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Acronyms

ASHP – Air Sourced Heat Pump

BM – Business Model

BMS – Building Management System

CST – Centre for Sustainable Technologies

DEM – Distributed Energy Management

DG – Distributed Generation

DH – District Heating

DHC – District Heating and Cooling

DHW – Domestic Hot Water

DSM – Demand Side Management

DSO – Distribution System Operator

EE – Energy Efficiency

EEB – Earth Energy Bank

EEM – Energy Efficiency Maturity

EHPA - European Heat Pump Association

ENEV – Energy Saving Ordinance

EPC – Energy Performance Coefficient

EPDB – European Data Protection Board

EPDV - Energy Performance Building Directive

ESCO – Energy Service Company

ESC – Energy Supply Contracting

EPC – Energy Performance Contracting

ESS - Exploitation Strategy Seminar

GHG – Greenhouse Gases

GSHP – Ground Sourced Heat Pump

H&C – Heating and Cooling

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HP – Heat Pump

HVAC – Heating, Ventilating and Air Conditioning

IDAE – Institute for Diversification and Energy Savings

IEP – Individual Exploitaiton Plan

JRC – Joint Research Centre

KER – Key Exploitation Result

NECP – National Energy and Climate Plans

NZEB – Nearly Zero Energy Buildings

PTES – Pit Thermal Energy Storage

PV – Photovoltaic

PV-T – Photovoltaic and Thermal

RES – Renewable Energy Sources

RHI – Renewable Heat Incentive

SHEMS – Smart Home Energy Management System

ST – Solar Thermal

STES – Seasonal Thermal Energy Storage

TES – Thermal Energy Storage

TSO – Transmission System Operator

UVP – Unique Value Propostion

WSHP – Water Sourced Heap Pump

ZCS – Zero Carbon Solution

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1. Introduction

The objective of this deliverable is to identify **replication opportunities in the area of heat integration systems for new and existing buildings aiming to nearly zero CO2 emissions.**

This document includes a market research evaluating the opportunities and threats for the CHESS SETUP solution wide implementation, an analysis of the different business models concerning all stakeholders represented in the consortium and the detailed Key Exploitation Results (KERs) with the roadmap planning to be undertaken after the project's successful termination.

The structure and contents of this deliverable complies with the following guidelines:

- The output of the **Exploitation Strategy Seminar** (ESS) conducted on October 16, 2019, in Sant Cugat (Spain) by the expert Tomasz Cichocki to support all the consortium partners to reflect on the project Key Exploitation Results.
- The requirements and description of work described in the **Grant Agreement.** Therefore the deliverable is divided in the following sections in:
  - Product and services analysis
  - Market analysis
  - Industrialisation potential
  - Analysis and definition of business models
  - Exploitation Plan: Including first the **Individual Exploitation Plans** of each consortium partner and the CHESS SETUP **Key Exploitation Results** (KERs) agreed among all partners.

It is important to highlight that this document, as the rest of the WP6 deliverables, were developed before the COVID-19 global pandemic emergence. Nevertheless, during May 2020 the consortium decided to conduct a risk analysis about the effects that COVID-19 might have on the last tasks and as a result of this votation the PO accepted a project extension in order to enable Corby's pilot to provide data. Therefore, during the period May- September 2020 new information was incorporated to the final version of the document, updating all relevant information linked to the business models.

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2. Product and Services Analysis

CHESS SETUP is a novel solution with a clear focus on **energy efficiency and CO2 reduction**, characterized by an **optimal combination of solar thermal energy production, seasonal heat storage and the use of a highly efficient heat pump**

At a time when heating and domestic hot water (DHW) represent 60% of the energy consumed in our dwellings, **CHESS SETUP represents a centralized system able to supply this demand all year-long.**

CHESS SETUP system does not develop new technology but relies on a combination of technologies, seeking the **optimization of the integrated operation** of solar panels, seasonal thermal energy storage (TES), and heat pumps according to some external factors, such as user requirements, weather predictions and energy prices by using a smart control and management system. It is technically easy to implement for new construction projects, but it can be also used in existing buildings.

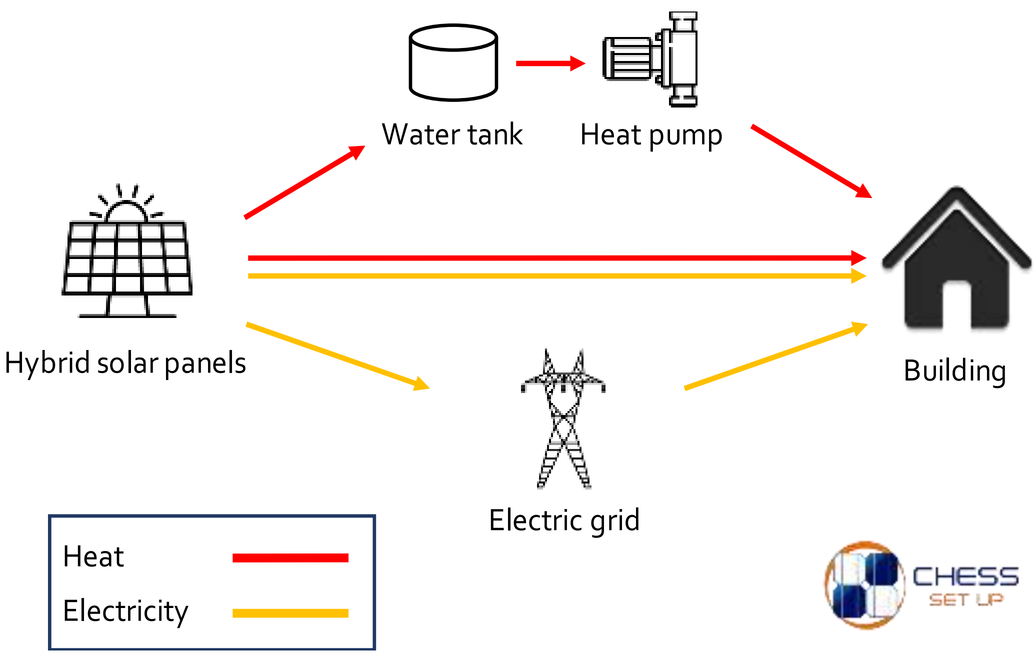

Figure 1: CHESS SETUP basic system operation

The system operation is based in:

1. **Solar panels** (thermal, photovoltaic and hybrids), <u>transforming the solar radiation into **heat**</u> to be stored and used for DHW and heating, in addition to **electricity** that can be used by the own system or by the **building**, and if there are surpluses can be stored in batteries or injected into the **grid**.

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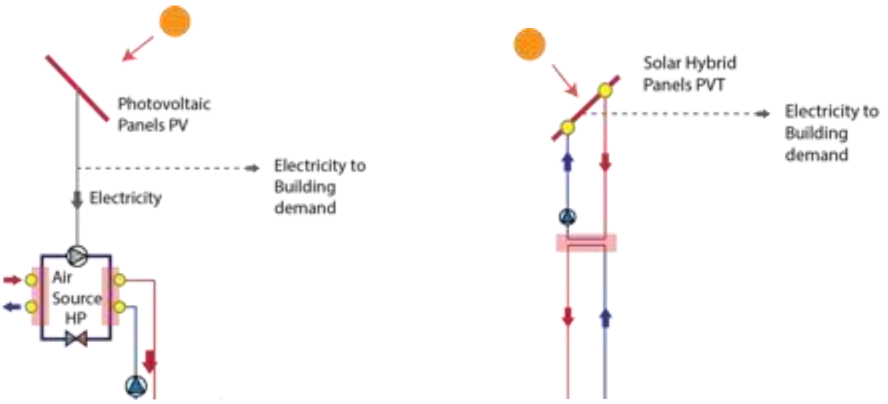

Figure 2: PV and PV-T solar panels proposed for the CHESS SETUP system implementation. Source: D3.6 Integration with other energy sourcers.

2. Seasonal **thermal energy storage** to <u>store the heat</u> collected by the solar panels, especially in summer, increasing the temperature of the medium that can be liquid (water, brine, etc.) or solid (ground).

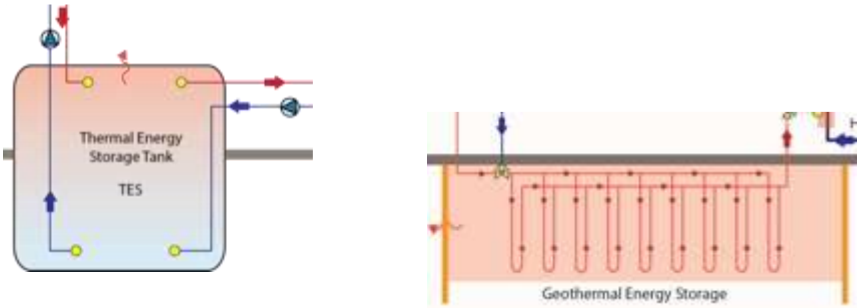

Figure 3: Water tank and geothermal proposed as seasonal thermal energy storage for the CHESS SETUP system implementation. Source: D3.6 Integration with other energy sourcers.

3. The **heat pump** that is used to <u>supply the heating and DHW demands</u> of the building, recovering the heat stored in the seasonal storages at high efficiencies.

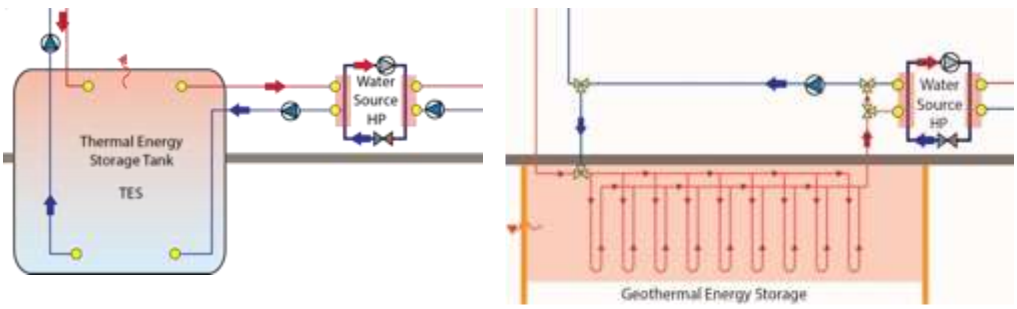

Figure 4: Heat pump operation scheme proposed in the CHESS SETUP system. Source: D3.6 Integration with other energy sourcers.

Furthermore, CHESS SETUP solution is linked with the **smart cities** concept as the centralized installation is managed and controlled by a digital software that takes into

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account external factors, such as the electricity price, weather forecasts and the remaining energy stored.

The seasonal thermal energy storage combined with the heat pump and the smart management system provides great benefits to the electrical grid, flattening the electric demand curve and allowing greater integration of renewable sources.

This is achieved through the control system, which can activate the heat pump for example during periods of low electricity demand or when the grid is not able to absorb the energy produced by renewable sources.

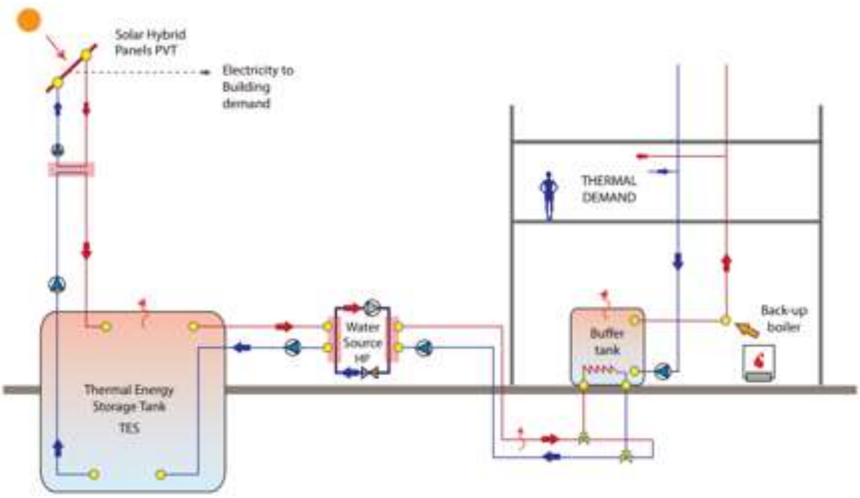

Figure 5: Diagram of the CHESS SETUP system operation scheme. Source: D3.6 Integration with other energy sourcers.

The system can be combined with other renewable sources (e.g. biomass, heat waste, etc.) and can be **adapted to any local climate and site characteristics**. The figures below show examples of different energy sources and potentially appropriate technologies to be integrated with the CHESS SETUP system.

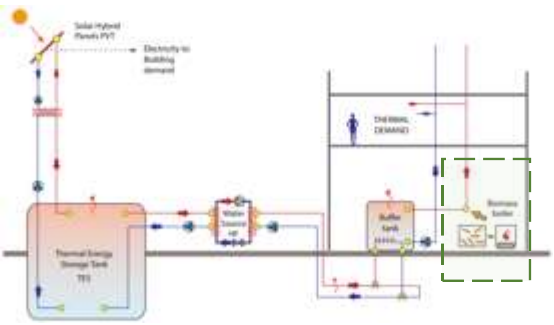

Figure 6: Schematic of CHESS SETUP system with biomass boiler. Source: D3.6 Integration with other energy sourcers.

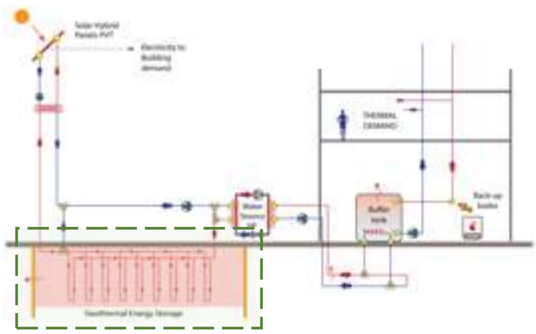

Figure 7: Schematic of CHESS SETUP system with geothermal energy. Source: D3.6 Integration with other energy sourcers.

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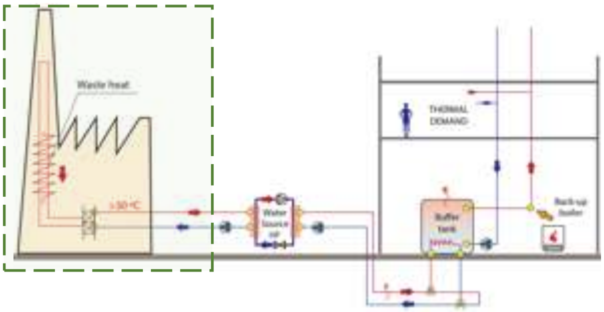

Figure 8: Schematic of CHESS SETUP system with waste heat. Source: D3.6 Integration with other energy sourcers.

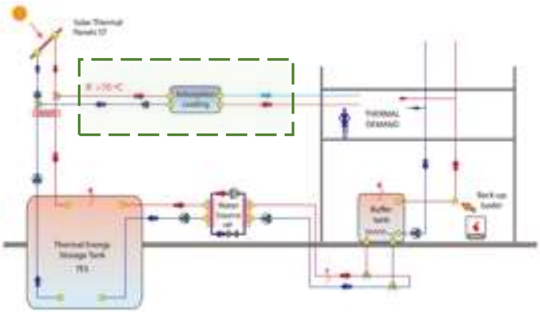

Figure 9: Schematic of CHESS SETUP system with adsorption cooling. Source: D3.6 Integration with other energy sourcers.

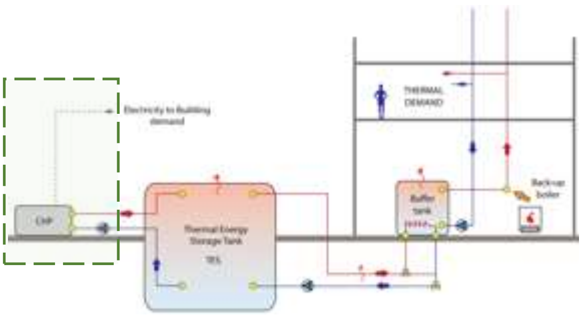

Figure 10: Schematic of CHESS SETUP system with combined heat and power. Source: D3.6 Integration with other energy sourcers.

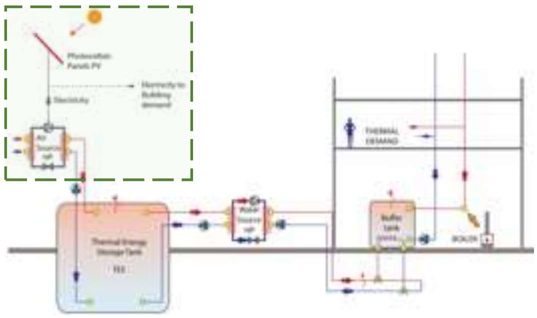

Figure 11: Schematic of CHESS SETUP system with Photovoltaic and air source heat pump. Source: D3.6 Integration with other energy sourcers.

3. Market Analysis

The objective of the market research is to identify important macro-market aspects that can affect the **exploitation and opportunities of CHESS SETUP** as well as the detection of interested parties and market segments.

It is focused in the HVAC sector, specially **heating equipment for residential and commercial uses** for Nearly Zero Emissions Buildings (NZEB) and in general for **building construction**, **energy renovation** and **retrofit**. As for geographical areas, main focus has been **Europe** given the advanced legislation on NZEB and the **influence area of the consortium partners.**

To facilitate its revision and in order to respond to all the requirements of the Grant Agreement we have divided the information in the following sections:

a. Market Size	b. Market Trends	c. Market Threats	d. Similar Initiatives

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a. MARKET SIZE

The **building sector accounts indicatively for 40% of the energy consumption and 36% of Greenhouse emissions in the European Union (EU).** More specifically, energy consumption intended for heating and cooling represents around half of total final energy consumption [1]. Heating (and cooling) systems have been influenced by, amongst other things, demographics, the efficiency of the building stock, energy availability, energy policies, economic structure, and climate considerations. As a result, final energy demand for heating or cooling varies across Europe. In 2015, as shown in Figure 12, the largest consumer by far was Germany, which alone accounted for about 22%, followed by France (12%), Italy (11,5%), and the UK (10.5%). These four markets accounted for more than half of the total energy used in final energy demand for heating and cooling (56%).[2]

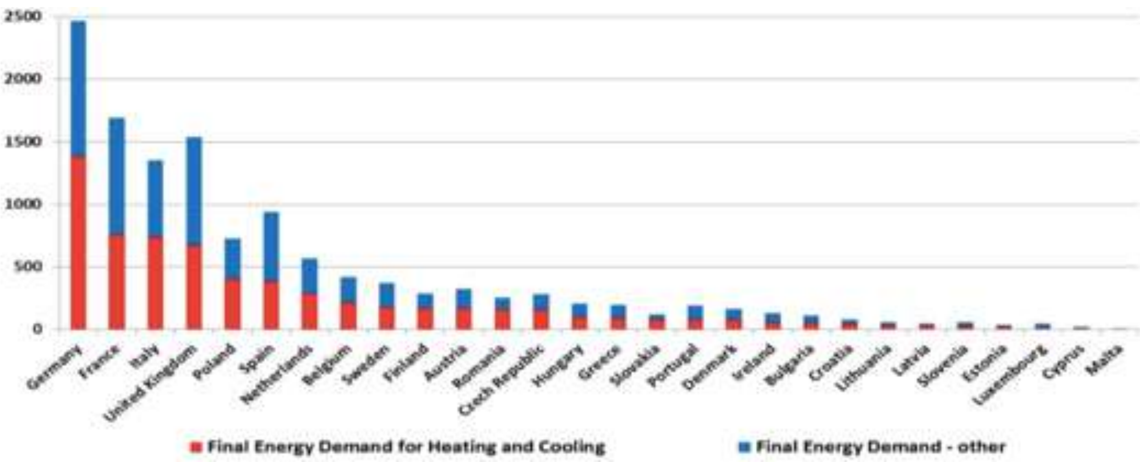

Figure 12: Final energy demand per country in the EU, 2015, in TWh (Eurostat data and data from Heat Roadmap Europe, a low carbon heating and cooling strategy 2050)

Almost half of the EU buildings have individual boilers installed before 1992, with efficiency of 60% or less. Furthermore, 22% of individual gas boilers, 34% of direct heaters, 47% of oil boilers, and 58% of coal boilers are older than their technical lifetime[3]. These data shows the **low level of efficiency of the installed stock** in European buildings.

Hence, Europe is projected to experience a **high interest and demand for energy-efficient products as heating and cooling industries need to decarbonise over the next 30 years**. Increasing the share of renewable energy sources used in heating and

[1] European Commission. Heating and Cooling. https://ec.europa.eu/energy/topics/energy-efficiency/heating-and-cooling_en

[2] The Oxford Institute for Energy Studies, 2018.Decarbonisation of heat in Europe: implications for natural gas demand.

[3] Fraunhofer 2015. EU Strategy for Heating and Cooling. Brussels, 2016

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cooling could have a positive impact simultaneously on the economy, society and environment.

Favourable government policies related to reach the climate overall targets of **32,5% of energy efficiency** and **renewable energy share of at least 32%** by 2030, specially knowing that the building sector is key, are projected to boost the demand and installation of **heat pumps from renewable energy sources (RES)**. Besides, the recovering of the construction sector is projected to contribute to the growth of the market. Therefore, **the benefit of the CHESS SETUP system makes this technology a prime candidate for a central role in a sustainable European energy system.**

With approximately **244 million residential buildings in Europe**, the heat pump market share in the building stock is about **5%**, being different that rate for each EU member. The market data exposed by the European Heat Pump Association (EHPA, 2019) states that with a 12% increase reached in 2018, the European heat pump market has achieved double-digit growth for the fourth year in a row. At this rate, **a doubling of the European heat pump market by 2024 is expected.** Thanks to the **11.8 million units** installed across Europe, heat pump technology has quickly developed into a cornerstone of Europe's heat supply. Currently, heat pumps are heating slightly less than **10% of all buildings**, but there is still a big potential to be developed. With their thermal and demand-side flexibility potential, heat pumps will be required in the new energy system to achieve the 2050 climate targets and offer an enthusiastic re-industrialisation project for the EU. In this sense, the European Heat Pump Association in its "Statistic and Market Report 2018" exposes that the 12% increase of heat pump stock in Europe has meant **128 TWh of renewable energy**, 164 TWh of final energy saved and 32,98 Mt of Greenhouse gas emissions avoided.

The following figures show the sales overview by year (Figure 13), type of heat pump (HP) and units sold by country (Figure 14):

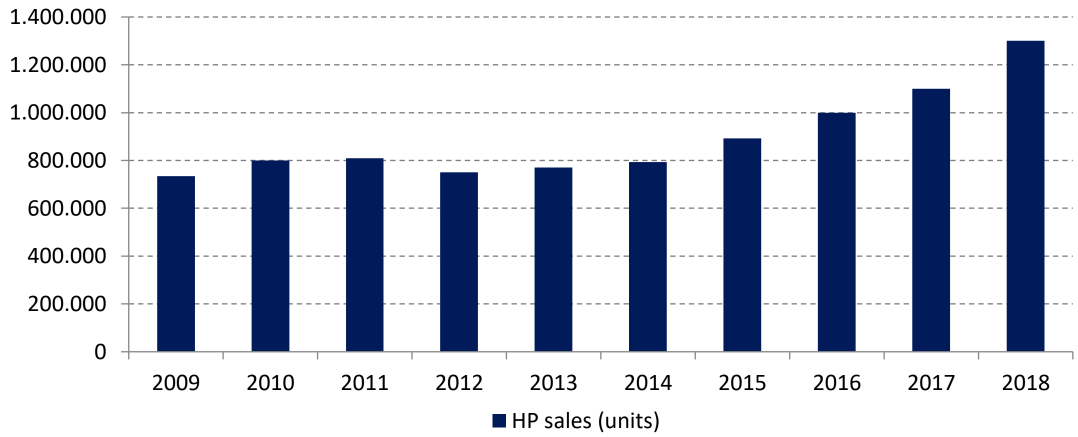

Figure 13: HP 2018 sales development, 21 European Countries (Data from EHPA Statistic and Market Report 2018)

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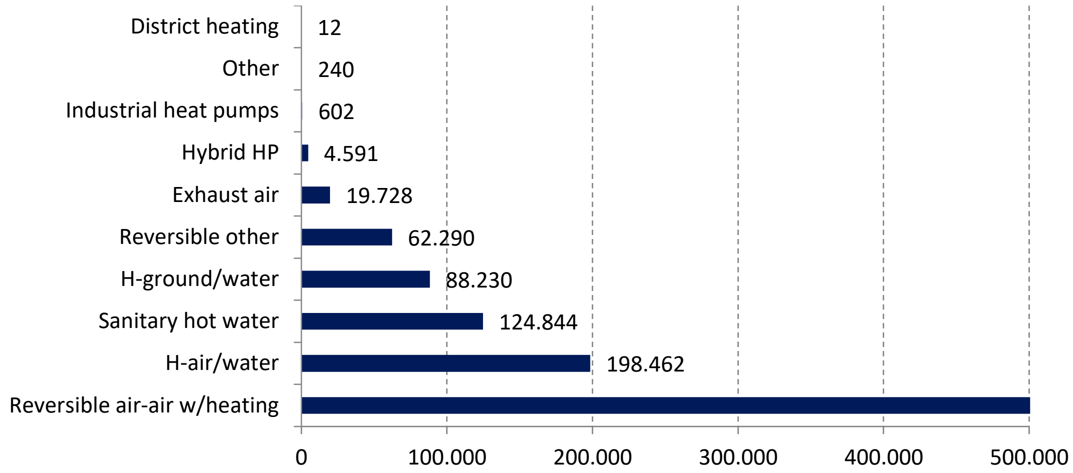

Figure 14: HP sales units in 2018 by type (Data from EHPA Statistic and Market Report 2018)

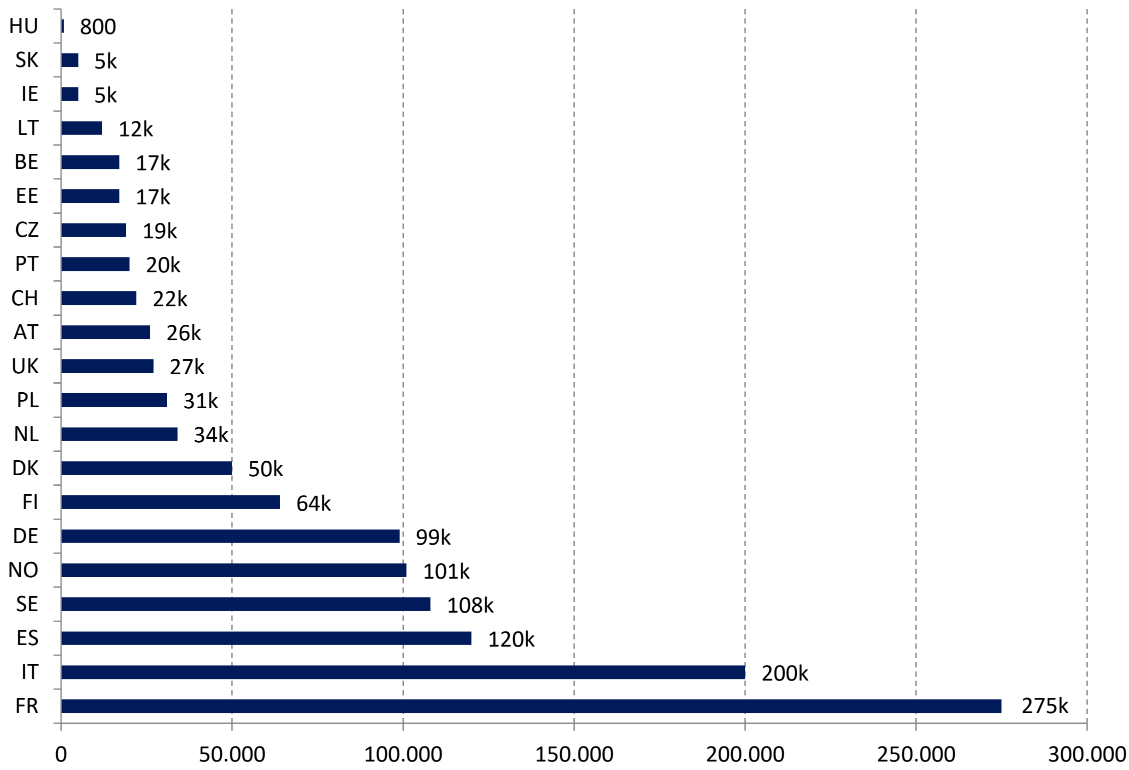

Figure 15: HP sales units in 2018 by EU country (Data from EHPA Statistic and Market Report 2018)

We can observe a growing interest in the technology over the years and the most bought type are reversible air-to-air, followed by air-to-water heat pumps. With regards to CHESS SETUP system, in the Sant Cugat and Corby pilots it has been used the Water Source Heat Pump (WSHP) and in case of Lavola pilot the Air Source Heat Pump (ASHP). By country, the top 10 mature markets in Europe with a highest interest in heat pumps installation, in order of sales, are: France, Italy, Spain, Sweden, Norway, Germany,

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Finland, Denmark, Netherlands and Portugal, and very closely followed by United Kingdom. It is interesting to note that all areas of influence or countries of CHESS SETUP Consortium partners are included within this range.

