during operation and affect the structural elements of the construction, including the enclosing structures and elements of buildings, facilities and elements of the technical infrastructure - heating, ventilation, air conditioning, electrical, water supply, sewage and other installations.

According to the Long-term national building strategy **Deep renovation** is defined at two levels:

- Achieving a light or medium degree of the renovation as part of a phased renovation – up to the legally required class C for buildings in operation or energy savings below 60%;

- Achieving deep renovation - reaching class "B" and higher, incl. utilization of energy from renewable energy sources (with technical possibilities), energy savings of over 60%.

Greece

According to Law 4122/2013 about the energy performance of the buildings, the deep renovation is defined as the renovation that fulfils the following conditions:

a) The total cost of the renovation activities in the building envelope or the technical systems exceeds 25% of the current value of the building based on the estimated minimum construction cost of the building excluding the value of the terrain where the building has been constructed.

b) More than 25% of the surface of the building envelope is renovated.

Portugal

Portugal does not have a specific definition of nZEB for renovation, but the same requirements must be met to achieve a nZEB for the cases of new and existing buildings. Complying with nZEB requirements for the renovation of existing buildings is not mandatory, but it is encouraged. A deep renovation is related to measures being made in the building envelop.

Latvia

Currently there is no definition for deep renovation in Latvia. Deep renovation is a term, which till the recast of Building energy performance directive (EPBD) in 2023 has been widely used to describe holistic building renovation to achieve high energy efficiency standards. As of now, in the recast of EPBD the deep renovation means a renovation which transforms a building or building unit:

(a)before 1 January 2030, into a nearly zero-energy building;

(b)as of 1 January 2030, into a zero-emission building;

In this context the national definition of nearly zero-energy building is provided.

1. A building shall be classified as a nearly zero-energy building if it conforms to all of the following requirements:
    - the energy consumption of the building for heatin does not exceed the level indicated in Annex 3 to this Regulation for a Class A building; *(For building with heated area smaller than 120m^2 annual heating energy consumption is ≤ 60 kWh/m^2, for buildings with heated area smaller than 250m^2 annual heating energy consumption is ≤ 50 kWh/m^2, and for MFBs annual heating energy consumption is ≤ 40 kWh/m^2)*
    - the primary non-renewable energy consumption of the building for heating, hot water supply, mechanical ventilation and cooling does not exceed the values indicated in Table 2 of Annex 3 to this Regulation for Class A buildings; *(For buildings with heated area smaller than 120m^2 primary non-renewable energy consumption is ≤ 110 kWh/m^2, for buildings with heated area smaller than 250m^2 primary non-renewable energy consumption is ≤ 100 kWh/m^2, and for buildings with heated area larger than 250m^2 primary non-renewable energy consumption is ≤ 95 kWh/m^2)*

- the engineering systems installed in the building conform to the ecodesign requirements and the energy labelling confirms to at least Class A, if the corresponding energy labelling for the specific equipment is applicable;

2. The assessment of a nearly zero-energy building shall assume that the indoor temperature conditions in the heating period are at least at the level of category II and in the non-heating period - at least at the level of category III in accordance with the standard LVS EN 16798-1:2019 "Energy performance of buildings. Ventilation of buildings. Part 1: Indoor microclimate input parameters for the design and assessment of the energy performance of buildings, taking into account indoor air quality, temperature regime, lighting and acoustics. Module M1-6" to the requirements of Annex B; *(At least 20°C during heating period and no more than 27°C during summer time).*
3. The assessment of a nearly zero-energy building shall assume that the ventilation air exchange is sufficient to ensure the supply of fresh air or technological conditions in the serviced area in accordance with the requirements laid down in the laws and regulations regarding construction. The energy efficiency assessment should assume that the air exchange conditions in rooms when people are staying in them are not lower than the category III level in accordance with the standard LVS EN 16798-1:2019 "Energy performance of buildings. Ventilation of buildings. Part 1: Indoor microclimate input parameters for the design and assessment of the energy performance of buildings, taking into account indoor air quality, temperature regime, lighting and acoustics. Module M1-6" requirements; *(Standard provides three distinct methods for design air flow calculation. Absolute minimum air supply for residential buildings is defined as 4 l/(s per person) combined with 0,4 l/(s per m^2) for low polluting building).*

2 Deep renovation barriers and benefits for the national context

Deep renovation, the comprehensive transformation of existing buildings to significantly improve their energy efficiency and sustainability, plays a pivotal role in addressing the ever-increasing global energy consumption and reducing carbon emissions. While its benefits are undeniable, the journey towards deep renovation is fraught with several significant challenges and barriers. These obstacles extend beyond mere technical complexities, encompassing financial, regulatory, and behavioural hurdles that hinder the widespread adoption of deep renovation practices.

2.1 Deep renovation barriers

Energy renovation barriers refer to the obstacles, challenges, or factors that hinder the adoption, implementation, or success of energy retrofit projects in buildings. These barriers can exist at various levels, e.g., individual, organisational, societal, financial, etc., and may vary depending on the specific context, such as the country, region, or type of building (Figure 2).

Understanding and addressing these barriers is essential for overcoming resistance, unlocking the full potential of energy retrofits, and facilitating their widespread adoption to achieve energy efficiency goals in the built environment.

Behavioural/Social barriers

- Resistance to change and comfort with existing routines and habits
- Inertia and reluctance to invest time and effort in retrofit initiatives
- Limited motivation and perceived lack of personal benefit from energy retrofits
- Perception of renovation as a complex and irreversible undertaking
- Lack of a 'culture of saving'
- Limited social norms and peer influence promoting energy-efficient behaviors and retrofits
- Lack of trust in authorities, institutions, or contractors involved in retrofit programs
- Uncertainty about functionality requirements
- Lack of consumer acceptance of new technologies
- Disruption factor, such as noise and dust or the need to move out during renovation work
- Variation in attitudes toward renovation based on factors like age, gender, education, and cultural values, etc.

Financial barriers

- High investment cost of deep renovations
- Long payback periods for energy savings measures
- Limited access to finance (especially for vulnerable households)
- Reluctance of traditional lenders to provide loans for renovation projects
- Reduced availability of subsidies and grants
- Risk of free-rider effect in subsidy programs
- Difficulty in demonstrating increased asset value due to energy performance improvements
- Energy pricing structures that do not fully reflect negative externalities
- Lack of consideration for lifecycle costs
- Diseconomies of scale and lack of ongoing capacity for maintenance (especially for RES)

Knowledge/informative barriers

- Lack of awareness and understanding of energy retrofit benefits and cost-saving opportunities
- Technical complexity and overwhelming terminology
- Limited access to clear, accurate, and impartial information from trusted sources
- Lack of reliable and accessible tools and databases
- Lack of easily accessible and up-to-date information on energy efficiency programs, incentives, and financing options
- Absence of centralized platforms or easily navigable websites
- Conflicting advice and outdated guidelines
- Difficulty in calculating costs for new technologies (for contractors)

Organisational and decision-making barriers

- Challenges in decision-making and coordination for complex ownership structures
- Lack of engagement and collaboration among stakeholders
- Delays and abandonment of projects due to disagreements and lack of accountability
- Complex legal considerations and uncertainties (in collective housing)
- Insufficient communication channels and standardized processes
- Insufficient involvement of occupants or tenants in the retrofit process
- Split incentives and misalignment of incentives in rental properties
- Limited participation of small and medium-sized enterprises in public procurement schemes
- Fragmentation of the supply chain in the construction industry

Regulatory barriers

- Complexity of rules and regulations at EU and national
- Inconsistencies, delays, and gaps in energy performance targets, efficiency standards, and retrofit obligations
- One-size-fits-all approaches overlooking variations
- Unclear, unambitious, and maladapted national strategies
- Lack of common approaches and definitions
- Overlaps, conflicts, and delays in policy schemes, and lack of legislation on specific issues
- Uncertainty due to frequent changes in regulations
- Inadequate monitoring and enforcement
- Excessive administrative burden
- Inconsistent standards and labeling requirements
- Insufficient government subsidies and programs

Technical barriers

- Lack of skilled professionals and trained workforce
- Scarcity of examples of successful deep renovation projects
- Lack of standardised solutions and assessment tools
- Discrepancies between predicted energy savings and actual performance
- Concerns about maintenance, durability, and long-term performance of retrofit systems
- Complexity of integrating new solutions with existing infrastructure
- Limited availability of energy-efficient materials and components
- Safety and seismic risks associated with deep renovation processes

Figure 2. Energy renovation barriers

2.2 Barriers to deep renovation in the four REVERTER pilots

All four pilot areas show, to a greater or lesser extent, the challenges mentioned in the previous sections. In the following, some critical aspects of these challenges are discussed, based on literature and the experience of local partners.

A. Brezovo, Bulgaria

The main barriers to deep renovation in the Bulgarian pilot are, as follows:

- Regulatory barriers: the current framework does not encourage deep renovation, as there are no requirements or incentives to renovate public buildings to levels higher than class C. The complex administrative process and the need for unanimous agreement among owners in multi-unit buildings hinder deep renovation efforts. Furthermore, there is a lack of restrictions on the use of non-environmental solid fuels. Finally, shortfalls include the absence of Energy Performance Certificates (EPCs) for residential buildings smaller than 1,000 m^2.
- Financial barriers: the reliance on grants provided by the National Programme for Energy Efficiency in Multifamily Residential Buildings blocks other forms of financing because homeowners are unable to finance energy efficiency renovations themselves. Municipalities often limit renovation projects to shallow measures due to cost concerns. Additionally, low energy prices and the high transaction costs associated with the complex administrative process further impede deep renovation.
- Knowledge/informative barriers: there is a lack of awareness among customers and investors about the benefits of deep renovation. Municipalities, which manage the program, lack motivation to design and implement new renovation programs and often limit renovation projects to shallow measures due to a lack of understanding of the wider benefits.
- Technical barriers: incomplete inventories of public buildings, limited information on energy consumption and efficiency measures, and the absence of detailed renovation plans create significant challenges. R&D efforts in deep renovation are fragmented and not part of a holistic local or national plan. Technical capacity and knowledge for deep renovation are also insufficient in many municipalities, there is a lack of specialized intermediaries to provide expert assistance and a lack of necessary skills of professionals to adequately promote energy efficiency products.
- Organisational and decision-making: there is a lack of reliable mechanisms for effective control of compliance with the law and unprofessional and insufficient management of multi-family buildings. Also, challenges are created due to the presence of unoccupied apartments in multi-family residential buildings.

B. Athens metropolitan area, Greece

As far as the Greek pilot is concerned, the main barriers identified are the following:

- Financial barriers: the economic benefits derived from energy-efficiency renovations are often undervalued over time, making the returns uncertain compared to other investments. Given Greece's economic crisis and increased country risk, the uncertainty and risk associated with long-term investments are more pronounced. The reduction in bank loans, traditionally a primary funding source for building renovations, has further impacted investment in this sector. Additionally, the decrease in income and changes in consumption habits due to the recession have made energy-efficiency renovations a lower priority for many. This is particularly true for the most vulnerable households. The existing subsidy scheme offers a 75% grant for personal income up to 5,000 Euros per year and family income up to 10,000 Euros per year. Given their very low income, most of the time these households do not have access to loans from commercial banks.

- Regulatory barriers: Greece lacks an established national standard for accurately measuring the actual energy consumption of buildings. The existing calculation method, based on the asset method rather than the operational method, is insufficient for recording actual consumption. Establishing a reliable standard for energy and water savings measurement is crucial. Internationally recognized protocols have been developed for this purpose.
- Technical barriers: the market for energy-efficiency renovations is still in its early stages and faces common challenges associated with new markets. Technical restrictions, such as architectural and infrastructure access issues, common heating systems, and outdated regulations in apartment blocks, complicate the decision-making process. Inadequate renovation service supply chains, a lack of energy labelling and certification schemes for construction materials, and insufficient technical support further hinder progress. Additionally, the absence of meters or direct mechanisms to showcase energy savings from renovations poses a problem.
- Knowledge/informative barriers: there is a shortage of skills and training among professionals responsible for implementing energy-efficiency renovation works. Insufficient knowledge of energy-saving technologies and renewable energy sources used in renovations is prevalent. The scarcity of reliable information on deep renovation's energy efficiency delays the adoption of new techniques. General information available is often challenging to adapt to specific investor and user circumstances, making it difficult to assess the overall benefits of energy-efficiency investments. Educational institutions need to update their curricula to include energy-saving concepts in building renovation, covering both technical and financial aspects.
- Organisational and decision-making: many vulnerable households live in homes that they do not formally own, e.g. they may belong to parents who have passed away but have not been inherited for financial reasons (inheritance taxes have not been paid). Therefore, they are not entitled to a subsidy from state programmes.
- Behavioural/social barriers: many vulnerable households, even if they have access to loan capital, prefer not to implement energy saving projects. Given the uncertainty in their future financial situation, they find it easier to reduce their energy expenditure than to take the risk of repaying a loan.

C. Riga, Latvia

The most important barriers to deep renovations identified in the Latvian pilot are the following:

- Regulatory barriers: subsidy and policy uncertainty (e.g., support schemes for apartment building renovation were discontinued for over 2 years between 20014 and 2016, some of the potential projects were frozen and business activities stopped overall).
- Financial barriers: low energy prices, high risk level of financial investment in territories with low economic activity that increases loan interest rates, ESCOs are typically small and cannot

borrow to further their business (long-term commercial financing continues to be a major barrier because banks are reluctant to lend against long-term energy efficiency projects).

- Knowledge/informative barriers: lack of information about and complexity of the concept (both at the policy level and at the level of residents/owners), insufficient information dissemination and training for stakeholders.
- Technical barriers: lack of knowledge, energy advice, audits, and construction supervision on a large scale, lack of and measurement and verification practices.
- Organisational and decision-making: lack of standardised contracts.
- Behavioural/social barriers: lack of trust from the clients, reluctance to acquire debt.

D. Coimbra, Portugal

As far as the Portuguese pilot is concerned, there are several barriers to energy renovations including:

- Financial barriers: One of the main barriers is the high cost of energy renovations (higher than new construction, per square meter, which can make it difficult for homeowners and businesses to invest in energy-efficient solutions. Access to financing for energy renovations can be limited, especially for homeowners and small businesses that may not have the financial resources to undertake large-scale projects.
- Regulatory barriers: Portugal has a complex regulatory framework for energy efficiency and renewable energy, which can make it difficult for homeowners and businesses.
- Knowledge/informative barriers: Many people in Portugal are not aware of the benefits of energy renovations and the available financial incentives to support them.
- Technical barriers: There is a shortage of skilled labour in the energy renovation sector, which can make it challenging to find qualified professionals to undertake renovations. Moreover, many buildings in Portugal are old and have design constraints or are located in heritage protected areas that make it difficult to retrofit energy-efficient solutions. Finally, there may be a limited availability of energy-efficient products and services, making it challenging for homeowners and businesses to find the right solutions for their needs.

2.3 Benefits of deep renovation

The main benefits of deep renovation for the households and the community are summarised in the following Figures 3 and 4.

Social benefits

- Increasing the energy efficiency in households leads to a number of social benefits, including reflects on household incomes, energy poverty reduction and people's health. Therefore, the social effects of energy saving are evaluated mainly for the household sector

Increase in household income

- The cost of improving the energy efficiency of households is usually repaid through reduced heating costs, allowing consumers to use their income for other purposes after the investment has been paid off in the long term, but it should be noted that the payback of these investments usually takes a long time.

Economic benefits

- Economic benefits have an important role in energy efficiency policies because they should be implemented in a cost-effective way. The assessment of additional economic benefits makes investments in energy efficiency more attractive and significantly reduces the payback period of the applied measures.

Health benefits

- The health benefits of implementing energy efficiency measures are indirect and are related to reducing harmful emissions in the atmosphere (sulfur and nitrogen oxides, fine dust particles, etc.) and improving thermal comfort in buildings. This leads to a decrease in morbidity and mortality

Increasing the value of buildings

- Major renovation of buildings increases the value of the properties in them, as it makes them more sustainable, with a better appearance and increases their life. Various analyses of real estate agencies show that currently, the sales value of renovated apartments increases by 10-15%.

Figure 3. Deep renovation benefits for the households

Environmental benefits

By upgrading insulation, replacing windows and doors, installing energy-efficient heating and cooling systems, and domestic hot water systems, households can reduce their energy consumption. By decreasing the demand for electricity and heating fuels, building energy renovations contribute to reducing the emission of CO_2 and other greenhouse gases and help to mitigate global warming. For instance, energy efficiency measures are expected to contribute 44% of the carbon abatement needed by 2035, and deep renovation, in particular, can lead to a 75% reduction in final energy consumption by 2050, compared to 2010.

Competitiveness:

The development of technologies related to energy efficiency has a positive effect on the economy and its competitiveness. The assessment of the impact of energy efficiency is made for individual products or branches of the industry by comparing the export and import of this product or branch with the total export and import of the country, and if the result is positive, increased competitiveness is reported.

New jobs in the region

There are two main factors that determine the effect on employment: investments in energy efficiency create jobs in the industry that produces the relevant products and services, and the energy savings achieved reduce in the long term the consumption of energy products. In turn, a reduction in consumption has an effect on the added value produced, and a change in the added value leads to an effect on employment in the relevant sector.

Figure 4. Deep renovation benefits for the communities

3 Types of building renovation measures

Exemplary energy-saving measures in buildings are recommended by institutions, administrative bodies, offices and agencies of the European Union, including recommendations of the EC to establish requirements for building installations. An example list of measures is presented in the following table.

Table 2. Examples of deep renovation measures

Measures on building envelope	Measures on building systems	Measures for utilization of energy from renewable sources and utilization of waste heat
Complete laying or upgrading of existing thermal insulation on the walls of existing buildings	Installation or improvement/modernization of a heating installation (based on fossil fuels and/or renewable energy, with a boiler for cooling the flue gases below the dew point — condensing boiler, heat pumps, etc.) in all buildings	Air-to-air heat pumps
Complete laying or upgrading of existing thermal insulation on the roofs of existing buildings	Modernization of an existing vertical heating installation by building a horizontal heating system	Air-to-water heat pumps
Thermal insulation of the same roof elements in existing building roofs	Control and measuring devices for regulating the temperature of the internal air and water	Ground-connected heat pumps for utilizing the heat of the ground
Thermal insulation of an existing ground floor in an existing building	Installation or improvement of a ventilation installation (forced ventilation with heat recovery, forced suction-discharge ventilation, suction ventilation)	Solar systems for DHW
Increasing the thermal inertia of the building structure by using massive building materials exposed to radiant energy in the building space (Note: it can only be applied in certain types of climate conditions).	Improving the use of daylight. Energy-efficient lighting	Heating systems utilizing geothermal energy
Installation of windows and doors with good thermal insulation properties for the winter period	Installation or improvement of photovoltaic systems	Photovoltaic systems for the production of electrical energy for own consumption
Better shading against sunlight	Changing the energy carrier for a given installation	Heat recovery from exhaust air
Better sealing against air infiltration (the maximum sealing possible with the relevant state of the art).	Replacing pumps and fans	
Changing the ratio between transparent and opaque surfaces (optimization of glazing percentage)	Thermal insulation of pipes	
Openings for night ventilation (cross or chimney ventilation	Direct-fired boilers or boilers with an intermediate heat carrier, and	

	accompanied by hot water tanks, can be combined with thermal solar installations Installations for the utilization of solar energy for heating or cooling, and for DHW of different power-intensive night ventilation	
	Installation of energy-efficient office and household appliances	

4 Building renovation main steps

This part of the technical guide describes the overall process of initiating, developing and implementing an energy efficiency project for residential buildings, regardless of the source of funding. The aim is to familiarise the trainees with the terminology in a standardized process and renovation project for deep renovation in its specific implementation.

4.1 Main steps of the building renovation process

The section includes short descriptions for all pilot countries, but the national translated versions will be enriched with more detailed information for the local context:

A. Bulgaria

There are four main stages in the renovation process:

Stage 1: Pre-investment study

1.1. Initial assessment of eligibility, needs, benefits, and the required financial resources for execution

- Determining the eligibility of the residential building according to the "mechanical resistance and stability" requirement - based on visible signs.
- Defining the level of ambitions for energy-efficient renovation.
- Predictively determining:
  - the necessary renovation activities.
  - the financial resources required for the execution of the energy efficiency investment project, including all costs

1.2. Conducting surveys of the residential building

- Developing measures to improve energy efficiency, including a technical-economic assessment.
- Calculating projected energy savings and assessing CO2 emissions.
- Determining the financial resources required for the implementation of energy efficiency measures.
- Analyzing the possibilities for using energy from renewable energy sources.
- Establishing compliance of the residential building with the essential requirements for construction.
- Defining measures that do not have a direct ecological impact but are mandatory in the European context to ensure habitation safety.
- Determining the financial resource

Stage 2: Preparation of project documentation for the implementation of an energy-efficient investment project

2.1. Preparation of a Technical Specification/Design assignment

- Sets the conditions for the preparation of a high-quality investment project.
- Defines the parameters of the investment project in terms of phases, project components, volume, scope, and regulatory framework.
- Determines the boundaries of project development in connection with previously conducted surveys and examinations.

2.2. Preparation of project documentation/investment project

- Presents in graphic and text form, in accordance with applicable regulatory requirements, the technical, economic, technological, functional, and planning-compositional requirements for the object.
- Details the requirements for the execution technology and the materials used, including drawings and working details, as well as detailed technical specifications for the envisaged construction materials.
- Serves for the execution of construction and assembly works, as well as for conducting procedures for the selection of contractors for construction and installation works during construction.

2.3. Evaluation of compliance with investment projects

- Provides confidence to the Client/Owner that the investment project complies with regulatory requirements and that its execution will achieve the predetermined goals and indicators.
- Facilitates/expedites the approval process by the municipal administration and the issuance of a construction permit.

<u>Stage 3: Implementation of energy efficiency measures (Construction and Assembly Works)</u>

3.1. Construction Permitting

- Ensures compliance with the law during the execution of construction and assembly works

3.2. Commencement, Execution, and Completion of Construction

- Execution of construction and assembly works in accordance with the issued construction permits.
- Installation of materials in accordance with project technical specifications.
- Implementation of control measures during execution in compliance with regulatory requirements and the specifics of residential buildings.

<u>Stage 4: Monitoring and assessment of achieved savings</u>

4.1. Assessment of achieved energy savings following the implementation of energy efficiency measures

- Demonstrates the achieved energy savings as a result of implemented energy efficiency measures through conducting a subsequent energy audit.

4.2. Monitoring the behavior of the residential building after renovation

- Conducts real control through monitoring measurements and taking corrective actions. Changes in the behavioral patterns of the occupants regarding energy usage in the renovated residential building.

B. Greece

There are three main building renovation steps to be considered by homeowners:

Step 1. Collecting information, assessing and deciding on building renovation

To assess the potential energy renovation of a dwelling, preliminary actions are required, which include, but are not limited to:

I. Conducting a thermographic audit to determine the heat loss from the building envelope.

II. Discussion with other owners (in case of multi-family buildings) regarding the necessity of the energy renovation. In the case of apartment buildings, the decision of the general assembly and the authorisation of a responsible person to carry out all the actions required for the energy upgrade are required. Organisation of a meeting to provide clarification and presentation of the potential benefits of the energy upgrade of the building are useful.

III. Estimation of the preliminary cost of implementing the renovation measures, taking into account the period of time during which the building is being renovated, the technical condition of the building, the region, etc.

IV. Mapping the different financing options (e.g. grants, loans) and understanding the conditions for their use.

V. Identify potential contractors who could carry out the necessary works.

Step 2. Preparation of building renovation

The first action in preparing the renovation of the building is the issuance of an Energy Performance Certificate through the implementation of an energy audit, which will identify what work needs to be carried out in order to achieve maximum energy savings. The energy audit of the building is carried out by a certified energy inspector. The inspector assesses the technical condition of the building, and may investigate whether the building under consideration complies with the requirements of the various funding programmes, with an emphasis on possible irregularities.

This report will accurately specify the work required, facilitating a more accurate calculation of the implementation costs and the identification of the most advantageous financial offer by the construction companies and contractors concerned.

Step 3. Financing building renovation

Financing of building renovations can be implemented through owner's equity or alternative sources, such as, but not limited to, grants through existing state programmes or bank loans. To receive funding, it is necessary for owners to understand the terms and conditions and provide the necessary documentation.

Interested contractors will send a financial offer for the energy renovation of the building together with a detailed description of all the work to be carried out, the materials to be used, deadlines, etc. Once the financial offers have been received, they will be compared to select the most economically advantageous one.

Portugal

The renovation process essentially takes place in main phases from the idea of renovation to an energy-efficient building.

The First Phase consists of Obtaining information, evaluating and making a decision about the renovation of a building and is divided into 3 main stages:

1) Obtaining and evaluating information such as: Thermographic maps; Consultancy and counselling; Estimating preliminary renovation costs; Financing options for the renovation.

2) Decision by the building's residents in favour of renovating the building;

3) Creation/Election of the Condominium with administrator and assembly.

The Second Phase consists of preparing the building documentation and is divided into 3 main stages:

1) Obtaining an energy certificate: a "roadmap" that provides consumers with information on the energy performance of buildings, which includes cost savings, improved thermal comfort and access to financing and tax benefits. It can indicate which works should be carried out and in what order to achieve maximum energy savings;

2) Technical opinion: The result of a technical inspection that can be carried out by a duly certified professional. During this process, all parts of the building are examined to determine their degree of deterioration and safety, resulting in an operational plan and the order in which the work should be carried out.

3) Documentation for the refurbishment operation: This phase requires an individual description of the building's refurbishment plan with a specific list of works to be carried out, based on the opinion of the technical inspection and the energy certificate.

The Third and final Phase consists of financing and renovating the building and is divided into five main stages:

1) Financing the renovation project: Once the opinion has been obtained, it is possible to go ahead with the renovation project, but first it is necessary to take care of the sources of financing, own and/or request for auxiliary financing;

2) Selection of the builder: According to the requirements developed for the renovation of the building, construction companies can be selected. The construction companies draw up their detailed proposals for the renovation of the building, so that the one with the most favourable conditions for the project is chosen;

3) Renovation of the building: The renovation of the building is carried out in accordance with the specifications, which contain information on the work to be carried out, the materials used and the timetable for the work. The person responsible for the work and the person responsible for monitoring the work control and monitor the renovation work to ensure that it is carried out in accordance with the building project. If in doubt, residents should contact these specialists;

4) Transfer of the building: The contractor renovates the building in accordance with the contract. Once a month, summaries of the work completed are made and recorded in the works diary. A report is drawn up (including photographs) on the completed work phases. This report is signed by the construction manager, who is a person chosen by the residents and represents the interests of

the building's residents. The construction manager checks that the materials and technologies agreed in the contract have been used and that they comply with the previous documentation (specifications). If deficiencies are detected in any of the renovation phases, the construction manager informs the contractor and makes sure they are eliminated. When all the work has been completed, the acceptance and handover document is signed, which confirms that the work has been completed in accordance with the requirements of the contract;

5) Applying for funding: this must be done before starting work. There are government instruments in Portugal that support the energy renovation of buildings.

Latvia

Stage 1: Obtaining information, evaluating it and taking a decision on the renovation of an apartment building

Step 1: Collection and evaluation of information

In order to evaluate the possibilities of renovating an apartment building, it is necessary to obtain high-quality and versatile information.

- Thermography maps – their creation is provided free of charge by the Riga Energy Agency. Thermography allows to assess the loss of thermal energy in an understandable way – in a thermogram. Thermography also allows to identify construction deficiencies or damage caused during operation, thermal bridges, air infiltration and other sources of heat loss. It is possible to carry out thermography during the heating season. Find out more about the possibility of performing thermography by applying for a consultation or by calling +371 67012437. Apply for a consultation
- Advice – Residents of the building can receive free advice and information on issues of interest to them in relation to the renovation. Apply for a consultation
- Preliminary renovation costs – this can be determined on the basis of historical data on the renovation of similar buildings. However, it should be borne in mind that the renovation of each building may vary significantly in terms of cost, taking into account the period of time when it is renovated, the technical condition of the building, its area, etc. View data
- Renewal financing options – Carefully study and identify all available support and loan financing options and their terms. You can apply for free consultations about support programs.
- Identifying potential construction companies – identify potential contractors who could renovate a building. Learn more

Step 2: The decision of the residents of the apartment building in favor of the renovation of the building

In order to decide in favor of the renovation of an apartment building, a positive vote of 50% + 1 vote of the residents of the building is required.

The elder of the house can hold a vote in a variety of ways — a general meeting of the building's residents and/or official questionnaires. In this process, it is important to make sure that the vote is open, transparent and that all residents of the building have received full information before voting.

After the vote, the elder or the person in charge of the house collects information about the vote and draws up a record.

Stage 2: Preparation of documentation

Step 1: Obtaining an energy performance certificate

An energy performance certificate is an action plan that explains what works need to be carried out in what order in order to obtain the maximum energy savings. For example, changing windows, insulating the walls of a building, etc.

- The energy audit of the building shall be carried out by an independent expert registered in the Construction Information System. More information about experts.
- An insight into the energy audit process can be found in this video.

Step 2: Opinion of the technical inspection

Technical inspection may be carried out by a certified civil engineer. In the course of this process, all parts of the building are examined to determine their degree of wear and tear and safety. The civil engineer evaluates the technical condition of the building in accordance with the regulations of the Cabinet of Ministers, the action plan and the sequence of how the work should be carried out. Such a survey must be carried out on each building at least once every 10 years.

- The construction must comply with the conclusions of Section 9 of the Construction Law.
- The final document describing the technical condition of the building is the opinion of the technical inspection.

In order to obtain the energy performance certificate and the Technical Survey opinion, it is possible to receive support from the Riga Energy Agency. Learn more

It is possible to recover the co-financing for the development of technical documentation also after the performance of construction works by participating in the co-financing programmes of the Riga City Council or ALTUM.

Step 3: Construction documentation

Construction documentation is, on the basis of the opinion of the technical inspection and the energy performance certificate, a description of the building renovation intention developed by an architect or construction company with a specific to-do list. In this process, a control board is also developed, which allows the residents of the building to more accurately identify both a detailed list of work to be performed and potential costs. The control board is an internal document that will allow residents of the building to better evaluate the offers of construction companies and choose the most economically advantageous one.

Stage 3: Financing and renovation of the building

Step 1: Renovation project funding

With aggregated information and prepared documentation, it is possible to further advance the restoration project. At this stage, it is necessary to reserve an energy efficiency discount in one of the programs – Altum or riga state city municipality.

The implementation of the project can be carried out on the accrual of the repair fund of the residents of the house. If the amount of savings is insufficient, it is possible to attract additional financing.

In order to obtain financing, it is necessary to provide all the documents requested by the financier and/or lender.

Step 2: Builder selection

According to the developed requirements for the renovation of the building, the selection of construction companies can be carried out. Construction companies create their own proposal for the renovation of the building together with a detailed description of the amount of work to be performed, materials to be used, deadlines, etc. After receiving the tenders, they are compared with a checklist in order to choose the most economically advantageous service provider. A contract is concluded with a construction company.

We recommend that you familiarize yourself with ALTUM material on supplier selection.

Step 3: Renovation of an apartment building (renovation of the building)

During the renovation of the building, its residents can continue their usual rhythm of life. The renovation of the building is carried out in accordance with the construction documentation, which contains information about the work to be performed, the materials used, as well as the time plan. The construction supervisor and the author's supervisor control and monitor the restoration works in order to ensure their high-quality execution in accordance with the construction project. If there is any confusion, residents should contact these certified specialists. Excellent if there is an authorized person in the building who, if necessary, does it on behalf of the residents of the building. It is the innovator's responsibility to comply with the project and implement it in good faith.

Step 4: Building transfer process

The contractor shall carry out the renovation of the building in accordance with the contract. Once a month, a summary of the work done is prepared, which is recorded in the construction journal. An overview (including photographs) is made of the stages of work that are being concluded. This report is signed by the construction supervisor, who is a person chosen by the residents and represents the interests of the residents of the building. The construction supervisor checks whether the materials and technologies stipulated in the contract are used, whether they correspond to specific certificates (if such are necessary and are mentioned in the contract). If deficiencies are found at any stage of the restoration, the construction supervisor shall inform the contractor thereof and make sure that they are rectified. Upon completion of the entire set of works, an act of acceptance and transfer is signed, confirming that the funds intended for the restoration of the building have been absorbed and the work was carried out in accordance with the requirements of the contract.

Step 5: Granting of Altum aid

After the conclusion of the renovation of the apartment building, the appropriate documentation must be submitted to the construction board, as well as to the project financier. Based on this information, Altum grants aid amounting to 49 % of the eligible costs, which significantly reduces the credit of the building's occupants. The remaining amount must be covered by the residents of the building together with the heat bill as a monthly payment.

Important! After the renovation of the building, the heat bill is significantly reduced, and together with the repayment of the loan for the renovation of the building after the renovation, the total bill is often less than the heat bill before the renovation of the building.

The following chapters includes the detailed description of the renovation process in Bulgaria. In the same way each partner will provide detailed descriptions in the national translated modules:

4.2 Building Assessment and Energy Auditing

The initial assessment of eligibility, needs, benefits and necessary financial resources for implementation, which, depending on the specifics of the investment intention, includes:

Building Assessment and Energy Auditing are critical processes in evaluating and improving the energy performance and overall sustainability of buildings. These assessments help identify areas of inefficiency, recommend energy-saving measures, and contribute to more environmentally friendly and cost-effective building operations.

It is also the stage in which it is determined whether the building is eligible for application under a specific financing procedure. Determining the eligibility of the residential building according to the "mechanical resistance and stability" requirement - based on visible signs.

4.2.1 Building Assessment

Building assessment is a comprehensive evaluation of a building's physical condition, performance, and overall sustainability. It involves a detailed examination of various building systems, components, and their interactions.

The building assessment is the process of developing a technical passport of the building.

Initial assessment of eligibility, needs, benefits and necessary financial resources for implementation, which, according to the specifics of the investment intention, includes:

- Determining the eligibility of the residential building according to the requirement of "mechanical resistance and resistance".
- Determining the necessary renovation activities related to:

Development of project documentation/investment project

a) Presents in graphic and textual form, according to the applicable regulations, the technical, economic, technological, functional and planning-compositional requirements for the object;

b) Details the requirements for the technology of implementation and the materials used, containing drawings and working details, as well as detailed technical specifications of the intended construction materials;

c) Serves for the implementation of construction and repair activities, as well as for conducting procedures for selecting their implementation.

Compliance assessment of investment projects:

a) Gives confidence to the Employer/Owner that the investment project meets the regulatory requirements and that its implementation will be achieved in advance

the set goals and indicators;

b) Facilitates/accelerates the process of approval by the municipal administration and issuance of a building permit.

Construction permit:

a) Guarantees legality in the implementation of SMP.

4.2.2 Commencement, execution and completion of construction

Monitoring and evaluation of achieved savings

a) Implementation of construction and assembly activities in accordance with the issued construction documents;

b) Insertion of materials according to the design technical specifications;

c) Carrying out control during implementation according to the regulations and the specifics of the residential buildings.

Assessment of achieved energy savings after implementation of EE implementation measures

a) The proof of energy savings achieved as a result of implemented EE measures by means of a subsequent energy audit.

Monitoring the behaviour of the residential building after the renovation

a) Exercising real control by means of control measurements and taking corrective actions. Changes in the behavioural model of the owners when using energy in the renovated residential building:

- Increasing the energy efficiency of the building.
- Possibility of applying alternative measures incl. providing energy from renewable sources.
- Improvement of operational characteristics related to
- increasing the safety and comfort of living.
- Estimated benefit assessment - savings, etc.
- Estimated financial resources necessary for the implementation of
- the investment project for EE with all costs included - energy survey, investment design and assessment of compliance with essential requirements, construction
- supervision, investor control, and administrative costs related to construction authorization and commissioning, including VAT, when applicable.

The initial assessment of eligibility, needs, benefits and the necessary financial resources for implementation can be prepared by one or more technical experts with experience in surveys, design of new buildings or renovation of existing buildings, implementation of EE measures incl. construction of new buildings.

4.2.3 Technical inspection

The assessment of needs is carried out according to the specifics of the residential building and the applicable regulations and/or the requirements of specific EE programs providing co-financing. The financial resource is determined on the basis of market prices for labour and materials, as well as prices of individual measures/operations/building activities in the implementation of similar investment projects.

The technical inspection goals are presented in Figure 5.

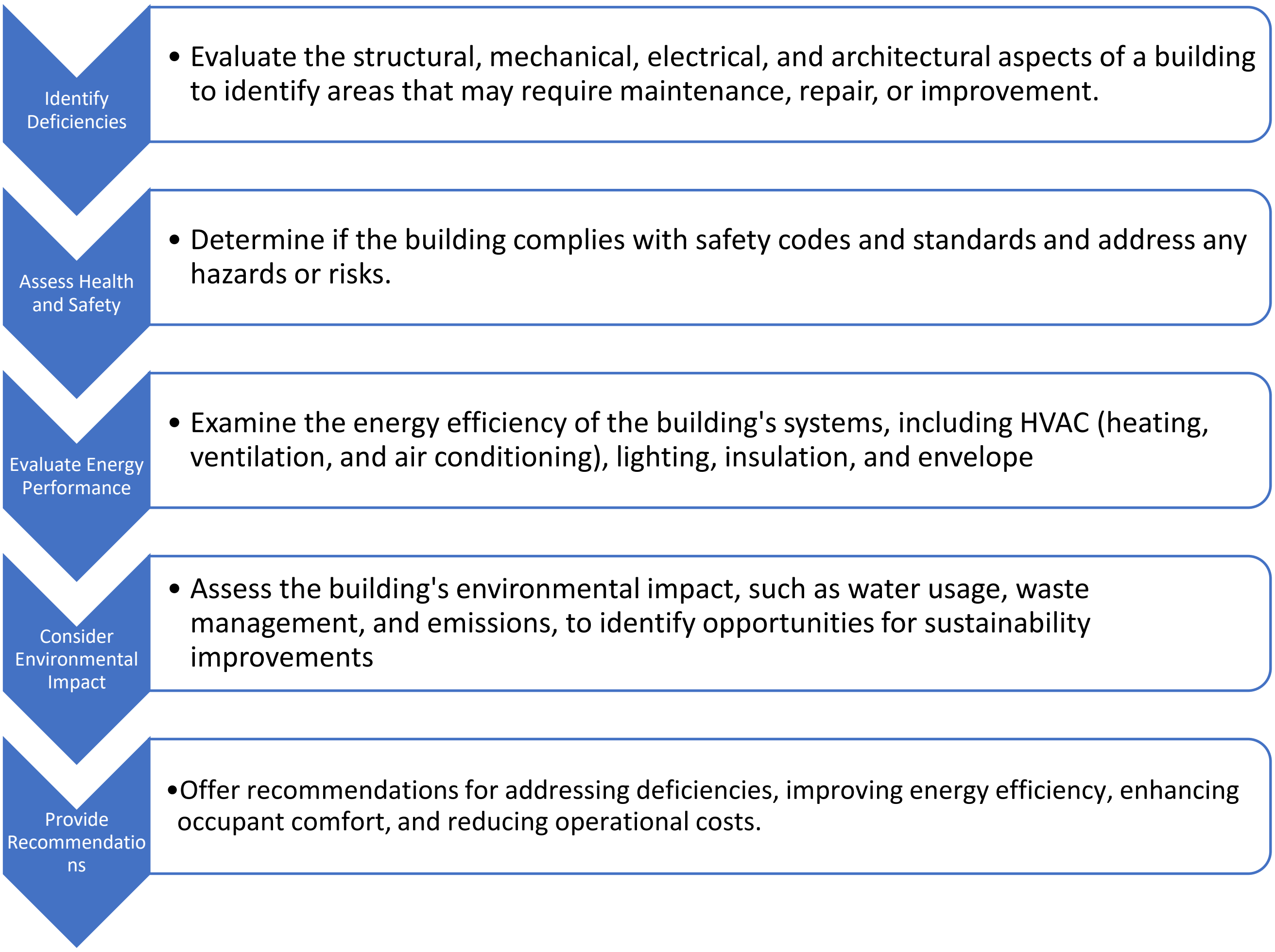

Figure 5. Technical inspection goals

4.2.4 Energy auditing

Energy auditing is a specialised form of building assessment focused primarily on evaluating and optimizing energy use within a building. The goals of an energy audit are shown in Figure 6.

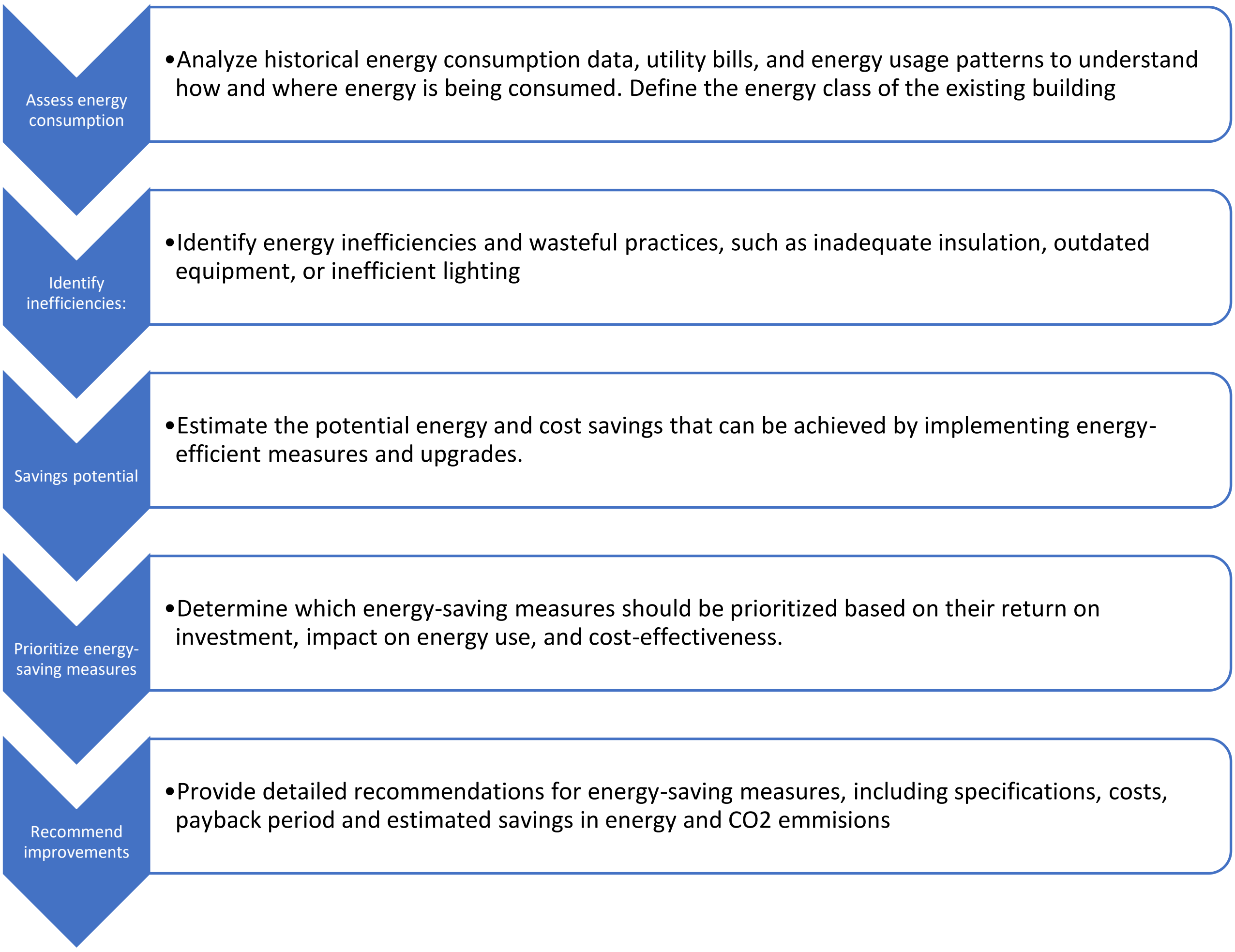

Figure 6. Energy auditing goals

Energy audits can range from basic assessments, such as walk-through audits or preliminary energy audits, to more comprehensive audits under the official EPC body and involve detailed data analysis, engineering calculations, and performance modelling.

Both building assessments and energy audits are valuable tools for building owners, facility managers, and OSS personnel to make informed decisions about improving energy efficiency, reducing operational costs, enhancing occupant comfort, and contributing to environmental sustainability. These processes are essential steps toward creating more energy-efficient and environmentally responsible buildings.

4.3 Preparation of project documentation for the implementation of an energy-efficient investment project

4.3.1 Development of a Technical Specification/design assignment

Technical specification/design assignment is an extremely important element of the investment project. The high-quality technical specification is a guarantee/necessary condition for the preparation of a high-quality investment project in the required scope and volume.

The technical specification is made on the basis of:

- Survey for EE and Certificate for energy characteristics;
- Technical inspection by parts and Technical Passport;
- Applicable regulations.

The selected package of priority energy-saving measures, proposed with the energy survey and containing technical parameters of the energy consumption indicators, essentially represents part of the technical-economic task for awarding and developing the investment project. A mandatory part of the assignment is the construction activities and operations that do not affect the consumption and saving of energy but are mandatory in connection with the recommendations of the examination of the technical parameters reflected in the technical passport.

The technical specification sets the requirements regarding:

- Design phase;
- Design parts that the documentation must contain, incl. calculations;
- Implementation materials;
- Applicable quality norms and standards;

4.3.2 Development of project documentation/investment project

The investment project for EE of residential buildings is drawn up in accordance with, Ordinance 4 on the scope and content of investment projects. The regulation defines the scope and content of investment projects, as well as related preliminary (pre-investment) studies and design tasks. The Ordinance applies to all sites for which an approved investment project is required when a building permit is issued.

The specifics of the renovation for EE of residential buildings (objects that are not particularly complex in terms of functionality, technology and/or installation and the availability of photographs and surveys) predominately imply a single-phase design - in the technical design or working design phase.

The renovation investment project for EE includes the following project parts:
1) parts for architecture and structures:
- architectural;
- constructive;

2) parts for installations and networks of the technical infrastructure:
- water supply and sewage;
- electrical (electrical supply, electrical equipment and electrical installations);
- heat supply, heating, ventilation and air conditioning;
- energy efficiency
- gas supply (if applicable).

3) Fire safety
4) Safety and health plan
5) plan for construction waste management
6) part Project-accounting documentation

The process of preparing technical documentation is preceded by providing a sketch of the property and a design visa. These documents should be provided in advance by the owner of the site for intervention/SS.

4.3.3 Compliance assessment of investment projects

The conformity assessment according to acceptance by an expert council of the approving administration - for residential and mixed low-rise buildings and cottage buildings (according to Territorial Planning Law), their reconstructions, alterations, major repairs and change of purpose or at the request of the contracting authority

4.4 Project Implementation and Management

4.4.1 Construction permit

Constructions can only be carried out if they are permitted in accordance with the Spatial Planning Act. The building permit is necessarily issued at the initiative of the contracting authority/owner within the meaning of the Territorial Planning Act and necessarily in his name. The issuance of a construction permit under the general rules of the Territorial Planning Act is carried out on the basis of approved technical or work investment projects, which are an integral part of it, by the chief architect of the relevant municipality in the location of the property in which it will be built. The building permit loses legal effect when construction has not started within three years of its entry into force.

4.4.2 Commencement, implementation and completion of construction/implementation of renovation measures for EE

The provisions of the Territorial Planning Act regulate the relationships and the interactions between the participants in the construction process and the administration during the initiation, implementation and completion of the construction, with the limits of responsibility of each of them defined. Participants in the construction process are the client, the builder, the designer, the consultant, the individual exercising technical control for the "Construction" part, the technical manager and the supplier of machinery, facilities and technological equipment.

4.5 Monitoring, Measurement, and Verification

The proof of the achieved energy savings as a result of implemented EE measures is regulated in the EE and is carried out no earlier than one year after the introduction of the measures to increase the energy efficiency of the end users of energy through an energy efficiency survey. The survey to prove the achieved energy savings is carried out by a company registered in the register under Art. 44, para. 1 and paragraph 2 of the EE Law (available on the SEDA website).

The evaluation for the proof of the achieved energy savings is prepared for all implemented effective measures and their corresponding terms of action. For the purposes of evaluating the achieved energy savings, the owner of the building shall provide available reports from inspections of the building and the certificates issued based on them, including documents proving the implementation of the measures and their technical characteristics in accordance with the recommendations of previous inspections and the investment project.

5 Deep renovation databases

5.1 Professionals and organisations

The OSS personnel can find useful information about energy efficiency specialists, energy auditors, contractors/technicians/installers needed for each step of the energy renovation. The following table provides an example for the Bulgarian pilot. In the translated versions of the training material each partner will share this information in national language.

Table 3. Sources of information for energy efficiency specialists, energy auditors, contractors, etc. in Bulgaria

Professionals/Organisations	Link	Assessment and auditing	Project designing	Installations, RES, Building envelope
Bulgarian Construction Chamber	https://ksb.bg/		X	
Chamber of architects in bulgaria	https://kab.bg/		X	
Chamber of Installation Specialists in Bulgaria	https://nisbg.org/		X	X
Bulgarian Association for Insulation in Construction	https://bais.bg/			X
Bulgarian Photovoltaic Association	https://www.bpva.org/			X
Chamber of Engineering in the Investment Design	https://www.kiip.bg/		X	
Chamber of energy auditors	https://www.bia-bg.com/bia/	X		

5.2 Public and regulatory bodies

OSS personnel will be also provided with information about the main bodies which design and implement policies on energy efficiency. The following table includes an example for the Bulgarian pilot. In the translated versions, each partner will provide this information in national language.

Table 4. Main public and regulatory bodies involved in energy efficiency policies in Bulgaria

Name	Main responsibilities	Link
Sustainable Energy Development Agency	The Agency for Sustainable Energy Development is an administration under the Minister of Energy for the implementation of state policy on increasing energy efficiency in the final consumption of energy and the provision of energy services, as well as for promoting the production and consumption of electrical energy, heat energy and energy for cooling from renewable sources, the production and consumption of gas from renewable sources and the production and consumption of biofuels and energy from renewable sources in transport.	https://www.seea.government.bg/bg/
Ministry of Energy	The Ministry's efforts are aimed at guaranteeing the energy independence of the country by developing its own deposits of energy resources and accelerating the diversification of the sources and routes by which Bulgaria receives imported ones.	https://www.me.government.bg/
Ministry of Regional Development and Public Works	The Ministry of Regional Development and Public Works is responsible for carrying out the reform in the regional development of the country, the organization of the territory, the construction of the main networks and facilities of the technical infrastructure.	https://www.mrrb.bg/

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC IV

Energy saving in households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. It has been designed to empower the trainees with practical knowledge and actionable strategies for low-cost energy efficiency improvements in households. In this direction, it provides a wide range of energy-saving tips and techniques that can be easily implemented in households of all sizes and types. From simple changes in daily habits to more significant upgrades in appliances and building infrastructure, they will gain the insights and skills needed to create a more energy-conscious and environmentally friendly living space. The RAs will be able to convincingly advise households on how to save energy during their visit and to provide the households with the knowledge and tools to make informed decisions about their energy consumption, how to reduce their carbon footprint and enjoy the benefits of a more energy-efficient home.

Table of Contents

REVERTER

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
EE	Energy Efficiency
RA	REVERTER Ambassadors
EPC	Energy Performance Certificate
R&D	Research and
ESCO	Energy Saving Contract Organisation
DHW	Domestic Hot Water
RES	Renewable Energy Sources

1 Energy efficiency measures in households

Nowadays, where environmental sustainability and cost-saving measures are of paramount importance, finding ways to save energy in our households is not just a wise choice, but a responsible one. Energy conservation not only helps reduce our carbon footprint but also translates into lower utility bills, leaving more money in our pockets. Fortunately, there are numerous practical steps and strategies that can be implemented in homes of all sizes and types to achieve significant energy savings. In this guide, we will explore a comprehensive list of general tips that will empower you to make informed choices and transform your household into an energy-efficient haven. From simple changes in lighting to more complex upgrades in appliances and insulation, these tips will not only benefit the household's wallet but also contribute to a more sustainable and environmentally conscious way of living.

Energy efficiency measures in households refer to various actions, technologies, and practices adopted by homeowners to reduce the amount of energy consumed in their homes while maintaining or even improving comfort and functionality. These measures are implemented with the goal of reducing energy bills, lowering environmental impact, and conserving energy resources. Some general tips are given in the following box.

General tips for saving energy in households:

- Keep track of your consumption. Check your consumption and your bills regularly: it will ease the planning of your family budget. Witness how changes in your behaviour may affect energy bills.
- Buying a more energy-efficient appliance could save you money over time when compared with similar products.
- Switch off all electrical appliances at the plug instead of using the "standby" mode. Appliances are still using electricity when on "standby" mode, and account for 6% of all electricity usage in the home.
- Remember to ventilate - Ventilation is needed to get fresh air in and let moisture and smells out. Open the windows daily. Please remember, the shorter, the better: 10 minutes is generally enough! In winter do that during the least-cold hours and turn the heating on only when ventilation is finished.

Source: http://www.fiesta-audit.eu/en/

The following table (Table 1) presents some common energy efficiency measures in households, which will be discussed in more detail in the next chapters.

Table 1. Energy efficiency measures and related benefits for households

	Energy saving measure	Benefits for the households
	Improved insulation	Proper insulation in walls, ceilings, and floors helps prevent heat loss in the winter and keeps the home cooler in the summer, reducing the need for heating and cooling.
	Energy-efficient windows	Replacing old, single-pane windows with energy-efficient double- or triple-pane windows with low-emissivity coatings can improve insulation and reduce heat transfer
	Energy-efficient appliances	Replacing old, energy-guzzling appliances with energy-efficient models can significantly reduce energy consumption. This includes appliances like refrigerators, washing machines, and dishwashers.
	Led lighting	Replacing traditional incandescent bulbs with energy-efficient LED (Light Emitting Diode) lighting can save a substantial amount of electricity and have a longer lifespan.
	Sealing air leaks	Identifying and sealing gaps, cracks, and leaks around windows, doors, and ducts can prevent drafts and heat loss, making the home more comfortable and energy-efficient.
	Programmable thermostats	Installing programmable thermostats allows homeowners to set temperature schedules, ensuring the heating or cooling system operates efficiently when needed.
	High-efficiency HVAC systems	Upgrading heating, ventilation, and air conditioning (HVAC) systems to high-efficiency models can reduce energy consumption for heating and cooling.
	Smart home technology	Using smart thermostats, lighting controls, and appliances that can be remotely controlled and programmed for optimal efficiency.
	Water saving	Installing low-flow faucets, showerheads, and toilets can reduce water heating costs and overall water consumption.
	Behavioural changes	Encouraging household members to adopt energy-saving habits like turning off lights when not in use, unplugging electronics, and using appliances efficiently

To achieve balancing of energy consumption in a household, it is necessary to perform the steps illustrated in Figure 1.

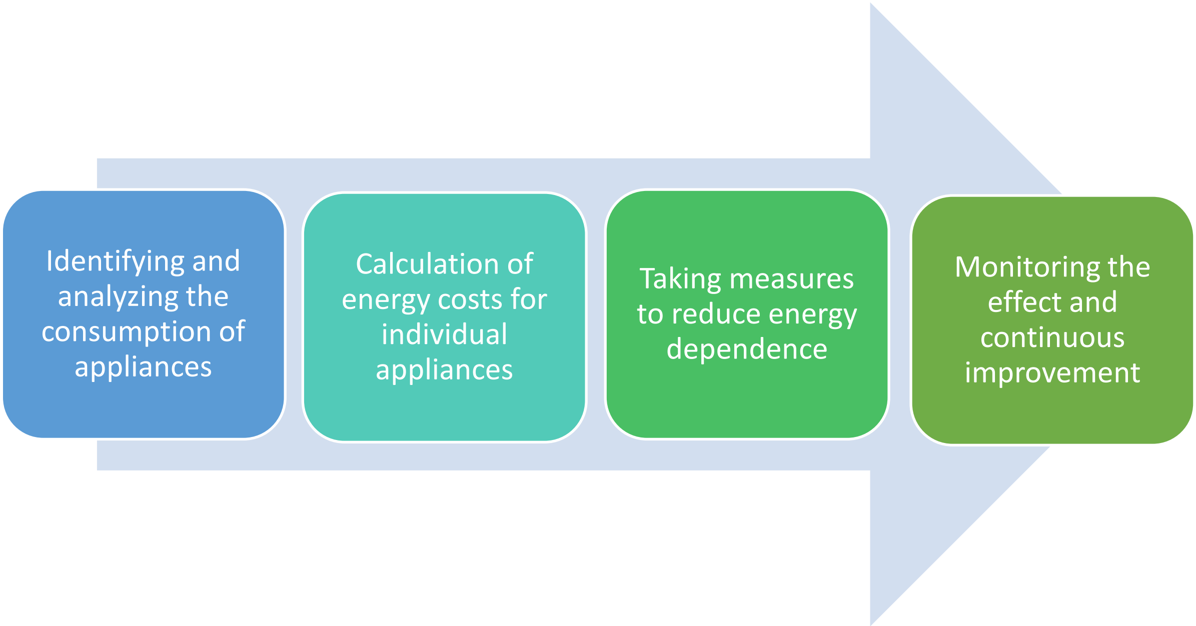

Figure 1. Steps in balancing energy consumption

2 Energy saving tips for heating and cooling

Energy consumption for heating and cooling accounts for a significant portion of a household's energy expenses. Therefore, implementing energy-saving tips in this area can have a substantial impact on both your comfort and your utility bills. Here are some energy-saving tips specifically tailored to heating and cooling.

The measures categorised as “Relatively Easy” are simple changes or practices that most homeowners can implement without much difficulty or cost. "Moderate" measures may require a bit more effort or investment but are still manageable for many households. The “More Involved” measures often involve larger investments, such as home improvements or appliance replacements, and may require professional assistance in some cases. Remember that the easiness of implementation can vary depending on individual circumstances, such as the age and condition of your home, your budget, and your DIY skills. It's a good idea to prioritise the measures that make the most sense for every specific situation and gradually work toward more involved upgrades as household’s budget and resources allow.

Tables 2 and 3 provide some recommended energy efficiency measures for heating and cooling, respectively.

Table 2. Energy efficiency measures for heating

EE measures for heating	Description	Level of applicability
Set your thermostat wisely	The most straightforward method to conserve energy for heating is to adhere to the recommended indoor temperatures. During winter, maintaining a daytime temperature of 21ºC and a nighttime range of 15 - 18ºC should provide ample comfort at home. A simple adjustment, such as lowering your thermostat by just 1 degree centigrade, has the potential to yield significant savings—up to 10% on your annual fuel bill	Relatively Easy
Seal leaks	Inspect doors, windows, and other openings for drafts. Seal any gaps and use weather-stripping to prevent heat from escaping	Moderate
Use curtains or blinds	In winter, close curtains or blinds at night to trap heat inside. During the day, open them to let in natural sunlight and warmth.	Relatively Easy
Regular furnace maintenance	Have your furnace serviced annually to ensure it's running efficiently. Clean or replace air filters regularly as well	Moderate
Use space heaters efficiently	If you're using space heaters, only heat the rooms you're occupying and turn them off when you leave. Electric blankets can also be energy-efficient alternatives for staying warm	Moderate
Upgrade insulation	Insulate your attic, walls, and basement to keep heat from escaping. Adequate insulation can make a significant difference in your heating costs	More Involved
Maintain your radiators properly	Furniture in front of a radiator will block or absorb the heat	Relatively Easy
Reflective radiator panels	Reflective radiator panels behind the radiators could reduce your heating bill by up to 20%. When radiators are installed on a poorly insulated wall, most of the heat will dissipate through the wall and to the outside. To avoid heat losses, a thin reflective panel between the wall and the radiator can be installed (they are easily available at stores)	Moderate
Drying your clothes	Drying your clothes on the radiator makes your boiler work harder than it needs to and costs more.	Relatively Easy
Keep heat where you need it.	Effectively manage heated spaces by closing doors to retain warmth, or, conversely, open them to allow heat to disperse into adjoining rooms. Leaving a door ajar in a room you intend to heat can result in unnecessary energy and financial losses. By conscientiously controlling the flow of heat within your living space, you not only enhance energy efficiency but also contribute to cost savings	Relatively Easy
Don't switch off the heating during the night	In the colder days, it is recommended not to switch off the heating during the hours when you are away from home, only to reduce it. When it is turned off, your home will cool	Relatively Easy

	down too quickly, which will lead to overheating to reach a favourable temperature	
Reduce the heating temperature during the working day, but not below 15 degrees	If you are away from home during the day or for a longer time, reduce the temperature, but not below 15 degrees, otherwise, the air in the room becomes too humid and the risk of mould increases. You should know that the lower the temperature in a room, the more often you need to ventilate the room to reduce the humidity	

Table 3. Energy efficiency measures for cooling

EE measures for cooling	Description	Level of applicability
Use ceiling fans	Ceiling fans help distribute cool air more evenly and can allow you to set your thermostat a few degrees higher without sacrificing comfort	Relatively Easy
Maintain your air conditioner	Schedule regular maintenance for your air conditioning system to ensure it runs efficiently. Clean or replace filters as recommended	Relatively Easy
Programmable thermostat	Install a programmable thermostat to automatically adjust your cooling settings when you're not at home or when you're sleeping	Relatively Easy
Seal leaks	Just like in heating, seal any gaps around doors, windows, and ductwork to prevent cool air from escaping	Relatively Easy
Shade and ventilate	Use shades, blinds, or curtains to block out direct sunlight during the hottest part of the day. Use exhaust fans in bathrooms and kitchens to remove heat and humidity.	Relatively Easy
Upgrade to energy-efficient cooling	If your air conditioner is old and inefficient, consider upgrading to a newer, energy-efficient model. Look for the ENERGY STAR label	More Involved
Plant shade trees	Planting trees strategically around your home can provide natural shade, reducing the need for cooling	Relatively Easy
Keep the recommended indoor temperatures	he most straightforward approach to reduce energy consumption from cooling devices is to adhere to recommended indoor temperatures. During summer, maintaining a temperature of 26°C should provide sufficient comfort. Elevating the thermostat by just two degrees not only allows you to enjoy a full day of cost-free cooling but also helps prevent unnecessary colds	Relatively Easy
Take advantage on natural ventilation	Optimize natural ventilation by opening windows on the north and south sides of your home when the outside temperature is cooler. This facilitates cross ventilation, promoting a refreshing airflow and further reducing the need for artificial cooling	Relatively Easy

3 Energy saving tips for the building envelope

Improving the energy efficiency of the building envelope, which consists of the walls, roof, windows, doors, and foundation, is crucial for reducing energy consumption in a building. Enhancing the energy efficiency of the building envelope not only reduces energy consumption but also improves comfort and indoor air quality. Depending on the age and condition of your building, you may need to prioritize different measures to achieve the best results.

Some energy-saving tips for enhancing the building envelope, described and categorised by ease of implementation are given in the following table.

