



Smart Energy Services to Improve the Energy Efficiency of the European Building Stock

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Abbreviations and Acronyms

Acronym	Description
DEEP	De-risking Energy Efficiency Platform
DSO	Distribution System Operator
EEM	Energy Efficiency Measure
EEOS	Energy Efficiency Obligation Scheme
ESCO	Energy Service Company
M&V	Measurement and Verification
P4P	Pay-for-Performance

Executive summary

This report is aimed at defining a list of indicators that can be used to evaluate the impact of implemented Pay-for-Performance (P4P) programs for energy efficiency. Firstly, an introduction to P4P schemes is provided, including a description of the advantages of this type of program and more specifically, the benefits of aggregating energy efficiency projects into programs. Then, the SENSEI model is introduced, and the interaction between the different actors taking part in this scheme are specified. After that, the indicators to evaluate P4P project data are defined. The factors taken into account for the definition of these indicators are; the size, impact, cost-effectiveness and timing of the program, as well as characteristics of the implemented Energy Efficiency Measures (EEMs) and the buildings included in the programs. The indicators have been defined so that they can easily be included in the De-risking Energy Efficiency Platform (DEEP), an open-source database which includes information about energy efficiency investments and achieved savings. The platform has the goal of up-scaling energy efficiency investments in Europe by providing data about existing projects in buildings and industry. In the final section of this report, the DEEP platform is presented and recommendation for inclusion of the defined indicators in their database is provided. The inclusion of the defined indicators in the DEEP platform will allow the collection of empirical data on the effectiveness of P4P schemes and could possibly help build a case for the implementation of such programs in place of regular energy efficiency projects.

1 Introduction to P4P schemes

The building sector is currently responsible for approximately 28% of yearly global carbon dioxide emissions, meaning that emissions could be significantly reduced by using sustainable building design and implementing energy conservation strategies. While focusing on sustainable design for new buildings is necessary, it is also important to remember that new buildings only represent a small portion of the built environment. Several research studies have highlighted that up to three-quarters of the existing building stock will still be standing in 2050 (International Energy Agency, 2013). These numbers depict the vast untapped energy savings potential that lies in efficient building energy management and in the implementation of energy retrofit programs. Efficiency is a central topic in the energy field, as shown by several reports from the International Energy Agency (IEA). These reports state that energy efficiency policies alone could result in more than 40% of the emissions reductions required to reach the Paris Agreement (International Energy Agency, 2018). In the building sector, different reports have pointed out the role of the untapped potential of energy efficiency, with the European Commission estimating that retrofit projects in buildings can reduce Europe's total CO₂ emissions by 5% (European Commission, 2019). Although the EU has a substantial amount of public funds available for energy efficiency, it appears clear that the actions required to reach the energy and climate goals cannot be implemented based on public funding alone. An additional 260 B€ per year will be required, over the next decade, to reach the ambitious EU 2030 climate and energy targets, and in order to obtain this capital, new schemes to make energy efficiency projects more attractive to private investors need to be contemplated and devised (European Commission).

Pay-for-Performance (P4P) schemes are an innovative model for energy efficiency projects and are based on the main idea of quantifying the extra added benefits on top of energy efficiency measures. So, therefore, whomever is benefitting can pay depending on the value generated by the implemented energy efficiency measure. The key elements of P4P strategies for energy efficiency are summarized as follows:

- Take distance from deemed savings subsidy schemes for energy efficiency by replacing one-off payments with periodic payments which are proportional to the realized energy savings calculated using Measurement and Verification techniques previously agreed upon by all participants in the program.
- Aggregate individual projects into portfolios, which can help attract investments from private funds which are more willing to invest in bigger projects and with an improved risk management strategy.
- Assess the extra benefits that are created by energy efficiency projects, and attempt to quantify them and sell them to interested parties. These periodic payments for the added benefits of energy efficiency generate a cash flow that allows energy efficiency investments in P4P schemes to be treated as project finance.

Regarding the last bullet point, there are several extra benefits of energy efficiency which have been analysed by different studies. These are divided into three main categories of beneficiaries: the Utility System, the program Participants, and Society as a whole. Figure 1 provides a visualisation of these benefits as a layer cake in which it is possible to see how energy efficiency projects are not only beneficial for participants, but also have considerable impact on the electrical network as well as at a societal level.