As CHESS SETUP solution is based in the optimal combination of solar thermal energy production, seasonal heat storage and high-efficient pump used for heating and hot water supplying in buildings, the **market size could be comprised by all buildings with a significant heating demand**.

Taking into account that **CHESS SETUP system is technically easy to implement for new build construction projects, but it can be also be adapted while retrofitting existing buildings**, we consider the following **main customer segments** as potential CHESS SETUP solution adopters:

Potential customer segments

1. Professional customers for new housing construction such as developers, construction groups and public administrations in charge of new social housing are encompassed in this segment.
2. New residential construction is the biggest market in Europe. New buildings are well insulated and thus suitable for heat pumps and for designing the implementation of renewable energy installations.
3. It is interesting also to consider residential areas where the neighbourhood community shares the HVAC and DHW energy production and distribution, typically using heat pumps.

1. Private and professional customers for housing renovation market such as private building owners, retrofitting business, construction groups (including architects and installation engineers) and installation providers in charge of housing renovation creates another potential customer segment.
2. In spite of new housing market being nowadays the biggest in Europe, there are increasing and promising prospects in the housing renovation market, which accounts for 80% of the building stock.
3. Nowadays, heat pumps can supply higher temperatures and better meet the energy needs of the older housing stock.

Private and professional customers for public buildings as well as offices/facilities buildings with a considerable heat demand can take huge profit from the deployment of this solution, matching heat needs with required equipment. Hence, public institutions representatives, construction developers, construction groups, urban planners and public administrations are included as another customer segment for commercial buildings construction and renovation.

Apart from buildings in urban areas, businesses such as rural tourism hotels or ecological farms in unpopulated rural areas or island could be included in this segment of potential customers from this clean and efficient energy source and storage system that is CHESS SETUP.

Furthermore, not only it should be considered the building user as a possible customer. Once the aggregator figure plays a key role in the electric system (grid and market), the system could give extra services and benefits for the Distribution System Operator (DSO), so these same aggregators would be interested in extending the use of the system proposed.

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As a conclusion, **new residential construction** is the biggest market in Europe and therefore the main target market for the solution. Nevertheless, in much of the existing building stock there are **potentials for refurbishments that involve the introduction of RES technologies** to deliver heating and cooling and replacing old, and often fossil-based solutions.

As another indicator to help complementing the customer segments, the **prediction of sales** made by same European Heat Pump Association (EHPA) for 2050 in the **residential sector** is that the system implementation could reach 50% of the **new residential buildings** constructed and 30% of undergoing **residential building renovation**, thus signifying a positive trend.

Additionally, as shown in the following figures (Figure 16 and Figure 17), the JRC estimates that approximately 1.5 million new residential buildings are constructed per year, and 2.5 million undergo substantial renovation. In the EU28 (28 countries in EU), the residential sector current investments in energy renovations are about 200 billion Euros per year. Another 200 billion appears to be invested in non-residential buildings. Further significant growth would occur if renovation activities moved towards a level that ensures a decarbonised building stock by 2050. Then energy renovation investments would probably exceed those in non-energy renovation.[4]

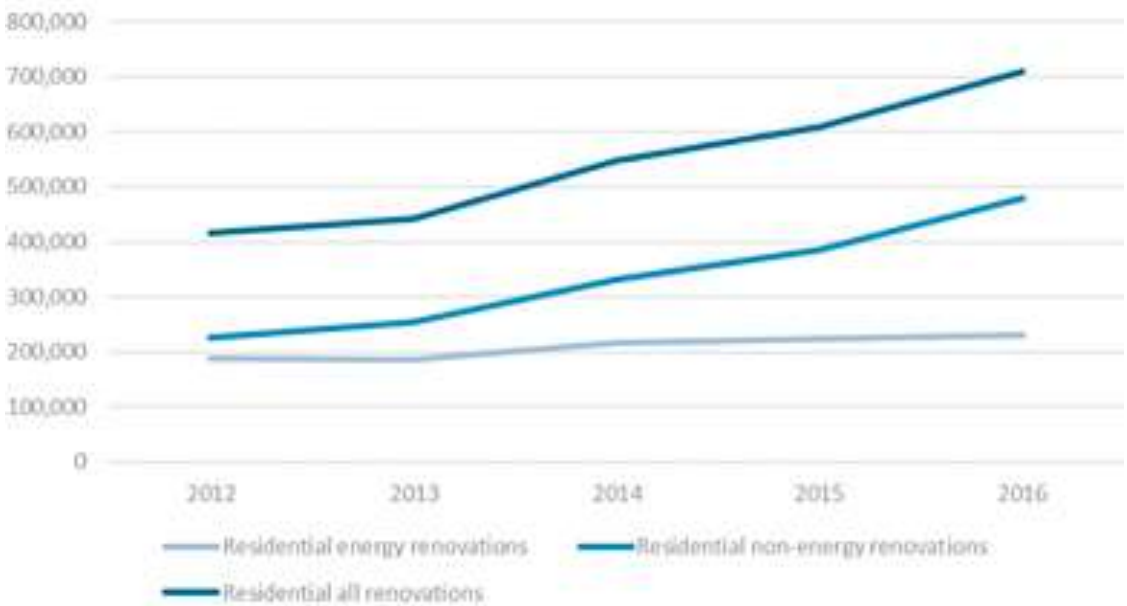

Figure 16: Residential renovation investments in million Euro per year (Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU, 2019).

[4] European Commission, 2019. Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU. Final Report.

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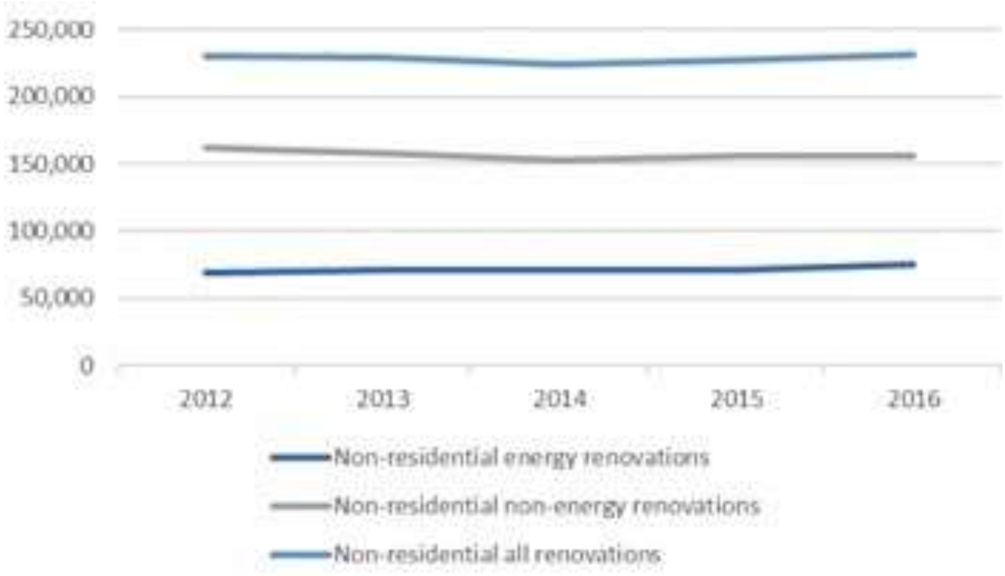

Figure 17: Non-residential renovation investments in million Euro per year (Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU, 2019).

Finally, it is interesting to underline the identification of potential stakeholders and interested parties done in **D6.3 "Database of stakeholders and interested parties"**. A database of potential customer segments mentioned above (including building developers, constructor groups, retrofitting business, public administrations, etc.) has been identified for all the Consortium partners in their influence areas in Europe. Moreover, as detailed in Annex 1 we include the interest letters received from different stakeholders encompassing all the aforementioned segments. They have expressed their interest in the results and conclusions of the project and to be treated as potential customers of the CHESS SETUP system.

b. MARKET TRENDS

As stated before, 40% of the energy consumption and 36% of the CO_2 emissions in the EU are related to the building environment[5], which exemplifies the increased focus on improving the energy efficiency of buildings.

The market trends in the coming years are therefore related to the growing tendency towards **smart homes, development of energy efficient systems and adoption of renewable energy sources and green technologies**. Furthermore, nearly energy-zero performance levels initiated by the European Union's Energy Performance of Buildings Directive will bring significant drives in the building sector in the next few years. This Directive states that all new buildings in the EU from 2021 onwards are expected to

[5] European Commission, 2018. Buildings. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

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reach “nearly zero-energy” performance levels using innovative and cost optimal technologies with integration of renewable energy. Well designed and combined systems can improve **building’s self-sufficiency, energy efficiency and comfort level**, yielding significant **cost savings**, promising payback period and **less greenhouse gases emissions** to the atmosphere.

Energy efficiency is thus one of the key concerns that global manufactures of HVAC are focusing on. Moreover, low-energy heating and cooling sources that requires that **thermal energy storage (TES)** is integrated into sustainable building design, with a combination with space heating, domestic hot water and space cooling (such as CHESS SETUP solution), has recently received much attention. In fact, electricity and thermal storage technologies have been present in Europe for the last decades, especially on the Northern countries such as Sweden, Norway, Finland, Denmark, or the ones near them such as Germany.

Furthermore, it is interesting to note the absence of a harmonised strategy at the European Union level related to heating and cooling markets which have led to relatively slow progress in the sector. Nevertheless, for the period from 2021 onwards, the recast of the **Renewable Energy Directive** strengthens the provisions that promote renewable heating and cooling options. Under this new directive (RED II), Member States are required to develop integrated **National Energy and Climate Plans (NECPs)** to carry out an assessment of their energy potential coming from renewable sources, in particular to **promote energy from renewable sources in heating and cooling installations** as well as promote competitive and efficient district heating and cooling. Member States shall also endeavour to increase the share of renewable energy in that sector by an indicative 1,3 percentage points per year from 2020 to 2030[6].

In order to know the market trends for NZEBs, we have explored, among others, the research done by ZEBRA2020, the EU H2020 funded project which has assessed the share of implementation and **the performance of technologies in new or renovated NZEBs.** They performed an investigation in 17 European countries (Austria, Belgium, Czech Republic, Denmark, France, Germany, Italy, Lithuania, Luxemburg, Norway, Poland, Romania, Slovakia, Spain, Sweden, Netherlands and United Kingdom) on design strategies and technologies implemented on a sample of 411 residential and non-residential buildings, with a special focus on the influence of the boundary conditions on the technologies adopted. In our line of analysis, the results showed a **recurrent specific technologies in the HVAC system (i.e., heat pumps and mechanical ventilation)**, while the climatic conditions do not drive significantly the design approach and the NZEB features[7]. Therefore, we can state that **heat pumps** are a **common and effective technology** to achieve NZEB parameters in European buildings and, in general, for building construction and energy renovation. As we have

[6] European Commission, 2019. Competitiveness of the heating and cooling industry and services. Final Report. ENER/C2/2016-501.

[7] EURAC Research, Institute for Renewable Energy, 2017. Nearly Zero Energy Buildings: An Overview of the Main Construction Features across Europe.

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stated in the previous section, this trend can be proved observing the increasing uptake of heat pumps in Europe. The largest markets are the southern European countries where the heat pumps are primarily used to deliver cooling. Italy, Spain and France together count for almost 80% of the sales [8].

Society as a whole is recognizing heat pumps potential as using renewable and waste energy, their energy efficiency and cost savings. They are also applauded for their inherent reduction of CO_2 emissions in heating and for their contribution to sector integration. In terms of consumer prices, the **operating costs of heat pumps are among the lowest in the heating and cooling sector**. However, upfront investment costs are high, resulting in pay-back times of up to 20 years.

Government support schemes of institutional or financial nature (commonly referred to as incentives) can accelerate the deployment of heat pumps in the heating market. This has been proven over time by successful schemes in Sweden (supporting all building renovation efforts); Germany (level of support differed widely over time and from new to renovated buildings, from energy efficient buildings to drillings, to heat pumps); or France (direct income tax reduction or direct payment based on the investment cost of the heat pump, decreasing over time).[9]

Therefore, government financial support programs for renewable energy incentives, including heat pumps, could help recoup investment in a shorter period of time, accelerate market penetration of this technology and reduce paybact periods in the residential sector to 10 years.

The fast decline of the production cost of photovoltaic (PV) systems also influences the heating market: using **self-produced electricity in combination with a heat pump system** provides a very low-cost energy source for buildings. CHESS SETUP system is designed this way, providing clear benefits and cost and GHG emissions reductions savings. An **additional benefit or selling point** of CHESS SETUP system is that surpluses can be **stored in batteries or injected to the grid**.

Finally, related to local and international strategies it is important to mention that, in order to boost building renovation, the European Commission has announced the intention to launch the new **'Renovation Wave'** initiative, as part of the European Green Deal, the roadmap for making Europe's economy more sustainable. The aim of this renovation wave is **to increase the rate of renovation of existing buildings** and bring together the different actors in the sector to develop financing possibilities, promote investments in buildings and pool renovation efforts. Therefore, the Renovation Wave for Buildings should accelerate the replacement of old and inefficient heating and cooling systems installed in Europe's buildings with new, highly efficient

[8] Research and Markets, 2019. European Heat Pump Market and Statistics Report 2019. https://www.researchandmarkets.com/reports/4856637/european-heat-pump-market-and-statistics-report?w=4
[9] European Copper Institute, 2018. Integrating technologies to decarbonise heating and cooling. https://www.ehpa.org/fileadmin/user_upload/White_Paper_Heat_pumps.pdf

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and renewable-based ones. Deep energy renovation of our buildings (at a 3% renovation rate per year) will enable the **EU's goal of climate-neutrality by 2050**.

Additionally, CHESS SETUP Consortium, on May 2020, supported the call ***Renovation Fund for All Europeans***, along 125 actors in Europe, for the **EU Green Deal Recovery Plan** to ensure that energy renovation of the EU building stock plays a central role in getting the EU back on its feet (Figure 18).

Figure 18: Signers of the call "Renovation Fund for All Europeans under the "Renovation Wave" related to EU Green Deal (Renovate Europe, 2020).

c. MARKET THREATS

There are many other heat and DHW supplying systems, such as centralized or particular biomass boilers, cogeneration, geothermal solutions, different combinations of electrical generation to feed the heat pumps, underfloor heating systems, etc. Those other systems and technology solutions have already been present in the market with successful results, so actual market trends are powerful and CHESS SETUP solution could face some important challenges if it seeks for market competitiveness.

In particular, **natural gas boilers are the main competitor of heat pumps**, as they carry lower up-front investment costs. Home owners wants to maximise space and there has been a trend to eliminate hot water storage cylinders to allow that footprint to be used for other home use. On the other hand, **CHESS SETUP system's heat pump** has the **added value** to perform a space heating task, providing hot water and minimising water use by avoiding running water until it is hot as well as combining them with **solar energy** and **thermal energy storage**. Additionally, biomass technologies, gas and electric heaters and air conditioners are other competitors in the residential sector.

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Currently, heat pumps in Europe are marketed as a **"high value product",** and few companies dominate a large share of the market which enables them to exercise some competitive power on price and conditions. In the long term, the market may mature and make it more difficult for companies to exercise the same power. More suppliers are expected to enter the market and the small buyers would constitute an ever-smaller share of the market[10].

The key factors that limit the deployment of heat pumps into the European heating and cooling sector are related to **finance, convenience and awareness**.

In terms of financials, the operation costs of heat pumps are among the lowest in the heating and cooling sector, however their high upfront investment costs may be considered a disadvantage when selecting the technology. With regards to convenience and awareness, currently the installation process takes longer as is more complex than for example natural gas boilers and installers are less familiar with the installation of heat pumps and might tend to favour other technologies. However, this issues will become less relevant as both customers and installers will become more experienced in this area.

In conclusion, CHESS SETUP main competitors are the technology and service providers offering different heat and DHW solutions and alternative TES applications. In order to differentiate and provide a competitive advantage to CHESS SETUP, specific promotion initiatives and the adoption of financial support schemes could be considered to strengthen its value proposition. The objective would be the provision of the lowest price and best performance ratio to the market. The aforementioned **'Renovation Wave'** initiative, as part of the European Green Deal, is a good starting-point. The aim of this renovation wave is **to increase the rate of renovation of existing buildings** and bring together the different actors in the sector to develop financing possibilities, promote investments in buildings and pool renovation efforts.

d. SIMILAR INITIATIVES

Another key objective of the market analysis is to review the **project alignment with other initiatives** in nearly zero energy buildings and with some of the world's largest solar projects. Therefore we have identified **seventeen existing solutions and initiatives** related to the CHESS SETUP system or part of it. They all offer different thermal energy storage technologies linked with the production of renewable energy, for different applications, purposes and buildings typologies.

As a result, these similar initiatives identified provides further key information to consider in future adoptions of CHESS SETUP system in the wider market and confirms that all around Europe there is a growing demand, viability and acceptation to new

[10] European Commission, 2019. Competitiveness of the heating and cooling industry and services. Final Report. ENER/C2/2016-501.

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green and energy efficient technology adoption in the building market, specifically related to the CHESS SETUP system.

Furthermore, we would like to highlight the similarity of these seventeen installations to the CHESS SETUP pilots, as they involve the application of solar energy and thermal storage in different buildings such as family houses (Corby pilot), public buildings (Sant Cugat) and office builnding (Lavola). In fact, one of the projects described below is is a large-scale example of the use of thermal storage tanks that shows that its use is technologically and economically feasible in large public buildings with a large energy demand such as an airport.

In the case of the family houses, one of the projects described below provides further evidence that houses achieve an important reduction of greenhouse gas (GHG) emissions per home per year, as the system might fulfill up to 90% of each home's space heating requirements from solar energy resulting in less dependency on limited fossil fuels.

To facilitate the understanding of the relevance and alignment of CHESS SETUP with the following seventeen initiatives, we have included in each initiative description the value generated and the **relation with CHESS SETUP.**

1) Pit Thermal Energy Storage (PTES), Vojens Fjernvarme

Location: Vojens, Denmark

Storage technology: Pit Thermal Energy Storage (PTES)

Description: The world largest solar heating plant (70,000 m²) and the world largest underground thermal storage pit (200,000 m³).

The storage is excavated in an old sand pit. The 200,000 m3 water volume is separated from the district heating water by a heat exchanger. A huge "plastic bag", formed by a special welded plastic liner, ensures that the water does not disappear into the sand and remains clean.

Value generated: The huge storage system was designed to operate as an interseasonal heat storage allowing the solar heating plant to deliver more than 50% of the annual heat production to the network. The cost of heat in winter from the solar heating combined with the interseasonal heat storage is competitive against the heat from gas boilers, due to economy of scale.

CHESS SETUP relation: It shows the potential and viability of thermal energy storage solutions, especially in big installations due to economy of scale. The pit thermal energy

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storage could be a plausible option for future large scale CHESS SETUP replication projects.

Source: https://stateofgreen.com/en/partners/ramboll/solutions/world-largest-thermal-pit-storage-in-vojens/

2) Marstal District Heating

Location: Marstal, Denmak

Storage technology: Pit Thermal Energy Storage (PTES)

Description: Marstal District Heating supplies heat based on 100% renewable sources with a solar fraction of 41 % (33,300 m2 solar system) and biomass to cover the remaining (8,3 MW bio-oil boilers).

The long term storage in Marstal is a Pit Thermal Energy Storage (PTES) with water as storage medium and size of 75,000 m3. The storage is charged to 80-85°C during summer and discharged down to 10°C during winter, and it is used directly and as a heat source for the heat pump.

Value generated: The system distributes heat to 1,481 consumers in a total connected floor area of 296,278 m2. In terms of energy, 32,000 MWh of heat is produced and 24,640 MWh is sold at a variable price of 107€/MWh.

CHESS SETUP relation: It shows the potential and viability of thermal energy storage solutions, especially in big installations due to economy of scale. Besides that, one of the common objectives between CHESS SETUP and Marstral District Heating is the goal of consuming 100% renewable energy.

Source:
https://ens.dk/sites/ens.dk/files/Forskning_og_udvikling/sol_til_fjernvarme_brochure_endelig.pdf

3) Plant in Dronninglund

Location: Dronninglund, Denmark

Storage technology: Pit Thermal Energy Storage (PTES)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Description: This consumer-owned plant in Dronninglund has 37,573 m2 of solar collectors achieving a solar power of 26 MW, and a Pit Thermal Energy Storage of 60,000 m3 that operates with water.

Value generated: The system distributes heat to nearly 1,350 consumers in a total connected floor area of 294,432 m2. In terms of energy, 38,700 MWh of heat is produced and 29,700 MWh is sold at a variable price of 71€/MWh.

CHESS SETUP relation: It is another example of the great use of the pit storage system in Denmark. It could be a plausible option for the replication phase of CHESS SETUP to study the implementation of similar thermal storage systems in Denmark and in other countries with similar conditions.

Source:
https://ens.dk/sites/ens.dk/files/Forskning_og_udvikling/sol_til_fjernvarme_brochure_endelig.pdf

4) Pit Storage in Eggenstein

Location: Eggenstein, Germany

Storage technology: Pit Thermal Energy Storage (PTES)

Description: A 4,500 m³ pit storage which was finished at the end of 2007. Wells are used to charge and discharge heat by direct water exchange on the top and at the bottom of the storage system.

Pit thermal energy storages are made of an artificial pool filled with storage material and closed by a lid. Eggenstein thermal system has 1.600 m² of solar thermal flat plate collectors.

Value generated: The system delivers 37% of the yearly heat demand of the school and sports centre retrofitted with the system.

CHESS SETUP relation: This project has great similarity with the CHESS SETUP pilot in Sant Cugat because of the building typology supplied by the system: a retrofitted sports centre. This experience shows that the pit energy storage could be an option to analyse in future similar projects.

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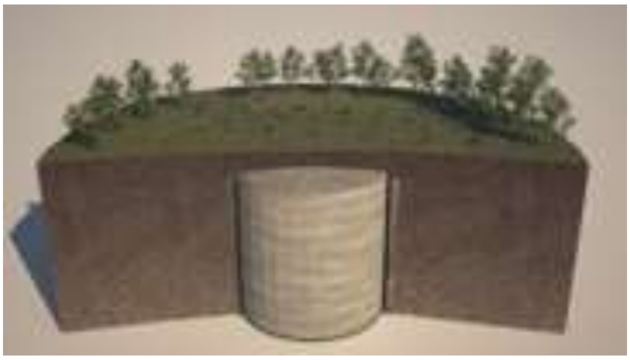
Source: https://www.solarthermalworld.org/sites/gstec/files/news/file/2016-07-27/task45_b_saisenal_storages.pdf

5) **Tank Thermal Energy Storage (TTES) Ecovat**

Location: Germany

Storage technology: Tank Thermal Energy Storage (TTES)

Description: The Dutch startup Ecovat is making the energy supply in the built environment sustainable, by creating a large thermal storage tank that can store high temperature heat (to around 90 degrees C) over a long period (> 6 months) with a loss of energy during that period of less than 10%.



Value generated: Building an Ecovat saves 50% construction costs. Besides that, this kind of storage is 40% more energy-efficient than conventional thermal storage solutions, because of the working principle of the heat exchangers and because the natural stratification of the water is not disturbed.

CHESS SETUP relation: Ecovat shows the existing market opportunity for Thermal Energy Storage systems and its associated technology. It also shows how these solutions are particularly suitable for installations aiming to achieve 100% renewable energy consumption.

Source: https://www.ecovat.eu/

6) **SolarHouse 50+**

Location: Germany

Storage technology: Tank Thermal Energy Storage (TTES)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Description: SolarHouse 50+ could be the next standard in Germany for small scale Seasonal Thermal Storage.

It is a solution for low heat demand in summer and no long-term storage capacity. This system could consist of collector areas of 30 to 60 m², and hot water storage tanks of 6.000 to 10.000 liters.

Value generated: This type of houses aim to decrease significantly the storage size and the solar collector area, and therefore the cost of the system.

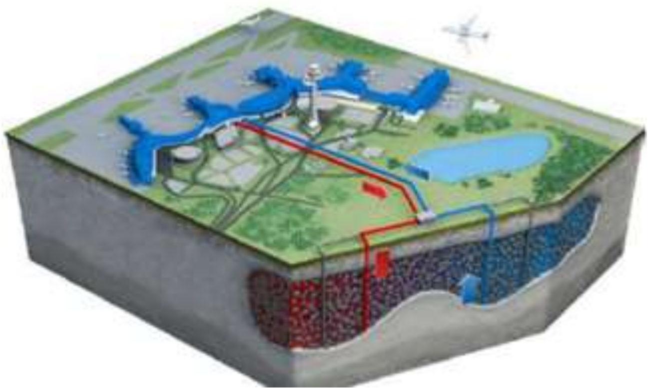
CHESS SETUP relation: It shows the market potential of these solutions, and the public interest in promoting them from an environmental point of view. It is interesting to highlight the similarities of these small scale solutions with the pilot project Lavola's offices.

Source:http://www.rhc-platform.org/fileadmin/Events/4_-_Kerskes_seasonal_TES.pdf

7) **Aquifer Thermal Energy Storage (ATES) Arlanda Airport**

Location: Stockholm, Sweden

Storage technology: Aquifer Thermal Energy Storage (ATES)



Description: An Aquifer Thermal Energy Storage (ATES) system was installed in the Stockholm-Arlanda Airport, in order to supply the airport with renewable heat and cold, replacing conventional chillers and reducing the dependency of district heating.

The main appeal of heat pumps used in the Arlanda Airport is that they take low grade heat from a renewable, cost-free source and transfer it at a higher temperature to where it is needed, in an energy efficient manner.

