Investing in Energy Efficiency in buildings

Why and How?

EBC

Energy in Buildings and Communities Programme

Conference Proceedings from the First Investor's Day 6 November 2014 in Brussels

BPIE
BUILDINGS PERFORMANCE INSTITUTE EUROPE

Climate Protection and Energy Agency of the State of Baden-Württemberg
KEA

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This event was considered to be a follow-up of the EEFIG report on financing energy efficiency and is considered to be carried out in autumn 2015 for the second time.

This report summarizes the presentations and the discussions held at the meeting. It is hoped that the information will be the starting point for deeper discussions between ESCOs, financiers, technical specialists, and building owners both within the government and in the private sector, on methods and processes to achieve a significant scale up of number and quality of DER projects.

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and

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Summary

Dr. Alexander Zhivov & **Rüdiger Lohse**,Co-operating agents of IEA EBC Annex 61

The main objective of Annex 61 of the International Energy Agency's Energy in Buildings and Communities (IEA-EBC) Program is to reduce energy use in public buildings through deep energy retrofit (DER) projects. Annex 61 defines a "deep" energy retrofit as one that achieves energy savings of at least 50% relative to a baseline that includes all energy use in the building, including plug loads. It is well known that reducing energy use by this amount, even to the level of "net zero" energy NZEB use, is technologically feasible in many locations and for many applications. The difficulty lies in funding such projects, and developing methods of implementing them on a large scale. The following are among the motivations for the work being carried out by Annex 61:

- DER refurbishments are required to achieve the ambitious targets that have been set for government buildings in both the United States and the European Union (EU).
- DER refurbishments require an integrated approach to design that considers all energy sources and equipment in the building. DER is impossible to achieve with singlemeasure retrofits, which commonly lead to suboptimal results.
- Achieving low or even modest energy reductions implies a wasted opportunity for the remaining 30-40 years of the building´s life.
- The highest priority should be to document and replicate cost effective DER measures as part of normal building renovation activities.

Knowledge is lacking in two key areas:

- While much is known about the savings potential of single measures, there is not a great deal of experience in the selection and application of bundles of energy conservation measures (ECMs), which create valuable synergies. Synergies exploit the benefits that accrue from the interaction of different measures' implemented jointly, which together can result in downsized components, reduced investment costs, and increased energy savings. Pre-selected ECM bundles for various climates and building types can also reduce survey and project design costs, leading to more cost-effective projects.
- Few DER projects have been thoroughly evaluated, and knowledge is restricted mostly to modeling results.

For these reasons, IEA believes that the most important objectives are to:

- Develop methods to document and replicate cost effective deep energy renovation as part of normal building renovation activity.
- Establish the business case for buildings not currently planned for renovation by targeting a challenging goal and looking beyond energy efficiency. To achieve a life-cycle-cost neutral approach, both energy and non-energy related benefits must be quantitatively valued.
- Establish mitigation cost for early renovation – this would likely require carbon trading and be a lower cost option compared to other solutions such as carbon capture and storage.

The barriers to DER implementation are most often financial; the availability of public money is limited. These financial problems are exacerbated by the declining availability of government funding for energy conservation projects. The following actions are needed to increase the efficiency of investing into Energy Efficiency (EE) and DER:

- Strategies must be devised to decrease the cost of ECM bundles. Different strategies have been applied in the past to decrease cost of emerging technologies. In some EU countries, photovoltaic (PV) technologies have been subsidized to increase the demand for PV and to decrease its price. One way of applying this strategy to DER ECM bundles could be to restrict the application of grants and subsidies to DER building refurbishment, and to combine this effort with an R&D effort to evaluate the initiated projects.
- Business models that perform more efficiently should be preferred. EE is most commonly implemented in "owner directed" business models. Because they perform more efficiently, building owners turn to Energy Performance Contracts (EPCs) and other performance related types of Public-Private Partnerships (PPP) to achieve energy reduction goals. In an EPC, an energy service company (ESCO) installs energy conservation measures in a government building and guarantees their performance. EPC increases the available funding because the project is financed by the recurring energy and energy-related cost savings generated by the measures themselves, thereby avoiding the need for capital appropriations by the government.
- One of the issues with EPC is that the available cost savings are limited (e.g., by the current energy and maintenance budget, fuel prices, etc.), and may be insufficient to finance all of the equipment required to achieve higher levels of energy savings such as thermal insulation. In the United States, where use of EPC is widespread at all levels of government, project energy savings typically fall within 15% to 25% of baseline energy use. Relatively low energy prices in many parts of the United States are undoubtedly one factor affecting this range, but even in Europe, where energy prices are much higher, it is rare to see EPC used to achieve energy savings in excess of 40%.
- Subtask B of Annex 61 is addressing this problem by developing and analyzing new business models that will allow EPC to be used to achieve deeper energy savings. Toward this end, on November 6, 2014 Annex Subtask B with sponsorship of the Buildings Performance Institute Europe (BPIE) and the Climate-protection and Energy Agency of Baden- Württemberg (KEA) in the context of the research project EDLIG funded by German Federal Ministry of Economic and Trade hosted a meeting entitled "Investing into Energy Efficiency Projects: Why and How?" at the Buildings Performance Institute Europe (BPIE) in Brussels, Belgium. The event brought together numerous public and private stakeholders, investors, and ESCOs for a day of networking, presentations, and panel discussions on various issues surrounding the financing and implementation of deep energy retrofit projects in Europe and beyond.

To significantly scale up the number and quality of DERs, the meeting discussed the following objectives:

- Providing investors and energy service companies (ESCOs) with information obtained through Subtask A on case studies involving DER projects already accomplished to show that such efforts can be cost effectively achieved;
- Providing valuable technical and performance information on bundles of technologies required for DER that are readily available on the market;
- Providing information on synergies between various technologies that reduce energy-related costs;
- Creating confidence between investors, ESCOs, and building owners by developing eligible quality assurance and quality control mechanisms that minimize the risks related to the achievement of energy goals;
- Advancing EPC business and financing models by integrating energy and non-energy related benefits of DER into financing mechanisms;
- Demonstrating and evaluating case studies that have implemented innovative business and finance models for DER projects in Europe and the United States.

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KEYNOTE ADDRESS

How to drive new finance for energy efficiency investments. Findings from the Energy Efficiency Financial Institutions Group (EEFIG)

Paul Hodson, DG Energy, European Commission

In late 2013, the European Commission launched the Energy Efficiency Financial Institutions Group ("EEFIG") as a working group tasked with bringing together a broad range of stakeholders from the financial service industry and the energy efficiency community. The working group discussed three sectors in different sessions: the buildings sector, industry, and small and medium sized enterprises (SMEs). In March 2014, the group published an interim report based on the results of the initial session, which focused on the buildings sector. This report presented the following recommendations:[1]

- Energy efficient renovations of buildings provide many benefits that should be fully captured and concretely communicated with real-world examples to the most important financial decision makers, such as public authorities, real estate owners and managers, as well as individual households. Decisions should be based on the many broad benefits of renovation, not solely on energy savings. This will require better data than is currently available and easier access to relevant parameters.
- Construction processes and buildings standards, such as Energy Performance Certificates, building energy codes etc. that inform and guide the energy performance of buildings should be more harmonized. Compliance with these standards should be better enforced, particularly during real estate transactions such as rental or sale.
- Data is a key stumbling block. Industry decision makers must have easier access to much better data about buildings than is currently available. Processes should be established to ensure that data are reliable and transparent. Information must be provided in a way that links potential real estate value increases with respective efficiency investments. A key element is to standardize data and processes to achieve greater investment in energy efficiency.
- The energy efficiency industry is very diverse, but its many players have a common goal; the industry should make a greater effort to speak with one voice. At the same time, it should work to ensure that financial resources provided by EU Structural and Investment Funds are used effectively in public-private instruments. The amount of funding needed to renovate the building stock cannot be provided by public funding alone. The role of public financing should be designed to overcome market failures and provide risk reducing measures for the private investor.

The European Commission will take the recommendations of the EEFIG group very seriously to consider new initiatives to stimulate more investments into energy efficient renovation of the European building stock.

1 Since February 2015, the final report is available at www.eefig.com

Business and technical concepts for deep energy retrofits of public buildings Findings from IEA-EBC-Annex 61

Rüdiger Lohse, KEA Klimaschutz- und Energieagentur Baden-Württemberg, Karlsruhe
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Challenges in financing EE in the building stock

Governments worldwide are setting more stringent targets for energy use reductions in their building stocks. To achieve these goals, the annual rates at which projects are undertaken to refurbish and reduce energy use in the building stock must significantly increase. Seventy-five percent of the buildings currently in use and that will remain in use in 2050 were built in time periods when there were no energy efficiency policies. A major refurbishment offers an opportunity to overcome a building's shortcoming for its next "life-cycle period" of 30 or 40 years. When such a rare opportunity arises, it is worthwhile to consider whether to exceed the performance requirements of national building code legislation. With only 6 years remaining in the current planning period to meet EU 2020 targets, there is an obvious need to broadly apply deep energy retrofits (DERs) that target 70 to 90 % of energy use reduction[2] instead of more shallow and moderate approaches.

However, to comply with EU 2020 targets will require a financial investment of € 60–100 bn/a, which will create an additional demand of € 30–70 bn/a. Since public funding is scarce, private funds must play a strong role in the financing building energy efficiency. Still, private money does not seem to find its way to where it is needed. IEA-EBC Annex 61 is researching ways to identify and address the major barriers to the funding of energy efficiency projects, and to provide technical and business solutions to overcome them.

Implementation of a DER strategy creates additional financial demand of € 30- 70 bn

Major barriers to EE in the building stock

The major barriers to scaling up EE projects in buildings (Table 2.1) include barriers on the market level that are mainly related to the market structure. One major barrier that prevents the allocation of funds to EE projects is the lack of information about EE projects themselves. This lack of information creates uncertainty, undermines confidence, and ultimately drives decision makers to hesitate to invest private or public funds in EE projects. As yet, there is little good information on EE projects. After years of publicly funded energy retrofit projects, the amount of evaluated data on the effectiveness of retrofits is still insufficiently small. There is a need for more and better information to effectively assess and communicate the multiple benefits of EE in the building sector, essentially to build the investor's confidence required to channel finances into EE projects.

Major barrier for investing in EE: lack of information

2 BPIE, 2013

Level	Barriers to EE
Market	**Market organization-price distortions** prevent building owners from **appraising value of EE measures** Split incentives: investors cannot capture the benefits of EE investments Labile framework conditions do not allow for long term investment decisions
Financing	**Upfront costs** and **dispersed benefits** EE = shelf warmer: **complicated** and **risky** with **high transaction** costs Lack of **awareness** of potential financing entities
Information	Lack of **sufficient information** to prepare rational investment decisions
Regulatory/ institutional	**Discouraging energy prizes** (declining block prices) **Institutional bias towards supply-side** instead demand-side investments **Lack of sufficient business models** with incentives for EE and life-cycle costs Lack of **sufficient long term strategies** to deploy EE in building stock EE investment programs are mainly **perceived to be risky due to the uncertainty of predicted energy cost savings**: lack of evaluated projects and default analysis **Standardized protocols for de-risking** is not much in practice in the EU **Standardized evaluation methods for measuring and verification** is still lacking
Technical	Insufficient capacity to develop, implement, maintain high efficient ECM bundles

Figure 1.1: Major Barriers to Energy Efficiency (IEA 2010, KEA 2014)

How does IEA EBC Annex 61 contribute?

Provide decision making criteria to align MR and DER

IEA EBC Annex 61 contributes to the DER decision making process

In most cases, major renovation (MR) projects are not initiated to achieve energy goals, but to prepare the building for a new purpose or "next life-cycle," i.e., to increase the building's attractiveness and value. Annex 61 "Technical and Business Models for Deep Energy Retrofit" research has shown that it is possible to turn a "once in 30 years" deep retrofit opportunity into a deep energy retrofit (DER) that provides significant energy use reductions beyond those required by building codes, and that achieves low-energy and NZEB buildings. The combination of a MR with a DER creates positive cost-cutting efficiencies and benefits for both processes (Figure 1.2).

De-risking of long term project periods by securing frame-work conditions

DER measure and impact		MR measure and impact
	→	Building comfort level: Indoor climate is improved Life cycle cost savings: temperature level of heating can be reduced, temperature level of cooling can be increased
Airtightness	→	Indoor climate: better conditioning of indoor climate, low leakage rate
Investment cost reduction	←	Preparative steps (scaffolds etc.)

Figure 1.2: How DER contributes to MR and vice-versa

The level of energy savings that a DER project can achieve depends on the national framework and climate zones of the host country. In Work Package "A" of Annex 61, two DER approaches in participating countries were evaluated and compared to a "base-case scenario" in which a MR was designed to meet building code requirements.

Support confidence building for long term investment

Standardization of DER approaches will decrease DER investment costs

One major challenge to implement MR and DER in the building stock is the scarcity of both public and private funding. This work assumes that the public money available to refurbish the building stock will not increase significantly in the near future. Private funding sources often consider EE projects as risky investments. Historically, private investors have been reluctant to invest significant amounts in EE projects.[3] One important indicator that building owners and investors use to evaluate the attractiveness and potential risks of a DER investment is its payback period. There is often a greater willingness to fund a refurbishment investment project if the payback period is relatively short as the

3 EEFIG, Energy Efficiency is the First Fuel, Part 1: Buildings, 2014

risks for the technical and economic success of an investment are assumed to be larger for projects with long payback periods.

To enhance the number and quality of DER, the projects performance related business models will have to become the preferred choice

However, the implementation of DER in buildings can typically increase the payback periods to 20 years or more. To increase the confidence in DER projects, consistent methods to reduce the risks at different levels and stages of projects must to be developed. The first stage of the "de-risking" process is to instill the environment with robust conditions that support long term investments, which might include:

- Local demographic planning to define the future purpose of the building stock.
- Advanced local energy planning that considers local energy sources, EE strategies, and smart energy concepts.
- Highly cost effective technical solutions (DER measure bundles) for the different building types that offer a high potential for replication and declining investment costs.
- Performance related business solutions to implement DER in the building stock.