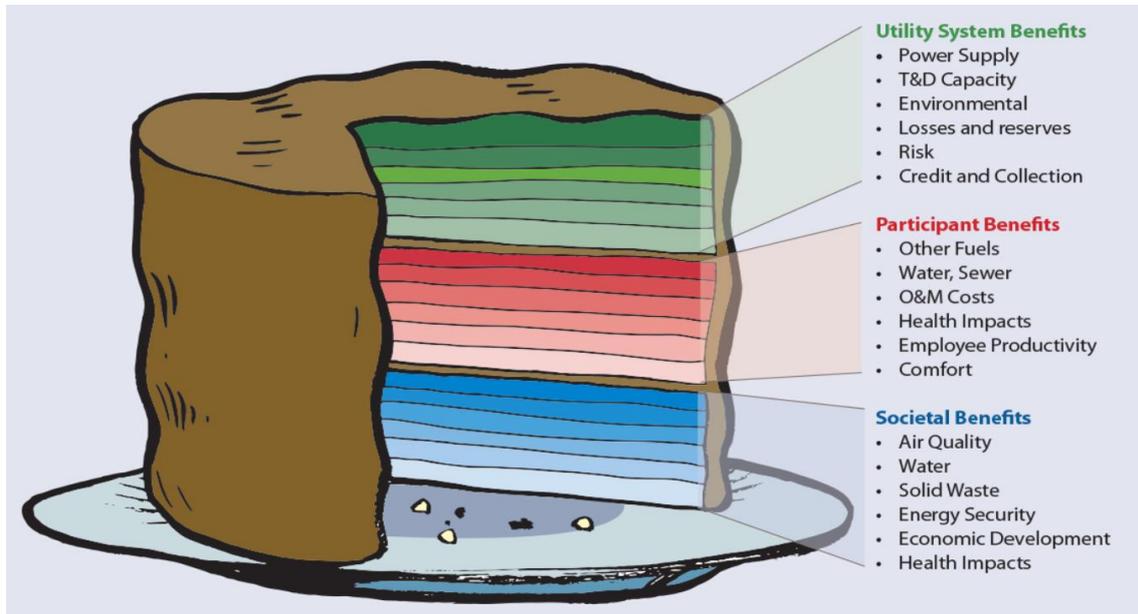


Figure 1 - Layer cake" visualization of various benefits from energy efficiency projects (Source: RAP)

When looking at the US case, P4P models have been built around the quantification and monetization of two main extra benefits of energy efficiency:

- The use of energy efficiency as a demand-side grid resource to avoid the need of technical upgrades and extension planning of the network infrastructure due to congestion (this is also known as 'non-wires alternatives').
- The use of energy efficiency as a demand-side energy resource. This means that it is possible to participate in capacity auctions by offering a reduction of demand for specific time periods.

In the US, it has been possible to create a business model that revolves around periodic payments from load serving entities interested in using energy efficiency as a demand-side grid or energy resource due to the characteristics of the electrical grid as well as regulation which allows for utilities to participate in capacity auctions with energy efficiency and demand-side flexibility. In Europe, different conditions apply. Deliverable 5.2 from the SENSEI project based on stakeholder consultation and desktop research has shown that, in Europe, system operators and utilities have very limited interest in paying for energy efficiency as a demand-side grid or energy resource. The reason behind this is that there is no existing regulation at present time which allows load serving entities to sell energy efficiency as a demand-side energy resource.

The current regulation and market conditions in Europe have subsequently made P4P schemes developed in the EU to have to consider several different financial inflows. In the next section the SENSEI scheme will be introduced. The SENSEI scheme is considered to be a structured methodology able to facilitate the implementation of energy efficiency projects, grant accountability of public subsidies, generate attractive investment opportunities for private capital, and maximize savings by incentivizing the industry as well as the end-users.

1.1 Aggregation at portfolio level

One of the fundamental characteristics of P4P programs is that they are usually composed of several individual projects aggregated in a single portfolio. Performing aggregation has several advantages, most importantly:

- Investing in standalone energy efficiency projects is often not deemed interesting enough to an investment fund considering that the amount of capital that most lenders want to provide will typically range from 1-5 M€. Pooling together projects into a single program can make groups of energy efficiency measures attractive. As a consequence, portfolio aggregation of EEMs is a requirement to meet the threshold of the investor which, in turn, enables financing for most projects (LAUNCH , 2019).
- Aggregating projects into portfolios represents a widespread technique to manage the risk of the investment. Predicting the final outcome of a single energy efficiency project is very hard to do, but within a portfolio the single projects will fall into a known distribution, making energy efficiency much like an insurance product for investors.
- Aggregation and standardization of projects can help lower the transaction costs associated with each individual investment (Carbon Trust, 2018).