Value generated: Cut the cost for energy with at least 1 million Euro annually (at energy prices at the time of investment). With an investment of approximately 5 million euros, a straight payback time in the range of 5 years was expected.

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From the energy side, the plant is expected to reduce the electricity use by 4-5 GWh/year, the district heating use by 10-15 GWh/year, and CO2-emissions by 7 000 tons/year

CHESS SETUP relation: This project is a large-scale example of the use of thermal storage tanks that shows that its use is technologically and economically feasible in large public buildings with a large energy demand such as an airport.

Source: https://intraweb.stockton.edu/eyos/energy_studies/content/docs/effstock09/Session_6_3_ATES_Applications/55.pdf

8) ATES in Rostock

Location: Rostock, Germany

Storage technology: Aquifer Thermal Energy Storage (ATES)

Description: It is the first German central solar heating plant with an Aquifer Thermal Energy Storage (ATES) system that went into operation in 2000. The system supplies a multifamily house with a heated area of 7000 m² in 108 apartments with heat for space heating and domestic hot water preparation

Value generated: The total cost of the installation was 1.018.200€, and during its first years of operation it achieved a solar fraction of nearly 50%. Due to the heat storage system, the heat pump is able to operate in excellent conditions, with COPs between 6 and 7, decreasing to approximately 3.5 at the end of the discharging period.

CHESS SETUP relation: This project confirms that thermal energy storage systems coupled with on-site renewable energy production is not a new concept, but they have been used for more than 15 years with success.

Source: http://www.solites.de/download/literatur/04-05.pdf

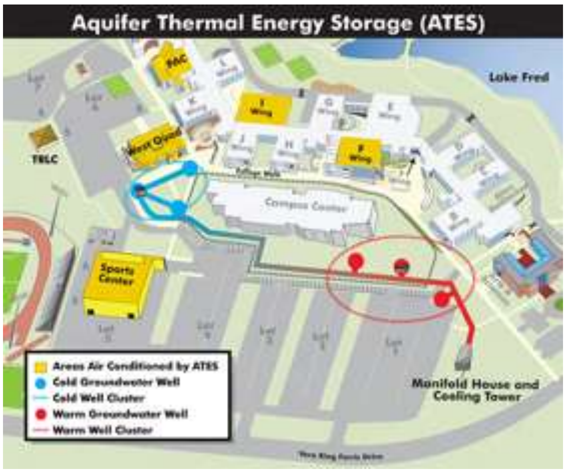
9) Stockton Universty

Location: Galloway, New Jersey

Storage technology: Aquifer Thermal Energy Storage (ATES)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Description: Stockton University is an innovator in sustainable heating and cooling using geothermal applications at their campus in New Jersey. Stockton's 1400 ton 400-bore closed-loop geothermal system was one of the largest geothermal HVAC installations in the world when it was constructed in 1994, and it has served Stockton for over 20 years now.



Stockton's Aquifer Thermal Energy Storage (ATES) system was constructed in 2007 and was also a first of its kind in the US.

Value generated: Stockton's ATES system was designed to provide 800 tons of cooling capacity using six ATES wells at a maximum aggregate pumping rate of 1200 gpm. The system is used for cooling only, and the cold store is charged during winter using a cooling tower to reject heat from the warm wells.

CHESS SETUP relation: In America there are also some success cases in which they use aquifers as thermal storage tanks with renewable energies, even for big constructions as an university campus. This shows that there is an existing market opportunity also outside of Europe.

Source: https://stockton.edu/facilities-construction/energy-climate.html

10) Gardermoen Airport

Location: Gardermoen, Norway

Storage technology: Aquifer Thermal Energy Storage (ATES)

Description: At Gardermoen, one of the largest groundwater reservoirs in Norway is located. This aquifer is used for both heating and cooling of Gardermoen Airport. In the summer, ground water is pumped from cold wells and used for cooling before it is returned to the warm wells. In winter, this process is turned around, as ground water from the warm wells is used as heat source for the heat pump.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Value generated: Compared with a district heating system heated by fossil fuels, and a conventional refrigeration system for district cooling, the payback period for the aquifer heat pump system is within a couple of years.

CHESS SETUP relation: It is an excellent example of an aquifer heat pump system, applied in a project with huge thermal demand as an airport, that is economically more profitable than conventional solutions based on fossil fuels.

Source:
https://www.sintef.no/globalassets/project/annex29/installasjoner/gshp_gardermoenhp_no1.pdf

11) Borehole Thermal Energy Storage (BTES)

Location: Hatfield, England

Storage technology: Borehole Thermal Energy Storage (BTES)

Description: A Thermal Bank is used to store warm temperatures over a very large volume of earth for a period of months, as distinct from a standard heat store which can hold a high temperature for a short time in an insulated tank. A Thermal Bank is a bank of earth used to store heat energy collected in the summer for use in winter to heat buildings. It is an integral part of an Interseasonal Heat Transfer system invented, developed and patented by ICAX to answer the need for on-site renewable energy without burning fossil fuels.

Value generated: ICAX doubles the performance of the heat pump by starting with a warm Thermal Bank instead of cold ground.

CHESS SETUP relation: It is an interesting example of an existing market solution for thermal energy storage that improves the efficiency of systems operating with a high share of on-site renewable energy production.

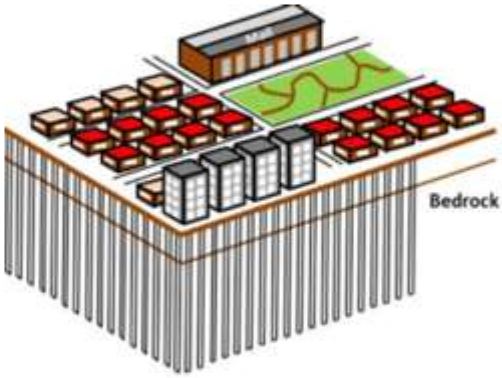
Source: https://www.icax.co.uk/image_thermalbank_installation.html

12) Borehole Thermal Energy Storage in Sweden

Location: Sweden

Storage technology: Borehole Thermal Energy Storage (BTES)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.



Description: There are about two million small scale BTES systems for single family houses. These consist usually of one borehole drilled to 60-200m. Such systems use to be connected to a heat pump.

The most common hesitation for BTES realisations is that the profitability is on the edge of being acceptable. In these cases, the less favorable economics are either related to restricted supply cooling temperatures or poor thermal conductivity of the underground. Because of that, too many borehole meters are required. However, an increasing number of customers value the long term environmental benefits, and also the long technical life of the boreholes and the low maintenance cost should be considered in the final calculation.

Value generated: In Sweden, which is a very cold and sparsely populated country, such small systems supply 15% of all heating (15 TWh out of 100 TWh).

Due to the environmental consciousness, several BTES systems have been installed even with payback return time of more than 8-10 year.

CHESS SETUP relation: The Swedish case demonstrates the great success of small scale energy storage systems in cold countries such as Sweden. It also proves the customer acceptance of environmentally friendly solutions such as the ones studied in CHESS SETUP.

Source: https://www.researchgate.net/figure/The-dominating-BTES-systems-in-Sweden-A-Heat-pump-supported-combined-heating-and_fig3_229014683

13) Drake Landing Solar Community

Location: Okotoks, Canada

Storage technology: Borehole Thermal Energy Storage (BTES)

Description: 52 houses are heated solely by warm water circulating through insulated, underground pipes of a district heating system. It is the first major implementation in North America of solar seasonal storage.

Solar thermal energy is collected in the summer, stored underground in a

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Borehole Thermal Energy Storage system composed by 144 boreholes with a depth of 37 meters, and then returned to the homes as heat during the winter.

Value generated: The system fulfills the 90% of each home's space heating requirements from solar energy and results in less dependency on limited fossil fuels. Houses achieve an average reduction of approximately 5 tons of greenhouse gas (GHG) emissions per home per year.

CHESS SETUP relation: It is interesting to highlight the similarities of this solution with Corby's dwellings pilot. It proves the market opportunity for replication and scalability of borehole thermal storage systems in communities of houses with a high share of renewable energy production.

Source: https://www.dlsc.ca/

14) Borehole Energy Storage in Crailsheim

Location: Crailsheim, Germany

Storage technology: Borehole Thermal Energy Storage (BTES)

Description: In the German town of Crailsheim, 7,300 m^2 of solar thermal flat plate collectors provide 50 % of the heat for a housing area with 260 units. Parts of the collectors are mounted on a noise barrier. Heat is stored in two water tanks (100 m^3 and 480 m^3) and in a seasonal borehole storage system with 37,500 m^3.

The current size was originally planned as 1st phase of the solar installation. For the second phase, a collector area of 9,700 m^2 (6.8 MW_{th}) and a borehole storage of 75,800 m^3 were foreseen. A 489 kWth high temperature heat pump transfers heat from the larger buffer storage to the smaller one when necessary, so there is always hot water at 70 °C available.

Value generated: The collectors provide 370 kWh/year · m2a, which is the 50% of the heat consumption of the 260 units of the housing area.

CHESS SETUP relation: It is another example of the great popularity and the market potential and feasibility of borehole thermal energy storage in Europe.

Source: http://www.solarthermalworld.org/content/solar-district-heating-crailsheim-seasonal-borehole-storage

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

15) Others. Eco-City

Location: 7 pilots in Hamburg, Hannover, Friedrichshafen, Neckarsulm, Steinfurt, Chemnitz and Rostock, Germany

Storage technology: Tank Thermal Energy Storage (TTES), Aquifer Thermal Energy Storage (ATES), Gravel-Water Thermal Energy Storage (GWTES) and Borehole Thermal Energy Storage (BTES)

Description: The systems combine collector surfaces of over 100 square meters with large-dimensioned long-term storage systems.

Four types of storage technologies are in operation: hot water storage tanks, subterranean tub storage, gravel and water storage, and aquifer storage tank.

Value generated: The system was constructed to contribute almost two thirds of the entire heat consumption for household heating and hot water through solar rays.

Nevertheless, high investment costs remain an obstacle for operators and the housing market. New financing concepts could help with this. Without state sponsorship, only local solar heating systems with short term storage could, in the foreseeable future, come into efficient operation. The goal of the long-term storage system is to reach prices that, without sponsorship, would be at the most twice as high as those for heat from natural gas or oil.

CHESS SETUP relation: It is interesting to highlight the similarity of these installations to the CHESS SETUP pilots in Corby, since both projects involve the application of solar energy and thermal storage in family houses.

Source: https://www.solarserver.de/solarmagazin/anlagejanuar2001-e.html

16) Rock Cavern Thermal Energy Storage in Oulu

Location: Oulu, Finland

Storage technology: Rock cavern Thermal Energy Storage (RTES)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

Description: This installation consists of two parallel rock caverns, with a total volume of 190,000 m3, previously used as oil storage for the Kemira factory. Nowadays the caverns are filled with water and connected to Toppilas's cogeneration plant. Waste heat from the Kemira factory is also utilized in the district heating system. The waste heat power is about 10 MW.

The heat storage facility is planned for seasonal storage of process waste heat when the heat production exceeds the demand of the district heating system of Oulu. The rock cavern could also be used for regulating the backpressure production of nearby power station.

Value generated: Although rock cavern heat storages have been demonstrated in full scale they are still too expensive to become an alternative to other hot water storage systems. Reconstruction of existing caverns or abandoned mines could however be make it economically feasible.

CHESS SETUP relation: In this case, the literature studied indicates that these systems are still not competitive from an economic and market point of view. Only in the cases where there is an available cavern this solution could be contemplated.

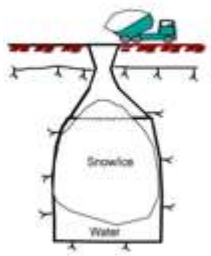
Source: http://large.stanford.edu/courses/2013/ph240/lim1/docs/UTES_Nordell.pdf

17) Snow Seasonal Storage in Sundsvall (SSS)

Location: Sundsvall, Sweden

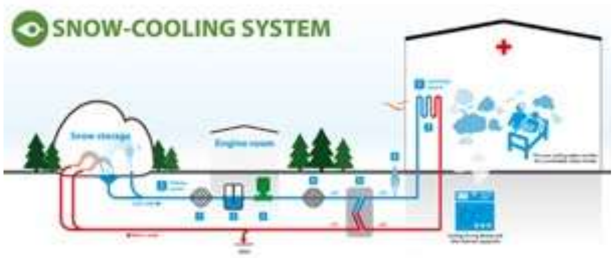
Storage technology: Snow Thermal Energy Storage (STES)

Description: This large snow storage plant in Sundsvall utilizes 75,000 m³ of snow in supplying cooling (4 MW; 3 GWh) for the Sundsvall regional hospital from May to September. The Sundsvall storage was taken into operation during the summer of 2000.



Value generated: The plant has worked very well and it has delivered cold considerably cheaper than conventional cooling systems.

CHESS SETUP relation: It could be an option to consider for the exploitation and replication of CHESS SETUP system. It is reasonable to believe that further snow storage systems should be built in areas where snow is stored in combination with existing deposits



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in or close to urban areas. One major problem with such storage systems is the expensive land cost in densely populated areas.

Source: http://large.stanford.edu/courses/2013/ph240/lim1/docs/UTES_Nordell.pdf

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4. Industrialisation potential

In the first place and following the guidelines of the Grant Agreement we include below a detailed analysis of the **European policies and national regulations** linked to the building construction and energy renovation sectors. This regulatory framework is a necessary point to understand the industrialisation potential of CHESS SETUP solution, as it sets the basis to ensure market acceptance and compliance with market trends.

EU POLICIES

- **European Directive 2010/31/EU on the Energy Performance in Buildings amended by Energy Performance of Buildings Directive (2018/844/EU).**

To boost energy performance of buildings and comply with the 2030 Framework for climate and energy that sets a 40% cut in Greenhouse Gas emissions compared to the 1990 level, the EU has established a legislative framework that includes the Energy Performance of Buildings Directive 2010/31/EU (EPBD) and the Energy Efficiency Directive 2012/27/EU. Both directives were amended, as part of the Clean energy for all Europeans package, in 2018 and 2019. Together, the directives promote policies that will help achieve a highly energy efficient and decarbonised building stock by 2050 create a stable environment for investment decisions enable consumers and businesses to make more informed choices to save energy and money.

This was amended by the **Energy Performance of Buildings Directive (2018/844/EU)** which introduces new elements and is an important part of the Juncker Commission's priority to build "a resilient energy union and a forward-looking climate change policy". When adopted in July 2018, it sent a strong political signal on the EU's commitment to the clean energy transition, as the building sector has a vast potential to contribute to a carbon-neutral and competitive economy.

- **Energy Efficiency Directive (EED, Directive 2012/27/EU) amended by Directive 2018/2002/EU**

This directive is also set to decarbonise the building stock. In 2018, as part of the '**Clean energy for all Europeans package'**, the new amending Directive on Energy Efficiency (2018/2002) was agreed to update the policy framework to 2030 and beyond.

The key element of the amended directive is a headline energy efficiency target for 2030 of at least 32.5%. The target, to be achieved collectively across the EU, is set relative to the 2007 modelling projections for 2030.

It confirms the requirement of a target for nearly zero-energy buildings (NZEB), starting from January 2019 for new public buildings, and from January 2021 for all new constructions. Therefore, the NZEB target for new buildings will become common practice.

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- **Renewable Energy Directive – Recast to 2030 (RED II)**

In the revised energy directive 2018/2001/EU**,** RED II, the overall **EU target for Renewable Energy Sources consumption by 2030 has been raised to 32%**. EU countries has to set out how they plan to meet these 2020 targets and the general course of their renewable energy policy in **National Renewable Energy Action Plans.**

Additionally, it is relevant to consider EU policies or recommendations including those to foster the transfer of information, and promoting the use of generic non-proprietary technologies:

- **Commission recommendation of 17.7.2012 on access to and preservation of scientific information:**

Among the actions to be taken under the 'Digital Agenda', publicly funded research should be widely disseminated through open access publication of scientific data and papers. The 'Innovation Union' initiative calls for a European Research Area (ERA) framework to be set up to help remove obstacles to mobility and cross-border cooperation. It states that open access to publications and data from publicly funded research should be promoted and access to publications made the general principle for projects funded by the EU research Framework Programmes.

- **The European Open Science Cloud (EOSC)**

EOSC is a trusted digital platform for the scientific community, providing seamless access to data and interoperable services that address the whole research data cycle, from discovery and mining to storage, management, analysis and re-use across borders and scientific disciplines.

- **GÉANT - A European Success Story**

GÉANT is Europe's leading collaboration on network and e-infrastructure services, helping to accelerate research, drive innovation and enrich education to ensure Europe remains at the forefront of scientific excellence.

NATIONAL REGULATIONS

The regulations that must be considered in each country are the **regulations governing public administration** (e.g. Public Sector Contract Law and the royal decree-laws for energy self-consumption, climate emergency or promotion of renewable energies, among others), agreements signed by the municipality at the level of commitments (e.g. Covenant of Mayors and the 2030 Agenda for Sustainable Development) and all those that regulate **the construction sector** (e.g. Technical Building Code).

Regarding existing buildings, the **Energy Performance of Buildings Directive 2018/844/EU** also commands that Member States have to take the necessary measures to ensure that when existing buildings undergo major renovations, the energy performance of the building or the renovated part also meets the minimum energy

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requirements of NZEB. With that European command, EU countries have drawn up national plans to increase the number of NZEBs in their respective countries.

The main points of the submitted national plans are summarized below (Figure 19), thanks to the study done by Concerted Action, Energy Performance of Buildings - funded H2020 EU project and the data provided by the EPDB country delegates. The following five main points have been analysed per country[11] in order to know the state of NZEB definition in each one and analyse how they have tackled with the main parameters of the NZEB concept:

- Is there a detailed NZEB definition available?
- How is the "very high energy performance" expressed?
- Where are the limits defined for "a very low amount of energy required"?
- Is there a requirement for "covered to a very significant extent by energy from renewable sources"?
- Is a "primary energy indicator in kWh/m2.year" in use?

Main points of the national NZEB definition (as reported by the CA EPBD delegates)			Country																												
				Belgium																											
			Austria	Brussels	Flanders	Walloon	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg *	Malta	Netherlands	Norway	Poland	Portugal	Romania	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom
Detailed definition	Included in a legal document	Governmental decree/law		■	■	■	■		■				■				■		■	■		■	■			■			■	■		■	
		Technical regulation						■		■	■	■		■				■	■		■								■				
		National NZEB plan	■					■																				■		■			
	Not yet included in a legal document														■	■						■		■	■		■				■		■
	Draft available														x							x		x							x		
Very high energy performance	Tighter requirements compared to current values for	General												■												■					x		
		Mean U-value of building envelope								■																							
		Reference technologies								■																		■					
		Heating energy demand																												■			
		Final energy	■																														
		Primary energy				■	■	■		■			■						■									■	■	■			
		(Primary) energy performance coefficient			■	■																		x									
	Top building class						■		■			■					■	■		■	■	■ x	■						■				x
	Specific new building class										■																						
	Passive house (building envelope) level			■																													
	KfW efficiency house 55/70														x																		
Nearly zero or very low amount of energy required. Limits on:	Component U-values				■	■			■								■	■	■					x		■			■	■	x		
	Thermal bridges																	■															
	Mean U-value of building envelope				■	■	■			■					x									x						■		■	
	Heat transfer coefficient/heat loss of building envelope																		■		■												
	Air permeability																	■															
	(Net) heat demand		■	■					■						x		■					■ x											
	Installed lighting power								■																								
	System efficiencies						■										■	■	■														
	Heating energy demand																		■	■										■	x		
	Cooling energy demand																		■												x		
	Total energy efficiency		■																														
	Electrical input																															■	
	Final energy (total or divided into energy uses)		■							■																■			■				x
	Primary energy			■	■	■	■	■	■	■	■	■	■	■	x		■	■	■	■	■	■ x	■	x		■		■	■	■	x	■	
	CO_2 emissions		■															■										■					x
	Summer overheating																■		■														
Very significant extent of renewable energy	Direct	Minimum share in %	■		■		■	■	■						x		■	■	■	■	■		■					■	■	■			
		Minimum contribution in kWh/m².year			■									■				■															
		(Choice of) exemplary RES measures	■		■						■								■														
	Indirect **			■		■				■	■	■	■									■ x		x		■					x	■	x
Primary energy indicator in kWh/m².year	Included		■	■		■	■	■	■	■	■	■	■	■	x		■		■	■	■	■ x	■			■		■	■	■	x	■	
	Other main indicator, but PE as additional/interim result. Main indicator:	CO_2																															x
		Primary EP coefficient			■	■												■						x									

* At the time of the factsheet Luxembourg had a national NZEB definition for residential buildings in place, but not yet a NZEB definition for non-residential buildings.
** Indirect: RES contribution required in order to achieve the minimum energy performance requirements.

Figure 19: National NZEB definition (National applications of the NZEB definition – The complete overview, 2018, Concerted Action, Energy Performance of Buildings)

In conclusion, the national NZEB definitions differ significantly from each other. Limits for the energy performance are, for example, set in addition to primary energy on many different characteristics. Related to the extent on **renewable energy source (RES)**,

[11] Concerted Action, Energy Performance of Buildings, 2018. National applications of the NZEB definition – The complete overview.

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most countries have defined **direct RES requirements for NZEBs**. Typically, they are included as a **required minimum share (percentage) of the energy use**, but also **minimum contributions in kWh/m2.year**. In some national NZEB definitions no such direct RES requirements are contained; however, in the majority of cases, **RES contributions are necessary to meet other minimum energy performance requirements in their national building codes**. This would be the case in the Consortium of CHESS SETUP's countries (Spain, France, Germany, Netherlands, and United Kingdom).

The submitted national plans are summarized below (Table 1), showing the efforts and progress made by the Member States towards the establishment of NZEB definitions and targets. As mentioned before, the data also comes from the most updated source including all the states.

Country	Residential Buildings (kWh/m2 /y or Energy Class)		Non-Residential Buildings (kWh/m2 /y or Energy Class)	
	New	Existing	New	Existing
Austria	160	200	170	250
Belgium	45 (Brussels region)	~54	(95-2.5) *(V/S) (Brussels region)	~108
	30 (Flemish region)		40 (Flemish region)	
	60 (Walloon region)		60 (Walloon region)	
Bulgaria	~30-50	~40-60	~30-50	~40-60
Cyprus	100	100	125	125
Czech Republic	75%-80% PE	75%-80% PE	90% PE	90% PE
Germany	40% PE	55% PE	n/a	n/a
Denmark	20	20	25	25
Estonia	50 (detached house)	n/a	100 (office buildings)	n/a
		n/a	130 (hotels, restaurants)	n/a
		n/a	120 (public buildings)	n/a
		n/a	130 (shopping malls)	n/a
	100 (apartment blocks)	n/a	90 (schools)	n/a
		n/a	100 (day care centres)	n/a
		n/a	270 (hospitals)	n/a
France	40-65	80	70 (offices without AC)	60% PE
		n/a	110 (offices with AC)	n/a
Croatia	33-41	n/a	n/a	n/a
Hungary	50-72	n/a	60-115	n/a
Ireland	45 (Energy load)	75-150	~60% PE	n/a
Italy	Class A1	Class A1	Class A1	Class A1
Latvia	95	95	95	95
Lithuania	Class A++	Class A++	Class A++	Class A++
Luxemburg	Class AAA	Class AAA	Class AAA	Class AAA

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Malta	40	n/a	60	n/a
Netherlands	0	n/a	0	n/a
Poland	60-75	n/a	45-70-190	n/a
Romania	93-217	n/a	50-192	n/a
Spain	Class A	n/a	Class A	n/a
Sweden	30-75	n/a	30-105	n/a
Slovenia	45-50	70-90	70	100
Slovakia	32 (apartment buildings)	n/a	60-96 (offices)	n/a
	54 (family houses)	n/a	34 (schools)	n/a
UK	~44	n/a	n/a	n/a

Table 1: Towards Nearly Zero Energy Buildings in Europe: A Focus on Retrofit in Non-Residential Buildings (Delia D'Agostino, Paolo Zangheri and Luca Castellazzi, 2017)

In Figure 20 we can also observe the efforts made by the EU countries towards NZEB buildings, showing the distribution of new dwellings built by national official NZEB definitions or by the national building code. France was leading the way in 2016 proving to be a reliant market at the time of adopting new and more efficient technologies. On the other hand, Germany, Slovakia, UK and Norway, among others, has started to build buildings with better standards than their building code, and Spain and Romania were still using their national building code standards.

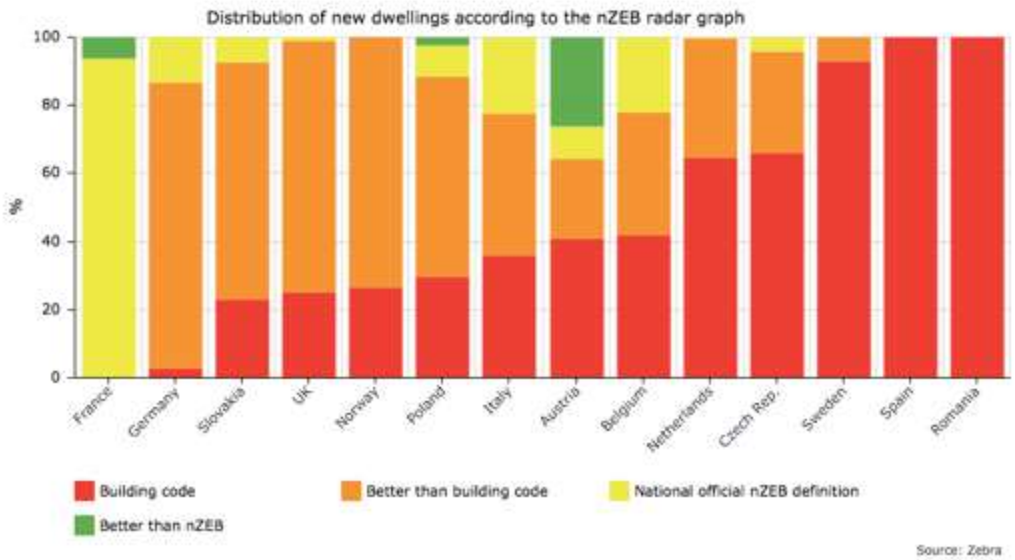

Figure 20: Distribution of new dwellings according to NZEB radar graph in 2016 (ZEBRA 2020 Project Tool).

Finally, below there is a summary regarding the situation and main national regulations related to buildings in the countries of CHESS SETUP Consortium, being the main areas of influence for the exploitation of the system:

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- **SPAIN:** The Spanish government shows a good political support for the transition of the country's energy system towards renewable energy. The renewable energy target is to increase the share of renewable energy from 20% in 2020 to 42% in 2030 (European Commission, 2019). In comparison, in 2018 the share of renewable energy was 16%. In buildings, the national Technical Building Code (**CTE, Código Técnico de la Edificación**) sets out an obligation on all new buildings, and buildings undergoing major refurbishments to cover part of the DHW with solar thermal energy. The contribution varies between 30-70%. Municipality solar obligations, together with the CTE, have proven a big driver for the solar thermal market. Related to HVAC systems, gas and electrical boilers are well established on the Spanish market, and the **economical factor** could be a challenge for heat pump installations. Finally, Spain has high goals for increasing the amount of renewable energy although the overall support mechanisms for solar energy in H&C applications is absent (Council of European Energy Regulators, 2018).