Deep Energy Retrofit: Bundles of Energy Conservation Measures (ECM)

Major renovations (MR) are not usually initiated to meet ambitious energy reduction goals, but they include significant opportunities to incorporate DER energy retrofit measures that can save > 50–70% of the building's baseline energy consumption. For example, residential buildings renovations in Karlsruhe[4] and Freiburg have shown that energy savings of 50-70% are both achievable and cost effective. In such cases, the cost effectiveness of the DER has shown itself to be an important decision-making criterion. To decrease the investment cost of the DER, Annex 61 is evaluating, modeling, and optimizing DER measure bundles for different building types in various climate zones. Annex 61 is using this data to develop a "tool box" of solutions that will provide an initial approach to estimate DER energy savings and investment costs associated with different building types. Such a "tool box" will help decrease the planning and investment costs on the project level.

Develop eligible business models for DER performance

Owner- directed business models do not create incentives for EE

Investors' lack of confidence in EE and DER projects is closely related to the way these projects are carried out and to the way the projects' performance documentation is maintained and communicated. The strong demand for evaluated EE project performance data cannot be satisfied because the method and implementation tool used to carry out EE projects – the business model – does not account for project performance. Many indicators show that we may be using the wrong method to implement EE projects.

4 EnEff Stadt Projekte: Volkswohnung Karlsruhe, Projekt Rintheim

More than 95% of all deep retrofits follow the "owner-directed" business model. This business model institutes a structure that does not maximize building energy efficiency, and that inherits most of the barriers listed in Table 2.1. The owner-directed business model structures the division of labor to support the investment phase, after which the risks of investment and operational performance are left to the building owner:

The evaluation and the self- optimization of EE projects is not foreseen in owner- directed business model

- The building owner, who is not typically an expert in the process, is responsible for providing funding (by securing bank loans) and maintaining building operations after completion of the construction phase.
- Architects/planners are responsible for planning, procurement, and quality assurance during the construction phase.
- Craftsmen/tradesmen are responsible for the construction and, to some extent, for maintenance services for a certain part of the life cycle.
- The model does not provide incentives to the planners, architects, and craftsmen to provide high-energy and cost efficient project structures, technologies, or methods of implementation.

The owner-directed business model has several serious shortcomings:

- The feedback model is "open" i.e., there is no feedback based on operational experience. This influences the quality of planning, construction, and operation.
- Decision making is fixed to one key criterion, initial investment, which does not account for life-cycle costs.
- Neither planners nor architects are required to provide follow up or respond to questions related to energy performance or the investment costs.

Currently, the experience derived from the performance of DER projects is not collected, evaluated, and or distilled into lessons learned. As yet, there is no competition for best-performing technical solutions and services in buildings as exists in, for example, household applications or the automotive industry. In other commercial or industrial settings, the business process would follow well defined steps that would include a "feedback loop." The experience of the DER project would be documented and evaluated and its performance measured and analyzed. This analysis would be used to produce lessons learned, which would be implemented in subsequent projects. Over time, this evolutionary process would improve the business model. The building sector would benefit from adopting these steps.

The structure of owner-directed business models does not provide reliable and bankable savings

One important failing of the owner-directed business model is that it gives little emphasis to long-term building performance. This is reflected in the early decision-making process of a DER project, which should vigorously compare different energetic solutions, and during the procurement process, which should provide the best of those energetic solutions to the project. Instead, this decision-making process focuses on purchase price. In the marketplace, which is commonly motivated by short-term gains, measurement and verification of the energy performance of a DER project play a somewhat small role relative to purchase price. As a result, many research projects fail to assess and evaluate these vital parameters.

Energy performance contracting provides guaranteed and bankable energy savings

Many engineering companies, energy consultants, etc. repeat business as usual approaches and have no incentive to assess the efficiency of EE projects. As a result, innovative technologies find their ways into application only slowly and even more slowly into efficient operation. For example, 20 years ago, the condensing boiler was a promising measure to cut the natural gas bill by at least 5 to 10%. The evaluation[5] of more than 80 condensing boiler systems installed in the last 15 years show that less than 30% actually achieve even that moderate target while 70% remain in operation in high temperature heating system and have been inappropriately applied in hydraulic heating systems. Similar experience has been made with the application of heat-pumps. After 20 years, during which the condensing boiler was invented, refined, and adopted in the heating market, three questions remain:

- Would the process of inventing and disseminating simple technologies into the market (like the condensing boiler, heat pumps, etc.) have been dramatically accelerated if planners and craftsmen had been made responsible to employ technologies that provide a minimum energy efficiency instead products that minimize the purchase price, coupled with a 2-year warranty?
- What lessons can we learn from the condensing boiler for DER projects?
- How much time do we have to wait?

The uncertainty, which results from a simple lack of information, has two major impacts: (1) building owners are reluctant to believe that DER may contribute significantly to the performance of their buildings (which restricts demand), and (2) private money does not find its way into these projects. Overall, it seems unlikely that the ambitious EU 2020 targets will be practically achieved in the EU as a whole, or on the level of any single nation, until this central problem is resolved: how can the EE market can verify the performance of investments in energy efficiency while applying the owner-directed business model. Until this problem is addressed, an important follow-on consideration is whether it makes sense to invest scarce public money in owner-directed business models that fail to employ a performance feedback loop.

5 Evaluation of energy commissioning reports of 30 municipal building pools in Baden-Württemberg, Lohse 2008

Annex 61: Advanced Performance Related Business Models

The approach taken by Annex 61 is to provide successful business models for DER that can bridge the scarcity of funding in the public sector caused by such factors as the austerity programs now seen in many EU countries. Annex 61 is also attempting to devise a financing scheme that avoids inflating the debt level of the public sector by ensuring that the DER benefits are accountable. Currently, only a few business models can provide accountable benefits. The prerequisite of accountability is a guarantee, in this case, for energy savings, which are stipulated in Energy Savings Performance Contracts (ESPCs) or Energy Performance Contracts (EPCs). This contrasts with the owner-directed business model, which does not provide bankable guarantees (nor do leasing, PPP or other business models on the market).

Advanced EPC business models may increase accuracy of DER and the available funding

ESPCs or EPCs are proven tools that guarantee energy and maintenance[6] cost savings and that provide some essential security in comparison with other business models. These tools can provide:

- Strong contract-based stimulation for both contract parties to achieve high cost effectiveness by providing a better savings/investment ratio.
- Guaranteed energy and maintenance cost savings between 25 and 40% in both the United States and the EU.
- Bankable energy and maintenance cost savings, which create reliable revenue streams to fund deep retrofit projects.
- Cost structure and decision making criteria aligned with life-cycle costs.
- Energy Service Company's (ESCO's) design and experience based knowledge on different ECM bundles (e.g., HVAC/biomass/CHP, etc.) that give satisfactory performance results.

Note that EPC is currently not the chosen vehicle for DER projects. The key strength of major ESCOs is still in the building automation. In some countries, the scope of EPC has already been extended to Renewable Energy and some infrastructural measures. Annex 61 research intends to provide the necessary framework to prepare ESCOs to enter into DER EPC pilot projects to advance existing EPC business models for DER projects by:

Annex 61 prepares a DER data base which is necessary to advance EPC business models for DER projects

- Creating financing schemes that can integrate revenue streams deployed by energy and maintenance cost savings.
- Assessing national framework conditions for public building owners to account for increased residual building values provided by a DER project.
- Quantifying and integrating non-energy or non-cost related benefits in the cash-flow analysis to monetarily quantify all DER benefits in addition to the energy-related benefits.
- Creating a viable database for DER projects to collect evaluated data.

6 KEA, Karlsruhe Baden-Württemberg EPC Model Contract, 2010

Annex 61 working structure

The business models will be practiced in DER case studies

To provide this functionality, IEA EBC has instituted the Annex 61 as multinational research project to develop technical and business models for DER in public buildings. Six countries have provided funding for research work on that national level, and another three countries are actively collaborating at their own expense. The research work (Table 2.3) is organized into the following subtasks (STs):

- **Subtask A: Evaluation of accomplished DER projects**
  - To establish confidence building A61 targets, this ST will create a viable database for information pertaining to completed DER projects, including pre- and post-DER data of typical buildings, DER measure bundles, investment costs, affected energy savings, and applied modeling tools.
  - To identify the key success factors and flaws of best practice projects (currently in progress).
  - To model and evaluate high-efficient energy conservation measures (i.e., that allow for savings >50% of the building's baseline energy consumption).
  - To assess modeling methodologies that have led to the most precise predictions.
  - To derive de-risking strategies (from the technical perspective).

- **Subtask B: Development of business models**
  - To evaluate existing business models in the building sector in the participating countries.
  - To collect energy and non-energy related benefits (ERB and NERBs) from ST A case studies and to assess their potential cost benefits.
  - To derive de-risking strategies from the financial perspective.
  - To develop business models based on guaranteed and bankable ERBs and NERBs for DER projects.
  - To develop a framework for certification of project feasibility and reliability.

- **Subtask C: Set up case studies**
  - To select buildings and carry out a feasibility study.
  - To model different energetic scenarios.
  - To adapt the business model to the case study and assess the financial streams.
  - To prepare the decision-making process together with the building owner.
  - To define conditions to measure post-retrofit energy use to verify energy savings.
  - To document the project and disseminate lessons learned.

- **Subtask D: Guidelines**
  - To prepare guidelines for decision makers that convey an overall approach and a general understanding of complex DER projects and of the certification process.
  - To prepare guidelines that define protocols and provide checklists that enable financiers and project facilitators to prepare investors for DER.
  - To prepare technical guidelines that enable ESCOs and PPP companies to provide DER projects. These guidelines will collect the experience from ST A and technical expertise of practitioners to provide specific knowledge on DER projects, organisational structures, and such pertinent construction details as how to avoid typical flaws in thermal bridges, how to ensure air tightness, and how to employ "best practices" currently available on the market.

To ensure that the Annex 61 project is generally applicable, Annex 61 will invite interested parties (e.g. stakeholder representatives from public building administrations, ESCOs, PPP Companies, facilitators, designers, architects, individuals in the financing sector, etc.) to join in on the national and international project level to review the research work and its progress.

	Subtask A	Subtask B	Subtask C	Subtask D
Targets	Evaluate DER case studies, technical modeling of new ECM bundles	Evaluate and develop business models for DER	Apply technical and business models in pilot projects	Decision maker guidelines for financing entities, ESCOs building owners
Leaders	Ove Moerk Alexander Zhivov	John Shonder Rüdiger Lohse	Cyrus Nasseri	Heimo Staller Rüdiger Lohse
Hurdles addressed	Lack of evaluated DER projects, reliability of predicted savings and investments, derisking strategy	Incentives for EE, performance related revenue streams, derisking strategy, performance protocols	Preparation of the decision making process and criteria, applicability	Lack of target group related information, dissemination, facilitation on policy making and project level

Figure 1.3: IEA EBC Annex 61 structures

Market potential for deep refurbishments

Dan Staniaszek, Buildings Performance Institute Europe (BPIE)

EE potential in buildings is by far the cheapest way for cutting CO_2 emissions

According to a McKinsey analysis,[7] buildings' Energy Efficiency (EE) ranks first in approaches with resource efficiency potential with a total resource benefit of approximately $700 billion until 2030. The IPCC[8] confirms that exploiting the vast EE potential in buildings is by far the cheapest way to cut CO2 emissions and thus reaching international Climate Protection Goals. (Figure 1.4)

Figure 1.4: Economic mitigation potential for CO_2 emissions[9]

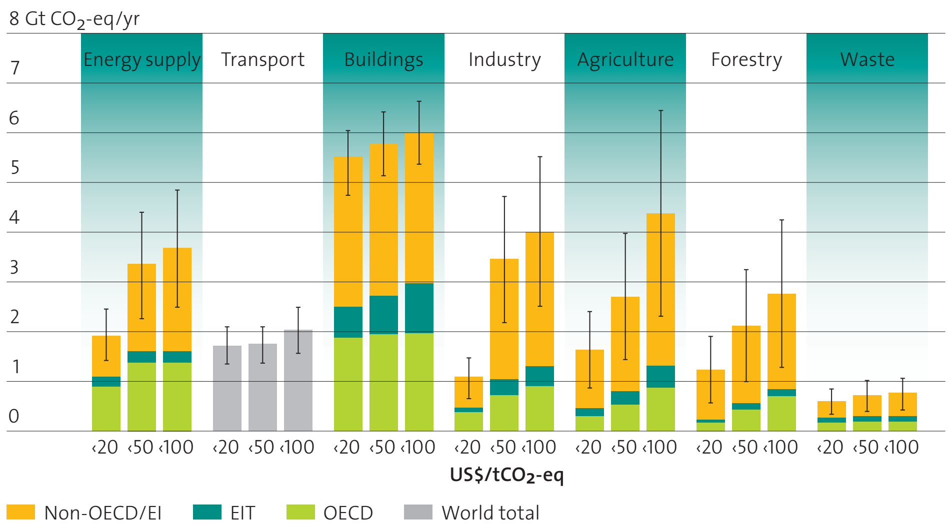


Figure 1 shows the economic mitigation potential for CO2 emissions of different sectors at three different carbon prices: <20, <50, and <100 US$/tCO2 equivalent. At all three carbon prices, the buildings sector has the greatest carbon abatement potential, both globally and individually within each of the three global regions: OECD, Economies in Transition (EIT), and the Rest of the World.

80% of EE potential in the building sector still remains untapped

However, according to a recent IEA[9] study, more than 80% of savings potential in the building sector remains untapped. Thus, the share of deployed EE in the building sector is lower than in the Industry, Transport, and Energy generation sectors.