2 SENSEI model scheme

The SENSEI model is a Pay-for-Performance scheme, made specifically for the European market with the goal of fostering energy efficiency in buildings through project aggregation and performance-based contracts. The scheme revolves around the role of the *energy efficiency aggregator*, an entity which has the objective of facilitating the creation of these energy efficiency programs by gathering financial investments from relevant institutions and aggregating individual energy efficiency projects into portfolios. Figure 2 represents the SENSEI model infographic: the diagram shows how the energy efficiency aggregator gathers the financial and data flows coming from public authorities, DSOs interested in paying for energy efficiency to stabilize the grid, and private investors looking to finance energy efficiency projects. Through the energy efficiency aggregator, the financial inflows are then channelled to ESCOs, which have

the technical expertise for implementing the energy renovation measures in the participant buildings and facilities. As a result of these actions, the achieved savings are then estimated using Measurement and Verification techniques. Periodic payments based on performance are then sent to, and redistributed by the aggregator.

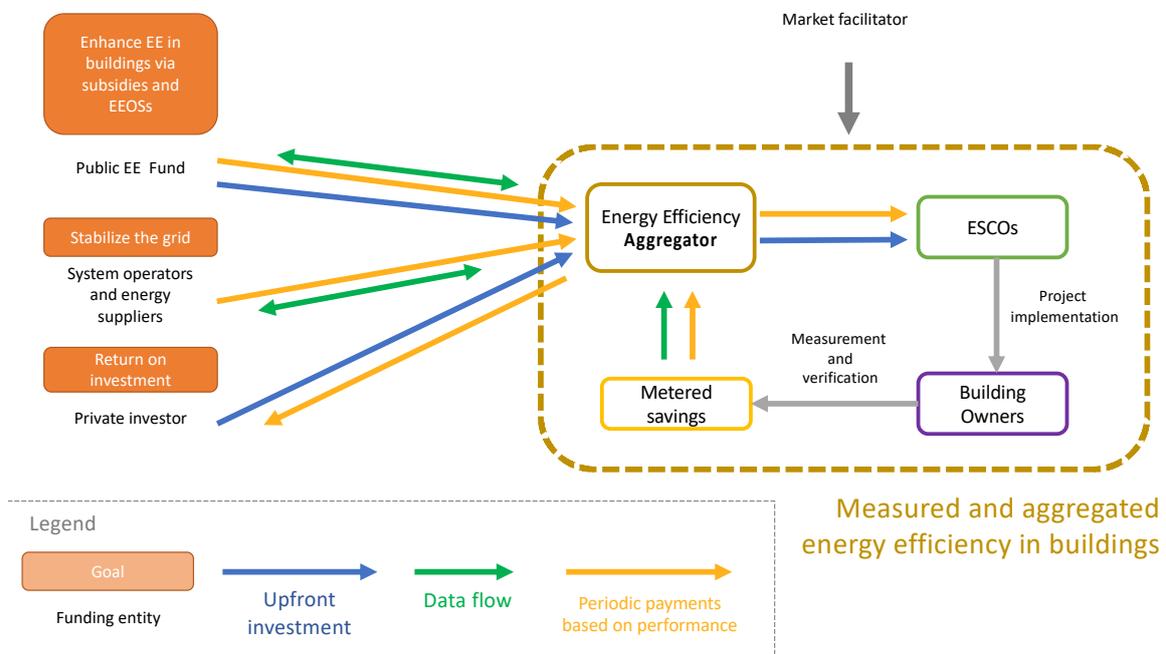


Figure 2 - The SENSEI model scheme

The energy efficiency aggregator is also the market player responsible for operationalizing the P4P program: project acquisition and aggregation, evaluation of projects according to predefined technical and financial eligibility criteria, management of interaction between different stakeholders, and implementation of Measurement and Verification (M&V) calculations.

The diagram also shows the *market facilitator*, the entity who is responsible for raising awareness, analysing market conditions, and proposing adaptations to regulatory and market framework where needed, in order to facilitate the introduction of P4P in Europe. Energy agencies at EU, national, or regional/local level are entities that could cover the market facilitator role.