- **FRANCE:** The French Government also shows a strong political support for the transition to clean energy and to tackle climate change, wanting to become climate neutral by 2050. The **French Climate Pact** has as a central pillar to use energy more responsibly and support residential areas to produce and use their own renewable energy sources. Related to the building environment, the **Law on Energy and Climate** was signed in 2019. This law includes measures to improve the energy efficiency of buildings and reduce emissions related to electricity generation. An interesting measure is that from the beginning of 2021, the owners of thermally inefficient properties will be prohibited from raising rent on their property until they have renovated it to make it more energy efficient. Therefore, a new renovation wave will be born in France making it a potential market for the adoption of energy efficient technologies and RES. Additionally, as stated before, France is one of the European countries in which **national NZEB definition** is more advanced.

- **GERMANY:** Germany also shows a very good support for the transition to clean and renewable energy. Germany has strong energy policies and a renewable energy target to progress from 18% in 2020 to 30% in 2030 (European Commission, 2019). The government's climate goals, the available funding for renewable energy and energy efficiency measures and the high level of electricity costs in the country are good opportunities to extent the market with technologies like CHESS SETUP. Related to the building sector, the national **Energy savings ordinance** (EnEV) also sets minimum requirements for the energy performance in new buildings and buildings undergoing major renovations. The requirements are explicit and it is very difficult to meet them using fossil fuel heating systems. Therefore, alternative heating systems are necessary to meet the requirements and both heat pumps and solar thermal are suitable options, being a very good point for adopting technologies like CHESS SETUP system.

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- **NETHERLANDS:** The Dutch Government in order to combat climate change wants to reduce the Netherlands' greenhouse gas emissions by 49% by 2030, compared to 1990 levels, and a 95% reduction by 2050. These goals are laid down in its **Climate Plan and National Energy and Climate Plan (NECP).** The building code in the Netherlands "Bouwbesluit" dedicates a chapter to technical building regulations in terms of energy efficiency and environmental construction. The policy is to tighten the energy performance coefficient (EPC) to 0.4 in 2015, with the ultimate goal of 'zero energy' house in 2020, following here too the national NZEB definition. In terms of investments, the Dutch Government has given funds to the building environment with its **Green Funds Scheme**, making it a good advantage for the boosting of offering new opportunities for highly energy efficient buildings and adoption of technologies similar to CHESS SETUP solution.

- **UNITED KINGDOM:** Carbon emissions reduction in buildings is an important element of the UK national carbon reduction strategy planned for horizon 2050 (CCC, 2010). UK regulations relating to building energy efficiency have been guided by the **EPBD** since 2006. Energy efficiency levels are related primarily on the basis of carbon emission rates. This gives the designers some flexibility to make choices between system type and fuels for the building systems. Besides the building regulations, another driver of the uptake of renewable technologies is the incentive scheme known as the **Renewable Heat Incentive (RHI)** which is promoting renewable technologies (both domestic and non-domestic) through payments based on kWh of renewable heat used. Therefore, the reliance on natural gas for heating buildings has to start going away and boost the electrification of the heating market. This could imply a large **market opportunity for heat pump technology** and the importance of retrofit applications, making CHESS SETUP solution a good alternative.

The following Table 2 summarizes the main characteristics and differences between the countries analyzed. It can be concluded that France has the most ambitious target for 2020 (23%) but considering 2030, the highest target has been fixed by Germany (65%).

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	Spain	France	Germany	Netherlands	United Kingdom
Renewable energy share target in 2020	20%	23%	18%	20%	20%
Renewable energy share target in 2030	42%	33%	65%	32%	32%
Minimum requirement set for renewable energy share and energy efficiency in buildings	Yes	Yes	Yes	Yes	Yes
Horizon 2050	Climate Neutral	Climate Neutral	Climate Neutral	95% of GEH emissions reduction	Climate Neutral

Table 2: Renewable energy share targets and climate pact for 2050 in the 5 countries of CHESS SETUP consortium (Data from European Commission 2050 long-term strategy)

Following the guidelines of the Grant Agreement, we include below the industrialisation potential of the CHESS SETUP innovative equipment, taking into account the regulatory framework detailed earlier and highlighting the relevant aspects in terms of background and foreground rights, IPR issues and certification systems linked to the product development.

Through the implementation of CHESS SETUP project it has been developed a heating system which relies on a combination of technologies, using renewable energies and working on seasonal cycles.

- With regards to the CHESS SETUP system, the proposed solution could be implemented in different building types and different climate zones. The flexibility of the proposed system (energy production, storage and a highly efficient heat pump) allows combining different energy sources and technologies, according to the specific conditions and availability of the site's resource (biomass, geothermal energy, waste heat, solar thermal, photovoltaic, absorption) to supply the thermal demands.

  The optimal combination of the three different elements (energy production, storage and a highly efficient heat pump) in a unique and novel solution with a clear focus on **energy efficiency and CO2 reduction**.

  Regarding the certification and market acceptance systems, most of the components of the proposed CHESS SETUP system (energy production, storage and heat pump) have their energy performance certificate as individual product, some exceptions could occur with storage thermal. The CHESS SETUP system will indicate: annual energy savings, total energy savings, return on investment, annual carbon savings.

- With regards to the CHESS SETUP control and monitoring tool designed by Wattia, it can be reusable in other projects as a whole (adapting the software

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tool to a new final implementation) or also divided in smaller pieces of software (libraries, objects, trends, ...) that can be directly used in other projects facilitating and speeding up the software implementation phase.

The software tool includes algorithms, parameters, variables to monitor, as well as low level and high level controls that can be implemented in a CHESS SETUP-like system, together with the hardware sensors and actuators that should be controlled and monitored by this software.

- With regards to the CHESS SETUP heat pump, the University of Ulster has developed an advanced heat pump capable of wide speed control to exactly match demand.

  Specifically, the enhanced air-source heat pump makes maximum use of its intelligent wide speed range compressor to match capacity needs when linked to smart building controllers. This allows the delivery of instantaneous hot water on demand, also providing demand-side response when linked with thermal storage.

  The heat pump is used to supply the heating and DHW demands of the building, recovering the heat stored in the seasonal storages at high efficiencies.

  For the product development it has been considered the IP licencing for the design knowledge. In this sense, CST at Ulster University has over 30 years experience of developing advanced heat pumps and related thermal storage options. It has worked closely with major component and system manufacturers in development and application of novel components and systems. A utility model will be provided with the selected manufacturer, and it has been foreseen 2 years to comply with the certification and field trials.

5. Analysis and definition of Business Models

The implementation of energy storage deployments such as CHESS SETUP is inevitable if we consider the need to develop a more sustainable future, as it represents a key element in balancing energy supply and demand.

Following the guidelines of the Grant Agreement we include below the foundations for new business models (BM) in which CHESS SETUP solution can be implemented in the wider market, taking into account the results of the general and real case studies analysed in D 6.2 – Standardisation of the solution.

We have englobed the new BM into the following main categories, highlighting its value proposition, users and main infrastructures:

1. **Energy storage for end-user customers**:

   In terms of users, this BM structure is conceived for installed storage assets at customer sites, regarding the deployment of the technology on the end-user facilities.

The value proposition of this BM refers to energy storage systems installed at customer facilities to manage peak demand charges and set the parameters to match the energy storage with lower energy prices or maximum generation (depending on the demand response strategy, under time-of-use or real-time pricings or under load shifting, load shedding and other direct load control and management systems).

The main objective of deploying residential energy storage systems, is to increase the profitability of solar PV systems through increasing "self-consumption".

These BMs are usually performed by EPC contracts (shared or guaranteed savings arrangements) or through the sale and financing of the storage assets. The different tipologies of EPC contracts have already been explained in D 6.1 – Business model analysis for the case studies.

2. **Energy storage and PV energy generation optimization for end-user customers:**

This BM structure is focused on taking into account a PV generation and energy storage partnership (as several major PV producers and electricity storage business have joined forces over the last years).

Since CHESS – SETUP thermal energy solution is not meant to connect distributed PV and storage assets with bulk power system markets or operators, this model is applicable in terms of maximizing end-users financial returns without integrating with the market or TSO/DSO operators, therefore its main interest is to create an efficient, profitable and scalable solution to maximize the use of energy storage and reduce end-users energy demand as much as possible.

3. **ESCO business model:**

The most attractive point of this model is the externalization of the energy services. From an energy saving engagement, the ESCO takes control of the client's installation and ensures an improvement on the energy consumption after its exploitation and some investments, which costs will be amortized at the end of the contract. Once the contract runs out, the client has a more efficient installation with a lower energy consumption. This BM is further detailed in this document in Section 6.2 - KER 2.

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6. Exploitation Plan

As stated in the Grant Agreement, the exploitation plan is the development and documentation of individual and joint strategies the project partners will utilise to realise the potential market opportunities identified in the market analysis.

Moreover, as detailed in the introduction of this document, the exploitation plan has taken into account the requirements of the Grant Agreement and also the methodology and recommendations of the ESS.

Therefore the following exploitation plan is divided in two sections:

- We first detail the **Individual Exploitation Plan** of each consortium partner.
- Secondly we include the joint **exploitation strategies decided by all the partners**, which are reflected in the description of the KERs.

Specific attention has been applied on the detailing of the future joint exploitation activities so that partners are positioned to continue activities post project.

6.1 Individual Exploitation Plans

CHESS SETUP consortium is formed by 10 partners from different areas of expertise. The Individual Exploitation Plan (IEP) of all partners included below summarizes how the project created value for each partner, and how each partner will exploit that value in the future. It has been generated with the roadmap planning to be undertaken after the project's successful termination to further replicate and exploit the results (up to three years).

To facilitate the task of completing each Individual Exploitation Plan (EIP) and ensure coherence among all the different documents, Edenway as leader of the deliverable, provided the following template with guidelines to each partner.

The layout and structure of the IEPs follows the recommendations provided during the ESS.

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INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	*Partner name and location*
Role and solution	*Describe in a few lines your role and contribution to the project. Include your result and/or solution (e.g. product, service, process, policy recommendation, publication, ...)*
Value	*Describe the value created by CHESS SETUP project in your organisation. What have you gained from the project? (e.g. knowledge, technology, contacts, etc)*
Lessons learned	*What could have been possible to optimize along the project's life? From a technical and organizational perspective. For your own benefit and the benefit of others.*
Next steps	*What content could be exploited? Describe the planned use of project results.*
Approach to Exploitation	
Actions	*Briefly describe the* ***actions*** *planned to exploit or scale up the project: short-term, mid-term and long-term.*
Journey Map	*List the main milestones and priorities, preferably in a calendar like or timetable format.*
Risk Analysis	*Identify the main risks for the development of the exploitation actions defined.*
Revenues	*Which will be the main revenue streams when the solution is ready for the market? Describe the projected revenues and eventual profits over the next 1-3 years.*
Financial costs	*Provide information on estimated costs/investments of implementing the actions defined (you may invest in a patent, in the realisation of a prototype, distribution costs, hosting, people, etc.)*
Other sources of coverage	*Provide information on estimated financial needs and sources of funding to cover initial budget, consistent with the fields above. (e.g. partners' own budget, other project grants, national/regional incentives, risk capital, loans, etc.)*
Impact in 3-year time	*Describe impact in terms of growth/benefits for the society. Can be social, environmental and economic impact. (e.g. jobs created, investments mobilized, turnover generated,..).*
Key Metrics	Provide information on how you will measure to track the success (e.g. units sold, users registered, retaining users, paying customers, number of complaints ...)
Legal or normative concerns	*Describe the legal, normative and ethical concerns or requirements to take into account.* *Include the main measures for Intellectual Property Rights (IPR) protection.*
Other Comments	
Please include any other information that you consider relevant to the project.	

Figure 21: Template for the Individual Exploitation Plan

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6.1.1 SANT CUGAT DEL VALLÉS CITY HALL

SANT CUGAT INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Municipality Sant Cugat del Vallès
Role and solution	The role of Sant Cugat del Vallès has been the implementation of a pilot of the CHESS SETUP system in a municipal sports centre. The pilot foresees the supply of 50% of the thermal energy consumption necessary to heat the pool. The use of hybrid PVT plates also allows to produce enough electrical energy to power the system consumption.
Value	The knowledge acquired by municipal technicians in the operation and implementation of the CHESS SETUP system has been the highest value obtained. The implementation has allowed us to learn a new system that can be scalable, replicable and adaptable for existing and future installations. In addition, the technification of the installation allows a monitoring of the existing system and to have data of the operation in real time. With all this information the door is opened to the creation of action plans based on the optimization of the installation.
Lessons learned	As a public administration, the procedures to approve the project, tendering, and the construction phase are too long to be able to comply with the regulations that regulate all these procedures (e.g. law of public contracts). Projects funded by the EC should consider this aspect with public bodies partners. As a possible solution, an approved list of external experts and service companies could be useful to reduce the time to award public contracts.
Next steps	The data and information obtained from the operation of the system is the most relevant content. The values obtained will be real values, not theoretical values. These are much more reliable and foster the possibility of implementing the system in future actions. From here, the technical knowledge acquired and the monitoring and control system produced will be exploitable assets in the future **to implement the system in other buildings.**
Approach to Exploitation	
Actions	short term - Collection (during the first year) the seasonal data of the installation and the operation of the CHESS SETUP system. - Evaluation of alternatives assessment to improve the efficiency of the pilot. mid term - Implementation of system efficiency improvements that are achievable

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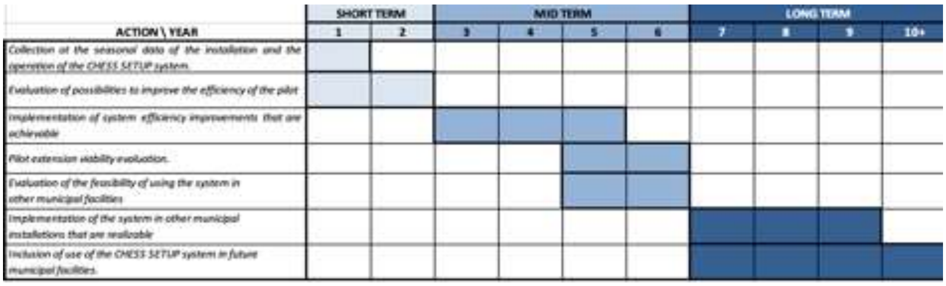
<table>
<tr><td></td><td>- Pilot extension viability evaluation.

- Evaluation of the feasibility of using the system in other municipal facilities (schools, offices, sports centers, social housing, ...)

<u>long term</u>

- Implementation of the system in other municipal installations that are realizable

- Inclusion of use of the CHESS SETUP system in future municipal facilities.</td></tr>
<tr><td>Journey Map</td><td>
</td></tr>
<tr><td>Risk Analysis</td><td>Every four years the municipal elections are called. Each new call, the government team can change and therefore also the municipal strategy. At a technical level, the strategy should not change but it is also necessary that the political strategy aligns with the technique. Otherwise, the planned actions may not be funded or may be delayed over time.</td></tr>
<tr><td>Revenues</td><td>The main sources of revenue for the solution implemented will come especially from the owners, the facilities managers and anyone who is responsible for the energy management of a building. On the other hand, technical offices of architecture and engineering can also adopt the technical solution in their construction projects and be advised by the technical specialists in the implementation of the CHESS SETUP system</td></tr>
<tr><td>Financial costs</td><td>The actions aimed at the inclusion of the system in new facilities or in remodelling existing facilities will be the data evaluated by the responsible partner.

On the other hand, because the pilot / prototype has already been implemented, there are no more costs in the pilot beyond those that allow an improvement or expansion of the pilot. The pilot improvement analysis and the implementation of the improvements are valued at € 50,000. The pilot's expansion analysis and its implementation would be between € 100,000 and € 200,000 depending on the degree of extension that could be executed.</td></tr>
<tr><td>Other sources of coverage</td><td>Although the pilot has been funded by the EC, during the design and execution of the works there has been an extra cost that has been supported by the town hall. The municipality, as public administration, aims to improve the sustainability of municipal facilities. Unfortunately, the high number of municipal facilities and the budget adjusted for its management, does not allow all the planned actions. At the study level actions, the municipality's own funds can make feasibility reports to scale and replicate the system but without the help of higher public administrations, the actions of execution of works can be delayed over time.</td></tr>
</table>

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Impact in 3-year time	The first impact will be the economic and environmental by the economic savings obtained with the production of green energy and with the reduction of the environmental footprint of the installation. The possible evolution of the system and a correct publication and promotion of the solution could become an impact of social awareness of the importance of reducing the energy consumption of cities at the local level. Finally, the knowledge acquired by municipal technicians should also result in an improvement of the service provided to the citizen.
Key Metrics	Energetic consumption and emission of Tn of CO 2 avoided in the facilities against the cost of maintenance.
Legal or normative concerns	The regulations that must be taken into account in the case of Sant Cugat are the regulations governing public administration (e.g. Public Sector Contract Law), agreements signed by the municipality at the level of commitments (e.g. Covenant of Mayors and the 2030 Agenda for Sustainable Development) and all those that regulate the construction sector (e.g. Technical Building Code).

6.1.2 WATTIA INNOVA

WATTIA INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	[Wattia Innova, S.L.U. Olot, Girona, Spain.]()
Role and solution	Wattia Innova has been in charge of the design and the development of the Control and Monitoring software tool for the CHESS SETUP project. Wattia Innova worked mainly in WP4 and WP5. In WP4.1 Wattia designed a software tool: algorithms, parameters, variables to monitor and low level and high level controls that should be implemented in a CHESS SETUP-like system jointly with the hardware sensors and actuators that should be controlled and monitored by this piece of software. In the WP4.2 Wattia developed the software tool implementing the design performed in WP4.1. Finally, in WP5 Wattia participated directly in the pilots by executing the commissioning and the follow up of the software tool designed and implemented in WP4. The software tool provides the information that is needed to later evaluate the performance of the whole system in WP6 and WP7.
Value	The participation in the CHESS SETUP project has created value in Wattia from two different points of view: 1) the business relationships point of view, and 2) the technical point of view. 1) Wattia is the first time that participates in an international project such as a European H2020 project. Wattia had the possibility to work together with other partners with different points of view and in other scopes in the execution of a project

	apart from the technical part. Moreover, thanks to this new knowledge Wattia has participated as partner in the submission of other European projects. 2) Wattia Innova is a company that started as a simple home and building automation company only involved in the integration of the different hardware sensors and controls in buildings. Little by little Wattia entered more and more in the control of the energy generation and distribution in the buildings with the aim of making the households and buildings as much efficient as possible. In the latest step towards being a company that offers integral solutions, Wattia incorporated the engineering, thus being able to provide turnkey solutions including the engineering, control and automation and installation, always focused more in the energy efficiency than implementing classical off the shelf solutions. In the CHESS SETUP project Wattia had the opportunity to perform the design and the implementation of the control system for a novel and different solution (seasonal energy storage combined with heat pumps and hybrid photovoltaic panels) with a clear focus on energy efficiency and CO_2 reduction. The whole know-how acquired is directly a value for Wattia usable in other projects. Therefore, depending on the final results, Wattia as an engineering and control company will be enabled to offer this kind of solution to their customers. To carry out the CHESS project implementation, Wattia had the opportunity to apply control and monitoring tools (such as PLCs and SCADAs) used typically in industrial applications to the field of the energy efficiency and, therefore, test its suitability and reliability. Moreover, the experience acquired using and evaluating the PVT panel performance, not widely used, is also important since in the CHESS SETUP Wattia had the opportunity to evaluate the real outcome compared to the manufacturer specifications by implementing specific evaluation algorithms. Apart from the CHESS SETUP control and monitoring tool as a whole, the software implementation is a composition of smaller pieces of software (objects and libraries) that are also reusable individually in other projects.
Lessons learned	Wattia already had the experience in other projects, such as District Heatings, constructed in existing buildings combining a new implementation with a building refurbishment. These previous experiences and some of the CHESS SETUP pilots demonstrate that, when there is a refurbishment implicit in the project, there is a cost overrun that could have a lot of weight in the final cost, sometimes more than the project itself, that has to be taken into account. If this extra cost is taken into consideration in the payback, it could make the whole project not redeemable. Wattia carries out engineering-only projects and engineering projects combined with the control, automation and the installations as turnkey projects. The CHESS SETUP is the first large project where Wattia only performs the control and automation. Therefore Wattia had to coordinate with external engineering companies, the installation companies and the other partners responsible of the pilots. In that process Wattia learned the complications associated to these way of proceeding: coordination, cost overruns, discrepancies in the project definition and the final installation that have an impact in the implementation of the control and monitoring

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	and its commissioning, as well as the bounding and settling of the responsibilities of each part. Eventually, Wattia learned that the best solution in terms of cost and execution simplicity is a turnkey project where a single company can provide the engineering, automation, installation, commissioning and follow up as Wattia is used to. At the time of submission Wattia believed that the implementation of the control system could done a priori, i.e. before the construction of the pilots, as the deliverable order of submission of WP4 reflects. However, the reality is that the differences between pilots, the changes that had to be performed in the pilots with respect to the initial definition, and the control software highly tailored to the final implementation, made it impossible. Therefore, the implementation had to be delayed (without any prejudice to other deliverables) until the latest stages of the pilots. Therefore, Wattia learned that in this type of projects the software implementation should be delayed as much as possible since any work done too early could be unusable due to changes in the concept.
Next steps	The main outcome of the project for Wattia is the possibility to add in its portfolio of HVAC and DHW solutions the usage of a seasonal storage combined with renewable sources such as the PVT panels plus the usage of a heat pump. The experience acquired in the project helps Wattia to know the applicability boundaries of a CHESS SETUP type of solution. Wattia is not proactively looking for places where to apply any specific solution or product such as the seasonal storage concept. Actually, is the other way around, customers look for engineering solutions to their problems and Wattia tries to find a suitable solution for these problems always taking into account the energy efficiency and usage, as far as possible, of clean energy. However, it is not unlikely that Wattia receives a project proposal where the CHESS SETUP could be applied since Wattia has customers, for instance, in unpopulated rural areas in Catalonia and Balearic Islands where new business such as rural tourism hostels and ecological farms are started, where a clean and efficient energy source and storage system is either suitable or required. Moreover, Wattia is also involved in engineering, control and automation projects in residential areas where the neighbourhood community shares the HVAC and DHW energy production and distribution, typically using heat pumps. This is another area of applicability for the CHESS SETUP solution. In the cases exposed above, where a CHESS SETUP solution is executed, the full developed software tool could be adapted to a new final implementation. Apart from the knowhow acquired in the software implementation, parts of this software (libraries, objects, trends, ...) will be directly used in other projects facilitating and speeding up the software implementation stage.
Approach to Exploitation	
Actions	In the short-term and mid-term Wattia, after an evaluation of the project results, will add in its portfolio the long term and seasonal energy storage combined with PVT

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	panels and heat pumps as a possible solution for the efficient and clean energy production and storage. Wattia is also willing to implement CHESS SETUP-like solutions in other public centres jointly with other partners in the area of Barcelona. In the short, mid and long term Wattia is willing to participate in other European projects related to energy efficiency. Actually, Wattia in the meantime already participated in another proposal submission jointly with partners known in the CHESS SETUP project.
Journey Map	Given that the feedback is obtained from the pilots is constraining the CHESS SETUP solution to determined parameters (available space, yearly energy, ...) and the type of projects Wattia is currently executing, the expectation is to execute a couple of projects based on or related to the CHESS SETUP in the next 3 years.The reusage of software modules, objects, libraries and algorithms is already being done in other projects.
Risk Analysis	There is no specific or foreseen risk for Wattia in the prescription (engineering) and implementation (software control and installation) of the CHESS SETUP solution in their projects because, as in any other project Wattia, as engineering company, will check the applicability and suitability of the CHESS SETUP in the solution for its customers. The reusage of the whole software control tool or parts has not any known or foreseeable risk.
Revenues	Wattia, as any other engineering company has fees for the engineering projects executed. If the CHESS SETUP solution is applicable to a customer and Wattia prescribes a solution based on the CHESS SETUP will generated the same fees as any other engineering project. In the case that Wattia executes the software design, implementation and installation, Wattia will also charge for it and, eventually, it will generate revenues and profit. Any of these revenues typically depend on the project size and, therefore, are difficult to predict.
Financial costs	There are not estimated costs/investments for implementing the actions defined above. The idea to prescribe the CHESS SETUP as another possible solution, but efficient and that uses clean energy for the production and storage, does not imply any extra cost for Wattia. Wattia do not typically act as an ESCO or uses energy PPA and it does not have in perspective working in this way. Typically, the same customer or other companies are responsible of the project funding.
Impact in 3-year time	Every CHESS implementation prescribed by Wattia as an engineering project, as well as its implementation will provide a direct revenue and profit to Wattia. Moreover, each new project installed using this technology and not using fossil fuels, or replacing old systems that currently use fossil fuels, will contribute directly to the CO_2 reduction.
Key Metrics	To measure the success Wattia will measure the amount of projects and the economic impact of every project (typically related to the size). These two parameters will directly be proportional to the Wattia revenue and the CO_2 reduction.