7 Mc Kinsey, Resource Revolution, 2011

8 IPCC, The mitigation of climate change, 2007

9 IEA, Capturing the Multiple Benefits of Energy Efficiency, 2014

BPIE estimates the deep renovation potential as:

- € 600-900 bn investment potential (present value; the range reflects different scenarios).
- € 1000-1300 bn savings potential (present value; the range reflects different scenarios).
- Net societal benefits are about 10 times higher than the savings potential. The main reason for this leverage is the use of a societal discount rate of 3%, as opposed to 10% for the consumer case (i.e., the investment and savings figures quoted). The societal benefit also includes the social cost of carbon.
- 70% of energy saving potential.
- 90% of CO2 reduction potential.

The investment potential for DER is estimated at € 600- 900 bn

Why is the potential so high?

- Huge floor area. The floor area of the EU building stock is about 25 billion m^2, 75% of which is residential and 25% non-residential buildings.
- Poor energy performance of older buildings. Most buildings were constructed before performance requirements were introduced in national legislation. In the EU, for example, the data from the French building sector show that a majority of the building stock dates back to before 1974, when no building code focused on energy efficiency. Figure 1.5 shows the relation between the year of construction and the required energy performance for different building categories, which shows a good example of requirements concerning roof insulation

The high potential results from the building stock mainly built without energy requirements

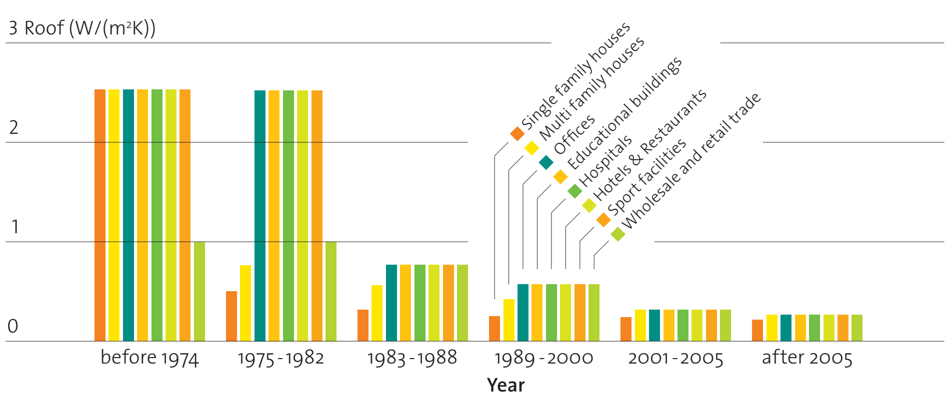


Figure 1.5:
Most buildings constructed before performance requirements introduced (example: France)

- Slow pace in refurbishment. Estimated renovation rates across Europe are only ~ 1% floor area per year[10] although the knowledge of actual renovation rates is poor. With the current rate of renovation it would take about 100 years to refurbish the whole EU building stock.

In the business as usual scenario the refurbishment of the EU building stock would take 100 years

10 BPIE data hub, www.buildingsdata.eu

DER will contribute significantly to EU energy security planning, which would take 100 years

Poor energy performance, in combination with rising energy prices, adversely affects the quality of life and the health of many low-income families. Paradoxically, some Member States with warmer climates have some of the highest rates of households struggling to keep adequately warm: Cyprus (30.7%), Portugal (27%) and Greece (26.1%)[11] because energy performance was not considered important until very recently, with the introduction of the Energy Performance of Buildings Directive. The building stock in these countries and indeed throughout Europe requires significant deep refurbishment to change this picture.

The contribution of deep renovation to EU energy security

Deep renovation is also important to EU energy security as it can reduce EU dependence on energy imports. A recent ECOFYS study [5] compared the impact of a shallow renovation to deep renovation from the present (baseline) through 2050. It found that a deep refurbishment strategy will reduce a baseline energy consumption of 3,500 TWh/a by approximately 2/3 by 2050. A shallow renovation will reduce that same consumption by 1/3.

Conclusions

- The deep renovation potential is, on any metric, extremely large and exists throughout Europe
- Current renovation rates need to ramp up from 1% p.a. to 2.5-3% p.a. and should remain on this level until 2050
- The proposed renovation rate corresponds to a life cycle of 33 to 40 years. To prepare a building for its next life cycle, there is a need to move swiftly from prevailing shallow renovation to deep renovation.
- There is a large demand for investments that deliver attractive rates of return (when considered over long term)
- Macro-economic costs can be reduced through economies of scale, mandatory minimum requirements, and research and development (R&D) into new holistic solutions.

11 BPIE, Alleviating Fuel Poverty in the EU, 2012.

Market potential for ESCOs in Europe: Findings of the JRC 2013 ESCO Report

Bodgan Atanasiu (BPIE) for Paolo Bertoldi, JRC European Commission

JRC, the Joint Research Center of the European Commission monitors the ESCO market by continuously reviewing the market development in each EU member state and in 15 non-EU European countries using a project database maintained jointly by national researchers and stakeholders. The ESCO report describes EU and national framework conditions for ESCOs and presents an overview of specific market features and structures, market barriers, policy background, financing opportunities, and future expectations. The current JRC report on the European ESCO[12] market, the fourth in the series, describes the status of the ESCO markets as of 2013 and market changes since 2010.

JRC´s 4th ESCO Report shows that Europe indicates a growing demand for the energy service market

Market volume increase due to growth of demand

During the past 3 years, most European ESCO markets have grown in volume and the number of ESCOs and ESCO projects has increased. Also, the market has emerged in segments (households) where it was previously rare. This has especially been the case in the Czech Republic, Denmark, and the UK where the public sectors have shown an increasing interest in alternative financing and management models to improve their energy refurbishment projects. However, examples from Italy, Greece, and Slovakia show that even sub-optimal regulatory framework does not hinder the growth of ESCO markets.

Energy Performance Contracting (EPC) still plays a role in only a few countries

Countries overview

The ESCO market has seen good development in Austria, Czech Republic, France, Germany, and the UK. Most other EU countries are at early stages of developing preliminary or moderate markets and show moderate or slow growth. In the past 3 years, two newly initiated markets have been developed in Denmark and Spain.

Institutionalisation of ESCO markets and regulatory framework

The well-developed markets are driven by the demand side and/or ESCO project facilitators. Policies in increasing numbers of countries acknowledge and support ESCO models. This is considered to have had a positive impact of the EU and on national level legislation and programs. In Germany, for example, ESCOs play an active role in the 2014 NEEAP.

The four major barriers for the development of the ESCO market are legal and political barriers, low level of Institutionalisation, financial barriers and partnership problems

In most of the well-developed markets, a certain number of model contracts, standardised project structures, and dissemination programs have been established. However large differences exist between national markets. The ability to transfer findings from one market to another is limited.

Facilitators have appeared on the market to support the demand side in initiating ESCO projects and in providing information on ESCO business models. This is especially the

12 The European ESCO Market Report 2013; available for download at http://iet.jrc.ec.europa.eu/energyefficiency/publications/all/339

case in the public sectors of Austria, Germany, Belgium, and the UK. One reason for the involvement of facilitators is that public procurement codes, which are widely unknown to public bodies, create a need for assistance. Often national or regional energy agencies take the role of facilitators. In some markets, private energy consultants and legal advisors take this action.

Contract types

The most commonly used contract type is still the "chauffage" contract, which is an Energy Supply Contract (ESC) (e.g., for heating supply). These contracts stipulate the refurbishment or new installation of an energy plant to provide heating, or combined heating, electricity, and cooling for a building or neighborhood. In these contracts, the demand side is most commonly left untapped. This contract type is well-known among SMEs, building trade companies, and utilities.
There are only a few countries where Energy Performance Contracting (EPC) dominates, e.g. in Austria or the Czech Republic. Even in Germany, where EPC enjoys significant popularity, only 8-10% of the ESCO market is covered by EPC, while the majority of the market is covered by ESC.
In the past few years, a number of new and innovative contract types have been developed:

Drivers for the ESCO market are research, legislation and grant programs at EU level such as EIB-ELENA

- Integrated Energy Contracting (IEC), which combines energy efficiency and energy supply measures in an EPC project (applied in Germany and France).
- Smart EPC, which integrates energy performance, maintenance, comfort level and building value in an EPC model (applied in Belgium).
- EPC+, which is a Latvian ESCO contract model that combines state grants and forfeiting, primarily for panel houses.
- "Function agreements," "comfort agreements"or"chauffage" contracts, which are based on the provision of an agreed level of comfort or function (applied in Sweden).

Currently no business model for Deep Energy Retrofit (DER) is available. ESCO-driven projects are limited to the renewal of building services. Opponents criticise this shallow approach as "cream skimming," which spoils DER opportunities for 20 years and more.

Remaining Barriers to Energy Services

Stakeholders have identified four major barriers for the market development:

In the building sector, a large efficiency potential still remains mostly untouched.

- **Legal and political barriers.** Such barriers consist of unpredictable legislation, lack of official and/or generally accepted ESCO definition and/or certification scheme and/or standards, contradicting interpretation of legislation and lack of acceptance of the ESCO concept by the public financiers. Also, in some countries, procurement-related barriers that do not allow procuring construction and energy services in one contract create additional challenges for market development.
- **Low level of/lack of institutionalisation.** An important barrier to acceptance of energy services and the resulting cost-effectiveness is the lack of standardised project tools that force building owners to develop individual contracts or appropriate measurement and verification practice. Markets without facilitators are developing very slowly.
- **Financial barriers**. European countries consider EPC projects as loans; this burdens scarce loan programs of public authorities. In most markets, the creditability of the public administrations and ESCOs is limited. Banks have little awareness or motivation to become engaged in funding ESCO projects.
- **Partnership problems**: In the development of ESCO markets, the lack of trust between clients and ESCOs is a serious challenge. Additional barriers include the lack of well-established partnerships between ESCOs and subcontractors and the legacy of failed projects.

Positive drivers

EU legislation (Energy Service Directive, Energy Performance of Buildings Directive) has scaled up market development. The IEE and the newly initiated H2020 grant program have provided excellent framework to address some of the major barriers. Some IEE projects that have been working in the field are: Eurocontract, Change-Best, Permanent, Transparense, EESI, EESI2020, and Combines. EU grant programs for facilitation (European Investment Bank EIB-ELENA) and available financing lines from EU and IFI (e.g. European Energy Efficiency Fund, EBRD) have also been supporting market development.

2

Key Policy and Metrics to Enable Investments in Deep Energy Renovation

Marc LaFrance, IEA International Energy Agency, Paris

In its annual World Energy Outlook 2013 report, the International Energy Agency (IEA) pointed out that, in the building sector, large and mostly untouched energy efficiency and carbon reduction potentials still remain, waiting for development. Significant technological progress has not yet been implemented. Still, combinations of best practice building technologies and renewable energy sources remain in small niches of the building sector. Greater education is needed to highlight the fact that investing in highly efficient building materials and installations can replace long-term energy imports, contribute to lifecycle cost cutting, and create numerous new jobs. To support policy implementing efforts, the IEA supports deep energy renovation and advanced building codes as two top priority goals. To get the building sector on track, it is critical that these policies include two key criteria: (1) a whole-building systems approach with advanced components, and (2) the adoption of enforceable building codes, especially in emerging building markets, and applicable of those codes to component replacement in developed countries.

IEA calls for a major paradigm shift which is required to upgrade building stock by 2050

IEA supports deep energy renovation and advanced building codes

To provide background information on the technological scope IEA has recently published a Technology Roadmap for Energy Efficient Building Envelopes, which:[1]

- Maps out a construction transformation strategy for the building stock.
- Provides a technical, economic, and strategic framework.
- Makes an assessment of high priority areas for 12 regions of the world.
- Establishes policy criteria and evaluation.

The Major Paradigm Shift

Three main elements of the long-term DER strategy were chosen by IEA to achieve a major paradigm shift

IEA calls for a major paradigm shift, which is required to upgrade building stock by 2050. If the "business as usual scenario" is continued, the energy demand is to be expected to increase by 50% in the building sector. The energy equivalent to current energy use in Russia and India combined could be saved by 2050 if best level technologies are widely deployed. The IEA recommends that the EU should focus limited public funding resources on "only advanced systems and advanced components rather than marginal improvements" and that currently focused component policies need to be aligned to support DER. The three main elements of the longterm DER strategy to achieve a major paradigm shift are:

- The highest priority should be to document and replicate cost effective deep energy renovation as part of normal building renovation activity.
- Establish the business case for buildings not currently planned for renovation by targeting a challenging goal and looking beyond energy efficiency. To achieve a lifecycle, costneutral approach, both energy and nonenergy related benefits must be quantitatively valued.

1 IEA, Technology Roadmap Energy Efficient Building Envelopes, 2014

- Establish mitigation cost for early renovation – this would likely require carbon trading and be a lower cost option compared to other solutions such as carbon capture and storage.

R&D will be needed to reduce costs of high performance components

Foster the system approach:

Even though the focus should be on systems, additional R&D will still be needed to reduce costs of high performance components. High performance products should also be promoted by component incentives, education instruments, and labeling. Measures to support the system approach could include:

DER could be fostered by aligning component policies and incentives towards DER and by developing effective financing instruments

- Enforcing energy labels: Example: for windows, "A" category should be awarded only for energy neutral or positive windows (design labeling schemes with the future in mind)
- Require mandatory testing of the building envelope's quality in regular in-tervals, e.g., by introducing a mandatory air leakage test before issuing an Energy Performance Certificate (every 10 years)
- Setting high regulatory standards to promote high level component replacements instead of " justaverage" replacements

Deep Energy Retrofit (DER) could be fostered by aligning component policies and incentives towards DER and by developing effective financing instruments for DER. The private sector is investing in modest savings; public policy with its influence and funding can help drive DER (e.g., see the Lithuania case study vs. Investor Confidence Project).

Staging? Refurbishment Management is needed

The overwhelming number of building renovations results in modest energy savings and can be categorized as "shallow refurbishments" (not DER). Shallow refurbishments, especially HVAC replacement offers a large risk for a "missed opportunity", if envelope improvements, such as façade upgrade, or roof or window replacement are not undertaken. Still the common understanding and decision making do not refer to a whole-building approach. In practice, HVAC measures are rarely combined with refurbishment of the building envelope. This combined approach would have allowed a downsizing of the HVAC-system due to lower heating and cooling demands, and elimination of perimeter zone conditioning, and will likely offer improved comfort.