The other stakeholders included in the scheme are public authorities (through public funds and EEOs), Distribution System Operators, and private investors. In the SENSEI scheme it has been assumed that each of these stakeholders would be interested in taking part in a P4P scheme because of the added value that would ensue from participation in this type of innovative project. There is a short description below of the added value for each of these stakeholders whilst participating in a P4P scheme in accordance with the SENSEI model:

- **Public EE funds:** P4P programs enable public authorities to access a detailed account of the concrete effect of public subsidies and EEOs. By using hourly M&V and a continuous monitoring of the electrical network, public authorities can make sure that the invested funds will effectively result into the expected energy efficiency savings, while also being able to link the achieved energy savings to avoided CO₂ emissions.
- **DSOs:** By use of dynamic M&V techniques used in P4P programs, which make it possible to evaluate hourly savings generated with energy efficiency measures, DSOs can invest in measures that contribute to the solution of grid stability and congestion problems.
- **Private investors:** by taking part in a P4P program, third-party investors are provided with the possibility of investing in aggregated portfolios of energy efficiency projects. The aggregation helps investors manage their risk, while also enjoying shorter payback periods as a result of the possibility of leveraging public subsidies and investments from DSOs.

It is important to note that the presented model specifications, which include the actors involved, their role in the scheme, and the concrete financial and data flows described, are only one of several options available when building a P4P programme. The one provided here is a general overview of a how the SENSEI model is structured, but the concrete specifications of each P4P scheme built under this framework will have to be decided upon in regard to the involved stakeholders, the regulatory environment, and the analysis of the market in which the programme will be carried out.

3 Definition of P4P indicators

In this section, different indicators used to evaluate implemented Pay-for-Performance programs have been defined. The indicators have been listed to highlight the main characteristics and advantages of running P4P programs. The indicators are divided into three categories: portfolio-level indicators, information about individual projects, and results obtained. Table 1 shows the details of each of these indicators.

Table 1 - Indicators to evaluate P4P projects

	Indicator name	Description	Units
I	Portfolio-level indicators		
1	Total number of projects	Number of energy efficiency projects included in the program	-
2	Total portfolio investment	Total aggregated investment for the portfolio	Euros
3	Program timing	The time duration of the P4P program	Years

4	Revenue stream from public subsidies	Total financial inflow received from public EE funds and EEOs	Euros
5	Revenue stream from system operators and energy suppliers	Total financial inflow received from DSOs, TSOs, or energy suppliers	Euros
6	Percentage of positive savers	Percentage of the program participants with positive energy savings at the end of the program	%
7	Measurement and Verification methodology used	The Measurement and Verification methodology used to estimate the savings achieved resulting from energy efficiency interventions	-
II	Project-level metadata		
1	Building type	Typology of the building where the energy efficiency measures were implemented	-
2	Building total floor area	Total floor area of the building/unit	m ²
3	Building primary use	Primary use category of the building where the energy efficiency measures were implemented	-
4	Building location	Country and city	-
5	Measure implemented	Details of implemented energy efficiency measures	-
6	Measure investment	Total investment to implement the individual measures	Euros
III	Results (portfolio or individual project level)		
1	Energy saved	Total energy saved by the energy efficiency interventions	kWh
2	Avoided GHG	Total avoided greenhouse gas emissions avoided as a result of energy efficiency interventions	Tons
3	Financial savings	Total savings on energy bills as a result of avoided energy use	Euros
4	Energy saved at peak hours	Total energy saved during hours of maximum congestion of the electrical grid network	kWh

3.1 Portfolio-level indicators

Portfolio level indicators provide key information at the program level, such as the total number of buildings/projects included in the program, the timing, and the total amount invested in the portfolio. An indicator has also been included to quantify potential additional revenue streams which were considered in the program (subsidies from the government, periodic payments from system operators or energy utilities, etc.). Since not all the energy efficiency projects in a portfolio always translate into actual energy

savings on the bill, an additional indicator is also defined to represent the percentage of projects in the portfolio which saw their average energy consumption go down at the end of the program.

3.2 Project-level metadata

Project-level metadata include different information that can be used to characterize the individual projects that were implemented within the portfolio. Data regarding the characteristics of the buildings where the measures were implemented, as well as, information regarding the energy retrofit actions have been included in this category. Additional statistics can then be calculated based on these indicators, such as the average floor area of the buildings which have been refurbished, the average investment per energy efficiency project, the most common categories of implemented measures, etc.