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6.1.3 UNIVERSITY OF ULSTER

ULSTER NDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Ulster University, UK
Role and solution	Heat Pump sizing and development, having developed an advanced heat pump capable of wide speed control to exactly match demand.
Value	Wide heating demand ranges stretched the design concepts to seek and then design and operate heat pump equipment to the edges of their operating envelopes.
Lessons learned	The system was developed and tested under EN14511 style laboratory conditions. It lacked testing in a real environment i.e. in a home or business. Field trials are a necessity for industrial acceptance.
Next steps	System development and field trials in housing developments.
Approach to Exploitation	
Actions	Short-term: a field trial unit will be developed and deployed in Ulster's Terrace Street – real homes with families living in them Medium-term: Seek funding to build prototypes and deploy field trials Long-term: Work with companies associated with the medium term stage to build a successful system
Journey Map	Dec 2020: Field Trial results from Ulster's Terrace Street Test Houses June 2021: Dissemination of Results and seeking industrial development and field trial funding Dec 2021: Negotiations for sites for deployment for limited field trial of pre-prototypes June 2022: Commence deployment of field trials June 2023: Results of field trials Dec 2023: Completion of negotiations for wider licence and development
Risk Analysis	Performance is insufficient: Academic expertise at Ulster in developing such systems will overcome difficulties Market: EU energy policies are promoting heat pumps
Revenues	With their thermal and demand-side flexibility potential, heat pumps will be required in the new energy system to achieve the 2050 climate targets and offer an enthusiastic re-industrialisation project for the EU. Among the national markets, France confirms its leading position, followed by Italy and

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<table>
<tr><td></td><td>Spain. Therefore initially 100 units in year 1, 200 units in year 2 and 300 units in year 3 in predicted. Typically, 5000 euro per unit for an average house, costed at 3000 euro per unit to build.</td></tr>
<tr><td>Financial costs</td><td>Buildings: (rented) 15000 euro per year for 100m2

Staff: 5 year 1, 6 year 2 and 7 year 3

Materials 3,000 euro per unit

Sales 5000 euro per unit

<table>
<tr><th></th><th>Year 1</th><th>Year 2</th><th>Year 3</th></tr>
<tr><td>Rent</td><td>15000</td><td>15000</td><td>15000</td></tr>
<tr><td>Units</td><td>100</td><td>150</td><td>200</td></tr>
<tr><td>Materials</td><td>300000</td><td>450000</td><td>600000</td></tr>
<tr><td>Sales</td><td>500000</td><td>750000</td><td>1000000</td></tr>
<tr><td>Staff</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Salaries</td><td>200000</td><td>240000</td><td>280000</td></tr>
<tr><td>Euro +/-</td><td>-15000</td><td>45000</td><td>105000</td></tr>
</table>
</td></tr>
<tr><td>Impact in 3-year time</td><td>As above</td></tr>
<tr><td>Key Metrics</td><td>Sales as above</td></tr>
<tr><td>Legal or normative concerns</td><td>EN14511, H&S compliances and CE compliances</td></tr>
</table>

6.1.4 LAVOLA

LAVOLA INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	[LAVOLA, Manlleu (Spain)]
Role and solution	The role of LAVOLA in the CHESS SETUP project has been the leadership of the WP3 ("System simulation and optimization") and the Pilot in the Lavola's Headquarters in Manlleu. WP3 has been focused on the analysis of the technical and economic aspects for the system configuration under specific

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	circumstances as well as the analysis of the present situation and the future configuration of the CHESS SETUP systems for the three pilot experiences. Regarding the Pilot, Lavola's Ecobuilding experience, located in Manlleu (Spain), originally consisted of a small-scale prototype for an office building. However, the initial system configuration had to be modified to adapt to the circumstances of the existing building. In order to accomplish the goals of the CHESS-SETUP system implementation in the Ecobuilding, and after studying the challenges and constraints (different possibilities for the location of the thermal storage tank and its operability with the solar-hybrid panels and water source heat pump) a variation has been build and it represents a show case for existing buildings with lack of space for thermal storage and renewable technology potential. The final solution maintains the photovoltaic panels as the energy production side of the system that feeds an efficient air source heat pump to heat the thermal storage, which in this case is the thermal mass of the building slab upper layer of mortar where the radiant floor heating is already installed.
Value	The Ecobuilding, is a singular project that was constructed in 2006 according to sustainability criteria, that is, it is economically feasible, socially integrator and environmentally respectful. It represents the values of the company as a meeting point and a common place for all people who work in it and intends to ensure the best working and comfort conditions. It can be visited, so it has educative and communicative functions. It shows the economic and technical feasibility and utility of applying sustainable criteria from designing and through all stages of the construction process. It must be underlined that in 2010 the building achieved the LEED Gold certification for Existing Buildings, which it was renovated in 2015. According to the sustainability policy of the company, Lavola is working on the transformation of the building into a Nearly Zero Energy Building (nZEB). The value of the CHESS SETUP project in the company is to approach the building into this goal, which will make a significant contribution towards the aim to be autonomous in energy.
Lessons learned	One lesson learned is that we need to drive impact for people and clients. As mentioned above, the building receives visits as a show case on sustainability. Our mission to bring benefits on others is to spread the technology of CHESS SETUP and its results in order to aware people and companies towards sustainability. For this reason, after the project implementation, the following workshops/sessions took place in the building and a visit to the system has been carried out: - Energy saving in a company: the opportunity of the photovoltaic self-consumption - Energy sustainability: key to the competitiveness of companies - Act for the climate emergency: apply measures to mitigate your footprint

Next steps	The content that can be exploited are: - The energy saving results for training and awareness-rising of the citizens - Use the solution as an energy saving measure (EEM) for companies that are willing to improve their sustainability. - Assessment service for implementing CHESS SETUP
Approach to Exploitation	
Actions	The actions to exploit the project as an assessment service are the following: - Take advantage of the visits in the building to create visibility of the solution (short-term) - Include the solution as an EEM in energy audits or energy plans of our clients (short-term) - Consultancy service: Assessment on the design and results orientation for the solution implementation (mid-term)
Journey Map	First action above, is already in place. However, for the two next, the following up of the results of the pilot cases is required to have more consolidated data to properly design for other clients.

Tasks	*Month*										
	f	*m*	*m*	*a*	*j*	*j*	*a*	*s*	*o*	*n*	*d*
Publicize the CHESS SETUP solution to raise awareness (*)											
Propose the solution in energy audits (**)											
Assessment on the design and implementation											

(*) Take advantage of the Ecobuilding visits to show and explain the Pilot.

(**) Huge amount of energy audits are foreseen until November due to its required renovation for RD56/2016 compliance. Great opportunity to introduce the system to our clients.

(***) By the end of the year it is possible that some clients that shown interest in the Pilot and the EEM will request a further assessment for the implementation of the system in their building. For the implementation it is considered the renewable part of the system (PV or PVT), for other elements other contractors will be needed.

Risk Analysis	The main risk for the development of the exploitation of the assessment service is that in the first evaluation of the EEM payback periods are not attractive and suppose a barrier for the client to conduct a detailed analysis of the solution for his site.

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<table>
<tr><td>Revenues</td><td>The main revenue streams will be the increase of consultancy services to offer CHESS SETUP assessment and the design and execution for the renewable energy part (PV or PVT).
<table>
<tr><td rowspan="2">Tasks</td><td colspan="3">Year</td></tr>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Revenues (€)</td><td>10.000</td><td>35.000</td><td>70.000</td></tr>
</table>
(1) First assessment.
(2) Assessment and PV/PVT installation (1 project)
(3) Assessment and PV/PVT installation (2 projects)</td></tr>
<tr><td>Financial costs</td><td>For implementing the actions defined we will have the following costs:
- Consultancy staff costs
- Partner company costs (material provider and installation of PV/PVT)</td></tr>
<tr><td>Other sources of coverage</td><td>When we offer the service, we also will provide to the client information regarding the funding of the system based on the available grants currently prevailing.</td></tr>
<tr><td>Impact in 3-year time</td><td>Offering this assessment will provide a growth on CHESS SETUP projects implementation and it will have environmental benefits for the energy and costs savings associated an economic impact as well for the society because new installations will be executed.</td></tr>
<tr><td>Key Metrics</td><td>To track the success the following registers will be gather:
- Number of sessions/visits in the Ecobuilding and the feedback of the participants who attended it that shown interest on the system.
- Number of energy audits which we include the technology.
- Number of clients how request an offer for the detailed assessment.
- Number of projects implemented after the assessment.</td></tr>
<tr><td>Legal or normative concerns</td><td>The following are the normative to take into account:
- Directive UE/2018/844
- RD 244/2919 related to photovoltaic self-consumption
- Decree-Law 16/2019 related to climate emergency</td></tr>
</table>

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6.1.5 BCNECOLOGIA

INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Agencia de Ecología Urbana de Barcelona (BCNecologia)
Role and solution	BCNecologia is the project coordinator and was involved in all the technical WPs to assure that the project achieves the technical excellence. Also was responsible for the financial and legal management in the different tasks and issues related to the consortium or its members. BCNecologia has presented a previous project named SCACS in Pamplona (CIBARQ, 2010) and in Madrid (POLIS 2011) as the best way to supply heat in buildings from solar energy. This system was the base to develop the CHESS SETUP system.
Value	The knowledge developed during the project, both theoretical and practical, allow to BCNecologia have a wide vision of the system implementation, its operation, its combination with other energy sources and their impacts (e.g. increased use of renewable energy sources, reduction of primary energy consumption, CO_2 emission savings, impact on the power grid, etc.). Also, BCNecologia as a public consulting has increased their participation and collaboration in events related to the implementation of renewable energy sources at a regional, municipal and local level. This gave more visibility to the CHESS-SETUP project and allowed to increase the Agency contacts.
Lessons learned	Time was the critical point for the development and implementation of the system. For the pilots, meet the planned schedule was a constants issue due to the particular conditions of each of them. The high turnover of staff in several partners of the consortium also caused difficulties (loss of time and problems transferring information). Also, the communication with the EU commission and between the partners was a weak point at the beginning and has been optimized during the project.
Next steps	For BCNecologia the content to be exploited in the following years will be the knowledge about the CHESS-SETUP system implementation, its operation, the improvement of the renewable energy penetration on the grid and the impacts in the decarbonisation of the energy consumption in the building sector.
Approach to Exploitation	

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Actions	As a public entity, BCNecologia has the ability to work closely with governments, municipalities and local entities. The objective is to give visibility to the project at regional and a local scale. BCNecologia works on the implementation of an "Ecosystemic development plan", including the implementation of CHESS-SETUP systems in existing buildings and in buildings to be built in order to improve the energy efficiency, reduce the primary energy consumption and promote the energy generation at a local level. BCNecologia also proposes support to the local entities to manage subsidies or aid with the objective of reducing the payback period. Since the beginning of 2019, BCNecologia has been working closely with small municipalities with the aim of proposing the implementation of CHESS-SETUP systems. In November 2019, an agreement was signed with the Municipality of Viladecans to promote the implementation of the CHESS-SETUP system in three different Sports Centres. After obtaining approval from the municipality, BCNecologia has helped the application for EIE (Feder in Spain) grants. Also, collaboration with other municipalities is being analyzed.			
Journey Map	Nº	Milestone	Due date (months)	Means verification
	1	Methodology for the Local energy planning	8	Define and describe a methodology for local energy planning. Include information about different options and energy sources. The report includes practical data synthesized in tables about energy production, primary energy consumption savings, emissions saving, cost of implementation, pay-back, etc. It will be useful to determinate the most suitable option for different circumstances. A decision-making diagram will be developed.
	2	A quick guide to finance local projects	10	Define a database on the possible sources of financing to execute the projects (grants, loans, energy services contract, energy efficiency improvement contract, crowdfunding, etc.)

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<table>
<tr><td></td><td>3</td><td>Framework contract</td><td>12</td><td>Define a framework contract to provide the energy consulting service to local, municipal or regional entities.</td></tr>
<tr><td>Risk Analysis</td><td colspan="4">Internal risk:
• During 2020, BCNecologia will begin the liquidation process as a public consortium and through a business succession will become part of Barcelona Regional, a private company with public capital.
• Uncertainty of being able to continue the project development due to the merge of companies. The interest of new managers and the availability of resources (human and economic) are still unknown.
External risk:
• Lack of knowledge and commitment of regional and local authorities on the different impacts of climate change and energy transition (negatives and positives).
• Withdrawal of subsidies or public aid at the local level for the implementation of policies or projects in energy transition or climate change.
• Private companies could also provide the 'local energy planning' as a service.
• Difficulty obtaining disaggregated energy consumption data.
• Lack of a national legal framework regarding local energy communities and energy aggregators</td></tr>
<tr><td>Revenues</td><td colspan="4">The main revenue streams will come from the developments of 'Local energy planning' roadmaps for regions, cities, neighbourhoods, industrial parks, towns and rural areas in the Metropolitan Area of Barcelona. It will be difficult to define a specific amount of revenue from the CHESS-SETUP system due that the system will be part of a wide solution plan, not only the implementation of the CHESS SETUP system.</td></tr>
<tr><td>Financial costs</td><td colspan="4">2 technicians working 40% and 60% of their time in the project to collect the data of energy consumptions, the requirements of the contracting party, analysis the data collected, draft the proposal and coordinate the different tasks related to each contract.</td></tr>
<tr><td>Other sources of coverage</td><td colspan="4">As a company with public capital, not the entire budget comes from the revenue generated by the company. A percentage comes from contributions from the different public entities that constitute the company's society, nationals and regional incentives and other projects grant.</td></tr>
<tr><td>Impact in 3-year time</td><td colspan="4">The application of the proposed 'energy transition plan' (Ecosystemic development plan) aims to generate impacts in the following areas:
• Environmental: primary energy consumption reductions, GHG emissions reduction, increase of the local renewable energy generation, increase the energy self-sufficiency, etc.
• Social: development of an energy culture, enhancement of local territory, mitigation of energy poverty, governance (new model of participatory and equal management in resource management) etc.</td></tr>
</table>

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	• Economics: the creation of new local jobs (installers, maintenance, suppliers, etc.), activation of the local economy, equitable distribution of income generated by energy sales, etc.
Key Metrics	All those indicators have to be considered at a local level • Environmental: - Annual final primary energy consumption - Annual natural gas consumption - Annual electric consumption - Electrification rate - Number of local renewable energy installation (Annual and accumulated) - Installed capacity of local renewable energy (Annual and accumulated) - Total annual CO_2 emissions - Total annual CO_2 emissions avoided (related to the regional or local electrical grid mix) • Socials: • Number of citizens or members linked to the energy community • Number of women linked to the energy community • Number of homes with energy poverty • Number of energy rehabilitations • Number of seminars, conferences and courses related to the energy sector • Economics: • Number of citizens or members linked to the energy community • Number of companies linked to the energy community • Economics savings related to the energy supply • Number of citizens unemployed
Legal or normative concerns	The regulations regarding access to instant energy consumption data must be taken into account.
Other Comments	
During 2020, BCNecologia will begin the liquidation process as a public consortium and through a business succession will become part of Barcelona Regional, a private company with public capital.	

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6.1.6 WANSDRONK ARCHITEKTUUR

WANSDRONK ARCHITEKTUUR

INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Wansdronk Architektuur, Amsterdam
Role and solution	Wansdronk develops a solar energy, zero-emission and material saving building concept Emporium: a warm water storage container and a heat collector provide the space heating and hot water supply. Emporium is integrated in the CHESS SETUP WP1 and WP2 deliverables.
Value	Zero-emission interests and values. The exploitation and replication plan contains around 1,385 contacts and 415 documents, and its analysing and summarizing to collect and select business interests and its related stakeholders, including participation in workshops to analyse, discuss and learn blockchain functionalities, to design a blockchain carbon credits wallet for individuals to be used house by house for example.
Lessons learned	Blockchain carbon credits wallet. The carbon credits wallet requires a blockchain technology, and a blockchain technology independent Unique Object Identifier (UOI) which will be developed by Dutch authorities as well. Besides carbon credits value, a zero-emission concept can receive Non-Governmental Organization (NGO) support, in case that it covers Sustainable Development Goals (SDGs).
Next steps	TRL related exploitation opportunities. The Emporium's Technology Readiness Level (TRL) is high for its solar heating, making it exploitable as knowledge, and is low for its blockchain wallet and infrared cooling, making it exploitable as research. The worldwide floor space doubling in the coming decades, built in warmer continents and requiring indoor cooling, will impact global emissions as well. An Emporium low-energy infrared cooling collector avoids emissions, by using space temperature instead of electricity.
Approach to Exploitation	
Actions	Local teams' pilot projects. The today Emporium strategy is to learn to deliver with local partners, by pilot projects with local teams, and sharing its outcome and knowledge on an open source basis.
Journey Map	Mission driven project focus. The today focus of the implementation process is changing to mission driven projects, in which zero emission ambitions are organized in advance as part of the project, such as the bi-annual Olympic and Paralympic Summer and Winter Games in 2022, 2024, 2026 and 2028 for example.

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Risk Analysis	Validation and access approval and organization. A zero-emission building concept is a safe asset, due to its emission reduction compared to today emission reduction alternatives. Nevertheless its emission reduction validation, and its access to an Emission Trading Scheme (ETS), has to be approved and organized.
Revenues	Knowledge transfer and knowledge development. The Emporium solar heating and seasonal storage knowledge transfer revenue streams will be related to pilot projects and its cooperation budgets. The Emporium low-exergy infrared cooling collector, and blockchain carbon credits wallet, knowledge development revenue streams will be related to R&D projects and its cooperation budgets.
Financial costs	Implementation and R&D costs and investments. The main costs are personnel costs and operational costs which are estimated on 45,000 to 50,000 euro and 20,000 to 25,000 euro per year, and in total 65,000 to 75,000 euro per year.
Other sources of coverage	Financial needs funding source. All costs and investments will be financed by private capital, which will be settled by pilot project and R&D project cooperation budgets or grants, in case that these additional co-financing opportunities arise.
Impact in 3-year time	Zero emission and low exergy strategy. Emission reduction is a main goal, which can be realized more economical by low exergy (heat) demand systems, compared to high exergy (electricity) demand systems, especially in case of long term (seasonal) energy storage. The Emporium heat storage technology (€ 2.74/kWh) is 100 times cheaper compared to electric home battery technologies (€ 300/kWh).
Key Metrics	Knowledge transfer and development indicators. The Emporium solar heating and seasonal storage knowledge transfer can be measured by the 'learn to deliver with local partners' cooperations and projects numbers. The Emporium low-exergy infrared cooling collector, and blockchain carbon credits wallet, knowledge development can be measured by its successful outcomes, financial support, and Intellectual Property Rights (IPR) protection in case that these occur.
Legal or normative concerns	Preferably the carbon credits wallet could be linked to, and owned by, the building, instead of the (building) owner. In that case a building becomes an entity, such as a company, which requires new legislation. The Emporium energy system has been patented, including an application and publication in China.
Other Comments	
The CHESS-SETUP WP6 Individual Exploitation Plan Appendix includes the related background information.	

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6.1.7 EUROGRANT

INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Eurogrant GmbH, Dresden, Germany (EUG)
Role and solution	Support of the consortium, especially the coordinator, with all legal, administrative and financial tasks and issues.
Value	EUG was able to foster new contacts and broaden their network. This came from the consortium, but also from the outside through other events connected to the CHESS-Setup project. They were also able to gain insight into the energy field which proved valuable for further projects and to establish future collaborations.
Lessons learned	EUG should have more intensively pushed for a deeper involvement in administrative issues to speed up some operations. EUG will take these lessons learned to optimize their support.
Next steps	EUG will try to build new projects with the new contacts that were gained in the project.
Approach to Exploitation	
Actions	Short-term it will be the identification of new topics that could be interesting for Eurogrant's new contacts and the communication of these towards them. Mid-term there will be the establishing new collaborations with the aim to prepare proposals with interested parties in national and European funding programmes. New projects can be achieved in long-term.
Journey Map	Mid 2020: identification of new, suitable topics for proposals with interested partners from CHESS-Setup or contacts that were gained through CHESS-Setup End 2020: New proposals for EU-funded projects with these interested parties Mid 2021: New projects with above mentioned partners These processes are ongoing, so that the identification of new topics, finding collaborations and submitting proposals will not stop and go on in parallel.
Risk Analysis	No new contact could be interested in the new topics. The building of a new, competitive consortium could fail, even though parties would be interested in topics. The proposals could not be successful due to tough competition for grants. New parties could seek to cooperate with other partners or networks,

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	due to various reasons, e.g. because a potential coordinator has already established a cooperation.
Revenues	To support a consortium in the preparation of a proposal is one stream for revenues. Another is the organisation of workshops and network events. Project participation as project management office, is the third stream for Eurogrant. As project management office, Eurogrant works cost-based and doesn't create profits. With the participation in projects, it is not the aim to make profit, only actual costs are reimbursed.
Financial costs	No new major costs will arise from Eurogrant's plans, besides normal personnel costs and some minor acquisition costs.
Other sources of coverage	The services of EUG are paid by entrepreneurs, scientists or others who mainly hire them for proposal writing support or external support during the project. Furthermore, EUG gets funded by the EC, if they are a full partner for project management in a project.
Impact in 3-year time	With their long-lasting experience, EUG can mostly create benefit for their customers and supports them to finance their research and research ideas. Furthermore, they profit from Eurogrant's growing network, so they can find new possible cooperation partners. With strong new collaborations, ideas and thus, innovations will be created and strengthen the potential of research and economy of the costumers. Other researchers can also benefit from EUG's network, since EUG will also connect interested partners, even if they are not working together with EUG at the moment.
Key Metrics	Number of new contacts through CHESS-Setup and the network Number of new proposals with contacts gained through CHESS-Setup Number of successful proposals = number of new projects A metric for success in a greater sense is also the number of new cooperations that are enabled by EUG, even without direct participation of EUG. Just the establishment of new connections.
Legal or normative concerns	EUG does not have any of these concerns.

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6.1.8 VEOLIA (SERVEIS CATALUNYA)

<table>
<tr><th colspan="2">INDIVIDUAL EXPLOITATION PLAN</th></tr>
<tr><th colspan="2">Organisation profile</th></tr>
<tr><td>Partner</td><td>Veolia Serveis Catalunya, S.A.U. (VLC), Barcelona, Spain</td></tr>
<tr><td>Role and solution</td><td>The result of VLC's contribution to CHESS – SETUP is providing expertise and knowledge over an efficient management of energy installations, district heating/cooling and O&M on industrial, hospital and commercial buildings. VLC's role in the project includes:

Leadership of WP 2 Heat Storage System, by providing the following:

State of the art about different thermal storage systems, materials and construction techniques, analysing their suitability for the three CHESS SETUP demo pilot sites;
Guidance for building thermal storage systems regarding legislation/framework applicable, civil works, investment and operation/maintenance costs, etc.;
Make use the gathered information in adapting thermal storage systems to decide the most efficient, highly adapted and low-cost solution for each of the demo pilot sites of the project.

Significant participation on WP 6 Business models, standardization and exploitation, by providing the following:

State of the art about different business methodologies and strategies to create and assess business models, applying them to energy services markets and develop an ESCO business model for CHESS SETUP project;
Calculate the main economic information of technology deployment such as total investment costs, total O&M costs, etc., alongside with economic indicators (IPC, VAT, etc.) to replicate the proposed ESCO business model on each demo pilot site;
Analyse different barriers and success factors, as also experimentation and feedback on implemented business models to assess on the standardisation of the solution.

</td></tr>
<tr><td>Value</td><td>Main valuable outcomes for VLC regarding CHESS SETUP project:

Increased expertise and knowledge on the deployment and building of thermal energy storage systems;
Increased perception of a business opportunity on installing, commissioning and operating thermal energy storage facilities;
Increased contact list on possible business partnerships regarding energy storage projects and exploitation/replication plans;
Possibility to test thermal energy storage technology on field, analysing its feasibility and economic/financial results.
</td></tr>
<tr><td>Lessons learned</td><td>Improvements to be considered for further projects on TES:

Pre – feasibility analysis on the requirements to deploy the project's solution on the demo pilot sites, so we can provide a first basic analysis to see if the system is feasible/profitable;
</td></tr>
</table>

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	• Definition of a common criterion to match the technological solution with main building typologies, so that different deployment proposals ease the pre – feasibility analysis; • Earlier deployment of the monitoring & control system deployed on each demo pilot site, to see if the deployed technology's behaviour fits with what was theoretically expected.
Next steps	VLC will perform different actions in order to approach the CHESS SETUP technical configuration to suit it with the firm's business model and figure out which client can take higher benefit of a TES system deployment. Those next steps are: • **Benchmarking and key performance indicators analysis**: To find out which are the best indicators so when a replication of CHESS SETUP system is performed in a client's installation, it operates under the best conditions in terms of performance, cost optimisation and GHG emission's decrease. • **Market targeting and customer segment identification**: VLC will perform a deep market analysis to search for the most suitable, attractive and potential benefiter of the CHESS SETUP solution. • **Market competitors' analysis**: VLC will get in touch with TES system service providers to evaluate their strengths and weaknesses, not only on the service deliverance itself but also in all marketing involved in the service, including technical, economic and financial indicators. • **Technology providers/manufacturers of TES equipment:** VLC will focus on searching the most suitable firms that manufacture each of the main TES system elements (PV-Thermal panels, heat pumps, storage tanks, accessories (pipeline, wires, pumps, actuator, controller, etc.), SCADA systems, metering systems, etc.). • **Replication and/or escalation of CHESS SETUP system configuration:** VLC will focus the most suitable customer segments available in the market in order to perform a replication and/or escalation of the CHESS SETUP system.
Approach to Exploitation	
Actions	In order to exploit an EPC/ESC contract, a technical proposal must be completed so that the ESCO complies with all expected phases of an energy service project deliverance. *Please refer to section 2 (KER 2) for details.*
Journey Map	*Included under section 2 (KER 2).*
Risk Analysis	*Included under section 2 (KER 2).*
Revenues	*Included under section 2 (KER 2).*
Financial costs	*Included under section 2 (KER 2).*
Other sources of coverage	Apart from every partner's own budget or incomes/revenue streams, there are many funding possibilities in the energy sector of the EU (Horizon 2020, CEF, Cohesion Fund, etc).

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Impact in 3-year time	Veolia Group is a global leader company in optimizing energy resources management. With nearly 171.000 employees, the group designs and provides different water, energy and wasted resources management to contribute in the world's transition to a sustainable way of life, contributing to develop sustainable cities and industries. That's why projects like CHESS SETUP are aligned with Veolia's activity: apart from the main three activities, the group also develops access solutions to these resources, helping to preserve existing basic resources and developing strategies to engage and keep a renewable and sustainable energy model. The group has valuable and proven experience in those three main fields and its associated activities, thus acting as an important role of the economy decarbonisation.
Key Metrics	As an international firm being present all over the world, our success is not only measured by achieving our technical and financial objectives (which is obviously an important part of the business environment) but also based on its clients' satisfaction on the service/solution provided. Some of the basic ones can be: - Achieving energy consumption reduction; - Achieving energy costs reduction; - Providing highly profitable solutions; - Deploy all tasks stated in the contracts in the most professional, effective and efficient way to ensure result achievement but also providing satisfaction and trustworthy bonds; - Retain existing clients by continuously offering them innovative and sustainable solutions to reduce their costs by also taking part in the climate change fight and economy decarbonisation; - Reaching as much new clients as possible by improving marketing and social strategies.
Legal or normative concerns	Veolia is compromised in developing its work in the most professional, effective and efficient way. In that path, VLC and the rest of the Veolia group has: - Certification ISO 9001 (Quality management), - Certification ISO 140001 (Environmental management) - Certification ISO 50001 (Energy Efficiency Management)

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6.1.9 ELECTRIC CORBY

INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Electric Corby CIC – Corby, UK
Role and solution	Electric Corby CIC's role has been to provide the pilot location for implementing, monitoring and evaluating the commercial benefits and viability of an inter-seasonal heat storage system in a new build residential context drawing energy from PVT renewable heat and electricity generation. A new build development of eco-homes being brought forward by Project Etopia in Corby was identified by Electric Corby CIC to accommodate and deliver the pilot installation of PVT panels, an Earth Energy Bank (EEB - shallow bore ground based thermal store) and ground source heat pump drawing from the EEB – collectively called the Zero Carbon Solution or ZCS provided by Caplin Solar - all supported by a SHEMS (Smart Home Energy Management System) to optimise use of self-generated energy and minimise use of grid supplied energy. The pilot provides energy systems data to the project and also provides evidence, learning and a case study for the business case stage and exploitation of CHESS-SETUP going forward. The ZCS energy system was to have been rolled out in 31 of the homes of 5 different types as they were built. However, delays to the start of development resulted in a reduction to 26 homes while maintaining the 5 home types for the CHESS-SETUP research.
Value	CHESS-SETUP has played an important part in Electric Corby CIC's creation of one of the leading showcase eco-home developments in the UK. This attracted significant attention and focus from UK central government with frequent visits from government departments and agencies such as Homes England, BEIS and MHCLG. In particular the Building for 2050 research programme for BEIS selected the Corby pilot to gather evidence on future homes standards and achieving zero carbon homes objectives. Electric Corby CIC has gain significant positive contacts and networks with the above agencies and with many Local Authorities who have visited the pilot over the past 18 months of construction. Electric Corby CIC has also been able to gain further understanding of the challenges and limitations around new technology integration into residential developments in the UK and to be introduced to new or emerging technical solutions for future application.
Lessons learned	One of the key objectives, beyond demonstrating and monitoring system installation, was to pilot and demonstrate the commercial case for delivery at scale i.e. beyond a single home or small cluster of homes – so as to represent and test the exploitation potential in the volume residential construction sector.