To create DER best practice examples governments should set an example

More importantly, a combined bundle of short and long term payback periods including all options could have provided a longer but reasonably economic opportunity that will not be pursued. "Creamskimming" the HVAC and other shorter term options will make future investments for remaining items even less appealing since the shortest term investment would have already ready been done. Policy must target such crucial decision points and steer decision makers toward a "whole-building" approach. This is most important for HVAC whereas policies for other components can be specified to require high

Access to public subsidies should be limited to DER projects targeting ambitious levels of energy performance

To scale up DER first of all reliable data has to be prepared and distributed

performance without the risk of missing out on the economics of the systems approach (e.g. specifying code compliant roof insulation or window criteria during component replacement will not negatively impact future HVAC upgrades). Therefore, incentives such as access to public subsidies should be limited to DER projects that target ambitious levels of energy performance (e.g., that follow the GBPN approaches of 50% energy use reduction or < 60 kWh/m2/a for renovation).

One objective could be a collection of system level packages

However, one concern is that households will be reluctant to go for complex, integrative refurbishments. In the beginning they might indeed, but best practice examples will create awareness and the demand to secure future energy costs in households as well. Therefore governments should set an example by going ahead and systematically refurbishing their building stock with DER through consequent public investment policies.

This approach has major benefits beyond efficiency and climate (e.g., job creation and gas security). The multiple benefits beyond efficiency are described in detail in a recently published IEA[2] report.

Specific data requirements to scale up DER in buildings

To scale up DER in buildings all reliable data must first be prepared and distributed among the building owners, funding institutes, and energy service companies:

- Access to eligible data. A common understanding for the need of documentation and evaluation must be established to begin collaboration between the investment community and manufacturers to measure, collect, and derive required metrics for action and project approval.
- Capital cost/performance curves. For specific representative building types in regional markets capital cost and performance curves are needed to learn which DER measure bundles work well, how they perform, and how much the investment costs. To achieve this, evaluation of accomplished and ongoing DER projects has to start immediately.
- Create standard solutions. One objective of the DER project evaluation could be a collection of system level packages including best practice technology components, installed cost, and savings performance indexed to climate conditions. This would create “standard solutions” as a first approach for different building types which refer to the requirements of different climate zones.

2 IEA, Capturing the Multiple Benefits of Energy Efficiency, 2014

Metrics and Data to drive policy—much more data is needed

Reliable global models are needed to back up and support more stringent policy making. Although the IEA already has an extensive global buildings model, more effort is needed to assess individual policy impacts on separate countries and regions that will require improvement in the next few years. The IEA is seeking greater collaboration and working on metrics for a joint IEA/IPEEC BEET MEF project.

Data collection must be intensified and expanded to include, for example, new technology adoption rates, market share of zero-energy buildings, energy intensity of stock and most advanced buildings by end-use/building type, district heating and CHP etc. Core modeling will focus on the building code portion of loads including HVAC, water heating, and hard wired lighting, even though miscellaneous use including plug loads such as office machinery are extremely important too. Even more specific performance criteria are needed for the most advanced regions, e.g., more mean stringent EU specifications for renovation in public buildings and greater stringency and harmonization of near zero energy buildings definitions by type and climate, etc.

2

Development of new business models to integrate deep refurbishment

John Shonder, Oak Ridge National Research Laboratory, USA

In the United States, the Energy Independence and Security Act of 2007 require each federal agency to reduce energy intensity (in terms of site-consumed energy per unit building area) by 3% per year, or 30% by 2015, compared to a 2003 baseline. In addition, as of August 2014, 24 US states had policies in place that establish specific energy savings targets.

In the past few years, energy performance contracts (EPC) have become the main vehicle for implementing comprehensive energy retrofits in US federal government buildings, and in many US states as well. The two most common funding mechanisms in the federal sector are Energy Savings Performance Contracting (ESPC), in which an Energy Services Company (ESCO) arranges private financing to install energy conservation measures at a federal site; and Utility Energy Service Contracts (UESC), in which the serving utility plays the role of the ESCO.

On average, EPC projects – both ESPC and UESC – have been able to achieve 20% reductions in energy use. Thus, meeting the 30% goal will require the government to go beyond the scope of retrofit projects that have been implemented so far.

Targets of DER in US federal buildings

The definition of a deep energy retrofit will always be subjective, as it is related to the energy use before the retrofit took place. Nevertheless, given the current average 20% energy reduction from EPC projects, a reasonable target for deep energy retrofits in the US federal sector is 50% savings and above.

Energy use of US federal buildings

According to the US Department of Energy's Buildings Energy Databook (http://buildingsdatabook.eren.doe.gov), federal buildings in the United States consumed 0.88 quadrillion BTUs (928 PJ) of primary energy in fiscal year 2007, the most recent year for which comprehensive data are available. This quantity represented 56% of total federal energy consumption, 2.2% of all building energy consumption in the United States, and 0.9% of total US energy consumption. Adjusting for delivery losses, site energy consumption in federal buildings was 0.39 quads (411 PJ), of which 49% came from electricity. Other fuels consumed included natural gas (34%), fuel oil (7%), coal (5%), and purchased steam (4%).

Five federal agencies were responsible for 83% of all federal building primary energy consumption in Fiscal Year 2007: the Department of Defense (DOD) (54%), the US Postal Service (USPS) (10%), the Department of Energy (DOE) (10%), the Department of Veterans Affairs (VA) (6%), and the General Services Administration (GSA) (5%). These five agencies occupied 87% of all federal building floor space with DOD accounting for 63% of the total, USPS 10%, GSA 6%, VA 5%, and DOE 3%.

Common business models

Two different models have emerged for implementing DER projects in the US federal sector: through conventional EPC project, and through EPC projects that are combined with comprehensive building renovations. The US Army is experimenting with the combined approach. The model would use two different contractors: a renovation contractor funded by appropriated funds to accomplish non-energy-related upgrades, and an ESCO, which obtains private financing to implement energy upgrades. The advantage is that the cost of envelope-related conservation measures – which are not often included in EPC projects – can be reduced by coordinating them with the activities of the renovation contractor. For example, the ESCO's cost to replace wall cavity insulation will be lower if the renovation contract includes replacement of wallboard. Several challenges exist however: coordination of project design and construction, management of the overall project, and dispute resolution between the two contractors. While a procurement strategy exists on paper, the Army is still considering pilot sites at which to implement this approach.

The General Services Administration (GSA) has had success in reducing the energy use of its buildings, but as shown in Figure 2.1, by 2012 progress had begun to stall. For this reason, GSA began a program focused on achieving deeper energy savings using the conventional ESPC process. Toward this end, in March, 2012, GSA issued a Notice of Opportunity (NOO) for a nationwide deep energy retrofit (NDER). The NOO included a list of 30 GSA-owned buildings covering a total occupied area of 16.9 million square feet in 29 states and the US Virgin Islands. Among the objectives for the project were the following:

- Retrofit plans that move a building toward net zero energy consumption
- Use of innovative technologies
- Use of renewable energy technologies.

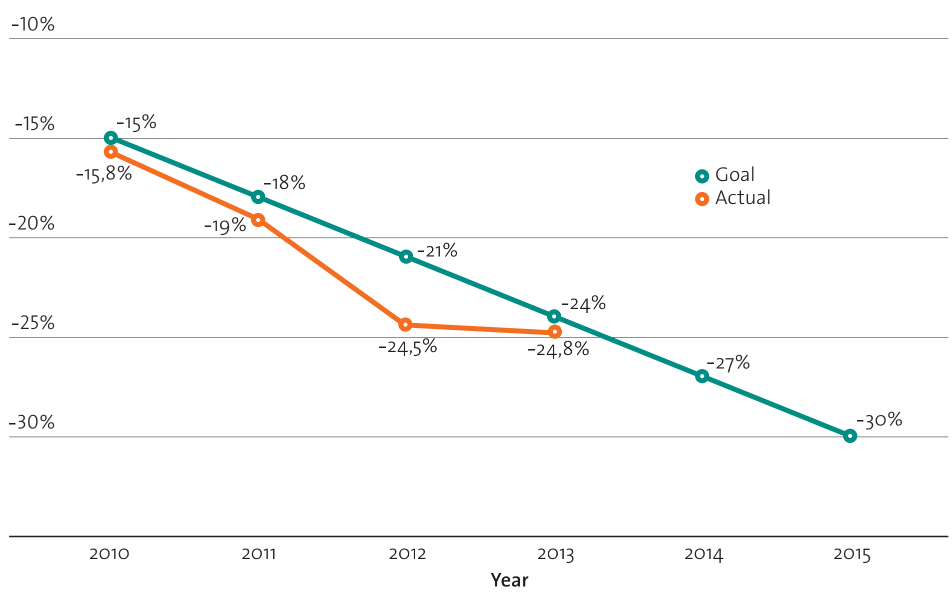


Figure 2.1: Energy intensity reduction in GSA buildings since 2010(Source: ORNL)

Evaluation of GSA´s NDER projects

GSA averaged 38.2% energy savings in recent ESPC awards

GSA ultimately awarded 10 ESPC Task orders with a total value of $172 million distributed among seven ESCOs. The projects covered a total of 14.7 million square feet of space in 23 buildings. It will reduce GSA's energy consumption by 365 billion Btu per year, resulting in a first-year guaranteed cost savings of $10.8 million, which will be used to pay pack the investment over time. A key result from the project was the average 38.2% proposed energy savings over the baselines, which is more than double the average proposed energy savings in a sample of 80 other recent federal ESPC awards. Figure 2.2 compares the percent energy reduction of the GSA projects (filled circles) with the percent energy reduction of the other federal projects (open circles).

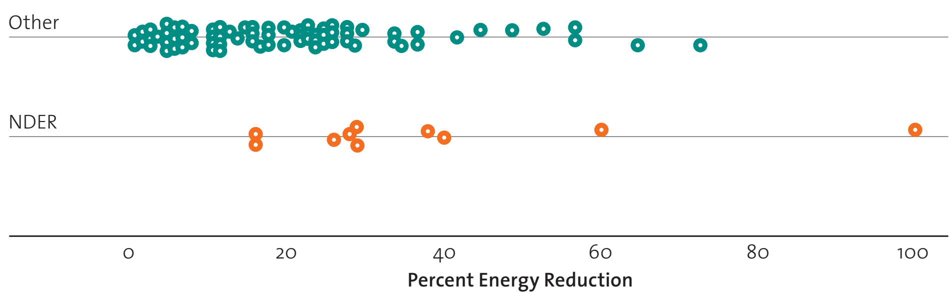


Figure 2.2: Percent energy reduction of NDER projects compared with other US federal ESPC projects (Source ORNL)

While GSA's NOO expressed a preference for innovative technologies and renewables, it is noteworthy that the majority of savings in the NDER projects were achieved using conservation measures similar to those encountered in other projects: lighting upgrades, controls retrofits, chiller and boiler replacements, etc.

ORNL´s analysis of the GSA NDER projects showed the following:

- Key success criteria for success includes:
  - Buildings that have not undergone recent energy retrofit projects;
  - Emphasis from GSA to target DER, which encouraged ESCOs to propose longer-payback ECMs, and regional managers to accept them;
  - Thorough audit process by the ESCOs to identify ECMs;
  - An integrated design approach that considers the building, its occupants, and energy consuming equipment as a system.

- Realization that deep retrofits cost more than conventional projects in terms of energy savings achieved per dollar invested.

- Building envelope measures were not a major factor in achieving deeper savings;

- What is not (necessarily) required to achieve deeper energy savings in ESPC:
  - a. High energy prices. The level of savings obtained in the projects was unrelated to site energy prices.
  - b. High energy consumption baseline. The level of savings in the projects was unrelated to baseline energy intensity.
  - Advanced ECMs. As stated above, the projects included a variety of conventional ECMs.
  - Large "buydowns" of appropriated funds in the form of initial payments from savings. The level of savings was unrelated to the size of the up-front payment.

2

Deep retrofitting via EPC

Johan Coolen, Factor4

Energy is not often the driver for deep retrofit projects

Facilitation is one of the crucial tools helping to scale up ESCO business in most of the growing or mature markets in Europe. The Belgian facilitator Factor4 has been involved in a number of EU projects such as Transparense[3] and the "European Energy Service Imitative 2020 (EESI 2020)" [4] and in IEA DSM Task 16 research work[5]. Inspired by these international projects Factor4 enhanced the EPC (energy performance contracting) business model into "SmartEPC".

Integrating non-energetic measures and benefits in EPC

"SmartEPC" inherits non-energy related savings into the cost balance

"SmartEPC" mirrors the building owners' needs. The owners' investment decisions are often not driven by the aspiration for more energy efficiency. Sometimes energy efficiency is merely a positive "side-effect" of a building refurbishment. The mechanisms of "business as usual" EPC are exclusively related to the energy savings. The integration of non-energetic measures into the scope of EPC projects means to increase investment costs for these measures. To keep the balance between investment costs and savings, "SmartEPC" inherits non-energy related savings into the cost balance, to include: (1) increased value of the building, and (2) a higher level of indoor climate and user comfort. "SmartEPC" provides calculation methods to make the non-energy related savings accountable and gives guidance on how to assess and to verify their performance.

"SmartEPC" requires the fulfillment of basic project requirements (functionality of the refurbished building, safety, legal standards, etc.) but offers maximal decision autonomy for the ESCO in choosing the strategy to achieve these energy and non-energy related benefits.

General concept

The decision making criteria is, like in most of the EESI 2020 driven EPC procurements, to select the ESCO with the maximum net-cost saving. The net-cost saving is the annual guaranteed energy cost savings added to the increased value at the end of the project minus the annual remuneration of the ESCO.