3.3 Results

This category includes different indicators which are used to evaluate the impact of the energy efficiency projects in terms of energy saved, avoided greenhouse gas emissions, and financial savings related to the energy consumption reduction. To calculate these indicators, measurement and verification techniques able to produce baseline energy consumption predictions at hourly granularity are fundamental. These predictions represent the counterfactual consumption, that is to say, the estimated energy consumption the building would have had if the energy efficiency intervention had not taken place. By comparing the real metered consumption at a certain hour and the counterfactual consumption predicted for the same hour, the energy savings are estimated. The avoided GHG emissions and the financial savings are then estimated by linking the energy saved at a certain hour with the equivalent CO₂ emissions and the energy cost at that hour. An additional indicator is included to evaluate the energy that was saved at hours of maximum congestion of the electrical grid network. This indicator can be used as a rough estimation of the grid flexibility that the P4P program could provide, as a consequence of implementing energy efficiency strategies that permanently reshape the load curve. All the indicators included in this category can be represented either at individual project level or at whole program/portfolio level.

3.4 Additional indicators

By combining the indicators presented in Table 1, additional indicators can be obtained, which will make it easier to perform benchmarking and comparison between individual projects and programs as a whole. Example of such ratio-based indicators might be:

- Energy saved / Total portfolio investment
- Energy saved / Total floor area
- Avoided GHG / Energy saved
- Energy saved at peak hours / Energy saved

Interested stakeholders should be able to combine the base indicators which have been presented to create custom analytics that could better represent the actual performance of different projects and programs.

4 DEEP platform

The De-risking Energy Efficiency Platform (DEEP) is a platform that has been developed and maintained by the Energy Efficiency Financial Institutions Group (EEFIG). This group was established in 2013 by the European Commission Directorate-General for Energy and the United Nations Environment Programme Finance Initiative (UNEP FI), which uses policy design and market-based solutions to address barriers to energy efficiency financing and with the goal of increasing the scale of energy efficiency investments across Europe.

DEEP is an open-source initiative aimed at up-scaling energy efficiency investments in Europe by means of a platform that guarantees improved sharing and transparent analysis of existing energy efficiency projects in buildings and industry across the globe. The DEEP database enables energy efficiency investments performance monitoring and benchmarking by collecting data regarding implemented energy efficiency projects and their results. The final goal of this initiative is to increase energy efficiency financing by enabling improved understanding of the actual risks and benefits of energy efficiency investments based on market evidence and investment track records.

The platform includes more than 15,000 anonymized energy efficiency projects in buildings and industry from 30 different data providers. Different indicators and metrics are shown, reflecting major project characteristics (geography, energy efficiency measures, verification status, industry / type of building, CO₂ savings, distribution of energy demands before and after the energy efficiency investments, etc.). Financial performance indicators are also provided, such as payback time, which allows assessment of minimum loan tenure needed and Avoidance Cost, which allows assessment of financial viability at different interest rates and energy prices. Within the platform, it is also possible for financial institutions to upload private projects or portfolios and benchmark them against sub-sets of the projects in DEEP according to user-selected criteria.

The DEEP platform allows for the visualisation and analysis of several indicators that represent individual energy efficiency projects, but does not provide a way to analyse portfolios or wider energy efficiency programs in which individual projects are aggregated. For this reason, the inclusion of a section where aggregated portfolios of projects can be uploaded and analysed in their entirety has been suggested in DEEP in this particular deliverable. By doing so, it will be possible to understand the effect of aggregation on the payback time and feasibility of the projects, analyse the impact of potential additional financial inflow that might be included in the context of P4P programs and provide investors with a clear and representative view of the advantages of investing in an aggregated portfolio of energy efficiency projects.

If P4P programs start gaining momentum in Europe, a proper way to showcase the results obtained by such programs is necessary. This could be done by creating a dedicated section for aggregated portfolios of projects within the DEEP platform to serve this purpose. As introduced in previous sections, one of the main objectives of P4P schemes is to create programs which can attract private investment. Since the DEEP platform has the goal of providing actuarial data that can be used to de-risk and up-scale energy efficiency projects, a section showcasing the advantages and characteristics of aggregated portfolios of investment would be a solid way to ensure this objective.

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