Table 4. Energy saving measures for the building envelope

EE measures for building envelope	Description	Level of applicability
Insulate your facade and roof	Adequate insulation in walls, floors, and attics helps maintain a stable indoor temperature. Consider adding or upgrading insulation to meet or exceed recommended U-values	More involved
Seal air leaks	Identify and seal gaps, cracks, and holes in the building envelope. Use weather-stripping, caulk, and foam insulation to seal leaks around doors, windows, pipes, and electrical outlets	Relatively Easy
Install energy-efficient windows and doors	If replacing windows and doors is not an option, consider adding storm windows and doors to improve insulation and reduce drafts	Moderate
Use insulated window coverings	Install insulated curtains or blinds to reduce heat transfer through windows during hot summers and cold winters	Relatively Easy
Reflective roofing	Choose reflective or cool roofing materials to reduce heat absorption and keep the building cooler in hot weather	Moderate
Seal and insulate the attic	Properly seal and insulate the attic to prevent heat loss in winter and heat gain in summer	Relatively Easy
Upgrade siding and exterior finishes	Consider adding insulated siding or exterior finishes to improve the thermal performance of the walls	Moderate
Manage solar gain	Use shading devices such as awnings, pergolas, or planting deciduous trees strategically to block direct sunlight during the hottest parts of the day	Relatively Easy
Optimize foundation insulation	Ensure the foundation is properly insulated to prevent heat loss from below ground	More involved
Inspect and maintain	Regularly inspect the building envelope for damage, wear, or water leaks, and promptly address any issues to maintain its integrity	Relatively Easy
Energy audits	Consider getting a professional energy audit to identify specific areas of improvement in your building envelope and prioritize upgrades	More involved

The measures categorised as “Relatively Easy” are relatively simple changes or projects that most homeowners can tackle with moderate effort and budget. “Moderate” measures may require a bit more effort or investment but are still manageable for many households. The “More Involved” measures often involve more extensive renovations or design considerations and may require professional assistance.

4 Energy saving tips for lighting

Energy-saving tips for lighting in households can significantly reduce electricity consumption and lower your utility bills. Here are some tips for more efficient lighting, with average price in the EU.

Switch to led bulbs: Replace incandescent and CFL bulbs with energy-efficient LED bulbs. LEDs use significantly less energy and last much longer. The cost of LED bulbs can vary depending on the brand and type (e.g., standard, dimmable, smart). On average, you can expect to pay between €2 to €10 per bulb.

Dimmer switches: Install dimmer switches in rooms where adjustable lighting is desirable. Dimming lights can save energy when full brightness is not needed Dimmer switches typically range from €15 to €30 each, not including installation costs.

Motion sensors: Use motion-activated lights for outdoor areas, closets, and hallways. They ensure that lights are on only when needed. The cost of motion sensors for indoor use is usually between €10 to €30 per sensor. Outdoor motion sensors can range from €20 to €50 each.

Smart lighting systems and timers: Use timers and smart lighting systems to automate when lights turn on and off, particularly when you're away from home. Smart lighting systems can vary widely in price. Basic smart bulbs start at around €10 to €20 per bulb, while more advanced systems with hubs and colour-changing capabilities can cost €50 or more per bulb. Simple plug-in timers can cost as little as €5 to €15 each.

Task lighting (Desk Lamps, Under-Cabinet Lights): Use task-specific lighting, such as desk lamps or under-cabinet lights, for activities like reading, cooking, or working. This allows you to illuminate only the area where it's needed. Prices for task lighting fixtures vary widely, ranging from €20 to €50 or more per fixture.

Solar-powered lights: For outdoor lighting needs like pathway or garden lighting, consider solar-powered options that charge during the day and provide illumination at night. Solar-powered outdoor lights are relatively affordable, with prices typically ranging from €10 to €50.

Energy-efficient fixtures: Dust and dirt on light fixtures can reduce their brightness. Regularly clean bulbs, lamps, and fixtures to ensure optimal light output.

Also, energy savings can be achieved by **changing energy behaviour**, e.g.:

- Choose light paint colours: Light-coloured walls and ceilings can reflect more light, reducing the need for higher-wattage bulbs.
- Educate family members: Teach everyone in your household about the importance of energy-efficient lighting and encourage them to turn off lights when leaving a room.
- Consider lighting zones: Install multiple light switches in rooms with different lighting zones to allow you to control specific areas independently.
- Regular maintenance: Check for flickering or malfunctioning bulbs and fixtures and replace them promptly. Faulty lighting can waste energy.
- By implementing these energy-saving tips for lighting, you can reduce your electricity consumption, lower your energy bills, and contribute to a more sustainable and environmentally friendly household.

5 Energy saving tips for household equipment

The importance of energy efficiency in household equipment is of importance, when talking about cost reduction and higher life standards. From kitchen appliances to electronic devices, our daily lives are intertwined with different types of equipment that, when used inefficiently, can lead to energy waste and higher energy and water bills. However, with the right knowledge and practices, it is possible to experience the convenience of modern appliances and devices while reducing energy consumption and the associated environmental impact.

Below simple energy-saving tips are presented, categorised by type of appliance. These are measures that households could easily implement. Average costs and range of implementation are also provided.

<u>**A. Refrigerators and Freezers**</u>

Set temperature wisely: Keep your fridge at around 6-8°C and the freezer at -18°C (0°F) for optimal efficiency. Avoid colder settings, as they increase energy usage without significant benefits.

Cost: Free

Ease: Relatively Easy

Clean coils and seals: Dusty coils and damaged seals can reduce efficiency. Clean coils annually and replace damaged seals.

Cost: A coil brush costs around €5-€10.

Ease: Relatively Easy

Upgrade to energy-efficient models: Energy-efficient refrigerators and freezers with the ENERGY STAR/ or ECO LABEL can save you money over time.

Cost: €300-€1,500+ (varies by size and features).

Ease: Moderate

Keep the refrigerator full: A well-stocked fridge retains cold better than an empty one. However, avoid overfilling to allow for proper air circulation.

Cost: Free

Ease: Relatively Easy

Cover and store food properly: Use airtight containers or covers to prevent moisture loss and odors from spreading inside the fridge. This reduces the workload on the compressor.

Cost: Free

Ease: Relatively Easy

More energy-saving tips for refrigerators and freezers:

- Regularly Defrost Manual Defrost Freezers: If you have a manual defrost freezer, make sure to defrost it regularly (when frost reaches about 1/4 inch) to maintain its efficiency.

- Position the Fridge Wisely: Place your refrigerator in a cool, well-ventilated area, away from direct sunlight, heat sources, and the stove. Ensure there is adequate space behind and on top for heat dissipation.
- Clean the Coils: Dust and dirt can accumulate on the refrigerator's condenser coils, hindering heat exchange. Vacuum or brush the coils at least once a year to keep them clean.
- Check the Door Seals: Ensure that the refrigerator and freezer doors sealed tightly. Replace damaged or worn-out gaskets to prevent cold air leaks.
- Use Energy-Saving Mode: Some newer refrigerators have an energy-saving mode that reduces power consumption during periods of low activity, like when you're away.
- Avoid Excessive Opening: Limit the number of times you open the refrigerator door, and avoid keeping it open for extended periods. This reduces the need for the compressor to work harder.
- Organize for Efficiency: Keep frequently used items toward the front of the refrigerator for quick access. Store less-frequently used items toward the back.
- Allow Hot Foods to Cool: Let hot foods cool down to room temperature before placing them in the fridge to reduce the energy required to lower their temperature.
- Use the Crisper Drawers: Store fruits and vegetables in the designated crisper drawers. Adjust the humidity settings as needed to keep produce fresh longer.
- Consider a Newer, Energy-Efficient Model: If your refrigerator is old and inefficient, upgrading to an Energy Star-rated model can lead to significant energy savings over time.
- Turn off Ice Makers and Water Dispensers: If your refrigerator has ice makers and water dispensers, consider turning them off if you don't use them regularly, as they can increase energy consumption.
- Plan Your Shopping: Minimize food waste by planning your grocery shopping and meals to use up perishable items before they go bad.

B. Washing Machines and dryers

Use cold water: Washing with cold water reduces energy consumption by avoiding the need to heat water.

Cost: Free

Ease: Relatively Easy

Run full loads: Maximizing the load size reduces the number of cycles and saves energy.

Cost: Free

Ease: Relatively Easy

Choose high spin speeds: High spin speeds remove more water, reducing drying time and energy use.

Cost: Free

Ease: Relatively Easy

Option for energy-efficient models: Look at the energy label when buying appliances. ENERGY STAR-rated washing machines are designed to be more efficient.

Cost: €300-€1,000+ (varies by capacity and features).

Ease: Moderate

More energy-saving tips for washing machines and dryers:

- Pre-treat stains: pre-treat stains or heavily soiled areas to avoid running the wash cycle again, which saves energy and water.
- Front-load vs. Top-load: front-load washing machines are generally more energy-efficient than top-load machines. Consider this when shopping for a new washer.
- use delay start: some washing machines have a delay start feature, which allows you to run cycles during off-peak hours when energy rates may be lower.
- Maintain the machine: regularly clean the lint filter and check for blockages in the drain pump or hoses. Keeping the machine in good working condition ensures it operates efficiently.
- Drying your clothes outside on the terrace is free. If you use a dryer, consider its energy efficiency characteristics.
- Drying the same fabrics together speeds up the drying process.
- Drying clothes in the tumble dryer is expensive and makes them harder to iron
- Clean the lint filter: after each load, clean the lint filter to maintain proper airflow, which allows the dryer to work more efficiently.
- Use moisture sensors: if your dryer has a moisture sensor setting, use it. These sensors detect when clothes are dry and automatically shut off the machine, preventing over-drying.
- Dry full loads: just like with washing machines, dry full loads whenever possible to make the most efficient use of the appliance.
- Separate heavy and lightweight fabrics: when drying mixed loads, separate heavier items (like towels and jeans) from lighter fabrics (like shirts and delicates) to optimize drying times.
- Dry towels and heavier cotton in a separate load from lighter-weight clothes.
- If your dryer has a "cooling cycle", it allows the clothes to finish drying with the residual heat in the dryer.

C. Dishwashers

Run full loads: Like washing machines, running full dishwasher loads conserves energy. Dishwashers are most energy-efficient when they run full loads. Wait until you have enough dishes to fill the dishwasher before running it.

Cost: Free

Ease: Relatively Easy

Use efficient settings: Select shorter or eco-friendly cycles when possible. Many dishwashers offer an energy-saving or eco-friendly cycle. Use this setting to reduce water and energy consumption during the wash.

Cost: Free

Ease: Relatively Easy

Air dry dishes: Some dishwashers have a heated dry option. Skip the heated drying cycle and allow dishes to air dry. Turning this off and allowing dishes to air dry can save energy.

Cost: Free

Ease: Relatively Easy

Upgrade to energy-efficient models: If you're in the market for a new dishwasher, consider purchasing an Energy Star-certified model, which meets energy efficiency guidelines and may qualify for rebates. Look at the energy label!

Cost: €400-€1,200+ (varies by size and features).

Ease: Moderate

More energy-saving tips for dishwashers:

- Scrape, Don't Pre-Rinse: Modern dishwashers are designed to handle food residues on dishes, so there's no need to pre-rinse dishes under running water. Scrape off large food particles instead.
- Load Dishes Properly: Arrange dishes so that they do not block the spray arms. Proper loading ensures that all items are thoroughly cleaned and reduces the need for rewashing.
- Use Rinse Aid: Rinse aid helps dishes dry faster and with fewer water spots, which can reduce the need for extended drying cycles.
- Avoid Excessive Detergent: Using too much dishwasher detergent can lead to excess suds and more rinse cycles. Follow the manufacturer's recommendations for detergent usage.
- Select Shorter Wash Cycles: Choose shorter wash cycles when possible, as they use less energy and water than longer, intensive cycles.
- Use Delay Start: If your dishwasher has a delay start feature, use it to run the machine during off-peak energy hours when rates may be lower.
- Regular Maintenance: Clean the dishwasher's filter and spray arms regularly to ensure they work efficiently. A well-maintained dishwasher is more energy-efficient.
- Check Water Temperature: Make sure your water heater is set to a temperature of at least 120°F (49°C) to ensure effective dishwashing.
- Fix Leaks: Check for and repair any leaks in your dishwasher promptly. Leaks can waste both water and energy.
- Load Utensils Properly: Load utensils with handles facing down to allow for better water and detergent distribution.
- Don't Overcrowd: Avoid overloading the dishwasher, as it can obstruct water flow and reduce cleaning efficiency.

D. Water Heaters

Lower temperature: Reduce the water heater thermostat to 49-52°C. This is typically sufficient for most household needs and helps prevent overheating and energy waste.

Cost: Free

Ease: Relatively Easy

Insulate the tank and pipes: Wrapping the tank with an insulating blanket reduces heat loss. Insulate also the hot water pipes in your home, especially those that run through unheated spaces. This prevents heat loss and ensures hot water reaches its destination faster.

Cost: €20-€50 for an insulating blanket.

Ease: Moderate

Use night tariff: Use a night tariff when possible, this will not save electricity but will reduce the cost (bill)

Cost: Free

Ease: Relatively Easy

More tips for domestic water heating:

- Use water-saving shower aerators - this will reduce water flow. The payback period for new efficient showers is less than 1 year;
- If your boiler is old, replace it, possibly energy-saving. Due to the presence of scale in the water, it accumulates on the heat exchange surface of the boiler, which leads to a gradual increase in electricity consumption for water heating.
- When heating an electric boiler: During the winter the temperature of the hot water should not be higher than 55 ° C, and in the summer it is recommended that the temperature of the hot water be lower. In order to prevent Legionnaires' disease, it is necessary to heat the temperature of the hot water from the boiler to at least 60 ° C once a month.
- Hot water from TPP: Hot water leaves the subscriber station with a temperature of 52 to 55 ° C, depending on the setting of the thermostatic valve.
- Check for hidden water losses with water meters! If there is no increase in the water meter reading after two hours when the water taps in the apartment are closed everywhere, then everything is fine. Otherwise, look for leaks;
- Check for water losses from the toilet cistern! For this purpose, a water colourant can be used in it. If without dropping the cistern, after 30 minutes there is staining of the water in the toilet bowl, then there is a leak. Replacing defective seals is not a problem for anyone;
- Remember that the biggest consumer of water is the toilet cistern! Place small plastic bottles filled with water and some sand or pebbles at a safe distance from moving parts to sink to the bottom. In this way you can save up to 20 litres per day or replace the old cistern with a new one, with a smaller volume;
- Stop the water after wetting the toothbrush and while brushing your teeth;
- Use a glass of water to rinse your mouth. Use the washing machine and dishwasher only when fully charged.
- When washing dishes by hand, do not let the rinsing water in the sink run constantly;
- Do not cool drinks with running tap water but in the refrigerator. This will save a lot of water;
- Eliminate damage causing leaks or drips immediately;
- When buying a washing machine (the second largest consumer of water), prefer those with a water factor of less than 9.5, which uses 35 - 50% less water and consumes up to 50% less energy per charge.

E. Computers and Electronics:

Enable power-saving features: Activate power-saving modes and set computers and devices to sleep when not in use. Right-click on the desktop> Properties> Screen saver> Power. Your monitor will reactivate within seconds of moving the mouse. Turn off the monitor when you are away from your desk (while at lunch and meetings) and your computer at night.

Cost: Free

Ease: Relatively Easy

Unplug chargers and devices: Chargers and electronics consume energy even when not in use. Unplug or use smart power strips.

Cost: Free

Ease: Relatively Easy

Upgrade to energy-efficient models: When replacing devices, look for ENERGY STAR-rated models. A computer with energy class B-A can save 2,000 kWh per year

Cost: Varies by device, e.g., €500-€2,000+ for a new laptop.

Ease: Moderate

More tips for Computers and Electronics:

- A monitor left to work overnight uses the energy to laser print 800 pages;
- For a 12-month period, a computer left to run 24 hours a day will consume up to 2,500 kWh of electricity per year
- Hibernation is energy efficient if you leave your laptop running all night. This option is designed for laptops and may not be available for all computers. Hibernate mode uses less power than Sleep, and when you restart your computer, you return to where you left off (though not as fast as Sleep). Use Hibernation when you know you will not be using your laptop or tablet for an extended period of time and will not be able to charge the battery during this time. First, make sure that this option is available on your computer and turn it on, if available.

F. TVs

Adjust brightness and contrast: Lower the brightness and contrast settings on your TV to reduce energy consumption. Many modern TVs have automatic brightness controls that adjust according to the room's lighting conditions

Cost: Free

Ease: Relatively Easy

Power saving setting: enable power-saving features: Most TVs have power-saving or energy-saving modes that reduce energy consumption during periods of inactivity. Enable these features in the TV settings.
Cost: Free

Ease: Relatively Easy

Set a sleep timer: If you tend to fall asleep while watching TV, set a sleep timer to automatically turn off the TV after a certain amount of time. This prevents the TV from running all night.
Cost: Free

Ease: Relatively Easy

Optimize audio: If you have external speakers or a sound system connected to your TV, make sure they are turned off when not needed to save energy.

Cost: Free

Ease: Relatively Easy

More energy-saving tips for TVs:

- Choose Energy-Efficient Models: When purchasing a new TV, look for models that are ENERGY STAR-certified. These TVs are designed to meet energy efficiency guidelines.
- Turn Off the TV When Not in Use: It may seem obvious, but turning off the TV when you're not actively watching it is one of the most effective ways to save energy.
- Use a Power Strip: Plug your TV and related devices (DVD players, game consoles, streaming devices, etc.) into a power strip. This allows you to turn off all devices with a single switch when they're not in use, preventing energy "vampires" from drawing power in standby mode.
- Disable Screen Savers: Modern LED and LCD TVs do not need screen savers. Disable them to save energy.
- Unplug Unnecessary Devices: If you have devices connected to the TV via HDMI or other ports, unplug them when not in use to prevent the TV from constantly searching for signals.
- Choose a Smaller Screen: Consider using a smaller TV if it meets your needs. Smaller screens typically consume less energy than larger ones.
- Stream Wisely: Streaming video content from the internet can consume a significant amount of energy. Use streaming devices or smart TVs with energy-efficient processors, and turn off streaming devices when not in use.
- Keep the TV Clean: Dust and dirt can accumulate on the TV's vents and components, leading to overheating and reduced efficiency. Clean the TV regularly to ensure proper airflow.
- Leaving your TV and all accessories attached to it in standby mode all the time can cost you up to BGN 60 per year. Use standby power strips and turn them off during the day.
- The new TV with energy class B-A can save about 160 kWh / year.

G. Energy saving tips for cooking

Some energy saving measures that can be useful for cooking are, as follows:

- Household microwave appliances consume on average about 1/2 less energy than the energy consumed by conventional household appliances.
- When you open the oven door during cooking, you lose up to 30% of the oven temperature.
- Preheat the oven only when necessary.
- The diameter of the hob must correspond to the diameter of the pan placed on it - so the heat is transferred optimally.
- Always cover the pot when cooking.
- Turn off the hobs before the end of the boiling time to use the residual heat.
- Heat portions up to 400 g in the microwave oven - this will save both time and energy.
- When frying meat for a short time, a pan should be used.
- Making coffee in a coffee machine is 50% cheaper than boiling water on the stove.
- Use a deep fryer instead of an electric stove, so you save up to 25% electricity.
- Baking the slices with a toaster is a more energy-saving method (by about 70%) compared to using the oven.
- When cooking eggs for breakfast, it is better to use an electric egg cooker than a pot, which will save up to 50% of electricity.

6 Intelligent meters and devices for energy management in households

Lack of information is a present barrier to consumer energy saving. Lack of information constitutes a barrier on two levels: consumers lack information on the energy consumption of their household appliances, as well as on how this consumption can be reduced. By using smart plug equipment and feedback on the individual consumption patterns of their appliances, consumers will be given a very easy way to learn about how much energy their appliances are using. Smart plugs allow consumers to monitor the extent of energy savings through changed behaviour when using individual appliances. Seeing this immediate effect is one of the most promising ways to change habits.

A. Smart equipment components

Intelligent meters and devices for energy management in households, often referred to as smart meters or smart home energy management systems, represent a significant advancement in how we measure, monitor, and control energy consumption within residential settings. These technologies combine hardware, software, and communication capabilities to provide homeowners, utility companies, and grid operators with detailed insights and improved control over electricity usage. Here's an explanation of how these systems work and their key components:

- **Smart meters**: Intelligent meters, or smart meters, are the cornerstone of these systems. They replace traditional analogue meters and digitally record electricity consumption data. Smart meters measure electricity usage at shorter intervals, often in 15-minute increments, compared to the monthly readings of traditional meters. This granular data is sent to utility companies automatically.
- **In-home energy monitors:** In addition to smart meters, some systems include in-home energy monitors or sensors that provide real-time information on electricity use within the household. These monitors can be connected to the main electrical panel or individual appliances to provide insights into energy consumption.
- **Wireless networks:** Smart meters and in-home monitors communicate with a central data collection point or the utility company through wireless networks, such as Wi-Fi, Zigbee, or cellular networks. This enables the transmission of data without the need for physical meter readings.
- **Data management and analytics:** Homeowners can access their energy consumption data through user-friendly web portals or mobile apps. These dashboards display real-time and historical usage data, allowing residents to track their energy consumption trends and make informed decisions.
- **Control and automation:** Some intelligent systems include load control devices that can remotely manage certain appliances during periods of peak demand or high electricity rates. For example, these devices can cycle air conditioners or water heaters on and off to reduce load.
- **Thermostats**: The thermostat is a device that automatically responds to changes in ambient temperature by turning on or off a heating or cooling system to constantly maintain a set desired temperature indoors. The biggest benefit of using the thermostat is the ability to set

different temperature regimes and schedules. When the operation of the heating or cooling system or appliances is optimized, significantly less energy is used in the long run.

- **Temperature control** - It is possible to set a lower temperature (heating during the day when you are not at home and at the same time a program) with digital thermostats, to reach and maintain a comfortable temperature when you get home. saving energy during our absence and at the same time when we return home, we are waiting for a cosy and warm home.
- **Smart home appliances:** Smart energy appliances, also known as smart appliances or connected appliances, are household devices and equipment that integrate advanced technology, sensors, and connectivity features to enhance energy efficiency, convenience, and functionality. These appliances are designed to interact with users and other devices, offering greater control and automation while helping homeowners manage their energy consumption more effectively.

B. Benefits of the intelligent energy management system

Intelligent meters and devices for energy management in households offer a range of benefits that can help homeowners, utilities, and society as a whole. Here are some of the key advantages:

Real-time data monitoring

- Intelligent meters provide real-time data on electricity consumption, allowing homeowners to track their usage patterns accurately. This data empowers consumers to make informed decisions about energy consumption

Energy usage insights

- Intelligent meters and devices offer insights into which appliances and activities consume the most energy, enabling homeowners to identify areas where they can make energy-saving improvements.

Reduced energy costs

- With the ability to monitor energy consumption closely, homeowners can implement energy-saving strategies and reduce their utility bills. This can lead to significant cost savings over time.

Remote disconnect/reconnect

- Intelligent meters allow utilities to remotely disconnect and reconnect service, eliminating the need for physical visits by technicians. This enhances service efficiency and reduces downtime during maintenance or non-payment situations

Enhanced billing accuracy

- Intelligent meters provide accurate data on electricity usage, reducing billing errors and disputes. Homeowners receive more transparent and fair billing statements

Promotion of energy efficiency

- Access to real-time data and insights encourages homeowners to adopt energy-efficient practices, such as using high-efficiency appliances and turning off lights and devices when not in use.

Environmental benefits	Enhanced customer engagement	Promotion of energy efficiency
• Lower energy consumption at the household level, as a result of intelligent energy management, contributes to reduced greenhouse gas emissions and environmental preservation.	• Intelligent meters and accompanying data portals foster greater engagement between utilities and consumers, promoting energy conservation and customer satisfaction.	• Access to real-time data and insights encourages homeowners to adopt energy-efficient practices, such as using high-efficiency appliances and turning off lights and devices when not in use.

7 Energy labels

The legislation for energy labelling and Ecodesign in the European Union aims to enhance the energy efficiency of products available in the EU market. Ecodesign establishes standardized minimum standards across the EU, eliminating the least efficient products from the market. Energy labels offer a straightforward indication of a product's energy efficiency and key features at the point of purchase. This simplifies the process for consumers to save money on household energy expenses and contribute to reducing greenhouse gas emissions throughout the EU.

Initially introduced in 1994 for select household appliances and expanded in 2004 with a comparative scale from A (most efficient) to G (least efficient), the EU energy label has been instrumental in guiding consumers toward more energy-efficient choices. Simultaneously, it incentivizes manufacturers to innovate by adopting more energy-efficient technologies. Beyond energy consumption details, these labels also provide specific information on other relevant usage features, such as noise emissions or water consumption.

As the market introduced increasingly energy-efficient products, and distinctions between A^{++} and A^{+++} became less evident to consumers, the EU energy label categories underwent a gradual adjustment, returning to the simpler A to G scale. For instance, a product originally labelled as A^{+++} for energy efficiency might be reclassified as class B or lower after rescaling, despite no change in its energy consumption. The initial A class was left empty to accommodate future, more energy-efficient models.

In 2021, five product groups underwent this rescaling process, and additional product groups with EU energy labels are expected to undergo similar adjustments in the years ahead.

A. Fridges and freezers

The EU energy labels for household fridges and freezers (Figure 2) use, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The labels provide information on the product’s:

- energy efficiency class
- energy consumption
- storage volume(s)
- whether or not it has a freezer compartment
- noise emissions

Other factors may apply to the label, for example for wine storage units, which shows the number of bottles that can be stored. By switching to more energy efficient refrigerating appliances, a household can save up to €200 over the lifetime of an average product.

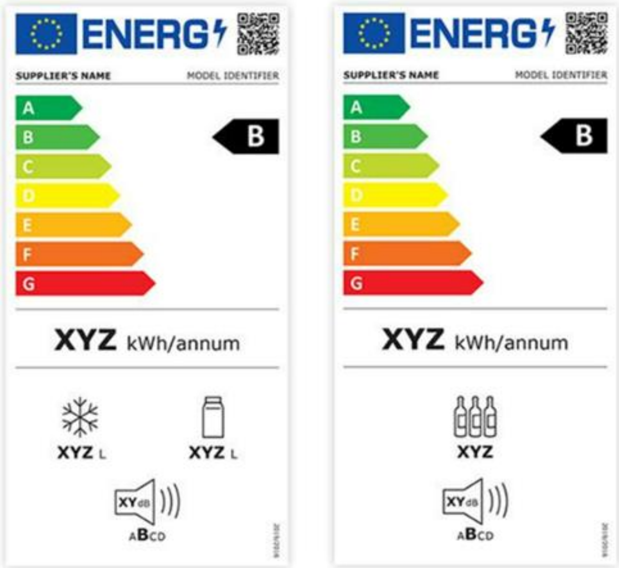

Figure 2. Energy label for fridges and freezers

<u>B. Dishwashers</u>

The EU energy label for household dishwashers (Figure 3) uses, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The label provides information on the product's:

- energy efficiency class
- energy consumption for 100 cycles
- eco-programme duration
- water consumption for 1 cycle
- capacity of the dishwasher
- noise emissions

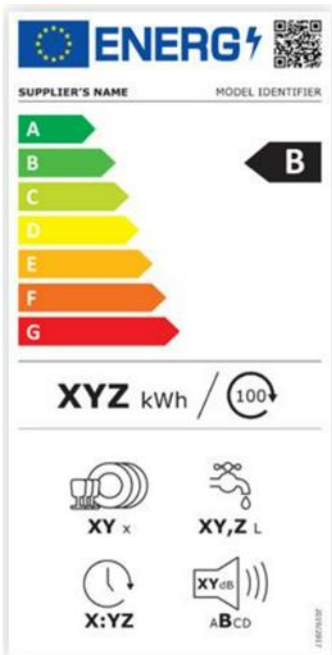

Figure 3. Energy label for household dishwashers

C. Washing machines and washer-dryers

The EU energy labels for household washing machines and washer-dryers (Figure 4) use, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The labels provide information on the product’s:

- energy efficiency class(es)
- energy consumption for 100 cycles
- water consumption for 1 cycle
- duration for 1 cycle
- noise emissions

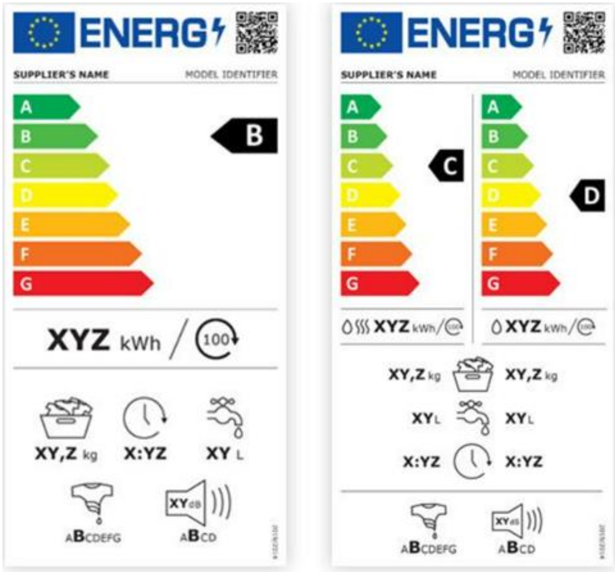

Figure 4. Energy label for household washing machines and washer-dryers

D. Electronic displays including televisions

Electronic displays, such as televisions, computer monitors, or signage displays, are categorised on an energy efficiency scale from A (most efficient) to G (least efficient). The updated scaling system represents an enhancement, taking into account the screen area. These new labels (Figure 5) also provide information on a product's efficiency when displaying content in HDR, recognizing that such settings can consume up to twice as much energy as other configurations. Additionally, the label includes details about the diagonal size of the display and its resolution, enabling consumers to make more informed comparisons between similar displays.

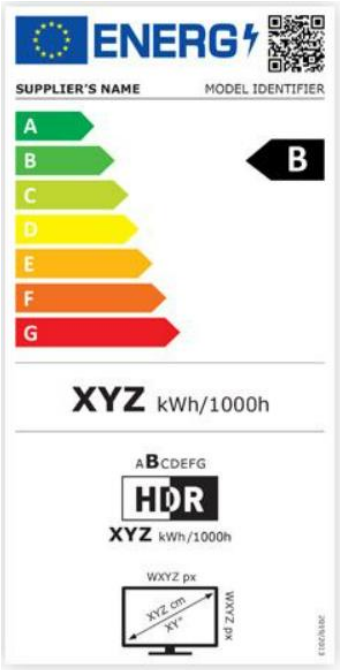

Figure 5. Energy label for electronic displays

E. Lighting

Lighting products encompass various elements, including light sources like light bulbs (halogen, compact fluorescent, etc.) or LED modules/lamps. Additionally, control gears, such as ballasts, electronic components, and drivers, are considered part of lighting products, serving as devices necessary for connecting light sources to the electrical mains.

It's important to note that energy labelling and ecodesign regulations no longer apply to lamps or luminaires as of December 25, 2019, although a label was previously applicable. A luminaire constitutes a comprehensive electric light fixture responsible for distributing, filtering, or transforming light from one or more lamps, for instance, table, wall, or ceiling lamps.

Following the rescaling of the EU energy label for light sources starting from September 1, 2021, the revised labels now utilize a scale ranging from A (most efficient) to G (least efficient). This adjustment was prompted by the ongoing enhancements in energy efficiency, leading many products under the original label to attain A^{+} or A^{++} ratings. Consequently, the rescaling was implemented to offer consumers clearer insights into the most efficient products available on the market. The labels (Figure 6) provide information on the product's:

- energy efficiency class
- energy consumption

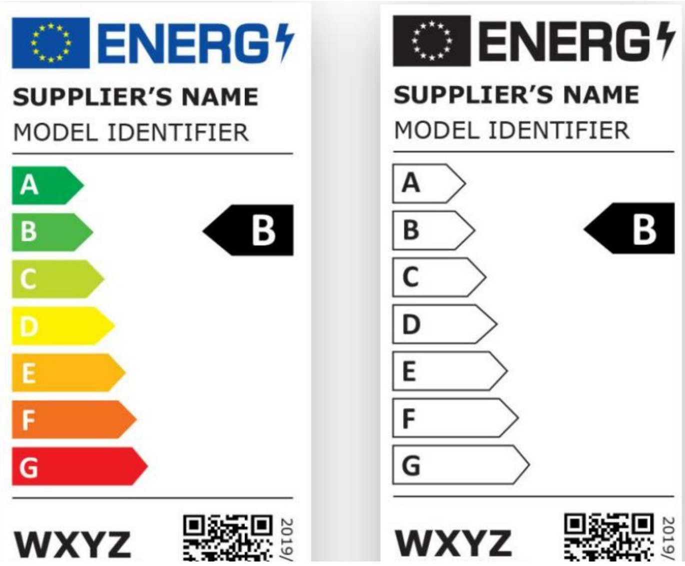

Figure 6. Energy label for lighting products

More information how to read the energy label of the household appliances can be found here: https://www.label2020.eu/

8 How to read your energy bill

This chapter provides information on how the customers can easily understand their energy bills and how they can select the best energy supplier. The analysis is provided for the REVERTER pilot countries. More detailed information will be included in the national versions and will be discussed during the training activities.

A. Bulgaria:

Understanding the electricity bill can sometimes be a challenging task. This chapter explains some of the main key players in electricity supply, the key components of an electricity bill and what prices are charged.

- **Regulated electricity market -** EVN Electric Supply, in its role as a final supplier, ensures the supply of electrical energy for household customers with sites connected at low voltage to the network of Elektroraspradelenie Yug in South-Eastern Bulgaria, for which no electricity supplier has been selected on the free market. The prices at which the final supplier delivers to its customers are regulated by KEVR and change every year from the first of July.
- **What is a network operator/electricity distribution company?** The network operator is the owner of the electricity network who takes care of its management and maintenance. The network in Bulgaria is managed by different network operators depending on the voltage level and geographical location. There is only one network operator on a given network. The network operator of the high voltage network is ESO EAD. Elektroraspredelenie Yug is the only network operator in South-Eastern Bulgaria. All network operators are regulated by the KEVR. Everyone who is connected to the network of Elektrorazpradelenie Yug is its customer - he has an individual contract or a contract under general conditions, pays for the network services provided to him and complies with the rules and procedures established by the operator and the regulatory framework.
- **What are Network Services?** Transmission and access services provided by the network operator.
- **What is Measurement Point Number?** Measurement Point Number, is a unique 7-digit number that identifies the object. It is used to receive information or make cashless payments. It is located in the customer data block, next to the customer number on the monthly invoice.
- **What is a customer number?** The customer number identifies the customer. To one customer number, there can be several measurement points (TIN, several objects). Paying bills with a customer number is a great convenience for customers who have several ITNs (objects) in their name. Entering a customer number facilitates all procedures related to EVN Bulgaria's customer service and reduces payment time at the cash register. Your customer number is located in the data block of each paid monthly bill.
- **Active energy.** One of the key components of your bill is active energy. This is the amount you consume at your business or home. Active energy is usually measured in kilowatt hours (kWh). On your electricity bill, you will see the amount of electricity you used during the reporting period, as well as the price per kWh you were charged.
- **Trade allowance and/or administration fee.** The value of the administrative fee and/or commercial surcharge includes the cost of electricity balancing and administrative customer

service and is determined and received by the electricity trader. The trade surcharge is a fixed value or % that is added by the trader to the price for each kWh of electricity consumed. Unlike the commercial surcharge, the administrative fee is not directly linked to the amount of electricity consumed. It is a fixed amount and is charged on a monthly basis for each object.

- **Excise duty.** Excise duty is a tax imposed by the state on certain goods or services. The value of the excise tax for electric power is determined once a year and is the same for all consumers, regardless of the trader. The excise tax is charged by the electricity trader on the customer's monthly invoice, after which the whole value is paid by the trader to the state. Revenue generated by excise taxes is often used to fund specific programs or initiatives, such as health care or infrastructure improvements.
- **Network charges and services.** It includes the value of electricity distribution services. These fees are determined by the Energy and Water Regulatory Commission and are the same for all consumers. The trader pays the value of these services to the Electricity Distribution Companies, and the purpose of these funds is for the maintenance and development of the infrastructure in order to guarantee a constant and high-quality distribution of electricity in Bulgaria.
- **Final prices** including VAT and excise duty for residential customers of EVN Elektrosnabdiavane until December 2023:

Metering method	Periods within the day	Price, BGN/kWh
With two rates	Day Night	0.25751 0.14788
With one rate	—	0.25751

Final prices for residential customers are calculated in accordance with the Electricity Market Rules and include:

- the prices of EVN Elektrosnabdiavane and prices for grid services approved by EWRC's Decision No. C-14 / 30.06.2023
- 20% VAT
- 0% excise duty.

REVERTER

Фактура № xxxxxxxxxx-*ОРИГИНАЛ* - детайлна информация

Клиентски номер:	xxxxxxxxxx	Място на потребление:	№ xxxxxxx / ИТН / НАСЕЛЕНО МЯСТО УЛИЦА НОМЕР
Отчетен период:	xx.06.2022 – xx.07.2022	Обозначение:	бит

Отчетени показания

Електромер	№ / тарифа	отчетен период	п.старо	п.ново	разлика	служ.ен.кВтч	
xxxxxxx /	дневна	xx.06.2022 – 30.06.2022	26821	26946	125	125	Консумирана дневна енергия по цени до 30.06.2022 г.
xxxxxxx /	нощна	xx.06.2022 – 30.06.2022	10332	10392	60	60	Консумирана нощна енергия по цени до 30.06.2022 г.
xxxxxxx /	дневна	01.07.2022 – xx.07.2022	26946	27071	125	125	Консумирана дневна енергия по цени от 01.07.2022 г.
xxxxxxx /	нощна	01.07.2022 – xx.07.2022	10392	10452	60	60	Консумирана нощна енергия по цени от 01.07.2022 г.

*Крайни цени на електрическа енергия – ниско напрежение /НН/		кВтч	Ед. Цена/лв	Общо/лв	
дневна ел.енергия	xx.06.2022 – 30.06.2022	125	0.20011	25.01	Крайна цена дневна енергия без ДДС и акциз
нощна ел.енергия	xx.06.2022 – 30.06.2022	60	0.11390	6.83	Крайна цена нощна енергия без ДДС и акциз
дневна ел.енергия	01.07.2022 – xx.07.2022	125	0.20677	25.84	Крайна цена дневна енергия без ДДС и акциз
нощна ел.енергия	01.07.2022 – xx.07.2022	60	0.11875	7.13	Крайна цена нощна енергия без ДДС и акциз
Общо:		**370**		64.81	

***Крайната цена на електрическата енергия включва:**

Цена на електрическа енергия за дневна тарифа	xx.06.2022 – 30.06.2022	0.14433
Цена на електрическа енергия за дневна тарифа	01.07.2022 – xx.07.2022	0.10917
Цена на електрическа енергия за нощна тарифа	xx.06.2022 – 30.06.2022	0.05812
Цена на електрическа енергия за нощна тарифа	01.07.2022 – xx.07.2022	0.02115
Акциз	xx.06.2022 – xx.07.2022	0.00000
Пренос през ел.разпределителната мрежа НН	xx.06.2022 – 30.06.2022	0.03783
Пренос през ел.разпределителната мрежа НН	01.07.2022 – xx.07.2022	0.07105
Достъп до електроразпределителната мрежа НН	xx.06.2022 – 30.06.2022	0.00598
Достъп до електроразпределителната мрежа НН	01.07.2022 – xx.07.2022	0.00598
Цена за пренос и достъп през/до електропрен. мрежа	xx.06.2022 – 30.06.2022	0.01197
Цена за пренос и достъп през/до електропрен. мрежа	01.07.2022 – xx.07.2022	0.02057

Цени на компоненти, включени в крайните цени на електрическата енергия

Предоставена мощност за обекта – X кВт

*** Цените на електрическата енергия,задължения към обществото и мрежовите услуги до 30.06.2022 г. са определени с Решение № Ц – 27/01.07.2021 г. на КЕВР, а цените на електрическата енергия, задължения към обществото и мрежовите услуги от 01.07.2022 г. са определени с Решение № Ц – 19/01.07.2022 г. на КЕВР.**

В крайните цени на електрическата енергия е включена и цената за задължения към обществото

Данъчна основа на доставката	64.81
Размер на данъка / Данъчна ставка ДДС 20%	12.96
Обща стойност на фактурата в лева	**77.77**

Словом: седемдесет и седем лева и 77 ст.

Съставил: /шиф. 0911/

Доставчик:
ЕВН България Електроснабдяване ЕАД

Figure 7. Explanation of electricity bill – invoice

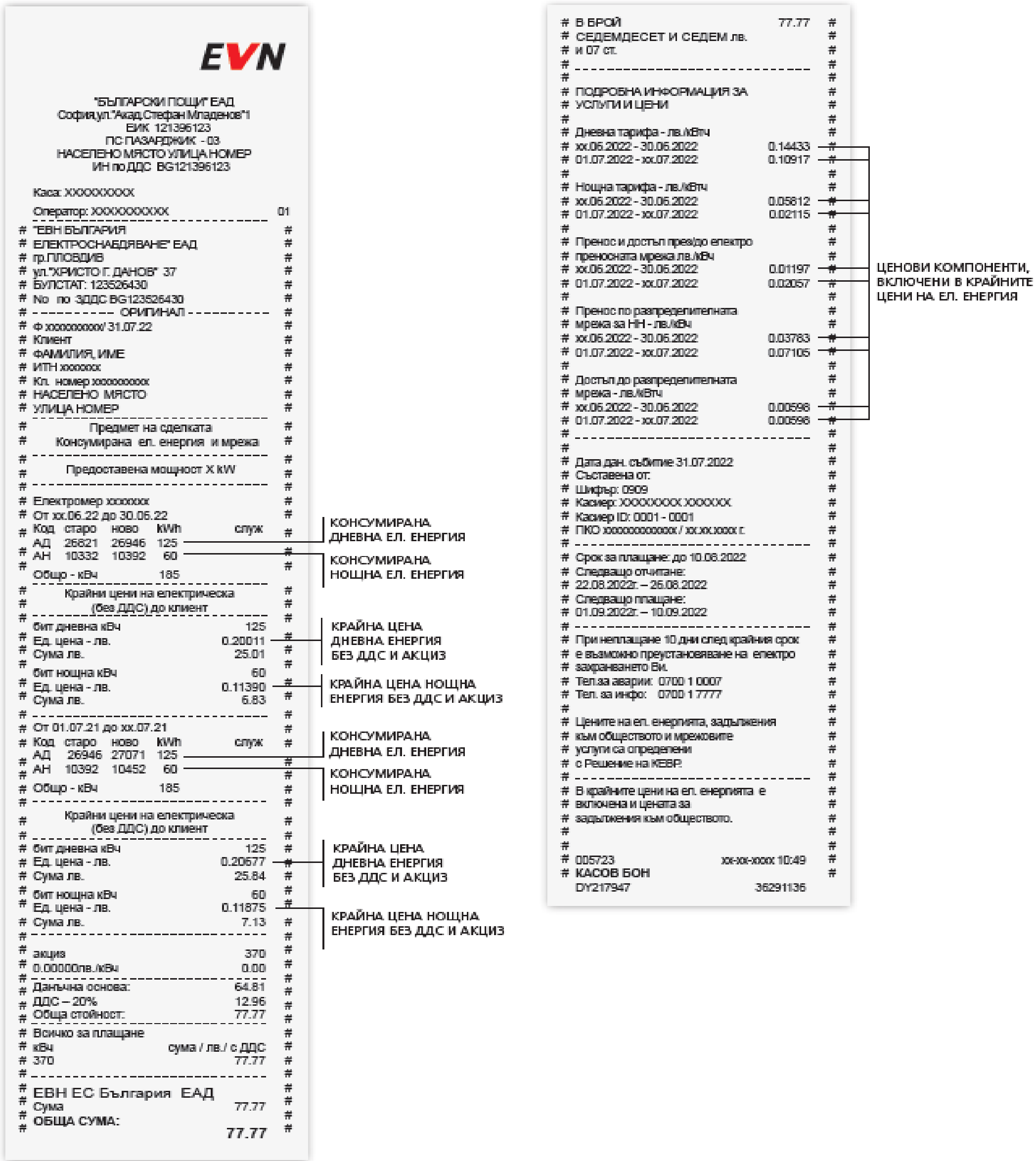

Figure 8. Explanation of Electricity bill – cash receipt

B. Greece:

Through the electricity bills, the consumers reimburse:

1. The full cost of providing electricity to them, including the production and supply of electricity (supply/consumption charge),
2. The regulated charges which encompass, among others, the charges for the transmission and distribution of electricity to their property (charges for the Electricity Transmission System and the Electricity Distribution Network). The Distribution Network and the Transmission System fees are collected by the suppliers and are attributed to the Distribution Network and Network System Operator respectively, for the proper operation, maintenance and expansion of the Distribution Network and Transmission System.

3. Various charges, such as Municipality charges, charge for ERT (State Radiotelevision Company), and
4. VAT charged on the electricity supply/consumption charge.

Regarding the supply/consumption charge, four new electricity tariffs are established by the Law 5066/2023, which will be valid from 1.1.2024. These tariffs are fixed, fluctuating and dynamic and for the convenience of the consumer, the invoices were associated with a color (see figure 1). The blue one for the fixed tariff, the green and the yellow ones for the fluctuating tariffs and the orange invoice for the dynamic tariff.

More specifically:

- Fixed are fixed-term invoices, with a fixed billing price for the entire period of the contract.
- Fluctuating are the tariffs, which are linked to the wholesale price on the Energy Exchange. These are divided into two main categories: i. by setting a price in advance of the consumption period (green invoice) and ii. with post-fixing of price (yellow invoice).
- Dynamic, which refers to the possibility of dynamic pricing, with different prices - even during the day - based on market prices. A condition for the selection of these tariffs is the operation of a smart telemetered meter in the supply of consumers.

Figure 9. Four coloured invoices, and their characteristics, as they are announced by the Ministry of Energy and the Environment

C. Portugal:

Reading and fully understand the energy bills, in Portugal, can be a nightmare even for people with a technical background! Besides the specific units, there are several items related to the specific tariff and the different discounts by the operators, that make the bill very complex to read. There is no format template to follow, but the National Energy Regulator requires certain minimum information to be included in the energy bill. In relation to raising people awareness, there are a number of websites that inform people about how to read and how to change to another operator, by providing user friendly simulators online.

What should be on the bill?

The electricity bill must contain the following information:

- The contracted power, including the price.
- The dates and means by which customers can report readings.
- Actual and estimated consumption (associated quantities).

- The price of energy and the tariffs applicable to the sale and consumption of energy (unit and total price).
- The total and unbundled value of the network access tariff.
- The billing period.
- The applicable fees and taxes, itemised.
- The conditions, deadlines and means of payment The consequences of non-payment.
- The costs of general economic interest (CIEG).
- The value of the discount corresponding to the social tariff, where applicable.
- The difference between the amount paid and what you would pay if you had the regulated (transitional) tariff.

The invoice must also include information on:

- other services provided, if applicable
- CO_2 emissions corresponding to the energy consumed and invoiced
- the supplier's contact details
- contacts for reporting faults and emergencies
- value (in %) of the primary energy sources used to produce electricity (wind, hydro, natural gas, coal, etc.)

To better understand the bill, there are several Apps and videos where the user can find user-friendly explanation about the energy bill, listed below:

https://www.erse.pt/consumidores-de-energia/eletricidade/compreender-a-fatura/)

You Tube channel where informative materials are available in Portuguese:

https://www.youtube.com/playlist?list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS

About energy bills, there are two videos with clear general explanations:

https://www.youtube.com/watch?v=_R71DCvjKq4&list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS&index=6

https://www.youtube.com/watch?v=6CkZE52DCUI&list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS&index=12

The main operator in Portugal, EDP, also provides information on how to read the invoice:

https://www.edp.pt/particulares/apoio-cliente/como-ler-fatura/

On the first page, the electricity invoice highlights the amounts to be paid for each component of contracted energy, additional services (if you have contracted services), taxes and fees and shows the values of the readings taken into account for the invoice. On the second page there are details of invoicing, with an explanation of all the consumption invoiced and explanatory texts on the fees and taxes payable (Figure 10).

Figure 10. The first two pages of the electricity invoice in Portugal

On the last page of the invoice (Figure 11) there is an area illustrating energy performance with a history of consumption, a graph explaining the origin of the energy and a detachable card for payment by ATM. In the event of a debt, an extra page is shown on the invoice which tells the customer how much they have to pay. This outstanding amount is not included in the amount shown on the first page.

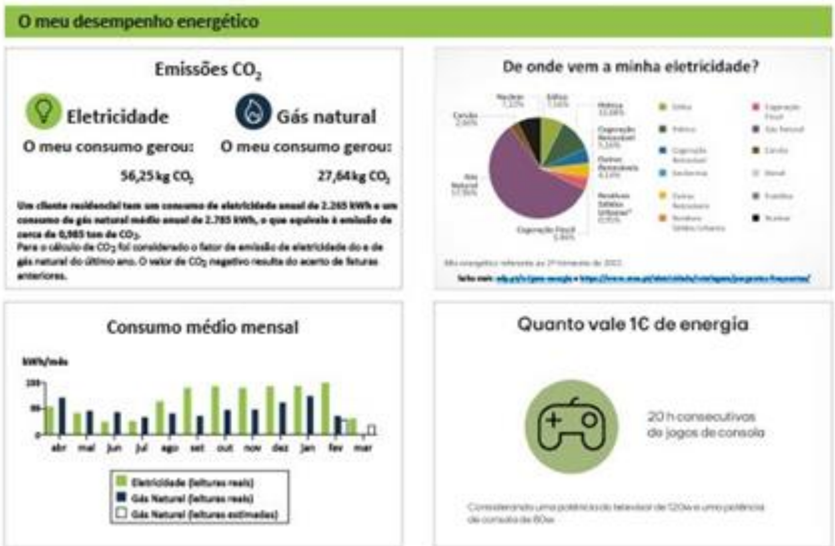

Figure 11. The last page of the electricity invoice in Portugal

The main consumers Association, DECO, provides a virtual assistant with much information about energy use and energy savings, in particular one section with basic information to take into consideration when reading an energy bill:

https://academiaeva.deco.pt/

https://poupaenergia.pt/#/

D. Latvia:

It should be taken into account that due to the amount of electricity consumed, the bill will fluctuate from month to month. In turn, for those who choose the levelized payment with a specific monthly fee, the calculation of the real amount of electricity consumed will be made at the end of the year or with the change of the electricity provider. Determining your own electricity price is easiest when calculating the price per 1 kilowatt hour (kWh). To do this, it is necessary to add up all the amounts indicated in the bill for electricity and divide by the number of kWh consumed. In different bills, the names of the indicators may differ from one provider to another, but most often include "charge for electricity" and "service fee" or "connection fee". Payments relating to distribution and transmission services, as well as the mandatory procurement component for electricity, are not included in this calculation, as they will be the same for all service providers.

In the bill, the layout of the information is determined by EU regulations and laws, the electricity trader cannot vary with the content. Each electricity trader's bill includes the MPC (mandatory procurement components) as well as the distribution and transmission fee part. When dividing the sum of bills as a percentage, about 28% is made up of the share of the MPC, about 40% is the share of distribution and transmission, while the remaining 32% is the direct electricity consumption and electricity trader's fee – of which about 28% is made up of electricity purchases on the stock exchange or at the wholesaler, and about 4% is made up of electricity trader.

You can reduce your electricity bill fee by limiting your electricity consumption and/or by choosing dynamic electricity tariff taken from Nord pool electricity exchange. The exchange tariff allows you to use energy wiser – by slightly adjusting your habits and using electricity more actively at times when its price on the electricity exchange is lower, it is possible to save. In addition, the process is automated – the accounting of electricity consumption takes place automatically through a smart meter, and the price for electricity consumption is calculated hourly – according to its current fee on the electricity exchange.

Sources of information

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- https://www.cez.bg/bg/za-klienta/energijna-efektivnost/racionalno-izpolzvane-energy.html

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC V

Financing schemes and mechanisms

Co-funded by the European Union

Executive Summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. It aims to provide a summary of the most important financing mechanisms and schemes that exist in the four REVERTER pilots towards promoting deep renovations and RES installations. In the national versions of the training material, these financing mechanisms and schemes will be presented in detail. The aim is for the REVERTER Ambassadors and OSS personnel to be able to provide advice on how to benefit from the existing financing schemes, select the most appropriate measures, etc.

Annex I summarises indicative financing schemes in the four REVERTER pilots. The OSSs personnel will be provided with detailed and updated information for the purposes of the OSS.

Table of Contents

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
RA	REVERTER Ambassadors
EP	Energy Poverty
PV	Photovoltaics
RES	Renewable Energy Sources

1 Financing schemes and mechanisms in Brezovo pilot

Currently there exists only one national programme, namely the “Support for Sustainable Energy Renovation of the Residential Building Fund” (total investment: BGN 1,176,960,000.00), aiming at providing financial, organisational and technical assistance to improve the energy performance of the housing stock in the Republic of Bulgaria. The programme will run between 2023 and 2027 and has introduced a financial scheme in support of sustainable energy renovation of residential buildings. According to the current procedure, which represents the first stage of the implementation of the sub-measure “Support for sustainable energy renovation of the housing stock”, for proposals implemented under the conditions of the “non-aid” regime, co-financing is not required from the final recipient of the funds - aid intensity is 100%. In the second stage of the implementation of the sub-measure “Support for sustainable energy renovation of the residential building stock”, which will be the subject of a separate procedure, the final recipients will be required to co-finance 20% of the amount of eligible costs under the project. The criteria for the proposals in order to be approved require that the buildings reach energy consumption class minimum B after applying energy-saving measures; that the measures stimulate a minimum of 30% primary energy savings, implement resource efficiency, economic expediency, decarbonisation through RES, sustainable construction process, reduce energy poverty by reducing energy costs, and ultimately, improve the conditions and quality of life of the population in the country through technological renewal and modernization of the building stock.

As far as the support of RES installation is concerned, the Republic of Bulgaria has established the “National scheme to support households in the field of energy from renewable sources”, under the “National plan for recovery and sustainability of the Republic of Bulgaria”. The aim of this scheme is to support households in the field of energy production from RES, so as to promote the decentralised production of energy from RES, stimulate the consumption of ecologically clean energy, and reduce the consumption of solid fuels in the household sector. It provides financing for the purchase of solar installations for domestic hot water supply (DHW) and the purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems. The total amount of the financial scheme is BGN 80 million, where each proposal can receive up to 100% of the value of the installation, but no more than BGN 1,960 for the purchase of solar installations for DHW, and up to 70% of the value of photovoltaic systems up to 10 kWp including the electrical energy storage systems, but not more than BGN 15,000.

2 Financing schemes and mechanisms in Athens Urban Area pilot

In 2021, the “Exoikonomo 2021” programme began, financed under the framework of the National Recovery and Resilience Plan Greece 2.0 with funding from the European Union – NextGenerationEU. The “Exoikonomo 2021” is a residential energy upgrade program, which is the successor scheme of the “Exoikonomo kat' Oikon” and “Exoikonomo-Autonomo” programs, with a total budget of EUR 632 million. In 2023, the successor of the programme “Exoikonomo 2021”, namely “Exoikonomo 2023” was announced. The programme concerns buildings that have a building permit or other legal document, they are used as a main residence and whose owners meet specific income criteria. The design of the programme takes into account the integrated approach of energy-saving interventions in the domestic building sector and aims to (a) reduce the energy needs of buildings and pollutant emissions that contribute to the worsening of the greenhouse effect, (b) achieve cost savings for citizens, improving daily living conditions and comfort as well as their safety and health when using these buildings and (c) attain a cleaner environment. The program aims to improve the energy class of households by at least 3 energy classes (over 30% of primary energy saving). The “Exoikonomo” programmes will contribute to energy savings of at least 213 ktoe per year and to the energy renovation of at least 105,000 homes by 2025. Particular care is taken to support poor and vulnerable households in the form of an increased grant rate and a separate budget of EUR 100 million and EUR 60 million, in “Exoikonomo 2021” and “Exoikonomo 2023”, respectively.

Also in 2023, the Greek State announced the “Photovoltaic on the roof” Programme with a total budget over EUR 200 million. The Programme aims to install PV in combination with battery systems, to the aim of bringing the building stock to near-zero energy consumption standards by 2050, and to lower living costs. The Programme subsidises households for the installation of PV systems with storage and farmers for the installation of PV systems with or without storage for self-consumption with the application of energy offsetting. Subsidies for households range from 45% to 75% of the total cost depending on their income. In total, EUR 45 million was earmarked for vulnerable households while citizens with an annual income of up to EUR 20,000 or families with an income of up to EUR 40,000 are entitled to an overall EUR 100 million.

3 Financing schemes and mechanisms in Riga pilot

In 2022, the Latvian ALTUM financial institution began the programme “Energy efficiency of private houses” for energy efficiency of private houses, which provides state support (up to 6,000 EUR per household) for the renovation of private houses and the improvement of energy efficiency or installation of electricity production equipment (solar panels, wind generation). The overall goal of the policy is to reduce MFB heat energy consumption and CO_2 emissions reduction to achieve national goals for energy efficiency improvement in the building sector. Also in 2022, the ALTUM financial institution started an initiative with the same goals, the “Energy efficiency of apartment buildings 2022-2026”. The programme aims at reducing energy consumption of MFBs by providing a grant for deep renovation measures. (up to 49% excl. VAT of the total MFB renovation costs if at least 30% reduction of primary energy consumption is achieved).

Latvia introduced a support program for the use of renewable energy resources in households in the same year (i.e., 2022). The support program envisages the provision of support for the replacement of fossil fuel (e.g. natural gas, diesel, coal) equipment with new equipment using renewable energy resources (biomass pellet boilers, heat pumps, solar collectors) or connection to a centralized heat supply system, as well as for the production of electricity from renewable energy resources (solar panels, wind generators) for household self-consumption. The purpose of the competition is to reduce greenhouse gas emissions and improve energy efficiency in households by supporting the purchase of heat energy or electricity generation equipment for installation in residential homes to ensure the production and supply of heat energy or electricity for household needs or the establishment of household connections to the centralized heat supply system.

4 Financing schemes and mechanisms in Coimbra pilot

In 2020, the financial scheme IFRRU2020 - Financial Instrument for Urban Rehabilitation and Revitalisation from 2020, was launched. This scheme focuses on energy efficiency, deep renovation, and renewables. It is a financial instrument that mobilises the funds approved by the Regional Operational Programmes of Portugal 2020, with the objectives of revitalising cities, supporting the physical revitalisation of the space dedicated to disadvantaged communities and supporting energy efficiency in housing. The fund is complemented with financing from the EIB and the Council of Europe Development Bank. The IFRRU 2020 provides loans at more favourable conditions than those available on the market, for the full rehabilitation of buildings, whether for housing or other activities, including the most appropriate integrated energy efficiency solutions within the scope of that rehabilitation. The scheme thus aims to facilitate access to funding by promoting investments in the area of urban regeneration, improving the financing conditions, appropriate to the circumstances and specificities of the projects, and diversifying the supply of financing solutions on more favourable terms than those available in the market. When focusing on disadvantaged communities, it is also important to promote physical regeneration, associated with initiatives that contribute to economic stimulation and job creation, as fundamental elements for social inclusion and the fight against poverty.

The Directorate General of Energy and Geology, ADENE, began a financial scheme in 2023, in support of Renewable Energy Communities and collective self-consumption. The objective of this program is to finance measures that promote the production of energy from renewable sources in Collective Self-Consumption and Renewable Energy Communities. It is intended that the supported measures can lead to, on average, at least a 30% reduction in primary energy consumption in the buildings, and reinforce the capacity of self-consumption and/or RECs in the residential, central public administration and services sectors by, at least, 93 MW.

Annex I: Energy efficiency financing schemes in the four REVERTER pilots

Country	Title	Period	Scope	Brief description	Beneficiaries	Managing body	Volume of funding	What is the main goal of the policy	Source
Bulgaria	**National scheme to support households in the field of energy from renewable sources** /Under the National plan for recovery and sustainability of the Republic of Bulgaria	2023-2026	National	With the implementation of the investment, the decentralized production of energy from renewable sources will be promoted, the consumption of ecologically clean energy will be stimulated and the consumption of solid fuels will be reduced in the household sector. The purpose of the investment is to increase the use of renewable energy in the final energy consumption in the household sector by providing financing for: • Component 1: Purchase of solar installations for domestic hot water supply (DHW); • Component 2: Purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems.	All households	MINISTRY OF ENERGY	Planned amount of investment: •Total - BGN 80 million; • Maximum amount of funding for a proposal under: - Component 1: Purchase of solar installations for DHW - up to 100% of the value of the installation, but not more than BGN 1,960.83; - Component 2: Purchase of photovoltaic systems up to 10 kWp, including the electrical energy storage systems - up to 70% of the value of the system, but not more than BGN 15,000.	The purpose of the investment is to increase the use of renewable energy in the final energy consumption in the household sector by providing financing for: Purchase of solar installations for domestic hot water supply (DHW); • Component 2: Purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems. Support at least 10,000 households with inefficient solid fuel heat sources to install the best equipment for DHW solar installations and photovoltaic systems up to 10 kWp, including electrical energy storage systems.	https://eumis2020.government.bg/bg/s/800c457d-e8be-4421-8ed9-9e78d0a75c39/Procedure/Info/dbc86350-cccd-414a-a175-a1d440952525

Bulgaria	**SUPPORT FOR SUSTAINABLE ENERGY RENOVATION OF THE RESIDENTIAL BUILDING FUND**	2023-2027	National	The current project is aimed at provision of financial, organizational and technical assistance to improve the energy performance of the housing stock in the Republic of Bulgaria.	All households	MINISTRY OF ENERGY	Investment: BGN 1,176,960,000.00. According to the current procedure, which represents the first stage of the implementation of the sub-measure "Support for sustainable energy renovation of the housing stock", for proposals for the implementation of the sub-measure, implemented under the conditions of the "non-aid" regime, co-financing is not required from the final recipient of the funds - aid intensity is 100%. In the second stage of the implementation of the sub-measure "Support for sustainable energy renovation of the residential building stock", which will be the subject of a separate procedure, the final recipients will be required to co-finance 20% of the amount of eligible costs under the project.	improving the energy characteristics of the national building stock of residential buildings, by applying integrated energy-efficient measures; - reaching energy consumption class minimum B after applying energy-saving measures in residential buildings; - stimulating a minimum of 30% primary energy savings for renovated residential buildings; - resource efficiency, economic expediency, decarbonization through RES, sustainable construction process; - reducing energy poverty by reducing energy costs; - improvement of the conditions and quality of life of the population in the country through technological renewal and modernization of the building stock.	https://eumis2020.government.bg/bg/s/800c457d-e8be-4421-8ed9-9e78d0a75c39/Procedure/Info/dbc86350-cccd-414a-a175-a1d440952525

Greece	**The "Exoikonomo 2021" programme**/ Financed under the framework of the National Recovery and Resilience Plan Greece 2.0 with funding from the European Union – NextGenerationEU.	2021-2025	National	The "Exoikonomo 2021" program is a residential energy upgrade program, which is the successor scheme of the "Exoikonomo kat' Oikon" and "Exoikonomo-Autonomo" programs, with a total budget of €632 million. The program concerns buildings that have a building permit or other legal document, they are used as a main residence and whose owners meet specific income criteria.	All households	Ministry of Environment and Energy	(a) In the case of personal income <= €5000 and family income <= €10000, the funding rate for home ownership by the applicant is 75% and for free concession to another person/rental is 65% (b) In the case of personal income > €5000-€10000 and family income > €10000-€20000, the funding rate for home ownership by the applicant is 70% and for free concession to another person/rental is 60% (c) In the case of personal income > €10000-€20000 and family income > €20000-€30000, the funding rate for home ownership by the applicant is 55% and for free concession to another person/rental is 45% (d) In the case of personal income > €20000-€30000 and family income > €30000-€40000, the funding rate for home ownership by the applicant is 45% and for free concession to another person/rental is 40% (e) In the case of personal income > €30000 and family income > €40000, the funding rate for home ownership by the applicant is 40% and for free concession to another person/rental is 40%.	The design of the program takes into account the integrated approach of energy saving interventions in the domestic building sector and aims to (a) reduce the energy needs of buildings and pollutant emissions that contribute to the worsening of the greenhouse effect, (b) achieve cost savings for citizens, improving daily living conditions and comfort as well as their safety and health when using these buildings and (c) attain a cleaner environment. The program aims to improve the energy class of households by at least 3 energy classes (over 30% of primary energy saving). The total investment of the project will contribute to energy savings of at least 213 ktoe per year and to the energy renovation of at least 105,000 homes by 2025.	https://exoikonomo2021.gov.gr/welcome

Greece	**M1. Improvement of the Social Tariff**	2021-2030	National	Policy measure M1 aims to maintain and improve the social tariff scheme for the supply of electricity to households affected by energy poverty. In the context of this specific policy measure, the adoption of a preferential price of electricity sale is foreseen for the case of the affected households, which experience conditions of energy poverty.	Vulnerable households	Ministry of Environment and Energy	40 million € annually	Short-term alleviation of the energy poverty Provision of a preferential tariff for the supply of electricity in order to protect the affected households from extreme and extraordinary conditions of energy poverty.	
Greece	**M2. Provision of energy card to energy poor households**	2021-2030	National	Policy measure M2 aims to provide specific quantities of energy products at a preferential price through an "energy card", which will be allocated to cover the minimum thermal comfort conditions of households affected by the phenomenon of energy poverty. The provided "energy card" will enable the consumption of a certain amount of energy products by the affected households, while it will not be possible to replace them with the equivalent amount of their purchase or their eventual substitution with another energy product.	Vulnerable households	Ministry of Environment and Energy	40 million € annually	Short-term alleviation of the energy poverty Provision of specific quantities of energy products at a preferential price for the purpose of consumption by affected households through the provision of an "energy card".	
Greece	**M4. Energy upgrade of the energy poor households' building including the installation of RES systems**	2021-2030	National	Policy measure M4 aims to address the phenomenon of energy poverty in the long term by improving the energy efficiency of the residential buildings of households affected by this phenomenon and installing RES systems to cover their total energy needs in the most efficient way. The "Exoikonomo 2021" program has already been implemented within the framework of the current measure. Three different programmes will be launched namely for the installation of photovoltaic systems for the promotion of auto consumption, the installation of solar thermal systems and the "Exoikonomo-Anakainizo for young people".	Vulnerable households	Ministry of Environment and Energy	1.8 billion €	Long-term alleviation of the energy poverty Installation of energy saving systems and technologies as well as RES systems in buildings of households affected by energy poverty.	