3 revenue streams: fixed, bonus-malus and validated energy savings

The "SmartEPC" accounts for the following performance criteria to determine the revenue between building owner and ESCO:

- Fixed price (payment) during the contract period related to the fulfillment of basic project requirements defined in procurement requirements mostly targeting maintenance measures
- Bonus-malus payments if defined comfort performance parameters are under- or overachieved during the contract period

3 www.transparense.eu/be

4 www.eesi2020.eu/be

5 www.ieadsm.org/

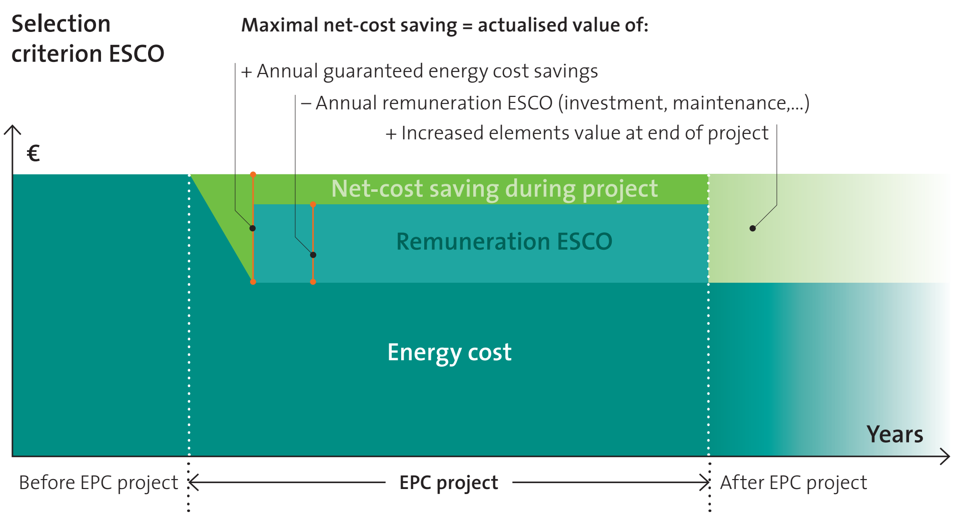


Figure 2.3: Awarding criteria in the procurement process (Source: Factor4)

Energy cost savings are forwarded to the ESCO

- Energy savings validated with an energy price fixed during the contract period related to the measured and verified energy savings during the contract period
- At the end of the contract period, a bonus-malus payment according to the increased or declined elements and building value is settled. If an additional value is achieved, e.g., by appropriate maintenance, the ESCO is awarded a down payment at the end of the contract period.

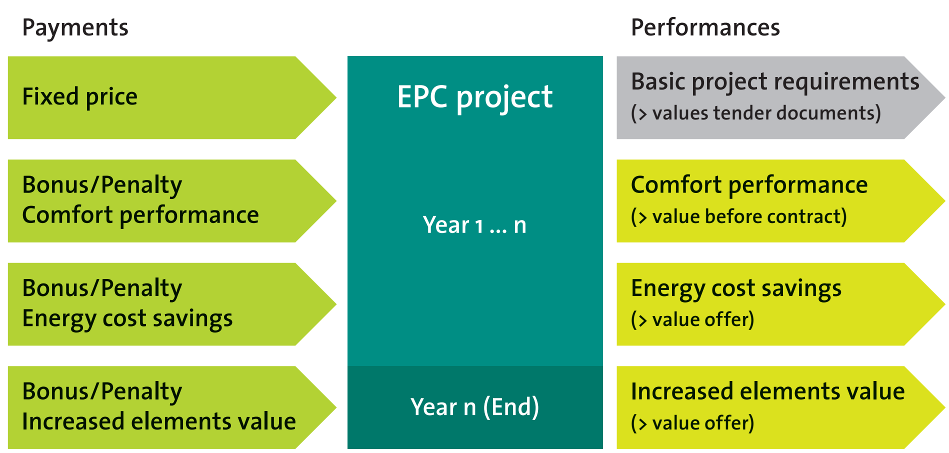


Figure 2.4: Revenues within the EPC project (Source: Factor4)

Energy performance

Comparable to the business as usual EPC, ESCOs in the "Smart EPC" take over the energy-saving performance risk and are paid according to the energy saving performance. The money that the customer saves on energy costs (or part of them) is forwarded to the ESCO during the project duration.

Maintenance performance

The maintenance condition and the value of elements are evaluated at the end of the EPC period costs

In "SmartEPC" the ESCO is technically and financially responsible for operation, maintenance and replacement costs for the whole building including all installations in and at the building such as building envelope, windows, roof, HVAC, lighting, elevators. For taking over the risks for existing and replaced equipment, the ESCO receives a fixed price as a kind of extended maintenance fee. "SmartEPC" provides an additional incentive for the ESCO for high-level maintenance by evaluating the maintenance condition and value of elements[6] at the end of the EPC contract period. The ESCO participates in increased elements value and may extend its remuneration. This approach is a strong incentive for the ESCO to conduct a sustainable maintenance program by putting in place measures with long technical lifetime that mitigate life cycle costs for the building owner.

Comfort Performance

In business as usual (BAU) EPC contracts, the indoor climate and the indoor quality is only a qualitative factor in the sense of a basic requirement which should be met by the ESCO after the refurbishment. The money value of comfort performance is not taken into account in EPC contract. BAU EPC-contracts define the indoor climate quality typically according to indoor condition codes, that is:

- Space temperature in summer: <26°C.
- Relative humidity >40%.
- luminance level >500 lux.

The BAU EPC approach does not allow for a money value of comfort performance:

- The definition of the indoor climate quality is questionable and needs numerous detailed descriptions to be definitely.
- The value of comfort aspects e.g., customer-friendliness of ESCO is not a performance criterion.
- In the BAU EPC approach the building owners are mostly not involved in the design of measures that may affect the indoor comfort level. To involve the users may help to distinguish non-critical and critical comfort aspects from the buildings users' perspective. This may also increase the cost effectiveness of the investment if some overvalued measures, e.g., a luminance level, may be put below the building codes and still be sufficient and acceptable for the users.
- The measurement and verification of the comfort performance level is expensive due to the needed metering and reporting efforts.

6 NEN 2767 Dutch standards

“Smart EPC” allows for accounting comfort performance

A deep energy retrofit (DER) offers the opportunity to increase the comfort performance and to create additional value for the building users and owners. For example, wall insulation and high efficient windows will reduce cold or hot indoor surfaces, which allow the location of good quality working places much closer to the wall than before the retrofit. “SmartEPC” introduces mechanisms to increase the remuneration streams by transparently validating and monetarily quantifying the comfort performance. Comfort parameters are metered in “Comfort-meter” (www.comfortmeter.eu) which is an online questionnaire for the building users to qualify the indoor comfort conditions and to set up a comfort score. The “Comfortmeter” has been developed by Factor4 in close cooperation with universities and is a low priced alternative to large measurement and verification programs. The comfort score has a minimum required level which the ESCO has to guarantee. Each score beyond that minimum level may increase the remuneration of the ESCO. The scale of the remuneration is calculated assuming, for instance, that an increased comfort-score of +1% generates 0.2% productivity increase. This relation between comfort-score and (self) reported productivity was proven via a Comfortmeter survey of 1500 employees working in 35 buildings. The Comfortmeter questionnaire polls the comfort experience of the employees via 35 comfort questions related to different comfort aspects, such as temperature, sound, and air, but also the expected effect of the comfort on their productivity. Through a statistical analysis of the 1500 survey results, the mentioned relation between comfort score and productivity could be estimated.

Conclusions

Within “SmartEPC”, ESCOs are more focused on higher comfort and employee satisfaction. Altogether “SmartEPC” is thus able to create additional value to contribute to the financing of cost intensive deep energy retrofit by: (1) monetarily quantifying comfort performance, and (2) providing a business model in which incentives for a high level maintenance program are given based on the ESCO’s participation in the increased building´s component value at the end of the EPC contract. Both financing contributions extend the financing scope of BAU-EPC business models significantly.

2

Experiences from Annex 61 deep refurbishment case studies

Ove Moerck, Cenergia/IEA EBC Annex 61

Targets of Annex 61 Subtask A

Annex 61, Subtask A, "Business and Technical Concepts for Deep Energy Retrofits in Public Buildings," which runs until 2016, is part of the IEA Program Energy in Buildings and Communities.

In the first stage, Subtask A will review experiences of accomplished deep retrofit projects on national level and in different climate conditions. This preparative work is necessary to learn more on the impacts of deep energy retrofits (DER) and to derive conclusions regarding the planning, calculation, modeling, and construction of DER for the future. One major challenge for the dissemination and broad implementation of DER concepts is the lack of private funding. Private investors are still not confident in the reliability of DER concepts and often hesitate to invest in the projects. Essential information will be derived from ST A to increase the credibility of DER concepts and projects and to pave the way for public investors to provide funds for DER projects.

What DER measure bundles have been applied?

Evaluation of DER projects

To derive lessons learned from DER projects, only completed DER projects were selected in which the energy baseline before refurbishment and measured energy consumption after refurbishment were available. Information on the modeling process, on applied DER measure bundles, and on investment costs was also required. The selected buildings were evaluated according to the following criteria:

- The climate zone in which the building is operated.
- The building categories that were refurbished (whether these building categories could be described by typical constructive details).
- The baseline for energy consumption, and whether energy prizes were awarded.
- The results that were predicted, and which of those were achieved (e.g., energy performance, investment cost budgets).
- The DER measure bundles that were applied to the buildings and the specific costs of measure bundles.
- The modeling methodologies that led to predictions that fell closest to the measured and verified performance data.
- The quality assurance regime that led to good results.

Scarcity of well documented DER projects

It was a challenge to locate a sizeable collection of DER projects with sufficient data. In some countries, a database of DER projects exist, but could not provide the information needed to evaluate DER projects. So far, eight case studies have been reviewed. To increase the confidence in the predictions of DER modeling, the number of well documented and evaluated projects must increase dramatically. The data for this evaluation was collected using an A61 case study template that gathered data on: building and purpose, climate zone, energy prizes, energy consumption and cost baselines, installations and building construction before and after the DER, investment cost, and the business model in which it was carried out.

DER measure bundles

The bundle of measures varies as does the energy reduction

The bundle of measures undertaken in the D.E.Rs varies, as does the accomplished energy reduction (Figure 2.5).

Case Study	Energy reduction (%)	
	Heating	Electricity
Johann-Böhm-Straße, Austria	85	
Hoheloogstraße Ludwigshafen, Germany	94	
Gymnasium Ostfildern, Germany	52	2
School BaWü, Germany	33	66
Angela School, Germany	77	0
Office Passive house retrofit, Germany	75	66
Stengårds school, Danmark	33	68
USA	100 (gas)	19

Figure 2.5: Achieved energy reduction in case studies

Which business models were used?
In all cases, the "owner-directed" business model was used to carry out the DER. Architects, energy planners, and HVAC planners prepared the modeling, planning, and specification of components and services. In the procurement process, tradesmen were engaged to carry out installation. The responsibility for financing, for the investment budget, and for building operation after the DER completion fell to the building´s owner. In most of the cases, neither the building owner nor any of the planners provided monitoring and verification of the planned energy balances.

Which benefits were achieved by DER?
Apart from energy savings, the DER achieved a number of co-benefits. These co-benefits are important as decision-making criteria and, if monetarily quantified, could also contribute to the financing schemes of DER.

Key co-benefits from energy-related measures (E.R.M.) in the case-studies included:

- Improved Indoor-air-quality.
- Improved operational comfort (new control systems).
- Daylight Improvement (e.g., sun blinds).
- Improved thermal comfort.
- Key co-benefits from non-energy-related measures (N.E.R.M) in the case-studies included:
- Increased architectural quality by a modern facade.
- Environmental friendly construction improving the reputation of the building.
- New functional area for the resident.
- Increased living space.
- New design for the utilization of main areas.
- A pleasant, secure, and safe environment.
- Increased access to building sections i.e., by a new central stairway.

Lessons learned

Most of the evaluated buildings are sited in ASHRAE Climate Zones 5 and 6. The evaluation has not yet considered arid, hot, or hot-humid climates. Although the evaluation is not yet fully concluded, the following lessons learned were compiled from the reviewed DERs:

Effects of D.E.R. on building's energy use reduction:

- First of all, the energy for heating and electricity must be collected to secure a viable baseline against which to compare the savings. To make relatively savings comparable between different countries, the baseline definition must be transparent and comparable as well. In the United States and Canada, the baseline includes the electricity consumption for "plug loads," which may include office machinery, domestic appliances, among others. In most of the European countries, this is not the case. Also, since national energy codes differ, "energy" must be defined very carefully. Some countries tend to provide primary energy; however others exclude heating energy, etc. Relative savings must be considered very carefully. Since the focus of this work is on business models, measurement of final energy savings was given the highest priority.
- The energy consumption for heating is reduced by at least 50% by the DER. The DER measures include the building envelope together with the HVAC system. In two cases in Denmark and Germany, the energy use reduction was only 33% due to previously accomplished refurbishments in both assessed buildings.

- The reduction of the primary energy was increased by connecting the buildings to district heating based on renewable energy or CHP.
- Energy reduction by approximately 80% was achieved through insulation combined with a ground water heat pump.
- Electricity consumption for cooling and lighting was significantly reduced by passive solar building design and active solar technologies such as solar heating or solar cooling.
- Energy exchange between buildings with different user and energy load profiles offers the potential for further energy demand mitigation. This potential is not often fully displayed in the evaluated projects.
- A plus-energy standard for multi-story buildings has been achieved

Effects of D.E.R. on building's use and comfort

- In all buildings a significant improvement of the indoor air quality was achieved by the installation of a new ventilation system in combination with a more or less airtight building. The most significant progress was made in environments with relatively stable humidity and little air pollution.
- The building control systems provide a high level of temperature stability that can be specified and distinguished for different zones in the building.
- Warm interior walls increased the comfort level significantly.