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	Selecting a pilot site with a more established and experienced construction / development company could have mitigated the risk of delays that have been ongoing. It could not eliminate all delays (particularly the start date which was a force majeure beyond either Electric Corby or Project Etopia's control) and construction developments are always vulnerable to practical issues such as weather, property market volatility and site implementation problems. Technical Challenges: Integration of data flows between the main system elements – primarily the heat pump and SHEMS has been an unexpected and ongoing challenge. A decision was made by the ZCS team (Zero Carbon Solutions – providers of the energy systems services) to switch from Vaillant heat pumps to MasterTherm before installation started ironically (in part at least) on the basis that the latter were willing to share greater levels of data detail than Vaillant. The problems have been technical rather than policy related. This has impacted the flow of data to CHESS-SETUP since it began in summer 2019. The EEB is fundamentally a very simple system. The primary technical challenge has been installation in poor weather. The UK has suffered one of the most prolonged wet weather periods for many years and this caused problems with the shallow bore holes – primarily collapse of the bore sides in the brief period between drilling and filling the bores
Next steps	The planned exploitation of the project results falls into 2 areas – Commercial and Ongoing R&D. Commercial Exploitation: The primary exploitation plan has been to offer the Zero Carbon Solution (combination of EEB, PVT and Heat Pump) to the volume new build residential market targeting construction and building companies as the primary customer. The ZCS has been demonstrated and deployed for one-off custom build and self-build, a relatively niche market. Demonstrating deliver at scale for more commercial focused clients (house builders rather than one-off homeowners) opens up significant potential while reinforcing the value of the ZCS for existing niche
Approach to Exploitation	
Actions	**Short-term:** Electric Corby CIC remains focused in the short term on addressing the challenges of integration of technologies within a volume residential construction context. More positively, our actions focus on the aforementioned Building for 2050 programme which looks at post occupancy performance monitoring and at assessment of occupier's perceptions and experiences and offers a platform to expand market opportunities for the ZCS and associated solutions deployed in Corby. **Medium-term:** Reviews of the ZCS installed to date will lead to the design of a ZCS v2 for the final homes and the apartment building ready for implementation in Q3 of 2020. Electric Corby CIC will support this but it is within the control and decision making of Project Etopia as the site developers. Plans for exhibitions and conference presentation of the outcomes from the pilot and for the ZCS v2 are targeted at the Offsite Show (Q4

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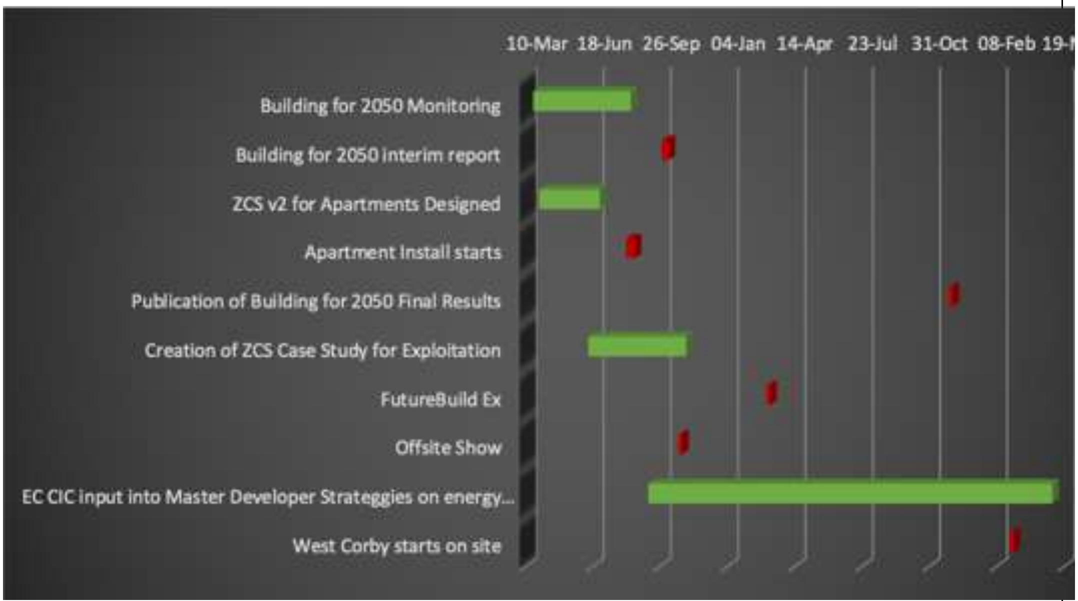
	2020) and FutureBuild (Q1 2021). Publication of the results from Building for 2050 are expected in Q4 2021 and will provide a basis for further exploitation activity Electric Corby CIC is working with Master Developers to aid them in taking account of the future infrastructure needs of homes that have different heating solutions and therefore energy demands and profiles. It is our goal to positively influence these parties to adopt heat storage and heat pump based solutions. **Long Term:** Electric Corby CIC is working with the landowners and developers of 2 large extensions to Corby (total of 5,000 homes) to embed the learning and evolved solutions coming out of the CHESS-SETUP project into the development frameworks for those schemes starting from 2022 onwards
Journey Map	
Risk Analysis	The primary risk is not being able to evidence commercial viability based on the total system cost compared to alternative means of providing for domestic heating and hot water. It is hoped that deployment in the pilot enable further system cost improvement and in particular installation efficiencies to reduce costs. A secondary risk relates to industry perceptions and inertia centred on such issues as unknown lifetime maintenance costs or indeed the viability of being able to address system failures that might occur with the EEB (i.e. in the ground under the home). This industry resistance may manifest in a reluctance to adopt the ZCS and/or for industry regulators, building warranty providers or mortgage finance providers.
Revenues	Electric Corby CIC is not planning financial exploitation of the project outcomes but Caplin Solar Systems (providers of the ZCS) are targeting sales of the ZCS to home builders as the revenue stream from the project outcomes.
Financial costs	Again, Electric Corby CIC is not proposing to exploit the project outcomes for revenue purposes but we will be leveraging the learning to advance R&D on energy system solutions within future projects. Our investment in this will be staff time and communications collateral to disseminate learnings and attract future R&D

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	projects/partners and advance Corby as a demonstrator location for future living, working and mobility solutions.
Other sources of coverage	Electric Corby CIC activity will be from its own budgets for the short and medium term activity. Beyond that point R&D and innovation growth funding is being pursued.
Impact in 3-year time	Electric Corby CIC's objective with this project is for it and the products (ZCS) and learning that flow from it to push towards Net Energy Positive developments being the new normal or state of the art for residential construction projects.
Key Metrics	For Caplin Solar Systems the Key Result will be measured in terms of ZCS systems deployed per annum. For Electric Corby CIC there are much broader more strategic metrics for Corby as a location in terms of new homes build and jobs created. Much of this will not be attributable to the project. However, a metric that assesses the percentage of new homes that are Net Energy Positive is being considered, working jointly with Corby Borough Council as the planning authority.
Legal or normativ e concerns	The primary IPR element of the project (the ZCS) was protected by patent prior to the project start which is why Caplin Solar Systems was a single source procurement where no other providers could offer the deployed solution.
Other Comments	
The exploitation opportunities from the Corby pilot are effectively split, some falling to the partner (Electric Corby CIC) and the remaining, mainly commercial opportunities sitting with the ZCS provider Caplin Solar and the developer Project Etopia. Some of the significant challenges of the pilot have been associated with the integration of the ZCS into a multi-unit residential development, when previously it's only been used in one-off homes and in association with that, the commercial viability going beyond a period when grant funding subsidises installation. This has created the potential opportunity to commercialise the learning around integration or to maintain that learning as a competitive advantage for ZCS and Project Etopia. It should stressed, however, that no commercial decision has been made by Project Etopia to take the ZCS forward because of commercial viability concerns and therefore commitment to exploitation targets cannot be expected from them.	

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6.1.10 EDENWAY

EDENWAY INDIVIDUAL EXPLOITATION PLAN	
Organisation profile	
Partner	Edenway, Barcelona, Spain
Role and solution	We have been responsible for the business models, standardization and exploitation work package (WP6) as well as the coordination of the communication and capitalization activities of the project (WP7).
Value	CHESS SETUP has provided us the opportunity to further develop our knowledge from a technical perspective -in relation to the energy efficiency field and also from an organizational perspective- managing different partners and work packages. By developing the database of stakeholders and the market research we have extended our contacts and skills in heating equipment for residential and commercial uses to other geographic areas. From the communication perspective, we have gained experience in community management tools and we have increased our participation in local, national and international events to provide more visibility to CHESS SETUP as a whole. It has been specially rewarding the collaboration with other EU funded projects focused on seeking energy efficiency and self-sufficiency in buildings, cross-promoting and disseminating our projects and actions together. In this sense, we have conducted successful networking activities collaborating with sister projects and contributing with articles and news in the BUILD UP community.
Lessons learned	The main issue encountered during the project and with a direct impact to the whole consortium has been the budget lag between the estimated cost of the solutions and the final budget required to implement the pilots. The final cost of the technology in the three pilots has been higher than expected and, therefore, the project was delayed for 1 year.
Next steps	For Edenway the content to be exploited in the following years will be to act as a facilitator or binder of different solutions portfolios, creating successful business models and formulas. Our focus will be existing solutions and technologies targeting the building and retrofitting areas, covering the energy efficiency and reduction of emissions fields.
Approach to Exploitation	
Actions	Specifically, we aim to develop the "Business Model 30/30/30", creating integrated and multi-stakeholder business models including three different partners, each of them responsible for one third of the whole solution. In our experience, both in CHESS SETUP and other international projects, combining the following stakeholders in the business models allows to respond better to the market needs:

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	1. Public agents or administrations with competencies in the energy field (eg. ICAEN, IDAE, ADEME, EVE). Their role will be to define and balance the business models through two possible financing mechanisms: grants or taxes. 1. Business sector. Mainly companies in the energy service and utility area (eg. Veolia). Their role will be to design and deliver the technological solution or the service related to energy management. 2. Final client. They will be the recipients of the service or solution. We target business models for non-commercial buildings in urban space. (e.g. homes, offices, sport centres, etc.)
Journey Map	Our journey map will be driven by the geographic areas that we plan to cover. Responding to our geographical presence and market knowledge, our plan to is to explore Spain in the first place, prioritizing Catalonia and the Basque Country, followed by the rest of the Spanish communities and lastly enter France. In all these countries the activity sectors we will address will be related to Utilities, Building, Research and Innovation and Smart Ciities and Communities. Phase 1 – 2020/2021: Catalan area and Basque Country in Spain Phase 2 – 2021/2022: Rest of Spain Phase 3 – 2022/2023: France For each phase the key milestones should be the following: 1. Gather information and map the existing technologies or solutions impacting energy efficiency in urban environments. 2. Develop a stakeholder mapping, identifying key public entities, potential customers and the companies providing the required technology. 3. Conduct the necessary interviews, questionnaires, study visits, etc. 4. Develop and implement the collaboration agreements. 5. Implement a monitoring process in order to keep track of success.
Risk Analysis	The main risk we may face is the lack of clearly defined financing mechanisms. Also, the timing of these mechanisms might be an issue, as the procedures to identify, create and award the financing structure have a direct impact on the implementation.
Revenues	We project a revenue structure linked to the model itself and, therefore, divided into three different revenue streams. Firstly, the public entities will provide support to our services in terms of investments, visibility and participation. Secondly, the companies providing the technology to deliver the solution will also pay for our services, either contributing with a fixed fee or a flexible percentage linked to the results and success of implementation. Lastly, the final consumer should also pay for the solution, either for the implementation of the system itself or its utilization (pay-per-use).
Financial costs	The expected costs are consultancy staff costs and might also be required specific business trips to formalize the collaborations or conduct study visits.

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Other sources of coverage	An additional service that Edenway may offer to further develop the creation of new business models is the creation of a "Finance Office", responsible for gathering all the different financing sources and mechanisms available to execute these type of projects (public grants, loans, private calls, awards, etc.).
Impact in 3-year time	Our objective for a 3 year horizon is to create three or four business collaborations based in an existing technology following the scheme described.
Key Metrics	We will define a control panel including KPIs to measure progress and facilitate the decision process, including the following indicators: Energetic consumption, number of solutions identified, number of market players involved (both public and private), number of business models proposed, number of collaborations signed, emission of Tn of CO_2 avoided, number of citizens involved.
Legal or normative concerns	Our framework of action will be the European Green Deal policies, tackling the implementation of the EU energy and climate targets triggering the transformation of Europe's neighbourhoods to net-zero energy districts (NZED). We will also take into account the national laws of each country and region in terms of energy, building and renovation of existing buildings. For example, in Spain, the Technical Building Code.
Other Comments	
We have already identified the following ongoing projects, that we plan to address during Phase 1 and Phase 2 of our journey map to explore collaboration opportunities: - COMPOSE project, which tackles the challenge of increasing the share of RES in energy mix of rural and island areas in the Mediterranean area. Our contact will be the Granollers City Council, one of the project partners. - SUNHORIZON project, which objective is to demonstrate up to seven innovative and reliable Heat Pump solutions. Thanks to CHESS SETUP we are already in contact with them and might offer us the opportunity to collaborate in Spain.	

6.1.11 Lessons learned

As a summary of the above IEPs and with the objective to consolidate the experiences and knowledge gathered by the partners throughout the work performed we include below the main lessons learned which the partners can use for their own benefit and for the benefit of others, mainly for future Thermal Energy Storage (TES) projects.

Regarding the Project Design:

- A pre – feasibility analysis on the requirements to deploy the project solution on the demo pilot sites should be conducted to validate if the system is feasible and profitable. In this sense, field trials are a necessity for industrial acceptance.

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- It is necessary to develop a definition of a common criteria to match the technological solution with main building typologies, so that different deployment proposals ease the pre – feasibility analysis.
- Earlier deployment of the monitoring and control system should be deployed on each pilot site, to verify if the deployed technology fits with what was theoretically expected.
- The software implementation should be aligned with the deployment proposals since any work done too early could be unusable due to changes in the concept.
- When there is a **refurbishment implicit in the project, there is a cost overrun that has to be taken into account as migh have a lot of weight in the final cost**, sometimes more than the project itself.

In terms of Project Management:

- A handover plan should be developed within the partners to deal with the turnover of staff to ensure a correct knowledge transfer and avoid loss of time.
- Ensuring a constant, efficient and proactive communication with the EU commission and between the partners is a critical point during the whole project lifecycle.
- For the correct coordination of the different partners involved it is necessary a regular monitoring and communication of the responsibilities, the progress, and the next steps to avoid delays, cost overruns and discrepancies.
- In the project calendar, each pilot particular conditions should be considered to facilitate the implementation of the planned schedule. In this sense, the external factors affecting the pilots such as weather, technical challenges and site implementation problems should also be considered.

6.2 Key Exploitable results (KERs)

The CHESS SETUP KERs were agreed among the whole consortium, considering both the above individual exploitation plans and also the collaborative discussions throughout the project, especially during the Exploitation Strategy Seminar (ESS).

For further clarification we detail below the collaborative methodology used for the selection of the KERs with regards to the ESS:

- During the May 2019 CHESS SETUP project meeting, the consortium accepted the proposal of the PO to consider the support service for the exploitation of the research results.
- During the Exploitation Strategy Seminar (ESS) preparation stage the project partners suggested 7 KERs to be discussed during the seminar, including exploitation of pilot sites, simulation and monitoring tools and a technical solution.

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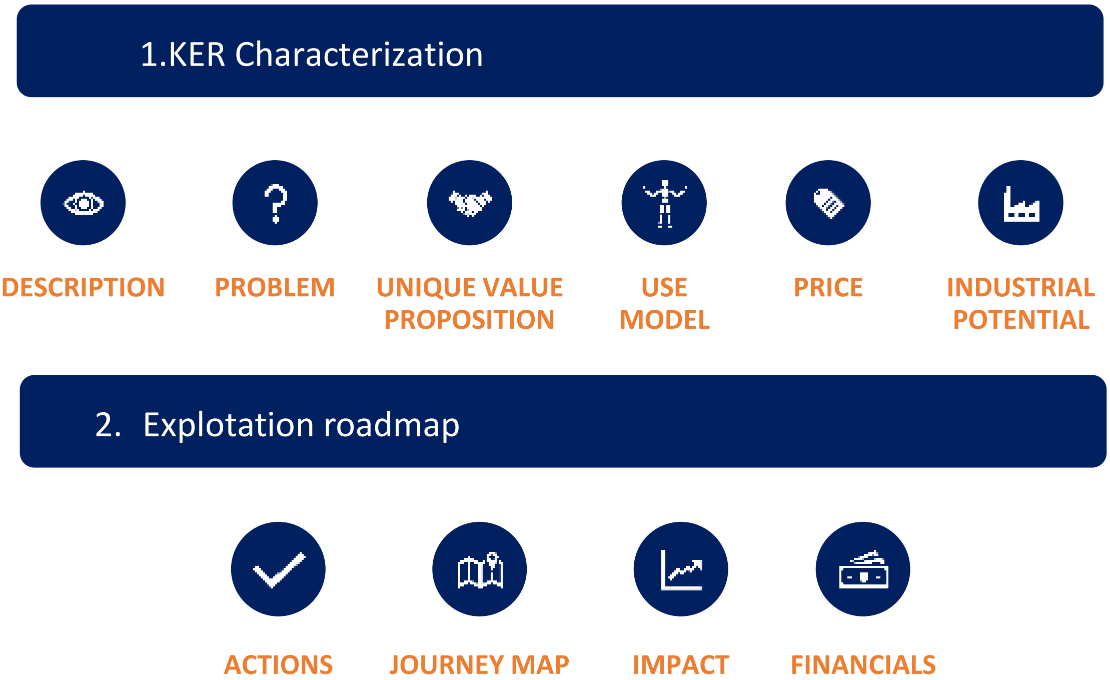
- The ESS took place in October 2019, and 4 KERs were selected and analysed by all the partners in face-to-face collaborative workshops.
- After the ESS, the expert prepared a report summarising the results of the seminar and project partners discussed internally their interest in the exploitation of the results.

  It was then agreed by all the partners during one of the regular progress meetings to focus on 2 KERs, the ones considered to have a greatest impact in project results (KER 1: CHESS SETUP system and KER 2: CHESS SETUP services).

The following scheme summarizes how each KER has been detailed, following the ESS recommendations and methodology, which includes first a detailed **characterization of the result** followed by the **exploitation roadmap** information:



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6.2.1 Key Exploitable Result No 1 (KER 1): CHESS SETUP System

KER 1 Characterization

DESCRIPTION:

The first KER agreed among all CHESS SETUP consortium partners and led by BARCELONA ECOLOGIA (BCN) is **the technical solution** that can be implemented into the wider market benefiting from the project results: a reliable and efficient seasonal energy storage system able to supply heating and domestic hot water in buildings mainly from renewable energy sources, increasing the self-sufficiency of the building and reducing its emissions.

The optimal combination of the three different elements (energy production, storage and a highly efficient heat pump) in a single system managed by an intelligent monitoring and control system, is a novel solution with a clear focus on **energy efficiency and CO2 reduction**.

This system can be replicated and escalated in a different climatology, geography and building conditions, especially in dense urban areas where there are many limiting factors, such as roof availability, RES generation capacity or available surface/area for TES.

BCNecologia has over 15 years of experience developing heating and DHW solutions based on solar energy and thermal storage. It has worked closely with component and system manufacturers in the development and application of novel systems. As a background, BCNecologia has presented a previous project named SCACS in Pamplona (CIBARQ, 2010) and in Madrid (POLIS 2011) as the best way to supply heat in buildings from solar energy.

The description of all elements of the system and how are inter-connected has already been explained earlier in the document (Section 2 - Product and Services Analysis).

PROBLEM:

The issue that KER 1 is addressing is related to the use of DHW and climatization in internal environments, which represents **large energy consumption and considerable economic expenditure**, as detailed below.

Heating and cooling demands account for a significant proportion of the European total final energy demand (50%) – Figure 22. The building sector alone consumes 64% of the total heating and cooling demand, of which around 62% is used for space heating and domestic hot water production. In addition, single-family houses uses twice as much energy for space heating as multi-family houses.

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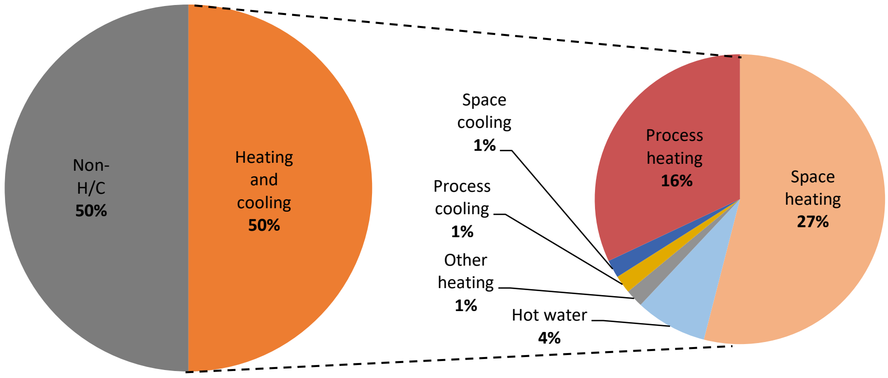

Figure 22: EU 28 heating and cooling final energy consumption by end-use in 2015 [1]

Most of the thermal energy is produced from fossil fuels (66%) and only 13% comes from renewable energy. Electricity and district heat together supply 21% of heat, which may or may not be renewable, depending on local circumstances.

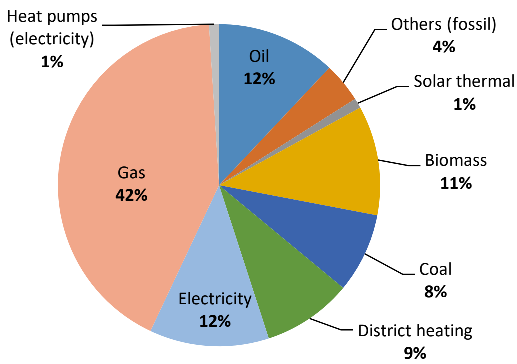

Figure 23: EU28 heating and cooling energy consumption by energy carrier in 2015 [1]

Until now, boilers (Natural Gas, Carbon, Fuel oil, Biomass, etc.), stoves and electric heaters were the predominant heating and DWH systems used in the different building types (residential, commercial and services), but as already explained in the Market Analysis, in the last 10 years, the heat pumps (air source, geothermal, etc.) and the district heating have increased their penetration in the market.

UNIQUE VALUE PROPOSITION (UVP):

CHESS SETUP solution is able to supply heat and hot water to new and existing buildings mainly from renewable sources, offering an innovative solution in the upcoming energy services market. Specifically, KER 1 enables users to benefit from a heating and DHW system in an efficient way with low-cost operation and maintenance. As stated in D6.1 Business Models for the Case Studies, in the three pilots the CHESS SETUP system, compared to the original installed system (baseline) has shown savings in energy consumption (kWh / year), economic operating savings (€ / year) and has reduced CO_2 emissions (tCO_2 / year).

With regards to the potential market, it presents dedicated benefits for the following types of potential customers:

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- **Private customers**: KER 1 satisfies the heating and DHW demand, providing at the same time a solution that is easily deployed to many different types of buildings in terms of **energy efficiency**, primary energy consumption, operation and maintenance costs.
  As potential customers, buildings in dense urban areas where there are many limiting factors are a key target, but also new businesses such as rural tourism hostels and ecological farms in unpopulated rural areas or islands can benefit from this clean and efficient energy source and storage system, either because it is suitable or is it required. Another potential customer are residential areas where the neighbourhood community shares the HVAC and DHW energy production and distribution, typically using heat pumps.

- **Professionals as a customer**: The renovation of the heating and DHW installations of the built-up park will lead not only to a great demand for installers but also engineers, increased production of suppliers companies and R&D increase in industries (e.g. solar panels, storages, heat pumps, controls and monitoring systems).

- **Private and public administrations as a customer:** The wide implementation of KER 1 implies benefits to the electrical grid, flattening the electric demand curve and allowing greater integration of renewable sources. It should be noticed that CHESS SETUP system could also play an important role in demand management and aggregation.

Therefore, not only should be considered the building user as a possible customer of KER 1. Once the aggregator figure plays a key role in the electric system (grid and market), the system can give extra services and benefits for the distribution system operator (DSO), so these same aggregators would be interested in extending the use of the system proposed.

USE MODEL:

In relation to how KER 1 will be put in use and be available to customers to generate an impact, the proposal of BCN ECOLOGIA as leader of KER 1 and agreed by the consortium, is through a consulting company that would act as a thermal solution provider, selling the CHESS SETUP solution to ESCOs or architecture offices who can deploy CHESS SETUP solution by paying for it or directly to end-users, leading also directly the deployment and maintenance of the solution.

The use model is to provide consulting services by hiring experienced and qualified people (company members of the same consortium partners) and having them assigned on client's projects, following the consulting business model. The consulting company would charge on an hourly basis, taking a percentage share based on the successful completion of the project (based on the energy savings, emissions reductions, operational cost reduction, etc).

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In order to gain a competitive role in the market and a strong position respect key competitors we have given a special consideration to the following factors:

- It is necessary to count on a professional engineering firm capable of conducting the deployment, installation and commissioning of the solution in order to guarantee the greatest overall energy system performance. The engineering firm will lead the project's scheme, operation, control parameters, constraints and variables.
- In the same path, knowledge on actual framework and permissions is essential to reduce the manpower, installation and commissioning task costs, which will reduce the overall cost of the solution and be more competitive.

Taking into account these requirements, the consortium members interested that also responds to the above considerations are the following:

- **Electric Corby** is a Community Interest Company (CIC) established with three main objectives:

  1. Position Corby as a leading edge location for business.

  2. Become the UK's leading practical, community scale test centre for energy efficient living and low carbon transportation.

  3. Redistribute the benefits of its labours to the Corby community.

  Electric Corby has been involved in a number of projects such as building Zero Energy Bill homes, developing an electric car charging infrastructure, creating a Community Energy deal to rival more established providers and establishing a CleanTech Hub to promote and share new technology and ways of working for businesses interested in clean technology.

- **Edenway** is a consulting firm that has been created on sustainable development, social innovation and economic pragmatism beliefs. The company works on two areas of expertise: business development and implementation of innovation projects for urban transformation. Its approach is to develop sustainable business cases and has done so for a wide range of projects and organisations both public and private.
- **Lavola** is a consulting firm specialized in sustainability, allied with the organizations, territories and people committed to a more sustainable word.
- **BCNecologia** provides solutions in the fields of mobility, energy, waste management, water management, urban planning, biodiversity and social cohesion for both public and private entities. The Agency is composed of a trans-disciplinary team, able to identify problems and their cause, make proposals, analyse the technical feasibility, quantify the results and provide administrative support during projects' implementation.
- **Wattia Innova** offers a comprehensive service to improve energy efficiency in all kinds of facilities, thanks to their experience in the residential, industrial and

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tertiary sectors, and the use of advanced monitoring tools developed with their own technology.

In terms of cost and execution simplicity, these five companies will have different participations in the consulting company:

- **Electric Corby, Edenway** and **Lavola** will be responsible for the identification of potential customers, the development of business contracts and negotiations, and the verification of the system correct implementation as well as conducting the quality and risk management.
- **BCNecologia** will be responsible for the data collection, analysis and proposal of CHESS SETUP system solutions (KER1) for the customers.
- **Wattia Innova** will be responsible for the engineering project, combined with the control, automation and installation in the projects.