Greece	**M5. Provision of incentives to energy poor households within the framework of the Just Transition Plan**	2021-2030	National	Policy measure M5 aims to address the phenomenon of energy poverty in the long term by improving the energy efficiency of the buildings of the affected households and installing RES systems to cover their total energy needs in the most efficient way.	Vulnerable households	Ministry of Environment and Energy	210 million €	Long-term alleviation of the energy poverty Installation of energy saving systems and technologies as well as RES systems in buildings of affected households for more efficient and economical coverage of their minimum energy needs in the areas affected by the Just Transition and the decarbonization of the electricity generation sector.	
Greece	**M6. Provision of incentives to energy poor households within the framework of the EEOs**	2021-2030	National	Policy measure M6 aims to strengthen actions in households affected by the phenomenon of energy poverty by the Obliged Parties within the framework of the Energy Efficiency Obligation Scheme of the period 2021-2030.	Vulnerable households	Ministry of Environment and Energy	70 million €	Long-term alleviation of the energy poverty Provision of incentives to the Obliged Parties within the framework of the Energy Efficiency Obligation Scheme for the implementation of interventions in affected households in order to deal with energy poverty in terms of cost-effectiveness.	
Greece	**M7. Provision of incentives to energy poor households within in the framework of the Energy Communities**	2021-2030	National	Policy measure M7 aims at revising the existing operational framework of energy communities in accordance with the provisions of Directives 2019/944 and 2018/2001 in order to maximize the social benefit by addressing the phenomenon of energy poverty. In addition, the actions, including financial incentives, aim for the energy produced (electricity, heating and cooling) from RES to be used by both civil and renewable energy communities to cover the energy needs of households, which are affected by the phenomenon of energy poverty.	Vulnerable households	Ministry of Environment and Energy	100 million €	Long-term alleviation of the energy poverty Review the institutional framework and provision of incentives to address energy poverty through the mechanism of energy communities.	

Latvia	Energy efficiency of apartment buildings 2022-2026	2022-2026	National	The programme is aimed at reducing energy consumption of MFBs by providing a grant for deep renovation measures.	All households	ALTUM financial institution	Up to 49% excl. VAT of the total MFB renovation costs if at least 30% reduction of primary energy consumption is achieved.	The overall goal of policy is to reduce MFB heat energy consumption and CO2 emmissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://www.altum.lv/pakalpojumi/iedzivotajiem/daudzdzivoklu-maju-energoefektivitate-2022-2026/?tab=1
Latvia	**Support for the development of technical documentation for multi-apartment residential buildings**	2023	Local	The programme is aimed at proviging financial aid for technical documentation preparation - building energy sertification preparation and building technical survey for buildings in Riga.	All households	Riga Energy agency	70% of necessary costs are financed not exceeding 800 EUR for building energy certifiaction and 1100 EUR for building technical survey	The overall goal of policy is to reduce MFB heat energy consumption and CO2 emmissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://rea.riga.lv/upload/media/default/0001/01/bc739a045c2576b7b6d361c73253e1b2b0dbc421.pdf
Latvia	**Support program for the use of renewable energy resources in households**	From 2022 till all the funding is exhausted from the programme	National	The support program developed by VARAM envisages the provision of support for the replacement of fossil fuel (e.g. natural gas, diesel, coal) equipment with new equipment using renewable energy resources (biomass pellet boilers, heat pumps, solar collectors) or connection to a centralized heat supply system, as well as for the production of electricity from renewable energy resources (solar panels, wind generators) for household self-consumption.	All households	The Ministry of Environmental Protection and Regional Development	Up tp 70% of eligible costs according to the rules set out in the regulation. Maximmum amount of funding for one project is up to 15 000 EUR. As of time the information is gathered there are 11,537 million left in the programme from total of 30 million euros available at the start of the programme.	The purpose of the competition is to reduce greenhouse gas emissions and improve energy efficiency in households by supporting the purchase of heat energy or electricity generation equipment for installation in residential homes to ensure the production and supply of heat energy or electricity for household needs, or the establishment of household connections to the centralized heat supply system.	https://www.varam.gov.lv/lv/atbalsta-programma-atjaunojamo-energoresursu-izmantosanai-majsaimniecibas?utm_source=https%3A%2F%2Fwww.bing.com%2F

Latvia	**Energy efficiency of private houses**	2022 till now	National	State support for renovation of a private house and improvement of energy efficiency or installation of electricity production equipment (solar panels, wind generation).	All households	ALTUM financial institution	Up to 6000 EUR per household.	The overall goal of policy is to reduce MFB heat energy consumption and CO_2 emissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://www.altum.lv/pakalpojumi/iedzivotajiem/privatmaju-energoefektivitate/

Portugal	Support to Renewable Energy Communities and collective selfconsumption / Investimento C13-i01; 02; 03 - Apoio à concretização de Comunidades de Energia Renovável e Autoconsumo Coletivo	2023	National	The objective of this programme is to finance measures that promote the production of energy from renewable sources in Collective Self-Consumption and Renewable Energy Communities. It is intended that the measures to be supported can lead to, on average, at least a 30% reduction in primary energy consumption in the buildings, and to reinforce the capacity of self-consumption and/or RECs in the residential, central public administration and services sectors by, at least, 93 MW.	All households	Directorate General of Energy and Geology, ADENE	Total available funding: 30 million Euros; (-) 10 million for residential buildings (70% co-financing); (-) 10 million for Central Administration buildings (100% financing); (-) 10 million for commercial and service buildings (50% co-financing). For the three typologies, the amount to be provided is limited to 200K (UPAC) + 500K (Collective self-consumption and Renewable Energy communities).	The aim is to contribute to the objectives expressed in the Council Implementing Decision on the adoption the evaluation of the Resilience and Recovery Facility, of reducing the country's energy bill, greenhouse gas emissions and the country's energy dependence.	https://www.fundoambiental.pt/ficheiros/2023/aviso-prr-c13_cer_4-republicacao_31012023-pdf.aspx https://www.fundoambiental.pt/apoios-prr/c13-eficiencia-energetica-em-edificios/c13-i01-02-03-apoio-a-concretizacao-de-comunidades-de-energia-renovavel-e-autoconsumo-coletivo.aspx

Portugal	IFRRU2020 - Instrumento Financeiro Reabilitação e Revitalização Urbanas 2020 / Financial Instrument for Urban Rehabilitation and Revitalisation 2020	2021-2027	National	Is a financial instrument that mobilises the funds approved by the Regional Operational Programmes of Portugal 2020, with the objectives of revitalising cities, supporting the physical revitalisation of the space dedicated to disadvantaged communities and supporting energy efficiency in housing. The fund is complemented with financing from the EIB and the Council of Europe Development Bank. The IFRRU 2020 provides loans at more favourable conditions than those available on the market, for the full rehabilitation of buildings, whether for housing or other activities, including the most appropriate integrated energy efficiency solutions within the scope of that rehabilitation.	All households	Through a tender procedure, the financial management entities were selected, which provide the financial products (loans or guarantees) through which the urban rehabilitation operations are financed - Santander Totta, Banco BPI and Millennium BCP.	IFRRU 2020 thus has a financing capacity of 1,400 million euros, generating an investment of around 2,000 million euros.	The IFRRU 2020 thus aims to facilitate access to funding by promoters of investments in the area of urban regeneration, improving the financing conditions, appropriate to the circumstances and specificities of the projects, and diversifying the supply of financing solutions on more favourable terms than those available in the market. In disadvantaged communities, it is also important to promote physical regeneration, associated with initiatives that contribute to economic stimulation and job creation, as fundamental elements for social inclusion and the fight against poverty.	https://ifrru.ihru.pt/web/guest/ifrru2020#O_QUE_%C3%89

REVERTER

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC VI

Communication and advising of vulnerable households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to train them on:

- how to identify users in situation of energy vulnerability among the clients served;
- how to communicate with energy-poor people and to be able to support the households; (with focus on vulnerable consumers) in being more efficient with their energy consumption;
- how to carry out a role of “Ambassador” of energy saving measures.

In the course of communication training, the participants need to be prepared especially for the situation of giving advice to vulnerable households.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
RA	REVERTER Ambassadors
EP	Energy Poverty

1 Energy poverty

1.1 What is energy poverty?

Energy Poverty is a ‘symptom’, an expression of a ‘precondition’ that affects our livelihoods, namely through the lack of access to essential energy services. Energy poverty typically stems from a combination of factors, including high energy costs, limited income, and homes that are inefficient in terms of energy use, which can be affected by factors such as the age, condition, and construction materials of the building envelope, as well as the energy efficiency of appliances. Additionally, factors like residential status (whether they own or rent their home) and the type of heating/cooling system in place also play a role in determining the ability to make energy-related improvements. Individuals with lower incomes often reside in dwellings with subpar insulation and frequently rely on second-hand or outdated appliances that are not energy efficient. Moreover, they often have to manage their electricity and gas expenses through pre-payment systems, which can result in them incurring higher unit costs compared to those using monthly billing systems.

The concept of energy poverty was introduced in the EU energy policy in 2009 by the Directive concerning common rules for the internal market in electricity (EC, 2009).

> *'energy poverty is a growing problem in the Community. Member States which are affected and which have not yet done so should therefore develop national action plans or other appropriate frameworks to tackle energy poverty, aiming at decreasing the number of people suffering such situation. In any event, Member States should ensure the necessary energy supply for vulnerable customers. In doing so, an integrated approach, such as in the framework of social policy, could be used and measures could include social policies or energy efficiency improvements for housing. At the very least, this Directive should allow national policies in favour of vulnerable customers. (EC, 2009).*

However, it was only defined in 2012, in the Energy Efficiency Directive (EC, 2012):

> *'a household's lack of access to essential energy services that underpin a decent standard of living and health, including adequate warmth, cooling, lighting, and energy to power appliances, in the relevant national context, existing social policy and other relevant policies' (EC, 2012)*

The way Energy Poverty is addressed through regulatory requirements has been significantly strengthened through the ‘Fit for 55’ package and in 2023, in the Energy Efficiency Directive (Recast) (EC, 2023), the Energy Poverty definition was updated to:

> *“Article 2*
> *‘energy poverty’ means a household’s lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes…” (EC, 2023)*

1.2 How to identify people in energy poverty

Energy poverty mostly affects low-income households – retired people, unemployed or poorly paid, dependent on social benefits, and single households. A person living in energy poverty is primarily a precarious one, with low resources. It is generally mixed with poor housing, leading to difficulties in payment of energy bills. Their economic disadvantage is often accompanied by poor energy efficiency of their homes (poor insulation, outdated heating systems, expensive or polluting fuel) and linked to poor health (elderly or disabled). It is often the case that energy-poor households are socially isolated and lack support from others. All in all, they tend to be subject to physical and mental health risks, degradation of dwellings, and excessive debt.

Energy poverty is usually measured through objective (or expenditure-based) and subjective (or consensual) indicators.

Objective indicators are generally based on the share of the energy costs in the total household income that is used for keeping the dwelling at an adequate temperature. These indicators can be easily compared in different Member States, ensuring that climate correction and purchase power are taken into consideration. However, this data usually refers to the household expenditure for the provision of electricity and fuel, and therefore it does not reflect the cost to ensure thermal comfort in the dwelling. Lack of data, particularly data with adequate granularity, is reported as an important barrier to tackling EP.

Subjective indicators assess basic parameters or characteristics of a dwelling and are therefore understood under a social dimension. These indicators are related to questions about the ability to maintain the appropriate temperature and pay bills before the deadline, as well as other questions about housing conditions.

Typical socio-economic and housing characteristics related to energy poverty are, as follows:

<u>A. Socio-economic characteristics</u>

- Vulnerable persons or households (based on the national or local definition)
- Arrears on utility bills
- Low income
- Difficulties in coping with energy costs
- Inability to keep home adequately warm
- Inability to keep the home adequately cool
- High share of energy expenditure in relation to income

<u>B. Facilities / Housing characteristics</u>

- An old building that has not been renovated, (e.g. deteriorated windows, which allow air draft)
- Insufficient heating, caused by a deprivation of heating, a lack of insulation or/and an inadequate heating system
- The use of single space/room heating, which is preferred sometimes in order to get a better control of the consumption
- Signs of humidity or mould, reflecting a bad state of the building and/or lack of heating
- Over-equipment or overheating leading to increased energy consumption
- A continued presence in the house, causing higher consumption
- Old and inefficient appliances

A. EP in the context of the Bulgarian pilot

According to the newly approved Ordinance On The Criteria, Conditions And Procedure For Determining The Status Of Households In A Situation Of Energy Poverty And The Status Of Vulnerable Electricity Supply Customers, "*a vulnerable electricity supply customer is a residential customer who purchases electricity for the domestic needs of a household of which he is a member, and he and/or another member of the household is critically dependent on electrical equipment due to the presence of at least one of the following circumstances*:

- a person over 65 years old, living alone or with other people over 65 years old, with disposable income under Art. 5, para. 1 after reduction with energy expenditure less than or equal to the officially declared poverty line;
- a person with established 50 and over 50 percent permanently reduced working capacity or type and degree of disability, with disposable income under Art. 5, para. 1 after reduction with energy expenditure less than or equal to the officially declared poverty line;
- persons who need aids for independent living and/or life support medical devices, the functioning of which depends on a source of electrical energy;
- persons who receive monthly social benefits and/or targeted assistance for heating under the Social Assistance Act for the previous heating season."

This ordinance defines the criteria, conditions and procedure for determining the status of households in a situation of energy poverty and the status of vulnerable customers for the supply of energy electrical energy:

- the order and mechanism of functioning of the information system;
- the conditions and procedure for assessing the number of households in a situation of energy poverty.

Appendix no. 1 to art. 4 of the Ordinance includes a methodology for estimating household energy costs. The assessment of energy costs per household is carried out for the calendar year preceding the assessment year.

B. EP in the context of the Greek pilot

The alleviation of energy poverty has been specified as an essential objective within the framework of the final NECP, which was submitted at the end of 2019. A quantitative target has been set for reducing energy poverty at least by 50% and 75% in 2025 and 2030 respectively, in comparison to 2016, while the foreseen level in 2030 should be below the EU average in 2030. It should be noted that the same targets have been retained also in the draft revised NECP, which was submitted in October 2023. Moreover, targeted policy measures should be designed and implemented so as to tackle effectively the phenomenon of energy poverty, while emphasis should be given on the improvement of comfort conditions and the avoidance of triggered health problems. Finally, the compilation of the Action Plan for the Confrontation of Energy Poverty was foreseen also in order to specify the required measures.

The Action Plan for the Confrontation of Energy Poverty was prepared in September 2021 specifying the policy measures to ensure the fulfilment of the specified targets within the NECP. Moreover, the definition of energy poor households was determined. Specifically, a household is characterized as energy poor in the case that both of the following conditions are simultaneously fulfilled:

- Condition I: The total final energy consumption of the household is lower than the

80 % of the minimum final energy consumption, which is required theoretically for covering the thermal needs.

- Condition II: The total normalized income of the household, based on the number of the household's persons according to the equivalence scale of OECD is lower than 60 % of the median income of all the households in Greece.

Totally, nine policy measures have been integrated into the Action Plan for the Confrontation of Energy Poverty to fulfil the specified targets. The proposed policy measures have been classified into the following three categories:

I. Measures for the short-term protection of energy poor households

II. Measures for the energy upgrade of the energy poor households' buildings and the promotion of RES

III. Information and awareness-raising measures

Finally, a holistic monitoring mechanism has been developed based on the combination of bottom-up and a top-down procedures. The bottom-up approach is performed through the statistical model, which has been developed to identify energy poor households taking into consideration various parameters, while the top-down monitoring is applied through the Greek Observatory of Energy Poverty (http://energypoverty.gr/).

The central role for carrying out the foreseen monitoring procedures is assigned to the Working Group, which has been established for monitoring and assessing the progress of the NECP with the following duties:

- Management, evaluation, and improvement of a monitoring mechanism.
- Evaluation of the implemented policy measures in the period 2021-2030.
- Formulation of proposals either for improving existing policy measures or designing and implementing new more efficient ones.
- Preparation of the annual progress report.

C. EP in the context of the Portuguese pilot

Portugal has been pointed out as being among the most vulnerable countries in Europe to energy poverty in the European Union according to several indicators generally used to assess energy poverty. According to recent statistics by Eurostat, in 2022, the country recorded the fourth highest rate in the European Union (17.5 %) of people who were unable to heat their homes properly, with the European Union average standing at 9.3%.

Focusing on the Pilot area and looking at the indicators being used by official statistics, the percentage of *population living in a dwelling with leaks, damp or rot* is higher than the national average (almost by 2%). The percentage of *population not being able to keep home adequately warm* also exceeds the national percentage (almost by 3%). A better condition is observed in the case of the indicator *Share of population having arrears on utility bills*, at least for the recent years.

Since, so far, there was no consensus nor an official definition of EP, actions being carried out were aiming to characterize the circumstances that contribute to the energy poverty of vulnerable consumers, as well as their impacts, to identify intervention opportunities that can combat energy poverty. In the absence of an official Energy Poverty definition, the phenomenon is understood as the inability to maintain housing with an adequate level of essential energy services, due to a combination of low income, low energy performance of dwellings and high energy costs, which can be translated by the following indicators:

- arrears on utility bills;
- low absolute energy expenditure;
- high share of energy expenditure in income;
- inability to keep home adequately warm.

While the social energy tariff is typically identified as an appropriate measure to combat energy poverty, existing programmes addressing EP in Portugal are using it as eligibility criteria to provide grants to vulnerable households. For example, households that are already recipient of the Social Energy Tarif mechanism (eligibility criteria) are eligible to get financial incentives so that they can invest in improving the thermal comfort of their homes.

Social tariff is a support granted to consumers in a situation of economic deprivation to help them decreasing the burden on their energy costs, electricity and gas. For instance, solidarity supplement for the elderly, social re-insertion subsidy, Social Integration Income, those receiving unemployment benefit or old age pension, family allowances, social disability pensioners, supplement to the social benefit for inclusion, are entitled to the social tariff. In addition, those with an annual income of up to 5808 euros, increased by 50% for each element of the household without income, up to a maximum of 10 people.

The main aim of the social tariff is to help to reduce the amount to be paid in monthly electricity and natural gas bills of consumers in a situation of economic deprivation. This support works through a percentage discount on the energy bill, published annually by the regulator ERSE. The social tariff discount is the same for all eligible consumers, regardless of whether they are in the regulated or liberalised market. However, the percentage applied is different for electricity and natural gas

Driven by the European Policies, and recognizing EP as a significant social, economic and public health problem, after a long period under public consultation, the Portuguese Government finally (November 2023) approved the resolution establishing the National Long-Term Strategy to Combat Energy Poverty 2023-2050. Its main goal is to eradicate energy poverty in Portugal by 2050, protecting vulnerable consumers and actively integrating them into the energy and climate transition, which is intended to be fair, democratic and cohesive. The final document, as far as it is possible to know by this date (15Dec2023), does not diverge from the draft document and aims to reduce the percentage of Portuguese without money to heat their homes in winter by 7.4%, establishing a level of people living in energy poverty in 2030 of no more than 10 %. This is a very modest ambition, considering the moderate climate of Portugal and the EU average standing at lower value already by now (9.3% in 2022). To achieve this end, the strategy is structured around four strategic lines of action:

- promoting the energy and environmental sustainability of housing;
- promoting universal access to essential energy services;
- promoting integrated territorial action;
- promoting knowledge and informed action.

In addition, the National Energy Poverty Observatory was also created, with the mission of monitoring the evolution of energy poverty at national level, thus completing one of the milestones set out in the reprogramming of the Recovery and Resilience Plan.

D. EP in the context of the Latvian pilot

Energy poverty as defined in the Energy law.

> *Energy poverty - the inability of a household user to maintain an appropriate temperature in the dwelling or to use the services provided by energy supplier, or to pay for them due to low energy efficiency or because the payment for these services has a high share in household income;*

Energy law also states criteria for identification of households, which are affected by energy poverty. The criteria are very general, and it does not completely cover the circumstances households may face described in the definition.

> *Section 120.*
>
> *A household affected by energy poverty is a household within the meaning of the Law on Social Services and Social Assistance which conforms to at least one of the following criteria:*
>
> *1) it has been recognised as low-income household and receives a material support for covering the expenditures related to the use of a housing;*
>
> *2) it is renting a residential space or social apartment belonging to or leased by a local government in accordance with the Law on Assistance in Solving Apartment Matters or the law On Social Apartments and Social Residential Houses.*
>
> *Section 121.*

(3) The criteria referred to in Section 120 of this Law shall be used for the evaluation of the number of households affected by energy poverty.

In the national context, households in the risk of energy poverty are identified through social services. Social services could provide information on those households who are receiving housing support from the social services of the municipality. Alternatively, the vulnerable households can be identified through the building elders, which are willing to renovate their apartments. OSS can see if they can help to apply for a social welfare program.

1.3 Consequences of energy poverty

The main consequences of EP are the following:

A. Financial consequences:

- Use of aids, and other assistance mechanisms
- Indebtedness and loans
- Use of budgets usually used for other important needs such as housing, food, education, etc.
- Creation of restriction mechanisms or deprivation leading to other consequences.

B. Consequences due to technical restrictions in heating:

- Under-heated housing will be humid.
- Under-ventilated housing will be humid and unhealthy.
- Humid housing will result in deterioration, enabling the development of mould, which leads to unsanitary conditions.

C. Health consequences:

A cold environment is not by itself a factor of diseases, but generates a number of negative consequences:

- To maintain its internal temperature in a cold environment, the body has to work harder. Situations like this can lead to exhaustion.
- Cold promotes vasomotor reactions, sneezing, runny nose, which can encourage the transmission of pathogens.
- Colder air temperature in many situations means not sufficient air humidity.

D. Suspected causal links regarding cold living conditions exist for a number of diseases:

- Respiratory diseases
- Cardiovascular diseases
- Arthritis
- Depression

2 Communication skills

2.1 How to improve your communication skills

Effective communication encompasses various skills that enable individuals to convey messages clearly and interact with others successfully. Some types of basic communication skills along with brief explanations are given in the following Table 1.

Table 1. Basic communication skills

Communication skill	Explanation	What to do
Verbal communication	Verbal communication involves using words to convey messages. It includes speaking, listening, and the ability to articulate thoughts and ideas clearly.	• Practice speaking clearly and confidently. • Expand your vocabulary and language skills. • Work on voice modulation and tone to convey emotions effectively
Effective communication	The ability to communicate clearly and effectively with citizens, team and partners is essential to ensure proper understanding and cooperation.	• Adapt technical language to everyday vocabulary that is easy to understand (use of comparisons, analogies, etc.)
Nonverbal communication	Nonverbal communication refers to the use of body language, facial expressions, gestures, and tone of voice to convey meaning. It can often convey emotions and attitudes more strongly than words. NONVERBAL LANGUAGE- SIGNS OF DISTRUST AND DISCOMFORT – Avoidant eye contact: The person may avoid making eye contact or looking away, indicating a lack of confidence or discomfort. – Crossing your arms: Crossing your arms over your chest can be a defensive gesture that indicates a protective or closed-off attitude. – Lack of facial expression: Lack of facial expression or a tense facial expression may suggest discomfort or distrust. – Restless gestures: Nervous or restless movements, such as touching your hair, hands or fingers, can be signs of tension or anxiety. – Physical distance: Physically moving away from the person or subtly backing away can be an indicator of discomfort or need for personal space. – Fixed or intense gaze: In some cases, an intense or fixed gaze can be interpreted as a sign of distrust, especially if it feels threatening.	• Pay attention to your body language and gestures. • Practice maintaining eye contact without staring. • Use facial expressions that match your message. • Adequate eye contact: Maintaining adequate eye contact conveys confidence. Looking into the eyes of the person you are talking to shows that you are engaged and honest in the conversation. • Relaxed and friendly facial expression: An open and friendly facial expression shows that you are comfortable and receptive. Smiling appropriately can make the message more pleasant and trustworthy. • Open, relaxed posture: Maintaining an upright, open posture with your arms down at your sides or open shows confidence. Avoiding a closed posture, such as crossing your arms, can contribute to more positive communication.

	– Excessive blinking: Excessive blinking or rapid blinking can indicate nervousness or stress. – Muscle tension: Tension in the muscles of the neck, shoulders or jaw can be a sign that the person is uncomfortable. – Closed body language: Keeping the body hunched or closed, such as hunching or hunching, may indicate that the person is protecting themselves in some way. – Unusual voice tones: Changes in voice tone, such as becoming more tense or lower than normal, can be signs of discomfort.	
Active listening	Active listening is the skill of giving full attention to a speaker, understanding their message, and providing feedback to demonstrate understanding. It involves not just hearing but also comprehending and empathizing.	• Focus on the speaker and minimize distractions. • Use verbal cues like nodding and "I see" to show you're listening. • Avoid interrupting; let the speaker finish before responding.
Empathy	Empathy is the capacity to understand and share the feelings of another person. It involves showing compassion, acknowledging emotions, and providing support	• Practice putting yourself in others' shoes to understand their feelings. • Listen actively and validate their emotions. • Show empathy through your responses and actions.
Clarity and conciseness	Communicating with clarity means expressing thoughts and ideas in a straightforward and easily understandable manner. Being concise involves using as few words as necessary to convey the message effectively	• Organize your thoughts before speaking or writing. • Use simple and direct language. • Eliminate unnecessary words or details.
Conflict resolution	Conflict resolution is the ability to address and resolve disagreements or disputes in a constructive and peaceful manner, often involving active listening, negotiation, and problem-solving	• Develop problem-solving skills. • Practice active listening during conflicts. • Focus on finding mutually agreeable solutions
Assertiveness	Being assertive means expressing one's needs, opinions, and feelings confidently and respectfully while also respecting the rights and opinions of others. It strikes a balance between passive and aggressive communication.	• Build self-confidence in expressing your needs and opinions. • Use "I" statements to communicate your feelings and preferences. • Maintain respect for others' opinions while expressing your own.
Interpersonal skills	Interpersonal skills involve the ability to interact and build positive relationships with others. These skills include effective communication, active listening, empathy, and conflict resolution.	• Develop rapport with others through genuine interest and respect. • Practice effective communication, empathy, and conflict resolution. • Foster positive relationships through trust and cooperation.
Cultural sensitivity	Cultural sensitivity is the awareness and respect for cultural differences in communication styles,	• Educate yourself about different cultures, norms, and customs.

	norms, and customs. It ensures effective communication in diverse settings.	• Avoid making assumptions or judgments based on cultural differences. • Be open to learning and adapting to diverse communication styles
Adaptability	Adaptability in communication is the skill to adjust one's communication style and approach based on the context, audience, and situation. It allows for effective communication in various scenarios	• Assess the communication needs of each situation or audience. • Be flexible in your approach and adapt to different communication styles. • Continuously learn and adjust based on feedback.
Feedback giving and receiving	Providing constructive feedback helps others improve, while receiving feedback gracefully is essential for personal and professional growth. Effective feedback is specific, actionable, and respectful.	• Provide constructive feedback with specific examples. • Be open to receiving feedback and use it for self-improvement. • Foster a culture of open and honest feedback in your relationships.
Conflict avoidance	Sometimes, avoiding unnecessary conflicts is a valuable communication skill. It involves recognizing when a situation doesn't warrant a confrontation and choosing to let minor issues go.	• Prioritize which conflicts are worth addressing and which can be let go. • Practice diplomacy and compromise when minor conflicts arise. • Focus on maintaining positive relationships.

2.2 Forms of communication

There are three forms of communication: **verbal, para-linguistic** and **non-verbal** communication.

Verbal communication refers to all elements of speech: **words, letters, sentences and numbers**

- Purely verbal communication is very difficult. As we have already learned in the discussion of perception, what we say is frequently understood very differently by the person with whom we are speaking, because the other person has a different understanding of the words we choose.
- Speech conjures up images which the person speaking and the person addressed do not always understand in the same way, frequently representing a source and cause of misunderstandings and anger.

Para-linguistic communication refers to the **manner in which we speak**: intonation, speaking rate, pauses, laughing, sighing. These elements are influenced by sensations, such as nervousness, as indicated by "ums" and "hms", speaking rate or, for example, irritation and anger expressed by speaking loudly.

Non-verbal communication includes:

- **Body language:** posture, gestures and facial expressions
- **External attributes**, such as clothing; jewelry; status symbols, such as holidays, a car, a flat/house create and characterise the impressions conveyed. This represents a type of code, characterising a certain image of a person.

- **Posture:** The manner in which a person appears before another person for the purpose of discussions, for example with shoulders hanging, breast stretched forward, etc.
- **Gestures:** Forms of expression by the body:
  - Nodding the head – signalling agreement
  - Pat on the back – signalling encouragement
  - Shaking hands – greeting
  - These gestures are however not understood in the same way in all cultural groups.
- **Facial expressions:** Possible facial expressions: The signals conveyed by facial expressions are nearly identical in all cultural groups. They therefore have a significant influence on communication.
- **Gaze:** The eyes are a **central part of the face**. The gaze is an important instrument for establishing contact as it can demand contact; it can signal distance, it can express sympathy and feelings or it can refuse contact.

3 Communication with vulnerable people

3.1 Dos and Don'ts for communication with vulnerable people

Effective communication with vulnerable individuals is built on trust, respect, and understanding, while avoiding behaviours that may cause discomfort or harm. The most important "dos" and "don'ts" are shown in Table 2.

Table 2. "Dos" and "don'ts" when communicating with vulnerable people

Dos for Communicating with Vulnerable People	Explanation	Don'ts for Communicating with Vulnerable People	Explanation
Show empathy and actively listen.	Acknowledge their feelings and concerns.	**Rush or pressure them.**	Avoid making them uncomfortable or anxious.
Be patient and give them time.	Understand they may need more time to express themselves or make decisions.	**Make assumptions about their experiences.**	Each person's situation is unique; avoid generalizations.
Use plain and clear language.	Communicate in a straightforward manner, avoiding jargon or technical terms.	**Use stigmatizing language or labels.**	Refrain from using derogatory or judgmental language.
Respect their autonomy and choices.	Acknowledge their right to make decisions about their own lives.	**Minimize or dismiss their concerns.**	Take their concerns seriously, regardless of size.
Ask open-ended questions to encourage dialogue.	Promote conversation by asking questions that require more than a yes/no answer.	**Overwhelm with too much information at once.**	Provide information in manageable portions.
Maintain privacy and confidentiality.	Ensure that their personal information and discussions remain private.	**Violate personal boundaries.**	Respect their privacy and avoid prying questions.
Provide information and resources.	Offer details about available resources, support services, or community organizations.	**Assume they need saving or rescuing.**	Allow them to make decisions; don't impose help.
Treat them with respect and dignity.	Interact with them in a respectful and dignified manner.	**Display impatience or frustration.**	Maintain patience and compassion in interactions.
Offer reassurance and emotional support.	Let them know that you are there for them and that help is available.	**Discriminate based on their circumstances.**	Treat everyone fairly and equally, without bias.
Use open questions: "tell me about …".		**Don't use "Energy poor" or "vulnerable"**	The terms "vulnerable" or "poor" or "energy poor" should not be used in communications with households!
Use probing questions: "I want to understand a bit more, can you give me some examples …"		**Avoid leading questions: "presumably …"**	If the customer doesn´t want to disclose information it may not be reasonable to continue asking questions.
Be friendly	Engage in small talk to establish the atmosphere for discussions (weather, flat, travel route, etc. – whatever appears to be appropriate)	**Make empty promises**	Don't make promises you can't keep. It's important to be honest about the limitations and extent of the help you can offer.
		Being invasive	Respect boundaries and do not enter private areas of the home without permission or a valid reason.
		Disregarding consent	Make sure you obtain consent before taking photos, recording audio or video, or sharing information with third parties.

4 Vulnerable households advising step-by-step

Preparing for an energy advising visit to vulnerable households requires careful planning and consideration of the unique needs and challenges faced by these households. Here are steps to help you prepare for such visits.

A. Preparation

1. Be sure for the goals:

Clarify the purpose of the visit. Is it to reduce energy costs, improve energy efficiency, or address specific concerns (e.g., heating, cooling, insulation)?

2. Gather information:

Ask for relevant information about the household, such as energy bills, the home's layout, age, and any existing energy-efficient measures or concerns.

3. Schedule appointments:

Set up appointments with the household members to ensure their availability and cooperation during the visit.

4. Assemble necessary materials:

Prepare materials you may need during the visit, such as energy efficiency pamphlets, checklists, and informational resources.

5. Equip yourself:

Bring any tools or equipment needed for assessments, such as a flashlight, a thermal camera, a power meter, or a notebook for recording information.

6. Dress appropriately:

Wear comfortable and appropriate clothing, especially if you'll be inspecting areas like attics or crawl spaces.

Dress professionally and respectfully to convey seriousness and credibility.

7. Prepare a checklist:

Use a checklist of areas to assess, questions to ask, and common energy efficiency issues to look for during the visit.

8. Establish trust:

Begin the visit by introducing yourself, explaining your role, and building rapport with the household members. Show empathy and respect for their situation.

B. Household visit

1. Introduce yourself

Present your ID cards, hand over a business card, certificate of training.

2. Explain the objective of the visitation and how the visitation is going to be performed.

Explain the purpose of your visit, your duties, and how you can help. Clear up any misunderstandings and offer transparency in your role.

2. Transition to advisory discussions

Inform your customer exactly about the procedure you will follow.

3. Present and ask to sign the Consent form

4. Acquire/correct client data

Household size, energy behaviour, and any energy issues they meet

5. Conduct a simple home energy assessment

Walk through the home to assess its energy performance. Check for drafts, insulation quality, appliance efficiency, and the condition of heating and cooling systems.

6. Identify energy-saving opportunities

Based on your assessment, identify specific areas where energy efficiency improvements can be made. Prioritize recommendations based on the household's needs and budget.

7. Provide practical advice

Offer practical, actionable advice for reducing energy consumption and improving comfort. Explain the benefits and potential cost savings of each recommendation.

8. Give the REVERTER brochure for energy-saving tips

9. Offer assistance

Inform the household of available assistance programs, incentives, or financial aid for energy efficiency improvements. Help them with the application process if necessary.

10. Share information about the One stop Shop

Explain the OSS can offer more detailed assistance in: incentives, financial aids. Encourage them to visit the OSS. Explain the meaning of the One stop shop, the possibilities for support, and provide the location and contacts (brochure)

11. Address concerns and questions:

Be prepared to answer questions and address any concerns the household members may have. Provide clear explanations and options.

12. Document findings

Take notes during the visit to document your findings and recommendations. This will help in follow-up discussions and reports.

13. Leave contacts

Leave your telephone number or business card in case the customer has questions.

14. Say "Thank you"

Politely thank the person and leave.

For the OSS personnel:

1. Follow-Up: Update the data gathered from the RAs to the platform/visitation. Revise and validate the data with the RA. After the visit, follow up to check on their progress, answer additional questions, and provide further assistance if needed.

2. Report and documentation

If the household visits the OSS for more info, prepare a detailed report summarizing the assessment, recommendations, and any actions taken during the visit. Share this report with the household for reference.

3. Coordinate with support Services

If the household faces additional challenges beyond energy efficiency (e.g., financial hardships, health issues), coordinate with relevant support services or organizations to provide holistic assistance.

Remember that vulnerable households may have unique circumstances and sensitivities, so approach your energy advising visit with empathy, patience, and a focus on practical solutions that can improve their energy efficiency and overall well-being. However, it is important to judge your communication and words according to each setting and situation.

Some common tips for the visits are given in Figure 1.

Preparing for advisory discussions

- Are all parts required for the household visit (checklists, packages, questionnaires) there?
- Is my laptop/phone/tablet functioning (accumulator charged)?
- Are all measuring instruments (thermo vision camera) functioning?

Don't be late

- Make certain that you arrive punctually for the agreed meeting.
- Take account of travel times and routes.
- Study train schedules, city maps, etc.

Clothing

- You should feel comfortable in your clothing.
- Clothing should be clean, neat and orderly.
- Clothing should be appropriate for the situation. Not only sloppy clothing, but also exaggerated clothing causes uneasiness.
- In case of doubt, clothing should primarily be decent. Super-mini skirts and plunging necklines are out of place.
- Jewellery and accessories should fit to the overall image and the situation

Posture

- Not too stiff, but not too careless. If you move about in a stiff posture, you give the impression of being unapproachable. A careless posture signals superficiality.
- An open sitting posture demonstrates interest (do not cross your arms).
- Maintain a friendly facial expression and smile occasionally.
- Maintain visual contact.
- Gestures: movements of the hands in support of the verbal presentation reinforce your words. However, excessive gestures can detract from the presentation and harm concentration.

Manner of speaking

- Speak clearly, understandably, freely and calmly.
- An exaggerated choice of words or the use of many specialised terms creates mistrust and restraint. This can give the customer the impression of being persuaded and not advised.
- Do not use slang expressions or strong language. These irritate the customer and give the impression of incompetence.
- When necessary to enter other rooms always ask permission.
- When making measurements, explain why these are necessary.

Figure 1. Common tips for the household visits

5 Reacting to atypical situations

Mentally preparing for visits to households where you may encounter compromising situations, violence or extreme poverty is essential to play your role effectively and compassionately. Some steps for mental preparation and how to deal with difficult situations are shown in Figure 2.

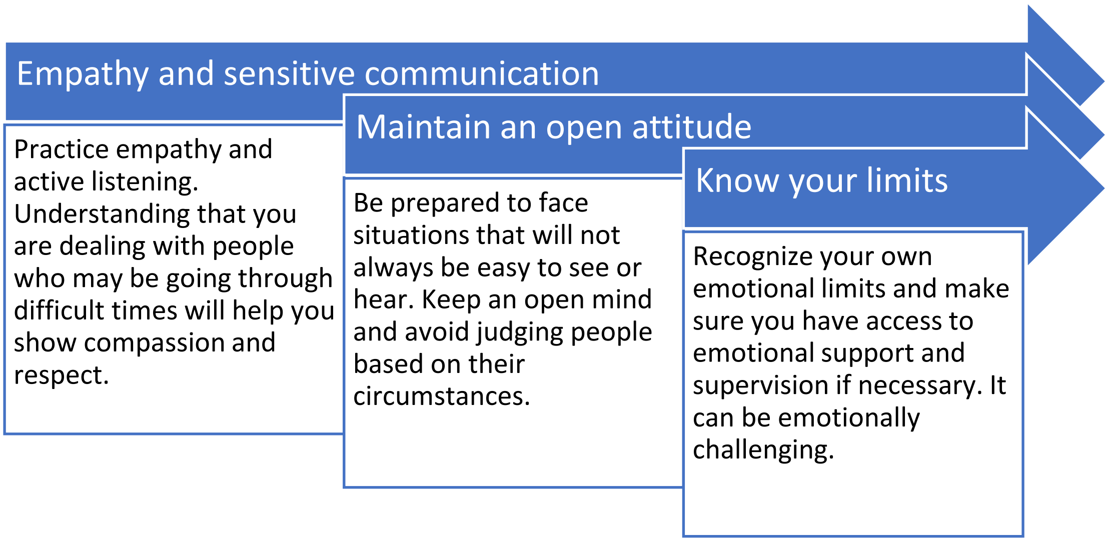

Figure 2. Mental preparation for dealing with atypical situations

How to proceed to avoid problems related to uncomfortable or even dangerous situations:

- Announce your visit: Always announce your visit in advance and schedule a suitable time. Confirm the visit the day before. Surprise can be uncomfortable and provoke resistance.
- Actively listen: Allow people to speak and express their concerns. Listen without judgment and offer a sympathetic shoulder.
- Visits in pairs of ambassadors: in the case of conflictive neighbourhoods, visits in pairs will be considered and will be carried out during daylight hours.
- Report to authorities: If you encounter situations of abuse or immediate danger, it is your duty to inform the relevant authorities to ensure the safety of those involved.
- Prioritize personal safety: Your safety is the most important thing. If you perceive an immediate threat to yourself or others, find a safe place.
- Stay calm: Try to stay calm in potentially dangerous situations. Panic can make it difficult to make good decisions.
- Communicate your concern: If you are accompanied by others, immediately communicate your concerns and perceived danger signs.
- Call authorities: If there is a clear and serious threat, call law enforcement, such as the police, and provide the location and a description of the situation.
- Exit the situation: If it is safe to do so, remove yourself from the dangerous situation. Leave the home or area as soon as possible.

- Don't become an intermediary in cases of violence: If you perceive domestic violence or a dangerous conflict, do not become an intermediary. Instead, call authorities and alert trained professionals.
- Do not intervene in dangerous situations: Do not try to intervene in violent or dangerous situations if you are not trained to do so. Your safety is paramount.
- Inform your supervisors or contacts: After ensuring your safety, inform your supervisors, employers or relevant contacts about the situation you have experienced.
- Seek emotional support: After a potentially dangerous experience, seek emotional support. Talking to colleagues, friends, or mental health professionals can be helpful in processing what you've experienced.

Remember that your safety is the most important thing in any situation. You should not take unnecessary risks. It is always preferable to call authorities or trained hazard professionals rather than attempting to address the situation on your own.

Sources of information

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Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC VII

Establishment and operation of OSS

Co-funded by the European Union

Executive Summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER Ambassadors. The specific objective of this document is to prepare the establishment and operation of the OSS. This document is a generic model. This module will be adapted to the needs of each of the pilots. Each of the pilot leaders will complete the document by providing a summary of the studies carried out to know the context of each of the pilots and thus contextualize the One-Stop Shop personnel and Ambassadors who will manage the day-to-day life of the OSS. Furthermore, the OSS’s organizational chart will be adapted to the existing resources defined in the Grant Agreement.

Table of Contents

List of figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One-stop shop
RAs	REVERTER Ambassadors
EP	Energy poverty
Lead	People interested in receiving information from
NGOs	Non-governmental organizations
PESTEL	Political, Economic, Social, Technological, Legal, and Environment

1 Desk Research

In the REVERTER project, extensive studies have been conducted to understand the vulnerability situation of the 4 municipalities where the One-Stop Shops will operate: PESTEL analysis, surveys, analysis of building characteristics.

A "desk research" that includes PESTEL analysis and surveys is essential for designing an effective One-Stop Shop. The PESTEL analysis provides a comprehensive understanding of the external context in which the One-Stop Shop will operate, identifying political, economic, socio-cultural, technological, legal, and environmental factors that can influence the operability and success of the OSS. This ensures that the One-Stop Shop is aligned with existing policies, sensitive to economic and socio-cultural conditions, leverages appropriate technologies, operates within a clear legal framework, and contributes positively to the environment.

Surveys, on the other hand, offer a direct internal view of the needs, desires, and challenges of vulnerable households targeted by the One-Stop Shop. They enable the design of services that are truly useful and accessible to these households, identifying barriers they might face and tailoring proposed solutions to effectively meet their specific needs in terms of energy efficiency and reducing energy poverty. Attached below is a summary of the studies conducted to understand the context in which the OSS will intervene.

PESTEL ANALYSIS	Pilot:	Brezovo
PESTEL analysis for Public buildings The PESTEL analysis for deep renovation measures in public buildings reveals several critical external factors that influence the success of such initiatives. In political aspects the main positive factors include alignment with EU energy efficiency goals and well-structured cost-effective renovation packages, described in the National strategy for energy renovation in buildings. However, challenges arise from limited local finance mechanisms, especially the in the small municipalities, political instability, and a lack of long-term planning, impacting decision-making at both national and local levels. In terms of economic aspect, on the positive side, the development of energy-efficient technologies and the potential creation of new jobs are identified as good pOne-Stop Shopibility from realization of energy efficiency measures in buildings. Conversely, high inflation, escalating energy prices, and a shortage of skilled professionals pose economic challenges, hindering the overall success of renovation efforts. Regarding the positive social factors, it is identified that the municipal policies supporting regional strategies and initiatives to build administrative and professional capacity in the energy planning and social inclusion. However, a lack of socio-economic studies assessing the wider benefits of building renovation and engaging citizens is a notable drawback. In terms of technology factors, favourable aspects encompass significant potential for renewable energy utilization and improvement of thermal conditions through energy-efficient measures in the public buildings. However, challenges arise from a lack of technical capacity in local authorities, inefficient spending of social aid for heating, and a slow recognition of smart metering. The positive environmental factors involve established municipal programs for energy efficiency and renewable energy. However, limited knowledge for mitigation and adaptation actions for buildings to climate change poses a challenge.		

In legal aspect, the positive legal factors include changes in territorial development laws supporting renewables and the adoption of a national energy and climate plan. Conversely, complicated procedures for excess energy purchase represent a legal barrier.

PESTEL analysis for deep renovation measures in residential buildings

The positive factors include aligned policy goals with EU energy efficiency objectives and cost-effective renovation proposals. Governance structures exhibit organization at the municipal level, enhancing management efficiency. However, challenges arise in financing, where priority favours multi-family buildings despite a predominance of single-family houses in the subsidy programs. Political instability, a lack of predictability, lack of urban data platform and limited long-term planning hinder effective decision-making.

In economical aspect, technological development for energy efficiency holds promise for local competitiveness, but financial constraints, high inflation, and soaring energy prices pose significant hurdles. A shortage of skilled professionals and inadequate incentives compound challenges, although potential job creation and reduced energy consumption offer some optimism.

In social aspect, insufficiency in the local administration's awareness of social innovation, the absence of a One-Stop Shop for renovations, and a lack of socio-economic studies present barriers. However, the presence of social services and potential lifestyle improvements through increased energy efficiency are positive elements. Demographic challenges include a declining and aging population, while high levels of energy poverty and low awareness among end-users underscore social complexities.

Regarding the technological aspect, the region demonstrates a huge potential for implementing energy-efficient measures, yet limitations in technical capacity, skilled staff, and regulatory frameworks pose obstacles. Environmental considerations highlight a lack of knowledge in adapting buildings to climate change, despite high potential for sustainable energy resources.

In legal aspect, reductions in national ordinances related to energy efficiency and positive changes in territorial development laws are encouraging. However, challenges persist in complex energy purchase procedures and the absence of legislation for energy communities.

In conclusion, addressing financial constraints, enhancing political stability, fostering awareness, and navigating regulatory complexities are pivotal for successful deep renovation measures in residential buildings. A comprehensive strategy, considering the interplay of economic, social, technological, environmental, and legal factors, is essential for effective renovation roadmaps.

PESTEL ANALYSIS	Pilot:	Athens Urban Area

The PESTEL analysis concluded that the current policy developments at national and European level constitute a meaningful driver so as to foster the energy renovation of the residential buildings in Greece. More specifically, the ambitious building renovation target within the National Energy and Climate Plan at national level for 2030 and the adopted Long-Term strategy for the renovation of the building stock will enable the implementation of targeted policy measures in residential sector. Moreover, the current deviations in 2021 and 2022 from achieving the building renovation target will lead to the initiation of additional policy measures. The current programme for the renovation of the residential buildings (Exoikonomo programme) should be considered as the fundamental basis for the implementation of energy efficiency interventions, while the centrally designed and implemented buildings renovation policies and measures will facilitate the coordinated and more effective implementation of the foreseen policy measures. Moreover, the promotion of PV systems in buildings for self-consumption through the conduction of targeted policies and measures will mobilize the further penetration of RES along with the energy efficiency measures. Finally, the improvement and simplification of the existing renovation programmes are imperative so as to become more effective.

The sufficient availability of lending funds from the banking sector and the imposition of more realistic requirements in order to provide the necessary lending funds to the households are considered as the main economic factors for the energy renovation of the residential buildings. The high interest rates, the limited access to loans and the difficulty for households to provide the own funds for implementing the required renovation interventions constitute the main barriers hampering the further renovation of the residential buildings. The notable increase of the cost of living and the energy expenses due to the energy crisis and the increased levels of energy taxation hinder the implementation of energy efficiency interventions. Nevertheless, the interest and willingness to renovate their buildings has been increased considerably so as to address the triggered impacts by the energy crisis creating high demand for energy efficiency interventions. The uncertainty about the economic development in the future and the lack of stability due to various economic factors pose additional concerns leading to the postponement of the investment decisions. Finally, the materialization of energy efficiency interventions will trigger positive impacts to the Greek economy (e.g., increased GVA, reduced unemployment) due to the considerable growth of the construction sector.

The deterioration of the energy poverty due to the high energy prices and the increased inflation has created significant social problems highlighting the urgent need to address them. Moreover, the low level of awareness and knowledge about energy efficiency issues has been identified as a main obstacle. Nevertheless, the continuously increased understanding and acceptance of the prosumerism and community-based energy are considered as additional enabling factors fostering the renovation of the residential buildings.

The further promotion of technological solutions in buildings is essential due to the limited digitalization of the energy sector and the low penetration of smart meters. Nevertheless, the high penetration of RES technologies can boost the technological improvement of the energy sector.

The building sector is characterized by a considerably high RES and energy efficiency potential contributing to the achievement of the environmental targets. The limited environmental restrictions during the renovation and the lack of knowledge for adapting buildings to climate change have been identified as barriers minimizing the environmental performance of the building sector. Finally, the low resistance and preparedness towards future pandemics and energy crisis should be addressed appropriately ensuring the continuous renovation of the residential buildings.

The adoption of the required legislative and regulatory framework for all energy related issues will facilitate the achievement of the imposed renovation targets along with the implementation of the policy measures as foreseen within the framework of the National Energy and Climate Plan and the long-term strategy for the renovation of the building stock. Furthermore, the Action Plan for the alleviation of energy poverty will lead to the massive energy renovation of the buildings that dwell energy poor households combating energy poverty on a long-term basis. Finally, the renovation of the buildings should be reinforced with the update, simplification and optimization of the related to the building sector legislative and regulatory framework.

PESTEL ANALYSIS	Pilot:	Riga

Latvia aims to renovate at least 2000 MFBs by 2030. Long-term renovations strategy (LTRS) outlines the necessity to renovate 4860 MFBs in Latvia. To accelerate building renovation rates it is planned to develop typological renovation packages for specific building series. Financial incentives include a national investment bank program and tax reductions by some municipalities for building deep renovation. Legislation changes and challenges in monitoring progress are noted which would be in line with the LTRS and current EU legislation and framework, i.e. Fit-for-55 package.

MFB renovation subsidies along with funds from the banking sector are available, with strict requirements for MFBs. Support from national investment bank is available in regions lacking private funding. There are construction sector capacity challenges to substantially increase the renovation rate of MFBs. High energy expenses, inflation, and interest rates impact the economy. Increased demand for renovation can be observed, however difficulties in financing and scepticism among households hinder the decision-making process for deep renovation of MFBs.

Reduction in energy consumption due to external factors, i.e., economic recession and energy crisis. Low awareness of renewable energy impacts and energy saving measures, diverse informational spaces for different groups of society, and a tendency to over-save energy, to levels below minimum comfort levels. Aging population, increasing energy poverty and resistance to change are also factors which influence the decision-making process. Tenant issues in MFBs and varying willingness to accept energy efficiency measures also play their role.

Lack of frameworks for promoting automation, innovation, and disruptive technologies. Limited penetration of new energy-saving technologies and low digitalization of the energy sector. Challenges in smart city concepts and smart meter deployment.

Limited knowledge for adapting buildings to climate change. High potential for energy savings and renewable energy. Lack of initiatives for circular economy at the national level.

Revision of national laws to align with sustainable goals and energy targets.

Adoption of legislative frameworks, including the National Energy and Climate Plan.

Addressing issues hindering energy efficiency interventions in multi-apartment buildings. The need for compliance updates in laws and regulations on permissions and licenses.

PESTEL ANALYSIS	Pilot:	Coimbra

PESTEL analysis for MFB and SFB

The PESTEL analysis for deep renovation measures in residential buildings, social housing, for both typologies multi apartment buildings and single-family houses, reveals several critical external factors that affect building renovation roadmaps. Among the overall political factors, the national framework is aligned with European Directives, going further in the reduction targets established in the long term. The Portuguese government aims to achieve carbon neutrality by 2045. There is no definition of deep renovation but the National Energy and Climate Plan and the Long term Renovation Plans, together with the recently approved National Strategy for Energy Poverty, are important drivers to increase building renovation rates, thus creating a favourable framework for the diffusion of the REVERTER roadmaps. Local regulations at the Municipal level often limit the scope of renovation pOne-Stop Shopibility due to specific requirements for the façades, etc., (e.g. Municipal Masterplan and Municipal Urbanisation and Building Regulations) as well as there are too many formalities (licenses, etc. ...) to start the process. This implies a long process for each individual procedure. Time and bureaucracy are important barriers for the roadmaps to be implemented in a short time.

In relation to financing help for building renovations, there are National Incentives and interesting instruments for lending funds for renovation works (IFRRU and 1º Direito), as well as specific financial incentives for low-income families, such as the energy efficiency vouchers, available since November 22, which can amount to 3900€ per household and there is also VAT reduction for energy renovations. The central government has also been promoting the use of RES by low income households, by creating the regulatory framework for the establishment of REC. Transposition of new targets regarding energy savings (new EED recently approved with new yearly reduction targets), and the ongoing revision of the EPBD, setting more ambitious targets and requirements such as the MEPS for existing buildings, will ensure the ongoing efforts to improve the building stock, starting with the most energy inefficient buildings. At the local level, several municipalities already developed the Local Strategy for Housing and the SECAPs.

In terms of regulations, Portugal is well advanced, yet the bureaucracy and complexity behind the processes postpone the household decision to enter into a renovation process by themselves. If the roadmaps are embraced by the Municipalities and included under Urban Planning, then the constraints for improving the building stock are lessened. A roadmap defining a common intervention framework will guide commercial companies and facilitate comparisons by clients, increasing the demand for energy renovation services, and thus promoting economic competitiveness and innovation.

The lack of relevant stakeholders to deliver renovation works at reasonable cost and quality, the lack of know-how and acceptability from households, who still do not trust in services being provided by ESCOs, the cultural habits of living in a mild country weather, among other factors such as tenure of the house, do not motivate households to invest in the house. Projects Aggregation by ESCOs in collaboration with housing departments of the municipalities, can have a significant impact in lowering the cost of renovation with high impact in the roadmaps. However, the ESCO market is not yet well developed in this area in Portugal, particularly in the offering of services for the residential sector.

In conclusion, the relatively mild climate (Households may consider it normal and acceptable to feel both cold and hot at home, either in winter or in summer), the low household income, the high electricity costs, and the low level of literacy among the lowest income, explain the rationale when it comes to managing the household budget leaving many households to live in Energy Poverty, a significant problem that tends to increase in the present socio-economic situation Portugal is facing. Being the front runner in terms of renewable energy production, in terms of policy framework, implementation of legislation and social support does not mean there is a sound field implementation, and therefore the policies have a little effect on improving living conditions of the population.

SURVEYS	Pilot:	Brezovo

The results of the targeted sociological survey on the territory of Brezovo municipality show the following main conclusions:

The main type of residential buildings in Municipality of Brezovo are detached houses and there are a few multi-family buildings in the region. More than a half of the respondents live in detached houses with two levels and 35% live in detached houses on one level.

The buildings are very old, as the largest share of the existing residential building stock was created before 1949. After 2000, with the entry into force of modern and highly demanding normative documents for EE, only 3% of the residential buildings were put into operation. Most of the dwellings (i.e., 94%) are privately owned without financial obligations. The analysis shows how the household members characteristics affect the annual energy costs - households with children less than 5 years old and disabled spent more money to meet their energy needs, but pensioners and unemployed spend less for energy.

Regarding the heating source, most of the respondents have indicated that they are heated with air conditioners, followed by heating with firewood. The air conditioners are preferred in the last years because of the increased demand of cooling, as well as the relatively low electricity prices. Still, 29% of those who are using air conditioners as primary heating source have additional heating sources as wood/pellets stoves, electrical devices, or open firewood. Also, those who are finding it very difficult to live on current income rely mainly on individual firewood/pellet stoves, air conditioners, and open fireplaces. That is, they most probably heat only part of their homes and use (as far as the open fireplaces and firewood/pellet stoves are concerned) heating systems that degrade indoor air quality, still, the households indicated that they reach the comfort indoor temperature and they are not deprived of heating, but it is common to restrict other necessary products or services or basic needs in order to be able to pay energy bills.

Regarding the electricity-related awareness and behavioural issues, most of the respondents stated that they compare electricity consumption with previous years and read the consumption in the electricity bill, still some of them don't understand the charges. Only 11% often check the electricity meter reading, which means that further educational actions should be focused on energy monitoring in the households.

Regarding the EE measures implemented, it can be seen that most of the households have implemented new energy efficient windows and doors, but only 40% have wall/ceiling insulation. Most of the have also installed energy-saving lamps and new energy efficient appliances.

Regarding the RES installations in the households only 4% have installed solar water heater. Also only 3% indicated that they had new heating or cooling sources, but this may be due to deep-seated habits of using wood stoves and reluctance to change habits.

As mentioned before, it should be noted here that until recently, Brezovo was not priority in the programs for financing energy saving measures, because according to the national program for energy renovation of homes, priority was mainly given to multi-family residential buildings, and single-family houses prevail in Brezovo. Also, the environmental protection program, which relied on the replacement of heating sources with modern low-emission ones, was only for large cities. The program for the introduction of RES in households has only recently been opened, and no real activities for the installation of photovoltaic or solar collectors for hot water can be reported yet.

This is why almost all of the respondents haven't participated in any subsidy programs for energy efficiency.

Regarding the reasons for not applying for financing programs for energy saving measures - more than a half indicated that they don't know about any programs. Asked if they had not participated in funding programs, whether they would participate in the future, 67% answered positively, but a quarter answered that they would not participate.

This means that more information campaigns should be focused among the population. It also turns out that the worry of excessive bureaucracy and administrative obstacles in the participation and implementation of energy efficiency measures under financing programs is not a small problem.

SURVEYS	Pilot:	Athens Urban Area

The survey targeted mainly vulnerable households residing in Athens Urban Area (also known as Greater Athens). About half of the households live in houses built before 1980, when the first building insulation regulation was adopted, and only a small percentage of houses have been built according to modern insulation regulations or have undergone radical energy renovation. As regards EP:

- According to the consensual EP indicators studied, about half of households claim inability to keep their houses adequately warm or cool, one-third of them report condensation on windows and walls during winter, one-fifth report arrears on their energy bills and about 5% said that their electricity/gas supply was disconnected during the last 12 months. Moreover, about one-third of the households report health issues related to inadequate heating and/or the presence of high moisture in the house.
- According to the expenditure-based indicators, about 35.7% of the households spend more than 10% of their net income on energy services, 20% face high energy poverty risk due to low income and high energy costs or medium income risk and high energy cost risk or low income risk and medium energy cost risk (LIHC modified indicator), and also 20% of the households are low-income households living in very low energy efficiency homes (LILEE modified indicator).

Moreover, about 80% of the households have restricted the use of electricity, more than 75% the use of heating, and about 50% the use of DHW to be able to pay for energy use during the last 12 months. Also, more than half report cutbacks on food purchases, yet about one-third of them still live in thermally uncomfortable homes,

There is a significant percentage of very low or low energy efficiency buildings, and a noticeable share of households at risk of energy poverty that could be alleviated through energy efficiency upgrades to their homes. However, the survey highlighted several barriers in this direction.

The most important barrier is the financial one that is the inability of households to invest in high upfront cost measures. On average, households claim that the ratio of total expenditure to net income is 86.8%. All households with a net income below €680 and about 75-80% of the households with an income between €680 and €1,250 say that they find it difficult to make ends meet and therefore unable to cover the cost of renovation work from their own resources. At the same time, because of their low income, they are faced with a further financial barrier, namely the limited access to bank loans.

Three other barriers were identified during the survey. The first is a regulatory barrier, namely the complex administrative process, excessive paperwork, lengthy approval procedures, and bureaucratic hurdles required to enrol a household into existing energy efficiency subsidy programmes. The second one is a known decision-making barrier, i.e., split incentives between tenants and landlords. The third barrier is an organisational barrier related to ownership status of the. This is a relatively common problem for vulnerable households, as they often live in a house that they have inherited from their family but do not have full ownership, as they cannot afford to pay inheritance taxes or other financial obligations that may exist. Finally, two informative/behavioural barriers were raised, namely the perceived lack of personal benefit from energy retrofits and the lack of awareness about such subsidy programmes.