3. Effects of D.E.R. on user behavior in buildings

- Human behavior plays a key role in the energy consumption before and after refurbishment. Especially high level DER projects can often be a challenge for building users. Users have reported good experiences in a few projects in which they were integrated early in the planning phase. Knowledgeable users who are familiar with the building refurbishments and who have been consulted in an early phase of the planning process can identify typical weak points and thereby positively affect the building's comfort and performance. Also, users who have been involved from an early stage of the project typically evaluate building comfort levels more positively. Nevertheless, no training materials exist to educate occupants on the building's features after a DER is completed even though energy consumption has been shown to decrease significantly when users have been provided with appropriate training and improved documentation for common IT control equipment.
- In most of the cases, heating consumption performance has turned out higher than initially calculated. Building owners and planners often claim that changes in user behavior are responsible for the gap between planned energy demand and verified energy consumption after the DER. In most cases, no other reasons were considered. In fact, none of the planners further evaluated the consumption after the DER.

Recommendations for the organization of DER projects

Decisions made in early project stages strongly influence energy performance and costs in the DER project. Thus, to be successful, DER refurbishments must be well prepared. The modeling and planning for a DER should include a sound assessment of the energy use reduction potential of both old and new building envelope, heating system, ventilation, sun protection, and lighting to show the potential for optimization.

Projects pursuing net zero energy should consider these 3 stages:

- **Stage 1:** Occupant engagement for energy use, including IT representatives.
- **Stage 2:** Investment of deep energy retrofit.
- **Stage 3:** After 1-year of post occupancy install renewable resources to offset tracked energy demand.

Cost Effectiveness of DER projects:

Cost-effectiveness of DER projects, based on current energy prices, usually falls within the range of 11 to 31 years simple (not dynamic) payback time. In the next step of the evaluation these figures must be assessed and distinguished into “any way measures” to be carried out according to the requirements of the national building codes and the DER specific measures and additional costs related to a higher efficiency level[7].

These results pertain to the eight case studies that have been reviewed so far. However, even this limited number of case studies shows that cost effectiveness is strongly influenced by different factors, for example, the bundle of DER measures that was chosen, whether and an optimization carried was out, and how the project preparation was done.

To evaluate the cost effectiveness of a DER, all benefits must be taken into consideration. The business models that will be developed in the next step of Annex 61 must address both ER and NER benefits of the renovation.

7 Rocky Mountain Institute, How to calculate and present DER value, 2014

Case study – European Energy Efficiency Fund

Account of **Zarpana Signor's** slides, Deutsche Bank

EEEF is an innovative public-private partnership dedicated to mitigating climate change through market based financing in the member states of the European Union. The EEEF's beneficiaries are municipal, local, and regional authorities, or public and private entities acting on behalf of those authorities such as utilities, public transportation providers, social housing associations, ESCOs, etc. (Figure 1).

EEEFs Actors

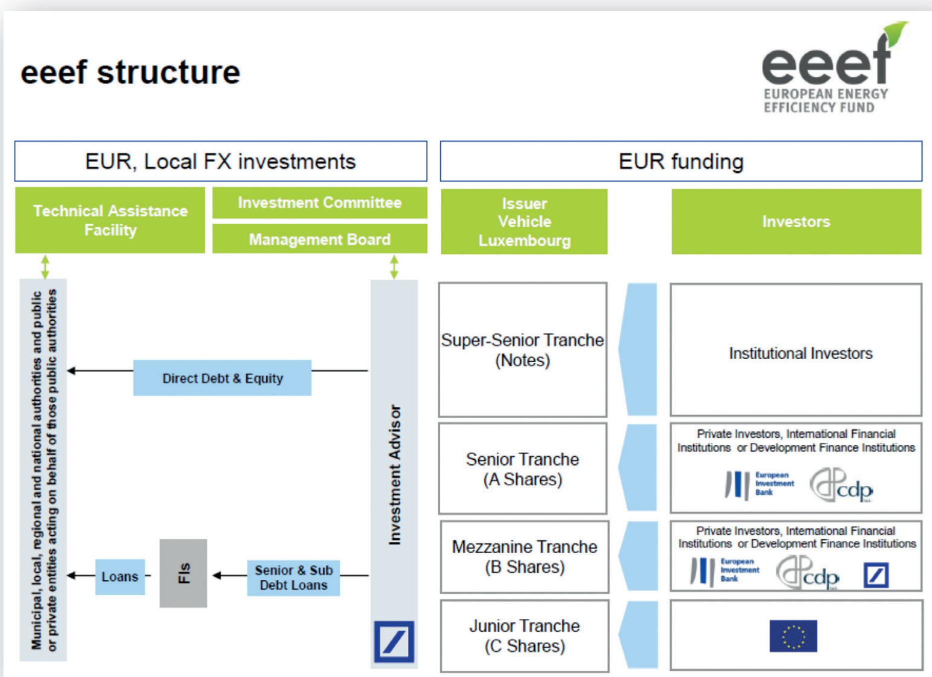
The initial capitalization fund amounting to € 265 m was provided by the European Commission, the European Investment Bank, Cassa Depositi e Prestiti, and Deutsche Bank.

The concept of EEEF

The EEEF's investments are split into three project categories:

- Energy Efficiency (EE).
- Renewable Energy (RE).
- Clean Urban Transport.

Figure 3.1: EEEF structure and actors



For its customers EEEF has three key advantages:

1. *Fast and flexible financing*.

- Professional investment advisor to help the customers.
- Short time line for decision making process. From initial screening (assuming all information is provided) until approval will in most of the cases not take longer than 6 months.
- One-stop shop from project development support via grants from the TA facility to tailor-made financing of projects.

2. *Various financing instruments*.

- The fund offers various financing instruments including senior debt, mezzanine, equity, leasing structures and forfeiting loans.
- The fund can also operate as the sole investor in projects (single investor transactions) to simplify implementation and to lower the execution costs.
- Long maturities.
- Flexibility with respect to maturities: Debt can be provided for maturities up to 20 years, equity or mezzanine capital can be provided to act as co-sponsor or long-term subordinated risk taker.

Eligibility criteria for the application of EEEF:

The access to EEEF money is dedicated to the municipal sector which has set up ambitious energy efficiency and carbon reduction targets and is able to provide an action plan how to put in place these targets. The most significant criteria for eligibility are:

- The beneficiary's municipal link.
- Serious commitment of municipality to mitigate climate change (e.g., Covenant of Mayors Initiative).
- Primary energy savings of at least 20% (CO_2 savings for certain technologies). Furthermore, each technology may have its own specific eligibility criteria
- Application of proven and market ready technologies.
- Preferable project range of € 5 m to € 25 m. Smaller project sizes will be reviewed on a case-by-case basis.
- Alignment of all proposed activities with EU legislation.

Project examples	Characteristics	Project structures
Building upgrades	Energy audits completed, vast energy savings potential Sufficient know-how of ESCO in case of big projects Saving guarantee required Depending on counterparty risk additional parental/municipal guarantee required	Senior dept Mezzanine / equity Funding via co-investments in SPV or NewCo Forfaiting Leasing (mostly for clean urban transport projects)
Street lighting	Only light bulbs, switch boards plus EE related measures can be financed, not the light pole itself Ownership of lighting points need to be in municipal hand Technology with good track-record only	
Biomass plants	Contracts for input (feed-stock) / output (e.g. Electricity/heat) in place Substitution of input possible Technology with good-track record (e.g. boilers, turbines etc.) O&M concept	
Photovoltaic	Land ownership in municipal hand Grid connection secured Feed-in tariff secured O&M concept Bankable module supplier	

Figure 3.2: EEEF's scope of projects

Project example 1:
Energy efficiency upgrade of a University Hospital in Bologna

In Bologna´s University hospital, the largest energy efficiency upgrade in Italy under a Public Private Partnership (PPP) framework was put in place. This is considered to be a lighthouse project for the Italian and European energy efficiency market demonstrating the positive impact of a major energy efficiency investment in a complex hospital infrastructure. The technical solution and the financing concept bear a high replication potential in other health-care companies in Italy.

Key data of project and financing structure:

- Total project volume: € 41 m (equity provided by Manutencoop Facility Management, Siram, Sinloc and Iter Cooperativa Ravennate), EEEF funded volume: € 32 m via a project bond structure.
- Duration of financing: 20 years.
- Key measures and results:
- Upgrade of entire fluids' production and distribution system of the hospital
- Installation of a tri-generation plant for the combined production of cooling, heat and power (CCHP)
- Reduction of CO_2 emissions of 14,136 t p.a., approx. 31% compared to baseline

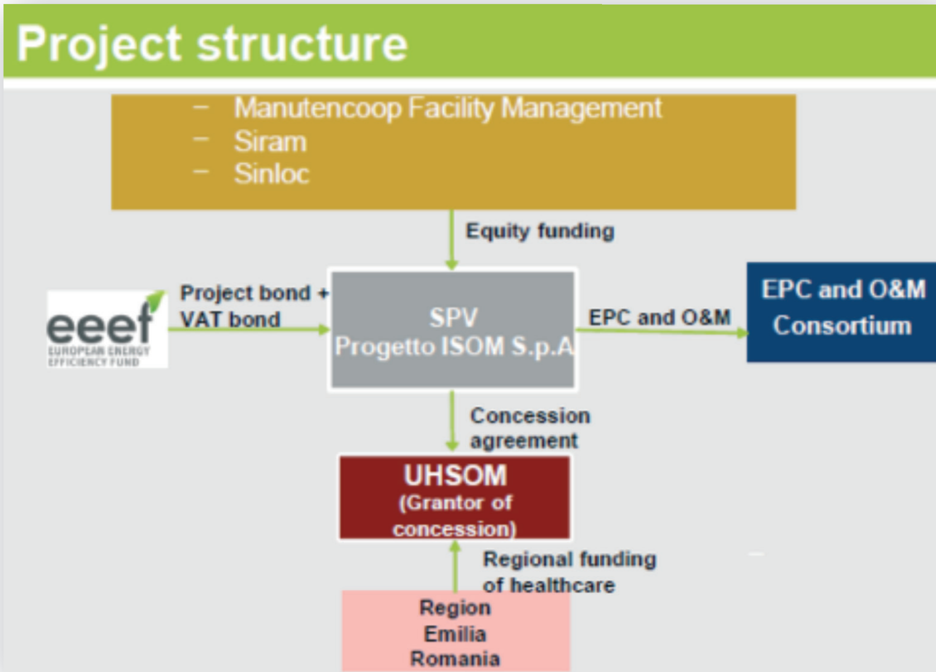


Figure 3.3: University hospital Bologna – project structure

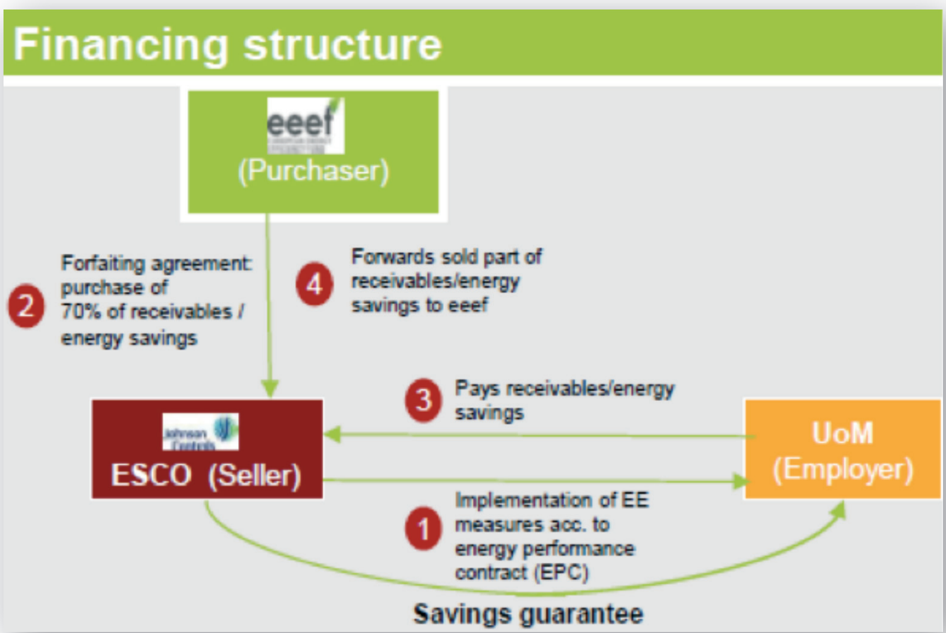


Figure 3.4: University hospital Bologna – financing structure

Project example 2:
Building retrofit of the University of Applied Sciences in Munich

In the UoAS Munich the EEEF was funding an energy performance contract in a forfeiting structure. The financing volume was € 0.6 m with duration of 10 years. The forfeiting, which is a buy-in of loan obligations, could stand as role model for further energy efficiency investments in the public sector.

Measures and Results:

The measures carried out in the high school were a combination of reduction of energy demand and efficient energy supply measures:

- Installations of combined heat and power plant.
- Installation of energy efficient lighting.
- Optimization of heating.
- Optimization of building management.

The results are guaranteed energy savings within the EPC contract:

- Reduction of CO_2 emissions 88t p.a. approx. 11.6% compared to baseline.
- Guaranteed energy savings € 118,860 p.a. (41.7%).

Experiences with EPC business models in Latvia's Residential Building Sector

Eric Berman, RenESCO

Housing market in Latvia

Latvia and other east European countries from the former Soviet Union are facing serious challenges in their existing building stock. The severe housing deprivation[1] rate is more than three times higher than the EU-27 average.[2] The overcrowding rate[3] of almost 60% is the highest among the EU-27, more than three times the EU-27 average. About 60% of the Latvian people are at risk of poverty, twice as high as the EU-27 average. On the national level, Latvia´s floor area per person is very limited. A further degradation would lead to a severe housing crisis. Currently, two major challenges have arisen:

- The buildings were designed in the 1960/70s to be built "cheap and fast" with an expected lifetime of ±30 years. They were not properly designed to withstand harsh weather conditions. Consequently, external parts are now corroding due to the effects of weather, panel joints are becoming crushed, balconies are crumbling, and roofs are leaking. Internal parts such as water, sewage, and ventilation networks, which were poorly designed, have become heavily corroded.
- Ninety-seven percent of Latvia's building stock is owner-occupied. After the breakdown of the Soviet Union, tenants became owners of their flats. However many people cannot afford to undertake the necessary conservation measures. Most importantly, they lack the organizational capacity to live up to their responsibilities.