The consulting company could require the active participation of different companies like the following:

- Providers (solar panels, heat pumps, thermal energy storage, accessories)
- Installers
- Other third parties interested in exploitation

It would not be necessary to integrate these stakeholders as new partners, as agreements or contracts for participation could be made based on projects.

PRICE:

There is no defined price for CHESS SETUP system (KER 1) as a standard solution, since the system depends on the following specific characteristics of each project:

- Location and climate zone
- Type of demand
- Percentage of the thermal demand covered by the system
- Specific characteristics and assets of the building
- Roof space availability for solar panels
- Space availability for seasonal thermal energy storage

Table 3 shows the price ranges for the different components of the CHESS SETUP system. This information comes from the experience gained in the CHESS SETUP project, technical studies, other CHESS SETUP proposals, data collection from suppliers and manufacturers, and market prices analysis, among others.

Components	Price range	
Photovoltaic solar panels (Jäger-Waldau, A., 2020)	1000-1500	€/kWp
Hybrid solar panels (IEA SHC Task 60, 2020)	400-1200	€/m2
WSHP heat pump - Residential (Taylor, 2020)	1200-1800	€/kW
WSHP heat pump - Industrial (Taylor, 2020)	300-1200	€/kW
ASHP heat pump - Residental (Taylor, 2020)	800-1800	€/kW
ASHP heat pump - Industrial (Taylor, 2020)	300-800	€/kW

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Lithium-Ion batteries (Tsiropoulos I., 2018)	200-1200 €/kWh
Thermal Energy Storage (Water/ground) (Sarbu & Sebarchievici, 2018)	0.1-10 €/kWh

Table 3: CHESS SETUP components prices

In the table above, it is observed that the price range has a considerable variation, this is mainly due to the size of the facility and the market's region or country.

There is a relationship between the cost of installing CHESS SETUP system, and the scale of the project since when the installed power is greater, a better return on investment is obtained.

Table 4 presents orientative CHESS SETUP system implementation costs. For this purpouse, the relationship between the building type, the thermal demand, conditioned area and the percentage of demand to be covered by the system has been established. It has also been considered 100% roof availability for solar panels and space availability for the thermal energy storage. Please note that the figures are indicative and are based on the experience obtained in the CHESS SETUP project, other technical studies for different CHESS SETUP proposals, the collection of data from suppliers and manufacturers and the analysis of market prices. For proper sizing, a technical and financial study must be carried out.

Building Type	Thermal demand type	% thermal demand covered	CHESS SETUP estimated implantation cost (€/m2)
Sport Centres	Swimming pool+DHW	30-60	600-800
Sport Centres	Heating+DHW	60-80	500-700
Dwellings[12]	DHW+Heating+Battery	60-80	150-250
Office	Heating+Cooling	50-80	140-300

Table 4: CHESS SETUP estimated implementation costs

These CHESS SETUP estimated cost values are only applicable to new buildings. For those cases in which it is required to implement the system to an existing building, the cost of architectural work to adapt the building, or to carry out energy rehabilitation should be considered.

INDUSTRIALISATION POTENTIAL:

As discussed in the ESS and pointed out by the expert there are no significant challenges regarding the IPR between partners for the deployment of KER 1.

The primary IPR element of the project is the Zero Carbon Solution (ZCS), the combination of EEB, PVT and Heat Pump, which was protected by patent prior to the project start. For this reason, during the CHESS SETUP project Caplin Solar Systems was a single source procurement where no other providers could offer the deployed solution.

[12] Including 2.5 kW Lithium-Ion battery

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For the correct deployment of KER 1 and to ensure the constant renovation and compliance with client requirements, the new firm will consider the following international certifications:

- Certification ISO 9001 (Quality management), which specifies the requirements to deploy a quality management in compliance of legal requirements and applicable framework. Also includes a handbook for SMEs wishing to implement a quality management system based on ISO 9001:2015.
- Certification ISO 140001 (Environmental management), which specifies the requirements to deploy an environmental management system so that firms can show and prove their compromise with the compliance and follow of the environmental and sustainability legal framework, but also controlling their environmental impact when performing their tasks.
- Certification ISO 50001 (Energy Efficiency Management), which specifies the requirements to deploy an energy management system. It also shows the firm's compromise to implement a strict energy policy and to effectively manage all energy related aspects of its activity, thus allowing energy savings by using existing energy resources in the most effective and sustainable way.

KER 1 Exploitation Roadmap

ACTIONS:

In order to exploit and scale up the CHESS SETUP system implementation (KER 1) in the most appropriate way, it is planned to deploy a series of actions described below.

- **Short-term actions:**
  - Identification of business opportunities in the area of the of heat integration systems for new and existing buildings. Possible early adopters: public administrations, industries and services companies with sustainability policies would be the primary customers in a first phase as they should lead the deployment of the CHESS SETUP system in their buildings (news and renovated) in order to open the path to the further implementation of this solution in every customer segment.
  - Preliminary energy-use analysis, included a detailed breakdown final energy consumption, O&M variations, a detailed savings summary including energy, emissions and economics, etc.
  - For each study case identify implementation costs and savings expected for CHESS SETUP implementation.

- **Mid-term actions:**
  - On-site visits to verify the technical configuration, equipment and system operation. This stage also, includes:
    - Energy measurements (data collection);

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        - Energy analysis (energy consumption over the last years, energy contracts with retailers, actual energy consumption and trends, correlation between measurement and equipment operation and performance, etc.);
        - Benchmarking, allowing a comparative between different KPIs of an optimal operation and service performance which allows the extraction of valuable information on the energy behaviour of the facilities involved in the project;
        - Measure and verification plan, modelling actual energy consumption and forecasting future energy dispatching through independent variables (such as energy production, climatology, economic and financial indicators, etc.) to ensure the most accurate forecast on the TES system performance in the upcoming years;
        - CHESS SETUP system proposal, including a technical description, energy and economic savings.
    - Planning and follow-up meeting, before the technical report is delivered to the client. It is proposed a review of the work done, including:
        - Explanation of the CHESS SETUP system proposed, considerations made and justifications, to discuss it with the client;
        - Set a new round of on-field visits (if necessary).
    - Final report presentation, providing detailed energy analysis, identifying the client's building/facilities weaknesses and providing a series of energy efficiency measured to ensure an improvement on the energy use. It is included:
        - Characterization of actual energy system;
        - Improvement potential on the actual scenario;
        - Analysis of the CHESS SETUP system proposed;
        - Conclusions.

- **Long-term actions:**
    - Executive project of the CHESS SETUP system proposed (memory report, calculations, layouts, budget, etc.);
    - Installation and commissioning of the system;
    - Follow up the energy savings periodically via monitoring system;
    - Ensure the correct performance of the installation regarding the parameters considered in the simulation and verification process;
    - Identification of replication and/or escalation opportunities in the area of heat integration systems for new and existing client's facilities.

JOURNEY MAP:

The following journey map (Figure 24) represents the main milestones and tasks involved in KER 1 'CHESS SETUP system' exploitation plan, including the next steps to follow after the CHESS SETUP Project finalization.

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Figure 24: CHESS SETUP system KER1 exploitation plan

Milestone 1 (MS1) is expected to be completed 6 months after project finalization. This milestone includes benchmarking and KPI analysis of the CHESS SETUP system.

After that, in Milestone 2 (MS2), the market will be analyzed to define the target market, and identify the segment to introduce the new product. This task is expected to ends in month 12.

Milestone 3 (MS3) includes the analysis of the market competition, 9 months of work are planned to complete this milestone.

Milestone 4 (MS4) develops a detailed analysis of technology manufacturers and suppliers regarding the CHESS SETUP system components. The process covers a 10 months period, ending in month 20 after the project finalization.

Finally, milestone 5 (MS5), includes replication and escalation of the CHESS SETUP system. It could start the third year after the project finalization, becoming the system proposed a new line of business that generates benefits for the company.

IMPACT:

In order to demonstrate the real impact of KER 1 we describe below the interest it has raised already during the project development, linked both with the market analysis and the WP7 communication activities.

Firstly, as a result of the generation of a stakeholders community conducted during the early stages of the project, interested parties in the implementation of CHESS SETUP were identified. Specifically, during 2018 the following firms expressed their interest in the results and conclusions of the project demonstrating the real potential of KER 1 (the formal interest letters are included in the Appendix 7.1):

- Sociedad Municipal de Zaragoza Vivienda
- Construcciones Almozara 2000 S.L.
- Arquitecto en Zaragoza
- Centro Nacional de Energías Renovables CENER
- Clima Import Spain SRL

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- Ingeniería Torné
- Zeroaplus Consulting S.L.

During 2019, the City Council of Viladecans has signed an agreement with BCNecologia in order to develop technical and economic feasibility studies for the implementation of CHESS SETUP systems in three different public sports centers, with a payback that varies between 10 to 16 years.

These studies were presented to IDAE (Institute for Diversification and Energy Savings) requesting 'Aid and Financing for Sustainable Urban Development in Projects of Local Entities that favor the transition to a low-carbon economy (European Regional Development Fund FEDER - POPE 2014- 2020)'. Due to COVID-19 the award process has been suspended on March 14, 2020 and has been reactived on June 1, 2020. The resolution is expected in early summer 2020. The interest letter is included in Annex 1.

Moreover, another relevant example of the current impact of KER 1 is that ABORA, the company that supplied the hybrid panels to the Sant Cugat pilot, has been very interested in the development and results of CHESS SETUP during the whole project life.

As a result, we include below the projects and their status that are being implemented following the CHESS SETUP model:

- The British school in Zaragoza: the construction will be concluded during the last quarter of 2020.
- Arpa industry: Already executed and operating.
- Philosophy faculty of the Zaragoza University: In progress
- Barbastro Health center: Designed, tender conducted during July 2020
- Business center EXPO Zaragoza: Designed, tender conducted during July 2020
- San Sebastián prison: Designed
- Atlas Copco Industry: Budgeted.

These are the projects that are already operating or in the process of installation, but there are more projects that have been presented and are pending of the final approval of the clients.

During the final phase of the project and the completion of this deliverable in 2020, the CHESS SETUP brochure together with a brief survey was sent to the interested companies and organizations in order to obtain their view and identify possible further interests or collaboration, obtaining a positive feedback, which we summarize below:

- All of them have already prescribed the CHESS SETUP solution and one of them has already implemented it.
- In terms of benefits, they have highlighted that CHESS SETUP solution is a a great way to provide clean energy in a building system of heating and hot water for domestic use, especially in medium or big size buildings (30 dwellings or more).

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- In terms of potential risks, they agree that the initial investment and maintenance costs have to be taken into account in advance and that it may seem an elevated cost in a first place but it is not.
- They are interested to be informed about other democases even in other countries.

The survey was sent to several companies, receiving answers from three of them. All the survey responses are included in the Appendix 8.

Therefore, CHESS SETUP system or KER 1 has already settled a new standard for other projects, representing a key and catalyst project promoting change and evolution in the energy sector.

FINANCIALS:

The investment costs of the CHESS SETUP solution highly depends on the client's needs and facilities (building characterisation, energy assets, heating & cooling demand, electricity demand, occupancy profile, etc.). Anyway, the main investment costs should include at least the following elements:

- Total investment costs (including all the equipment associated to the deployment of CHESS SETUP solution such as PV – ST panels, their structure, seasonal heat storage, heat exchangers, heat pumps, circuit pumps, valves, pipelines, etc.);
- Total O&M costs (workman, tools, clothing, security measures, vehicles, subcontracting, etc.);

Apart from every partner's own budget or incomes, all according to their specific role in the market, **public support** is needed in order to place KER 1 as a competitive solution among existing well-entrenched technologies and enhance the overall transformation in this area.

In these sense, different funding opportunities in the research, SME, energy and innovation fields have been analysed. Below we describe the different funding possibilities selected as potential additional financing for KER 1 implementation:

- Horizon 2020 and Horizon Europe: energy research and innovation programme with €5.9 billion budget, aiming for the creating and improvement of energy technologies such as smart energy networks, tidal power and energy storage, building a low-carbon, climate-resilient future.

- Connecting Europe Facility (CEF): a €33 billion plan between 2014 – 2020 for boosting energy, transport and digital infrastructure. The latest proposal for 2021 – 2027 with a budget of €42,3 billion is made to support investments in the infrastructure networks for energy (€8.7 billion), transport (€30.6 billion) and digital (€3 billion), representing a 47% increase compared to 2014 – 2020;

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- Cohesion Fund: programme between 2014 – 2020 aimed to reduce economic and social disparities between Member States, focusing on those whose Gross National Income (GNI) per inhabitant is less than 90% of the EU average which are Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. The Cohesion fund allocates a total of €63,4 billion to activities such as trans-European transport networks and energy or transport projects, as long as they clearly benefit the environment in terms of energy efficiency, use of renewable energy, developing rail transport, etc.;
- European Regional Development Fund (ERDF): program to strengthen economic and social cohesion in the EU by correcting imbalances between it regions, focusing its investments on several key priority areas such as innovation and research, digital agenda, support for small and medium-sized enterprises (SMEs) and low-carbon economy;
- European Investment Bank (EIB) and European Fund for Strategic Investments (EFSI): EIB focuses on unlocking energy efficiency investments, decarbonising energy supply theough increased support for renewables, supporting innovation and innovative energy infrastructure and ensuring power grid investment through the implementation of energy lending policy (in 2019, their loans helped construct 30.400 km of power lines and generate 13.177 MW of electricity, 98% of it from RES) and EFSI is supporting investments in energy efficiency and renewable under the Juncker Plan, providing a first loss guarantee and allowing the EIB to invest in more, often riskier, projects and helping the transition to a resource efficient, circular and zero-carbon economy (at least 40% of EFSI infrastructure and innovation projects aim to contribute to climate action in line with the Paris Agreement);
- Just Transition Mechanism: programme focused on regions and sectors that are most affected by the green transition, given their dependence on fossil fuels, consisting on providing grants, crowding in private investments and releasing a public sector loan facility along with EIB to mobilise additional investments and leverage public financing.
- SME Instrument: this Horizon 2020 programme offers small and medium-sized businesses funding for innovation in different phases (a first concept and feasibility assessment phase followed by a second innovation project), help in accessing private financing (the third commercialisation phase) and coaching.

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6.2.2 Key Exploitable result No 2 (KER 2): CHESS SETUP Services

KER 2 Characterization

DESCRIPTION:

The second KER agreed during the ESS among all consortium members to be implemented into the wider market as a benefit of the project is service oriented and consists on offering a **global integrated solution based on energy services**.

In this sense, Veolia (VLC), as an energy services company, offers the replication of an **Energy Savings and Maintenance Contracting model** introduced by the "*Instituto para la Diversificación y el Ahorro de la Energía*" (IDAE) where the ESCO takes responsibility to supply the services engaged (Energy Management, Maintenance, Full Warranty Service and Improvement works and Installations Renewal) in order to guarantee energy savings and its subsequent economic savings on the deployment of the CHESS SETUP solution.

PROBLEM:

Customers may be facing some of the following issues: too much primary energy consumed, too much energy billing although consumption is not excessive, low performance or efficiency of the energy system, bad habits in equipment use, lack of knowledge on new market technologies regarding energy efficiency, lack of environmental commitment, no use of RES energy generation, etc.

In the same path, many clients do not have the tools or knowledge to be in charge of their energy management and, therefore, they need to externalise those services via ESCO or other energy management agent.

In relation to how costumers have solved this issue so far, most consumers who have minimum knowledge on Home Energy Management Systems or Smart Metering may have deployed those technologies at their homes. In the same way, many customers have changed habits in their energy usage via new more efficient equipment acquisition, smart control and monitoring systems, choosing the tariff that best matches with their consumption habits.

Although that might have increased their energy efficiency and their perception on a rational use of their energy assets, most end-users are still not aware of the main framework, developments and solutions available in the energy market.

UNIQUE VALUE PROPOSITION (UVP):

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KER 2 can be distinguished from other competitors in terms that a powerful ESCO can provide a full range of combined options depending on the client's needs and capacity, optimizing and lowering energy consumption and leading to energy and cost savings.

This is based in the fact that the ESCO model is able to provide different services depending on the client needs. Whether if the client wants to externalise its energy management (thus giving the ESCO full control on cost analysis and energy dispatching), its operation and maintenance or if the client wants to improve its installation and equipment (thus asking the ESCO or a third party to assume the financial investment of the solution, which is implemented by the ESCO, in order to increase energy performance of the client's energy system).

The following target segmentation defines where the efforts will be focused in order to facilitate the selection of the channels. In this sense, the proposed main customer segments for KER 2 are:

- **Private stakeholders, firms or communities** with high energy demand, concerned about their energy consumption or environmental issues and also with high industrial complexity facilities, requiring expertise and knowledge from a professional energy manager to ensure the maximum global performance (thus leading to increased revenues and cost reduction).
  This UVP can be seen as an opportunity to invest in innovative and ground-breaking solutions (usually for citizens grouped in smart energy communities, since a single end-user has very low financial capacity and improvement potential) thus improving life quality of the community. This will also lead, as for the rest of potential clients, to energy and cost savings but also to free the energy community of the engineering analysis tasks, which would be led by the ESCO, therefore giving them the power to take decisions that best fit with their worries and objectives but externalising the manpower and technical issues to an expertise agent.
- **Public institutions**, as they can lead the change of legal procedures and framework to promote energy efficiency and a rational use of energy assets. For public administrations, this UVP can be seen as a way to publicly promote energy efficiency measures, thus implementing cost reduction solutions for public equipment and installations and therefore serving as an example for citizenship on the compromise to fight climate change and reduce GHG emissions.
- **For professional and industrial clients**, the UVP offered by the ESCO can be seen as a unique opportunity to lower energy costs, improving energy assets performance and externalising a task which was probably not considered as an improvement opportunity in their financial balance. Since big industrial firms usually have financial capacity and different supply chains, their improvement potential is huge when talking about energy efficiency.

We consider that KER 2 should be addressed first to public administration and companies promoting sustainability as they can lead the change of paradigm in energy usage, in order to promote new trending behaviours which include a rational and more

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efficient energy usage, lower GHG emissions and decarbonisation of their facilities. As long as the services business model is attractive to major consumers, small ones will be able to enter the market.

COMPETITORS:

The main competitors are the technology and service providers that might offer different heat and DHW solutions and alternative TES applications. Their strengths are that they might have a more integrated and low cost solution and higher performance ratios. However, in most cases the problem of technology providers is that they only provide equipment but no operation and maintenance services, which usually leads to a lower service life of the product.

We might also face other ESCOs present in the market, since our solution combines either technology deployment and would integrate its exploitation via ESCO business model. In that case, the main differences can be the packages offered in every service, their cost, their capacity depending on their financial, technical and manpower resources. In our case, we plan to differentiate KER 2 from other competitors offering an O&M contract in the most optimized way with the technology to be deployed.

GO TO MARKET – USE MODEL:

KER 2 will be available to customers to generate an impact, selling a global integrated solution based on energy services, including the following:

- The calculation of the total operational cost, providing know-how about the operational cost of the systems including preventive, normative and corrective maintenance, operation control, material replacement, indirect costs, etc.
- The generation of a measurement and verification plan based on energy savings through a baseline definition.
- An analysis of the most feasible business strategy and energy services modality, taking into account the economic and financial viability.

The CHESS SETUP equipment will be deployed so that the ESCO business model is implemented through an Energy Savings and Maintenance Contracting model, which includes the following elements:

1. **Energy management:** performing all energy management tasks (supplying guarantees in terms of quality, quantity, safety and lowering purchase costs) via any of the main EPC (guaranteed savings contract, shared savings contract, etc.), ESC (improved energy costs) or forfeit contracts;
2. **Maintenance:** performing different types of maintenance that must be applied in order to guarantee the correct and optimal operation conditions, but also ensuring that all equipment deployed is preserved and controlled effectively and efficiently (fixed fee includes professional personnel costs, materials, transportation, communication and management systems, supervision, etc.);
3. **Full warranty repair:** providing a full reparation service of all failures that may occur during the operation of the installation, so that the ESCO assumes all

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technical and substitutional risks of the equipment deployed (fixed fee includes professional personnel costs, materials to replace all equipment included in the contract, transportation, communication and management systems, supervision to minimize operational risks, etc.);

4. **Improvement works and installation renewal:** providing a regular innovation and improvement analysis so that the client is offered different energy efficiency improvements on the installation via self-financing or third-party financing of the new equipment in order to guarantee a performance improvement of the whole system.

The CHESS SETUP solution itself, if operated appropriately, should always represent an energy consumption improvement, so that the energy demand is fulfilled but the energy generation and consumption is reduced, thus implying also a cost reduction. It is hard to define the breakeven point but it is expected to produce an interesting payback as long as TES technology is big enough to improve the heat pumps performance, therefore, improving overall system performance.

PRICE:

It's not feasible to provide a unique estimation of the price either from the equipment itself, as it depends on the needs and size of the client, its estimated potential energy and economic savings and the length of the contract or the O&M of the solution. The CHESS SETUP solution itself, if operated appropriately, should always represent an energy consumption improvement, so that the energy demand is fulfilled but the energy generation/consumption is reduced, thus implying also a cost reduction.

It's hard to define the breakeven point but it is expected that CHESS SETUP solution has an interesting payback as long as TES technology is big enough to improve the heat pumps' performance, therefore, improving overall system performance. In order to go to market with an interesting proposal, the implementation of TES in buildings must correspond with similar solutions already available in the market in terms of energy and cost savings. If we want to increase profitability, we must find the most suitable algorithm between total investment cost of each of the project's consignments and its associated energy and economic savings, either by increasing hybrid photovoltaic and solar thermal panels (PV – ST) or increasing TES capacity, so that the savings grow in a major proportion than the total investment cost. For so, the price highly depends on the buildings' assets and characteristics. Therefore, in order to provide a competitive price where the CHESS SETUP solution is deployed, fixed costs must match with similar existing solutions in the market which offer a similar energy and cost reduction.

As a reference, the main investment costs of each pilot demonstration case (a sports center, an existing offices building and a new construction residential building) have already been included and justified in D6.1 – Business Models for the Case Studies.

INDUSTRIALISATION POTENTIAL:

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KER 2 (equipment deployment plus energy service management, plus O&M and financing if needed) has a huge industrialisation potential as a whole industrial package to be sold in the market, taking into account the following information:

- The business model information already detailed in *D6.1 - Business models analysis for the case studies*.
  - Current energy consumption as a baseline/reference;
  - Current energy costs, referenced either to thermal energy consumption [€/kWht] and electricity consumption [€/kWhe];
  - Estimated energy savings generated with the new equipment/solution:
    - Thermal energy consumption savings [kWht], as energy saved substituting fuel consumption by seasonal thermal energy storage and installing hybrid panels (heat production);
    - Electrical energy consumption savings [kWhe], as energy saved by installing hybrid panels (electricity production) ;
  - Estimated economical savings generated with the new equipment/solution:
    - Thermal energy economical savings [$€_t$], by multiplying thermal energy consumption savings [kWht] and current energy thermal energy costs [$€/kWh_t$];
    - Electrical energy economical savings [$€_e$], by multiplying electrical energy consumption savings [kWhe] and current electricity energy costs [$€/kWh_e$];
  - Periodical updated savings provided by the monitoring & control system deployed on each demo pilot site, to see if the deployed technology's behaviour fits with what was theoretically expected;
  - Total investment costs;
  - Total O&M costs;
  - Current economic indicators (IPC, VAT, etc.);
  - Legal framework applicable to RES project deployments on each Member State/country.
- The background of heat and DHW supply solutions and its applicable **European and local regulation,** already described in the previous section:
- The required **equipment certifications** provided by the manufacturer, which will allow to sell KER 2 in the market, assuring that the equipment works under the parameters and agreements established in the ESCO contract.

KER 2 Exploitation roadmap

ACTIONS:

In order to exploit an EPC/ESC contract, the technical proposal will be completed so that the ESCO complies with all expected phases of an energy service project deliverance.

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Therefore, following the path of an energy audit project (with its necessary amendments, since every case and client requires a specifically adapted methodology), VEOLIA will deploy the following actions to provide the most suitable way to exploit and scale up KER 2:

- **<u>Short-term actions:</u>**
    - Preliminary meeting with the client (potentially interested in TES systems or via commercial approach by the sales department), preferably with the team in charge of the energy consumption control and management. This will serve as a first approach on the client's interests, energy consumption/production habits, perception on the solution offered and overall status review of the facilities/installations involved. This task also includes asking for all available documentation/data from the facilities, so that the VLC team has all relevant inputs to start the feasibility analysis.
    - Walk-through, identifying rough costs and savings expected for Energy Efficiency Measure (EEMs) and also identifying capital projects. This also includes a revision of safety framework, resources available from the client, an explanation from VLC on the methodology and metering equipment to be deployed and any other circumstances that might affect the project.
    - Preliminary energy-use analysis, comprising the end-use breakdown energy consumption, detailed pre-analysis, generic cost & savings for EEMs, O&M changes that might take place when deploying the TES system, etc.

Please note that the analysis of the different methodologies to find the market segment that best suits what the company can offer has been included in D 6.1.Business Models Analysis for the Case Studies.

- **<u>Mid-term actions:</u>**
    - On-site visits to verify the technical configuration, equipment and system operation with the VLC Energy Department engineers. Once VLC has created closer ties with the client, it's time to engage the next steps of the project, including:
        - Energy measurements, either from data acquisition from VLC metering equipment deployed or via an existing SCADA/data collection and management software available in the client's facilities;
        - Energy analysis including energy consumption over the last years, energy contracts with retailers, actual energy consumption and trends, correlation between measurement and equipment operation and performance, etc.;
        - Benchmarking, allowing a comparative between different KPIs of an optimal operation and service performance which allows the extraction of valuable information on the energy behaviour of the facilities involved in the project;
        - Measure and verification plan, modelling actual energy consumption and forecasting future energy dispatching through independent variables (such as energy production, climatology,

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economic and financial indicators, etc.) to ensure the most accurate forecast on the TES system performance in the upcoming years;
    - EEMs proposal, including a technical and investment description, energy evaluation, economic and financial evaluation (including profitability, liquid assets and risk indicators such as VAN, TIR, payback, etc.).
  - Progress meeting, so that some weeks before the technical report is delivered to the client VLC offers a review of the work done so far, including:
    - Explaining what EEMs are being considered and why, to discuss it with the client;
    - Match proposals on different EEMs;
    - Set a new round of on-field visits (if necessary).
  - Final report deliverance, providing a deep and detailed energy survey & analysis, identifying the client's facilities weaknesses and providing a series of EEMs to ensure an improvement on the energy dispatch. The report includes:
    - Executive summary of the work done;
    - Characterization of actual energy system at the client's facilities;
    - Diagnosis of the improvement potential on the actual scenario;
    - Analysis of each EEM proposal;
    - Overall analysis of the EEMs and mixed effects;
    - Conclusions.

- **Long-term actions:**
  - Executive project of the EEMs (memory report, calculations, layouts, budget, investment options, financing, etc.);
  - Installation and commissioning of the EEMs;
  - Operation & Maintenance of the client's facilities (the ones included in the energy service contract considered);
  - Measure and verification plan under IPMVP international protocol for future improvements:
  - Follow up the energy savings periodically via monitoring system;
  - Ensure the correct performance of the installation regarding the parameters considered in the simulation and verification process;
  - Identification of replication and/or escalation opportunities in the area of heat integration systems for new and existing client's facilities.

JOURNEY MAP:

The following journey map represents the main milestones and tasks involved in KER 2 exploitation plan, including the next steps just after the ending of CHESS SETUP Project.