The last two barriers, and to a certain extent the problem of bureaucracy for enrolment in a subsidy scheme, can be addressed during the pilot operation of the One-Stop Shop in the area of interest, in combination with other actions that will take place in the context of the project (e.g., local engaging events, information materials, awareness campaigns, etc.).

SURVEYS	Pilot:	Riga

The information was collected through an online survey conducted between June 26th and September 9th, 2023, targeting households in multifamily buildings in Riga. A total of 935 people participated, and 445 completed the survey. The respondents were predominantly female (62.7%), with varying age groups and educational backgrounds. Most households included two persons (28.5%), and about 19.1% had children under 7 years old. The majority of respondents (76.9%) had access to higher education, and over 79.8% had at least one member employed full-time.

In terms of demographics, the average net monthly income was €1,584. The survey explored heating and housing characteristics, revealing that 60% of dwellings were constructed during Soviet occupation, and 25.1% were built before World War II. The majority of homes (82.7%) used district central heating systems, and 45.4% had energy-saving lamps.

Energy costs were analysed, showing an average monthly heating cost of €149 during winter, with an average electricity cost of €61 in winter and €39 in summer. The total annual energy cost per year was about €1,570.673. The study found that older buildings generally had higher reported energy costs.

Regarding energy efficiency awareness, approximately half of the households had implemented energy-efficient windows and doors, while 6.3% reported deep renovation of their buildings. About 43.6% had digital meters installed to monitor consumption regularly.

The survey assessed energy vulnerability, identifying households unable to keep homes warm (41.8%) and experiencing health issues due to inadequate heating (21.6%). The composite consensual indicator classified 9.2% of households as energy poor, rising to 14.7% for those with a monthly income below €900.

Expenditure-based indicators revealed that 37.0% of households spent more than 10% of their net income on energy services. The 'Ten-Percent-Rule' (TPR) showed energy poverty at 37.0%. The 'local' 2M and M/2 indicators were 9.3% and 10.1%, respectively.

For those, who could be classified as energy poor according to indicators mentioned above, cutbacks on essential spending were reported by 42.2% of households for electricity, 18.7% for heating, and 37.8% for hot water. About 33.3% reported cutbacks on food purchases.

The survey highlighted challenges and barriers to participating in energy-saving subsidy programs, with 30.5% citing the inability of apartment owners to apply as a significant barrier.

SURVEYS	Pilot:	Coimbra

The survey attracted a larger number of males, representing 45.5% against 32.4% females. Regarding the education level, 52% of the households answering the questionnaire have a university degree, mainly with a technological background, which represents about 36 percent of the total households. In total, 146 respondents have a university degree in a technical area, being 92 males and 54 women. We can assume that these numbers provide some evidence about the impact of background education towards engaging in energy related issues, emphasizing the power of education in relation to the regarding the empowerment and engagement of citizens.

In relation to the number of members per household, most households include two persons (32.1%), 2.4% are formed by three persons, 15.7% with four persons, 11.7% single family, 5% with five persons and only 1.3% with six persons. In the total sample, 6% of respondents did not provide this information.

Regarding the employment status of the members of the household, the rate of employment is quite high. About half (46.5%) of the households have two members working full time on a regular basis, 29% and 2.7% have one and three members, respectively, also working full time. Only 8.4% of the households have one member who is unemployed.

The share of the population for which the ratio of Expenses/Income is above 1 is significant; Over 30% of respondents spent more than 85% of their income, and for 17% of the households, the available income is not even enough to cover monthly expenses. Assuming there is naturally some embarrassment in admitting this fact, we can deduce that this percentage is most probably higher, and the situation should be even more dramatic.

75% of the houses were built between 1960-2010, built on concrete structures and low insulation, before the first thermal building code was introduced in Portugal. The most common type are apartments.

83 respondents (about 26%) own their house without financial obligations, among which, only 10 respondents indicated their decision must be validated by a condominium. Another 26% own their house but with a financial obligation (mortgage or loan). 15% of the respondents live in a rented house that is owned by the Municipality (social housing, with low rents).

houses built between 1960 and 2010, before the first thermal building code adopted in Portugal, use a larger amount of energy; older houses, built with thick walls and high inertia, also seem to have a better performance. Of course, this should be taken with caution because of the limited sample, but this clearly shows the direct relationship between the energy bill and the envelope of the building.

Houses with radiant floors and central system provide the best comfort. It is also interesting to see that those HH indicating less comfort issues at home have solar PV and solar thermal installed**.** Regarding air conditioning, 43% of households have some kind of cooling device, mostly local systems. However, the literature indicates lower penetration rates, of around 22%. The market studies also indicate there is a big difference in the penetration of this equipment according to the related region. In the South, the figures are 73% higher than the national average. There are also significant differences between social classes.

Another important limitation is the "denial of reality bias" that many researchers point out. Energy-poor people might deny seeing themselves as being in an uncomfortable situation and, therefore, do not declare it (only 8 respondents admitted not cooling the house because they cannot afford the bill!). This analysis must be taken with caution and there is a need to cross indicators to get an overall and comprehensive picture of the situation. The survey confirmed energy poor does not only occur in winter, as the researchers have been stressing.

When comparing programmes and supports by tenure and level of education, there is no surprise that those with a technological degree are keener on energy issues and therefore are applying more for EE support measures, and those with low levels of education if have low incomes, automatically receive subsidies from the state, like the social energy tariff, and are not so engaged with applying for support because of illiteracy but also because these are usually complicated processes.

CHARACTERISTICS OF THE BUILDING STOCK	Pilot:	Brezovo

The residential sector of the municipality of Brezovo occupies the largest percentage of the final energy consumption of the municipality - 59.4%, consuming a total of 26.6 GWh of energy. Looking at the percentage of energy sources used, the dominant use is the use of raw wood for domestic heating (47%), followed by the consumption of electricity (39%) and coal (12%).

On the base of the results from the social survey, about 55% of respondents live in detached houses with two levels and 35% live in detached houses on one level. 10% of the respondents are living in are apartments. Most of the apartments (5%) are on the first floor of the building, followed by apartments in the intermediate floor of the building (3%) and the top floor (2%).

CHARACTERISTICS OF THE BUILDING STOCK	Pilot:	Athens Urban Area

Based on the 2011 Greek Housing Census, the total number of residences is around 1,662,500. About 62% of the houses were built before the implementation of thermal requirements and energy-related building codes (before 1980). The area with the oldest houses is Central Athens, followed by Piraeus region. On the other hand, North Athens shows the lowest percentage of old buildings, while West and South Athens lie in the middle. As far as the size is concerned, 12.4% of dwellings are less than 50 m^2, 39.3% between 50 and 79 m^2, 32.5% between 80 and 109 m^2, and the rest more than 110 m^2.

According to the results of the 2011 Housing Census, about 53% of residences in the area of interest have some kind of insulation. Nevertheless, based on the analysis of more than 797,000 Energy Performance of Buildings Certificates (EPBCs), issued in the period 2011-2021, more than 71% of dwellings in the Greek pilot are classified in the three worst energy classes (E, F and G), about 25% in the middle energy classes (C & D), and only 4% in the highest energy classes (A+ to B). Also, about 62% of primary energy consumption is used for heating, 21.8% for domestic hot water (DHW), 16.2% for cooling and less than 0.01% for lighting. Moreover, only 0.02% of primary energy consumption is produced by RES.

Of particular interest are the results of the energy upgrading of houses that participated in the programmes “Exoikonomo I and II”, “Exoikonomo – Autonomo” and “Exoikonomo 2021”. In these dwellings, it is observed that the largest percentage, after the energy interventions, is classified in energy categories C, D and E. From the year 2021, the energy interventions lead to dwellings in energy categories B to A+. It is worth noting the energy saving potential of the three lowest energy classes (E, F and G), which ranges from 21% (when houses are upgraded by a maximum of one energy class) to around 96% (when they are upgraded to the highest energy class).

CHARACTERISTICS OF THE BUILDING STOCK	Pilot:	Riga

In the City of Riga, there are in total 11.7 thousand three- or more apartment buildings (about 29.7% of the total number of apartment buildings in Latvia). Referring to the data provided by the REA, the total useful area of apartment buildings in Riga is 18,615 thousand m^2, where the average useful area is 1,585 m^2 per building.

Apartment buildings and their quarters are located in different areas of the city of Riga. Based on the years of construction of apartment buildings, which also affect their energy performance requirements, they can be divided into the following groups:

- Pre-war buildings built until 1945. They are basically located in the Riga City Centre District and the Old Town.
- Buildings built during soviet occupation (USSR) built between 1946 and 1991, which are mainly located in the peripheral districts of the city of Riga (e.g., Bolderāja, Imanta, Mežciems, Pļavnieki, Purvciems, Ziepniekkalns, Zolitūde, etc.). They account for the largest share of apartment buildings in Riga both in number and area.
- New buildings built after 1992, which are located in different districts of the city of Riga and are in relatively small numbers.

The largest share of buildings (59%) are buildings that were put into operation in the period up to 1945. Buildings put into operation in the period from 1946 to 1993 have the largest useful area (56% of the total), that is, buildings built during the USSR. Studies show that the energy efficiency requirements of multi-apartment buildings built during the USSR occupation and up to 2015 do not comply with the requirements of the currently valid Cabinet Regulation No. 280 "Regulations Regarding the Latvian Construction Standard LBN 002-19 "Thermal Engineering of Building Envelopes". As a result, Riga has a high share of buildings in need of deep renovation (about 6,000 apartment buildings) and at the same time low activity of renovation of existing buildings. By 2019, only 159 or 1.4% of the total number of apartment buildings in the city of Riga have been renovated in Riga.

CHARACTERISTICS OF THE BUILDING STOCK	Pilot:	Coimbra

The Coimbra Municipal Housing Park (social housing) consists of a total of 854 dwellings, with different typologies, integrating building apartments and houses dispersed over the city. The buildings were built before the first building code entered into force in 1990, and therefore those buildings do not have any thermal insulation. Part of the social housing park in the city centre has recently undergone some retrofits, but the actions taken were mainly on painting the façades. Hence, the existing potential for energy renovations is high. Moreover, a large share of inhabitants is elderly and low educated, who cannot afford to carry out improvements and construction works or do not have the knowledge on how to start the renovation journey, and therefore a holistic approach is required to have a high impact. Sound impartial advice on what is best for improving the overall environment and actions geared towards behavioural changes and capacity building can lead to significant improvements in households' well-being.

Regarding the type of construction, like most of the Portuguese multi-family buildings built between 1971 and 1980, the pilot buildings have reinforced concrete structures, rendered and painted façades, and pitched roofs with ceramic tiles. Electricity is the main energy source for heating, followed by natural gas. The main energy source for heating DHW is also electricity. Apart some exceptions owing a portable air conditioning, space cooling does not exist in the pilot buildings.

The building characteristics of Coimbra region are influenced by its historical and cultural heritage, as well as its geographical and climatic conditions. Coimbra has a variety of architectural styles, ranging from Romanesque, Gothic, Renaissance, Baroque, to Modernist. The traditional buildings in Coimbra are mostly made of stone, brick, and timber, with tiled roofs and plastered walls. In the old city, the buildings are usually arranged along narrow streets and alleys, forming dense urban blocks and are, in general, in bad condition. Some of the common building features are balconies, arcades, courtyards, and decorative elements such as azulejos (painted ceramic tiles), stucco, and wrought iron. The city has grown in the decades 60´s-90´s with a boom of new constructions, mainly buildings with more than 4 floors and new districts have been set in the city. The decades 1961–1980 are typically considered as a period with buildings with poor energy performance. For example, some experts studied the constructive solutions and energy performance of Portuguese buildings and argue that buildings erected during the 60's, 70's and 80's are the ones with the highest energy saving potential. Others who studied the energy performance certificates of residential buildings in Portugal found that buildings erected before 1980 have higher levels of nominal heating energy needs.

The quality of residential buildings in the Coimbra region is affected by several factors, such as the design, materials, construction, maintenance, and performance of the buildings. According to a study, most of the traditional buildings in Coimbra have a high seismic vulnerability due to their poor structural condition and lack of adequate seismic capacity.

The study also found that the main causes of defects in the construction stage of residential buildings are related to the construction materials, inspections, equipment, management, and human errors. Therefore, it is recommended to adopt proper quality management practices and standards for the design, construction, and rehabilitation of residential buildings in Coimbra region.

2 One-Stop Shop Design

2.1 One-Stop Shop Services and Key Activities

2.1.1 Scope and goals

The ONE-STOP SHOP of the REVERTER project follows the “Facilitation” business model. The main objective is to inform citizens about how to improve energy efficiency in their homes and the procedures necessary to rehabilitate them to prevent energy poverty.

2.1.2 Services and activities

The activities that REVERTER's One-Stop Shop will carry out will be:

- A1. Raise awareness on energy renovation benefit.
- A2. Inform and educate households.
- A3. Provide information on optimal renovation works.
- A4. Provide information on available financial support schemes
- A5. Conduct a preliminary building analysis.

Optional activities could be:

- A6. Provide information to prepare all documents necessary for accessing to financial instruments.
- A7. Provide advice on how to optimize energy bills.

The objective and general tasks to be developed for each of the services detailed above will be specified below.

A1. Raise awareness on energy renovation benefits

This activity aims to raise awareness about energy efficiency, building renovation related topics. This may include:

- Conducting awareness campaigns about the importance of energy efficiency and reducing energy poverty.
- Distributing informational materials, such as brochures or flyers, explaining the improvements that can be made in homes to save energy and enhance comfort.

A2. Inform and educate households

This service aims to inform the public about how energy renovation can improve energy efficiency, reduce expenses, improve quality of life, and increase property value. This may include:

- Organizing talks, seminars, or workshops to showcase the benefits of saving energy and money through energy renovation.

- Distributing informational materials, such as brochures or flyers, explaining the improvements that can be made in homes to save energy and enhance comfort.

A3. Provide information on optimal renovation work

This service offers advice on which renovation works are most suitable and effective for each building or home. Additionally, it provides information on the process of carrying out the renovations. This includes:

- Identifying areas in the home where energy efficiency can be improved and providing guidance on how to do so.
- Providing information about the installation of new insulation systems, energy-efficient windows, low-consumption heating and cooling systems, etc.
- Offering personalized reports on which types of renovations and improvements are most suitable for the needs and characteristics of each home.

A4. Provide information on available financial support schemes:

This activity aims to help homeowners and landlords understand the financing options and grants available for energy renovations and explain how they can access them. The tasks to be developed include:

- Providing information on grant programs, tax credits, or other financial incentives available for energy renovation.
- Advising on bank loans, mortgage credits, or other financing options that can facilitate improvement works.
- Collaborating with local financial entities to offer preferred loan options or flexible payment plans.

A5. Conduct a preliminary building analysis:

This service includes an initial review of the current state of the house to identify areas for improvement in energy efficiency. This can be done through:

- Visual inspection of the home to identify obvious problems, such as inadequate insulation or poor condition of windows.
- General measurements of the home
- Utilizing tools or technologies to measure and record data such as current energy consumption and thermal losses.
- Generating an initial report that highlights areas for improvement and preliminary recommendations to reduce energy consumption.

The objective and tasks of the optional services that the One-Stop Shop could offer will be detailed below.

A6. Provide information to prepare all documents necessary for accessing to financial instruments (optional)

This service provides support in preparing and submitting all the required documents for financing applications. Possible activities include:

- Offering templates and guides for document preparation.
- Conducting document reviews and providing assistance during the application process.

A7. Provide advice on how to optimize energy bills (optional)

This service is focused on helping consumers better understand their electricity and gas bills. The goal is to identify opportunities to save money by adjusting pricing options and providers. This could include:

- Reviewing consumers' bills to identify possible areas for savings, such as reducing the contracted power if it is feasible.
- Advising consumers on different tariffs and providers that could be more economical or suitable according to their consumption.
- Organizing sessions to clarify the different components of energy bills and how these can be adjusted to optimize costs.
- Providing individualized support to resolve doubts and assist in the process of changing tariffs or providers if deemed convenient.
- Creating and distributing informational material to help consumers better understand and manage their energy bills.

These are the main activities and tasks to be developed in the REVERTER pilots' One-Stop Shop. However, in an Integrated One-Stop Shop, other services would be available: 360º advice (technical, economic, and administrative), project monitoring, grant processing, a directory/database of technicians and other professionals, energy audits, etc.

2.1.3 Format of the One-Stop Shop

The One-Stop Shop will carry out its activities in person at each of the physical OSSs of the four pilots. In addition, it will be supported by a Digital One-Stop Shop that will include information of interest to owners and communities about the benefits of energy refurbishment, best practices, the services offered by the physical OSSs, and how to contact them.

2.2 OSS Structure

2.2.1 Organizational structure

Following the "one stop shop" model, each pilot must offer technical, administrative, and financial assistance to vulnerable households. Therefore, it is recommended that the OSS staff has a set of Skills and Abilities to provide a service that meets the needs and desires of citizens and provides the highest quality service to encourage and streamline energy refurbishment and the use of renewable energies. These Skills and Abilities, while not an exhaustive list, would be the ones that should be included:

- Technical knowledge of energy efficiency and renewable energies.
- Ability to explain complex technical concepts in a simple, straightforward, and understandable way for the average citizen.
- Knowledge in the design of renovation projects.
- Knowledge in the management of changes in energy suppliers.
- Knowledge in the processing and management of grants.
- Basic knowledge of marketing, communication, and design.
- Knowledge of financial solutions.
- Administrative knowledge and customer service skills.
- Knowledge in managing people in situations of energy poverty and vulnerable profiles, etc.

2.2.1.1 One-Stop Shop Personnel

Each One-Stop Shop will require a different number of human resources depending on its scope. The essential professional profiles for the development of the services are described below. It should be noted that one person could have a dual profile and fulfil the responsibilities of several roles, depending on the resources available.

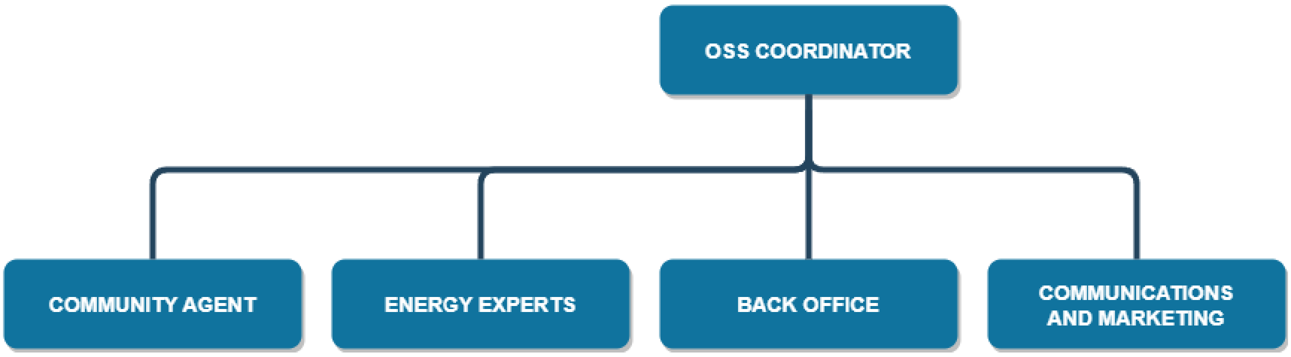


Figure 1. OSS generic organizational structure

This is a standard OSS organizational chart, understanding that depending on the final human resources available for each pilot, this structure may be adapted to align with the context. An organizational chart will be designed for each pilot, adapting it to the available resources and taking into account the existing OSS structure, as is the case with the Riga pilot.

Energy Expert

A technical profile with training in the field of energy efficiency, who will be responsible for accompanying and providing specialized advice to users.

Requirements:

- Basic training in building refurbishment and renewable energy.
- Knowledge about the processes for renovating a home.
- Knowledge of local regulations
- Knowledge of administrative processes and existing financing options.
- Knowledge of the local context (economy, demographics, characteristics of the building stock, etc.).

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- Education: Architecture, Technical Architecture, Engineering, or similar.
- Experience in the coordination and design of energy efficiency projects.
- Experience in projects and works of energy refurbishment and knowledge in carrying out administrative procedures such as management and processing of grants, construction licenses, bonuses, among others.
- Knowledge of current building technical regulations and other related regulations.
- Experience in energy audits.
- Experience in customer service.
- Specialization in renewable energies and energy refurbishments.
- Knowledge in the processing of administrative processes related to the energy refurbishment of a home such as processing licenses, grants, bonuses, etc.

Recommended Skills and Abilities:

- Ability to coordinate various projects at the same time.
- Ability to travel throughout the municipality.
- Customer orientation.
- Assertive communication and active listening. Ability to communicate complex technical ideas to the public.
- Teamwork.
- Dynamic and decisive person.
- Organized and autonomous person.

Back office

This is a profile that will perform administrative functions. It takes care of all the tasks and administrative procedures essential for supporting the One-Stop Shop in its management. It is a fundamental pillar that articulates the rest of the team.

Requirements:

- Knowledgeable about the local context (economy, demographics, characteristics of the building stock, etc.).
- Administrative Skills: document management, database management, and the ability to organize and coordinate multiple tasks and projects simultaneously.

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- University degree or professional training in administration, accounting, or similar.
- Theoretical and practical knowledge of the energy sector.
- Experience dealing with people with vulnerable profiles.
- Basic training in building refurbishment and renewable energy.
- Knowledge about the processes for renovating a home.

Recommended Skills and Abilities:

- Empathetic and patient person.
- Good conflict management skills.
- Ability to coordinate various projects at the same time.
- Assertive communication and active listening. Ability to communicate complex technical ideas to the public.
- Teamwork.
- Dynamic and decisive person.
- Organized and autonomous person.

Community Agent

A more social profile, in line with the functions of a community agent and/or mediator.

Requirements:

- Knowledgeable about the local context (economy, demographics, characteristics of the building stock, etc.).
- Effective Communication Capabilities.
- Negotiation and Conflict Resolution Skills.

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- University degree or professional training in social education, mediation, or psychology with experience.
- Ability to travel throughout the municipality.
- Basic training in building refurbishment and renewable energy.
- Experience dealing with people with vulnerable profiles.
- Experience in community mediation.

Recommended Skills and Abilities:

- Empathetic and patient person.
- Good conflict management skills.
- Ability to coordinate various projects at the same time.
- Assertive communication and active listening. Ability to communicate complex technical ideas to the public.
- Teamwork.
- Dynamic and decisive person.
- Organized and autonomous person.

Communication, Marketing, and Design

This person will develop the communication strategy to disseminate the One-Stop Shop activities creative ideas and raise awareness on energy renovation benefit concepts. This profile will provide designed documents (leaflets, brochures, roll-ups) to publicise and disseminate information to fulfil the objectives established by the OSS to promote energy refurbishment in an accessible manner.

Requirements:

- Effective Communication Capabilities.
- Basic knowledge of social media and web management.
- Knowledgeable about building refurbishment and renewable energy.
- Knowledgeable about the local context (economy, demographics, characteristics of the building stock, etc.).

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- Experience in Communication, Marketing, or Design. It would be beneficial if the candidate could demonstrate 2 years of experience in communications. A university degree in this field would be positively valued.
- Knowledge in Energy Refurbishment: understanding of sustainable and energy-efficient practices and technologies.
- Design Technologies and Software.

Recommended Skills and Abilities:

- Creativity.
- Effective Communication to communicate technical topics in a clear and accessible manner.
- Analytical Skills to examine data and marketing campaign results to assess effectiveness and make improvements.

Coordinator

The coordinator or manager of a One-Stop Shop plays a crucial role in integrating and supervising OSS activities in their day-to-day operations. This person will determine the strategy and action plan for the OSS to meet its objectives and will adapt it in relation to the results obtained throughout the operation. The coordinator will be in charge of contacting and coordinating the different stakeholders.

Requirements:

- Knowledgeable about building refurbishment and renewable energy.
- Knowledgeable about the local context (economy, demographics, characteristics of the building stock, etc.).
- Ability to lead and motivate the OSS team to achieve set goals.
- Ability to communicate clearly and persuasively with stakeholders and team members.
- Ability to identify priority strategies and lines of action to achieve the OSS's objectives.
- Ability to interpret monitoring reports and develop action and change management plans to improve results.

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- Degree in Project Management or Similar.
- Basic knowledge of energy efficiency, energy refurbishment of buildings, and associated technologies.
- Project management skills, including planning, organizing, and overseeing the team.
- Knowledge of the local context of the OSS.
- English proficiency.
- Knowledge of current laws and regulations related to energy efficiency and sustainability.
- Understanding the principles of sustainability and how to apply them to energy refurbishment projects.
- Experience in Event Coordination.

Recommended Skills and Abilities:

- Ability to manage and coordinate multiple projects simultaneously, meet deadlines, and achieve objectives.
- Ability to establish and maintain positive relationships with stakeholders and other actors involved in the project.
- A strong focus on achieving goals and effectively measuring results.
- Ability to adapt to changes in circumstances and project needs.

2.2.1.2 Associated personnel (Ambassadors)

Associated personnel will be responsible for visiting vulnerable households. Specifically, they will be responsible for conducting a preliminary building analysis and transfer the data to the One-Stop Shop.

Requirements:

- Passionate about energy efficiency and eager to make a positive impact on vulnerable households.
- Available to spend a few hours per week to help vulnerable household.

It is recommended, although not a requirement, that this role be carried out by someone with skills, experience and academic training as described below.

Recommended academic background and experience:

- Basic training in building refurbishment and renewable energy.
- Knowledge about the processes for renovating a home.
- Knowledge of local regulations
- Knowledge of administrative processes and existing financing options.
- Knowledge of the local context (economy, demographics, characteristics of the building stock, etc.).

Recommended Skills and Abilities:

- Empathy and Interpersonal Skills to connect with vulnerable households and create a comfortable environment for visits.
- Effective Communication to communicate clearly and persuasively present the benefits of energy refurbishment.

- Ability to collect data accurately and completely on the conditions of homes and the needs of tenants.
- Respect and collaborate with the team in a productive way.
- Ability to adapt to different situations.

2.2.1.3 Other Partners (technicians, constructors, etc.)

In the case of a "Integrated" One-Stop Shop, it could provide to the household a database/directory of professionals (technicians, installers, builders) to provide budgets to those interested in refurbishment works and to carry out the necessary work throughout the process: drafting the project, documentation, processing of subsidies if any, construction, work monitoring, etc. This One-Stop Shop aims to provide information to promote energy rehabilitation and does not monitor the entire construction process.

As a "Facilitation" OSS, this does not require external partners for the provision of professional services to start refurbishment works.

2.2.2 Participants roles and responsibilities

The team configuration will vary depending on the pilot and may change over time, adapting to the needs and requirements of the municipality at each moment. However, initially, it is proposed that the OSS, at a minimum, consists of the following roles and professional profiles.

One-Stop Shop Personnel:

- Energy Expert: A person knowledgeable about energy efficiency and renewable energies who will be responsible for accompanying and advising citizens on a technical, administrative, and financial level throughout the process:
    - Conduct energy reports based on information obtained during visits.
    - Inform about the procedures and management of grants, licenses, and bonuses.
    - Financial advice to introduce and explain in a simple way the different financing solutions existing in the market to facilitate their comparison.
    - Accompaniment and dynamization of awareness and sensitization days, such as awareness mornings, informative sessions, round tables, etc.
    - Provide advice to citizens on optimizing energy bills and tips on good domestic habits.
    - Drafting follow-up reports of the OSS and achieving the project's objectives.
- Community Agent: A person who will take care of mediation tasks with citizens and communities:
    - Support in the organization of awareness and sensitization sessions.
    - Act as a liaison between the One-Stop Shop and citizens, ensuring that the needs and concerns of the community are heard and addressed.
    - Organize and lead workshops, talks, and presentations in the community to raise awareness of the benefits of energy renovation and the opportunities available through the One-Stop Shop.

    - Conduct surveys and interviews in the community to identify specific needs in terms of energy renovation and potential beneficiaries of the One-Stop Shop, if applicable.
    - Assist citizens in understanding and navigating the procedures and requirements necessary to access One-Stop Shop services.
    - Collect constant feedback from One-Stop Shop users and transfer it to the team to make continuous improvements to the services offered. Perform follow-up of visits once conducted.
    - Establish and maintain relationships with other local entities, such as neighbourhood associations, NGOs, schools, and companies, to enhance the effectiveness and reach of the One-Stop Shop.
    - Monitor and report regularly on the impact and effectiveness of the One-Stop Shop interventions in the community.
    - Provide personalized advice and support to citizens who require more detailed information or help on energy renovations.

- Back Office: A person who will take care of the OSS's administrative tasks:

    - First telephone and online attention.
    - Management of the One-Stop Shop email.
    - Schedule visits to properties and communities of owners.
    - Organization of informative sessions in communities of owners.
    - Support in the organization of awareness and sensitization sessions.
    - Inform, guide, and advise people requesting the service.
    - Provide advice on good domestic habits.
    - Information on existing grants and financing options.
    - Management of the digital platform.

- Communication, Marketing, and Design: A person who will create and implement the communication and dissemination plan. This person will be the project's community manager, responsible for the organization and planning of social marketing actions, digital marketing actions, management of social networks, and design of graphic and audiovisual material of the OSS.

    - Administer and regularly update the project's social media profiles and website, ensuring that the content is up-to-date, relevant, and engaging.
    - Supervise and respond to comments or messages on social networks to maintain an active and committed community.
    - Develop attractive content and stories that resonate with the community and stakeholders and promote the mission and vision of the project.
    - Examine and evaluate the effectiveness of communication campaigns and strategies, adjusting as necessary to improve performance and reach.
    - Prepare regular reports summarizing activities, results, and recommendations for future communication strategies.

- Coordinator: Responsible for coordination, monitoring, and reporting of the One-Stop Shop team.

    - Ensure the proper functioning of the service and daily operations.
    - Coordination and supervision of the OSS team.

- Participation in the One-Stop Shop's strategic dissemination events, as well as in the search and involvement of stakeholders.
- Conduct follow-up reports of the program and collaborate in the drafting of an action plan and change management to achieve the objectives defined in the project.
- Support in identifying the strategy and priority lines of action.

Associated Personnel (Ambassador-RA):

- Associated Personnel: A volunteer or energy ambassador ideally with prior knowledge in energy efficiency and renewable energies who will be responsible for conducting initial visits to vulnerable homes and promoting visits to the One Stop Shop:
  - Basic initial advice to tenants through an initial diagnosis that will be carried out through an on-site visit to the property to understand the state of the housing, inform about energy efficiency measures and renewable energies that could be implemented, advice on best practices and disseminate the environmental, economic, and comfort benefits of energy refurbishment.
  - Transfer the data obtained during the visits to the One Stop Shop staff.
  - Promote visits to the One Stop Shop.

Table 1 provides a RACI matrix to clarify the responsibilities associated with tasks, deliverables, or decisions within the project.

Key:

- **R**: Responsible
- **A**: Accountable
- **C**: Consulted
- **I**: Informed

In this matrix:

- The "Responsible" is the one performing the task.
- "Accountable" is the one ultimately answerable for the correct and thorough completion of the task.
- "Consulted" are the ones whose opinions are sought; and with whom there is two-way communication.
- "Informed" are the ones who are kept up to date on progress; and with whom there is just one-way communication.

Table 1. RACI matrix to clarify responsibilities within the project

Tasks	OSS Personnel				Associated Personnel
	Energy Expert	Back Office/ Community Agent	Comm., Marketing, and Design	Coordinator	(RA)
Raise awareness on energy renovation benefits	R	R	I	A	I
Design and plan information and awareness campaigns.		I	R	A	
Organize and conduct presentations or workshops in the community.	R	I	R	A	
Collaborate with local media to disseminate information and benefits.	R	I	R	A	
Develop and maintain relationships with key stakeholders.				R/A	
Inform and advise citizens	R	I		A	
Evaluate the effectiveness of the awareness strategies implemented.				R	
Provide information on optimal renovation works	R	R	I	A	I
Advise citizens on the best renovation practices adapted to their needs.	R	I		A	
Conduct a preliminary building analysis	R	I	I	I	
Schedule and organize visits to vulnerable households	I	R		A	I
Conduct on-site visits to evaluate the current state of the buildings.	R			A	
Inform and advise on how to improve homes energetically.	R			A	R
Compile and organize the information collected for analysis.	R	R		A	
Prepare a preliminary report with findings and recommendations.	R			A	
Coordinate with One-Stop Shop to plan actions based on the analysis.				R	
Provide information on available financial support schemes	R			A	
Evaluate the applicability and advantages of each financial option.	R			A	
Keep information on financing and grants updated.	R			A	
Advise applicants on the best options according to their needs.	R			A	
Create and maintain relationships with financial entities and subsidy organizations.				R/A	
Optional activities:					
Provide information to prepare all documents necessary for accessing financial instruments	R			A	
Assist in the compilation of documents necessary for financial applications.	R			A	

Offer advice on the specific requirements of each financial instrument.	**R**			**A**	
Review and verify the accuracy and completeness of prepared documents.	**R**			**A**	
Provide continuous assistance with any questions or concerns.	**R**			**A**	
Ensure that requests are made according to established guidelines and deadlines.	**R**			**A**	
Provide advice on how to optimize energy bills.	**R**		**I**	**A**	
Examine and review users' current energy bills.	**R**			**A**	
Identify opportunities to reduce costs and improve energy efficiency.	**R**			**A**	
Advise on changes in contracts or energy suppliers.	**R**			**A**	
Education and training on understanding and managing energy bills.	**R**		**I**	**A**	

2.2.3 Internal Information Exchange

This internal communication plan aims to establish clear guidelines to guarantee effective and efficient communication between all participants involved in One Stop-Shop operations.

Table 2. Internal communication plan

Recipients	Necessary Information	Communication Frequency	Responsible	Format
Name of Interested Party or Group to whom the communication is directed	Contents that need to be communicated	How often should it be reported?	Person responsible for providing information	Format in which information is sent
One-Stop Shop Personnel & RA	**Policy and procedure updates.**	Monthly	Coordinator	Meetings and E-mail
One-Stop Shop Personnel & RA	**Training and development opportunities.**	Monthly	Coordinator	E-mail
One-Stop Shop Personnel & RA	**Feedback and performance evaluation.**	Quarterly	Coordinator	Meeting
One-Stop Shop Personnel	**Organizational changes.**	Daily	Coordinator	Meeting and e-mail
One-Stop Shop Personnel & RA	**News and upcoming events.**	Monthly	Coordinator	Meeting
One-Stop Shop Personnel	**Relevant data and reports.**	Quarterly	Coordinator	Meeting and report

2.3 Material and economic resources

The OSS should have the following material resources available.

1. OSS supplies
2. Technological resources
3. Measuring tools
4. Samples of materials
5. Communication and dissemination materials, channels, and tools
6. Digital One Stop-Shop

2.3.1 One-Stop Shop supplies

Here's a detailed list of OSS furniture, supplies, and tools commonly required for an OSS:

OSS Furniture:

1. Desks: Ergonomically designed for comfort. Should include spaces for computers, keyboards, and drawers for storage.
2. Chairs: Ergonomic OSS chairs that provide good lumbar support and are adjustable to various heights and angles.
3. Filing Cabinets: For storing important documents, project files, and other paper resources.
4. Shelves: For books, binders, and other reference materials.
5. Meeting Table: A large table for group discussions and client meetings.
6. Lighting: Adequate overhead lighting, as well as task lighting for desks.
7. Whiteboards/Chalkboards: For brainstorming sessions, planning, and team meetings.
8. Partitions/Dividers: If an open OSS plan is used, partitions can help create semi-private spaces.

Tools:

1. Computers: Desktops or laptops equipped with necessary software for design, analysis, and communication.
2. Printers & Scanners: For printing documents and scanning.
3. Photocopier: For making multiple copies of documents.
4. Projectors: For presentations and team meetings if it necessary.
5. Telephones: With voicemail capabilities for communication with clients and team members.

Supplies:

Items facilitate daily tasks, organize documents, schedule appointments, and ensure smooth communication within the team and with clients. This includes essential items: various sizes of paper, writing tools, staplers, paper clips, binders, notebooks, post-it notes, envelopes, stamps, folders, calculators, and calendars/planners.

2.3.2 Technological resources

Technological resources are essential for the efficient operation of an energy refurbishment OSS, as they facilitate both project planning and management, as well as communication with households and stakeholders. Below, the technological resources necessary with some software examples (These are not requirements but rather existing market examples):

1. **Information Systems and Databases:**
    - Project Management System: Tools such as Trello, Calendar or Microsoft Project that assist in planning, organizing, and monitoring projects.
    - Building Database: To store relevant information about the examined buildings, such as their structure, energy systems, interventions made, etc.
2. **Communication Tools:**
    - Video Conferencing Platforms: Zoom, Microsoft Teams, Google Meet, among others, for virtual meetings, client presentations, or training sessions.
    - Instant Messaging Tools: Slack, WhatsApp Business, or Teams for quick and direct communication within the team and with clients.
3. **Storage and Backup Solutions:**
    - Cloud Storage: Services like Google Drive, Dropbox, Microsoft OneDrive, or iCloud for storing and sharing documents, images, plans, and other important files.
    - Backup Systems: To perform regular backups and ensure data integrity and availability.
4. **Security and Protection:**
    - Antivirus and Antimalware Software: Like McAfee, Norton, Bitdefender, etc.
    - Firewalls: To protect the OSS network against external threats.
    - VPN (Virtual Private Network): To ensure secure connections, especially if the team works remotely.
5. **Web Platform and Related Tools:**
    - Content Management System (CMS): Like WordPress to maintain and update the website.
    - Web Analytics Tools: Google Analytics or similar, to monitor traffic and visitor behaviour on the website.
    - SEO Tools: Such as SEMrush to optimize website visibility in search engines.

2.3.3 Measuring tools

Measuring equipment plays an essential role in pre-diagnosis visits to vulnerable homes, allowing an accurate assessment of the current conditions of the home in terms of energy efficiency and environmental quality. These devices can identify problem areas, such as heat leak points, excessive humidity, or poor ventilation, which may be negatively affecting the well-being of inhabitants and unnecessarily increasing energy costs. By measuring and recording data in real time, these devices provide a clear and objective image of intervention needs in the home.

They allow areas where energy improvements can have a significant impact on residents' quality of life to be quickly identified and addressed. By providing quantitative data, measurement teams ensure that decisions are made based on evidence, thus maximizing the effectiveness and efficiency of any proposed renovation or intervention. The OSS's energy experts will be able to prepare more accurate reports on the homes visited by the Associated personnel (Ambassadors).

1. Diagnostic and Evaluation Equipment: This might, for example, include:
    - Thermal imaging cameras.
    - Humidity and temperature meters.
    - Measuring lasers or measuring tape.
2. Calibration Tools: To ensure that measurement equipment provides accurate readings.

2.3.4 Samples of materials

It is important to have samples of materials in the OSS to show examples of possible building improvements, it allows:

- Visual and Tactile Concretion: Although it is possible to describe the properties and benefits of a material, there is nothing like being able to see and touch it in person. Samples allow people to tangibly understand the characteristics and quality of the materials.
- Informed Decision Making: When people can compare different samples, they can make more informed decisions about which materials best fit their needs and budgets.
- Education and Awareness: Samples serve as educational tools. By introducing different materials, the One-Stop Shop can highlight the importance of energy efficiency, demonstrating how certain materials can improve insulation, reduce energy costs, and increase comfort.
- Promoting Sustainable Solutions: By having samples on hand, One-Stop Shop can actively promote more sustainable and eco-friendly solutions, showing customers greener alternatives and how they compare to traditional solutions.
- Trust Building: The presence of physical samples can increase customer trust in the One-Stop Shop. By seeing that the OSS invests in showing them real options, clients can feel that they are being guided in a professional and transparent manner.
- Innovation and Update: The world of energy efficiency is constantly evolving. By maintaining an up-to-date set of samples, the One-Stop Shop demonstrates that it is abreast of the latest innovations in materials and technologies.
- Establishing Relationships with Suppliers: By requesting and maintaining samples, the One-Stop Shop can establish and strengthen relationships with suppliers and manufacturers. These relationships can be beneficial for obtaining discounts, training, and staying up to date on the latest products on the market.

Below are some examples of materials that could be in the OSS:

1. Insulating Materials: Such as mineral wool, expanded polystyrene, polyurethane foam, among others, used in refurbishment to improve thermal envelope.

2. Renewable Energy Equipment: Such as photovoltaic solar panels, thermal solar collectors, small-scale wind turbines, among others.
3. Efficient Lighting Systems: Like LED lamps, lighting control systems, and motion sensors.

These material resources are just general examples.

2.3.5 Communication and dissemination materials, channels, and tools

Dissemination materials are essential to inform, educate and raise awareness among the community and potential stakeholders about the importance of energy refurbishment and the services offered by the One Stop Shop. Here are some of the outreach materials that might be needed:

- Brochures and Leaflets: These can provide general information about the One-Stop Shop, benefits of energy refurbishment, best practices, success stories and contact details.
- Posters and Banners: They can be used at events, conferences or within the OSS to highlight key statistics, benefits and services offered.
- Roll-ups: They are an essential communication tool, especially at events, conferences or in the One-Stop Shop lobby. They are vertical roll-up banners that stand on their own, are visible from a distance and can be transported and stored with ease.
- Videos: These can include testimonials from satisfied customers, tutorials on how to improve energy efficiency, or presentations on One-Stop Shop services.
- Press Kits: These can include press releases, high-quality photos, infographics, and other useful media materials.
- Presentations: Slides and presentation materials for workshops, seminars, and other educational events.
- Infographics: Graphic representations that simplify and visualize complex data and statistics related to energy efficiency and refurbishment.
- Social media post: Regular posts on platforms like Twitter, Facebook, Linkedin and Instagram can help keep the community informed and engaged.

It is important that all these materials are coherent in terms of design and message. It is important to update them regularly.

2.3.6 Digital One-Stop Shop

The Digital One-Stop Shop is an essential resource that provides detailed information, access to existing tools and resources, updates, news, access to project results, and a way to contact the OSS.

Those have already been developed and published:

- Bulgaria: www.reverter-brezovo.bg
- Greece: www.energeiakistegi.gr
- Latvia: www.renove.lv
- Portugal: www.renovar.coimbra.pt

3 One-Stop Shop Deployment

3.1 Technical-Legal framework

The specific objective of this task is to define the set of documents that will regulate the relationship between the different participants in the program.

Adhesion of professionals to the program:

This document includes all the necessary documents for a professional to join the One-Stop Shop. (Annex VII: Researcher's / Energy Ambassador's Individual and Legal Commitment Form of Deliverable 3.1 – Global methodology)

Data protection:

This document includes the authorization of the owner to visit their home, to collect the necessary data for the development of the project, and to follow up for monitoring the project's KPIs. (*Annex IV: Anonymous face-to-face survey consent form, Annex V: Face-to-face survey consent form during home visits, Annex VI: Extensive information form for home activities of the project* of the *Deliverable 3.1 – Global methodology)*

Contact form:

This document includes the authorization of the owner to follow up on the household visit through the contact channel provided.

3.2 One-Stop Shop Conditioning

3.2.1 Adequacy of premises and infrastructure

The OSS must be an accessible space that complies with local regulations. Additionally, it is important that the design and layout of the One-Stop Shop reflect the importance of energy efficiency and sustainability. The citizen must recognize the services provided and identify the OSS from the outside. So, identification signs will be necessary at the entrance to the premises and in the distributor in the case of sharing the space.

The OSS must be correctly identified as it could be within the town hall, shared office space, etc. There must be a conditioned space where OSS personnel can speak to citizens who require its services. This space may well be just a customer service desk. However, it is recommended that the OSS has the following spaces or can have access to shared spaces that can fulfil these functions:

- Reception: A welcoming area to greet visitors and provide a positive first impression of the service. First attention space.
- Work OSSs: Dedicated spaces for One-Stop Shop staff where they can carry out their daily tasks, answer calls and manage projects.
- Meeting room: A place to hold internal meetings, client presentations or informational workshops. It is recommended that you have a large worktable, projector, whiteboard, etc.
- Sample area: A space where samples of materials and technologies related to energy efficiency can be displayed for visitors to see and touch.

- Warehouse or archive: A secure place to store documents, tools, and other relevant materials.

Many OSSs will be located within other premises or public facilities. These will have rest spaces, bathrooms, convention rooms, etc. If it is an independent space, the premises should have:

- Rest area or kitchen: A small space with basic facilities so that staff can take a break, eat or prepare drinks.
- Bathrooms: Adequate facilities for staff and visitors.
- Training or workshop space: Depending on the nature of the One-Stop Shop, it might be useful to have a dedicated space for training and education for both staff and clients.
- Technology zone: A specific space for servers, printers, copiers and other technological equipment.

3.2.2 OSS Management tools

It is essential to have an OSS management system, specifically for managing leads, with leads being people interested in receiving information. This management system can be an Excel template or a digital platform. A system that allows for the automation of time-consuming daily operational tasks in project management by OSS staff, thereby significantly improving the quality and efficiency of the service. This, in turn, enables an increase in the program's activity and, consequently, its impact.

This document or platform should provide reports on service tracking in relation to leads, projects, and feedback from users who have used the service. It should also facilitate the program management and the administrative management of leads by the energy expert, back OSS, and other members of the OSS team. It's an internal management system of the OSS, only for the One-Stop Shop staff.

The platform should have the following characteristics and functionalities:

- **Easy to Use:** A very intuitive tool with a logical interface where relevant information is accessible and easy to find.
- **Operational Functionalities:** Allows for tracking a lead and changing its status as the process progresses, maintaining a history of statuses and tasks performed for that lead. It should allow for viewing data and storing this data over a long period of time, as this will be necessary to measure impact.
- **Project Management Platform:** Automates basic administrative management processes of the projects to reduce the need for manual actions: creation of reports, project tracking, KPI tracking, etc.
- **Generation of Reports:** Enables the creation of comprehensive reports and visualizes data in an aggregated and simple manner to monitor the program and make informed decisions.

The platform can integrate other digital tools necessary for the daily operations of the OSS such as the creation of emails and work environments, OSS tools, etc.

An example of the recommended sections of the platform would be:

- **Dashboard (Home Screen):** Provides a personal summary of ongoing leads, completed tasks, etc., and a general summary of the entire program.
- **Users:** Defines the users who have access to the platform and their roles.

- **Leads:** List of leads/people interested in receiving information of the One-Stop Shop.
- **Incidents:** Records any incidents that may have occurred in the program.
- **Information Requests:** Collects information requirements.
- **Tasks:** Lists the activities that platform users need to perform. These can be filtered by user, status, due date, etc.
- **Repository:** Relevant documentation for users utilizing the platform.
- **Reports:** Reports that can be automatically generated by the platform.

Such a system will significantly enhance the efficiency and effectiveness of managing leads and projects in the One-Stop Shop, ensuring that all information is systematically organized and easily accessible for analysis and decision-making.

3.3 Lead generation strategy

In marketing, sales and communication "lead generation" is the process of identifying and attracting potential customers, known as leads, who have expressed interest in a product or service. In the context of the REVERTER project and One-Stop-Shops, lead generation is a process of raising awareness about the need of building renovation, understanding the main benefits from the building renovation and taking further steps towards starting renovation process.

Barriers

Potential beneficiaries likely have not considered the need to make reforms in their housing to improve energy efficiency, and if they have detected deficiencies, the economic effort it entails and the complex process has led them to ultimately not consider making reforms to improve their homes energetically.

Proposals for energy improvement can be perceived as unnecessary or not a priority. Consequently, the communication process to generate demand should respond to general issues such as: quality of life, economic profitability, health improvements for tenants, etc.

Policies to reduce demand, GHG emissions, CO2, or energy dependence are concepts often unknown to citizens and do not necessarily respond to their most immediate interests, especially in cases of vulnerable households.

The OSS personnel are advised to take following steps in generating demand.

Table 3. Steps to generate demand

Stage	Awareness	Value and solution propositions	Conversion
Goal	Target audience is aware of the problem	Target audience understands the main benefits from the building renovation and knows where to search for possible solutions/ consultations / financial support	Target audience is willing to take next steps towards building renovation
What target audience do / feel or know?	• Target audience is aware of the problem • Target audience is aware that solutions exist • Target audience is willing to explore solutions • Target audience know that OSS can help with providing information and competent advice	• Target audience obtains specific information from OSS personnel or Digital OSS • Target audience participates in specific targeted events • Target audience understand what would be next steps to take • They know where to search for additional information and advice	• Target audience is ready to take next steps
Activities	A1. Raise awareness about energy efficiency and renovation benefits	A2. Inform and educate households A3. Provide information on optimal renovation works A4. Provide information on available financial support schemes A5. Conduct a preliminary building analysis A6. Provide information to prepare all documents necessary for accessing to financial instruments. A7. Provide advice on how to optimize energy bills	A6. Provide help to prepare all documents necessary for accessing financial instruments
Channels	• Social media communication • Communication on media (newspapers, radio, TV) • SEO strategy • Campaigns	• Consultations with OSS personnel • Consultations with Energy Ambassadors • Testimonials by those who have already got their building	In person or online/telephone consultation

		renovated (case studies) • Household visits	
CTA (Call to action)	• Learn more on Digital OSS • Visit the OSS • Visit OSS social media • Attend events organized by the OSS	• Apply for free consultation with OSS personnel • Apply for free household visit	• Apply for free consultation • Apply for free household visit

The communication tools and messages will vary depending on specific pilot area. However, they will all have similar approach. Communication and dissemination partner WIT in collaboration with OSS personnel and project partners who are responsible for implementation on the OSS has prepared main guidelines for all the OSS to generate the leads.

3.3.1 The approach to keywords

The approach to keywords is divided in two main blocks.

3.3.1.1 SEO

Search Engine Optimisation strategy has already been described in the Deliverable 5.1. and D5.2 the first steps have been taken and the first results has been communicated to the OSS personnel. Search Engine Optimisation of Digital OSS contributes to all three steps of lead generation.

Table 4. Steps for Lead Generation

Stage	Awareness	Value and solution propositions	Conversion
Description	Target audiences who are searching for possible solutions to their problem – not in particular related to renovation.	Target audiences who are searching information about renovation.	Target audiences who are searching for specific information to take the first steps.
Description of needs	How to reduce electricity bill How to save money on heating Why there is mold / humidity in my home and similar.	Support to renovation Renovation process How much does renovation cost Why renovate What are the benefits of renovation	What documents to submit for renovation

By taking into consideration these stages the specific content will be created and added to the website. It will be managed by the OSS personnel that will be trained both: How to optimise the content for Google Search Engine and how to add the content to the Digital OSS in practise (to the CMS – content management system).

The specific keywords have been already identified. The results from SEO will be monitored every 6 months and strategy towards content and this lead generation strategy will be adjusted.

Provided training materials on SEO on the Digital OSS are in English and they provide step by step process from writing a post to publishing it.

3.3.1.2 Specific messages

The specific keywords used in communication might vary in each pilot. These specific keywords are defined in this material. However, as the project will evolve they might change as the OSS personnel will be able to monitor which of them performs the best. These keywords can be included in the social media posts, press releases, videos and other communication materials aimed at the target audience. This approach applies mainly on "awareness" stage.

Description of the suggested "Gold keywords":

- reduce your energy bills
- increase the value of your property
- increase comfort of your family
- invest in your property and health not in your bills
- stop burning your money on heating

As the cultural background is different in each of the pilot countries the specific gold keywords are provided bellow.

3.3.2 Suggested lead generation strategies and channels

These lead generation campaigns and channels are mainly applicable for awareness and value and solution proposition stages.

The set of events does not exclude any other events that OSS personnel would like to implement in order to reach the goal of the project. In addition, the OSS personnel can also implement activities on its own that are not part of the project but are additional to it.

The list of possible communication channels is provided in the Deliverable 5.1. as well as list of national events. In addition, it is suggested for the OSS personnel to implement following specific activities:

- Door-to-Door campaigns
- Partnerships with local organizations
- Media – local press releases, articles or interviews on local newspapers, radio TV
- Local community events and workshops

3.3.3 Suggested visual guidelines for lead generation

In order to develop these materials WIT Berry has provided guidelines for project visual identity as well as produces specific set of base materials to be used for OSS personnel. The general project guidelines are provided within the Deliverable 5.1. The guidelines superficially created for the OSS personnel and to be used only for OSS purposes in the context of this project are provided below.

Each OSS follow the general REVERTER project visual identity guidelines in terms of colours used for communication materials in the communication activities in the context of REVERTER project. Additional guidelines have been created for each OSS.

3.3.3.1 Use of OSS logo

Each OSS has its own specific logo that provides explanation in the specific language. When creating communication materials that will be used in the pilot country the OSS logo has to be used. Two types of OSS logos have been provided – primary (Figure 2. Primary OSS logo) and secondary (Figure 3. Secondary OSS logo). The primary logo is mainly used when communication is only about one specific OSS. The secondary logo can be used when communication requires involvement of other OSSs – you can see example within the digital OSS landing page “About”. When information about all OSSs is communicated the secondary logo provides clear visual differences due to different colours used for the symbol of the buildings. These logos are used only on light background.

Figure 2. Primary OSS logo

Figure 3. Secondary OSS logo

Suggested use of the logos – summary

- On any communication material
- On light / white background
- On the first and last page (optional on the header / footer)

Inverted logo

Inverted logos for OSSs are demonstrated in theFigure 4. Inverted logo. These logos are used when the background is dark.

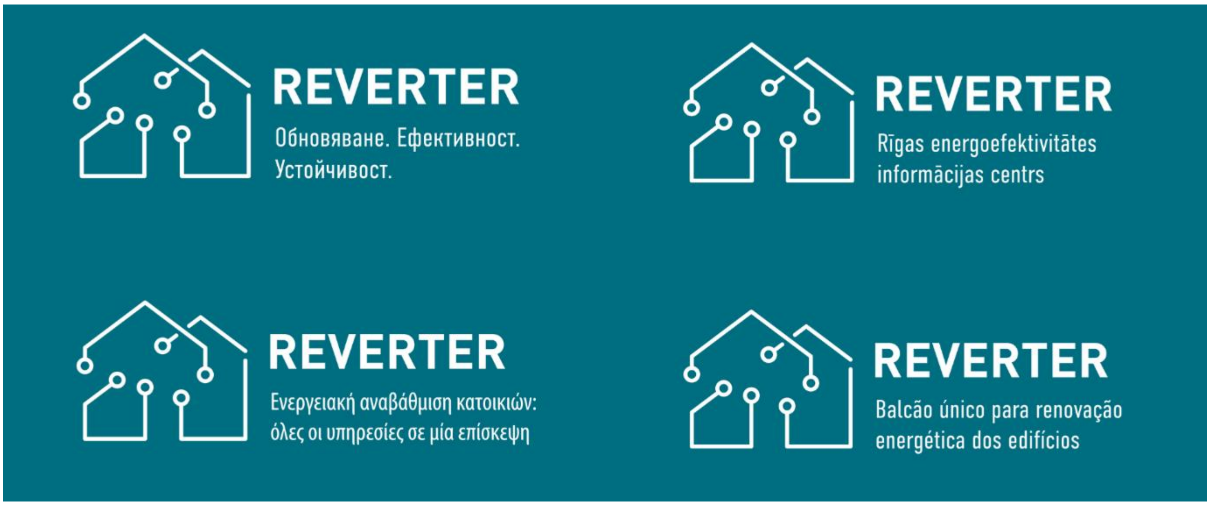


Figure 4. Inverted logo

Suggested use of the logos – summary

- On any communication material
- On dark background
- On the first and last page (optional on the header / footer)

Short version of logo

Short version of logo can be used when the space attributed to the logo is small. Thus, the short version of logo provides the same symbolism and the name of the project. They also can be used both on white / light background and dark background (inverted logo). Two types of logos are provided – vertical and horizontal for better adaptation of visual materials.

Figure 5. Short version logo

Suggested use of the logos – summary

- On any communication material when the space attributed to the logo is small and the primary or secondary logo doesn't fit or is not readable.
- On white / light background – original version
- On dark background (inverted version)

EU co-funding acknowledgement

When communicating to international audience the consortium use English version of the Life programme logo and co-funding acknowledgement. This is described and demonstrated in Deliverable 5.1.

When communicating locally the OSS personnel has to include Life programme logo and co-funding acknowledgement in their country's language. Several versions both horizontal and vertical as well as inverted version have been provided. This logo has to be included in all the communication materials, for example, flyers, presentations, PDF documents and so on. The logo has to have a decent size on the material.

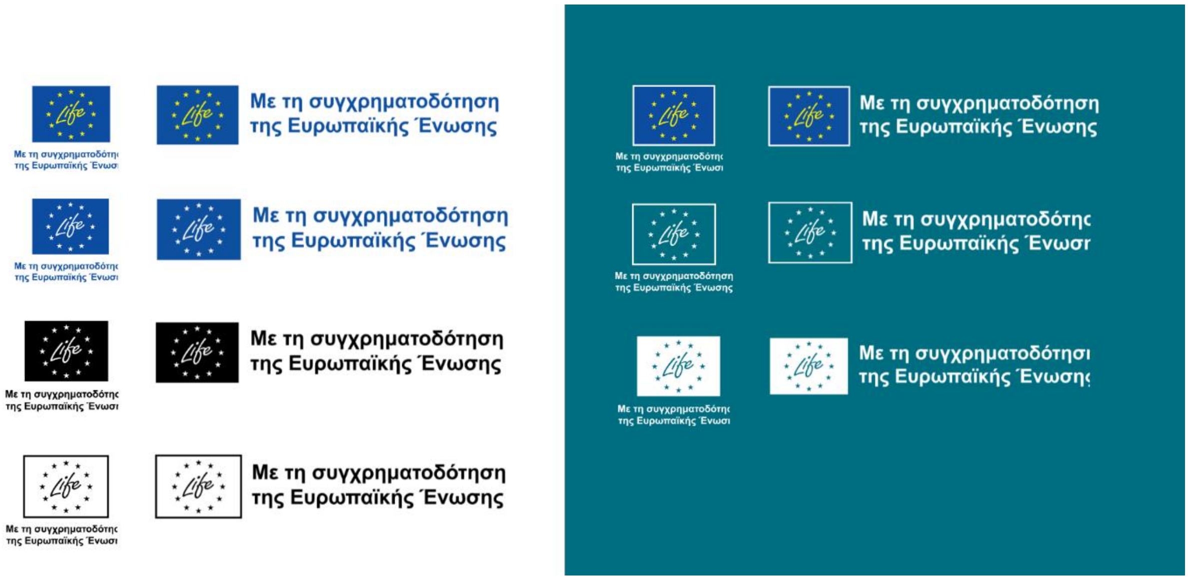


Figure 6. Life programme logo - Greek

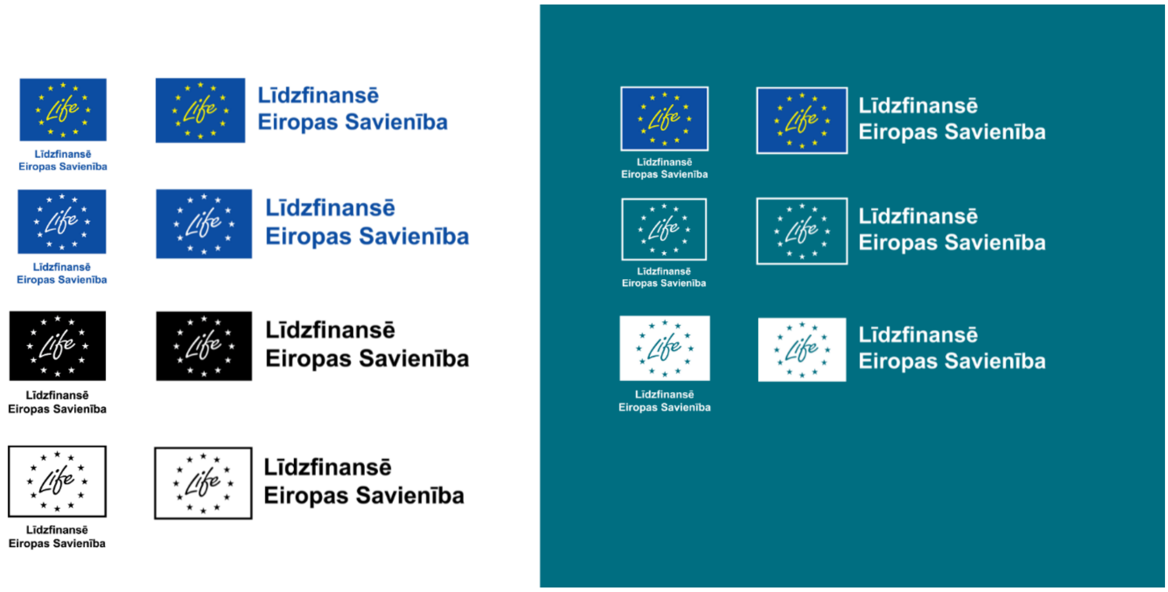


Figure 7. Life programme logo - Latvian

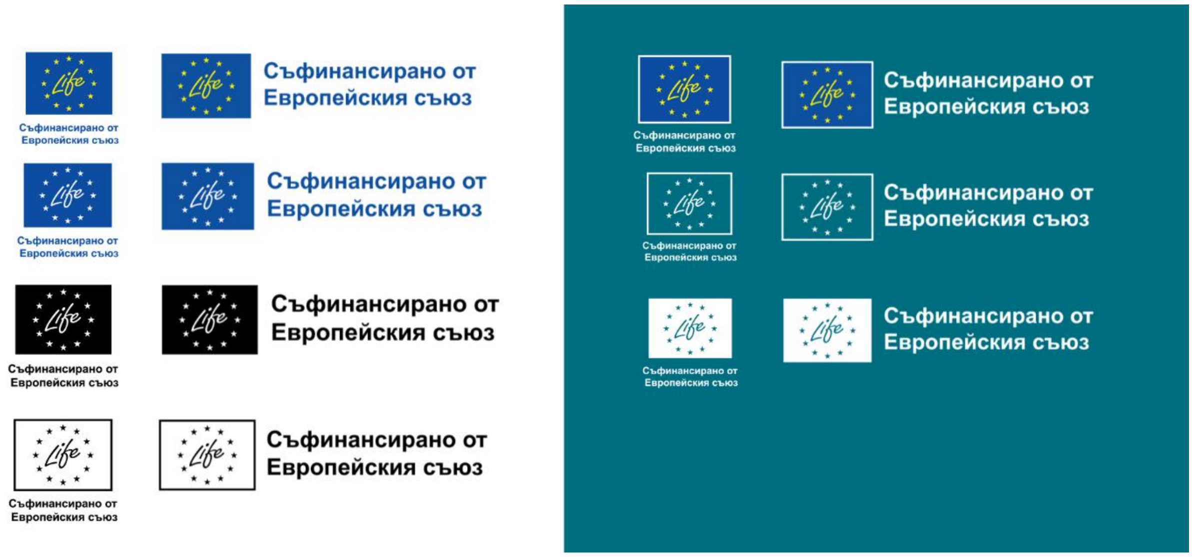


Figure 8. Life programme logo - Bulgarian

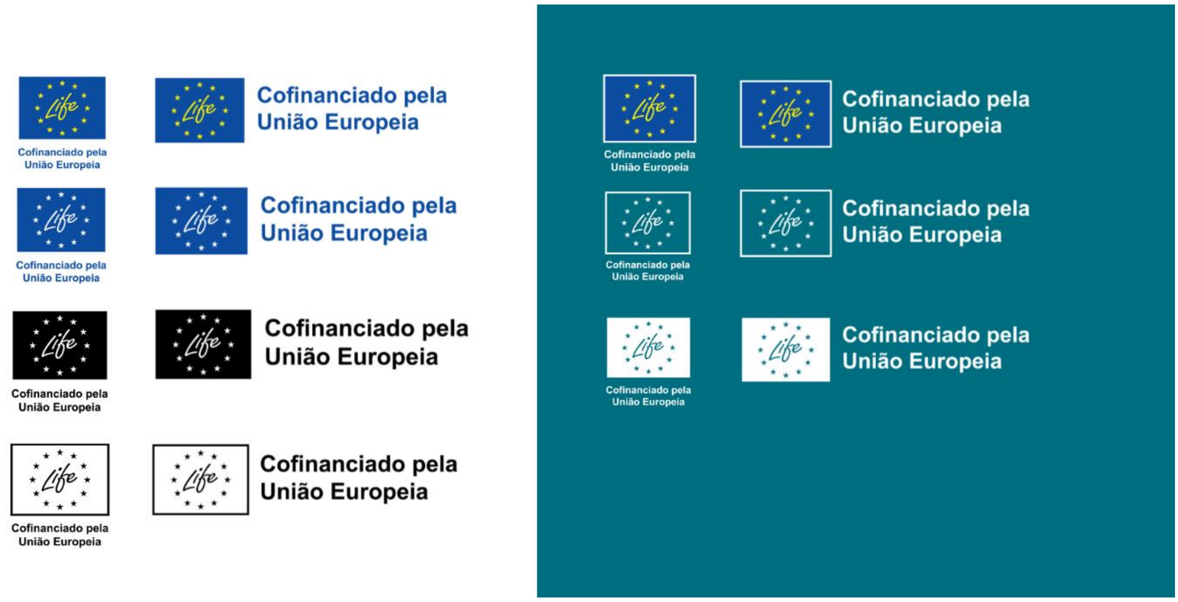


Figure 9. Life programme logo - Portuguese

3.3.3.2 Communication materials – documents, presentations, pdfs

WIT Berry has created basic templates for OSS communication materials – A4 documents, Power Point presentations. These documents can be used to create communication materials. In addition, if WIT or any other OSS partner creates specific communication materials that can be reused, they share the materials with all the team, so that other OSS representatives can take the created communication materials adapt them (for example, change the texts, images, icons and so on) and reuse them. This approach will help OSS personnel to save the effort and time.