RenEsco´s offers an EPC business model in which they take over the conservation and modernization process and the operation and maintenance for 20 years envelope was included

RenEsco's EPC business model for the housing sector

RenEsco is a residential private ESCO and a social enterprise that finances housing modernization through energy conservation. The ESCO is driven by the challenges of the deprived and overcrowded building stock. RenEsco won the European Energy Service Award 2011 in the category "Best Provider" for its commitment and its innovative approach.

RenEsco´s business model is based on an EPC contract, in which RenEsco takes over the whole conservation and modernization process of the apartment buildings, and also assumes responsibility for operation and maintenance for 20 years. The flat owners are obliged to pay the energy cost savings to RenEsco during the EPC period (20 years). RenEsco has the responsibility for the planning, implementation, funding, operation, maintenance, and measurement and verification.
The funding of the projects has come for roughly 60% from the energy cost savings financed by RenEsco, and 40% from the ERDF funded national renovation program.

1 Severe housing deprivation refers to the percentage of the population in a dwelling which is considered as overcrowded and exposed to at least one of the following three housing deprivation measures:
A leaking roof or damp walls, floors, foundations or rot in window frames or floor
Neither a bath, nor a shower, nor an indoor flushing

2 Source: RenEsco calculations based on EU-SILC 2009 – revision 1 of August 2011

3 A person is considered as living in an overcrowded dwelling if the household does not have a minimum number of rooms per person; Source: RenEsco calculations based on EU-SILC 2009 – revision 1 of August 2011

RenEsco's share of the investment currently consists of 60% debt-financing from a Latvian bank. The bank financing is solely based on the EPC contract. No other collaterals are used. The remaining 40% RenEsco´s must bring in as its own equity capital.

Benefits for residents

Energy savings have been evaluated and are in a range from 50 - 80%

For the apartment owners, the momentum to engage in the RenEsco business model is only indirectly related to the energy performance. Other concerns are:

- Increased indoor comfort, health, and reliability of the building, which are all part of the services provided by RenEsco.
- Conservation and modernization of apartments, which results in a 20-40% increase of the market value and directly benefits the residents.
- The refurbishment creates more comfortable and acceptable looking houses to live in. RenEsco guarantees a temperature level of 21.5 °C. (Currently, many apartments are severely under- heated)
- The flat owners incur no additional refurbishment costs.
- There is a 20-year guarantee on all construction works and therefore no additional cost for maintenance during the contract period.
- After 20 years, apartment owners will have recuperated their costs from energy savings. The savings are estimated to be in a range from 50-80%.
- RenEsco offers an additional value preposition and an incentive for the apartment owners to contribute to keep the energy consumption as low as possible by offering a 25% profit share of RenEsco's net result.

Achievements:

Where possible geo-thermal heat pump systems with vertical probes are installed

RenEsco provides a deep energy retrofit (DER) for the buildings:

- Within 5 years, RenEsco financed 100% of the cost and performed deep renovations of 15 typical soviet-era apartment buildings using an Energy Performance Contract (EPC) business model.
- The DER measures for this specific building type include the refurbishment of the complete building envelope in a thermal insulation composite system (TICS) with an average thickness of 10cm, installation of new domestic hot water and networks, new heating network, new ventilation with heat recovery systems, and cosmetic repairs.
- The existing "natural ventilation" system creates airflow from the leaking building envelope and windows to the indoor floor area and an uncontrolled exhaust air network in the bathrooms. The new ventilation system is a mechanized ventilation system with (90%) heat recovery and a control system. In the summer free cooling is provided. The DER reduces the building´s leakage rate to 10% of the value before the refurbishment.
- Improvements are made to the heat supply, which is typically city heating. Where possible, geothermal heat pump systems with vertical probes have been installed.

An evaluation by Ekodoma and the Riga Technical University has shown that the RenEsco business model provides high level DER. The energy saving guarantees and the EPC contracts have proven to be bankable by local financier. Compared to other municipal and private sector projects in Latvia, RenEsco's projects clearly illustrate a successful DER that includes a wide scope of non-energy related measures at the same or lower costs and that results in better quality.

Credit rating of housing owners

There is a perceived barrier from financing institutions assuming that low and medium income people will not be able to pay the bills. RenEsco's experience shows a different picture. Even during a time of economic crisis with high unemployment rates, RenEsco received 97% of payments on time, and 0% non-payment during its 6 years of operation. This can be explained by the explicit connection between apartment ownership and the heating and maintenance bills. The poor owner have a strong incentive to pay their utility bills because they will otherwise be forced to sell their renovated flats and move to another flat that has similar utility costs, but a lesser comfort level.

RenEsco's credit rating

Apart from the doubted creditworthiness of its customers, financiers fear that the expected energy savings will not be achieved, or that they will drop after some years of performance. RenEsco's experience shows that expected and performed savings are usually within a 2-5% range of error and that they remain constant over time. Since the building stock in RenEsco's projects is more or less of the same age, energy consumption per m2, and scope of measures, there was already a record of experience that helped mitigate performance risks.

	Perceived barrier	Real or Red Herring?
Performance	Low and medium income people have to pay the bills. Many will not be able to.	Proven Red Herring. Banks love to talk this up in order to increase the interest rates they can charge or collect extra guarantees from governments. Track record of renovation finance is excellent in Eastern Europe
	Expected energy savings will not be achieved or will drop after some years of performance.	Proven Red Herring. Thousand of similar building. Excepted savings usually within 2-5% margin of error. Savings do not decrease over time.
Policy	Lack of consistent policy. Start/Stopping of programms.	Major problem. It takes 1-2 years to develop projects. 3-5 years to develop capable organizations. Stopping programs destroy projects and renovation companies.
	Transaction costs. Complexity of support programs. Procurement rules.	Real. Consumes at least 70% of RenEsco staff time. Adds 10-15% to the total project costs. Creates many unnecessary risks and project failures. Leads to silly and poor decisions.
	No financing available. Subsidy yes – finance no. Especially problem for small private sector companies.	Real. Many approved projects cancelled because lack of finance. 1% lower interest over 20 years = 9% investment subsidy. ESCO cost of capital is much to high (7-10%).

Figure 3.5: Real and perceived risks in Latvian housing sector (source: RenEsco)

Nevertheless, there is no suitable financing available. Many approved projects had to be cancelled due to lack of finance. Despite the experience record of reliable payments by the apartment owners and reliable predictions on the energy saving performance, RenEsco´s cost of capital is still much too high (~7%). Creating a forfeiting fund to buy up the RenEsco's future cash flows is considered to be a viable option to lower RenEsco's financing costs and to enable a quicker recapitalization, but this has not yet been put in place.

RENESCO's experience in finding workable programs and finance

In the last period (2007-2013), many countries offered loan and subsidy programs that excluded third parties such as ESCO as borrower or grant receiver. The European Commission and International financial institutions went along with this, preventing ESCO's or other third parties to develop. One major challenge in the support of third private parties with public seed money or subsidies involves tight market regulations ("de-minimis") that target a market situation of "equal opportunities for all," which may not derailed by public grants. To bridge that issue, building owners should have access to public grants under the obligation that they engage an ESCO to implement the project.

The biggest barrier in implementing EE in residential buildings in most of the eastern European countries does not originate from the realization of energy savings. Instead it originates mainly from the lack of consistent policies from governments and financial institutions to realistically deal with the post-soviet housing legacy.

Local and international financial institutions still hesitate to give proper consideration to the example of successful projects like RenEsco's to allow, for example, EPC contracts to serve as collateral to secure financing streams. An evaluation of the practice and the development of project finance structures could contribute to overcome this barrier.

Funding of energy efficiency projects in the United States, Canada, and the EU

Matt Golden, Panama Bartholomy, Environmental Defense Fund

Barriers to Energy Efficiency Projects

Currently, the financial situation for EE is fragmented. There is a perceived gap between economically viable retrofit opportunities and actual number and quality of retrofit projects. The transaction costs are high, there is a lack of demand from the side of building owners, and the cost of capital is high. From a financier's perspective, energy efficiency projects entail high transaction costs and are perceived to be risky due to the difficulty of predicting accurately energy cost savings. Sufficient experience with underwriting and evaluating energy efficiency loans is still lacking. The lack of secondary markets[4] to provide exit opportunities for investors, or further liquidity to the investments is another important barrier. There are a number of additional barriers for EE-projects. A survey conducted by the Institute for Building Efficiency[5] shows three interacting criteria as major hurdles for the realization of EE-projects:

- Insufficient payback or return on investment (ROI) for EE projects. Most of the EE projects in the building sector are, if related to DER, long term payback with a moderate ROI. In practical application sometimes even those low level targets are missed in the projects as the energy savings do not always perform in the predicted way.
- Uncertainty regarding savings. Not many reference values are available as the number of DER projects is still small and the number of evaluated DER projects even smaller. To create certainty for savings, more DER projects must be consistently evaluated and documented.

These two criteria conspire to reduce the willingness of private investors to spend money in DER projects.

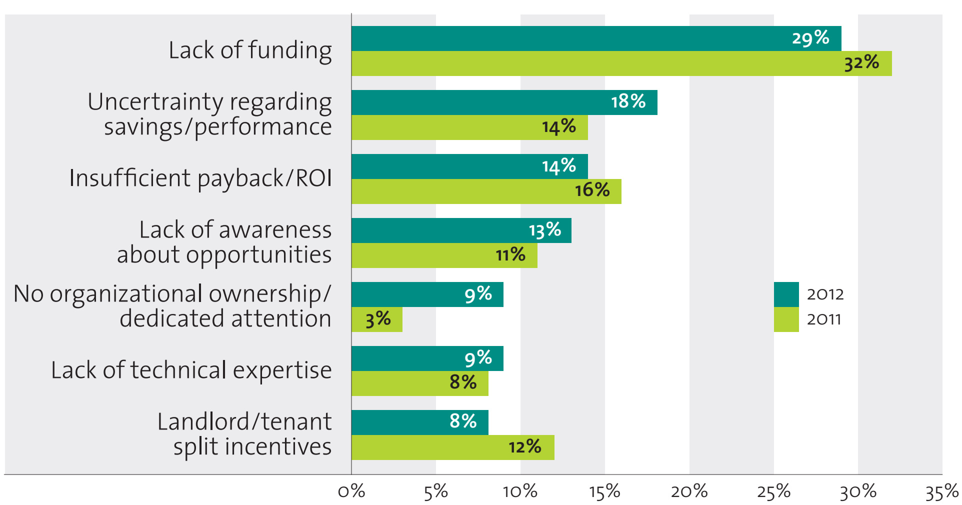


Figure 3.6: Barriers to Energy Efficiency projects (Credits: Institute for Building Efficiency)

4 Financing EE in buildings, JRC 2014

5 Institute for Building Efficiency, JCI 2013

Lack of standardization and risk management on the investors' side

The market-situation is currently shaped by a lack of standardization and eligible risk management on the investors' side and a lack of data on cost effectiveness for the building owners, energy planners, and service companies. These shortcomings result in high transaction costs and a high cost of capital, which leads to a decrease in demand for EE financing and a difficulty in processing financing.

The "Investor Confidence Project "(ICP)[6] was initiated to overcome this vicious cycle and to find solutions to these issues so that reliable and thus bankable EE-projects can be created. Its aim is to shape a business environment, in which capital markets become engaged in financing EE in the long-term.

Ways of financing EE projects in the United States

In the United States, different financing tools are available for EE projects:

1. Pay for it (Self-Fund)

Way of Financing	▪ Out of internal capital budget or by taking out corporate debt. ▪ On-balance sheet of building owner.
Scope	▪ Capital budget constraints and moderate ROIs for DER projects often lead to the realization of the most attractive single measures (cream skimming), ▪ Short-term projects that limit savings and do not optimize total building performance.

2. Tax Exempt Bonds (for the government)

Way of Financing	▪ Up to 100% financing for 15 to 20 year terms. ▪ On-balance sheet of building owner.
Characteristics	▪ Low cost of capital exempt financing rates.
Scope	▪ Limited to public sector customers with large-scale projects due to the high cost of bond issuance.

3. Leasing

Way of Financing	▪ Up to 100% financing via a capital or operating lease. ▪ 5 to10 year lease terms (longer terms, up to 15 years, are possible for tax exempt customers]. ▪ On-balance sheet (building owner).
Characteristics	▪ Relatively flexible on credit quality.
Scope	▪ Best for big ticket equipment

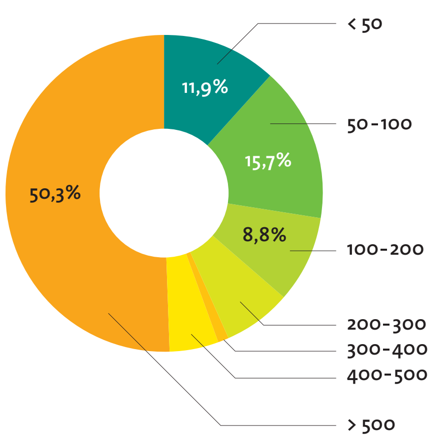
6 For information: see next presentation "Enabling markets for investor ready energy efficiency – practical examples from the US ICP project and first steps in Europe" or on http://www.eeperformance.org

4. Get A C-PACE Assessment on Building Property Tax Bill

C PACE Assessment is an off- balance solution

Way of Financing	■ Customers are not required to invest their own money. ■ Off-balance for building owner. ■ Customer owns project performance risk due to fixed annual payments. ■ Up to100% financing for 15 to 20 year terms. ■ Obligation for pay back is secured by priority lien on real property, no other collaterals. ■ The saving performance is secured by the building owner. ■ The re-funding of PACE money is provided by public entities with low interest rates.
Characteristics	■ The building owner´s payments are fixed as annual benefit assessment charge on the building's property tax bill. ■ Customer payments is bound to property, not present owner ■ Requires mortgage holder consent, which may be time consuming and tough to get.
Scope	■ Emphasis on commercial real-estate. ■ HVAC measures, building envelope, renewable energy. ■ Until June 2014, 256 projects with a volume of $75 m have been closed and more than 250 million are in PACE project application. ■ Commercial PACE can be applied for all types of buildings. The majority of projects are below 50.000 $, but project sizes up to $500.000 and more are possible, too.