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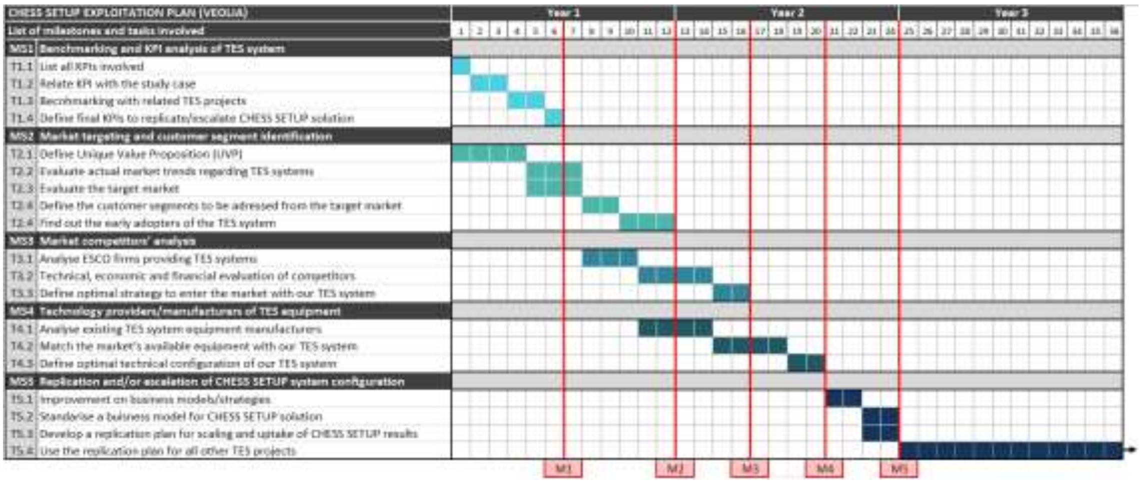

Figure 25: KER 2 Journey map (Source: VLA)

The first milestone (MS1) is meant to end 6 months after the project's ending, including benchmarking and KPI analysis of CHESS SETUP's TES system. After that, we'll need to develop the market targeting and segment identification, listed as MS2 and ending 12 months after the project's ending. MS3 includes market competitor's analysis, which could start in parallel with T2.4 and ending 16 months after the project's ending. MS4 includes a deep analysis on technology providers/manufacturers regarding TES systems, ending 20 months after the project closure. Finally, MS5 includes the replication and escalation of CHESS SETUP's TES system, which could start 24 months after the project's ending and become a new VEOLIA business line and revenue income.

IMPACT:

Veolia Group is a global leader company in optimizing energy resources management. That's why projects like Chess Setup are aligned with Veolia's activity: apart from the main three activities, the group also develops access solutions to these resources, helping to preserve existing basic resources and developing strategies to engage and keep a renewable and sustainable energy model. The group has valuable and proven experience in those three main fields and its associated activities, thus acting as an important role of the economy decarbonisation.

The main benefits provided by the Spanish branch of Veolia are:

- Energy: 8528 installations managed, more than 1.220.000 MWh produced, 177.000 tons of GHG emissions avoided each year and more than 120 MW of solar energy managed and maintained;
- Water: 24 million m³ of potable water produced, more than 52 million m³ of urban wasted water treated and more than 22 million m³ of industrial wasted water treated;
- Wastes: 279.744 tons of wasted have been treated, more than 158.000 tons of wastes valorised in matter or energy, nearly 70.000 MWh produced (electrical

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and thermal) out of wastes and nearly 80.000 tons of biomass consumed to provide energy.

Veolia's way of measuring a project success depends on many different inputs, not only technical ones but also social and demographic ones. As an international firm being present all over the world, our success is not only measured by achieving our technical and financial objectives but also based on its clients' satisfaction on the service/solution provided. The main indicators used to measure impact are:

- Achieving energy consumption reduction;
- Achieving energy costs reduction;
- Providing highly profitable solutions;
- Deploy all tasks stated in the contracts in the most professional, effective and efficient way to ensure result achievement but also providing satisfaction and trustworthy bonds;
- Retain existing clients by continuously offering them innovative and sustainable solutions to reduce their costs by also taking part in the climate change fight and economy decarbonisation;
- Reaching as much new clients as possible by improving marketing and social strategies, matching the global (and client specific) concerns with an optimal solution to improve the performance of the clients' facilities.

FINANCIALS:

The main **revenue streams** regarding the deployment of CHESS SETUP solution through the ESCO business model, are integrated in the following four elements already highlighted earlier in the KER 2 characterization:

- **Energy management**: through the performance of all energy management tasks (supplying guarantees in terms of quality, quantity, safety and lowering purchase costs).
- **Maintenance**: through the performance of different types of maintenance activities in order to guarantee the correct operation conditions and the optimal deployment of the equipment.
- **Full warranty repair:** providing a full reparation service of all failures that may occur during the operation of the installation.
- **Improvement works and installation renewal:** providing a regular innovation and improvement analysis.

On the other side, with regards to the **investments,** ESCO's don't usually invest in patents, product prototypes or distribution chains, the costs to implement the CHESS SETUP solution are mainly based on:

- Manpower, materials (either for maintenance or substitution), installation and commissioning task costs to perform an effective and efficient energy management and maintenance of all equipment included in the contract.

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- Energy management system control and operation costs (including engineering department professionals, monitoring system, benchmarking analysis, digitalisation of energy supplying information, measure & verification plans, etc.
- Investment costs for the renewing equipment (including total investment and associated financial risk analysis) when the client has no financial capacity to assume the total cost of the operation.

With regards to the **financing possibilites**, the most common tipologies specifically indicated for EPC contract types are the following:

- The client's self-financing, where the the client assumes the investment costs.
- Third-party financing, involving a contractual arrangement with a third party that provides the capital and charges the beneficiary an equivalent fee. This fee is related to the energy savings achieved as a result of the energy efficiency improvement measure. This third party may or may not be an ESCO.

- In an Energy Performance Contract – Guaranteed Savings model (EPC GS), the ESCO guarantees a certain savings on the client's energy bill and assumes all technical risk. The client obtains a bank loan or uses its own resources to pay contractually determined fees to the ESCO and to the bank and keeps the difference.

- In an Energy Performance Contract – Shared Savings model (EPC SS), the ESCO can provide financing (therefore assuming both technical and credit risks for the client), as well as project development and implementation costs. That can be valuable for the client as it avoids the need for upfront capital costs, with ongoing payments to the ESCO based on savings obtained.

Therefore, depending on the client's financial capacity, the chosen EPC changes the financial status but either if it's a guaranteed savings model or a shared savings model, the client relies on the ESCO to assume all technical risks as it provides all project development and implementation costs. The client can rely on the ESCO to assume all financial risks via contractual arrangement, normally with an interest rate lower than the bank's but again assuming all technical risk.

7. Conclusions

Firstly, in relation to the project context, CHESS SETUP represents **an innovative approach to thermal energy storage and self-sufficiency in buildings** aligned with the latest market drivers such as the **Energy Performance Building Directive** (EPDV, 2010) and the recast of the **Renewable Energy Directive**. Furthermore, all the targeted influence area in Europe has set ambitious targets to tackle climate change and achieve more energy efficiency and increase of RES in buildings as Europe is projected to experience a high interest and demand for energy-efficient products such as CHESS SETUP as heating and cooling industries need to decarbonize over the next 30 years.

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Well designed and combined systems can improve building's self- sufficiency, energy efficiency and comfort level, yielding significant cost savings, promising payback period and less green house gases emissions to the atmosphere. Therefore, **sustainable buildings** need to take advantage of renewable and waste energy to approach ultra-low energy buildings.

In this sense, the Thermal Energy Storage (TES) capacity of a building may be employed to optimize efficiencies and to suppress the heating and cooling energy costs, therefore its use in buildings combined with space heating, domestic hot water and space cooling has recently received much attention.

With regards to the project itself, CHESS SETUP responds to the increasing heating and domestic hot water demand in the building sector. As explained in the market analysis, at a time when heating and domestic hot water (DHW) represent 60% of the energy consumed in our dwellings and the building sector accounts for 40% of the energetic demand, CHESS SETUP KERs represent an important achievement into the european energetic transition and a commitment towards a sustainable development: a self-consumption system driving towards the European NZEB objectives, energy independence, a higher productivity of the grids and a low-carbon society.

Moreover, both KERs represent how the project has designed a flexible, sustainable and affordable solution able to supply heating and hot water in buildings mainly from renewable sources, increasing the self-sufficiency of the building and reducing its emissions, as summarized below:

- In terms of **flexibility,** and as described both in KER 1 and KER 2, CHESS SETUP heating (and cooling) system can be implemented wherever in Europe and applies for new and existing buildings, to supply one building or a set of housing, in dense population areas or in the countryside. After the analysis conducted during the project the most suitable conditions that have been identified are the following:
    - With regards to **external factors** (such as geography or space availability) these are the variables to take into account:
        - With regards to the climatic zone: A value that influences when defining the CHESS SETUP system implementation is the climatic zone, to define the annual solar radiation available.
        - In relation to the land or rooftop availability: It is also particularly important to determine those buildings that have a high technical potential for solar energy, given the total available land or rooftop area. Understanding the amount and characteristics of available space to install solar panels is essential.

      These factors will determine whether the solar collection will be a suitable energy source for the building. Other energy sources options to evaluate, depending on the availability of the resources in the area would be waste heat, geothermal, district heating, biomass, combined heat and power (CHP), etc.

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- With regards to **internal factors** (housing engineering, etc.) CHESS SETUP is expected to be more profitable in:
    - Those buildings with medium-high and constant thermal demand throughout the year, such as hotels, hospitals, laundries, sports centre, among others.
    - Buildings with available and easy-access space to install thermal energy storage, either inside or outside the building.
    - New buildings projects, in this way the system will be integrated from the initial design phase of the project.

- In terms of **sustainability**, CHESS SETUP system allows the energetic needs of the buildings to be residual, thanks to the use of renewable energies collected and transformed on site. This means a decrease in GHG emissions and an improvement in energy efficiency, aligned with the **EU Goals for 2020**.
- In terms of the **go to market use model**, CHESS SETUP was designed as an economic solution, requiring low investments which could be exploitable at different scales. Being a centralised system it also reduces maintenance costs and energy losses. Both the pilot sites implementation and the KERs have shown that is a suitable technical and environmental solution, as well as economically viable. Strategic alliances with manufacturers, suppliers, engineering companies and interested parties could open the range of opportunities to replicate the CHESS SETUP model, reducing costs and scaling the implementation of the system.

  Moreover, CHESS SETUP can allow significant energy savings for the buildings: the energy produced on-site will be consumed on site or reverted to the power grid if necessary. Overall, and taking also into account the impact already generated by the project and the feedback gathered by the stakeholders that have already implemented or are in the process of installation, CHESS SETUP has set a precedent for other projects playing a key role and a catalyst for other projects to be done.

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8. Annexes

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8.1 Annex 1: KER 1 Interest letters

Zaragoza VIVIENDA

ÁREA DE PROYECTOS Y OBRAS

D. Nardo Torguet Escribano, en calidad de Director Gerente de la Sociedad Municipal Zaragoza Vivienda con CIF:B-50005701 muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo CHESS SETUP (www.chess-setup.net).

Dicho proyecto marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

Por ello, en base a los resultados obtenidos, se analizará la viabilidad para su implantación en proyectos que promueva la Sociedad Municipal Zaragoza Vivienda.

En Zaragoza, a 22 de febrero de 2018

El Director Gerente,

Nardo Torguet Escribano

San Pablo, 61. 50003 Zaragoza. Tfno 976-28-26-59. Fax 976-28-10-62. www.zaragozavivienda.es
Sociedad Municipal Zaragoza Vivienda, Sociedad Limitada Unipersonal

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CARTA DE INTERÉS

En Zaragoza, a 21 de febrero de 2018

Mediante la presente carta **D. Joaquín Ramirez** con en representación de **Construcciones Almozara 2000 S.L.** con CIF: B-50870930 muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Construcciones Almozara 2000 es una empresa dedicada a la promoción y construcción de edificios en los que la sostenibilidad es un valor relevante. Como consecuencia, la aparición de nuevas tecnologías e instalaciones es de especial interés para poder ser aplicadas en futuras promociones.

La instalación que se va a realizar bajo el proyecto europeo CHESS SETUP en Sant Cugat marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

CONSTRUCCIONES ALMOZARA 2000

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

CARTA DE INTERÉS

En Zaragoza, a 21 de febrero de 2018

Mediante la presente carta **D. Basilio Tobías** Arquitecto colegiado con DNI: 17690287K muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Dicho proyecto marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

Como muestra del interés que despierta dicha instalación, este concepto de instalación es muy interesante para su futura prescripción en proyectos donde haya una elevada demanda térmica.

Fdo.: Basilio Tobías Pintre

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

CARTA DE INTERÉS

En Pamplona, a 26 de febrero de 2018

Mediante la presente carta **D./Dña. Sergio Díaz de Garayo Balsategui,** jefe de proyectos del Departamento de Energética Edificatoria del **Centro Nacional de Energías Renovables (CENER)** muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Dicho proyecto marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

Por ello, dichos resultados son interesantes para la integración de las energías renovables en los edificios y la evolución hacia la sostenibilidad de nuestros edificios.

FUNDACIÓN CENER CIEMAT
26 FEB. 2018
ENTRADA

SERGIO DIAZ DE GARAYO

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

CARTA DE INTERÉS

En Zaragoza, a 21 de febrero de 2018

Mediante la presente carta **D. Jesús Marcén** con en representación de **Clima Import Spain SRL** con RUT: 217277520018 muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Clima Import Spain SRL es una empresa de nueva creación en Uruguay, ubicada en la ciudad de Montevideo, que cuenta con la experiencia de una sociedad que lleva más de veinte años trabajando en el sector español de climatización, calefacción y fontanería.

La instalación piloto que se realizará en el polideportivo de Sant Cugat marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

Por ello, esta instalación es interesante de cara a su integración en el sector terciario como hoteles, hospitales, centros comerciales, etc. que Clima Import Spain promueve tanto en España como en Uruguay, Paraguay y Argentina.

FIRMADO JESUS MARCEN

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

En Zaragoza, a 21 de febrero de 2018

Mediante la presente carta **D. Octavio Cabello** en representación de **Zeroaplus Consulting S.L** con CIF: B87941753, en adelanta Zeroapus, muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Zeroaplus es una empresa de ingeniería y arquitectura, especializada en dar servicios de consultoría a grandes firmas, en control de proyecto y normativa, desarrollo de proyectos, presentación de ofertas y medición en las diferentes fases. Con una amplia experiencia en el sector de la edificación, y un equipo de expertos multidisciplinar Zeroaplus abarca el sector de la ingeniería y arquitectura en edificación, el desarrollo de I+D, eficiencia energética y sostenibilidad.

El proyecto piloto que se desarrollará en el polideportivo de San Cugat marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en los edificios. Por ello, Zeroaplus está interesado en los resultados y conclusiones de dicho proyecto con la perspectiva de poder integrarlo en futuros proyectos.

Octavio Cabello Villalobos

Administrador Solidario. Zeroaplus Consulting S.L.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 680556.

CARTA DE INTERÉS

En Zaragoza, a 21 de febrero de 2018

Mediante la presente carta **D. Sergio Torné** con en representación de **Ingeniería Torné** con **CIF: B50973296** muestra su interés en los resultados y conclusiones que se puedan extraer de la instalación que combina paneles solares híbridos (PVT), acumulación estacional y bomba de calor en el piloto del polideportivo municipal de Sant Cugat bajo el proyecto europeo **CHESS SETUP** (www.chess-setup.net).

Dicho proyecto marca un precedente en cuanto a integración de nuevas tecnologías renovables e instalaciones eficientes, permitiendo conseguir importantes coberturas solares (tanto eléctricas como térmicas) en nuestros edificios.

Como muestra del interés que despierta dicha instalación, este concepto de instalación se ha prescrito en los siguientes proyectos:

- Facultad de Filosofía y Letras de la Universidad de Zaragoza
- Centro Cívico Sarriguren (Pamplona)
- Centro de Educación Primaria Sarriguren (Pamplona)
- Hospital de Alcañiz (Teruel)
- Centro Comercial Dantxarinea (Urdax) Navarra

Sergio Torné Darnés

Ingeniero Industrial

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8.2 Annex 2: CHESS SETUP Exploitation Survey Responses

Summary | Question | Individual

What is the name of your organization?

3 responses

INGENIERIA TORNE S.L.

SOCIEDAD MUNICIPAL ZARAGOZA VIVIENDA SLU

CONSTRUCCIONES ALMOZARA 2000

Please provide a brief summary of your organization

3 responses

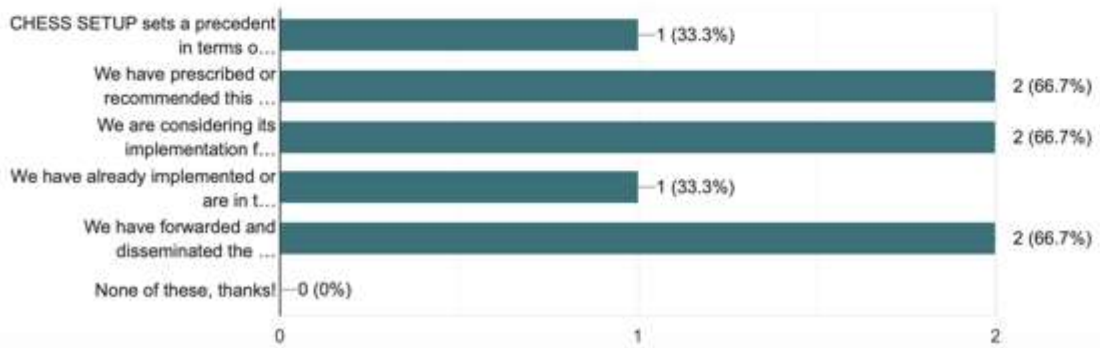
DESIGN, DEVELOPMENT, CONTROL AND CONDUCTION OF TECHNICAL PROJECTS RELATED WITH BUILDING INSTALLATIONS AND FACILITIES.

Building, renting and maintenance of social housing

Empresa constructora y Promotora de edificación residencial, centros comerciales, y equipamientos públicos. Mas de 20 años de experiencia en el sector y mas de 1500 viviendas realizadas.

What is your interest in CHESS SETUP solution?

3 responses



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In terms of benefits or positive findings, what are you conclusions regarding the CHESS SETUP solution?

3 responses

The CHESS SETUP solution is a great way to provide clean energy in a building system of heating and hot water for domestic use. This kind of project reflects the large capacity of the renewable energy, and the posibilities of progress when collaboration of many organization is orientated to obtain the best results.

It can be a great solution specially in medium or big size buildings (30 dwellings or more)

Es importante fomentar y ayudar a las energias renovables y la tecnologia que las usa, debemos conseguir un suministro sostenible y autosuficiente.

In terms of drawbacks or potential risks, which conclusions would you highlight?

3 responses

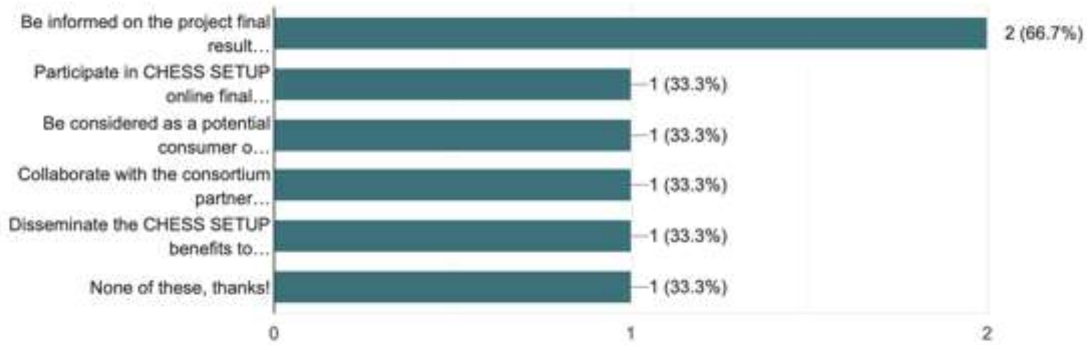
Maybe, the clients first impression could be that it is an elevated cost system. However, that is a wrong statement.

We have to calculate very well the initial investment and we don't know howmuch will be the maintanance costs.

Coste economico y repercusion covid-19 sector construccion

Would you like to...

3 responses



If applicable, please confirm the names of the organizations where CHESS SETUP is being or will be implemented (information will remain confidential).

1 response

SOCIEDAD MUNICIPAL ZARAGOZA VIVIENDA, as the owner of the building "80 dwellings and common facilities in C/Fray Luis Urbano 92, Zaragoza"

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Any comments, questions or suggestions?

1 response

I would like to know other democases even in other countries

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8.3 Annex 3: Emporium background analysis

- **Introduction**

Emporium is a solar energy, low exergy and zero emission building concept with an integrated seasonal storage system without energy losses, supplying indoor heating and hot tap water, for residential and utility buildings, in all climate zones. To support the Emporium building implementation by co-financing its characteristic long-term investments, various assets (values) and business (missions) topics are investigated. A carbon credits blockchain wallet offers citizens a small scale and decentralized asset connected to the building, and awareness and appeal as well, through active and direct engagement.

- **Assets (values)**

Heating in building energy demand is global 50%, and in Europe 70%, and nearly 75% including cooling. The energy transition, requiring security of supply, is a heat crisis, with a need to reduce gas imports, and to switch from fossil fuels to renewable heating and cooling technologies. Alternative gas sources are not necessary, because a differentiation of energy sources is needed, and the electrification of heating buildings is not a desirable solution.

The global Zero Energy Building (ZEB) revenue is expected to grow 2,225 times larger in 20 years (2014-2035). While several ZEB pilots are trying to prove the investment savings in lower energy bills, a stronger driver for the adoption of ZEBs is regulation. Policies like the EU's Energy Performance of Buildings Directive (EPBD) are forcing ZEB markets to come into place for new commercial, new residential, and retrofitted commercial space.

The global installed Distributed Energy Storage System (DESS) power capacity is expected to grow 7,066 times larger in 10 years (2014-2024). The power capacity unit hints that this mainly concerns electrical and, to a lesser extent, heat storage. Community energy storage seems to lag behind the residential and commercial energy storage markets. An Exponential Organizations' Fortune 100 ranking shows, that companies in the technology sector dominate the ExOs Top 10, while companies in the energy, finance, and healthcare sectors, occupy the ExOs Lowest Scores.

In 2050, globally, the number of households is expected to rise nearly 70%, from 1.9 billion in 2010 to 3.2 billion in 2050, and the total floor area (residential and services) is expected to increase 70%, from 206 billion m2 in 2010 to 356 billion m2 in 2050. When 78 billion m2 demolition 2010-2050 is included, only 128 of the 206 billion m2 (Pre-2010 stock) will be part of the 356 billion m2 in 2050, and 228 billion m2 (Post-2010 stock) will be new build.

The Dutch heat demand and its natural gas consumption power, varying from 20 GW in summer to 100+ GW in winter, has a seasonal pattern, while the Dutch electricity demand and power, fluctuating between 10 to 15 GW in both summer and winter, has a daily dynamics. The heat demand pattern, and its dimension and dynamics, is of a completely different order of magnitude than the electricity demand pattern. In case of electrification of the heat supply, this heat demand pattern and its storage requirement will have to be taken into account.

The financial and non-financial interests, or the assets and values, that have been investigated are, among others, rebalance of heat and power supply imbalance, money supply by real estate,

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value increase of sustainable buildings, residential energy and service costs, tax impact on sustainable investments, climate change costs and risks, and sustainable development goals and principles.

- **Business (mission)**

Solar energy is assessed positively by citizens, and associated with solar panels, sustainability and good, limited environmental impact,

no use of finite resources, and the generation of their own energy.

Solar panels, which are relatively easy to install and stand alone, have an active character and use a freely available energy source. The related solar water heater has a similar first interest, but in the end it is bought much less often because of the much higher disruptivity during installation, and the more passive character.

Market tips so that citizens embrace innovations are: the right time of customer contact, approach the customer through the woman (woman marketing), reduce effort for the consumer, and design attractive.

Many of the efforts aimed at selling energy innovations are aimed at men, however it is predicted that by 2028 women will influence or make 75% of all purchasing decisions. She does not make all these decisions herself, but strongly influences the purchasing decisions of other family members.

Social evidence helps, when people feel unsure about the usefulness, necessity and effect of a purchase, and follow the people with whom they feel related, such as by a neighborhood or collective purchase.

Sustainability analysis interpretation and understanding are often difficult to interpret, making results easy to deny by those not direct involved. Residents have a greater need for the arguments.

Transparency and comprehensibility of information, reliability and trust and to what extent the sender is independent, and long-term continuity and consistency, contribute to the chance of success.

There is demand for turnkey solutions and some kind of service integrator. End-customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider to coordinate all processes with subcontractors and partners, thus 'unburdenening' the end user.

Renewable Energy Service Companies (RESCOs) offer a solution for end-users and investors, which prefer mostly an investment as simple as possible, and have no interest in installations. Legislation and regulations may restrict initiatives to develop new energy systems and market models. To be an energy production supplier, to generate, distribute, store and trade its own energy in a defined area, may require an exemption from the energy law.

In the atomic economy, things often get more expensive, and free things still are paid by something else. In the bits economy, things get cheaper, and become really free when marginal costs get to zero.

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Free mainly works if it is really free, because a price of even a single cent makes that people start thinking about a choice as an incentive not to continue. At free, value moves to the next layer.

- **Carbon credits**

Carbon credits support building investors or owners directly, unlike most financial instruments, and, moreover, compared to today assets, zero emission buildings are immutable and secure assets to guarantee emissions reductions. Carbon credits are registered assets, through an Emissions Trading System (ETS), avoiding duplicate accounts, or a 'double wallet' dilemma when managed in a decentralized manner, and therefore ensure reliability and value.

Carbon credits value predictions are influenced by carbon reduction costs, carbon reduction prices, and carbon voluntary prices. Price predictions are, 35-65 €/tCO2 in 2020 and 40-80 €/tCO2 in 2030 to achieve the Paris targets, 40-80 $/tCO2 in 2020 and 50-100 $/tCO2 in 2030 to limit the rise in global average temperature to 2 °C, and a ceiling price of 200 €/tCO2.

The voluntary market offers higher prices in case that in projects qualitative aspects are involved, such as social impact or nature protection. Companies strive for climate-neutral or climate-positive business operations, products and services, and to contribute to the Sustainable Development Goals (SDGs). Public authorities are willing to pay 150-200 €/tCO2 in case that co-benefits apply, such as social community benefits for example.

- **Blockchain (wallet)**

A wallet, preferably owned by a house or building, is a small scale and decentralized application, appropriate for blockchain, which at the same time avoids a carbon credits 'double offering' dilemma. In the event that all blockchain wallets are open to being identified in a blockchain wallets community, capable of blocking duplications, then this community itself avoids the 'double wallet' dilemma, guaranteeing trust and value for both the wallet and the credits.

A carbon credits blockchain wallet can also be used as a reliable carrier for alternative values, such as Sustainable Development Goal (SDG) values. A Non-Governmental Organization (NGO) for example, specialized in one of the SDG values, can piggyback on the wallet, as an application. This application provides the NGO and its donor an accessible and reliable donation purpose, and provides the wallet and its owner additional donation credits upon the carbon credits received.

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