Examples of social media communication visual materials are provided in Deliverable 5.1. The main approach is to use the project and Life programme logos, colours, and fonts from the visual identity guidelines.

3.3.3.3 Validation of communication materials

Person who creates communication materials can ask the validation of these materials to their supervisor for content as well as to WIT Berry for implementation of specific project related guidelines. However, this process is suggested to be done only at the very beginning of the development of the materials or for very important communication campaigns. Otherwise, OSS personnel have to be able to implement and create communication materials on their own.

3.3.3.4 Training on creating visual communication materials

A short training will be provided by WIT. It will be recorded so that the change of the person responsible of communication would not impact the quality of communication materials.

3.3.4 Communication plan

The communication plan for each OSS is created by the OSS personnel. They provide WIT with the overview on their planned communication activities every 3 – 6 months. The plan includes the main communication activities. If an opportunity for an important communication activity arises, OSS personnel informs WIT. The OSS personnel do not have to inform WIT about such activities as social media posts and other simple daily activities, for example, posting and article on Digital OSS and similar.

Approach to communication “Magic star”

The "Magic Star" concept will be applied in all communication activities to effectively convey the core message to the audience. This approach involves addressing the essential 5 W questions:

- What?
- Why?
- Who?
- Where?
- When?

Additionally, it includes the supplementary question "How?" which, in the context of communication activities, predominantly pertains to the Call to Action, such as "How to participate."

The sequence in which these questions are answered can vary based on the specific context and objectives of the activity and message. The "Magic Star" concept empowers communicators to maintain focus and deliver information with maximum brevity and precision.

Approach to communication “Explain it to 5-year old”

Another important rule is to apply “Explain it to 5-year old”. This is a bit exaggerated of course, However, the OSS personnel are asked to try to provide the information as simple as possible to understand. As Albert Einstein said: “If you can't explain it simply, you don't understand it well enough.”

Thus, the main idea is that people who have no experience in building renovation and related subjects have to understand the content, or they should be able to identify what they do not understand or what additional information they would need to clarify it with the personnel of the OSS. This rule is important as very often in communication professionals assume that some facts are known by everyone. When creating the content, the communication manager should think of providing an info to a person who is not familiar with the project REVERTER, building renovation and so on.

These approaches are extremely important in the context of the Lead generation strategy.

The approach for communication activities:

- **Process** for these type of communication activities is described in the section 3.3.
- **Style and visual guidelines** are described in the Deliverable 5.1. and Suggested visual guidelines for lead generation3.3.3 of this document.
- **Approach** is provided within the description of lead generation strategy **–** section 3.3.4 and it has to be applied together with "Magic star" concept.
- **Messages** are provided in the section 3.3.1.2
- Specific activity related information is provided bellow.

3.3.4.1 Social media

Each OSS uses at least one social media channel where they communicate about the OSS related activities. Several social media channels are welcome.

Social media is used to:

- Raise awareness
- Demonstrate value and propose solution for building renovation

Types of content:

- Informative posts about energy efficiency, energy poverty, sustainable energy, building renovation and related topics
- Reposts communicated by national institutions, organisations, media that discuss the same topic
- Events – if OSS organises any public event it should be posted on social media (for example, Facebook) as an event by applying "Magic Star" concept.
- Information on OSS activities – posts that provide information on OSS activities within the pilot – events implemented, articles posted on digital OSS and so on.
- Information on REVERTER project implementation and results when relevant are suggested to be promoted on OSS social media.

The visual content has to include:

- OSS logo
- When possible and relevant Life programme logo and acknowledgement
- It should comply with visual guidelines

Content has to include:

- Main message when relevant including the golden keywords or keywords for SEO purposes
- Call to action with link for more information – when relevant
- Life programme acknowledgement when relevant (for example in the reposts of content created by other initiatives or media it is not relevant)

Monitoring:

- When possible, OSS personnel provide WIT with information on post views, comments, shares and other type of engagement.
- OSS personnel provide WIT also with a subjective feedback on what type of information works better on social media.

3.3.4.2 Digital OSS

Each pilot's digital OSS is the central place for any activities online. Thus, whenever any type of communication has been made, the communicator is required to reference Digital OSS for more info or any other type of call to action, for example, "Apply for free consultation", "Ask your question" and so on.

Digital OSS consists of two main types of content:

- Permanent content – all the main landing pages.
- News and Updates – content that changes frequently.

Permanent content

At the beginning of digital OSS operations, WIT will ensure the content to be added, removed, adjusted or improved. When OSS personnel will be more experienced in operating the News and updates content, WIT will ensure training for content management on the digital OSS.

Adding / removing / changing permanent content

Before the OSS personnel is trained how to manage the permanent content, WIT Berry will ensure these tasks:

1. OSS personnel inform WIT Berry about the changes that need to be implemented.
2. OSS personnel prepare content accordingly – the examples of existing content blocks are used as examples.
3. WIT Berry implements the update.
4. OSS personnel test and validates changes.

News and Updates content

The OSS personnel receive training on how to create and update content within "News & Updates"

They will post such news and updates:

- Articles for informative and SEO purposes.
- Information on upcoming events, campaigns and activities, other announcements to the general public and primary target audience.
- Results – from events, surveys, activities, campaigns and so on.
- Case studies – testimonials, interviews and so on.

The content creation:

- Content posted will always follow the "Magic star" and "Explain it to 5-year old" approach.
- They will contain "Gold keywords" and keywords for SEO purposes.
- The content will have H1 title, H2 and / or H3 titles, images with ALT texts and descriptions, Meta title and Meta description.

The training on content creation and publishing content on the Digital OSS is recorded in and provided in the form of video.

3.3.4.3 Media

OSS personnel decide when and what to communicate to the media. Also, centralised communication activities with media can be implemented. For example, the same type of message but adjusted to each pilot's specific needs and language. This work is coordinated by the WIT Berry but implemented by OSS personnel.

In communication with media OSS personnel use the templates provided – documents and presentations, specifically created for each pilot. If needed, OSS personnel can also create their own communication materials by applying the visual identity guidelines.

OSS personnel inform WIT about the activity and provides WIT with specific information required for monitoring the communication effort and results such as, for example:

- Number of press releases sent
- Links or any other materials where information has been published or disseminated.

3.3.4.4 Events – workshops, seminars

When organising events, OSS personnel inform WIT about the event in advance. They prepare plan for the event and communication campaign by applying the requested approach and visual guidelines. All public events, when specific invitations to specific individuals are not sent have to be announced on:

- Social media – in form of event and/or post
- On Digital OSS in the News and Updates section
- Important events and activities can be promoted also on the Home page of the Digital OSS or on any other relevant landing page.

The communication materials for event such as posters, flyers, presentations and so on are created by the OSS personnel. They can consult WIT Berry if needed. They can ask validation on communication materials to WIT Berry, if needed.

3.3.4.5 Creating communication materials

Any communication material – plyers, posters, roll-ups, videos have to be created according to the general guidelines – "Magic star", "Explain it to 5-year old" and visual identity of the REVERTER project (Deliverable 5.1.) and specific recommendations for OSSs described and provided in section 3.3.

The OSS personnel can request WIT teams support to create important communication materials as well as validation for their own created materials.

4 One-Stop Shop Operations

4.1 Activity Procedures

In this section, the protocols to be followed for the development of activities in the One-Stop Shop will be detailed.

4.1.1 A.1 Raise awareness on energy renovation benefits

Objective: Carry out the lead strategy plan by organizing events or dissemination publications so that the population is aware of the problem. The main objective is to generate interest in energy rehabilitation so that vulnerable households want to visit the OSS and finally do so.

Procedure:

1. Event Planning:
    - Define the objective, target audience, and format of the event. (Examples: World Cafés, Round Tables, hands on workshops, Collective Dialogues and sharing practices, among others.)
    - Prepare informational and visual materials to present during the event.
    - Prepare a strategy to promote the event – channels, timing, concept.
    - Prepare materials for event promotion campaign – social media posts, press releases, info on digital OSS and other materials.
2. Event Promotion:
    - Coordinate with the Communication and Marketing manager the activities and collect results during the campaign to adjust, improve and so on.
    - Involve local and regional media if it is possible.
    - Engage stakeholders to participate in the events.
    - Use suggested communication channels, messages and visual materials to promote the event and ensure wide participation.
3. Conducting the Event:
    - Present the benefits of energy renovation in a clear and attractive manner.
    - Encourage public participation through question-and-answer sessions or open discussions.
    - Encourage attendees to visit the One-Stop Shop for personalized advice. Ask them to subscribe our newsletter and visit web site.
    - Collect feedback from participants to improve future events.
4. Data Collection:
    - Inform about data protection.
    - Request information for project tracking and reporting.

    - Find out if they were aware of the One-Stop Shop before the organization of the event.
5. Monitoring and Reporting:
    - Track the impact of the event on networks.
    - Track the impact of the event:
        - Number of participants
        - Satisfaction of participants
        - Feedback from participants
        - Number of people advised during the event.
        - Number of people seeking advice due to the organized event.

Support Materials:

- PowerPoint presentations or similar visual materials that highlight key points.
- Brochures or printed materials that participants can take away for further reference.
- A list of online resources or platforms where participants can find more information or support later.
- Appropriate audiovisual equipment for the presentation (projector, microphone, etc.).
- Samples of materials
- In the case of outdoor events:
    - Folding tables.
    - Tent
    - Television
    - Roll-ups"

4.1.2 A.2 Inform and educate households

There are different scenarios in which this information can be offered: during visits/calls to the One-Stop Shop or during household visits.

4.1.2.1 Advisory at the physical OSS or online/phone call

Objective: To provide information and personalized advice on the benefits of energy renovation and other questions regarding procedures and financing at the One-Stop Shop.

Procedure:

Reception and Welcome:

Greet visitors in a friendly and professional manner.

For telephone inquiries, ensure to respond promptly and maintain clear and respectful communication.

Identification of Needs:

Ask and identify the specific needs of the visitor or caller to offer personalized information and advice.

Provision of Information:

Clearly and understandably explain the benefits of energy renovations, such as savings on energy bills, improved thermal comfort, and contribution to environmental sustainability. See the corresponding training module.

Present practical examples or success stories to illustrate the benefits of energy renovation.

If the assistance is via phone/online, invite the interested party to visit the One-Stop Shop for more information.

Inform about the possibility of conducting visits to perform a preliminary diagnosis of the home.

Data Collection:

Inform about data protection.

Request information for project tracking and reporting.

Find out how they heard about us.

Support Materials:

Informative brochures on the benefits of energy renovation.

Graphs or diagrams illustrating energy savings and environmental benefits.

A list of useful resources or links where visitors can find more information.

Samples of materials (thermal insulation, joinery with thermal break, etc.).

4.1.2.2 Advisory during visit to the respective households

This will be detailed in section 4.1.4 of this document.

4.1.3 A.3 Provide information on optimal renovation works

The action protocols will be the same as in the previous point. Consult the corresponding training module.

4.1.4 A.4 Conduct a preliminary building analysis

Objective: To conduct a preliminary analysis of buildings to identify opportunities for improvement in energy efficiency and point out possible areas for renovation or energy efficiency improvements.

Procedure:

1. Preparation:
    - Ensure that Ambassadors are adequately trained and familiar with the tools and methods of preliminary analysis.

- Coordinate and plan the visit, ensuring that permissions and necessary access are obtained.
    - Necessary information includes:
        - Exact address of the visit.
        - Person who will attend to the Ambassadors during the visit.
        - Contact of the interested party to send a reminder of the visit.
    - Information to be provided:
        - Name of the Ambassador who will carry out the visit.
        - Date and time of the visit.
        - An explanation of how the visit will be conducted and the expected results.
- Send a reminder of the visit to the interested party by email or call, depending on the contact details provided. Previous data will be confirmed.

2. During the Visit (Ambassadors):
    - Introduction of the Ambassador. Provide identification.
    - Explanation of the purpose of the visit.
    - Request for permissions (consent form to be signed) and inform about REVERTER data protection regulation. Request for permission to access their home.
    - Explain how the visit will be conducted and ask for permission to access the home.
    - Conduct an initial visual review. If it is not safe to access the home, inform the interested party and postpone the visit until safe access is possible.
    - Answer the questionnaire.
    - Answer the contact form if they accept that the OSS contact them after a period of time to follow up on the visit and evaluate its impact.
    - Optional: Capture clear photographs of problem areas for future reference and analysis if permitted. Do not take photographs of people. It is not a requirement.
    - Optional: In the event that tenants would like a more personalized evaluation of their home, a second exhaustive visit will be carried out.
        - Perform basic measurements such as temperature, the surface of the windows, living area surface, energy consumption, and other relevant factors for energy efficiency.
        - Identify deficiencies and areas for improvement.
    - Discuss these deficiencies and inform about the areas of improvement.
    - Provide interesting information: benefits of energy refurbishment, best practices, available subsidies, etc.
    - Clarify any doubts generated.

- Encourage visiting the OSS for more information. Provide information about the OSS services and contact details.
- Thank them for facilitating the visit. This moment would be interesting to expose that the OSS is interested in conducting as many visits as possible in the area and if the tenant knew of anyone who would like a preliminary analysis of their home, the One-Stop Shop would appreciate if they provided the OSS contact for information.
- Say goodbye.

3. After the Visit:
    - Compile the collected data (questionnaire and pictures (optional)).
    - Transfer the information from the questionnaire to a database.
4. Communication and Follow-up (if the tenant agreed):
    - Coordinate a follow-up plan. Between 1 and 6 months after the visit (recommended).
    - Introduction and identification.
    - Remind tenants that it was agreed to follow up on the visit.
    - Proceed to answer the monitoring, improvement, and impact questionnaire.
    - Clarify any doubts generated.
    - Encourage visiting the OSS for more information.
    - Provide information about the OSS services and contact details.
    - Thank them for their time and say goodbye.

Support Materials:

- A checklist for the energy assessment of buildings.
- Questionnaire to collect data during the analysis. In the absence of this technology, the sheet with the data to be collected during the visit will be printed.
- Camera for capturing photos of areas that need attention or improvement.
- Laser meter, thermal camera, and other basic tools for measuring environmental conditions.
- Brochures with basic information for households: benefits of energy refurbishment, best practices, One-Stop Shop services and contact, available subsidies, etc**.**

4.1.5 A.5 Provide information on available financial support schemes.

The action protocols will be the same as in chapter 4.1.1. Consult the corresponding training module.

4.1.6 A.6 Provide information to prepare all documents necessary for accessing to financial instruments (optional).

Objective: Provide information to help stakeholders to prepare and organize all necessary documents to apply for and access available financial instruments for the energy renovation of buildings.

Procedure:

1. Research and Information Compilation:
    - Maintain an updated database of all available financial instruments, including grants, loans, and tax incentives. Consult the corresponding training module.
    - Compile and keep up to date the guides, requirements, and specific criteria for each financial instrument.
2. Preliminary Advice:
    - Request for permissions and data protection.
    - Examine the specific needs of the project and identify the most suitable financial instruments.
    - Provide clear and concise information about the appropriate financial instruments and their application process.
3. Optional. Document Preparation:
    - Use standardized templates and forms to assist in compiling and organizing documents.
    - Ensure that all documents are complete, accurate, and presented in a professional manner.
4. Optional. Review and Verification:
    - Review all documents to ensure they meet the specific requirements of each financial instrument.
    - Verify that all provided information is accurate and backed up by relevant documentation.
5. Optional. Support during the Application Process:
    - Assist in submitting applications and ensure that it is done according to specific guidelines.
    - Provide ongoing support during the application process, answering any questions or clarifying doubts that may arise.
6. Optional. Monitoring:
    - Regularly track the status of the application and maintain constant communication with financial entities.
    - Assist in responding to any questions or additional requirements from financial entities.

Support Materials:

- Updated list of available financial instruments and their eligibility criteria.
- Guides or manuals detailing the application process for each financial instrument.
- Optional. Standardized document templates and forms required for each type of financial instrument.

4.1.7 A.7 Provide advice on how to optimize your energy bill (optional)

Objective: Advise on how to understand and optimize energy bills, helping to identify opportunities for savings without the need for significant changes in the home or consumption habits.

Procedure:

1. Examine Existing Bills:

    - Collect recent energy bills to examine consumption patterns and rates applied to each pilot.
    - Compare the energy bill with estimated energy consumption.
    - Identify any charges or fees that may be reduced or eliminated.
2. Identify Saving Opportunities:
    - Use tools and resources to identify saving opportunities, such as changing rates or providers.
    - Study options for reducing contracted power if possible.
3. Develop Optimization Strategies:
    - Provide specific recommendations for optimizing the bill, such as switching to a tariff with cheaper hours or adjusting the contracted power.
    - Consider the possibility of changing to a more economical provider if convenient.
4. Personalized Advice:
    - Request for permissions and data protection.
    - Provide personalized advice, tailoring optimization strategies to the specific needs and circumstances of each user.
    - Resolve doubts and provide clarifications on any aspect of the energy bill.
5. Education and Training:
    - Use educational materials to educate about understanding energy bills and how to manage them efficiently.
    - Organize informational sessions or workshops to educate about efficient energy bill management.
6. Ongoing Support and Monitoring:
    - Offer ongoing support for any inquiries or necessary clarifications related to the energy bill.
    - Perform monitoring to ensure that optimization strategies are implemented correctly and are yielding positive results.

Support Materials:

- Spreadsheets or applications to examine and work on energy bills.
- Educational materials such as guides, infographics, or videos that facilitate understanding of energy bills.
- A list of energy service providers, with their current rates and offers.

4.2 Monitoring committee

The Monitoring Committee has the responsibility of overseeing the progress of the One-Stop Shop and that the objectives are met efficiently, effectively and ethically. Its functions include:

- Regularly review the progress of the project based on predefined objectives and goals.
- Ensure that the activities carried out are aligned with the objectives and goals of the project.
- Evaluate the performance and results of the different phases of the project.
- Generate detailed reports detailing findings, achievements, challenges and recommendations.
- Communicate results and evaluations to relevant stakeholders.
- Identify potential risks and challenges in the early stages.
- Design and implement mitigation strategies to address identified risks.

- Monitor these risks and adjust strategies as necessary.
- Act as a bridge between One-Stop Shop teams and stakeholders, ensuring fluid and transparent communication.

The committee should meet regularly to review the progress of the project and ensure it is aligned with the objectives.

Composition of the OSS Monitoring Committee will be made up of the coordinator of One-Stop Shop and the municipality or OSS promoter:

- Coordinator: As an OSS leader, they have a global vision of all activities and, therefore, can provide Desirable knowledge insights into the progress of the operation. Responsible for preparing monthly OSS monitoring reports, detecting risks, and proposing an action plan to minimize them. The coordinator will evaluate the impact and effectiveness of the implemented actions and will ensure that all stakeholders are informed about progress, challenges and decisions made. Decisions will be made based on feedback and reports to improve or reorient actions if necessary and will establish a calendar of meetings to monitor OSS performance (see communications plan). Regular reports will be sent to the municipality or OSS Promoter
- OSS Promoter: Will provide an external perspective and ensure that the objectives and interests of the project are met.

However, the other members of the OSS will be key to the quality of the One-Stop Shop services and to achieve the objectives.

- Energy Specialist: Responsible for ensuring that the data obtained during the day in the OSS and the visits of the Ambassadors is correct.
- Back Office: Will ensure that administrative and financial processes are being carried out correctly and that all requirements are met.
- Community Agent: Provides direct feedback from the field and stakeholders, being the bridge between the community and the OSS Personnel.
- Communication, Marketing and Design expert: Evaluates the effectiveness of communication campaigns and how they are influencing the progress and perception of the project.

These agents will provide their feedback to the OSS Coordinator regularly so that it can write monitoring and performance reports.

4.3 Monitoring and reporting

The KPIs that were determined are broken down into "Deliverable 3.1 - Global methodology".

4.3.1 How to monitor this KPIs

The day-to-day information of the OSS will be recorded daily through an IT platform or reference document. This document will compile the necessary documentation to justify the project's KPIs. In addition, follow-up surveys will be carried out with the people advised during the course of the project.

This information will be collected in M34 to be able to make the reports and send them in M36 as planned in the project.

4.3.2 How to report this KPIs

Each trimester, an update report on the status of the KPIs will be drafted and sent to the monitoring manager (coordinator). During the monitoring session, the results will be examined, and an action plan for the following month will be defined to achieve the objectives set in the project.

Annex II: RAs training material

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC II

Energy consumption in households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to make the trainees aware of the basic principles of energy, building envelope characteristics, energy consumption in households, solutions for renewable energy and energy monitoring. In addition, the training material will provide OSS personnel and the RAs with necessary information to understand the environmental impacts of energy use, making the bridge to renewable energy sources and communities.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
A2A	Air To Air
ASHP	Air Source Heat Pump
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BESS	Battery Energy Storage System
BMS	Building Management System
BTU	British Thermal Unit
COP	Coefficient Of Performance
DC	Direct Current
DHW	Domestic Hot Water
EER	Energy Efficiency Ratio
EPS	Expanded Polystyrene
EU	European Union
GSHP	Ground Source Heat Pump
HVAC	Heating, Ventilation, and Air Conditioning
IEA	International Energy Agency
LED	Light Emitting Diode
LPG	Liquified Petroleum Gas
MEPS	Moulded Expanded Polystyrene
PIR	Polyisocyanurate
PUR	Polyurethane
PV	Photovoltaic
PVC	Polyvinyl Chloride
SCOP	Seasonal Coefficient Of Performance
SEER	Seasonal Energy Efficiency Ratio
SEER	Seasonal Energy Efficiency Ratio
XPS	Extruded Polystyrene

1 Basic energy concepts and units

1.1 Primary and final energy

The primary energy consumption encompasses the utilization and losses incurred during energy transformations within the energy industries, such as power generation and refineries. On the other hand, final energy consumption represents the cumulative energy used in various sectors like industry (excluding the energy sector), transport, buildings (residential and services), and agriculture. This excludes the fuels employed by autoproducers for power generation.

Primary energy comprises both renewable and non-renewable forms in their natural state, while final energy consumption quantifies the total energy expended to satisfy the needs of end-use applications. Examples include the electricity consumed by a lightbulb or the fuel burned by a truck. Notably, final energy consumption measurements exclude transmission and distribution losses or inefficiencies, which are considered in the assessment of primary energy demand.

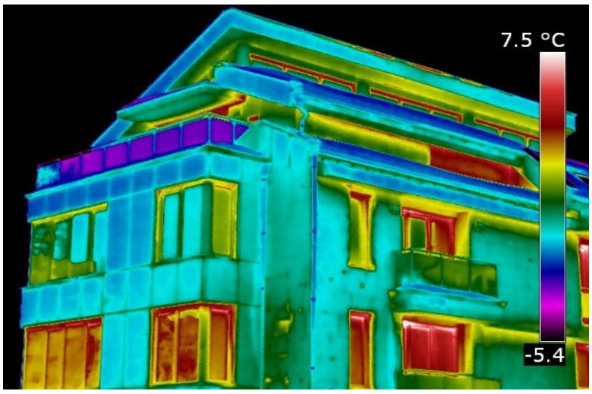
2 Building envelope

The building envelope acts as the physical barrier that separates the exterior and interior environments enclosing a structure. Typically, it consists of a combination of components and systems designed to shield the interior space from external environmental factors such as precipitation, wind, temperature, humidity, and ultraviolet radiation. The internal environment encompasses occupants, furnishings, building materials, lighting, machinery, equipment, and the HVAC (heating, ventilation, and air conditioning) system.

The building envelope performs various functions, which can be categorized into three main areas:

Support	Control	Finish
• it ensures strength and rigidity, providing structural support against both internal and external loads and forces	• it controls the exchange of water, air, condensation, and heat between the interior and exterior of the building.	• it serves aesthetic purposes, enhancing the visual appeal of the structure while still fulfilling its support and control functions

2.1 Heat losses through building envelope



Heat losses in residential buildings are the result of heat exchange through the external enclosing elements, depending on their thermal conductivity and the difference between external and internal temperatures. Heat transfer takes place from the area with higher to the area with lower temperature.

Reducing heat loss through the building envelope depends on the local climate and the local energy needs - certain architectural principles guarantee high energy efficiency and a high standard of visuals, warmth and health comfort in the spaces where different activities are realized.

- Most of the heat losses are through the roof (more than 30%) and through the walls (more than 20%).
- The most effective energy-saving measure is optimizing the thermal insulation of the external walls.
- The combination of insulation solutions on external walls and roofs can lead to a reduction of up to 50% of heat losses.
- Current regulatory requirements in Bulgaria require the laying of 10-12 cm insulation on the external walls and between 12-15 cm on the roof structures

Major sources of losses in non-insulated buildings (although it depends on the specific conditions):

- Roof: about 25 to 30% of heat losses;
- Walls: about 20 to 25% of heat losses;
- Ventilation and infiltration: about 20 to 25% of heat losses;
- Windows: about 10 to 15% of heat losses;
- Thermal bridges: about 5 to 10% of heat losses

The most intensive heat losses within a building are through the roof (more than 30%) and through the walls (more than 20%).

Reducing heat loss through the building envelope, depending on the local climate and the local energy, needs certain architectural principles:

- external or internal insulation;
- roof insulation
- change of windows and doors
- improving air-tightness.

By implementing them we can achieve high energy efficiency, as well as a high standard of visual, warm and healthy comfort.

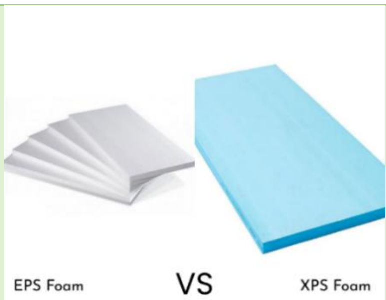
2.2 Different types of insulation

External wall insulation systems are materials that form the thermal envelope of a building. The primary objective of these insulation materials is to diminish heat transfer through walls, thereby reducing heat losses and, consequently, lowering the energy demand for heating. Thermal insulation, characterized by low thermal conductivity, typically below 0.1 W/mK, plays a crucial role in minimizing energy consumption in buildings by preventing heat loss through the building envelope.

An external wall insulation system involves the use of materials such as expanded polystyrene (extruded - XPS and expanded - EPS), mineral wool, polyurethane foam, or phenolic foam, combined with a reinforced cement-based, mineral, or synthetic plaster. Commonly used insulation materials include EPS, XPS, and mineral wool. Improving insulation, especially in existing buildings, can significantly reduce energy losses in both external walls and roofs. Insulation acts as a barrier against heat loss and gain, with its importance extending to protecting against summer heat in addition to winter cold in various climate zones.

A crucial characteristic of insulation materials is their ability to maintain R-value over time and continue providing insulation even when exposed to water for extended periods. Given that water is an efficient conductor of heat, water-soaked insulation loses its R-value. Additionally, if absorbed water undergoes freezing and thawing cycles, the insulation structure may deteriorate over time, compromising its structural integrity.

Table 1. Different types of insulation materials

Type of insulation material	Description
	**Fiberglass** is a commonly used insulation material in recent times. Fiberglass is a non-flammable insulating material. Moreover, it is an inexpensive insulation and is therefore a recommended option.
	**Mineral wool** refers to several different types of insulation. It can refer to glass wool (made from natural sand and/or recycled glass), rock wool (made from basalt) or slag wool (made from the slag that is generated in steel foundries). Mineral wool can be purchased in the form of plates or rolls. Most forms of mineral wool do not have additives to make them fire-resistant, but it is not flammable by itself.
	**Cellulose insulation** is undoubtedly one of the most environmentally friendly insulations. It is produced from recycled cardboard, paper and other similar materials, and is supplied in bulk form. Some recent research on cellulose has shown that it can be an excellent product for preventing fire damage.
	**Polyisocyanurate** (PIR) is a thermoset type of plastic, a closed-cell foam that contains a low-conductivity gas without hydrochlorofluorocarbon in its cells. Polyisocyanurate insulation is available as a liquid, as a spray foam, and as rigid foam boards. It can also be produced as laminated insulation panels with a variety of surface finishes.
	**Polystyrene** is commonly used to make foam, insulation boards, concrete insulation blocks or loose insulation from small balls. Moulded expanded polystyrene (MEPS) is often used as thermal insulation boards but is also available in bulk. Other polystyrene insulation material similar to MEPS is expanded polystyrene (EPS), graphite polystyrene (graphite EPS) and extruded polystyrene (XPS).

	**Polyurethane** is an insulating material in the form of foam, which contains a gas with low thermal conductivity in its cells. Polyurethane foam for insulation is available in closed and open-cell forms. In closed cell forms, the high-density cells are closed and filled with gas, which helps the foam to expand and fill the spaces around them. Open cell forms are not as dense and filled with air, giving this form of insulation a spongy structure and a lower R-value.

Source: ComAct (2021). Inventory of energy efficiency technical measures for energy-poor households. Available at: https://www.oneplanetnetwork.org/sites/default/files/from-crm/d4.1-identification-and-analysis-of-technical-measures-.pdf

The selection of materials for building construction is influenced by a diverse range of factors. Here are three examples:

1. XPS (Extruded Polystyrene):
    - XPS is produced through a continuous extrusion process, resulting in a consistent closed-cell cross-section.
    - The homogeneous structure of XPS contributes to its thermal and mechanical properties.
2. EPS (Expanded Polystyrene):
    - EPS is manufactured by expanding spherical beads in a mold, using heat and pressure to fuse the beads where they touch. Open spaces between the beads remain.
    - This method creates a structure with both closed and open cells, influencing its insulation characteristics.
3. Composite Insulated Panels (Sandwich Panels) with PIR/PUR Core:
    - Composite insulated panels consist of two rigid metal facings (typically steel or aluminum) with a core made of PIR/PUR foam insulation.
    - Rigid polyurethane (PUR) and polyisocyanurate (PIR) insulation products offer high effectiveness, low weight, excellent thermal conductivity, and a strong strength-to-weight ratio.
    - The closed-cell structure of the foam, with trapped gas having low thermal conductivity, contributes to excellent insulation.
    - During manufacturing, the PIR/PUR core expands, creating a robust semi-structural unit by bonding and laminating with the metal facings.
    - These panels provide superior thermal performance, ensuring continuous insulation and factory-engineered airtight joints.

In summary, the choice of building materials involves considering manufacturing processes, structural characteristics, and insulation properties. Each material, whether XPS, EPS, or composite insulated panels with a PIR/PUR core, has specific attributes that make it suitable for different applications in construction.

ADVANTAGES:

- Efficient Heat Conservation: Substantially decrease heat loss and reduce the energy demand for heating, leading to a decrease in CO_2 emissions.
- Common and Effective Solution: External wall insulation is a widely adopted solution, delivering notable energy savings, particularly in colder climates, with an impressive payback period.
- No Reduction in Floor Area: Implementation of external wall insulation does not diminish the floor area of the building.
- Enhanced Sound Resistance: Improves the building's resistance to sound transmission.
- Extended Wall Longevity: Increases the lifespan of external walls.
- Non-disruptive Application: Application can be carried out without causing disruption to the household.
- Aesthetic Renewal: Revitalizes the appearance of external walls.
- Diverse Design Options: Offers a broad range of renders and decorative finishes, providing nearly limitless options for textures and colors..

ENERGY SAVINGS:

The percentage of energy savings is a function from:

- The thickness of the thermal insulation and the respective U–value;
- The climate zone;
- The size, type and gross floor area of surrounding external walls;
- Other energy-saving measures implemented.

2.3 Glazing

Glazing refers to a sealed construction comprising two or more windows separated by variously sized spacers, creating double (single) or triple glazing (two-chamber) glass configurations. Insulated glass units are produced with glass thickness ranging from 10 mm to 16 mm.

The primary purpose of glazing is to facilitate optimal natural light entry into a room while offering visibility to the outside. It plays a crucial role in preventing bidirectional heat transfer between the interior and exterior of a building, with a focus on retaining heat during winter and excluding heat in summer.

The area of the windows typically reaches about 25% of the area of the dwelling. If these 25% are covered with energy-efficient windows, the average winter temperature in the dwelling can rise by 4-5°C. Thus, windows have a great influence on the heat loss in the dwelling.

The glass area within a window typically ranges between 70% and 90%, significantly impacting the overall thermo-technical parameters of windows. Achieving excellent thermal insulation is a key objective in residential buildings, aiming to substantially reduce energy needs, heating losses, and associated costs.

Various types of double and triple glazing windows with distinctive features and U-values include:

- **White Float Glass**: Widely used in combination with other types, available in varying thicknesses (3 mm up to 10 mm).
- **Low-Emission Glass (K-Glass)**: Enhances overall energy efficiency with a high solar heat gain coefficient and visible transmittance, reducing the U-factor significantly.
- **All-Season Glass**: Offers optimal thermal insulation, sunlight control, and insulation capabilities for a comfortable environment throughout the year without a "greenhouse" effect. Characterized by high selectivity and a low coefficient of thermal conductivity.
- **Laminated Glass**: A multi-layered glass type joined by high-tension film, providing high soundproofing and safety as it does not break into pieces when damaged.
- **Reflective Glass**: Suitable for walls or roofs, increases solar control, and exhibits high resistance to scratching and staining.
- **Tinted Glass**: Available in blue, green, brown, and grey tints, suitable for windows and doors.
- **Argon Gas Windows**: Feature windows filled with argon gas between panes to enhance overall energy efficiency. Argon, being heavier than air, prevents frost at the window's bottom and improves soundproofing. Three-paneled argon-filled windows provide dual insulation layers.

These varied glass options offer solutions tailored to specific needs, combining functionality, energy efficiency, and aesthetic considerations. The heat that passes through 1 m² of the window surface is characterized by the U value, while the amount of solar energy that passes through 1 m² is represented by "g" (solar energy transmittance). The lower the value of U, the more solar energy passes through it.

Types of glazing based on their efficiency:

- **Inefficient glazing** - single glazing (U-values up to 5.8 W / m²K) is considered **very inefficient for windows glazing**.
- **The energy-efficient glazing consists** of two or three layers of glasses separated by an air layer. (U-values from 1,20 W/m²K to 1,70 W/m²K))
- **The triple glazing is considered high-efficiency** (U-values from 0,4 to 1,1 W/m²K)

Table 2. Different types of joinery

Type	Description
Wooden windows	Excellent insulation characteristics; among the best materials for preserving the comfort of home; the cheapest option - joinery of coniferous trees (white pine or spruce). Of the broad-leaved woods, the most used are oak and ash
Double-glazed wooden windows	Providing twice as good sound and heat insulation compared to traditional woodwork and with no danger of condensation. It is produced from three-layer lamellas and this prevents it from rolling, shrinkage and cracking
Aluminium joinery	Ensures durability and security, maintenance is easy and inexpensive and does not require periodic painting. As a material, aluminium is an excellent conductor of heat and therefore heat loss in this type of window is greater. Quality aluminium windows require thermal insulating bridges in the profiles, which leads to their cost increase;
PVC (PVC) joinery	Very good heat and sound insulation properties. Maintenance is easy. The material is resistant to cold, heat, and chemicals. Greater and better energy performance is achieved with joinery with more internal chambers
Combined joinery	The most expensive option is joinery combining aluminium with wood. The wood is protected from atmospheric influences with an external aluminium lining on the profile. The best qualities of the two materials combine in aesthetic and functional terms

Important!
Regarding windows:
The "g"-values of windows exert a more significant impact on decreasing cooling demand than their U-values.

- For insulation:
    - There is a possibility that insulation may elevate cooling demand due to retained heat gains in the building.
    - The additional benefit of insulation in reducing cooling demand is most prominent in climates where heat reserves are minimized, achieved through external sunshades, efficient applications, and effective ventilation.
- In temperate climates, apart from the roof or top floor, the extra impact of insulation in reducing cooling demand is generally negligible.

3 Building installations

3.1 Heating devices and installations

Different means of heating are used to heat dwellings and buildings. Such systems could be centralized or decentralized, as well as individual or common (common system for the whole building).

- **Individual heating could be a heating stove**, electric heater, air conditioner, another type of heat pump, or individual boiler. Those heating solutions can be based on solid fuels, natural gas, oil or electricity.
- Common **heating systems could be a boiler that can run on biomass, oil, natural gas or a heat pump.**
- **Centralised heating systems** connected to district heating that runs on natural gas, solid or liquid fuels. The decentralized heating systems could be grouped into two different types, depending on the location of the heat source – direct and indirect heating.

3.1.1 Direct heating

When the heat source is in the room that is being heated, the heating unit belongs to the group of direct heating devices. There are different types of direct heating devices:

- fireplaces;
- stoves;
- cast iron heaters;
- combined stoves;
- Electrical heaters;
- individual air-to-air heat pumps (air conditioners).

In this group of heating devices, part of the heat is transmitted directly to the air or water so as to heat the room. The heating source for this type of heating is mainly wood, wooden pellets and coals or electricity.

- Systems (boilers, stoves, burners) with efficiency greater than 88-90 % are considered very efficient.
- Systems with efficiency lower than 88% are considered inefficient.
- Systems with efficiency between up to 70% are considered very inefficient.
- Electrical radiators or other electrical systems with an efficiency of 100 % are also considered inefficient (high energy consuming means of heating).

3.1.2 Indirect heating

The second group of heating systems includes different types of indirect heating. The heat source is outside the heated rooms. Most of the heat is transferred to a heat carrier (water or air) that is transported to the rooms to be heated by pipelines or ducts and heating units such as radiators, convectors/ fan coils. In the premises, the heat transfer medium indirectly or directly transfers part of the heat it transmits and returns it to the heat source. These are the systems with heating boilers, heat pumps, centralized heating.

- **Pellet boilers**

One of the most popular options for heating in houses is the use of wood pellets as a source of heat. They are small granules made from sawdust, agricultural or plant residues. These boilers are the most environmentally friendly appliances for solid fuel heating. Their burning efficiency reaches 90 % or more. In terms of convenience and cleanliness, they are easier to maintain and operate than traditional fireplaces. At the same time, the use of pellets leads to a reduction in greenhouse gas emissions. Their only disadvantage is the higher initial investment.

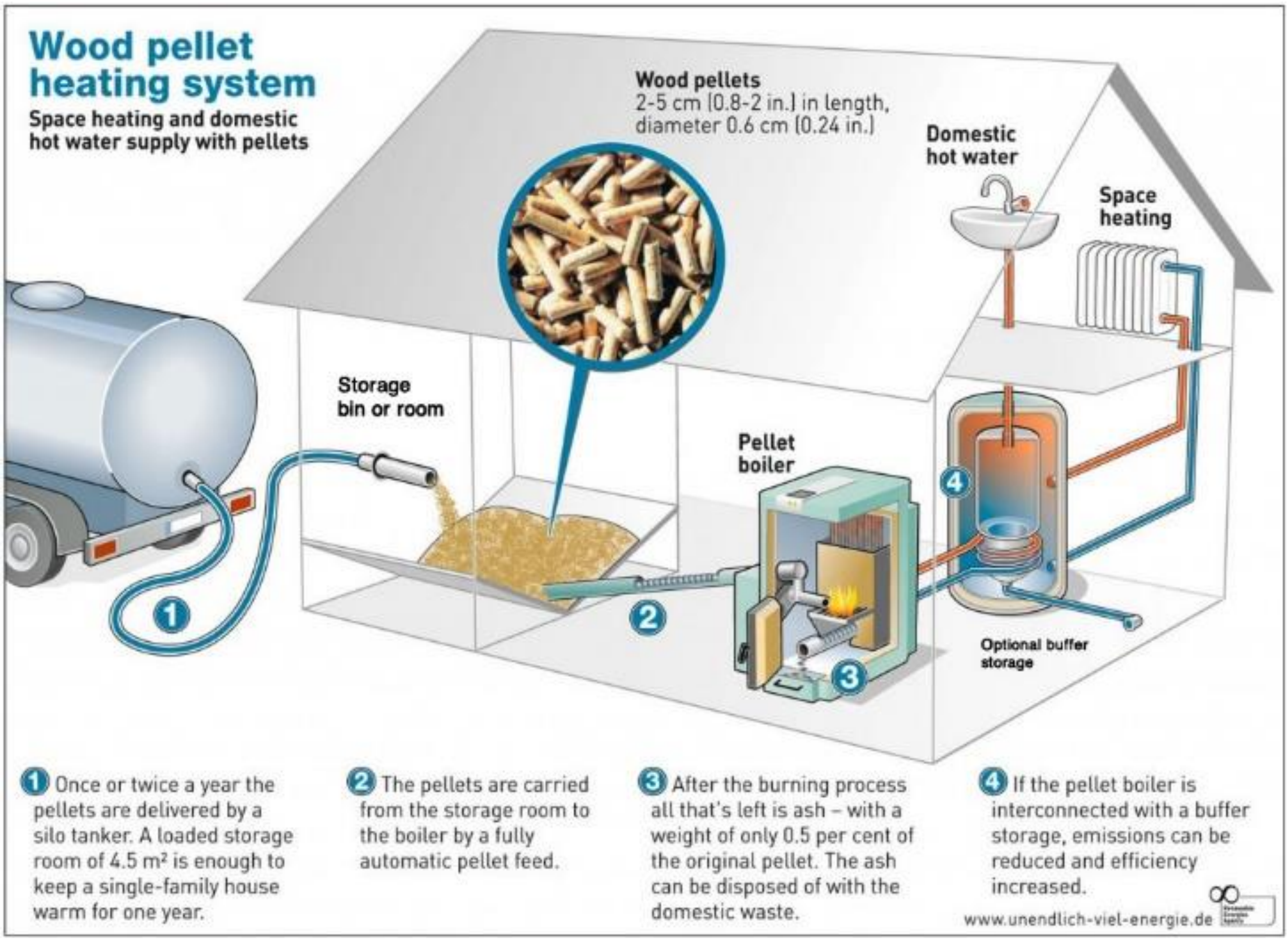


Figure 1. Wood pellet heating system (Source: Biomass Magazine)

As of 1 January 2022, reference Regulation (EC) 2015/1185, specific eco-design requirements are imposed for heating local solid fuel heating sources, namely: the seasonal energy efficiency of heating of local heating hot-fuel sources with a closed combustion chamber using pellets must be at least 79%. Seasonal energy efficiency means the relationship between the heating load covered by a local heating fuel source and the annual energy consumption required to cover this load, expressed as a percentage.

- **Condensing gas boilers**

Condensing boilers, powered by gas or oil, function as water heaters with high efficiency, typically exceeding 90% of the higher heating value. Their efficiency is achieved by condensing water vapor in the exhaust gases, recovering the latent heat of vaporization that would otherwise be wasted. The condensed vapor exits the system as liquid water through a drain.

In a conventional boiler, fuel combustion produces hot gases that pass through a heat exchanger, transferring much of their heat to water and raising its temperature. Water vapor (steam) is a byproduct of burning the hydrogen content of the fuel. A condensing boiler enhances efficiency by extracting additional heat from waste gases through condensation of water vapor to liquid form, recovering its latent heat of vaporization. This process can result in a typical efficiency increase of 10-12%. The effectiveness of condensation varies based on the temperature of the water returning to the boiler but is always at least as efficient as a non-condensing boiler.

Manufacturers of condensing boilers claim potential thermal efficiency of up to 98%, in contrast to 70%-80% with conventional designs (based on the higher heating value of fuels). Typical models achieve efficiencies of about 90%, placing most brands of condensing gas boilers in the highest available categories for energy efficiency

In terms of economy and environmental friendliness, gas heating is one of the most practical solutions for the home. Despite the economy and environmental friendliness, natural gas heating remained a less popular solution due to the poorly developed gas distribution network. The modern market offers a wide range of gas heaters with automatic (using a sensor) and manual control.

Condensing boilers - general characteristics

The condensing gas boiler uses not only the heat from the combustion of the gas, but also the heat released when the water vapor in the fuel condenses

- Burner modulates: in the range from 12.5 to 100 % of the maximum power, which means high efficiency even at lower load
- Automatically adapts to required heat.

Single circuit boilers

- works only in heating mode.
- They have the option of connecting to an external boiler with a coil for heating hot water for DHW

Double-circuit boilers with direct heating of domestic hot water

- hot water is heated according to current consumption
- no heat loss
- water does not stagnate in the boiler.

Double-circuit boilers with built-in water tank

- with larger dimensions, but provide higher comfort of hot water without an additional boiler
- completely eliminate the need to wait for the water to heat up and provide a sufficient amount of hot water at the moment.

- **Oil boilers**

A boiler serves two primary functions: heating the air inside a home and providing hot water. In the case of an oil boiler, the combustion of oil in the combustion chamber warms up cold water through a heat exchanger. The process is similar to that of a gas boiler, and oil boilers can approach the efficiency levels of gas boilers. Building regulations mandate that new oil boilers must have an energy rating of at least 86%, or A+, and a condensing oil-fired boiler typically achieves an efficiency of 90% or higher. Oil is considered a more efficient fuel than gas because oil boilers utilize nearly all the heat generated from burning fuel, minimizing wastage.

The primary distinction between a gas and an oil boiler lies in how they store their fuel. A gas boiler, connected to the mains, has a continuous fuel supply and doesn't require fuel storage. Conversely, an oil boiler necessitates a tank to store oil until needed. Despite their efficiency, oil boilers are often considered less environmentally friendly compared to gas or electric alternatives.

In new buildings, oil heating systems are increasingly rare due to their overall inefficiency and higher annual heating costs, especially when compared to more efficient alternatives like heat pumps. A new condensing oil-fired boiler typically achieves an efficiency rating of 92% to 93%, surpassing non-condensing boilers at 85%, and older systems at 60% to 70%. Replacing an old heating system with a high-tech heat pump can lead to significant savings, with a potential 30% reduction in annual heating costs when utilizing outdoor reset control and proper heat loss calculation, and over 270% compared to a modern heat pump.

3.1.3 Heat pumps

Heat pumps offer exceptional energy efficiency, operating similarly to refrigerators or air conditioners. They extract heat from sources such as the surrounding air, geothermal energy from the ground, water sources, or waste heat from industrial processes, amplifying and transferring the heat to the desired location. This method of transferring heat is more efficient than generating it, making heat pumps more cost-effective than traditional heating technologies like boilers or electric heaters. The coefficient of performance (COP) for a typical household heat pump is around 4, indicating that the energy output is four times greater than the electrical energy used to run it. This makes current models 3-5 times more energy efficient than gas boilers. Heat pumps can also be combined with other heating systems, commonly gas, in hybrid configurations.

There are various types of heat pumps, each with its unique characteristics:

1. **Air-to-Air Heat Pump:**
    - Transfers heat from the outside air to the air inside the home, increasing room temperatures.
    - Efficiency varies with outside temperatures, being less effective at lower temperatures.
    - Quick to install and does not require complex installations.
    - Does not heat water, requiring an alternative method for domestic hot water (DHW).
    - Requires a heat pump for each room needing heating or cooling.
2. **Air Source Heat Pump:**

- Transfers heat from the outside air to water, which heats rooms through radiators or underfloor heating.
- Can also heat water stored in a hot water cylinder.
- Absorbs heat into a fluid that passes through a heat exchanger, raising the temperature and transferring heat to water.

3. **Water Source Heat Pump:**
    - Uses heat energy from water for heating and hot water.
    - Two main designs: closed loop systems (lakes, lochs, or large ponds) and open loop systems (boreholes near rivers or suitable geological conditions).
4. **Ground Source Heat Pump (Geothermal):**
    - Transfers heat from the ground to heat the home and hot water.
    - Uses a loop of pipe buried in outdoor space, absorbing heat from the ground into a fluid that is then transferred to water.
    - Retains high efficiency even at low outside temperatures and is not affected by external factors.
5. **Hybrid Heat Pump:**
    - Combines a heat pump with another heat source, often a fossil fuel (gas, oil, or LPG) boiler.
6. **Cascaded Heat Pump System:**
    - Allows multiple heat pump units to work together to meet heating and hot water requirements.
7. **Exhaust Air Heat Pump:**
    - Transfers heat from a ventilation system to warm air that heats the home.
    - Can be used to heat water stored in a hot water cylinder, reducing the need for a wet central heating system.

Each type of heat pump has its advantages and is suitable for specific applications, offering environmentally friendly and energy-efficient solutions for heating and hot water needs.

Choosing a heat pump involves considering various factors, including costs, efficiencies, installation practicality, and available space. Here are key considerations.

Cost of heat pumps

- The installation cost varies between air source and ground source heat pumps.
- Common cost factors include the size of the dwelling, whether it's a new or existing building, preparation work needed for conversion, and potential radiator upgrades for improved efficiency.
- New builds with fulfilled efficiency standards can help keep costs down.

Efficiency

- Heat pump efficiency is influenced by the 'source' temperature (air, water, or ground).
- Air source heat pumps work with air temperatures ranging from -5°C to 25°C for most of the year.
- Ground source heat pumps extract heat from the soil, where temperatures don't reach as high but generally stay above 5°C throughout the year.
- Air source heat pumps can be more efficient in certain periods, but ground source heat pumps tend to be more efficient over the entire year.
- Ground source heat pumps are more efficient during extremely cold temperatures, making them a better option in colder climates.

3.1.4 Individual electric heaters

Traditional electric heating appliances are typically: fan coils; electric radiators: oil, water, dry (air); accumulating stoves; air conditioners. The air conditioners are modern heating systems that consume 3 to 4 times less electricity than the energy they bring into the heated / cooled room. In contrast, electric heaters, accumulator electric heaters, convectors and fan coils consume as much electrical energy as heating energy they provide.

The typical installed power of the electric heaters is shown in the following table.

Table 3. Typical installed power of the most prevalent electric heating appliances

Electric heating appliances	**Installed power, Watt**
Calorifier	2000
Fan coil	2400
Electric heater	2000
Accumulating electric heater	3000
Air conditioner 9000 BTU	950
Air conditioner 12000 BTU	1250
Air conditioner 18000 BTU	1750
Air conditioner 24000 BTU	2600

3.1.5 State of the art energy efficiency level of different devices

Different types of individual heating devices considered to be efficient include:

Table 4. Efficiency and power of different types of individual heating devices

DIRECT HEATING DEVICES	EFFICIENCY	INSTALLED POWER
PELLET HEATING DEVICES		
• **Hot air pellet fireplace**	88-92 %	6 / 8 / 10 / 12 kW
• **Pellet fireplace with water jacket**	88-92 %	12 / 18 / 25 kW
• **Pellet boiler**	88-92 %	15 / 25 / 35 kW
NATURAL GAS HEATING DEVICES		
Natural gas condensing boilers		
• **Single-circuit natural gas condensing boiler**	90-95 %	16 / 24 / 28/ 35 kW
• **Two-circuit natural gas condensing boiler**	90-95 %	24 / 35 kW
• **Condensing gas boiler with built-in water heater**	90-95 %	24 / 35 kW
Gas convectors		
• **Gas convector**	90-95 %	3 / 5 kW
ELECTRIC HEATING DEVICES		
• **Air Conditioners (A2A heatpump)**	350 to 470 %	9000 / 12 000 / 15 000 / 24 000 / 30 000 BTU

The most important feature of how individual units are characterised is their overall and seasonal efficiency. Nevertheless, the price efficiency is also a function of the price of the energy carrier

3.2 Electricity usage within households

3.2.1 General information

The distribution of electricity use can vary significantly based on individual habits, energy efficiency measures, and regional climate differences.

Household`s electricity consumption depends on:

- The number of people in a household
- Whether the household uses electricity as a heating means and the number of heating appliances;
- Whether the water is heated by an electric boiler;
- What type of food preparation is used;
- the energy efficiency of the lighting fixtures;
- Efficiency of appliances.

The distribution of electricity consumption in households depends mainly on the way of heating. As it was already presented above, the highest share of the final energy consumption in households takes the space heating (64,4%), followed by water heating (14,5%) and lighting and appliances (13,5%).

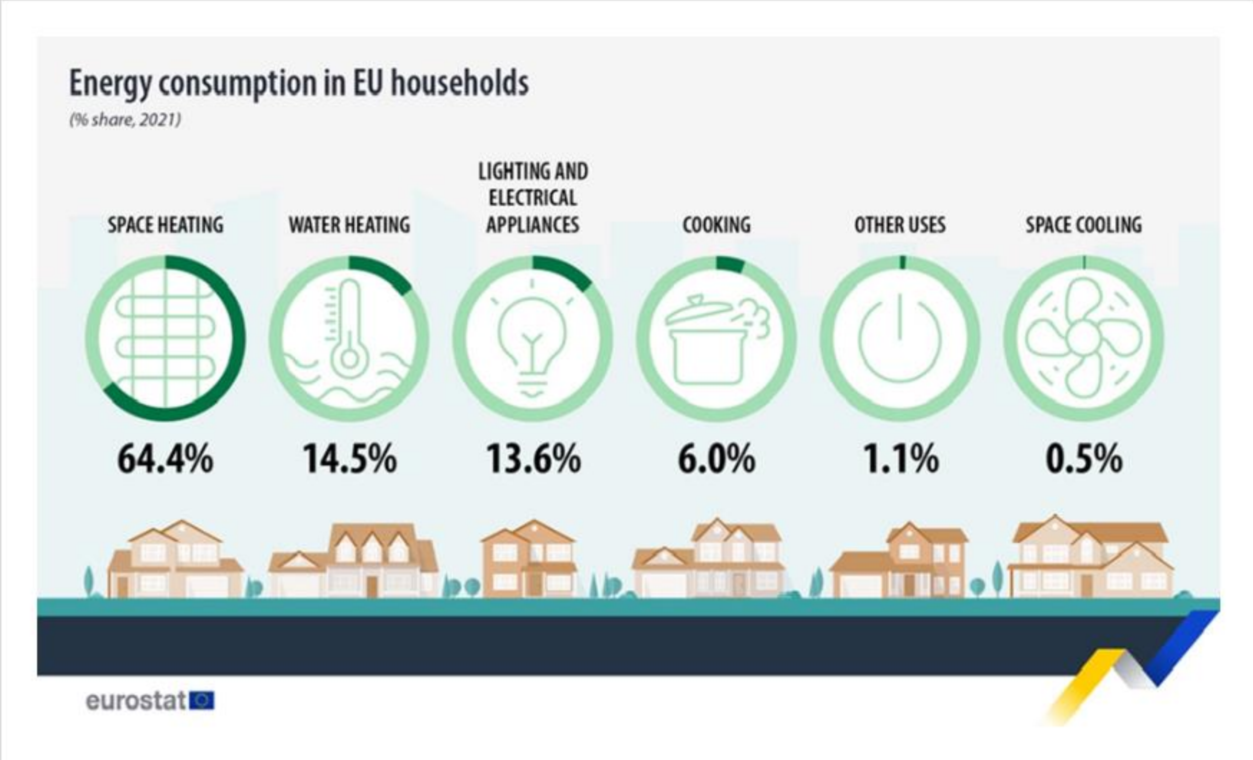


Figure 2. Distribution of energy consumption in EU households

Certainly, in some EU countries with warmer climates, cooling can be a significant portion of electricity use in households.

As it can be seen the fields with the highest potential for energy saving are domestic hot water, cooling, lighting and refrigeration appliances.

3.2.2 Refrigerators

Refrigerators and freezers are some of the biggest energy consumers in a household because of their constant work. The average temperature inside a refrigerator is between 2°C and 8°C.

- **Decreasing the temperature by one degree increases energy consumption by 6%.**
- **Therefore, the internal temperature setting should not be below 7°C. This saves about 30% of electricity compared to an internal temperature setting of 2°C.**

As a rule of thumb, a four-person household with an old refrigerator (12 years of more) or refrigerator-deep freeze chest will consume up to 700 kWh per year. By comparison, a new particularly energy-saving combined refrigerator-deep freeze with a refrigerator volume of more than 190 litres and a freezer section of 92 litres requires only around 200 kWh per year. Deciding in favour of purchasing energy-saving appliances saves around two-thirds of the electricity required.

The main reasons for the high electrical consumption of refrigeration equipment are the following:

Table 5. Main reasons for the high electrical consumption of refrigeration equipment

High electricity consumption due to	Reason
Poor thermal insulation	Old appliance
Unsealed door	Amortisation
High outdoor temperature	Wrong location
Too low temperature	Incorrect setup
Poor heat dissipation	Insufficient ventilation
Ice on the internal wall	Poor support

3.2.3 Domestic hot water

Domestic hot water refers to the heated water used in bathrooms, showers, and kitchens that flows from taps. In apartments, independent conventional water heaters are commonly powered by electricity or gas, with the latter often integrated into the heating system. The standard temperature for domestic hot water heating is typically set at least between 50 to 55°C in the boiler, although some heaters may only heat up to 40°C. Heating systems can be categorized as conventional or unconventional (innovative).

A. Conventional systems

Conventional systems can be flow-through (using electricity or gas) or tank (using electricity only), while unconventional systems are usually tank-based.

- Flow-Through Systems: Activated upon demand, these systems use electrical resistance or combustion (for gas heaters) to heat water. While designed for delivering small amounts of water at a single point, they minimize heat loss as the water is used immediately.
- Tank Systems: Involving volumetric water heaters with capacities of 60 to 100 litres, water is heated and stored in an insulated container. However, this storage can lead to heat loss (2 to 5%). Energy consumption can be adjusted based on factors like water temperature and off-peak tariffs..

B. Efficiency and Innovation systems

They can be distinguished in condensing gas boilers and innovative systems:

- Condensing Gas Boilers: The efficiency of these boilers for hot water, particularly in complex models, can reach up to 95%. Efficiency is influenced by the heater's location, the distance hot water travels, and the desired water temperature. Conventional hot water systems, especially electric water heaters, are considered to have reached their peak efficiency.
- Innovative Systems: Recent water heaters incorporate heat pumps, solar thermal systems, or a combination of both. Despite the presence of a tank leading to some heat loss, these systems are more efficient, providing cheaper hot water.

Regardless of the method used for domestic hot water, be it electric water heaters, centralised heating plants, gas boilers, or other systems, the provision of domestic hot water represents the second-largest expense in the total energy costs for each household. This highlights the importance of exploring innovative and energy-efficient solutions to optimize the cost-effectiveness of hot water provision.

3.2.4 Washing machines and dryers

Energy consumption of washing machines

Around 5% of the electricity consumed in the household is required for washing laundry. The greatest part of this is for heating the water. A washing machine requires a small part of the energy input (10 to 20%, according to the wash program) for the rotation of the washing, while the greatest part serves to heat the soapy water.

The energy requirements for a washing cycle increase with the amount of water and the washing temperature. The amount of water required for a washing cycle depends upon the machine, but also upon the selected wash program. In earlier times more than 100 litres of water flowed through the machine for a standard 60 °C wash program. Today, only somewhat less than 40 to 50 litres are required for five or even six kilogrammes of laundry.

The electricity consumption of a conventional old washing machine does not depend upon the filling level; that is, when only half loaded with the normal washing program, the washing machine requires the same amount of electricity as with a completely filled drum. If washing with only a partially loaded washing machine is unavoidable in your household, the most economical washing machines are those which adapt the amount of water to the amount of laundry. In new washing machines, this so-called automatic capacity regulation is already standard. However, a half-full washing machine still requires considerably more electricity per kilogramme of laundry than a small, but full washing machine.

Washing temperature

The energy consumption per washing cycle depends strongly on the washing temperature, as shown in the following table.

Table 6. Consumption and costs per washing cycle according to washing temperature

Washing temperature	Required electricity for each use
30°C	0.35 kWh
40°C	0.50 kWh
60°C	0.95 kWh
90°C	1.70 kWh

The selection of the best-suited wash program according to the type of textile and the level of soiling determines the consumption. As a rule, even for heavily soiled textiles, no pre-washing is required. At 95 degrees without pre-washing around 40% of the energy consumed can be saved. In view of the washing effectiveness of today's washing machines, the 60° program is sufficient for white laundry (underwear, hand towels). The 95° C program requires nearly double the energy of the 60° program.

Energy-saving programs

The different extra programs, such as the short program, the energy-saving program or the optimisation of the spin speed, can save energy. With energy-saving programs longer soaking times are used in place of high washing temperatures. Examine the times required for the respective wash programs in the user's manual. The so-called energy-saving program sometimes turns out to be more energy-intensive than, for example, the short program for lightly soiled laundry.

3.2.5 Energy and water consumption of dishwashers

Dishwashers require electricity to heat the water. This fraction constitutes around two-thirds of the consumption per washing cycle. Reducing the temperature of the dishwasher from 60°C to 50°C consumes around 30% less electricity.

When fully loaded, large dishwashers with space for 10 to 14-place settings are more economical in terms of electricity consumption than smaller dishwashers with space for seven to nine-place settings. There are usually programs for different degrees of food residues, which differ according to temperature (40 – 70°C), washing time (approximately 30 – 120 minutes) and energy required. However, nearly every dishwasher has special program settings, and the program times can be very different. By using energy-saving programs for these appliances, equally good results are obtained with longer washing times at lower temperatures, with less energy consumption than with shorter washing times at higher temperatures.

3.2.6 Energy consumption for cooking

The average power of an electric stove is 1000 to 1500 Watts (small hot plate), up to 2200 Watts (large hot plate) per hot plate in use. The oven has a power of around 2 kW. Thus, cooking one hour with a large hot plate consumes between 2 and 2.2 kWh of electricity. In terms of energy consumed, gas is more favourable for cooking, as the entire chain leading to the conversion of energy (e.g., coal) to electricity is no longer required.

Table 7. Typical annual electricity consumption for cooking, depending on the household size (Source: VDEW)

Household size	**Annual electricity consumption for cooking**
1 person	200 kWh
2 persons	390 kWh
3 persons	450 kWh
4 persons	580 kWh

Different efficiencies are found according to the type of cooking hob. The higher the efficiency, the greater the amount of heat directly supplied to the food being cooked in the cooking vessel and not only to the hot plate itself. Heating to the required temperature consumes between 70 and 80% of the electricity consumed, leaving only 20 - 30% for further cooking, particularly when the hot plate step is reduced in due time.

3.2.7 Air-conditioners for cooling

Classified by efficiency, the air conditioners rank:

- Conventional - these air conditioners do not change the power they give
- Inverter - these air conditioners change their power smoothly, allowing them to operate in an optimal mode.
- DC inverters – this is a variation of the inverter air conditioner, whose compressor is very efficient, which is reflected in increasing the efficiency of the whole machine and reducing the consumption of electricity.

The required installed power of the air conditioners for premises with different heated volumes is given in the following table.

Table 8. Required installed power of air conditioners

Space dimensions	Required power
< 50 m^3	2,0 kW
50-60 m^3	2,7 kW
60-90 m^3	3,5 kW
90-120 m^3	5,0 kW
120-170 m^3	7,0 kW

3.2.8 Lighting in households

Lighting in an average household represents about 10% of all energy consumption. The potential for savings in lighting is very high. Energy-saving lamps (LED lighting) can reduce annual consumption by half – from 200 kWh to 100 kWh without loss of comfort.

The many terms used in connection with lighting can be downright confusing. In the following box, the most important terms for the energy-saving check are briefly introduced and their meaning made clear:

Luminous flux - Luminous flux refers to the amount of light which a lamp produces. Luminous flux is measured in lumens (lm). The higher the number of lumens produced by a lamp, the brighter the lamp. Since 2010 the lumen output of energy-saving lamps must be specified and is now generally found on the packaging.

Illuminance - The basic parameter for the planning of lighting systems is the required illuminance. The illuminance expresses the amount of light falling on a surface. It is measured in lux (lx). Lux = lumen per square meter. For the workplace, different minimum illuminances are specified according to application. These vary from 50 lux in corridors and 200 to 500 lux in typical working areas to 1500 lux in Quality Control. An illuminance between 20,000 and 100,000 lux is required on the surface of an operating room table.

Luminous efficacy - The so-called luminous **efficacy** of a lamp describes the amount of light produced in relation to the required energy input. It is calculated as the ratio of the luminous flux (lumens) to the electrical power input (Watts).

Luminous efficacy = Lumens per Watt

The higher the "lumens per Watt value" (lm/W) of a lamp, the better the energy efficiency. This value is therefore a measure of the lamp's efficiency.

3.3 Intelligent/smart meters and systems for energy management in households

There are some good practices for reducing energy consumption in households as analysis of current energy consumption and calculation of costs by compiling a list of electrical appliances (especially energy-efficient goods) in the home:

- The rising cost of energy is just one of the many reasons why a change in thinking is essential. In general, we consume much more energy than we really need. To address this, there are many useful tools for measuring energy consumption. While awareness of the problems can help the consumer to save energy, the analysis and monitoring of energy consumption is crucial to save energy.
- The lack of information is an obstacle to saving energy for consumers. It is a barrier on two levels: consumers do not have information about the energy consumption of their household appliances, as well as how this consumption can be reduced. **By using intelligent equipment and feedback on the individual consumption patterns of their appliances, consumers will be given a very easy way to learn how much energy their appliances use**. Smart energy meters allow consumers to monitor the level of energy savings by changing their energy habits. Seeing this immediate effect is one of the most motivating ways to change habits.

Figure 3 Programmable thermostat as an application (Source: www.mothlighting.com)

- The **thermostat** is a device that automatically responds to changes in ambient temperature by turning on or off a heating or cooling system to constantly maintain a set desired temperature indoors. The biggest benefit of using the thermostat is the ability to set different temperature regimes and schedules. When the operation of the heating or cooling system or appliances is optimized, significantly less energy is used in the long run.
- **Temperature control** - it is possible to set a lower temperature (heating during the day when you are not at home and at the same time a program) (with digital thermostats) to reach and maintain a comfortable temperature when you get home, thus saving energy during your absence.

4 Renewable energy sources in households

Renewable energy, often referred to as clean energy, is energy that comes from natural sources or processes that are constantly replenished. For example, sunlight and wind, even if their availability depends on time and weather.

4.1 Solar energy

Solar energy is the most prominent technology for energy self-consumption, in particular solar PV, though solar thermal is also widespread. Solar energy is used both for hot water, as well as for electricity generation. Solar PV generates electricity directly from the sun using solar panels that are integrated into building structures, on the roof, walls or even windows (using transparent panels). Solar PV can be used directly in the building, fed into electricity networks or stored on-site. Today solar energy is also financially competitive.

4.1.1 Solar energy for hot water

Solar thermal energy is formed by the conversion of solar radiation into heat. This energy can be used directly for heating or indirectly for electrical energy by generating steam that drives generators. **However, the main use of solar collectors is for warming up water for domestic purposes.** There are two types of solar collectors: vacuum-pipe and plate panels as the vacuum-pipe collectors have always been the most efficient power generation systems.

Despite the increasing demand for solar collectors, modern manufacturing techniques have led to cost savings, so vacuum technology offers the greatest return on investment compared to any other solar system.

4.1.2 Solar energy for electricity production

Photovoltaic solar energy is formed by the transformation of light into electricity through semiconductors. A solar cell, or a photocell, a photoelectric converter, is a semiconductor device that converts light energy into electrical. This is one of the most environmentally friendly ways to extract electrical energy. The generated electricity can be used either at the moment or stored in batteries. A typical photovoltaic system employs solar panels, each comprising a number of solar cells, which generate electrical power. PV installations may be ground-mounted, rooftop or wall-mounted. The mount may be fixed, or use a solar tracker to follow the sun across the sky.

Nominal power of the PV installations

The maximum amount of energy a cell can produce (module) is called nominal / peak power (Wp). Generally, the amount of electricity produced is proportional to the amount of light falling on it: the greatest is direct radiation - strong sunlight without clouds. Peak power is defined under standard test conditions: 1000 W / m² sunshine and cell temperature 25 ^{o}C.

The required area to generate 1 kWp for different cell types is usually 2,5 m².

Influence of temperature on cell performance

Cell efficiency decreases with increasing temperature. Energy production declines by 0.5% with each degree Celsius increase in the temperature. At 30 °C, it decreases by 15%. Crystalline cells are more sensitive than thin films. In the amorphous silicon, productivity decreases by 0.2% every degree in the temperature range promotion. In summer, the module's temperature may reach 40-70 °C. Therefore, the modules should be kept as cool as possible. Cooling is very important! In fact, on a sunny winter day, the production peak may be higher than on a hot summer day.

Other factors affecting cell efficiency - *loss of reflection* - part of the radiation is reflected by the surface of the cells - decreases with anti-reflex coating; - *the radiation is not ingested* - part of the radiation does not have enough energy to emit electrons from the atoms; - *the radiation is too strong* - if the radiation has more energy to break off electrons, *excess energy is lost* - the cells are heated; temperature, shading, premature recombination before reaching P / N transition, electrical loss.

The main components of a photovoltaic system are:

1. Photovoltaic panels
2. A supporting structure
3. Inverter
4. Monitoring and control devices
5. Batteries (optional)

Photovoltaic panels

The photovoltaic panel converts the solar radiation into a constant voltage. There are different models and manufacturers of panels. Most manufacturers and importers offer a wide range of power from 50Wp to 670Wp.

The panels should be installed in lighted, unshaded places, with their orientation facing South, East and West. In home systems, the panels are most often installed on the roofs of buildings.

The panels are connected in series by grouping them in strings. The parameters of the string are determined according to the inverter that is used.

It is important during the installation of the panels that there is no shaded panel from tall trees, chimneys or other protruding things, because the shaded panel worsens the performance of the entire string, the entire row.

Construction

An additional construction is used for the installation of the panels. It depends on the place where the panels will be installed, which also determines their type. The most common types of constructions are:

- Tile roof construction
- Flat roof construction with counterweights or anchoring
  - Orientation - East / West
  - Orientation - SOUTH
- Construction for thermal panel or sheet metal
- Ground structure

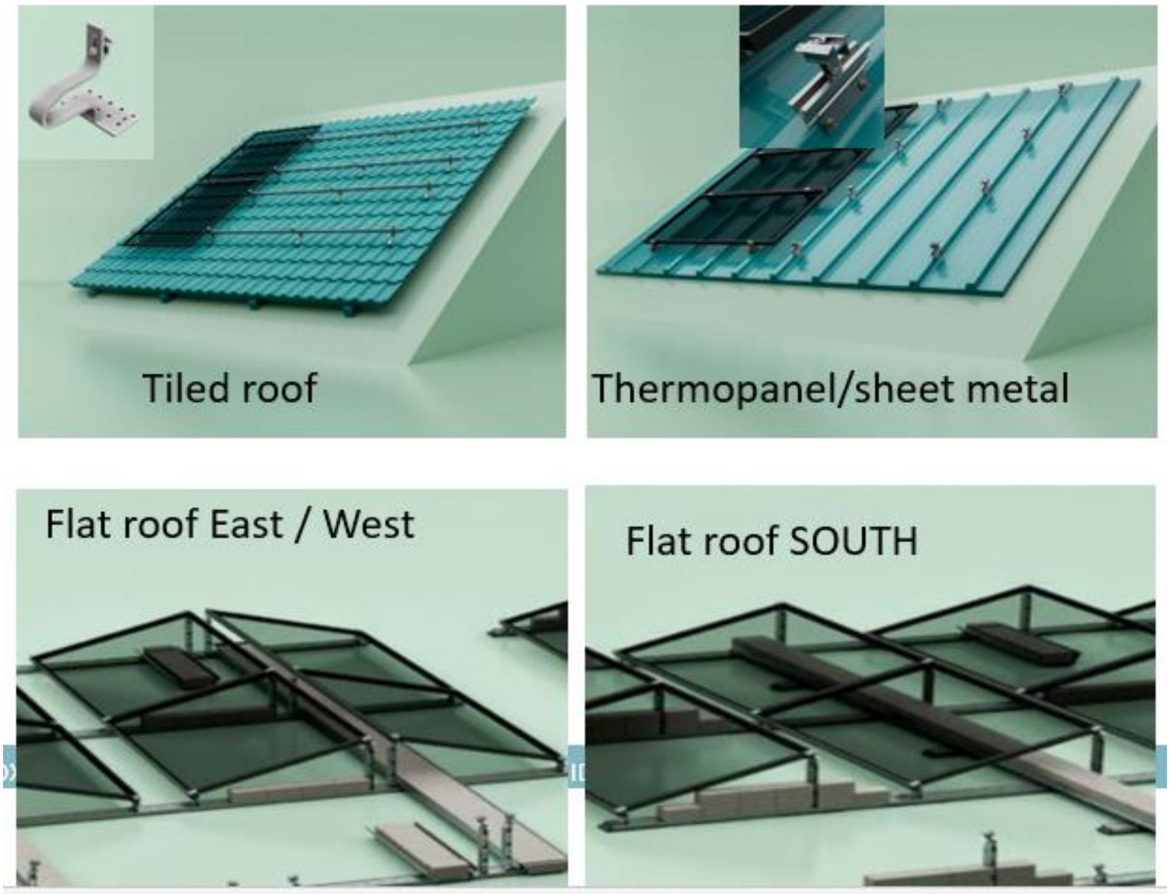


Figure 4. Different types of PV construction (Source: Kukov and Co Ltd.)

4.2 Geothermal energy

Geothermal, or "warmth on the ground", boreholes are needed to reach the heat. The depth of drilling depends on the temperature. In shallow drilling, the temperature is too low to be used directly for heating. Then a heat pump is needed to raise the temperature. Geothermal heat pumps are used mostly in places that are poor in sunlight and are an alternative to the solar system. The geothermal installation works contrary to the refrigerator principle. It delivers a compressive force to the compressor, which compresses a refrigerant, which in turn absorbs heat by evaporation in the environment.

There are two ways to extract geothermal energy:

- Drilled geothermal heat pump
- Geothermal heat pump with flat collector

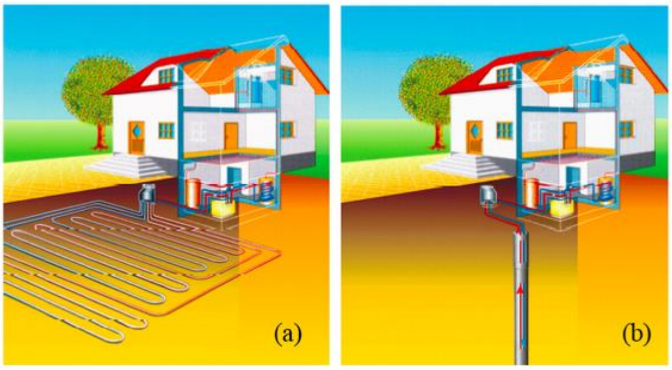


Figure 5. Different types of geothermal installation (Source: avelim.co.il)

A flat collector occupies considerable space, so it is good to plan it right from the start of the project. This system consists of pipes that are laid at no more than a meter and a half depth. For a single-family house, between 200 and 400 square meters of collector area are required in dry, clay soil. By rough estimate, the collector system's dimensions must be at least twice the area of the house.

For optimal use, moist soil and regular sunlight are most suitable, as most of the energy produced is stored in the ground. Soil and extraction capacity of flat collector:

- Dry, sandy soil: 15W / m
- Wet, sandy soil: 20W / m
- Dry, clay soil: 25W / m
- Wet, loamy soil: 30W / m
- Ground over groundwater: 35W / m

For a meter drilling, the probe generates up to 80 watts of energy. Soil and groundwater play a key role in reducing productivity; in dry areas, it can fall to less than 20 watts per meter. Different soil and thermal yield in watts per meter:

- Dry, sandy: 20W / m
- Wet, sandy: 40W / m
- Wet, rocky: 60W / m
- Groundwater: 80W / m

Advantages of using a geothermal heat pump installation:

- the unit price of a heating system with this type of system is 4-5 times lower than the price of conventional electric heating and about 2-3 times the use of other fuels;
- no fuels used for heating - no dependence on the price of the respective fuels;
- not affected by atmospheric conditions;
- No emissions; - the energy source is always available;
- easy maintenance and operation.

Requirements prior to installation of the geothermal heat pump:

- Studies before installation of the respective installation type are required
- Required water flow – 24-hour sample pumping from the wells;
- water temperature - at a depth of 20m, the temperature is about 10°C. Significant deviations from this value are a sign of permeate surface water in the underground;
- physicochemical composition of water - analysis in an authorized laboratory;

- determining the required number of wells and their location in order to ensure the necessary water flow.

4.3 Biofuels

Biofuels are the oldest source of energy used for heating, cooking or producing electricity. They are considered a renewable resource if the yield of material does not exceed the rate of growth of biomass. Biofuels are all types of liquid, solid and gaseous fuels that are produced from biological raw materials, and include wood from biomass crops, agricultural and forestry residues, bio-diesel, ethanol and methanol, and biogas from anaerobic digestion processes. According to the aggregate state biofuels could be:

- solid biofuels such as wood, wooden pellets, briquettes, chips, etc.
- liquid biofuels such as bioethanol and biodiesel
- gaseous biofuels - biogas and biomethane; syngas

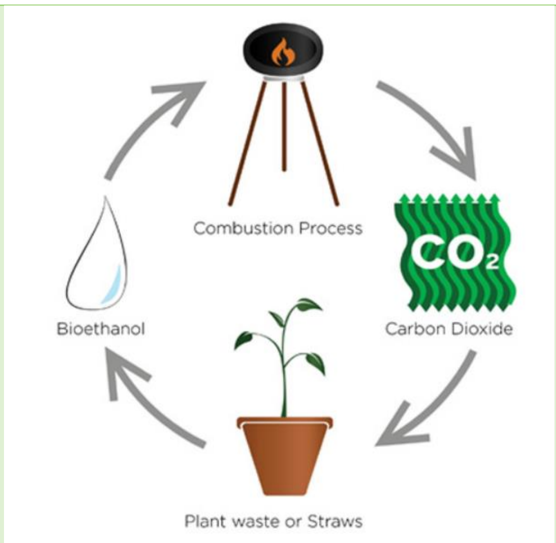
On a global scale, the demand for fossil fuels is increasing, but at the same time, the trend is to reduce their production, due to the limited deposits and the exploitation of increasingly difficult-to-access deposits. The massive use of conventional fuels leads not only to a drastic reduction of the available quantities but also to negative consequences for the environment, which directly reflect on the health of the population and the quality of life. The goals of modern society are aimed at ensuring the security and diversification of energy supplies, developing alternative sources of fuels, improving the technologies for their absorption and processing and, last but not least, reducing emissions of greenhouse gases.

Different types of bioenergy can be used for different purposes, as shown in the following table.

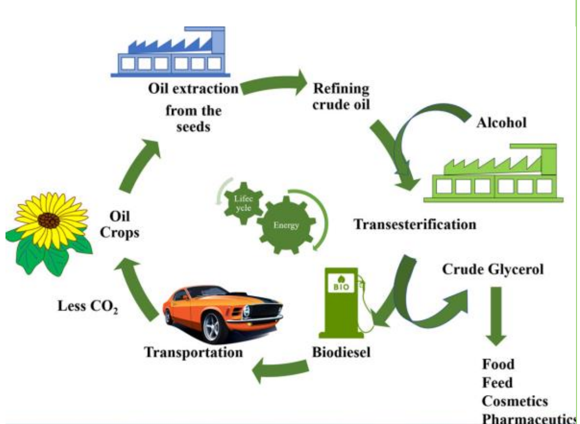
Table 9. Types of bioenergy and uses

Different types of biofuels	
	**Wood pellets** - made from dried and milled waste, pressed under high pressure and at high temperature, in the form of small cylinders. They do not contain adhesive substances. Lignin, which is contained in plant tissues at temperatures above 100 ° C, softens and allows the material to acquire the corresponding shape, as it appears, as a natural glue that supports the shape of the pellets. Basic Parameters of Wood Pellets: • **ash content**: because it is of natural origin, biomass has a certain amount of non-combustible Basic Parameters mineral mass that is naturally absorbed or mechanically encapsulated in the final product. Wood pellets are produced from the core of the wood. When the bark comes into them, the ash content increases and their quality is reduced. The ash content of woody biomass is less than that in cereal crops.

	• **moisture content -** the moisture content is mainly 8 ÷ 10%, which guarantees the mechanical strength of the fuel; • **mechanical resistance** - this parameter characterizes its resistance to shredding during transport. The high mechanical strength of the pellets guarantees a lower degree of pellet crushing and trouble-free operation of the feeder mechanisms. Different equipment requirements for mechanical resistance are different and should be taken into account when buying fuel.
	**Wood briquettes** - a product similar to pellets (obtained identically to wood pellets) but with a larger diameter (Ø 40-80 mm). Various feedstock can be used to produce them. Depending on this, the briquettes can be of deciduous wood (oak) or of coniferous wood (pine), etc. As with pellets, the production process of wood briquettes involves several stages: crushing the raw material, drying and pressing. Basic Parameters: - Ash content is <1.5%. - Calorific value ~ 4500kcal / kg
	**Wood chips** – a product that is produced by mechanized chipping of wood. Wooden chips are raw materials, which are made from inferior waste wood (wood pulp), pre-cut logging wood and / or wood for felling that is not suitable for woodworking. Wood chips are the main raw material for the production of paper and corrugated cardboard and in the last years, it has been used mainly as an energy raw material. Depending on the type of wood, wood chips can be made from hardwood (beech, oak, hornbeam, etc.) or softwood (pine, fir, poplar, etc.). The difference in chips obtained from different tree species (soft and hard) is mainly in density and, accordingly, inenergy value.
	**Sunflower pellets** - a product made from secondary raw materials. They are harvested from sunflower seeds, which are waste from oil-producing plants and nut-production plants (roasted peeled sunflower seeds). The technology for their pelleting is very similar to that of wood pellets. The difference is that sunflower flakes are of lower humidity (10-15% sunflower is used for the production of sunflower oil or nuts). Basic Parameters: Energy value: 5.1 kW / kg (14.76 MJ / kg, 3525 kcal / kg) Humidity: 10-15% Density: 350 kg / m³ Dimensions: Ø 6 mm x 10-25 mm Ash content: 5% Unit of measure: t (ton) Price: 215 leva / ton (VAT included) Packaging: Bulk or Big Beg (1.2 x 1.2 x 2 m)



Bioethanol– energy from plant and animal matter (often blended with petrol or diesel) used for heating or transport fuel (e.g., bioethanol used in a commercial vehicle). Bioethanol
Bioethanol is produced from plant sugar crops, starch or cellulosic raw materials. The main technology for converting biomass into ethanol is fermentation followed by distillation. Ethanol is currently produced in large quantities by fermenting sugar or starch residues from agricultural raw materials. The crops used for ethanol production vary by region and can be: sugar cane, wheat, corn, sugar beet, wine grape residues, etc. The main material for bioethanol is sugar, from which, with the help of enzymes and a yeast fungus, alcohol is obtained.
Bioethanol is primarily used as a fuel additive to reduce carbon monoxide and other harmful emissions emitted by vehicles. Statistics show that using a ten percent bioethanol additive to gasoline results in a 30% reduction in carbon monoxide content, up to 50% in exhaust particulate matter, up to 19% in greenhouse gases, and up to 25% in smog. Overall, exhaust gas toxicity is reduced by about 21%



Source: Recent advances in biodiesel production: Challenges and solutions (https://www.sciencedirect.com/science/article/abs/pii/S0048969721038237#ab0010)

Biodiesel
Biodiesel is produced by the esterification of vegetable oil extracted from oilseed crops - rapeseed, soybean and sunflower. Esterification involves the transformation of vegetable oil molecules into molecules similar to diesel hydrocarbons – an expensive process that makes biodiesel more expensive than mineral diesel. Usually, 1t of oil and 110kg of methanol produce 1t of biodiesel and 110kg of glycerin. The characteristics of biodiesel are very close to those of mineral diesel. The bio variant can be used in existing diesel motor vehicles in a mixture with mineral diesel - in any proportion. Its energy content is lower by about 8%, but it has a higher fuel density and better ignition qualities. Biodiesel is absolutely compatible with any type of diesel engine.
The only problem that would arise is with older, unmaintained engines - as biodiesel is a good solvent, the old rubber hoses need to be replaced.

5 Thermal comfort in home

Households spend a large part of their budget on providing thermal comfort - in summer for cooling, in winter - for heating. But actually – what does thermal comfort mean? Are there any objective dimensions, apart from our personal feelings - as many people as there are sensations?

In response to this question, the definition given by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) is most often cited: "it is a state of mind that expresses satisfaction with the thermal environment and is assessed by subjective assessment". Simply put – when you feel good, neither cold nor warm, you are in your thermal comfort zone. At a higher temperature, you get tired quickly, if you are cold - you become distracted and restless.

The presence or absence of thermal comfort is essential not only for our psycho-physical balance:

- It determines productivity in each area, as well as occupational accidents and injuries;
- affects the incidence rates of socially significant diseases such as cardiac, respiratory, joint, etc.;
- it costs a lot of energy and financial resources.

This proves to be a sufficient reason for the achievement of optimal thermal comfort to be the object of the searches of investors, architects and designers, manufacturers of building materials and systems for air conditioning and ventilation, and builders.

Thermal comfort depends on the exchange of heat between the human body and its environment. These exchanges depend on six factors that are classified into two categories, namely environmental and individual factors.

There are different factors, which define indoor comfort:

Table 10. Factors determining the indoor comfort

Environmental factors	Individual factors
Air temperature	Person’s activity level
Air speed	Clothing thermal resistance
Humidity	
Wall temperature	
Indoor air quality	

Thermal comfort

Human thermal comfort is a crucial aspect of building design and is defined as the state of mind that reflects satisfaction with the surrounding environment. Engineers focus on ensuring thermal comfort in their plans for heating, ventilation, air conditioning (HVAC), and the building envelope. Several factors contribute to determining thermal comfort: indoor and outdoor air temperature, air movement (i.e. the circulation or movement of air within a space - stagnant air can lead to discomfort, while controlled airflow can enhance comfort), relative humidity (that is the amount of moisture in the air), clothing, activity level (e.g. spaces with varying activity levels may require adaptable HVAC systems), and room temperature.

Within an accommodation, to feel comfortable, advised temperatures are the following:

- 17 °C in the bedrooms to sleep well
- 19° C in the living room, the kitchen and the living rooms
- 22 °C in the bathroom

Other health problems

The following health problems are related to unsuitable indoor conditions and are included in the extended assessment of the health benefits of energy renovation:

- unhealthy housing syndrome
- heart attacks
- brain strokes
- respiratory diseases
- flu.

Indoor air quality

Many health problems that lead to poor health and reduced productivity can be attributed to poor indoor environmental quality, where poor air quality plays an important role. A room with good air quality means low odours and pollutants, as well as acceptable levels of CO_2 and humidity. Limiting and controlling the sources of indoor air pollutants, combined with adequate ventilation, are critical to ensuring good indoor air quality. A starting point for assessing indoor air quality can be the monitoring of certain parameters, such as the levels of volatile organic compounds, CO_2, ozone, nitrogen dioxide and particulate matter in a representative sample of public buildings. It should include schools and hospitals where vulnerable groups of the population spend a significant part of their time.

Humidity

Humidity, in the context of building environments, refers to the amount of water vapor present in the air. Various sources contribute to the humidity levels in buildings, including:

1. Exhalation of Occupants:
    - The presence of people within a space contributes to humidity levels. The amount of water vapor released through exhalation is influenced by factors such as the level of physical activity.
2. Utilization of the Room:
    - Different activities conducted within a room, such as cooking, drying clothes, working, or engaging in sports, can release moisture into the air. These activities impact the overall humidity of the indoor environment.
3. "Free Water" from Materials and Construction:
    - New buildings can introduce moisture through "free water", which comes from the materials used in construction and the manufacturing processes involved in building construction. This can include water present in construction materials and introduced during the building process.

To quantify and describe the amount of water vapor in the air, the concept of "relative humidity" is used. Relative humidity is a measure that expresses the percentage of moisture in the air compared to the maximum amount the air could hold at a given temperature.

Managing humidity levels in buildings is crucial for maintaining indoor air quality, preventing issues such as mold growth, and ensuring the overall comfort of occupants. A comfortable feeling for a human being is at a relative air humidity of around 50% (air temperature of 20°C). The air within an accommodation must be constantly renewed, for several reasons:

- Bring new air and ensure our oxygen needs
- Filter out the excess humidity (water vapour) produced by our activities
- Filter out the air containing odours and pollutants

Ventilation is therefore absolutely necessary to ensure health, security and comfort in any accommodation.

In the past, ventilation was naturally done by opening the windows, or through the walls which were hardly airtight. In more newly built accommodations, where walls are insulated, ventilation is done through mechanical systems, thanks to air intakes located on the doors and the windows, and extraction units, set up in specific rooms, in bathroom and kitchen in particular. In any case, and in order to secure air exchange, it is important to manually ventilate its accommodation every day, both summer and winter, for about five minutes, by opening the windows and turning off the heat.

Air speed

Air motion in the accommodation influences the air temperature felt. Thus, the faster the air motion is, the higher the room temperature is needed to feel comfortable. For example: - For an air motion of 0.15 meters per second (m/ s), the comfortable temperature is 21 ° C - For an air motion of 1 meter per second (m/ s), the comfort temperature is 25 ° C Note: In old houses, generally not insulated, ventilation is more difficult to control. The air motion generates greater feelings of discomfort.

Table 11. Sustainable construction for thermal comfort

How sustainable construction affects thermal comfort in the building				
Orientation and glazing	**Building materials and systems**	**Heating, ventilation and air conditioning**	**Shading systems**	**Fans**
Solar heating can significantly increase the temperature in the building in winter, and its absence - reduce the need for cooling in summer. That is why the orientation of modern buildings in relation to the terrain and world directions is so important when designing. The area of windows and glazing is also important.	Fluctuations in the external temperature also affect the internal temperature. The more massive the building materials used, the more heat they accumulate and the more they give off when the inside of the building cools down. Skilful use of thermal inertia reduces sharp temperature fluctuations and their corresponding impact on thermal comfort.	In older buildings, there is natural air circulation and a constant exchange between the external and internal environments. This optimizes humidity and air currents in the building. Modern insulation and window frames close the home (office) hermetically. Ventilation is difficult, condensation and mold appear. In such cases, the solution that restores the optimal indoor environment is modern heating, ventilation and air conditioning (HVAC) systems.	With their help, you can adjust the strength of the sun's rays and the overheating of the premises in the summer with a minimum of costs.	Although they are probably the most suboptimal way to provide thermal comfort, they are cheap, readily available and portable – they are always where you need them.

Thermal comfort is experienced by each of us individually, however, at the same time, it has a high socio-economic value. Achieving and controlling it is the task of sustainable construction.

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Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC III

Step-by-Step Deep Renovation in Households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to provide OSS personnel and REVERTER ambassadors with the knowledge of how to plan and execute deep renovation projects, enabling them to transform existing buildings into energy-efficient and sustainable spaces. The trainees will gain a comprehensive understanding of the deep renovation process and the techniques involved in achieving significant energy savings, as well as the benefits of deep renovation.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
EE	Energy Efficiency
RA	REVERTER Ambassadors
EPC	Energy Performance Certificate
R&D	Research and
ESCO	Energy Saving Contract Organisation
DHW	Domestic Hot Water
RES	Renewable Energy Sources

1 Introduction to Deep Renovation

1.1 General information

Renovating a building can pose challenges in terms of complexity, cost, and time investment. In Europe, the majority of residential building renovations are executed incrementally over several years, introducing the risk of being "locked in" where current renovation decisions may constrain future possibilities. For homeowners, the lack of clarity on which renovation measures to undertake and their sequencing presents a significant hurdle to enhancing energy efficiency and the overall condition of their property. Compounding these challenges is the unique nature of each situation, as buildings differ in construction characteristics, renovation history, current use, and other factors. Homeowners themselves have diverse needs, preferences, and available resources. [1]

Building renovation not only has the potential to enhance energy performance but can also address other objectives, such as reconfiguring spaces or upgrading the facade. These various changes can be unified within a cohesive roadmap, optimizing the combination of interventions and encompassing the numerous benefits that a well-planned renovation can deliver, including enhanced thermal comfort, indoor air quality, sound insulation, and more.

Deep renovation denotes a thorough and comprehensive process aimed at enhancing the energy efficiency, sustainability, and overall performance of a building or structure. It entails significant modifications to the building's systems, components, and materials, bringing it in line with modern standards and reducing its environmental impact.

Key features of deep renovation typically include (Figure 1):

[1] iBRoad. My path towards an energy efficient home. December 2020. Available at: https://ibroad-project.eu/

Energy efficiency

The primary goal of deep renovation is to substantially reduce the energy consumption of a building. This may involve upgrading insulation, windows, doors, and HVAC (heating, ventilation, and air conditioning) systems to improve thermal performance and reduce heating and cooling costs.

Sustainability

Deep renovation often incorporates sustainable building practices and materials to minimize the environmental impact of the building. This may include using renewable energy sources, installing energy-efficient lighting, and incorporating water-saving features.

Structural improvements

Deep renovation may also address structural issues, such as repairing or replacing damaged building components, strengthening the foundation, or improving the overall structural integrity of the building

Indoor environmental quality

Efforts are made to enhance the indoor environmental quality of the building, including better ventilation, air quality, and natural lighting to create a healthier and more comfortable living or working environment.

Accessibility

Renovations often include improvements to make the building more accessible for people with disabilities, ensuring compliance with accessibility standards and codes.

Figure 1. Key features of deep renovation

Deep renovation involves making significant and comprehensive renovations to the building to boost energy efficiency and sustainability. This means going beyond simple renovation and cosmetic changes and focusing on improving the building's performance, which can lead to substantial cost savings and a greener, more comfortable living space.

> Deep renovation according to the European Commission refers to those building renovations that achieve more than a 60% reduction in primary energy consumption.

A huge potential for energy savings lies in the renovation of the existing building stock. The deep renovation of these buildings is a necessary condition for the construction sector to be able to reduce its greenhouse gas emissions and meet the targets for reducing energy consumption. The new Target 55-ready package aims to put the EU on the path to climate neutrality. Energy accounts for 75% of greenhouse gas emissions, and the building stock of EU member states - about 43% of energy consumption.

A major renovation can be defined as such renovation that meets the national standard and regulations of a specific country; a major renovation can also be defined as a minimum percentage of energy savings; Energy savings from non-renewable sources over 60%. Other definitions are related to standards for near-zero consumption buildings.

It is important to know that if the goal is to save energy above 60% (primary energy savings), this can be achieved by renovating the entire building, and this can mean a large investment out of reach for most European families.

It is possible a step-by-step basic energy renovation, for example, every 3-4 years, one investment for:

1. Replacement of windows;

2. Wall insulation;

3. Replacement of heating and cooling systems.

A road map with recommendations for reducing the energy consumption of the building or household can be developed with an estimated budget for each step and achieving standards approaching those of a near-zero consumption building in a few years.

1.2 National definition for deep renovation

Bulgaria

According to Bulgarian legislation (EE Law), **Major renovation** is defined as: "Major renovation" of a building is a complex of construction and installation works related to the fulfilment of the basic requirements under Art. 169, para. 1 and 3 of the Territorial Planning Law, which is carried out during operation and affect the structural elements of the construction, including the enclosing structures and elements of buildings, facilities and elements of the technical infrastructure - heating, ventilation, air conditioning, electrical, water supply, sewage and other installations.

According to the Long-term national building strategy **Deep renovation** is defined at two levels:

- Achieving a light or medium degree of the renovation as part of a phased renovation – up to the legally required class C for buildings in operation or energy savings below 60%;
- Achieving deep renovation - reaching class "B" and higher, incl. utilization of energy from renewable energy sources (with technical possibilities), energy savings of over 60%.

Greece

According to Law 4122/2013 about the energy performance of the buildings, the deep renovation is defined as the renovation that fulfils the following conditions:

a) The total cost of the renovation activities in the building envelope or the technical systems exceeds 25% of the current value of the building based on the estimated minimum construction cost of the building excluding the value of the terrain where the building has been constructed.

b) More than 25% of the surface of the building envelope is renovated.

Portugal

Portugal does not have a specific definition of nZEB for renovation, but the same requirements must be met to achieve a nZEB for the cases of new and existing buildings. Complying with nZEB requirements for the renovation of existing buildings is not mandatory, but it is encouraged. A deep renovation is related to measures being made in the building envelop.

Latvia

Currently there is no definition for deep renovation in Latvia. Deep renovation is a term, which till the recast of Building energy performance directive (EPBD) in 2023 has been widely used to describe holistic building renovation to achieve high energy efficiency standards. As of now, in the recast of EPBD the deep renovation means a renovation which transforms a building or building unit:

(a)before 1 January 2030, into a nearly zero-energy building;

(b)as of 1 January 2030, into a zero-emission building;

In this context the national definition of nearly zero-energy building is provided.

1. A building shall be classified as a nearly zero-energy building if it conforms to all of the following requirements:
    - the energy consumption of the building for heatin does not exceed the level indicated in Annex 3 to this Regulation for a Class A building; *(For building with heated area smaller than 120m^2 annual heating energy consumption is ≤ 60 kWh/m^2, for buildings with heated area smaller than 250m^2 annual heating energy consumption is ≤ 50 kWh/m^2, and for MFBs annual heating energy consumption is ≤ 40 kWh/m^2)*
    - the primary non-renewable energy consumption of the building for heating, hot water supply, mechanical ventilation and cooling does not exceed the values indicated in Table 2 of Annex 3 to this Regulation for Class A buildings; *(For buildings with heated area smaller than 120m^2 primary non-renewable energy consumption is ≤ 110 kWh/m^2, for buildings with heated area smaller than 250m^2 primary non-renewable energy consumption is ≤ 100 kWh/m^2, and for buildings with heated area larger than 250m^2 primary non-renewable energy consumption is ≤ 95 kWh/m^2)*
    - the engineering systems installed in the building conform to the ecodesign requirements and the energy labelling confirms to at least Class A, if the corresponding energy labelling for the specific equipment is applicable;
2. The assessment of a nearly zero-energy building shall assume that the indoor temperature conditions in the heating period are at least at the level of category II and in the non-heating period - at least at the level of category III in accordance with the standard LVS EN 16798-1:2019 "Energy performance of buildings. Ventilation of buildings. Part 1: Indoor microclimate input parameters for the design and assessment of the energy performance of buildings, taking into account indoor air quality,

temperature regime, lighting and acoustics. Module M1-6" to the requirements of Annex B; *<u>(At least 20°C during heating period and no more than 27°C during summer time).</u>*

3. The assessment of a nearly zero-energy building shall assume that the ventilation air exchange is sufficient to ensure the supply of fresh air or technological conditions in the serviced area in accordance with the requirements laid down in the laws and regulations regarding construction. The energy efficiency assessment should assume that the air exchange conditions in rooms when people are staying in them are not lower than the category III level in accordance with the standard LVS EN 16798-1:2019 "Energy performance of buildings. Ventilation of buildings. Part 1: Indoor microclimate input parameters for the design and assessment of the energy performance of buildings, taking into account indoor air quality, temperature regime, lighting and acoustics. Module M1-6" requirements; *(Standard provides three distinct methods for design air flow calculation. Absolute minimum air supply for residential buildings is defined as 4 l/(s per person) combined with 0,4 l/(s per m^2) for low polluting building).*

2 Deep renovation barriers and benefits for the national context

Deep renovation, the comprehensive transformation of existing buildings to significantly improve their energy efficiency and sustainability, plays a pivotal role in addressing the ever-increasing global energy consumption and reducing carbon emissions. While its benefits are undeniable, the journey towards deep renovation is fraught with several significant challenges and barriers. These obstacles extend beyond mere technical complexities, encompassing financial, regulatory, and behavioural hurdles that hinder the widespread adoption of deep renovation practices.

2.1 Deep renovation barriers

Energy renovation barriers refer to the obstacles, challenges, or factors that hinder the adoption, implementation, or success of energy retrofit projects in buildings. These barriers can exist at various levels, e.g., individual, organisational, societal, financial, etc., and may vary depending on the specific context, such as the country, region, or type of building (Figure 2).

Understanding and addressing these barriers is essential for overcoming resistance, unlocking the full potential of energy retrofits, and facilitating their widespread adoption to achieve energy efficiency goals in the built environment.

Behavioural/Social barriers

- Resistance to change and comfort with existing routines and habits
- Inertia and reluctance to invest time and effort in retrofit initiatives
- Limited motivation and perceived lack of personal benefit from energy retrofits
- Perception of renovation as a complex and irreversible undertaking
- Lack of a 'culture of saving'
- Limited social norms and peer influence promoting energy-efficient behaviors and retrofits
- Lack of trust in authorities, institutions, or contractors involved in retrofit programs
- Uncertainty about functionality requirements
- Lack of consumer acceptance of new technologies
- Disruption factor, such as noise and dust or the need to move out during renovation work
- Variation in attitudes toward renovation based on factors like age, gender, education, and cultural values, etc.

Financial barriers

- High investment cost of deep renovations
- Long payback periods for energy savings measures
- Limited access to finance (especially for vulnerable households)
- Reluctance of traditional lenders to provide loans for renovation projects
- Reduced availability of subsidies and grants
- Risk of free-rider effect in subsidy programs
- Difficulty in demonstrating increased asset value due to energy performance improvements
- Energy pricing structures that do not fully reflect negative externalities
- Lack of consideration for lifecycle costs
- Diseconomies of scale and lack of ongoing capacity for maintenance (especially for RES)

Knowledge/informative barriers

- Lack of awareness and understanding of energy retrofit benefits and cost-saving opportunities
- Technical complexity and overwhelming terminology
- Limited access to clear, accurate, and impartial information from trusted sources
- Lack of reliable and accessible tools and databases
- Lack of easily accessible and up-to-date information on energy efficiency programs, incentives, and financing options
- Absence of centralized platforms or easily navigable websites
- Conflicting advice and outdated guidelines
- Difficulty in calculating costs for new technologies (for contractors)

Organisational and decision-making barriers

- Challenges in decision-making and coordination for complex ownership structures
- Lack of engagement and collaboration among stakeholders
- Delays and abandonment of projects due to disagreements and lack of accountability
- Complex legal considerations and uncertainties (in collective housing)
- Insufficient communication channels and standardized processes
- Insufficient involvement of occupants or tenants in the retrofit process
- Split incentives and misalignment of incentives in rental properties
- Limited participation of small and medium-sized enterprises in public procurement schemes
- Fragmentation of the supply chain in the construction industry

Regulatory barriers

- Complexity of rules and regulations at EU and national
- Inconsistencies, delays, and gaps in energy performance targets, efficiency standards, and retrofit obligations
- One-size-fits-all approaches overlooking variations
- Unclear, unambitious, and maladapted national strategies
- Lack of common approaches and definitions
- Overlaps, conflicts, and delays in policy schemes, and lack of legislation on specific issues
- Uncertainty due to frequent changes in regulations
- Inadequate monitoring and enforcement
- Excessive administrative burden
- Inconsistent standards and labeling requirements
- Insufficient government subsidies and programs

Technical barriers

- Lack of skilled professionals and trained workforce
- Scarcity of examples of successful deep renovation projects
- Lack of standardised solutions and assessment tools
- Discrepancies between predicted energy savings and actual performance
- Concerns about maintenance, durability, and long-term performance of retrofit systems
- Complexity of integrating new solutions with existing infrastructure
- Limited availability of energy-efficient materials and components
- Safety and seismic risks associated with deep renovation processes

Figure 2. Energy renovation barriers

2.2 Barriers to deep renovation in the four REVERTER pilots

All four pilot areas show, to a greater or lesser extent, the challenges mentioned in the previous sections. In the following, some critical aspects of these challenges are discussed, based on literature and the experience of local partners.

A. Brezovo, Bulgaria

The main barriers to deep renovation in the Bulgarian pilot are, as follows:

- Regulatory barriers: the current framework does not encourage deep renovation, as there are no requirements or incentives to renovate public buildings to levels higher than class C. The complex administrative process and the need for unanimous agreement among owners in multi-unit buildings hinder deep renovation efforts. Furthermore, there is a lack of restrictions on the use of non-environmental solid fuels. Finally, shortfalls include the absence of Energy Performance Certificates (EPCs) for residential buildings smaller than 1,000 m^2.
- Financial barriers: the reliance on grants provided by the National Programme for Energy Efficiency in Multifamily Residential Buildings blocks other forms of financing because homeowners are unable to finance energy efficiency renovations themselves. Municipalities often limit renovation projects to shallow measures due to cost concerns. Additionally, low energy prices and the high transaction costs associated with the complex administrative process further impede deep renovation.
- Knowledge/informative barriers: there is a lack of awareness among customers and investors about the benefits of deep renovation. Municipalities, which manage the program, lack motivation to design and implement new renovation programs and often limit renovation projects to shallow measures due to a lack of understanding of the wider benefits.
- Technical barriers: incomplete inventories of public buildings, limited information on energy consumption and efficiency measures, and the absence of detailed renovation plans create significant challenges. R&D efforts in deep renovation are fragmented and not part of a holistic local or national plan. Technical capacity and knowledge for deep renovation are also insufficient in many municipalities, there is a lack of specialized intermediaries to provide expert assistance and a lack of necessary skills of professionals to adequately promote energy efficiency products.
- Organisational and decision-making: there is a lack of reliable mechanisms for effective control of compliance with the law and unprofessional and insufficient management of multi-family buildings. Also, challenges are created due to the presence of unoccupied apartments in multi-family residential buildings.

B. Athens metropolitan area, Greece

As far as the Greek pilot is concerned, the main barriers identified are the following:

- Financial barriers: the economic benefits derived from energy-efficiency renovations are often undervalued over time, making the returns uncertain compared to other investments. Given Greece's economic crisis and increased country risk, the uncertainty and risk associated with long-term investments are more pronounced. The reduction in bank loans, traditionally a primary funding source for building renovations, has further impacted investment in this sector. Additionally, the decrease in income and changes in consumption habits due to the recession have made energy-efficiency renovations a lower priority for many. This is particularly true for the most vulnerable households. The existing subsidy scheme offers a 75% grant for personal income up to 5,000 Euros per year and family income up to 10,000 Euros per year. Given their very low income, most of the time these households do not have access to loans from commercial banks.

- Regulatory barriers: Greece lacks an established national standard for accurately measuring the actual energy consumption of buildings. The existing calculation method, based on the asset method rather than the operational method, is insufficient for recording actual consumption. Establishing a reliable standard for energy and water savings measurement is crucial. Internationally recognized protocols have been developed for this purpose.
- Technical barriers: the market for energy-efficiency renovations is still in its early stages and faces common challenges associated with new markets. Technical restrictions, such as architectural and infrastructure access issues, common heating systems, and outdated regulations in apartment blocks, complicate the decision-making process. Inadequate renovation service supply chains, a lack of energy labelling and certification schemes for construction materials, and insufficient technical support further hinder progress. Additionally, the absence of meters or direct mechanisms to showcase energy savings from renovations poses a problem.
- Knowledge/informative barriers: there is a shortage of skills and training among professionals responsible for implementing energy-efficiency renovation works. Insufficient knowledge of energy-saving technologies and renewable energy sources used in renovations is prevalent. The scarcity of reliable information on deep renovation's energy efficiency delays the adoption of new techniques. General information available is often challenging to adapt to specific investor and user circumstances, making it difficult to assess the overall benefits of energy-efficiency investments. Educational institutions need to update their curricula to include energy-saving concepts in building renovation, covering both technical and financial aspects.
- Organisational and decision-making: many vulnerable households live in homes that they do not formally own, e.g. they may belong to parents who have passed away but have not been inherited for financial reasons (inheritance taxes have not been paid). Therefore, they are not entitled to a subsidy from state programmes.
- Behavioural/social barriers: many vulnerable households, even if they have access to loan capital, prefer not to implement energy saving projects. Given the uncertainty in their future financial situation, they find it easier to reduce their energy expenditure than to take the risk of repaying a loan.

C. Riga, Latvia

The most important barriers to deep renovations identified in the Latvian pilot are the following:

- Regulatory barriers: subsidy and policy uncertainty (e.g., support schemes for apartment building renovation were discontinued for over 2 years between 20014 and 2016, some of the potential projects were frozen and business activities stopped overall).
- Financial barriers: low energy prices, high risk level of financial investment in territories with low economic activity that increases loan interest rates, ESCOs are typically small and cannot

borrow to further their business (long-term commercial financing continues to be a major barrier because banks are reluctant to lend against long-term energy efficiency projects).

- Knowledge/informative barriers: lack of information about and complexity of the concept (both at the policy level and at the level of residents/owners), insufficient information dissemination and training for stakeholders.
- Technical barriers: lack of knowledge, energy advice, audits, and construction supervision on a large scale, lack of and measurement and verification practices.
- Organisational and decision-making: lack of standardised contracts.
- Behavioural/social barriers: lack of trust from the clients, reluctance to acquire debt.

D. Coimbra, Portugal

As far as the Portuguese pilot is concerned, there are several barriers to energy renovations including:

- Financial barriers: One of the main barriers is the high cost of energy renovations (higher than new construction, per square meter, which can make it difficult for homeowners and businesses to invest in energy-efficient solutions. Access to financing for energy renovations can be limited, especially for homeowners and small businesses that may not have the financial resources to undertake large-scale projects.
- Regulatory barriers: Portugal has a complex regulatory framework for energy efficiency and renewable energy, which can make it difficult for homeowners and businesses.
- Knowledge/informative barriers: Many people in Portugal are not aware of the benefits of energy renovations and the available financial incentives to support them.
- Technical barriers: There is a shortage of skilled labour in the energy renovation sector, which can make it challenging to find qualified professionals to undertake renovations. Moreover, many buildings in Portugal are old and have design constraints or are located in heritage protected areas that make it difficult to retrofit energy-efficient solutions. Finally, there may be a limited availability of energy-efficient products and services, making it challenging for homeowners and businesses to find the right solutions for their needs.

2.3 Benefits of deep renovation

The main benefits of deep renovation for the households and the community are summarised in the following Figures 3 and 4.

Social benefits

- Increasing the energy efficiency in households leads to a number of social benefits, including reflects on household incomes, energy poverty reduction and people's health. Therefore, the social effects of energy saving are evaluated mainly for the household sector

Increase in household income

- The cost of improving the energy efficiency of households is usually repaid through reduced heating costs, allowing consumers to use their income for other purposes after the investment has been paid off in the long term, but it should be noted that the payback of these investments usually takes a long time.

Economic benefits

- Economic benefits have an important role in energy efficiency policies because they should be implemented in a cost-effective way. The assessment of additional economic benefits makes investments in energy efficiency more attractive and significantly reduces the payback period of the applied measures.

Health benefits

- The health benefits of implementing energy efficiency measures are indirect and are related to reducing harmful emissions in the atmosphere (sulfur and nitrogen oxides, fine dust particles, etc.) and improving thermal comfort in buildings. This leads to a decrease in morbidity and mortality

Increasing the value of buildings

- Major renovation of buildings increases the value of the properties in them, as it makes them more sustainable, with a better appearance and increases their life. Various analyses of real estate agencies show that currently, the sales value of renovated apartments increases by 10-15%.

Figure 3. Deep renovation benefits for the households

Environmental benefits

By upgrading insulation, replacing windows and doors, installing energy-efficient heating and cooling systems, and domestic hot water systems, households can reduce their energy consumption. By decreasing the demand for electricity and heating fuels, building energy renovations contribute to reducing the emission of CO_2 and other greenhouse gases and help to mitigate global warming. For instance, energy efficiency measures are expected to contribute 44% of the carbon abatement needed by 2035, and deep renovation, in particular, can lead to a 75% reduction in final energy consumption by 2050, compared to 2010.

Competitiveness:

The development of technologies related to energy efficiency has a positive effect on the economy and its competitiveness. The assessment of the impact of energy efficiency is made for individual products or branches of the industry by comparing the export and import of this product or branch with the total export and import of the country, and if the result is positive, increased competitiveness is reported.

New jobs in the region

There are two main factors that determine the effect on employment: investments in energy efficiency create jobs in the industry that produces the relevant products and services, and the energy savings achieved reduce in the long term the consumption of energy products. In turn, a reduction in consumption has an effect on the added value produced, and a change in the added value leads to an effect on employment in the relevant sector.

Figure 4. Deep renovation benefits for the communities

3 Types of building renovation measures

Exemplary energy-saving measures in buildings are recommended by institutions, administrative bodies, offices and agencies of the European Union, including recommendations of the EC to establish requirements for building installations. An example list of measures is presented in the following table.

Table 1. Examples of deep renovation measures

Measures on building envelope	Measures on building systems	Measures for utilization of energy from renewable sources and utilization of waste heat
Complete laying or upgrading of existing thermal insulation on the walls of existing buildings	Installation or improvement/modernization of a heating installation (based on fossil fuels and/or renewable energy, with a boiler for cooling the flue gases below the dew point — condensing boiler, heat pumps, etc.) in all buildings	Air-to-air heat pumps
Complete laying or upgrading of existing thermal insulation on the roofs of existing buildings	Modernization of an existing vertical heating installation by building a horizontal heating system	Air-to-water heat pumps
Thermal insulation of the same roof elements in existing building roofs	Control and measuring devices for regulating the temperature of the internal air and water	Ground-connected heat pumps for utilizing the heat of the ground
Thermal insulation of an existing ground floor in an existing building	Installation or improvement of a ventilation installation (forced ventilation with heat recovery, forced suction-discharge ventilation, suction ventilation)	Solar systems for DHW
Increasing the thermal inertia of the building structure by using massive building materials exposed to radiant energy in the building space (Note: it can only be applied in certain types of climate conditions).	Improving the use of daylight. Energy-efficient lighting	Heating systems utilizing geothermal energy
Installation of windows and doors with good thermal insulation properties for the winter period	Installation or improvement of photovoltaic systems	Photovoltaic systems for the production of electrical energy for own consumption
Better shading against sunlight	Changing the energy carrier for a given installation	Heat recovery from exhaust air
Better sealing against air infiltration (the maximum sealing possible with the relevant state of the art).	Replacing pumps and fans	
Changing the ratio between transparent and opaque surfaces (optimization of glazing percentage)	Thermal insulation of pipes	
Openings for night ventilation (cross or chimney ventilation	Direct-fired boilers or boilers with an intermediate heat carrier, and	

	accompanied by hot water tanks, can be combined with thermal solar installations Installations for the utilization of solar energy for heating or cooling, and for DHW of different power-intensive night ventilation	
	Installation of energy-efficient office and household appliances	

4 Building renovation main steps

This part of the technical guide describes the overall process of initiating, developing and implementing an energy efficiency project for residential buildings, regardless of the source of funding. The aim is to familiarise the trainees with the terminology in a standardized process and renovation project for deep renovation in its specific implementation. It includes short descriptions for all pilot countries, but the national translated versions will be enriched with more detailed information for the local context:

A. Bulgaria

There are four main stages in the renovation process:

Stage 1: Pre-investment study

1.1. Initial assessment of eligibility, needs, benefits, and the required financial resources for execution

- Determining the eligibility of the residential building according to the "mechanical resistance and stability" requirement - based on visible signs.
- Defining the level of ambitions for energy-efficient renovation.
- Predictively determining:
    - the necessary renovation activities.
    - the financial resources required for the execution of the energy efficiency investment project, including all costs

1.2. Conducting surveys of the residential building

- Developing measures to improve energy efficiency, including a technical-economic assessment.
- Calculating projected energy savings and assessing CO2 emissions.
- Determining the financial resources required for the implementation of energy efficiency measures.
- Analyzing the possibilities for using energy from renewable energy sources.
- Establishing compliance of the residential building with the essential requirements for construction.
- Defining measures that do not have a direct ecological impact but are mandatory in the European context to ensure habitation safety.
- Determining the financial resource

Stage 2: Preparation of project documentation for the implementation of an energy-efficient investment project

2.1. Preparation of a Technical Specification/Design assignment

- Sets the conditions for the preparation of a high-quality investment project.

- Defines the parameters of the investment project in terms of phases, project components, volume, scope, and regulatory framework.
- Determines the boundaries of project development in connection with previously conducted surveys and examinations.

2.2. Preparation of project documentation/investment project

- Presents in graphic and text form, in accordance with applicable regulatory requirements, the technical, economic, technological, functional, and planning-compositional requirements for the object.
- Details the requirements for the execution technology and the materials used, including drawings and working details, as well as detailed technical specifications for the envisaged construction materials.
- Serves for the execution of construction and assembly works, as well as for conducting procedures for the selection of contractors for construction and installation works during construction.

2.3. Evaluation of compliance with investment projects

- Provides confidence to the Client/Owner that the investment project complies with regulatory requirements and that its execution will achieve the predetermined goals and indicators.
- Facilitates/expedites the approval process by the municipal administration and the issuance of a construction permit.

<u>Stage 3: Implementation of energy efficiency measures (Construction and Assembly Works)</u>

3.1. Construction Permitting

- Ensures compliance with the law during the execution of construction and assembly works

3.2. Commencement, Execution, and Completion of Construction

- Execution of construction and assembly works in accordance with the issued construction permits.
- Installation of materials in accordance with project technical specifications.
- Implementation of control measures during execution in compliance with regulatory requirements and the specifics of residential buildings.

<u>Stage 4: Monitoring and assessment of achieved savings</u>

4.1. Assessment of achieved energy savings following the implementation of energy efficiency measures

- Demonstrates the achieved energy savings as a result of implemented energy efficiency measures through conducting a subsequent energy audit.

4.2. Monitoring the behavior of the residential building after renovation

- Conducts real control through monitoring measurements and taking corrective actions. Changes in the behavioral patterns of the occupants regarding energy usage in the renovated residential building.

B. Greece

There are three main building renovation steps to be considered by homeowners:

Step 1. Collecting information, assessing and deciding on building renovation

To assess the potential energy renovation of a dwelling, preliminary actions are required, which include, but are not limited to:

I. Conducting a thermographic audit to determine the heat loss from the building envelope.

II. Discussion with other owners (in case of multi-family buildings) regarding the necessity of the energy renovation. In the case of apartment buildings, the decision of the general assembly and the authorisation of a responsible person to carry out all the actions required for the energy upgrade are required. Organisation of a meeting to provide clarification and presentation of the potential benefits of the energy upgrade of the building are useful.

III. Estimation of the preliminary cost of implementing the renovation measures, taking into account the period of time during which the building is being renovated, the technical condition of the building, the region, etc.

IV. Mapping the different financing options (e.g. grants, loans) and understanding the conditions for their use.

V. Identify potential contractors who could carry out the necessary works.

Step 2. Preparation of building renovation

The first action in preparing the renovation of the building is the issuance of an Energy Performance Certificate through the implementation of an energy audit, which will identify what work needs to be carried out in order to achieve maximum energy savings. The energy audit of the building is carried out by a certified energy inspector. The inspector assesses the technical condition of the building, and may investigate whether the building under consideration complies with the requirements of the various funding programmes, with an emphasis on possible irregularities.

This report will accurately specify the work required, facilitating a more accurate calculation of the implementation costs and the identification of the most advantageous financial offer by the construction companies and contractors concerned.

Step 3. Financing building renovation

Financing of building renovations can be implemented through owner's equity or alternative sources, such as, but not limited to, grants through existing state programmes or bank loans. To receive funding, it is necessary for owners to understand the terms and conditions and provide the necessary documentation.

Interested contractors will send a financial offer for the energy renovation of the building together with a detailed description of all the work to be carried out, the materials to be used, deadlines, etc. Once the financial offers have been received, they will be compared to select the most economically advantageous one.

Portugal

The renovation process essentially takes place in main phases from the idea of renovation to an energy-efficient building.

The First Phase consists of Obtaining information, evaluating and making a decision about the renovation of a building and is divided into 3 main stages:

1) Obtaining and evaluating information such as: Thermographic maps; Consultancy and counselling; Estimating preliminary renovation costs; Financing options for the renovation.

2) Decision by the building's residents in favour of renovating the building;

3) Creation/Election of the Condominium with administrator and assembly.

The Second Phase consists of preparing the building documentation and is divided into 3 main stages:

1) Obtaining an energy certificate: a "roadmap" that provides consumers with information on the energy performance of buildings, which includes cost savings, improved thermal comfort and access to financing and tax benefits. It can indicate which works should be carried out and in what order to achieve maximum energy savings;

2) Technical opinion: The result of a technical inspection that can be carried out by a duly certified professional. During this process, all parts of the building are examined to determine their degree of deterioration and safety, resulting in an operational plan and the order in which the work should be carried out.

3) Documentation for the refurbishment operation: This phase requires an individual description of the building's refurbishment plan with a specific list of works to be carried out, based on the opinion of the technical inspection and the energy certificate.

The Third and final Phase consists of financing and renovating the building and is divided into five main stages:

1) Financing the renovation project: Once the opinion has been obtained, it is possible to go ahead with the renovation project, but first it is necessary to take care of the sources of financing, own and/or request for auxiliary financing;

2) Selection of the builder: According to the requirements developed for the renovation of the building, construction companies can be selected. The construction companies draw up their detailed proposals for the renovation of the building, so that the one with the most favourable conditions for the project is chosen;

3) Renovation of the building: The renovation of the building is carried out in accordance with the specifications, which contain information on the work to be carried out, the materials used and the timetable for the work. The person responsible for the work and the person responsible for monitoring the work control and monitor the renovation work to ensure that it is carried out in accordance with the building project. If in doubt, residents should contact these specialists;

4) Transfer of the building: The contractor renovates the building in accordance with the contract. Once a month, summaries of the work completed are made and recorded in the works diary. A report is drawn up (including photographs) on the completed work phases. This report is signed by the construction manager, who is a person chosen by the residents and represents the interests of the building's residents. The construction manager checks that the materials and technologies

agreed in the contract have been used and that they comply with the previous documentation (specifications). If deficiencies are detected in any of the renovation phases, the construction manager informs the contractor and makes sure they are eliminated. When all the work has been completed, the acceptance and handover document is signed, which confirms that the work has been completed in accordance with the requirements of the contract;

5) Applying for funding: this must be done before starting work. There are government instruments in Portugal that support the energy renovation of buildings.

Latvia

Stage 1: Obtaining information, evaluating it and taking a decision on the renovation of an apartment building

Step 1: Collection and evaluation of information

In order to evaluate the possibilities of renovating an apartment building, it is necessary to obtain high-quality and versatile information.

- Thermography maps – their creation is provided free of charge by the Riga Energy Agency. Thermography allows to assess the loss of thermal energy in an understandable way – in a thermogram. Thermography also allows to identify construction deficiencies or damage caused during operation, thermal bridges, air infiltration and other sources of heat loss. It is possible to carry out thermography during the heating season. Find out more about the possibility of performing thermography by applying for a consultation or by calling +371 67012437. Apply for a consultation
- Advice – Residents of the building can receive free advice and information on issues of interest to them in relation to the renovation. Apply for a consultation
- Preliminary renovation costs – this can be determined on the basis of historical data on the renovation of similar buildings. However, it should be borne in mind that the renovation of each building may vary significantly in terms of cost, taking into account the period of time when it is renovated, the technical condition of the building, its area, etc. View data
- Renewal financing options – Carefully study and identify all available support and loan financing options and their terms. You can apply for free consultations about support programs.
- Identifying potential construction companies – identify potential contractors who could renovate a building. Learn more

Step 2: The decision of the residents of the apartment building in favor of the renovation of the building

In order to decide in favor of the renovation of an apartment building, a positive vote of 50% + 1 vote of the residents of the building is required.

The elder of the house can hold a vote in a variety of ways — a general meeting of the building's residents and/or official questionnaires. In this process, it is important to make sure that the vote is open, transparent and that all residents of the building have received full information before voting. After the vote, the elder or the person in charge of the house collects information about the vote and draws up a record.

Stage 2: Preparation of documentation

Step 1: Obtaining an energy performance certificate

An energy performance certificate is an action plan that explains what works need to be carried out in what order in order to obtain the maximum energy savings. For example, changing windows, insulating the walls of a building, etc.

- The energy audit of the building shall be carried out by an independent expert registered in the Construction Information System. More information about experts.
- An insight into the energy audit process can be found in this video.

Step 2: Opinion of the technical inspection

Technical inspection may be carried out by a certified civil engineer. In the course of this process, all parts of the building are examined to determine their degree of wear and tear and safety. The civil engineer evaluates the technical condition of the building in accordance with the regulations of the Cabinet of Ministers, the action plan and the sequence of how the work should be carried out. Such a survey must be carried out on each building at least once every 10 years.

- The construction must comply with the conclusions of Section 9 of the Construction Law.
- The final document describing the technical condition of the building is the opinion of the technical inspection.

In order to obtain the energy performance certificate and the Technical Survey opinion, it is possible to receive support from the Riga Energy Agency. Learn more

It is possible to recover the co-financing for the development of technical documentation also after the performance of construction works by participating in the co-financing programmes of the Riga City Council or ALTUM.

Step 3: Construction documentation

Construction documentation is, on the basis of the opinion of the technical inspection and the energy performance certificate, a description of the building renovation intention developed by an architect or construction company with a specific to-do list. In this process, a control board is also developed, which allows the residents of the building to more accurately identify both a detailed list of work to be performed and potential costs. The control board is an internal document that will allow residents of the building to better evaluate the offers of construction companies and choose the most economically advantageous one.

Stage 3: Financing and renovation of the building

Step 1: Renovation project funding

With aggregated information and prepared documentation, it is possible to further advance the restoration project. At this stage, it is necessary to reserve an energy efficiency discount in one of the programs – Altum or riga state city municipality.

The implementation of the project can be carried out on the accrual of the repair fund of the residents of the house. If the amount of savings is insufficient, it is possible to attract additional financing.

In order to obtain financing, it is necessary to provide all the documents requested by the financier and/or lender.

Step 2: Builder selection

According to the developed requirements for the renovation of the building, the selection of construction companies can be carried out. Construction companies create their own proposal for the renovation of the building together with a detailed description of the amount of work to be performed, materials to be used, deadlines, etc. After receiving the tenders, they are compared with a checklist in order to choose the most economically advantageous service provider. A contract is concluded with a construction company.

We recommend that you familiarize yourself with ALTUM material on supplier selection.

Step 3: Renovation of an apartment building (renovation of the building)

During the renovation of the building, its residents can continue their usual rhythm of life. The renovation of the building is carried out in accordance with the construction documentation, which contains information about the work to be performed, the materials used, as well as the time plan. The construction supervisor and the author's supervisor control and monitor the restoration works in order to ensure their high-quality execution in accordance with the construction project. If there is any confusion, residents should contact these certified specialists. Excellent if there is an authorized person in the building who, if necessary, does it on behalf of the residents of the building. It is the innovator's responsibility to comply with the project and implement it in good faith.

Step 4: Building transfer process

The contractor shall carry out the renovation of the building in accordance with the contract. Once a month, a summary of the work done is prepared, which is recorded in the construction journal. An overview (including photographs) is made of the stages of work that are being concluded. This report is signed by the construction supervisor, who is a person chosen by the residents and represents the interests of the residents of the building. The construction supervisor checks whether the materials and technologies stipulated in the contract are used, whether they correspond to specific certificates (if such are necessary and are mentioned in the contract). If deficiencies are found at any stage of the restoration, the construction supervisor shall inform the contractor thereof and make sure that they are rectified. Upon completion of the entire set of works, an act of acceptance and transfer is signed, confirming that the funds intended for the restoration of the building have been absorbed and the work was carried out in accordance with the requirements of the contract.

Step 5: Granting of Altum aid

After the conclusion of the renovation of the apartment building, the appropriate documentation must be submitted to the construction board, as well as to the project financier. Based on this information, Altum grants aid amounting to 49 % of the eligible costs, which significantly reduces the credit of the building's occupants. The remaining amount must be covered by the residents of the building together with the heat bill as a monthly payment.

Important! After the renovation of the building, the heat bill is significantly reduced, and together with the repayment of the loan for the renovation of the building after the renovation, the total bill is often less than the heat bill before the renovation of the building.

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC IV

Energy saving in households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. It has been designed to empower the trainees with practical knowledge and actionable strategies for low-cost energy efficiency improvements in households. In this direction, it provides a wide range of energy-saving tips and techniques that can be easily implemented in households of all sizes and types. From simple changes in daily habits to more significant upgrades in appliances and building infrastructure, they will gain the insights and skills needed to create a more energy-conscious and environmentally friendly living space. The RAs will be able to convincingly advise households on how to save energy during their visit and to provide the households with the knowledge and tools to make informed decisions about their energy consumption, how to reduce their carbon footprint and enjoy the benefits of a more energy-efficient home.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
EE	Energy Efficiency
RA	REVERTER Ambassadors
EPC	Energy Performance Certificate
R&D	Research and
ESCO	Energy Saving Contract Organisation
DHW	Domestic Hot Water
RES	Renewable Energy Sources

1 Energy efficiency measures in households

Nowadays, where environmental sustainability and cost-saving measures are of paramount importance, finding ways to save energy in our households is not just a wise choice, but a responsible one. Energy conservation not only helps reduce our carbon footprint but also translates into lower utility bills, leaving more money in our pockets. Fortunately, there are numerous practical steps and strategies that can be implemented in homes of all sizes and types to achieve significant energy savings. In this guide, we will explore a comprehensive list of general tips that will empower you to make informed choices and transform your household into an energy-efficient haven. From simple changes in lighting to more complex upgrades in appliances and insulation, these tips will not only benefit the household's wallet but also contribute to a more sustainable and environmentally conscious way of living.

Energy efficiency measures in households refer to various actions, technologies, and practices adopted by homeowners to reduce the amount of energy consumed in their homes while maintaining or even improving comfort and functionality. These measures are implemented with the goal of reducing energy bills, lowering environmental impact, and conserving energy resources.

General tips for saving energy in households:

- Keep track of your consumption. Check your consumption and your bills regularly: it will ease the planning of your family budget. Witness how changes in your behaviour may affect energy bills.
- Buying a more energy-efficient appliance could save you money over time when compared with similar products.
- Switch off all electrical appliances at the plug instead of using the "standby" mode. Appliances are still using electricity when on "standby" mode, and account for 6% of all electricity usage in the home.
- Remember to ventilate - Ventilation is needed to get fresh air in and let moisture and smells out. Open the windows daily. Please remember, the shorter, the better: 10 minutes is generally enough! In winter do that during the least-cold hours and turn the heating on only when ventilation is finished.

Source: http://www.fiesta-audit.eu/en/

The following table (Table 1) presents some common energy efficiency measures in households, which will be discussed in more detail in the next chapters.

Table 1. Energy efficiency measures and related benefits for households

	Energy saving measure	Benefits for the households
	Improved insulation	Proper insulation in walls, ceilings, and floors helps prevent heat loss in the winter and keeps the home cooler in the summer, reducing the need for heating and cooling.
	Energy-efficient windows	Replacing old, single-pane windows with energy-efficient double- or triple-pane windows with low-emissivity coatings can improve insulation and reduce heat transfer
	Energy-efficient appliances	Replacing old, energy-guzzling appliances with energy-efficient models can significantly reduce energy consumption. This includes appliances like refrigerators, washing machines, and dishwashers.
	Led lighting	Replacing traditional incandescent bulbs with energy-efficient LED (Light Emitting Diode) lighting can save a substantial amount of electricity and have a longer lifespan.
	Sealing air leaks	Identifying and sealing gaps, cracks, and leaks around windows, doors, and ducts can prevent drafts and heat loss, making the home more comfortable and energy-efficient.
	Programmable thermostats	Installing programmable thermostats allows homeowners to set temperature schedules, ensuring the heating or cooling system operates efficiently when needed.
	High-efficiency HVAC systems	Upgrading heating, ventilation, and air conditioning (HVAC) systems to high-efficiency models can reduce energy consumption for heating and cooling.
	Smart home technology	Using smart thermostats, lighting controls, and appliances that can be remotely controlled and programmed for optimal efficiency.
	Water saving	Installing low-flow faucets, showerheads, and toilets can reduce water heating costs and overall water consumption.
	Behavioural changes	Encouraging household members to adopt energy-saving habits like turning off lights when not in use, unplugging electronics, and using appliances efficiently

To achieve balancing of energy consumption in a household, it is necessary to perform the steps illustrated in Figure 1.

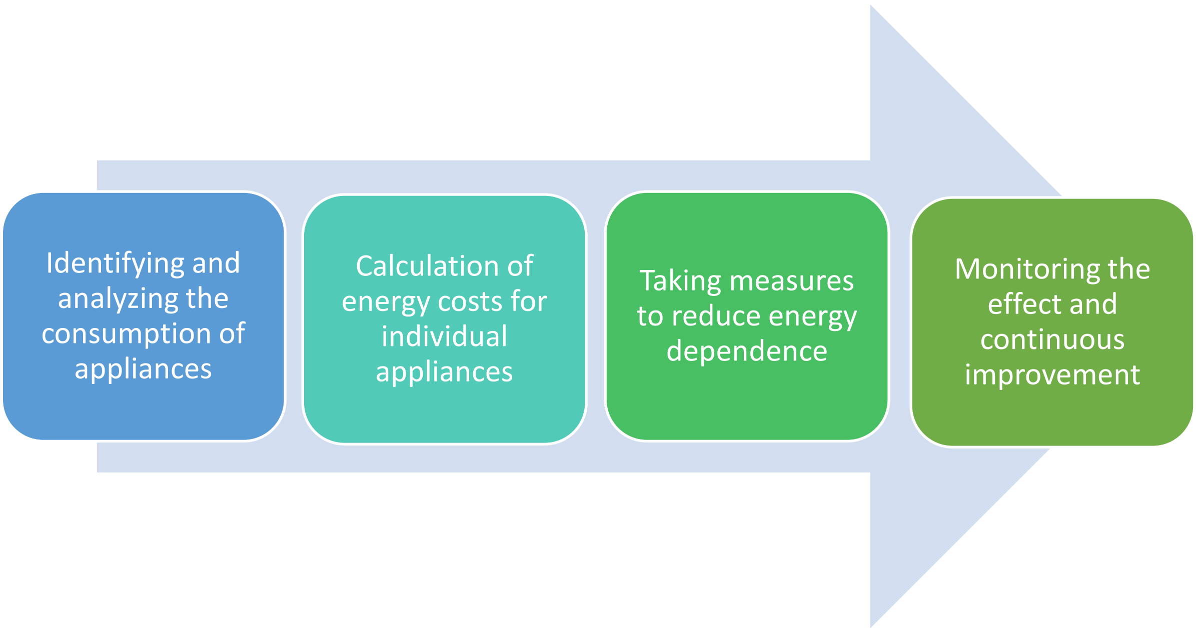

Figure 1. Steps in balancing energy consumption

2 Energy saving tips for heating and cooling

Energy consumption for heating and cooling accounts for a significant portion of a household's energy expenses. Therefore, implementing energy-saving tips in this area can have a substantial impact on both your comfort and your utility bills. Here are some energy-saving tips specifically tailored to heating and cooling.

The measures categorised as “Relatively Easy” are simple changes or practices that most homeowners can implement without much difficulty or cost. "Moderate" measures may require a bit more effort or investment but are still manageable for many households. The “More Involved” measures often involve larger investments, such as home improvements or appliance replacements, and may require professional assistance in some cases. Remember that the easiness of implementation can vary depending on individual circumstances, such as the age and condition of your home, your budget, and your DIY skills. It's a good idea to prioritise the measures that make the most sense for every specific situation and gradually work toward more involved upgrades as household’s budget and resources allow.

Tables 2 and 3 provide some recommended energy efficiency measures for heating and cooling, respectively.

Table 2. Energy efficiency measures for heating

EE measures for heating	Description	Level of applicability
Set your thermostat wisely	The most straightforward method to conserve energy for heating is to adhere to the recommended indoor temperatures. During winter, maintaining a daytime temperature of 21°C and a nighttime range of 15 - 18°C should provide ample comfort at home. A simple adjustment, such as lowering your thermostat by just 1 degree centigrade, has the potential to yield significant savings—up to 10% on your annual fuel bill	Relatively Easy
Seal leaks	Inspect doors, windows, and other openings for drafts. Seal any gaps and use weather-stripping to prevent heat from escaping	Moderate
Use curtains or blinds	In winter, close curtains or blinds at night to trap heat inside. During the day, open them to let in natural sunlight and warmth.	Relatively Easy
Regular furnace maintenance	Have your furnace serviced annually to ensure it's running efficiently. Clean or replace air filters regularly as well	Moderate
Use space heaters efficiently	If you're using space heaters, only heat the rooms you're occupying and turn them off when you leave. Electric blankets can also be energy-efficient alternatives for staying warm	Moderate
Upgrade insulation	Insulate your attic, walls, and basement to keep heat from escaping. Adequate insulation can make a significant difference in your heating costs	More Involved
Maintain your radiators properly	Furniture in front of a radiator will block or absorb the heat	Relatively Easy
Reflective radiator panels	Reflective radiator panels behind the radiators could reduce your heating bill by up to 20%. When radiators are installed on a poorly insulated wall, most of the heat will dissipate through the wall and to the outside. To avoid heat losses, a thin reflective panel between the wall and the radiator can be installed (they are easily available at stores)	Moderate
Drying your clothes	Drying your clothes on the radiator makes your boiler work harder than it needs to and costs more.	Relatively Easy
Keep heat where you need it.	Effectively manage heated spaces by closing doors to retain warmth, or, conversely, open them to allow heat to disperse into adjoining rooms. Leaving a door ajar in a room you intend to heat can result in unnecessary energy and financial losses. By conscientiously controlling the flow of heat within your living space, you not only enhance energy efficiency but also contribute to cost savings	Relatively Easy
Don't switch off the heating during the night	In the colder days, it is recommended not to switch off the heating during the hours when you are away from home, only to reduce it. When it is turned off, your home will cool down too quickly, which will lead to overheating to reach a favourable temperature	Relatively Easy
Reduce the heating temperature during the working day, but not below 15 degrees	If you are away from home during the day or for a longer time, reduce the temperature, but not below 15 degrees, otherwise, the air in the room becomes too humid and the risk of mould increases. You should know that the lower the temperature in a room, the more often you need to ventilate the room to reduce the humidity	

Table 3. Energy efficiency measures for cooling

EE measures for cooling	Description	Level of applicability
Use ceiling fans	Ceiling fans help distribute cool air more evenly and can allow you to set your thermostat a few degrees higher without sacrificing comfort	Relatively Easy
Maintain your air conditioner	Schedule regular maintenance for your air conditioning system to ensure it runs efficiently. Clean or replace filters as recommended	Relatively Easy
Programmable thermostat	Install a programmable thermostat to automatically adjust your cooling settings when you're not at home or when you're sleeping	Relatively Easy
Seal leaks	Just like in heating, seal any gaps around doors, windows, and ductwork to prevent cool air from escaping	Relatively Easy
Shade and ventilate	Use shades, blinds, or curtains to block out direct sunlight during the hottest part of the day. Use exhaust fans in bathrooms and kitchens to remove heat and humidity.	Relatively Easy
Upgrade to energy-efficient cooling	If your air conditioner is old and inefficient, consider upgrading to a newer, energy-efficient model. Look for the ENERGY STAR label	More Involved
Plant shade trees	Planting trees strategically around your home can provide natural shade, reducing the need for cooling	Relatively Easy
Keep the recommended indoor temperatures	he most straightforward approach to reduce energy consumption from cooling devices is to adhere to recommended indoor temperatures. During summer, maintaining a temperature of 26°C should provide sufficient comfort. Elevating the thermostat by just two degrees not only allows you to enjoy a full day of cost-free cooling but also helps prevent unnecessary colds	Relatively Easy
Take advantage on natural ventilation	Optimize natural ventilation by opening windows on the north and south sides of your home when the outside temperature is cooler. This facilitates cross ventilation, promoting a refreshing airflow and further reducing the need for artificial cooling	Relatively Easy

3 Energy saving tips for the building envelope

Improving the energy efficiency of the building envelope, which consists of the walls, roof, windows, doors, and foundation, is crucial for reducing energy consumption in a building. Enhancing the energy efficiency of the building envelope not only reduces energy consumption but also improves comfort and indoor air quality. Depending on the age and condition of your building, you may need to prioritize different measures to achieve the best results.

Some energy-saving tips for enhancing the building envelope, described and categorised by ease of implementation are given in the following table.

Table 4. Energy saving measures for the building envelope

EE measures for building envelope	Description	Level of applicability
Insulate your facade and roof	Adequate insulation in walls, floors, and attics helps maintain a stable indoor temperature. Consider adding or upgrading insulation to meet or exceed recommended U-values	More involved
Seal air leaks	Identify and seal gaps, cracks, and holes in the building envelope. Use weather-stripping, caulk, and foam insulation to seal leaks around doors, windows, pipes, and electrical outlets	Relatively Easy
Install energy-efficient windows and doors	If replacing windows and doors is not an option, consider adding storm windows and doors to improve insulation and reduce drafts	Moderate
Use insulated window coverings	Install insulated curtains or blinds to reduce heat transfer through windows during hot summers and cold winters	Relatively Easy
Reflective roofing	Choose reflective or cool roofing materials to reduce heat absorption and keep the building cooler in hot weather	Moderate
Seal and insulate the attic	Properly seal and insulate the attic to prevent heat loss in winter and heat gain in summer	Relatively Easy
Upgrade siding and exterior finishes	Consider adding insulated siding or exterior finishes to improve the thermal performance of the walls	Moderate
Manage solar gain	Use shading devices such as awnings, pergolas, or planting deciduous trees strategically to block direct sunlight during the hottest parts of the day	Relatively Easy
Optimize foundation insulation	Ensure the foundation is properly insulated to prevent heat loss from below ground	More involved
Inspect and maintain	Regularly inspect the building envelope for damage, wear, or water leaks, and promptly address any issues to maintain its integrity	Relatively Easy
Energy audits	Consider getting a professional energy audit to identify specific areas of improvement in your building envelope and prioritize upgrades	More involved

REVERTER

The measures categorised as “Relatively Easy” are relatively simple changes or projects that most homeowners can tackle with moderate effort and budget. “Moderate” measures may require a bit more effort or investment but are still manageable for many households. The “More Involved” measures often involve more extensive renovations or design considerations and may require professional assistance.

4 Energy saving tips for lighting

Energy-saving tips for lighting in households can significantly reduce electricity consumption and lower your utility bills. Here are some tips for more efficient lighting, with average price in the EU.

Switch to led bulbs: Replace incandescent and CFL bulbs with energy-efficient LED bulbs. LEDs use significantly less energy and last much longer. The cost of LED bulbs can vary depending on the brand and type (e.g., standard, dimmable, smart). On average, you can expect to pay between €2 to €10 per bulb.

Dimmer switches: Install dimmer switches in rooms where adjustable lighting is desirable. Dimming lights can save energy when full brightness is not needed Dimmer switches typically range from €15 to €30 each, not including installation costs.

Motion sensors: Use motion-activated lights for outdoor areas, closets, and hallways. They ensure that lights are on only when needed. The cost of motion sensors for indoor use is usually between €10 to €30 per sensor. Outdoor motion sensors can range from €20 to €50 each.

Smart lighting systems and timers: Use timers and smart lighting systems to automate when lights turn on and off, particularly when you're away from home. Smart lighting systems can vary widely in price. Basic smart bulbs start at around €10 to €20 per bulb, while more advanced systems with hubs and colour-changing capabilities can cost €50 or more per bulb. Simple plug-in timers can cost as little as €5 to €15 each.

Task lighting (Desk Lamps, Under-Cabinet Lights): Use task-specific lighting, such as desk lamps or under-cabinet lights, for activities like reading, cooking, or working. This allows you to illuminate only the area where it's needed. Prices for task lighting fixtures vary widely, ranging from €20 to €50 or more per fixture.

Solar-powered lights: For outdoor lighting needs like pathway or garden lighting, consider solar-powered options that charge during the day and provide illumination at night. Solar-powered outdoor lights are relatively affordable, with prices typically ranging from €10 to €50.

Energy-efficient fixtures: Dust and dirt on light fixtures can reduce their brightness. Regularly clean bulbs, lamps, and fixtures to ensure optimal light output.

Also, energy savings can be achieved by **changing energy behaviour**, e.g.:

- Choose light paint colours: Light-coloured walls and ceilings can reflect more light, reducing the need for higher-wattage bulbs.
- Educate family members: Teach everyone in your household about the importance of energy-efficient lighting and encourage them to turn off lights when leaving a room.
- Consider lighting zones: Install multiple light switches in rooms with different lighting zones to allow you to control specific areas independently.
- Regular maintenance: Check for flickering or malfunctioning bulbs and fixtures and replace them promptly. Faulty lighting can waste energy.
- By implementing these energy-saving tips for lighting, you can reduce your electricity consumption, lower your energy bills, and contribute to a more sustainable and environmentally friendly household.

5 Energy saving tips for household equipment

The importance of energy efficiency in household equipment is of importance, when talking about cost reduction and higher life standards. From kitchen appliances to electronic devices, our daily lives are intertwined with different types of equipment that, when used inefficiently, can lead to energy waste and higher energy and water bills. However, with the right knowledge and practices, it is possible to experience the convenience of modern appliances and devices while reducing energy consumption and the associated environmental impact.

Below simple energy-saving tips are presented, categorised by type of appliance. These are measures that households could easily implement. Average costs and range of implementation are also provided.

<u>**A. Refrigerators and Freezers**</u>

Set temperature wisely: Keep your fridge at around 6-8°C and the freezer at -18°C (0°F) for optimal efficiency. Avoid colder settings, as they increase energy usage without significant benefits.

Cost: Free

Ease: Relatively Easy

Clean coils and seals: Dusty coils and damaged seals can reduce efficiency. Clean coils annually and replace damaged seals.

Cost: A coil brush costs around €5-€10.

Ease: Relatively Easy

Upgrade to energy-efficient models: Energy-efficient refrigerators and freezers with the ENERGY STAR/ or ECO LABEL can save you money over time.

Cost: €300-€1,500+ (varies by size and features).

Ease: Moderate

Keep the refrigerator full: A well-stocked fridge retains cold better than an empty one. However, avoid overfilling to allow for proper air circulation.

Cost: Free

Ease: Relatively Easy

Cover and store food properly: Use airtight containers or covers to prevent moisture loss and odors from spreading inside the fridge. This reduces the workload on the compressor.

Cost: Free

Ease: Relatively Easy

More energy-saving tips for refrigerators and freezers:

- Regularly Defrost Manual Defrost Freezers: If you have a manual defrost freezer, make sure to defrost it regularly (when frost reaches about 1/4 inch) to maintain its efficiency.

- Position the Fridge Wisely: Place your refrigerator in a cool, well-ventilated area, away from direct sunlight, heat sources, and the stove. Ensure there is adequate space behind and on top for heat dissipation.
- Clean the Coils: Dust and dirt can accumulate on the refrigerator's condenser coils, hindering heat exchange. Vacuum or brush the coils at least once a year to keep them clean.
- Check the Door Seals: Ensure that the refrigerator and freezer doors sealed tightly. Replace damaged or worn-out gaskets to prevent cold air leaks.
- Use Energy-Saving Mode: Some newer refrigerators have an energy-saving mode that reduces power consumption during periods of low activity, like when you're away.
- Avoid Excessive Opening: Limit the number of times you open the refrigerator door, and avoid keeping it open for extended periods. This reduces the need for the compressor to work harder.
- Organize for Efficiency: Keep frequently used items toward the front of the refrigerator for quick access. Store less-frequently used items toward the back.
- Allow Hot Foods to Cool: Let hot foods cool down to room temperature before placing them in the fridge to reduce the energy required to lower their temperature.
- Use the Crisper Drawers: Store fruits and vegetables in the designated crisper drawers. Adjust the humidity settings as needed to keep produce fresh longer.
- Consider a Newer, Energy-Efficient Model: If your refrigerator is old and inefficient, upgrading to an Energy Star-rated model can lead to significant energy savings over time.
- Turn off Ice Makers and Water Dispensers: If your refrigerator has ice makers and water dispensers, consider turning them off if you don't use them regularly, as they can increase energy consumption.
- Plan Your Shopping: Minimize food waste by planning your grocery shopping and meals to use up perishable items before they go bad.

B. Washing Machines and dryers

Use cold water: Washing with cold water reduces energy consumption by avoiding the need to heat water.

Cost: Free

Ease: Relatively Easy

Run full loads: Maximizing the load size reduces the number of cycles and saves energy.

Cost: Free

Ease: Relatively Easy

Choose high spin speeds: High spin speeds remove more water, reducing drying time and energy use.

Cost: Free

Ease: Relatively Easy

Option for energy-efficient models: Look at the energy label when buying appliances. ENERGY STAR-rated washing machines are designed to be more efficient.

Cost: €300-€1,000+ (varies by capacity and features).

Ease: Moderate

More energy-saving tips for washing machines and dryers:

- Pre-treat stains: pre-treat stains or heavily soiled areas to avoid running the wash cycle again, which saves energy and water.
- Front-load vs. Top-load: front-load washing machines are generally more energy-efficient than top-load machines. Consider this when shopping for a new washer.
- use delay start: some washing machines have a delay start feature, which allows you to run cycles during off-peak hours when energy rates may be lower.
- Maintain the machine: regularly clean the lint filter and check for blockages in the drain pump or hoses. Keeping the machine in good working condition ensures it operates efficiently.
- Drying your clothes outside on the terrace is free. If you use a dryer, consider its energy efficiency characteristics.
- Drying the same fabrics together speeds up the drying process.
- Drying clothes in the tumble dryer is expensive and makes them harder to iron
- Clean the lint filter: after each load, clean the lint filter to maintain proper airflow, which allows the dryer to work more efficiently.
- Use moisture sensors: if your dryer has a moisture sensor setting, use it. These sensors detect when clothes are dry and automatically shut off the machine, preventing over-drying.
- Dry full loads: just like with washing machines, dry full loads whenever possible to make the most efficient use of the appliance.
- Separate heavy and lightweight fabrics: when drying mixed loads, separate heavier items (like towels and jeans) from lighter fabrics (like shirts and delicates) to optimize drying times.
- Dry towels and heavier cotton in a separate load from lighter-weight clothes.
- If your dryer has a "cooling cycle", it allows the clothes to finish drying with the residual heat in the dryer.

C. Dishwashers

Run full loads: Like washing machines, running full dishwasher loads conserves energy. Dishwashers are most energy-efficient when they run full loads. Wait until you have enough dishes to fill the dishwasher before running it.

Cost: Free

Ease: Relatively Easy

Use efficient settings: Select shorter or eco-friendly cycles when possible. Many dishwashers offer an energy-saving or eco-friendly cycle. Use this setting to reduce water and energy consumption during the wash.

Cost: Free

Ease: Relatively Easy

Air dry dishes: Some dishwashers have a heated dry option. Skip the heated drying cycle and allow dishes to air dry. Turning this off and allowing dishes to air dry can save energy.

Cost: Free

Ease: Relatively Easy

Upgrade to energy-efficient models: If you're in the market for a new dishwasher, consider purchasing an Energy Star-certified model, which meets energy efficiency guidelines and may qualify for rebates. Look at the energy label!

Cost: €400-€1,200+ (varies by size and features).

Ease: Moderate

More energy-saving tips for dishwashers:

- Scrape, Don't Pre-Rinse: Modern dishwashers are designed to handle food residues on dishes, so there's no need to pre-rinse dishes under running water. Scrape off large food particles instead.
- Load Dishes Properly: Arrange dishes so that they do not block the spray arms. Proper loading ensures that all items are thoroughly cleaned and reduces the need for rewashing.
- Use Rinse Aid: Rinse aid helps dishes dry faster and with fewer water spots, which can reduce the need for extended drying cycles.
- Avoid Excessive Detergent: Using too much dishwasher detergent can lead to excess suds and more rinse cycles. Follow the manufacturer's recommendations for detergent usage.
- Select Shorter Wash Cycles: Choose shorter wash cycles when possible, as they use less energy and water than longer, intensive cycles.
- Use Delay Start: If your dishwasher has a delay start feature, use it to run the machine during off-peak energy hours when rates may be lower.
- Regular Maintenance: Clean the dishwasher's filter and spray arms regularly to ensure they work efficiently. A well-maintained dishwasher is more energy-efficient.
- Check Water Temperature: Make sure your water heater is set to a temperature of at least 120°F (49°C) to ensure effective dishwashing.
- Fix Leaks: Check for and repair any leaks in your dishwasher promptly. Leaks can waste both water and energy.
- Load Utensils Properly: Load utensils with handles facing down to allow for better water and detergent distribution.
- Don't Overcrowd: Avoid overloading the dishwasher, as it can obstruct water flow and reduce cleaning efficiency.

D. Water Heaters

Lower temperature: Reduce the water heater thermostat to 49-52°C. This is typically sufficient for most household needs and helps prevent overheating and energy waste.

Cost: Free

Ease: Relatively Easy

Insulate the tank and pipes: Wrapping the tank with an insulating blanket reduces heat loss. Insulate also the hot water pipes in your home, especially those that run through unheated spaces. This prevents heat loss and ensures hot water reaches its destination faster.

Cost: €20-€50 for an insulating blanket.

Ease: Moderate

Use night tariff: Use a night tariff when possible, this will not save electricity but will reduce the cost (bill)

Cost: Free

Ease: Relatively Easy

More tips for domestic water heating:

- Use water-saving shower aerators - this will reduce water flow. The payback period for new efficient showers is less than 1 year;
- If your boiler is old, replace it, possibly energy-saving. Due to the presence of scale in the water, it accumulates on the heat exchange surface of the boiler, which leads to a gradual increase in electricity consumption for water heating.
- When heating an electric boiler: During the winter the temperature of the hot water should not be higher than 55 ° C, and in the summer it is recommended that the temperature of the hot water be lower. In order to prevent Legionnaires' disease, it is necessary to heat the temperature of the hot water from the boiler to at least 60 ° C once a month.
- Hot water from TPP: Hot water leaves the subscriber station with a temperature of 52 to 55 ° C, depending on the setting of the thermostatic valve.
- Check for hidden water losses with water meters! If there is no increase in the water meter reading after two hours when the water taps in the apartment are closed everywhere, then everything is fine. Otherwise, look for leaks;
- Check for water losses from the toilet cistern! For this purpose, a water colourant can be used in it. If without dropping the cistern, after 30 minutes there is staining of the water in the toilet bowl, then there is a leak. Replacing defective seals is not a problem for anyone;
- Remember that the biggest consumer of water is the toilet cistern! Place small plastic bottles filled with water and some sand or pebbles at a safe distance from moving parts to sink to the bottom. In this way you can save up to 20 litres per day or replace the old cistern with a new one, with a smaller volume;
- Stop the water after wetting the toothbrush and while brushing your teeth;
- Use a glass of water to rinse your mouth. Use the washing machine and dishwasher only when fully charged.
- When washing dishes by hand, do not let the rinsing water in the sink run constantly;
- Do not cool drinks with running tap water but in the refrigerator. This will save a lot of water;
- Eliminate damage causing leaks or drips immediately;
- When buying a washing machine (the second largest consumer of water), prefer those with a water factor of less than 9.5, which uses 35 - 50% less water and consumes up to 50% less energy per charge.

E. Computers and Electronics:

Enable power-saving features: Activate power-saving modes and set computers and devices to sleep when not in use. Right-click on the desktop> Properties> Screen saver> Power. Your monitor will reactivate within seconds of moving the mouse. Turn off the monitor when you are away from your desk (while at lunch and meetings) and your computer at night.

Cost: Free

Ease: Relatively Easy

Unplug chargers and devices: Chargers and electronics consume energy even when not in use. Unplug or use smart power strips.

Cost: Free

Ease: Relatively Easy

Upgrade to energy-efficient models: When replacing devices, look for ENERGY STAR-rated models. A computer with energy class B-A can save 2,000 kWh per year

Cost: Varies by device, e.g., €500-€2,000+ for a new laptop.

Ease: Moderate

More tips for Computers and Electronics:

- A monitor left to work overnight uses the energy to laser print 800 pages;
- For a 12-month period, a computer left to run 24 hours a day will consume up to 2,500 kWh of electricity per year
- Hibernation is energy efficient if you leave your laptop running all night. This option is designed for laptops and may not be available for all computers. Hibernate mode uses less power than Sleep, and when you restart your computer, you return to where you left off (though not as fast as Sleep). Use Hibernation when you know you will not be using your laptop or tablet for an extended period of time and will not be able to charge the battery during this time. First, make sure that this option is available on your computer and turn it on, if available.

F. TVs

Adjust brightness and contrast: Lower the brightness and contrast settings on your TV to reduce energy consumption. Many modern TVs have automatic brightness controls that adjust according to the room's lighting conditions

Cost: Free

Ease: Relatively Easy

Power saving setting: enable power-saving features: Most TVs have power-saving or energy-saving modes that reduce energy consumption during periods of inactivity. Enable these features in the TV settings.
Cost: Free

Ease: Relatively Easy

Set a sleep timer: If you tend to fall asleep while watching TV, set a sleep timer to automatically turn off the TV after a certain amount of time. This prevents the TV from running all night.
Cost: Free

Ease: Relatively Easy

Optimize audio: If you have external speakers or a sound system connected to your TV, make sure they are turned off when not needed to save energy.

Cost: Free

Ease: Relatively Easy

More energy-saving tips for TVs:

- Choose Energy-Efficient Models: When purchasing a new TV, look for models that are ENERGY STAR-certified. These TVs are designed to meet energy efficiency guidelines.
- Turn Off the TV When Not in Use: It may seem obvious, but turning off the TV when you're not actively watching it is one of the most effective ways to save energy.
- Use a Power Strip: Plug your TV and related devices (DVD players, game consoles, streaming devices, etc.) into a power strip. This allows you to turn off all devices with a single switch when they're not in use, preventing energy "vampires" from drawing power in standby mode.
- Disable Screen Savers: Modern LED and LCD TVs do not need screen savers. Disable them to save energy.
- Unplug Unnecessary Devices: If you have devices connected to the TV via HDMI or other ports, unplug them when not in use to prevent the TV from constantly searching for signals.
- Choose a Smaller Screen: Consider using a smaller TV if it meets your needs. Smaller screens typically consume less energy than larger ones.
- Stream Wisely: Streaming video content from the internet can consume a significant amount of energy. Use streaming devices or smart TVs with energy-efficient processors, and turn off streaming devices when not in use.
- Keep the TV Clean: Dust and dirt can accumulate on the TV's vents and components, leading to overheating and reduced efficiency. Clean the TV regularly to ensure proper airflow.
- Leaving your TV and all accessories attached to it in standby mode all the time can cost you up to BGN 60 per year. Use standby power strips and turn them off during the day.
- The new TV with energy class B-A can save about 160 kWh / year.

G. Energy saving tips for cooking

Some energy saving measures that can be useful for cooking are, as follows:

- Household microwave appliances consume on average about 1/2 less energy than the energy consumed by conventional household appliances.
- When you open the oven door during cooking, you lose up to 30% of the oven temperature.
- Preheat the oven only when necessary.
- The diameter of the hob must correspond to the diameter of the pan placed on it - so the heat is transferred optimally.
- Always cover the pot when cooking.
- Turn off the hobs before the end of the boiling time to use the residual heat.
- Heat portions up to 400 g in the microwave oven - this will save both time and energy.
- When frying meat for a short time, a pan should be used.
- Making coffee in a coffee machine is 50% cheaper than boiling water on the stove.
- Use a deep fryer instead of an electric stove, so you save up to 25% electricity.
- Baking the slices with a toaster is a more energy-saving method (by about 70%) compared to using the oven.
- When cooking eggs for breakfast, it is better to use an electric egg cooker than a pot, which will save up to 50% of electricity.

6 Intelligent meters and devices for energy management in households

Lack of information is a present barrier to consumer energy saving. Lack of information constitutes a barrier on two levels: consumers lack information on the energy consumption of their household appliances, as well as on how this consumption can be reduced. By using smart plug equipment and feedback on the individual consumption patterns of their appliances, consumers will be given a very easy way to learn about how much energy their appliances are using. Smart plugs allow consumers to monitor the extent of energy savings through changed behaviour when using individual appliances. Seeing this immediate effect is one of the most promising ways to change habits.

A. Smart equipment components

Intelligent meters and devices for energy management in households, often referred to as smart meters or smart home energy management systems, represent a significant advancement in how we measure, monitor, and control energy consumption within residential settings. These technologies combine hardware, software, and communication capabilities to provide homeowners, utility companies, and grid operators with detailed insights and improved control over electricity usage. Here's an explanation of how these systems work and their key components:

- **Smart meters**: Intelligent meters, or smart meters, are the cornerstone of these systems. They replace traditional analogue meters and digitally record electricity consumption data. Smart meters measure electricity usage at shorter intervals, often in 15-minute increments, compared to the monthly readings of traditional meters. This granular data is sent to utility companies automatically.
- **In-home energy monitors:** In addition to smart meters, some systems include in-home energy monitors or sensors that provide real-time information on electricity use within the household. These monitors can be connected to the main electrical panel or individual appliances to provide insights into energy consumption.
- **Wireless networks:** Smart meters and in-home monitors communicate with a central data collection point or the utility company through wireless networks, such as Wi-Fi, Zigbee, or cellular networks. This enables the transmission of data without the need for physical meter readings.
- **Data management and analytics:** Homeowners can access their energy consumption data through user-friendly web portals or mobile apps. These dashboards display real-time and historical usage data, allowing residents to track their energy consumption trends and make informed decisions.
- **Control and automation:** Some intelligent systems include load control devices that can remotely manage certain appliances during periods of peak demand or high electricity rates. For example, these devices can cycle air conditioners or water heaters on and off to reduce load.
- **Thermostats**: The thermostat is a device that automatically responds to changes in ambient temperature by turning on or off a heating or cooling system to constantly maintain a set desired temperature indoors. The biggest benefit of using the thermostat is the ability to set

different temperature regimes and schedules. When the operation of the heating or cooling system or appliances is optimized, significantly less energy is used in the long run.

- **Temperature control** - It is possible to set a lower temperature (heating during the day when you are not at home and at the same time a program) with digital thermostats, to reach and maintain a comfortable temperature when you get home. saving energy during our absence and at the same time when we return home, we are waiting for a cosy and warm home.
- **Smart home appliances:** Smart energy appliances, also known as smart appliances or connected appliances, are household devices and equipment that integrate advanced technology, sensors, and connectivity features to enhance energy efficiency, convenience, and functionality. These appliances are designed to interact with users and other devices, offering greater control and automation while helping homeowners manage their energy consumption more effectively.

B. Benefits of the intelligent energy management system

Intelligent meters and devices for energy management in households offer a range of benefits that can help homeowners, utilities, and society as a whole. Here are some of the key advantages:

Real-time data monitoring

- Intelligent meters provide real-time data on electricity consumption, allowing homeowners to track their usage patterns accurately. This data empowers consumers to make informed decisions about energy consumption

Energy usage insights

- Intelligent meters and devices offer insights into which appliances and activities consume the most energy, enabling homeowners to identify areas where they can make energy-saving improvements.

Reduced energy costs

- With the ability to monitor energy consumption closely, homeowners can implement energy-saving strategies and reduce their utility bills. This can lead to significant cost savings over time.

Remote disconnect/reconnect

- Intelligent meters allow utilities to remotely disconnect and reconnect service, eliminating the need for physical visits by technicians. This enhances service efficiency and reduces downtime during maintenance or non-payment situations

Enhanced billing accuracy

- Intelligent meters provide accurate data on electricity usage, reducing billing errors and disputes. Homeowners receive more transparent and fair billing statements

Promotion of energy efficiency

- Access to real-time data and insights encourages homeowners to adopt energy-efficient practices, such as using high-efficiency appliances and turning off lights and devices when not in use.

Environmental benefits	Enhanced customer engagement	Promotion of energy efficiency
• Lower energy consumption at the household level, as a result of intelligent energy management, contributes to reduced greenhouse gas emissions and environmental preservation.	• Intelligent meters and accompanying data portals foster greater engagement between utilities and consumers, promoting energy conservation and customer satisfaction.	• Access to real-time data and insights encourages homeowners to adopt energy-efficient practices, such as using high-efficiency appliances and turning off lights and devices when not in use.

7 Energy labels

The legislation for energy labelling and Ecodesign in the European Union aims to enhance the energy efficiency of products available in the EU market. Ecodesign establishes standardized minimum standards across the EU, eliminating the least efficient products from the market. Energy labels offer a straightforward indication of a product's energy efficiency and key features at the point of purchase. This simplifies the process for consumers to save money on household energy expenses and contribute to reducing greenhouse gas emissions throughout the EU.

Initially introduced in 1994 for select household appliances and expanded in 2004 with a comparative scale from A (most efficient) to G (least efficient), the EU energy label has been instrumental in guiding consumers toward more energy-efficient choices. Simultaneously, it incentivizes manufacturers to innovate by adopting more energy-efficient technologies. Beyond energy consumption details, these labels also provide specific information on other relevant usage features, such as noise emissions or water consumption.

As the market introduced increasingly energy-efficient products, and distinctions between A^{++} and A^{+++} became less evident to consumers, the EU energy label categories underwent a gradual adjustment, returning to the simpler A to G scale. For instance, a product originally labelled as A^{+++} for energy efficiency might be reclassified as class B or lower after rescaling, despite no change in its energy consumption. The initial A class was left empty to accommodate future, more energy-efficient models.

In 2021, five product groups underwent this rescaling process, and additional product groups with EU energy labels are expected to undergo similar adjustments in the years ahead.

A. Fridges and freezers

The EU energy labels for household fridges and freezers (Figure 2) use, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The labels provide information on the product's:

- energy efficiency class
- energy consumption
- storage volume(s)
- whether or not it has a freezer compartment
- noise emissions

Other factors may apply to the label, for example for wine storage units, which shows the number of bottles that can be stored. By switching to more energy efficient refrigerating appliances, a household can save up to €200 over the lifetime of an average product.

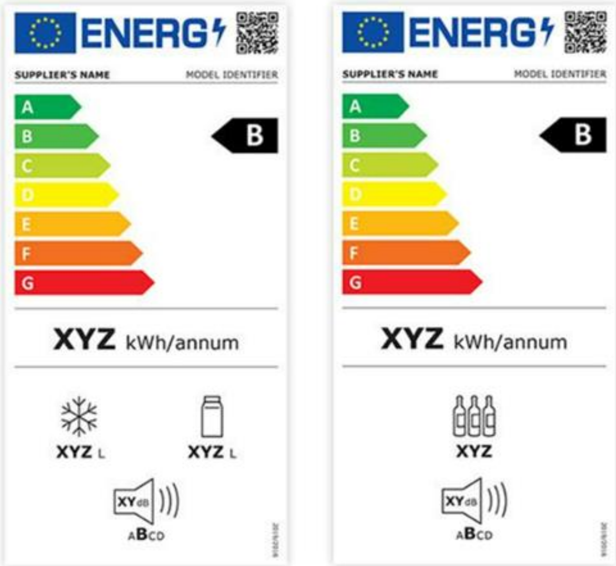

Figure 2. Energy label for fridges and freezers

B. Dishwashers

The EU energy label for household dishwashers (Figure 3) uses, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The label provides information on the product’s:

- energy efficiency class
- energy consumption for 100 cycles
- eco-programme duration
- water consumption for 1 cycle
- capacity of the dishwasher
- noise emissions

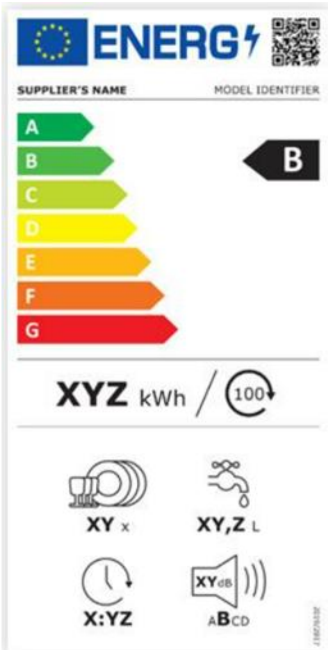

Figure 3. Energy label for household dishwashers

C. Washing machines and washer-dryers

The EU energy labels for household washing machines and washer-dryers (Figure 4) use, as of 1 March 2021, a scale from A (most efficient) to G (least efficient). The labels provide information on the product's:

- energy efficiency class(es)
- energy consumption for 100 cycles
- water consumption for 1 cycle
- duration for 1 cycle
- noise emissions

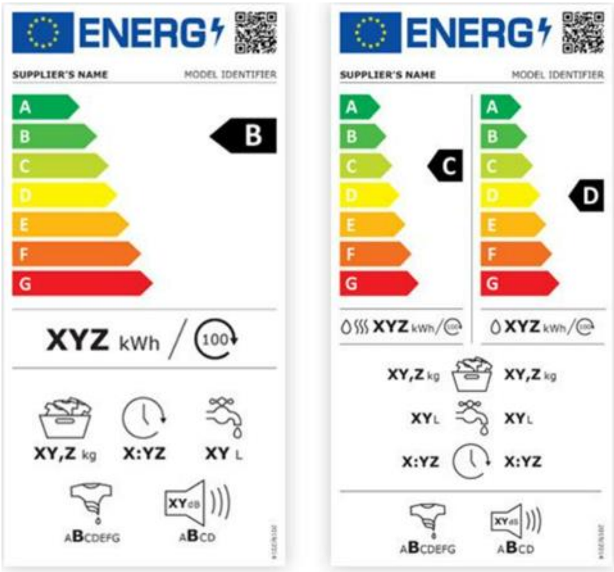

Figure 4. Energy label for household washing machines and washer-dryers

D. Electronic displays including televisions

Electronic displays, such as televisions, computer monitors, or signage displays, are categorised on an energy efficiency scale from A (most efficient) to G (least efficient). The updated scaling system represents an enhancement, taking into account the screen area. These new labels (Figure 5) also provide information on a product's efficiency when displaying content in HDR, recognizing that such settings can consume up to twice as much energy as other configurations. Additionally, the label includes details about the diagonal size of the display and its resolution, enabling consumers to make more informed comparisons between similar displays.

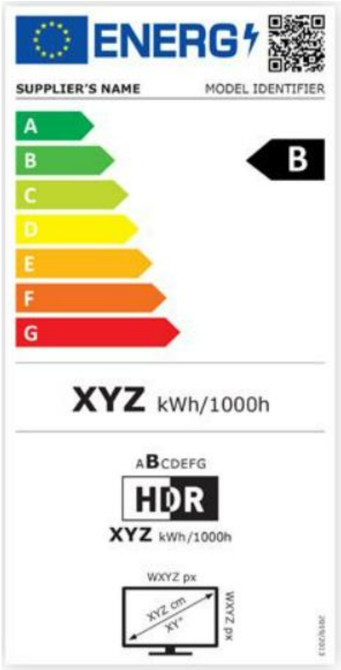

Figure 5. Energy label for electronic displays

E. Lighting

Lighting products encompass various elements, including light sources like light bulbs (halogen, compact fluorescent, etc.) or LED modules/lamps. Additionally, control gears, such as ballasts, electronic components, and drivers, are considered part of lighting products, serving as devices necessary for connecting light sources to the electrical mains.

It's important to note that energy labelling and ecodesign regulations no longer apply to lamps or luminaires as of December 25, 2019, although a label was previously applicable. A luminaire constitutes a comprehensive electric light fixture responsible for distributing, filtering, or transforming light from one or more lamps, for instance, table, wall, or ceiling lamps.

Following the rescaling of the EU energy label for light sources starting from September 1, 2021, the revised labels now utilize a scale ranging from A (most efficient) to G (least efficient). This adjustment was prompted by the ongoing enhancements in energy efficiency, leading many products under the original label to attain A^{+} or A^{++} ratings. Consequently, the rescaling was implemented to offer consumers clearer insights into the most efficient products available on the market. The labels (Figure 6) provide information on the product’s:

- energy efficiency class
- energy consumption

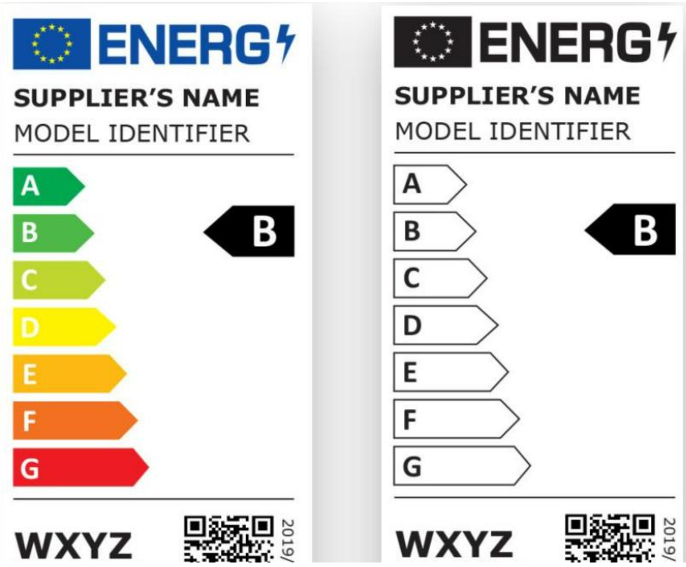

Figure 6. Energy label for lighting products

More information how to read the energy label of the household appliances can be found here: https://www.label2020.eu/

8 How to read your energy bill

This chapter provides information on how the customers can easily understand their energy bills and how they can select the best energy supplier. The analysis is provided for the REVERTER pilot countries. More detailed information will be included in the national versions and will be discussed during the training activities.

A. Bulgaria:

Understanding the electricity bill can sometimes be a challenging task. This chapter explains some of the main key players in electricity supply, the key components of an electricity bill and what prices are charged.

- **Regulated electricity market -** EVN Electric Supply, in its role as a final supplier, ensures the supply of electrical energy for household customers with sites connected at low voltage to the network of Elektraspradelenie Yug in South-Eastern Bulgaria, for which no electricity supplier has been selected on the free market. The prices at which the final supplier delivers to its customers are regulated by KEVR and change every year from the first of July.
- **What is a network operator/electricity distribution company?** The network operator is the owner of the electricity network who takes care of its management and maintenance. The network in Bulgaria is managed by different network operators depending on the voltage level and geographical location. There is only one network operator on a given network. The network operator of the high voltage network is ESO EAD. Elektraspredelenie Yug is the only network operator in South-Eastern Bulgaria. All network operators are regulated by the KEVR. Everyone who is connected to the network of Elektrorazpradelenie Yug is its customer - he has an individual contract or a contract under general conditions, pays for the network services provided to him and complies with the rules and procedures established by the operator and the regulatory framework.
- **What are Network Services?** Transmission and access services provided by the network operator.
- **What is Measurement Point Number?** Measurement Point Number, is a unique 7-digit number that identifies the object. It is used to receive information or make cashless payments. It is located in the customer data block, next to the customer number on the monthly invoice.
- **What is a customer number?** The customer number identifies the customer. To one customer number, there can be several measurement points (TIN, several objects). Paying bills with a customer number is a great convenience for customers who have several ITNs (objects) in their name. Entering a customer number facilitates all procedures related to EVN Bulgaria's customer service and reduces payment time at the cash register. Your customer number is located in the data block of each paid monthly bill.
- **Active energy.** One of the key components of your bill is active energy. This is the amount you consume at your business or home. Active energy is usually measured in kilowatt hours (kWh). On your electricity bill, you will see the amount of electricity you used during the reporting period, as well as the price per kWh you were charged.
- **Trade allowance and/or administration fee.** The value of the administrative fee and/or commercial surcharge includes the cost of electricity balancing and administrative customer

service and is determined and received by the electricity trader. The trade surcharge is a fixed value or % that is added by the trader to the price for each kWh of electricity consumed. Unlike the commercial surcharge, the administrative fee is not directly linked to the amount of electricity consumed. It is a fixed amount and is charged on a monthly basis for each object.

- **Excise duty.** Excise duty is a tax imposed by the state on certain goods or services. The value of the excise tax for electric power is determined once a year and is the same for all consumers, regardless of the trader. The excise tax is charged by the electricity trader on the customer's monthly invoice, after which the whole value is paid by the trader to the state. Revenue generated by excise taxes is often used to fund specific programs or initiatives, such as health care or infrastructure improvements.
- **Network charges and services.** It includes the value of electricity distribution services. These fees are determined by the Energy and Water Regulatory Commission and are the same for all consumers. The trader pays the value of these services to the Electricity Distribution Companies, and the purpose of these funds is for the maintenance and development of the infrastructure in order to guarantee a constant and high-quality distribution of electricity in Bulgaria.
- **Final prices** including VAT and excise duty for residential customers of EVN Elektrosnabdiavane until December 2023:

Metering method	Periods within the day	Price, BGN/kWh
With two rates	Day Night	0.25751 0.14788
With one rate	—	0.25751

Final prices for residential customers are calculated in accordance with the Electricity Market Rules and include:

- the prices of EVN Elektrosnabdiavane and prices for grid services approved by EWRC’s Decision No. C-14 / 30.06.2023
- 20% VAT
- 0% excise duty.

Фактура № xxxxxxxxxx-*ОРИГИНАЛ* - детайлна информация

Клиентски номер:	xxxxxxxxxx	Място на потребление:	№ xxxxxxx / ИТН /
Отчетен период:	xx.06.2022 – xx.07.2022		НАСЕЛЕНО МЯСТО
			УЛИЦА НОМЕР
		Обозначение:	бит

Отчетени показания

Електромер	№ / тарифа	отчетен период	п.старо	п.ново	разлика	служ.ен.кВтч	
xxxxxxx /	дневна	xx.06.2022 – 30.06.2022	26821	26946	125	125	Консумирана дневна енергия по цени до 30.06.2022 г.
xxxxxxx /	нощна	xx.06.2022 – 30.06.2022	10332	10392	60	60	Консумирана нощна енергия по цени до 30.06.2022 г.
xxxxxxx /	дневна	01.07.2022 – xx.07.2022	26946	27071	125	125	Консумирана дневна енергия по цени от 01.07.2022 г.
xxxxxxx /	нощна	01.07.2022 – xx.07.2022	10392	10452	60	60	Консумирана нощна енергия по цени от 01.07.2022 г.

*Крайни цени на електрическа енергия – ниско напрежение /НН/		кВтч	Ед. Цена/лв	Общо/лв	
дневна ел.енергия	xx.06.2022 – 30.06.2022	125	0.20011	25.01	Крайна цена дневна енергия без ДДС и акциз
нощна ел.енергия	xx.06.2022 – 30.06.2022	60	0.11390	6.83	Крайна цена нощна енергия без ДДС и акциз
дневна ел.енергия	01.07.2022 – xx.07.2022	125	0.20677	25.84	Крайна цена дневна енергия без ДДС и акциз
нощна ел.енергия	01.07.2022 – xx.07.2022	60	0.11875	7.13	Крайна цена нощна енергия без ДДС и акциз
Общо:		**370**		64.81	

***Крайната цена на електрическата енергия включва:**

Цена на електрическа енергия за дневна тарифа	xx.06.2022 – 30.06.2022	0.14433
Цена на електрическа енергия за дневна тарифа	01.07.2022 – xx.07.2022	0.10917
Цена на електрическа енергия за нощна тарифа	xx.06.2022 – 30.06.2022	0.05812
Цена на електрическа енергия за нощна тарифа	01.07.2022 – xx.07.2022	0.02115
Акциз	xx.06.2022 – xx.07.2022	0.00000
Пренос през ел.разпределителната мрежа НН	xx.06.2022 – 30.06.2022	0.03783
Пренос през ел.разпределителната мрежа НН	01.07.2022 – xx.07.2022	0.07105
Достъп до електроразпределителната мрежа НН	xx.06.2022 – 30.06.2022	0.00598
Достъп до електроразпределителната мрежа НН	01.07.2022 – xx.07.2022	0.00598
Цена за пренос и достъп през/до електропрен. мрежа	xx.06.2022 – 30.06.2022	0.01197
Цена за пренос и достъп през/до електропрен. мрежа	01.07.2022 – xx.07.2022	0.02057

Цени на компоненти, включени в крайните цени на електрическата енергия

Предоставена мощност за обекта – X кВт

*** Цените на електрическата енергия,задължения към обществото и мрежовите услуги до 30.06.2022 г. са определени с Решение № Ц – 27/01.07.2021 г. на КЕВР, а цените на електрическата енергия, задължения към обществото и мрежовите услуги от 01.07.2022 г. са определени с Решение № Ц – 19/01.07.2022 г. на КЕВР.**

В крайните цени на електрическата енергия е включена и цената за задължения към обществото

Данъчна основа на доставката	64.81
Размер на данъка / Данъчна ставка ДДС 20%	12.96
Обща стойност на фактурата в лева	**77.77**

Словом: седемдесет и седем лева и 77 ст.

Съставил: /шиф. 0911/

Доставчик:
ЕВН България Електроснабдяване ЕАД

Figure 7. Explanation of electricity bill – invoice

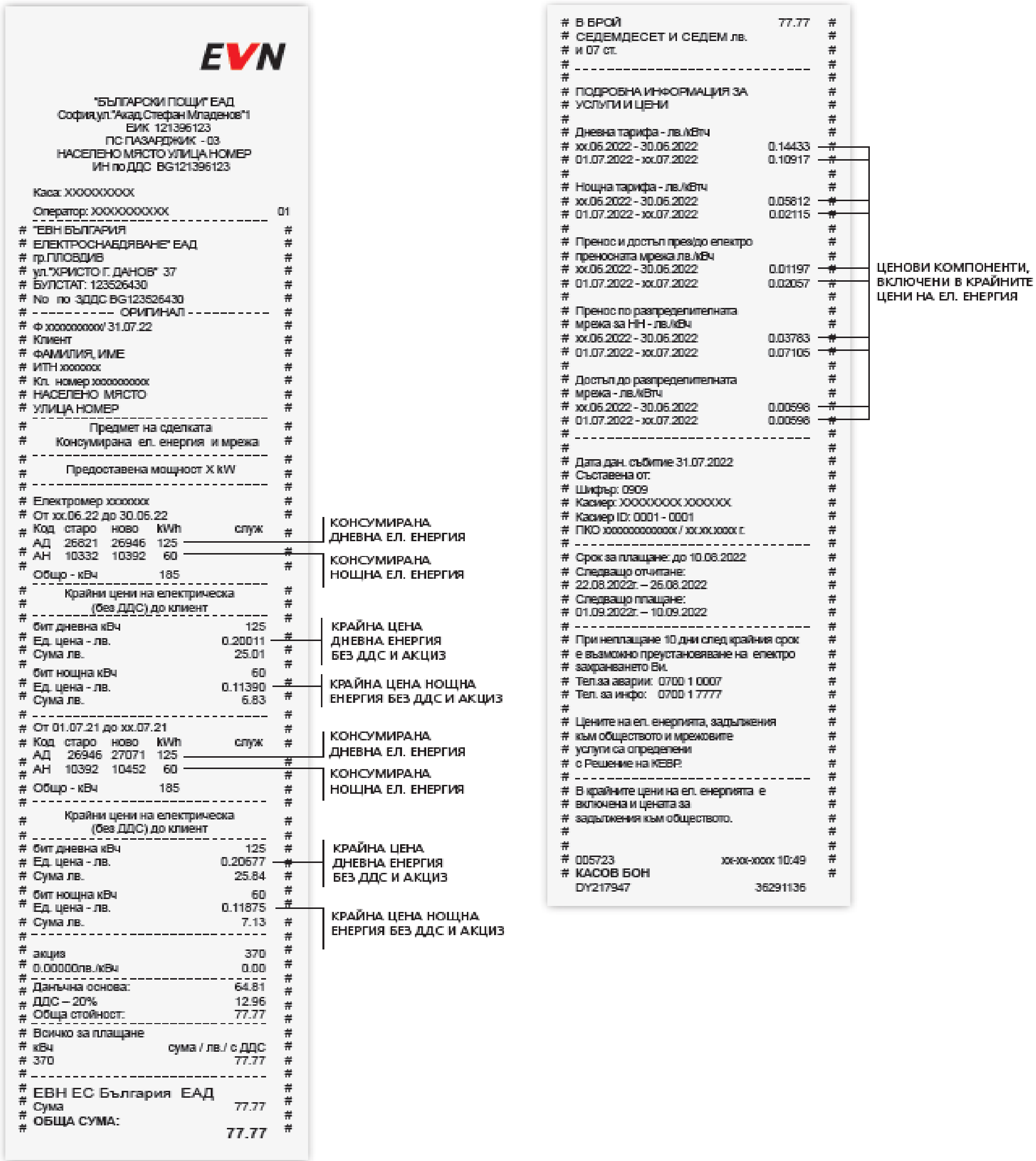

Figure 8. Explanation of Electricity bill – cash receipt

B. Greece:

Through the electricity bills, the consumers reimburse:

1. The full cost of providing electricity to them, including the production and supply of electricity (supply/consumption charge),
2. The regulated charges which encompass, among others, the charges for the transmission and distribution of electricity to their property (charges for the Electricity Transmission System and the Electricity Distribution Network). The Distribution Network and the Transmission System fees are collected by the suppliers and are attributed to the Distribution Network and Network System Operator respectively, for the proper operation, maintenance and expansion of the Distribution Network and Transmission System.

3. Various charges, such as Municipality charges, charge for ERT (State Radiotelevision Company), and
4. VAT charged on the electricity supply/consumption charge.

Regarding the supply/consumption charge, four new electricity tariffs are established by the Law 5066/2023, which will be valid from 1.1.2024. These tariffs are fixed, fluctuating and dynamic and for the convenience of the consumer, the invoices were associated with a color (see figure 1). The blue one for the fixed tariff, the green and the yellow ones for the fluctuating tariffs and the orange invoice for the dynamic tariff.

More specifically:

- Fixed are fixed-term invoices, with a fixed billing price for the entire period of the contract.
- Fluctuating are the tariffs, which are linked to the wholesale price on the Energy Exchange. These are divided into two main categories: i. by setting a price in advance of the consumption period (green invoice) and ii. with post-fixing of price (yellow invoice).
- Dynamic, which refers to the possibility of dynamic pricing, with different prices - even during the day - based on market prices. A condition for the selection of these tariffs is the operation of a smart telemetered meter in the supply of consumers.

Figure 9. Four coloured invoices, and their characteristics, as they are announced by the Ministry of Energy and the Environment

C. Portugal:

Reading and fully understand the energy bills, in Portugal, can be a nightmare even for people with a technical background! Besides the specific units, there are several items related to the specific tariff and the different discounts by the operators, that make the bill very complex to read. There is no format template to follow, but the National Energy Regulator requires certain minimum information to be included in the energy bill. In relation to raising people awareness, there are a number of websites that inform people about how to read and how to change to another operator, by providing user friendly simulators online.

What should be on the bill?

The electricity bill must contain the following information:

- The contracted power, including the price.
- The dates and means by which customers can report readings.
- Actual and estimated consumption (associated quantities).

- The price of energy and the tariffs applicable to the sale and consumption of energy (unit and total price).
- The total and unbundled value of the network access tariff.
- The billing period.
- The applicable fees and taxes, itemised.
- The conditions, deadlines and means of payment The consequences of non-payment.
- The costs of general economic interest (CIEG).
- The value of the discount corresponding to the social tariff, where applicable.
- The difference between the amount paid and what you would pay if you had the regulated (transitional) tariff.

The invoice must also include information on:

- other services provided, if applicable
- CO_2 emissions corresponding to the energy consumed and invoiced
- the supplier's contact details
- contacts for reporting faults and emergencies
- value (in %) of the primary energy sources used to produce electricity (wind, hydro, natural gas, coal, etc.)

To better understand the bill, there are several Apps and videos where the user can find user-friendly explanation about the energy bill, listed below:

https://www.erse.pt/consumidores-de-energia/eletricidade/compreender-a-fatura/)

You Tube channel where informative materials are available in Portuguese:

https://www.youtube.com/playlist?list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS

About energy bills, there are two videos with clear general explanations:

https://www.youtube.com/watch?v=_R71DCvjKq4&list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS&index=6

https://www.youtube.com/watch?v=6CkZE52DCUI&list=PLBfCweQrI1COuhWpvOJx1J39z4VJIcvPS&index=12

The main operator in Portugal, EDP, also provides information on how to read the invoice:

https://www.edp.pt/particulares/apoio-cliente/como-ler-fatura/

On the first page, the electricity invoice highlights the amounts to be paid for each component of contracted energy, additional services (if you have contracted services), taxes and fees and shows the values of the readings taken into account for the invoice. On the second page there are details of invoicing, with an explanation of all the consumption invoiced and explanatory texts on the fees and taxes payable (Figure 10).

Figure 10. The first two pages of the electricity invoice in Portugal

On the last page of the invoice (Figure 11) there is an area illustrating energy performance with a history of consumption, a graph explaining the origin of the energy and a detachable card for payment by ATM. In the event of a debt, an extra page is shown on the invoice which tells the customer how much they have to pay. This outstanding amount is not included in the amount shown on the first page.

Figure 11. The last page of the electricity invoice in Portugal

The main consumers Association, DECO, provides a virtual assistant with much information about energy use and energy savings, in particular one section with basic information to take into consideration when reading an energy bill:

https://academiaeva.deco.pt/

https://poupaenergia.pt/#/

D. Latvia:

It should be taken into account that due to the amount of electricity consumed, the bill will fluctuate from month to month. In turn, for those who choose the levelized payment with a specific monthly fee, the calculation of the real amount of electricity consumed will be made at the end of the year or with the change of the electricity provider. Determining your own electricity price is easiest when calculating the price per 1 kilowatt hour (kWh). To do this, it is necessary to add up all the amounts indicated in the bill for electricity and divide by the number of kWh consumed. In different bills, the names of the indicators may differ from one provider to another, but most often include "charge for electricity" and "service fee" or "connection fee". Payments relating to distribution and transmission services, as well as the mandatory procurement component for electricity, are not included in this calculation, as they will be the same for all service providers.

In the bill, the layout of the information is determined by EU regulations and laws, the electricity trader cannot vary with the content. Each electricity trader's bill includes the MPC (mandatory procurement components) as well as the distribution and transmission fee part. When dividing the sum of bills as a percentage, about 28% is made up of the share of the MPC, about 40% is the share of distribution and transmission, while the remaining 32% is the direct electricity consumption and electricity trader's fee – of which about 28% is made up of electricity purchases on the stock exchange or at the wholesaler, and about 4% is made up of electricity trader.

You can reduce your electricity bill fee by limiting your electricity consumption and/or by choosing dynamic electricity tariff taken from Nord pool electricity exchange. The exchange tariff allows you to use energy wiser – by slightly adjusting your habits and using electricity more actively at times when its price on the electricity exchange is lower, it is possible to save. In addition, the process is automated – the accounting of electricity consumption takes place automatically through a smart meter, and the price for electricity consumption is calculated hourly – according to its current fee on the electricity exchange.

Sources of information

- Energy Agency of Plovdiv. IDEA project - Training program - Technical part. 2019. Available at: http://www.project-idea.eu/
- Intense energy efficiency - Energy performance of buildings.
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- POWERPOOR. D5.2 Energy Poverty Guidebook for Energy Planning. 2021.
- Schneider Electric. Saving tips brochure
- Start2Act. Energy efficiency measures in the office. 2019. Available at: https://bg.start2act.europamedia.org/online-energy-saving-platform/e-learning
- https://ec.europa.eu/clima/citizens/tips_bg
- https://evn.bg/Home/Electricity.aspx?lang=en-us
- https://www.cez.bg/bg/za-klienta/energijna-efektivnost/racionalno-izpolzvane-energy.html

REVERTER

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC V

Financing schemes and mechanisms

Co-funded by the European Union

Executive Summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. It aims to provide a summary of the most important financing mechanisms and schemes that exist in the four REVERTER pilots towards promoting deep renovations and RES installations. In the national versions of the training material, these financing mechanisms and schemes will be presented in detail. The aim is for the REVERTER Ambassadors and OSS personnel to be able to provide advice on how to benefit from the existing financing schemes, select the most appropriate measures, etc.

Annex I summarises indicative financing schemes in the four REVERTER pilots. The OSSs personnel will be provided with detailed and updated information for the purposes of the OSS.

Table of Contents

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
RA	REVERTER Ambassadors
EP	Energy Poverty
PV	Photovoltaics
RES	Renewable Energy Sources

1 Financing schemes and mechanisms in Brezovo pilot

Currently there exists only one national programme, namely the “Support for Sustainable Energy Renovation of the Residential Building Fund” (total investment: BGN 1,176,960,000.00), aiming at providing financial, organisational and technical assistance to improve the energy performance of the housing stock in the Republic of Bulgaria. The programme will run between 2023 and 2027 and has introduced a financial scheme in support of sustainable energy renovation of residential buildings. According to the current procedure, which represents the first stage of the implementation of the sub-measure “Support for sustainable energy renovation of the housing stock”, for proposals implemented under the conditions of the “non-aid” regime, co-financing is not required from the final recipient of the funds - aid intensity is 100%. In the second stage of the implementation of the sub-measure “Support for sustainable energy renovation of the residential building stock”, which will be the subject of a separate procedure, the final recipients will be required to co-finance 20% of the amount of eligible costs under the project. The criteria for the proposals in order to be approved require that the buildings reach energy consumption class minimum B after applying energy-saving measures; that the measures stimulate a minimum of 30% primary energy savings, implement resource efficiency, economic expediency, decarbonisation through RES, sustainable construction process, reduce energy poverty by reducing energy costs, and ultimately, improve the conditions and quality of life of the population in the country through technological renewal and modernization of the building stock.

As far as the support of RES installation is concerned, the Republic of Bulgaria has established the “National scheme to support households in the field of energy from renewable sources”, under the “National plan for recovery and sustainability of the Republic of Bulgaria”. The aim of this scheme is to support households in the field of energy production from RES, so as to promote the decentralised production of energy from RES, stimulate the consumption of ecologically clean energy, and reduce the consumption of solid fuels in the household sector. It provides financing for the purchase of solar installations for domestic hot water supply (DHW) and the purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems. The total amount of the financial scheme is BGN 80 million, where each proposal can receive up to 100% of the value of the installation, but no more than BGN 1,960 for the purchase of solar installations for DHW, and up to 70% of the value of photovoltaic systems up to 10 kWp including the electrical energy storage systems, but not more than BGN 15,000.

2 Financing schemes and mechanisms in Athens Urban Area pilot

In 2021, the “Exoikonomo 2021” programme began, financed under the framework of the National Recovery and Resilience Plan Greece 2.0 with funding from the European Union – NextGenerationEU. The “Exoikonomo 2021” is a residential energy upgrade program, which is the successor scheme of the “Exoikonomo kat' Oikon” and “Exoikonomo-Autonomo” programs, with a total budget of EUR 632 million. In 2023, the successor of the programme “Exoikonomo 2021”, namely “Exoikonomo 2023” was announced. The programme concerns buildings that have a building permit or other legal document, they are used as a main residence and whose owners meet specific income criteria. The design of the programme takes into account the integrated approach of energy-saving interventions in the domestic building sector and aims to (a) reduce the energy needs of buildings and pollutant emissions that contribute to the worsening of the greenhouse effect, (b) achieve cost savings for citizens, improving daily living conditions and comfort as well as their safety and health when using these buildings and (c) attain a cleaner environment. The program aims to improve the energy class of households by at least 3 energy classes (over 30% of primary energy saving). The “Exoikonomo” programmes will contribute to energy savings of at least 213 ktoe per year and to the energy renovation of at least 105,000 homes by 2025. Particular care is taken to support poor and vulnerable households in the form of an increased grant rate and a separate budget of EUR 100 million and EUR 60 million, in “Exoikonomo 2021” and “Exoikonomo 2023”, respectively.

Also in 2023, the Greek State announced the “Photovoltaic on the roof” Programme with a total budget over EUR 200 million. The Programme aims to install PV in combination with battery systems, to the aim of bringing the building stock to near-zero energy consumption standards by 2050, and to lower living costs. The Programme subsidises households for the installation of PV systems with storage and farmers for the installation of PV systems with or without storage for self-consumption with the application of energy offsetting. Subsidies for households range from 45% to 75% of the total cost depending on their income. In total, EUR 45 million was earmarked for vulnerable households while citizens with an annual income of up to EUR 20,000 or families with an income of up to EUR 40,000 are entitled to an overall EUR 100 million.

3 Financing schemes and mechanisms in Riga pilot

In 2022, the Latvian ALTUM financial institution began the programme “Energy efficiency of private houses” for energy efficiency of private houses, which provides state support (up to 6,000 EUR per household) for the renovation of private houses and the improvement of energy efficiency or installation of electricity production equipment (solar panels, wind generation). The overall goal of the policy is to reduce MFB heat energy consumption and CO_2 emissions reduction to achieve national goals for energy efficiency improvement in the building sector. Also in 2022, the ALTUM financial institution started an initiative with the same goals, the “Energy efficiency of apartment buildings 2022-2026”. The programme aims at reducing energy consumption of MFBs by providing a grant for deep renovation measures. (up to 49% excl. VAT of the total MFB renovation costs if at least 30% reduction of primary energy consumption is achieved).

Latvia introduced a support program for the use of renewable energy resources in households in the same year (i.e., 2022). The support program envisages the provision of support for the replacement of fossil fuel (e.g. natural gas, diesel, coal) equipment with new equipment using renewable energy resources (biomass pellet boilers, heat pumps, solar collectors) or connection to a centralized heat supply system, as well as for the production of electricity from renewable energy resources (solar panels, wind generators) for household self-consumption. The purpose of the competition is to reduce greenhouse gas emissions and improve energy efficiency in households by supporting the purchase of heat energy or electricity generation equipment for installation in residential homes to ensure the production and supply of heat energy or electricity for household needs or the establishment of household connections to the centralized heat supply system.

4 Financing schemes and mechanisms in Coimbra pilot

In 2020, the financial scheme IFRRU2020 - Financial Instrument for Urban Rehabilitation and Revitalisation from 2020, was launched. This scheme focuses on energy efficiency, deep renovation, and renewables. It is a financial instrument that mobilises the funds approved by the Regional Operational Programmes of Portugal 2020, with the objectives of revitalising cities, supporting the physical revitalisation of the space dedicated to disadvantaged communities and supporting energy efficiency in housing. The fund is complemented with financing from the EIB and the Council of Europe Development Bank. The IFRRU 2020 provides loans at more favourable conditions than those available on the market, for the full rehabilitation of buildings, whether for housing or other activities, including the most appropriate integrated energy efficiency solutions within the scope of that rehabilitation. The scheme thus aims to facilitate access to funding by promoting investments in the area of urban regeneration, improving the financing conditions, appropriate to the circumstances and specificities of the projects, and diversifying the supply of financing solutions on more favourable terms than those available in the market. When focusing on disadvantaged communities, it is also important to promote physical regeneration, associated with initiatives that contribute to economic stimulation and job creation, as fundamental elements for social inclusion and the fight against poverty.

The Directorate General of Energy and Geology, ADENE, began a financial scheme in 2023, in support of Renewable Energy Communities and collective self-consumption. The objective of this program is to finance measures that promote the production of energy from renewable sources in Collective Self-Consumption and Renewable Energy Communities. It is intended that the supported measures can lead to, on average, at least a 30% reduction in primary energy consumption in the buildings, and reinforce the capacity of self-consumption and/or RECs in the residential, central public administration and services sectors by, at least, 93 MW.

Annex I: Energy efficiency financing schemes in the four REVERTER pilots

Country	Title	Period	Scope	Brief description	Beneficiaries	Managing body	Volume of funding	What is the main goal of the policy	Source
Bulgaria	**National scheme to support households in the field of energy from renewable sources** /Under the National plan for recovery and sustainability of the Republic of Bulgaria	2023-2026	National	With the implementation of the investment, the decentralized production of energy from renewable sources will be promoted, the consumption of ecologically clean energy will be stimulated and the consumption of solid fuels will be reduced in the household sector. The purpose of the investment is to increase the use of renewable energy in the final energy consumption in the household sector by providing financing for: • Component 1: Purchase of solar installations for domestic hot water supply (DHW); • Component 2: Purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems.	All households	MINISTRY OF ENERGY	Planned amount of investment: •Total - BGN 80 million; • Maximum amount of funding for a proposal under: - Component 1: Purchase of solar installations for DHW - up to 100% of the value of the installation, but not more than BGN 1,960.83; - Component 2: Purchase of photovoltaic systems up to 10 kWp, including the electrical energy storage systems - up to 70% of the value of the system, but not more than BGN 15,000.	The purpose of the investment is to increase the use of renewable energy in the final energy consumption in the household sector by providing financing for: Purchase of solar installations for domestic hot water supply (DHW); • Component 2: Purchase of photovoltaic systems up to 10 kWp, including electrical energy storage systems. Support at least 10,000 households with inefficient solid fuel heat sources to install the best equipment for DHW solar installations and photovoltaic systems up to 10 kWp, including electrical energy storage systems.	https://eumis2020.government.bg/bg/s/800c457d-e8be-4421-8ed9-9e78d0a75c39/Procedure/Info/dbc86350-cccd-414a-a175-a1d440952525

Bulgaria	**SUPPORT FOR SUSTAINABLE ENERGY RENOVATION OF THE RESIDENTIAL BUILDING FUND**	2023-2027	National	The current project is aimed at provision of financial, organizational and technical assistance to improve the energy performance of the housing stock in the Republic of Bulgaria.	All households	MINISTRY OF ENERGY	Investment: BGN 1,176,960,000.00. According to the current procedure, which represents the first stage of the implementation of the sub-measure "Support for sustainable energy renovation of the housing stock", for proposals for the implementation of the sub-measure, implemented under the conditions of the "non-aid" regime, co-financing is not required from the final recipient of the funds - aid intensity is 100%. In the second stage of the implementation of the sub-measure "Support for sustainable energy renovation of the residential building stock", which will be the subject of a separate procedure, the final recipients will be required to co-finance 20% of the amount of eligible costs under the project.	improving the energy characteristics of the national building stock of residential buildings, by applying integrated energy-efficient measures; - reaching energy consumption class minimum B after applying energy-saving measures in residential buildings; - stimulating a minimum of 30% primary energy savings for renovated residential buildings; - resource efficiency, economic expediency, decarbonization through RES, sustainable construction process; - reducing energy poverty by reducing energy costs; - improvement of the conditions and quality of life of the population in the country through technological renewal and modernization of the building stock.	https://eumis2020.government.bg/bg/s/800c457d-e8be-4421-8ed9-9e78d0a75c39/Procedure/Info/dbc86350-cccd-414a-a175-a1d440952525

Greece	**The "Exoikonomo 2021" programme**/ Financed under the framework of the National Recovery and Resilience Plan Greece 2.0 with funding from the European Union – NextGenerationEU.	2021-2025	National	The "Exoikonomo 2021" program is a residential energy upgrade program, which is the successor scheme of the "Exoikonomo kat' Oikon" and "Exoikonomo-Autonomo" programs, with a total budget of €632 million. The program concerns buildings that have a building permit or other legal document, they are used as a main residence and whose owners meet specific income criteria.	All households	Ministry of Environment and Energy	(a) In the case of personal income <= €5000 and family income <= €10000, the funding rate for home ownership by the applicant is 75% and for free concession to another person/rental is 65% (b) In the case of personal income > €5000-€10000 and family income > €10000-€20000, the funding rate for home ownership by the applicant is 70% and for free concession to another person/rental is 60% (c) In the case of personal income > €10000-€20000 and family income > €20000-€30000, the funding rate for home ownership by the applicant is 55% and for free concession to another person/rental is 45% (d) In the case of personal income > €20000-€30000 and family income > €30000-€40000, the funding rate for home ownership by the applicant is 45% and for free concession to another person/rental is 40% (e) In the case of personal income > €30000 and family income > €40000, the funding rate for home ownership by the applicant is 40% and for free concession to another person/rental is 40%.	The design of the program takes into account the integrated approach of energy saving interventions in the domestic building sector and aims to (a) reduce the energy needs of buildings and pollutant emissions that contribute to the worsening of the greenhouse effect, (b) achieve cost savings for citizens, improving daily living conditions and comfort as well as their safety and health when using these buildings and (c) attain a cleaner environment. The program aims to improve the energy class of households by at least 3 energy classes (over 30% of primary energy saving). The total investment of the project will contribute to energy savings of at least 213 ktoe per year and to the energy renovation of at least 105,000 homes by 2025.	https://exoikonomo2021.gov.gr/welcome

Greece	**M1. Improvement of the Social Tariff**	2021-2030	National	Policy measure M1 aims to maintain and improve the social tariff scheme for the supply of electricity to households affected by energy poverty. In the context of this specific policy measure, the adoption of a preferential price of electricity sale is foreseen for the case of the affected households, which experience conditions of energy poverty.	Vulnerable households	Ministry of Environment and Energy	40 million € annually	Short-term alleviation of the energy poverty Provision of a preferential tariff for the supply of electricity in order to protect the affected households from extreme and extraordinary conditions of energy poverty.	
Greece	**M2. Provision of energy card to energy poor households**	2021-2030	National	Policy measure M2 aims to provide specific quantities of energy products at a preferential price through an "energy card", which will be allocated to cover the minimum thermal comfort conditions of households affected by the phenomenon of energy poverty. The provided "energy card" will enable the consumption of a certain amount of energy products by the affected households, while it will not be possible to replace them with the equivalent amount of their purchase or their eventual substitution with another energy product.	Vulnerable households	Ministry of Environment and Energy	40 million € annually	Short-term alleviation of the energy poverty Provision of specific quantities of energy products at a preferential price for the purpose of consumption by affected households through the provision of an "energy card".	
Greece	**M4. Energy upgrade of the energy poor households' building including the installation of RES systems**	2021-2030	National	Policy measure M4 aims to address the phenomenon of energy poverty in the long term by improving the energy efficiency of the residential buildings of households affected by this phenomenon and installing RES systems to cover their total energy needs in the most efficient way. The "Exoikonomo 2021" program has already been implemented within the framework of the current measure. Three different programmes will be launched namely for the installation of photovoltaic systems for the promotion of auto consumption, the installation of solar thermal systems and the "Exoikonomo-Anakainizo for young people".	Vulnerable households	Ministry of Environment and Energy	1.8 billion €	Long-term alleviation of the energy poverty Installation of energy saving systems and technologies as well as RES systems in buildings of households affected by energy poverty.	

Greece	**M5. Provision of incentives to energy poor households within the framework of the Just Transition Plan**	2021-2030	National	Policy measure M5 aims to address the phenomenon of energy poverty in the long term by improving the energy efficiency of the buildings of the affected households and installing RES systems to cover their total energy needs in the most efficient way.	Vulnerable households	Ministry of Environment and Energy	210 million €	Long-term alleviation of the energy poverty Installation of energy saving systems and technologies as well as RES systems in buildings of affected households for more efficient and economical coverage of their minimum energy needs in the areas affected by the Just Transition and the decarbonization of the electricity generation sector.	
Greece	**M6. Provision of incentives to energy poor households within the framework of the EEOs**	2021-2030	National	Policy measure M6 aims to strengthen actions in households affected by the phenomenon of energy poverty by the Obliged Parties within the framework of the Energy Efficiency Obligation Scheme of the period 2021-2030.	Vulnerable households	Ministry of Environment and Energy	70 million €	Long-term alleviation of the energy poverty Provision of incentives to the Obliged Parties within the framework of the Energy Efficiency Obligation Scheme for the implementation of interventions in affected households in order to deal with energy poverty in terms of cost-effectiveness.	
Greece	**M7. Provision of incentives to energy poor households within in the framework of the Energy Communities**	2021-2030	National	Policy measure M7 aims at revising the existing operational framework of energy communities in accordance with the provisions of Directives 2019/944 and 2018/2001 in order to maximize the social benefit by addressing the phenomenon of energy poverty. In addition, the actions, including financial incentives, aim for the energy produced (electricity, heating and cooling) from RES to be used by both civil and renewable energy communities to cover the energy needs of households, which are affected by the phenomenon of energy poverty.	Vulnerable households	Ministry of Environment and Energy	100 million €	Long-term alleviation of the energy poverty Review the institutional framework and provision of incentives to address energy poverty through the mechanism of energy communities.	

Latvia	Energy efficiency of apartment buildings 2022-2026	2022-2026	National	The programme is aimed at reducing energy consumption of MFBs by providing a grant for deep renovation measures.	All households	ALTUM financial institution	Up to 49% excl. VAT of the total MFB renovation costs if at least 30% reduction of primary energy consumption is achieved.	The overall goal of policy is to reduce MFB heat energy consumption and CO2 emmissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://www.altum.lv/pakalpojumi/iedzivotajiem/daudzdzivoklu-maju-energoefektivitate-2022-2026/?tab=1
Latvia	**Support for the development of technical documentation for multi-apartment residential buildings**	2023	Local	The programme is aimed at proviging financial aid for technical documentation preparation - building energy sertification preparation and building technical survey for buildings in Riga.	All households	Riga Energy agency	70% of necessary costs are financed not exceeding 800 EUR for building energy certifiaction and 1100 EUR for building technical survey	The overall goal of policy is to reduce MFB heat energy consumption and CO2 emmissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://rea.riga.lv/upload/media/default/0001/01/bc739a045c2576b7b6d361c73253e1b2b0dbc421.pdf
Latvia	**Support program for the use of renewable energy resources in households**	From 2022 till all the funding is exhausted from the programme	National	The support program developed by VARAM envisages the provision of support for the replacement of fossil fuel (e.g. natural gas, diesel, coal) equipment with new equipment using renewable energy resources (biomass pellet boilers, heat pumps, solar collectors) or connection to a centralized heat supply system, as well as for the production of electricity from renewable energy resources (solar panels, wind generators) for household self-consumption.	All households	The Ministry of Environmental Protection and Regional Development	Up tp 70% of eligible costs according to the rules set out in the regulation. Maximmum amount of funding for one project is up to 15 000 EUR. As of time the information is gathered there are 11,537 million left in the programme from total of 30 million euros available at the start of the programme.	The purpose of the competition is to reduce greenhouse gas emissions and improve energy efficiency in households by supporting the purchase of heat energy or electricity generation equipment for installation in residential homes to ensure the production and supply of heat energy or electricity for household needs, or the establishment of household connections to the centralized heat supply system.	https://www.varam.gov.lv/lv/atbalsta-programma-atjaunojamo-energoresursu-izmantosanai-majsaimniecibas?utm_source=https%3A%2F%2Fwww.bing.com%2F

Latvia	**Energy efficiency of private houses**	2022 till now	National	State support for renovation of a private house and improvement of energy efficiency or installation of electricity production equipment (solar panels, wind generation).	All households	ALTUM financial institution	Up to 6000 EUR per household.	The overall goal of policy is to reduce MFB heat energy consumption and CO2 emissions reduction to achieve national goals for energy efficiency improvement in building sector.	https://www.altum.lv/pakalpojumi/iedzivotajiem/privatmaju-energoefektivitate/

Portugal	Support to Renewable Energy Communities and collective selfconsumption / Investimento C13-i01; 02; 03 - Apoio à concretização de Comunidades de Energia Renovável e Autoconsumo Coletivo	2023	National	The objective of this programme is to finance measures that promote the production of energy from renewable sources in Collective Self-Consumption and Renewable Energy Communities. It is intended that the measures to be supported can lead to, on average, at least a 30% reduction in primary energy consumption in the buildings, and to reinforce the capacity of self-consumption and/or RECs in the residential, central public administration and services sectors by, at least, 93 MW.	All households	Directorate General of Energy and Geology, ADENE	Total available funding: 30 million Euros; (-) 10 million for residential buildings (70% co-financing); (-) 10 million for Central Administration buildings (100% financing); (-) 10 million for commercial and service buildings (50% co-financing). For the three typologies, the amount to be provided is limited to 200K (UPAC) + 500K (Collective self-consumption and Renewable Energy communities).	The aim is to contribute to the objectives expressed in the Council Implementing Decision on the adoption the evaluation of the Resilience and Recovery Facility, of reducing the country's energy bill, greenhouse gas emissions and the country's energy dependence.	https://www.fundoambiental.pt/ficheiros/2023/aviso-prr-c13_cer_4-republicacao_31012023-pdf.aspx https://www.fundoambiental.pt/apoios-prr/c13-eficiencia-energetica-em-edificios/c13-i01-02-03-apoio-a-concretizacao-de-comunidades-de-energia-renovavel-e-autoconsumo-coletivo.aspx

Portugal	IFRRU2020 - Instrumento Financeiro Reabilitação e Revitalização Urbanas 2020 / Financial Instrument for Urban Rehabilitation and Revitalisation 2020	2021-2027	National	Is a financial instrument that mobilises the funds approved by the Regional Operational Programmes of Portugal 2020, with the objectives of revitalising cities, supporting the physical revitalisation of the space dedicated to disadvantaged communities and supporting energy efficiency in housing. The fund is complemented with financing from the EIB and the Council of Europe Development Bank. The IFRRU 2020 provides loans at more favourable conditions than those available on the market, for the full rehabilitation of buildings, whether for housing or other activities, including the most appropriate integrated energy efficiency solutions within the scope of that rehabilitation.	All households	Through a tender procedure, the financial management entities were selected, which provide the financial products (loans or guarantees) through which the urban rehabilitation operations are financed - Santander Totta, Banco BPI and Millennium BCP.	IFRRU 2020 thus has a financing capacity of 1,400 million euros, generating an investment of around 2,000 million euros.	The IFRRU 2020 thus aims to facilitate access to funding by promoters of investments in the area of urban regeneration, improving the financing conditions, appropriate to the circumstances and specificities of the projects, and diversifying the supply of financing solutions on more favourable terms than those available in the market. In disadvantaged communities, it is also important to promote physical regeneration, associated with initiatives that contribute to economic stimulation and job creation, as fundamental elements for social inclusion and the fight against poverty.	https://ifrru.ihru.pt/web/guest/ifrru2020#O_QUE_%C3%89

REVERTER

Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty

Deliverable 3.3 - Training material

TRAINING TOPIC VI

Communication and advising of vulnerable households

Co-funded by the European Union

Executive summary

EU-funded project REVERTER aims to contribute to the reduction of energy poverty and the improvement of the quality of life of people in Europe by providing tenants or landlords with comprehensive information and realistic building renovation solutions. Eight specific objectives are set in the project description, some of which are aimed at capacity building and knowledge sharing by developing dedicated training programs and materials aimed at different target groups – OSS personnel, REVERTER Ambassadors, and vulnerable households.

The training program of the REVERTER project is directed to REVERTER Ambassadors (RAs) and OSS personnel, who will advise energy poor and vulnerable households on simple technical issues of energy saving in home, retrofitting practices, benefits of retrofitting, energy financing mechanisms and innovative tools, etc.

This document represents part of the REVERTER training program, dedicated to OSS personnel and REVERTER ambassadors. The specific objective of this document is to train them on:

- how to identify users in situation of energy vulnerability among the clients served;
- how to communicate with energy-poor people and to be able to support the households; (with focus on vulnerable consumers) in being more efficient with their energy consumption;
- how to carry out a role of "Ambassador" of energy saving measures.

In the course of communication training, the participants need to be prepared especially for the situation of giving advice to vulnerable households.

Table of Contents

List of Figures

List of Tables

Glossary

Abbreviation / acronym	Description
OSS	One Stop Shop
RA	REVERTER Ambassadors
EP	Energy Poverty

1 Energy poverty

1.1 What is energy poverty?

Energy Poverty is a 'symptom', an expression of a 'precondition' that affects our livelihoods, namely through the lack of access to essential energy services. Energy poverty typically stems from a combination of factors, including high energy costs, limited income, and homes that are inefficient in terms of energy use, which can be affected by factors such as the age, condition, and construction materials of the building envelope, as well as the energy efficiency of appliances. Additionally, factors like residential status (whether they own or rent their home) and the type of heating/cooling system in place also play a role in determining the ability to make energy-related improvements. Individuals with lower incomes often reside in dwellings with subpar insulation and frequently rely on second-hand or outdated appliances that are not energy efficient. Moreover, they often have to manage their electricity and gas expenses through pre-payment systems, which can result in them incurring higher unit costs compared to those using monthly billing systems.

The concept of energy poverty was introduced in the EU energy policy in 2009 by the Directive concerning common rules for the internal market in electricity (EC, 2009).

> *'energy poverty is a growing problem in the Community. Member States which are affected and which have not yet done so should therefore develop national action plans or other appropriate frameworks to tackle energy poverty, aiming at decreasing the number of people suffering such situation. In any event, Member States should ensure the necessary energy supply for vulnerable customers. In doing so, an integrated approach, such as in the framework of social policy, could be used and measures could include social policies or energy efficiency improvements for housing. At the very least, this Directive should allow national policies in favour of vulnerable customers. (EC, 2009).*

However, it was only defined in 2012, in the Energy Efficiency Directive (EC, 2012):

> *'a household's lack of access to essential energy services that underpin a decent standard of living and health, including adequate warmth, cooling, lighting, and energy to power appliances, in the relevant national context, existing social policy and other relevant policies' (EC, 2012)*

The way Energy Poverty is addressed through regulatory requirements has been significantly strengthened through the 'Fit for 55' package and in 2023, in the Energy Efficiency Directive (Recast) (EC, 2023), the Energy Poverty definition was updated to:

> *"Article 2*
> *'energy poverty' means a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes…" (EC, 2023)*

1.2 How to identify people in energy poverty

Energy poverty mostly affects low-income households – retired people, unemployed or poorly paid, dependent on social benefits, and single households. A person living in energy poverty is primarily a precarious one, with low resources. It is generally mixed with poor housing, leading to difficulties in payment of energy bills. Their economic disadvantage is often accompanied by poor energy efficiency of their homes (poor insulation, outdated heating systems, expensive or polluting fuel) and linked to poor health (elderly or disabled). It is often the case that energy-poor households are socially isolated and lack support from others. All in all, they tend to be subject to physical and mental health risks, degradation of dwellings, and excessive debt.

Energy poverty is usually measured through objective (or expenditure-based) and subjective (or consensual) indicators.

Objective indicators are generally based on the share of the energy costs in the total household income that is used for keeping the dwelling at an adequate temperature. These indicators can be easily compared in different Member States, ensuring that climate correction and purchase power are taken into consideration. However, this data usually refers to the household expenditure for the provision of electricity and fuel, and therefore it does not reflect the cost to ensure thermal comfort in the dwelling. Lack of data, particularly data with adequate granularity, is reported as an important barrier to tackling EP.

Subjective indicators assess basic parameters or characteristics of a dwelling and are therefore understood under a social dimension. These indicators are related to questions about the ability to maintain the appropriate temperature and pay bills before the deadline, as well as other questions about housing conditions.

Typical socio-economic and housing characteristics related to energy poverty are, as follows:

A. Socio-economic characteristics

- Vulnerable persons or households (based on the national or local definition)
- Arrears on utility bills
- Low income
- Difficulties in coping with energy costs
- Inability to keep home adequately warm
- Inability to keep the home adequately cool
- High share of energy expenditure in relation to income

B. Facilities / Housing characteristics

- An old building that has not been renovated, (e.g. deteriorated windows, which allow air draft)
- Insufficient heating, caused by a deprivation of heating, a lack of insulation or/and an inadequate heating system
- The use of single space/room heating, which is preferred sometimes in order to get a better control of the consumption
- Signs of humidity or mould, reflecting a bad state of the building and/or lack of heating
- Over-equipment or overheating leading to increased energy consumption
- A continued presence in the house, causing higher consumption
- Old and inefficient appliances

A. EP in the context of the Bulgarian pilot

According to the newly approved Ordinance On The Criteria, Conditions And Procedure For Determining The Status Of Households In A Situation Of Energy Poverty And The Status Of Vulnerable Electricity Supply Customers, "*a vulnerable electricity supply customer is a residential customer who purchases electricity for the domestic needs of a household of which he is a member, and he and/or another member of the household is critically dependent on electrical equipment due to the presence of at least one of the following circumstances*:

- a person over 65 years old, living alone or with other people over 65 years old, with disposable income under Art. 5, para. 1 after reduction with energy expenditure less than or equal to the officially declared poverty line;
- a person with established 50 and over 50 percent permanently reduced working capacity or type and degree of disability, with disposable income under Art. 5, para. 1 after reduction with energy expenditure less than or equal to the officially declared poverty line;
- persons who need aids for independent living and/or life support medical devices, the functioning of which depends on a source of electrical energy;
- persons who receive monthly social benefits and/or targeted assistance for heating under the Social Assistance Act for the previous heating season."

This ordinance defines the criteria, conditions and procedure for determining the status of households in a situation of energy poverty and the status of vulnerable customers for the supply of energy electrical energy:

- the order and mechanism of functioning of the information system;
- the conditions and procedure for assessing the number of households in a situation of energy poverty.

Appendix no. 1 to art. 4 of the Ordinance includes a methodology for estimating household energy costs. The assessment of energy costs per household is carried out for the calendar year preceding the assessment year.

B. EP in the context of the Greek pilot

The alleviation of energy poverty has been specified as an essential objective within the framework of the final NECP, which was submitted at the end of 2019. A quantitative target has been set for reducing energy poverty at least by 50% and 75% in 2025 and 2030 respectively, in comparison to 2016, while the foreseen level in 2030 should be below the EU average in 2030. It should be noted that the same targets have been retained also in the draft revised NECP, which was submitted in October 2023. Moreover, targeted policy measures should be designed and implemented so as to tackle effectively the phenomenon of energy poverty, while emphasis should be given on the improvement of comfort conditions and the avoidance of triggered health problems. Finally, the compilation of the Action Plan for the Confrontation of Energy Poverty was foreseen also in order to specify the required measures.

The Action Plan for the Confrontation of Energy Poverty was prepared in September 2021 specifying the policy measures to ensure the fulfilment of the specified targets within the NECP. Moreover, the definition of energy poor households was determined. Specifically, a household is characterized as energy poor in the case that both of the following conditions are simultaneously fulfilled:

- Condition I: The total final energy consumption of the household is lower than the

80 % of the minimum final energy consumption, which is required theoretically for covering the thermal needs.

- Condition II: The total normalized income of the household, based on the number of the household's persons according to the equivalence scale of OECD is lower than 60 % of the median income of all the households in Greece.

Totally, nine policy measures have been integrated into the Action Plan for the Confrontation of Energy Poverty to fulfil the specified targets. The proposed policy measures have been classified into the following three categories:

I. Measures for the short-term protection of energy poor households
II. Measures for the energy upgrade of the energy poor households' buildings and the promotion of RES
III. Information and awareness-raising measures

Finally, a holistic monitoring mechanism has been developed based on the combination of bottom-up and a top-down procedures. The bottom-up approach is performed through the statistical model, which has been developed to identify energy poor households taking into consideration various parameters, while the top-down monitoring is applied through the Greek Observatory of Energy Poverty (http://energypoverty.gr/).

The central role for carrying out the foreseen monitoring procedures is assigned to the Working Group, which has been established for monitoring and assessing the progress of the NECP with the following duties:

- Management, evaluation, and improvement of a monitoring mechanism.
- Evaluation of the implemented policy measures in the period 2021-2030.
- Formulation of proposals either for improving existing policy measures or designing and implementing new more efficient ones.
- Preparation of the annual progress report.

C. EP in the context of the Portuguese pilot

Portugal has been pointed out as being among the most vulnerable countries in Europe to energy poverty in the European Union according to several indicators generally used to assess energy poverty. According to recent statistics by Eurostat, in 2022, the country recorded the fourth highest rate in the European Union (17.5 %) of people who were unable to heat their homes properly, with the European Union average standing at 9.3%.

Focusing on the Pilot area and looking at the indicators being used by official statistics, the percentage of *population living in a dwelling with leaks, damp or rot* is higher than the national average (almost by 2%). The percentage of *population not being able to keep home adequately warm* also exceeds the national percentage (almost by 3%). A better condition is observed in the case of the indicator *Share of population having arrears on utility bills*, at least for the recent years.

Since, so far, there was no consensus nor an official definition of EP, actions being carried out were aiming to characterize the circumstances that contribute to the energy poverty of vulnerable consumers, as well as their impacts, to identify intervention opportunities that can combat energy poverty. In the absence of an official Energy Poverty definition, the phenomenon is understood as the inability to maintain housing with an adequate level of essential energy services, due to a combination of low income, low energy performance of dwellings and high energy costs, which can be translated by the following indicators:

- arrears on utility bills;
- low absolute energy expenditure;
- high share of energy expenditure in income;
- inability to keep home adequately warm.

While the social energy tariff is typically identified as an appropriate measure to combat energy poverty, existing programmes addressing EP in Portugal are using it as eligibility criteria to provide grants to vulnerable households. For example, households that are already recipient of the Social Energy Tarif mechanism (eligibility criteria) are eligible to get financial incentives so that they can invest in improving the thermal comfort of their homes.

Social tariff is a support granted to consumers in a situation of economic deprivation to help them decreasing the burden on their energy costs, electricity and gas. For instance, solidarity supplement for the elderly, social re-insertion subsidy, Social Integration Income, those receiving unemployment benefit or old age pension, family allowances, social disability pensioners, supplement to the social benefit for inclusion, are entitled to the social tariff. In addition, those with an annual income of up to 5808 euros, increased by 50% for each element of the household without income, up to a maximum of 10 people.

The main aim of the social tariff is to help to reduce the amount to be paid in monthly electricity and natural gas bills of consumers in a situation of economic deprivation. This support works through a percentage discount on the energy bill, published annually by the regulator ERSE. The social tariff discount is the same for all eligible consumers, regardless of whether they are in the regulated or liberalised market. However, the percentage applied is different for electricity and natural gas

Driven by the European Policies, and recognizing EP as a significant social, economic and public health problem, after a long period under public consultation, the Portuguese Government finally (November 2023) approved the resolution establishing the National Long-Term Strategy to Combat Energy Poverty 2023-2050. Its main goal is to eradicate energy poverty in Portugal by 2050, protecting vulnerable consumers and actively integrating them into the energy and climate transition, which is intended to be fair, democratic and cohesive. The final document, as far as it is possible to know by this date (15Dec2023), does not diverge from the draft document and aims to reduce the percentage of Portuguese without money to heat their homes in winter by 7.4%, establishing a level of people living in energy poverty in 2030 of no more than 10 %. This is a very modest ambition, considering the moderate climate of Portugal and the EU average standing at lower value already by now (9.3% in 2022). To achieve this end, the strategy is structured around four strategic lines of action:

- promoting the energy and environmental sustainability of housing;
- promoting universal access to essential energy services;
- promoting integrated territorial action;
- promoting knowledge and informed action.

In addition, the National Energy Poverty Observatory was also created, with the mission of monitoring the evolution of energy poverty at national level, thus completing one of the milestones set out in the reprogramming of the Recovery and Resilience Plan.

D. EP in the context of the Latvian pilot

Energy poverty as defined in the Energy law.

> *Energy poverty - the inability of a household user to maintain an appropriate temperature in the dwelling or to use the services provided by energy supplier, or to pay for them due to low energy efficiency or because the payment for these services has a high share in household income;*

Energy law also states criteria for identification of households, which are affected by energy poverty. The criteria are very general, and it does not completely cover the circumstances households may face described in the definition.

> *Section 120.*
>
> *A household affected by energy poverty is a household within the meaning of the Law on Social Services and Social Assistance which conforms to at least one of the following criteria:*
>
> *1) it has been recognised as low-income household and receives a material support for covering the expenditures related to the use of a housing;*
>
> *2) it is renting a residential space or social apartment belonging to or leased by a local government in accordance with the Law on Assistance in Solving Apartment Matters or the law On Social Apartments and Social Residential Houses.*
>
> *Section 121.*

(3) The criteria referred to in Section 120 of this Law shall be used for the evaluation of the number of households affected by energy poverty.

In the national context, households in the risk of energy poverty are identified through social services. Social services could provide information on those households who are receiving housing support from the social services of the municipality. Alternatively, the vulnerable households can be identified through the building elders, which are willing to renovate their apartments. OSS can see if they can help to apply for a social welfare program.

1.3 Consequences of energy poverty

The main consequences of EP are the following:

A. Financial consequences:

- Use of aids, and other assistance mechanisms
- Indebtedness and loans
- Use of budgets usually used for other important needs such as housing, food, education, etc.
- Creation of restriction mechanisms or deprivation leading to other consequences.

B. Consequences due to technical restrictions in heating:

- Under-heated housing will be humid.
- Under-ventilated housing will be humid and unhealthy.
- Humid housing will result in deterioration, enabling the development of mould, which leads to unsanitary conditions.

C. Health consequences:

A cold environment is not by itself a factor of diseases, but generates a number of negative consequences:

- To maintain its internal temperature in a cold environment, the body has to work harder. Situations like this can lead to exhaustion.
- Cold promotes vasomotor reactions, sneezing, runny nose, which can encourage the transmission of pathogens.
- Colder air temperature in many situations means not sufficient air humidity.

D. Suspected causal links regarding cold living conditions exist for a number of diseases:

- Respiratory diseases
- Cardiovascular diseases
- Arthritis
- Depression

2 Communication skills

2.1 How to improve your communication skills

Effective communication encompasses various skills that enable individuals to convey messages clearly and interact with others successfully. Some types of basic communication skills along with brief explanations are given in the following Table 1.

Table 1. Basic communication skills

Communication skill	Explanation	What to do
Verbal communication	Verbal communication involves using words to convey messages. It includes speaking, listening, and the ability to articulate thoughts and ideas clearly.	• Practice speaking clearly and confidently. • Expand your vocabulary and language skills. • Work on voice modulation and tone to convey emotions effectively
Effective communication	The ability to communicate clearly and effectively with citizens, team and partners is essential to ensure proper understanding and cooperation.	• Adapt technical language to everyday vocabulary that is easy to understand (use of comparisons, analogies, etc.)
Nonverbal communication	Nonverbal communication refers to the use of body language, facial expressions, gestures, and tone of voice to convey meaning. It can often convey emotions and attitudes more strongly than words. NONVERBAL LANGUAGE- SIGNS OF DISTRUST AND DISCOMFORT – Avoidant eye contact: The person may avoid making eye contact or looking away, indicating a lack of confidence or discomfort. – Crossing your arms: Crossing your arms over your chest can be a defensive gesture that indicates a protective or closed-off attitude. – Lack of facial expression: Lack of facial expression or a tense facial expression may suggest discomfort or distrust. – Restless gestures: Nervous or restless movements, such as touching your hair, hands or fingers, can be signs of tension or anxiety. – Physical distance: Physically moving away from the person or subtly backing away can be an indicator of discomfort or need for personal space. – Fixed or intense gaze: In some cases, an intense or fixed gaze can be interpreted as a sign of distrust, especially if it feels threatening.	• Pay attention to your body language and gestures. • Practice maintaining eye contact without staring. • Use facial expressions that match your message. • Adequate eye contact: Maintaining adequate eye contact conveys confidence. Looking into the eyes of the person you are talking to shows that you are engaged and honest in the conversation. • Relaxed and friendly facial expression: An open and friendly facial expression shows that you are comfortable and receptive. Smiling appropriately can make the message more pleasant and trustworthy. • Open, relaxed posture: Maintaining an upright, open posture with your arms down at your sides or open shows confidence. Avoiding a closed posture, such as crossing your arms, can contribute to more positive communication.

	– Excessive blinking: Excessive blinking or rapid blinking can indicate nervousness or stress. – Muscle tension: Tension in the muscles of the neck, shoulders or jaw can be a sign that the person is uncomfortable. – Closed body language: Keeping the body hunched or closed, such as hunching or hunching, may indicate that the person is protecting themselves in some way. – Unusual voice tones: Changes in voice tone, such as becoming more tense or lower than normal, can be signs of discomfort.	
Active listening	Active listening is the skill of giving full attention to a speaker, understanding their message, and providing feedback to demonstrate understanding. It involves not just hearing but also comprehending and empathizing.	• Focus on the speaker and minimize distractions. • Use verbal cues like nodding and "I see" to show you're listening. • Avoid interrupting; let the speaker finish before responding.
Empathy	Empathy is the capacity to understand and share the feelings of another person. It involves showing compassion, acknowledging emotions, and providing support	• Practice putting yourself in others' shoes to understand their feelings. • Listen actively and validate their emotions. • Show empathy through your responses and actions.
Clarity and conciseness	Communicating with clarity means expressing thoughts and ideas in a straightforward and easily understandable manner. Being concise involves using as few words as necessary to convey the message effectively	• Organize your thoughts before speaking or writing. • Use simple and direct language. • Eliminate unnecessary words or details.
Conflict resolution	Conflict resolution is the ability to address and resolve disagreements or disputes in a constructive and peaceful manner, often involving active listening, negotiation, and problem-solving	• Develop problem-solving skills. • Practice active listening during conflicts. • Focus on finding mutually agreeable solutions
Assertiveness	Being assertive means expressing one's needs, opinions, and feelings confidently and respectfully while also respecting the rights and opinions of others. It strikes a balance between passive and aggressive communication.	• Build self-confidence in expressing your needs and opinions. • Use "I" statements to communicate your feelings and preferences. • Maintain respect for others' opinions while expressing your own.
Interpersonal skills	Interpersonal skills involve the ability to interact and build positive relationships with others. These skills include effective communication, active listening, empathy, and conflict resolution.	• Develop rapport with others through genuine interest and respect. • Practice effective communication, empathy, and conflict resolution. • Foster positive relationships through trust and cooperation.
Cultural sensitivity	Cultural sensitivity is the awareness and respect for cultural differences in communication styles,	• Educate yourself about different cultures, norms, and customs.

	norms, and customs. It ensures effective communication in diverse settings.	• Avoid making assumptions or judgments based on cultural differences. • Be open to learning and adapting to diverse communication styles
Adaptability	Adaptability in communication is the skill to adjust one's communication style and approach based on the context, audience, and situation. It allows for effective communication in various scenarios	• Assess the communication needs of each situation or audience. • Be flexible in your approach and adapt to different communication styles. • Continuously learn and adjust based on feedback.
Feedback giving and receiving	Providing constructive feedback helps others improve, while receiving feedback gracefully is essential for personal and professional growth. Effective feedback is specific, actionable, and respectful.	• Provide constructive feedback with specific examples. • Be open to receiving feedback and use it for self-improvement. • Foster a culture of open and honest feedback in your relationships.
Conflict avoidance	Sometimes, avoiding unnecessary conflicts is a valuable communication skill. It involves recognizing when a situation doesn't warrant a confrontation and choosing to let minor issues go.	• Prioritize which conflicts are worth addressing and which can be let go. • Practice diplomacy and compromise when minor conflicts arise. • Focus on maintaining positive relationships.

2.2 Forms of communication

There are three forms of communication: **verbal, para-linguistic** and **non-verbal** communication.

Verbal communication refers to all elements of speech: **words, letters, sentences and numbers**

- Purely verbal communication is very difficult. As we have already learned in the discussion of perception, what we say is frequently understood very differently by the person with whom we are speaking, because the other person has a different understanding of the words we choose.
- Speech conjures up images which the person speaking and the person addressed do not always understand in the same way, frequently representing a source and cause of misunderstandings and anger.

Para-linguistic communication refers to the **manner in which we speak**: intonation, speaking rate, pauses, laughing, sighing. These elements are influenced by sensations, such as nervousness, as indicated by "ums" and "hms", speaking rate or, for example, irritation and anger expressed by speaking loudly.

Non-verbal communication includes:

- **Body language:** posture, gestures and facial expressions
- **External attributes**, such as clothing; jewelry; status symbols, such as holidays, a car, a flat/house create and characterise the impressions conveyed. This represents a type of code, characterising a certain image of a person.

- **Posture:** The manner in which a person appears before another person for the purpose of discussions, for example with shoulders hanging, breast stretched forward, etc.
- **Gestures:** Forms of expression by the body:
    - Nodding the head – signalling agreement
    - Pat on the back – signalling encouragement
    - Shaking hands – greeting
    - These gestures are however not understood in the same way in all cultural groups.
- **Facial expressions:** Possible facial expressions: The signals conveyed by facial expressions are nearly identical in all cultural groups. They therefore have a significant influence on communication.
- **Gaze:** The eyes are a **central part of the face**. The gaze is an important instrument for establishing contact as it can demand contact; it can signal distance, it can express sympathy and feelings or it can refuse contact.

3 Communication with vulnerable people

3.1 Dos and Don'ts for communication with vulnerable people

Effective communication with vulnerable individuals is built on trust, respect, and understanding, while avoiding behaviours that may cause discomfort or harm. The most important "dos" and "don'ts" are shown in Table 2.

Table 2. "Dos" and "don'ts" when communicating with vulnerable people

Dos for Communicating with Vulnerable People	Explanation	Don'ts for Communicating with Vulnerable People	Explanation
Show empathy and actively listen.	Acknowledge their feelings and concerns.	**Rush or pressure them.**	Avoid making them uncomfortable or anxious.
Be patient and give them time.	Understand they may need more time to express themselves or make decisions.	**Make assumptions about their experiences.**	Each person's situation is unique; avoid generalizations.
Use plain and clear language.	Communicate in a straightforward manner, avoiding jargon or technical terms.	**Use stigmatizing language or labels.**	Refrain from using derogatory or judgmental language.
Respect their autonomy and choices.	Acknowledge their right to make decisions about their own lives.	**Minimize or dismiss their concerns.**	Take their concerns seriously, regardless of size.
Ask open-ended questions to encourage dialogue.	Promote conversation by asking questions that require more than a yes/no answer.	**Overwhelm with too much information at once.**	Provide information in manageable portions.
Maintain privacy and confidentiality.	Ensure that their personal information and discussions remain private.	**Violate personal boundaries.**	Respect their privacy and avoid prying questions.
Provide information and resources.	Offer details about available resources, support services, or community organizations.	**Assume they need saving or rescuing.**	Allow them to make decisions; don't impose help.
Treat them with respect and dignity.	Interact with them in a respectful and dignified manner.	**Display impatience or frustration.**	Maintain patience and compassion in interactions.
Offer reassurance and emotional support.	Let them know that you are there for them and that help is available.	**Discriminate based on their circumstances.**	Treat everyone fairly and equally, without bias.
Use open questions: "tell me about …".		**Don't use "Energy poor" or "vulnerable"**	The terms "vulnerable" or "poor" or "energy poor" should not be used in communications with households!
Use probing questions: "I want to understand a bit more, can you give me some examples …"		**Avoid leading questions: "presumably …"**	If the customer doesn´t want to disclose information it may not be reasonable to continue asking questions.
Be friendly	Engage in small talk to establish the atmosphere for discussions (weather, flat, travel route, etc. – whatever appears to be appropriate)	**Make empty promises**	Don't make promises you can't keep. It's important to be honest about the limitations and extent of the help you can offer.
		Being invasive	Respect boundaries and do not enter private areas of the home without permission or a valid reason.
		Disregarding consent	Make sure you obtain consent before taking photos, recording audio or video, or sharing information with third parties.

4 Vulnerable households advising step-by-step

Preparing for an energy advising visit to vulnerable households requires careful planning and consideration of the unique needs and challenges faced by these households. Here are steps to help you prepare for such visits.

A. Preparation

1. Be sure for the goals:

Clarify the purpose of the visit. Is it to reduce energy costs, improve energy efficiency, or address specific concerns (e.g., heating, cooling, insulation)?

2. Gather information:

Ask for relevant information about the household, such as energy bills, the home's layout, age, and any existing energy-efficient measures or concerns.

3. Schedule appointments:

Set up appointments with the household members to ensure their availability and cooperation during the visit.

4. Assemble necessary materials:

Prepare materials you may need during the visit, such as energy efficiency pamphlets, checklists, and informational resources.

5. Equip yourself:

Bring any tools or equipment needed for assessments, such as a flashlight, a thermal camera, a power meter, or a notebook for recording information.

6. Dress appropriately:

Wear comfortable and appropriate clothing, especially if you'll be inspecting areas like attics or crawl spaces.

Dress professionally and respectfully to convey seriousness and credibility.

7. Prepare a checklist:

Use a checklist of areas to assess, questions to ask, and common energy efficiency issues to look for during the visit.

8. Establish trust:

Begin the visit by introducing yourself, explaining your role, and building rapport with the household members. Show empathy and respect for their situation.

B. Household visit

1. Introduce yourself

Present your ID cards, hand over a business card, certificate of training.

2. Explain the objective of the visitation and how the visitation is going to be performed.

Explain the purpose of your visit, your duties, and how you can help. Clear up any misunderstandings and offer transparency in your role.

2. Transition to advisory discussions

Inform your customer exactly about the procedure you will follow.

3. Present and ask to sign the Consent form

4. Acquire/correct client data

Household size, energy behaviour, and any energy issues they meet

5. Conduct a simple home energy assessment

Walk through the home to assess its energy performance. Check for drafts, insulation quality, appliance efficiency, and the condition of heating and cooling systems.

6. Identify energy-saving opportunities

Based on your assessment, identify specific areas where energy efficiency improvements can be made. Prioritize recommendations based on the household's needs and budget.

7. Provide practical advice

Offer practical, actionable advice for reducing energy consumption and improving comfort. Explain the benefits and potential cost savings of each recommendation.

8. Give the REVERTER brochure for energy-saving tips

9. Offer assistance

Inform the household of available assistance programs, incentives, or financial aid for energy efficiency improvements. Help them with the application process if necessary.

10. Share information about the One stop Shop

Explain the OSS can offer more detailed assistance in: incentives, financial aids. Encourage them to visit the OSS. Explain the meaning of the One stop shop, the possibilities for support, and provide the location and contacts (brochure)

11. Address concerns and questions:

Be prepared to answer questions and address any concerns the household members may have. Provide clear explanations and options.

12. Document findings

Take notes during the visit to document your findings and recommendations. This will help in follow-up discussions and reports.

13. Leave contacts

Leave your telephone number or business card in case the customer has questions.

14. Say "Thank you"

Politely thank the person and leave.

For the OSS personnel:

1. Follow-Up: Update the data gathered from the RAs to the platform/visitation. Revise and validate the data with the RA. After the visit, follow up to check on their progress, answer additional questions, and provide further assistance if needed.

2. Report and documentation

If the household visits the OSS for more info, prepare a detailed report summarizing the assessment, recommendations, and any actions taken during the visit. Share this report with the household for reference.

3. Coordinate with support Services

If the household faces additional challenges beyond energy efficiency (e.g., financial hardships, health issues), coordinate with relevant support services or organizations to provide holistic assistance.

Remember that vulnerable households may have unique circumstances and sensitivities, so approach your energy advising visit with empathy, patience, and a focus on practical solutions that can improve their energy efficiency and overall well-being. However, it is important to judge your communication and words according to each setting and situation.

Some common tips for the visits are given in Figure 1.

Preparing for advisory discussions

- Are all parts required for the household visit (checklists, packages, questionnaires) there?
- Is my laptop/phone/tablet functioning (accumulator charged)?
- Are all measuring instruments (thermo vision camera) functioning?

Don't be late

- Make certain that you arrive punctually for the agreed meeting.
- Take account of travel times and routes.
- Study train schedules, city maps, etc.

Clothing

- You should feel comfortable in your clothing.
- Clothing should be clean, neat and orderly.
- Clothing should be appropriate for the situation. Not only sloppy clothing, but also exaggerated clothing causes uneasiness.
- In case of doubt, clothing should primarily be decent. Super-mini skirts and plunging necklines are out of place.
- Jewellery and accessories should fit to the overall image and the situation

Posture

- Not too stiff, but not too careless. If you move about in a stiff posture, you give the impression of being unapproachable. A careless posture signals superficiality.
- An open sitting posture demonstrates interest (do not cross your arms).
- Maintain a friendly facial expression and smile occasionally.
- Maintain visual contact.
- Gestures: movements of the hands in support of the verbal presentation reinforce your words. However, excessive gestures can detract from the presentation and harm concentration.

Manner of speaking

- Speak clearly, understandably, freely and calmly.
- An exaggerated choice of words or the use of many specialised terms creates mistrust and restraint. This can give the customer the impression of being persuaded and not advised.
- Do not use slang expressions or strong language. These irritate the customer and give the impression of incompetence.
- When necessary to enter other rooms always ask permission.
- When making measurements, explain why these are necessary.

Figure 1. Common tips for the household visits

5 Reacting to atypical situations

Mentally preparing for visits to households where you may encounter compromising situations, violence or extreme poverty is essential to play your role effectively and compassionately. Some steps for mental preparation and how to deal with difficult situations are shown in Figure 2.

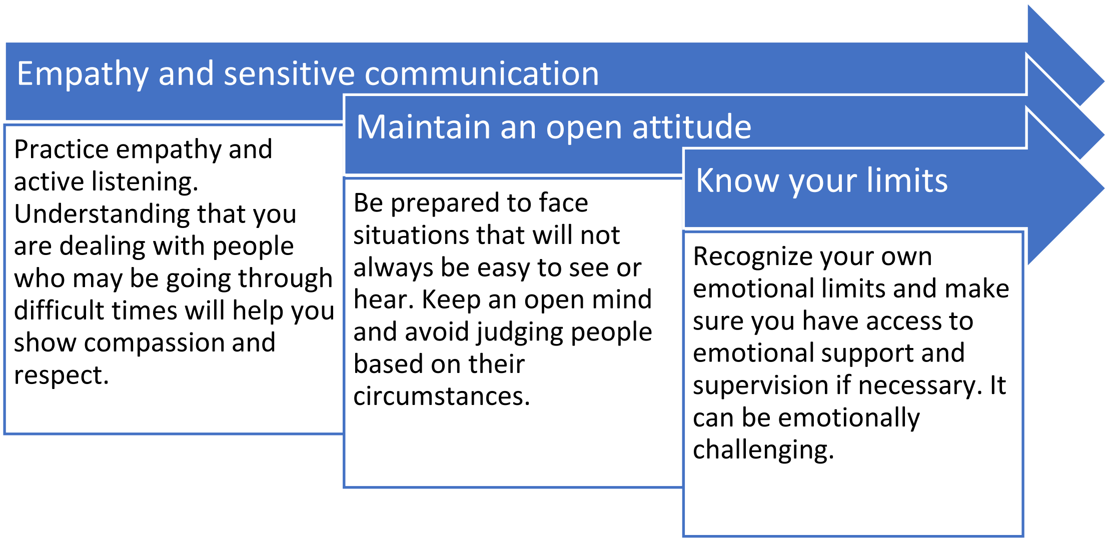

Figure 2. Mental preparation for dealing with atypical situations

How to proceed to avoid problems related to uncomfortable or even dangerous situations:

- Announce your visit: Always announce your visit in advance and schedule a suitable time. Confirm the visit the day before. Surprise can be uncomfortable and provoke resistance.
- Actively listen: Allow people to speak and express their concerns. Listen without judgment and offer a sympathetic shoulder.
- Visits in pairs of ambassadors: in the case of conflictive neighbourhoods, visits in pairs will be considered and will be carried out during daylight hours.
- Report to authorities: If you encounter situations of abuse or immediate danger, it is your duty to inform the relevant authorities to ensure the safety of those involved.
- Prioritize personal safety: Your safety is the most important thing. If you perceive an immediate threat to yourself or others, find a safe place.
- Stay calm: Try to stay calm in potentially dangerous situations. Panic can make it difficult to make good decisions.
- Communicate your concern: If you are accompanied by others, immediately communicate your concerns and perceived danger signs.
- Call authorities: If there is a clear and serious threat, call law enforcement, such as the police, and provide the location and a description of the situation.
- Exit the situation: If it is safe to do so, remove yourself from the dangerous situation. Leave the home or area as soon as possible.

- Don't become an intermediary in cases of violence: If you perceive domestic violence or a dangerous conflict, do not become an intermediary. Instead, call authorities and alert trained professionals.
- Do not intervene in dangerous situations: Do not try to intervene in violent or dangerous situations if you are not trained to do so. Your safety is paramount.
- Inform your supervisors or contacts: After ensuring your safety, inform your supervisors, employers or relevant contacts about the situation you have experienced.
- Seek emotional support: After a potentially dangerous experience, seek emotional support. Talking to colleagues, friends, or mental health professionals can be helpful in processing what you've experienced.

Remember that your safety is the most important thing in any situation. You should not take unnecessary risks. It is always preferable to call authorities or trained hazard professionals rather than attempting to address the situation on your own.

Sources of information

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Annex III: Energy saving tips leaflet for households

REVERTER

Co-funded by the European Union

Energy saving tips

Here are some practical tips simple changes you can make to not only reduce your energy bills but also improve your family's well-being.

Start with small changes today

These are the changes you can make today with no additional investment.

Investment
Difficulty
Impact

Unplug Devices

Unplug chargers, electronics, and appliances when they are not in use. Many devices consume a small amount of electricity even when turned off, known as standby power or phantom load.

Set temperature of your refrigerator wisely

Keep your fridge at around 6-8°C and the freezer at -18°C (0°F) for optimal efficiency. Avoid colder settings, as they increase energy usage without significant benefits.

Use your washing machine wisely

Choose to wash clothes with cool (or coolest water possible) it will reduce energy consumption by avoiding the need to heat water. Maximizing the load size reduces the number of cycles to saves energy.

Use night tariff

Use a night tariff when possible, this will not save electricity but will reduce the cost (bill).

Lower temperature of hot water

Reduce the water heater thermostat to 49-52°C. This is typically sufficient for most household needs and helps prevent overheating and energy waste. Heat to 55 °C only once a month to kill bacteria.

Don't decrease temperature below 18 degrees

Reduce heating temperature when going away for a weekend (not below 18 degrees), the air in the room becomes too humid and the risk of mold increases and you need to ventilate the room more often. Also, the home is too cold it will time more time and energy to heat it up.

Don't switch off the heating during the night

In the colder days, it is recommended not to switch off the heating during the hours when you are away from home, only to reduce it. When it is turned off, your home will cool down too quickly, which will lead to overheating to reach a favourable temperature

Keep track of your consumption

Monitor, record and analyze your monthly energy consumption. This will give you a clear idea of where you can optimize your energy consumption

Continue with improvements

These changes you can make step by step starting from one room or area in your house as they require some investment that can be made step by step.

Seal leaks

Inspect doors, windows, and other openings for drafts. Seal any gaps and use weather-stripping to prevent heat from escaping.

Switch to LED bulbs

LED bulbs are energy-efficient and last longer than traditional incandescent bulbs. They use significantly less electricity and can result in substantial savings over time.

Buy energy-efficient electronic appliances

When it is time to change your hair dryer, washing machine or any other electronic appliance check their energy consumption. Try to opt for D – A level.

Energy audit

Consider getting a professional energy audit for your home. This can help identify areas where energy is being wasted and provide recommendations for improvements. Address to Brezovo OSS to be advised.

Consider important improvements

These improvements will have the biggest impact on your energy savings and well-being. They will increase the value of your property as well as quality of life of your family.

Energy-efficient windows

Replacing old, single-pane windows with energy-efficient double- or triple-pane windows with low-emissivity coatings can improve insulation and reduce heat transfer and thus heating bills and comfort.

High-efficiency heating systems

Upgrading heating systems to high-efficiency models can reduce energy consumption for heating and/or cooling. Switch to modern and highly efficient heating equipment.

Smart thermostats

Install a programmable or smart thermostat to optimize heating and cooling based on your family's schedule.

Insulation of building

Proper insulation in walls, ceilings, and floors helps prevent heat loss in the winter and keeps the home cooler in the summer. Adequate insulation can make a significant difference in your heating costs.

Thermal insulation of your building can result in a 60% reduction in heating costs.