Projects by size (1.000 $)



Projects by type of building

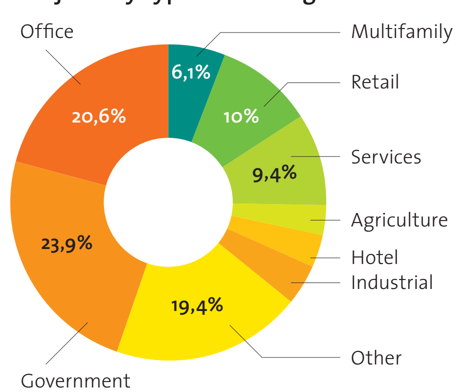


Figure 3.7: C PACE Project size and measures

5. Managed Energy Service Agreements (MESA)

Way of Financing	■ 100% financing for 5-10 year payback period projects. ■ MESA service provider owns the EE measures. ■ Off-balance sheet for building owner.
Characteristics	■ Cash flow neutral pricing payments set equal to historical utility costs, to cost-per-avoided-unit-of-energy, to a floating percentage of the actual utility rate. ■ Providers manage projects and costs, assume performance risk. ■ MESA provider takes control over customer utility relationship (MESA provider pays customer utility). ■ Does not run afoul of existing mortgage restrictions.
Scope	■ Emphasis on commercial real-estate

6. Energy Service Agreements (ESA)

Way of Financing	■ 100% financing for 5-10 year payback period projects. ■ off- balance sheet for building owner.
Characteristics	■ Cash flow positive prior payments set below current historical utility costs and based on per unit energy savings (i.e., “negawatt” charge). ■ ESA providers manage projects and costs, assume performance risk and give advice. ■ Ability to fund multi-facility Projects.
Scope	■ Strong customer credit profile, emphasis on owner-occupied facilities.

Risks and de-risking strategies of EE Financing

From the investor's perspective, the barriers to financing EE fall into three categories:

1. Asset risks. How does an EE project affect rental rates, resale values, and maintenance in mid- and long-term perspectives?
2. Credit risks. How to mitigate the risk of customer (building owner) how to mitigate risks of energy service company´s bankruptcy?
3. Performance risks. How to assure the performance savings of an EE project?

De-Risking strategies to mitigate Asset risks

- Benchmarking for buildings' energy performance has been introduced in a number of US States for public buildings and for residential buildings
- Asset Labeling: energy asset labeling allows a comparison of the energy efficiency of buildings on a performance level. Asset labeling may affect the asset value.

A survey by the Institute for Building Efficiency shows that the awareness for energy efficiency among customers has risen significantly among the customers. Thus, benchmarking, asset labeling and disclosure are becoming more and more important to increase a buildings value. Buildings that are recognized to provide a better energy performance may increase the lease rates. Thus the investor's asset risks can be mitigated.

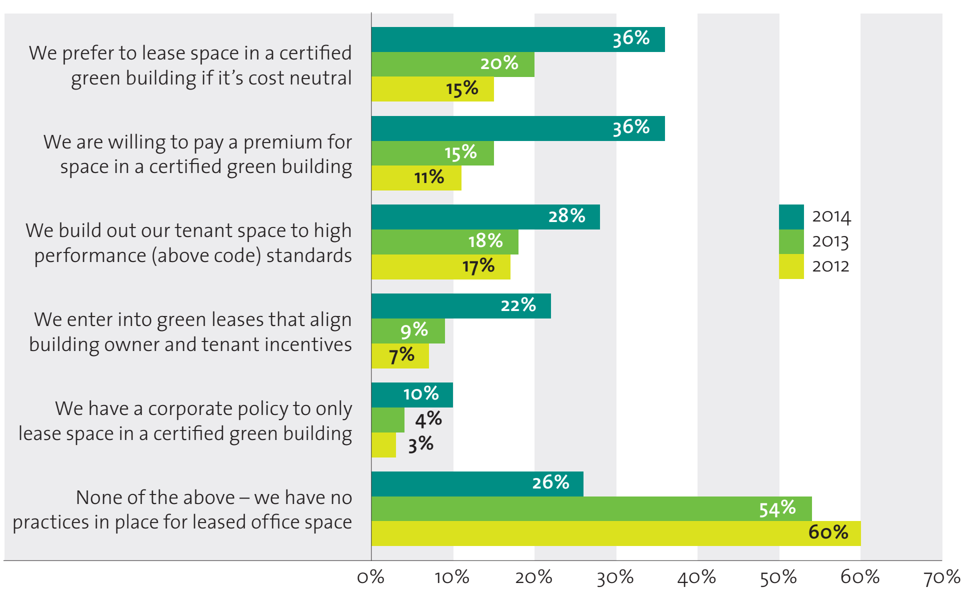


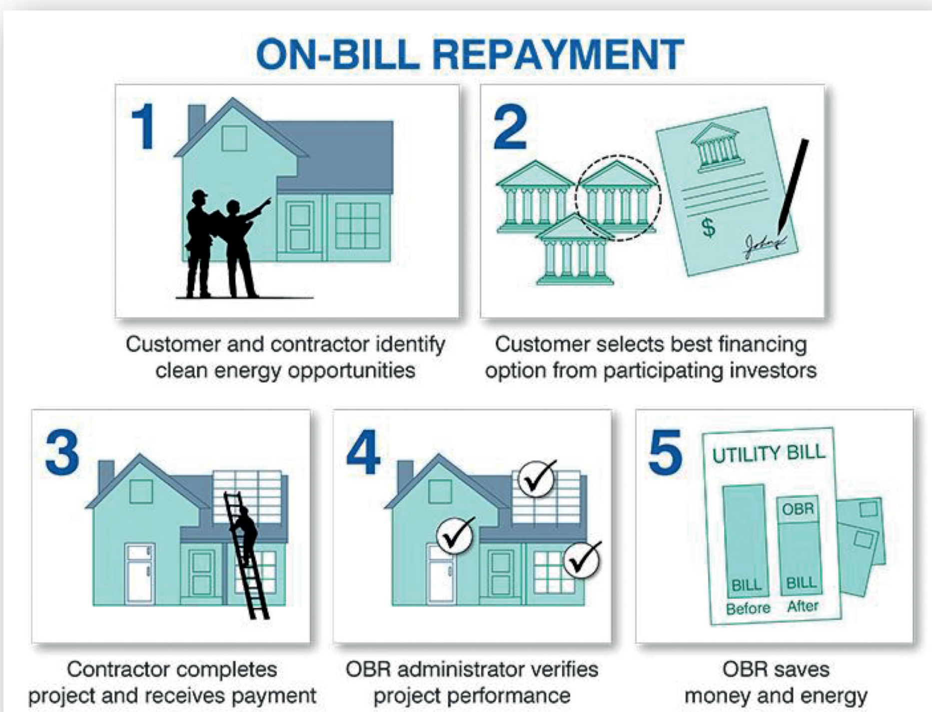
Figure 3.8: Value of EE in Tenant Occupied Buildings (Credits: Institute for Building Efficiency)

De-Risking strategies to mitigate credit risk

There are several innovative instruments available to mitigate the credit risk. Credit risks occur mainly with regard to the potential default of one of the involved parties in an EE project. On-Bill Payment, Commercial PACE, and Green banks are the most commonly applied de-risking strategies in the US market:

- **On-Bill Repayment (OBR)**
  In an on-bill-repayment (OBR) customer and contractor identify and realize viable EE-potentials in the building. After the verification of the project performance (installation of EE measures) the customer's loan is repaid by monthly surcharges added to the utility bill. Since energy costs decrease due to the investment in EE, the utility costs remain on the same level or are even reduced. The risk of default of the building owner is not completely eliminated, but the debt collection is facilitated as it is connected to the energy consumption of a building. As soon as energy is consumed, the OBR becomes a part of the account. Also the debt service is connected with the building not with the building owner. In case of transfer of a building, the debt service is handed over to the new proprietor.

Figure 3.9:
On-bill re-payment



Commercial PACE (Property Assessed Clean Energy)

PACE is a means of financing energy efficiency refurbishments or renewable energy installations for buildings.

A precondition for PACE is that the State has passed an enabling legislation.

In areas with PACE legislation in place, municipal governments offer a specific bond to investors and pass the investors' money forward to consumers and businesses so that they can undertake their energy retrofit. Since the investors lend their money to the community, which has a better credit rating, the community can thus pass on the relatively low rate of interest.

The de-risking method of C-PACE is to connect the loans repayment over the assigned term (typically 15 or 20 years) to an annual assessment on the building property tax bill. Fixing the loan to the property by a priority lien requires mortgage lenders to give their consent for a PACE project as their loan will now be subordinated, and might sometimes be more time-consuming to obtain.

In PACE a municipal government offers a bond to investors to secure their credit risk

Green Banks

The purpose of a state green bank is to use public funds and authority to lower the cost and increase the amount of private financing for clean energy technology. These funds bridge the gap between public funding in R&D and market maturity of EE technologies and services by providing public funding during the phase of demonstration and deployment.

Green banks' market incentive programs lower the cost of investment and thus help to make project's viable for private investors. Public funding is a leverage to increase the amount of private financing for clean energy technology. As soon as the investment costs decrease due to a proceeding product maturity and economies of scale, public funding can be redirected to other EE products/services.

Green Bank provide public money during demonstration phase of technologies

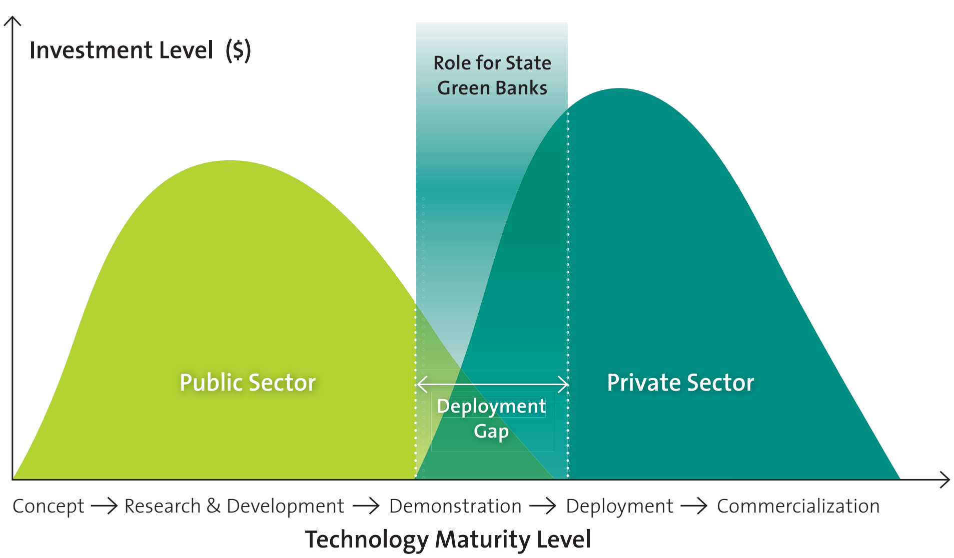


Figure 3.10: The clean energy "deployment-gap" (Credits: ICP)

De-Risking strategies to mitigate performance risk

- Basically, the way EE is financed has to be reconsidered and directed into the project financing. Project finance is a long-term financing-mechanism for projects based on the projected cash flows of each single project rather than the balance sheets of its sponsors. EE-projects in buildings are secured by the project assets and paid entirely from project cash flow. In case of EE they are repaid by the energy savings. Project financing creates additional funding with each new initiated project. Currently in most of EE projects the financing is stalled on the balance sheets and the credit rating of the sponsors. This mechanism limits the availability of funding on the market to the limited capability i.e., of the energy service companies. With each newly initiated project, the availability of funding decreases. Also, the credit rating of a company is in most of the cases only indirectly related to the success in EE projects. One major step in the de-risking strategy for EE projects is to focus the funding on the projected energy performance of each single project.

- The de-risking strategy for the performance risk has to address three additional issues:
  - Uncertainty of savings. Still, many approaches to calculate the savings exist without being evaluated with regard to their reliability, their fields of application. Besides the calculation of savings, the detailed planning, the installation, and the commissioning of the EE measures all inherit specific risks that must be assessed and evaluated.
  - Project origination costs. The costs to get an EE project started are high because the knowledge required to engineer and commission the process is not well distributed.
  - Actuarial data. Reliable data on the financial and energy performance of EE projects is largely not available.

Investor Ready Energy Efficiency – The Investor Confidence Project (ICP) approach

As described in the previous presentation, many approaches are already available to mitigate asset risks, credit risks, and performance risks associated to EE projects.

The Investor Confidence Project (ICP) has taken these approaches as a starting point to define a clear road-map from retrofit opportunity to reliable Investor Ready Energy Efficiency™. With a suite of Commercial and Multifamily Energy Performance Protocols in place, ICP reduces transaction costs by assembling existing standards and practices into a consistent and transparent process that promotes an efficient market, while increasing confidence in energy efficiency as a demand-side resource, and increasing cash flows for investors and building owners.

The parties involved in ICP[7] focused on creating an increased stakeholder value through a Standardization of processes in following segments:

- Baseline definition
- Savings projection
- Design, Construction, and Commissioning
- Operation, Maintenance, and Monitoring
- Measurement and Verification (M&V).

Through the standardization a certain level of quality assurance is implemented. All standards are documented in the Energy Performance Protocols:

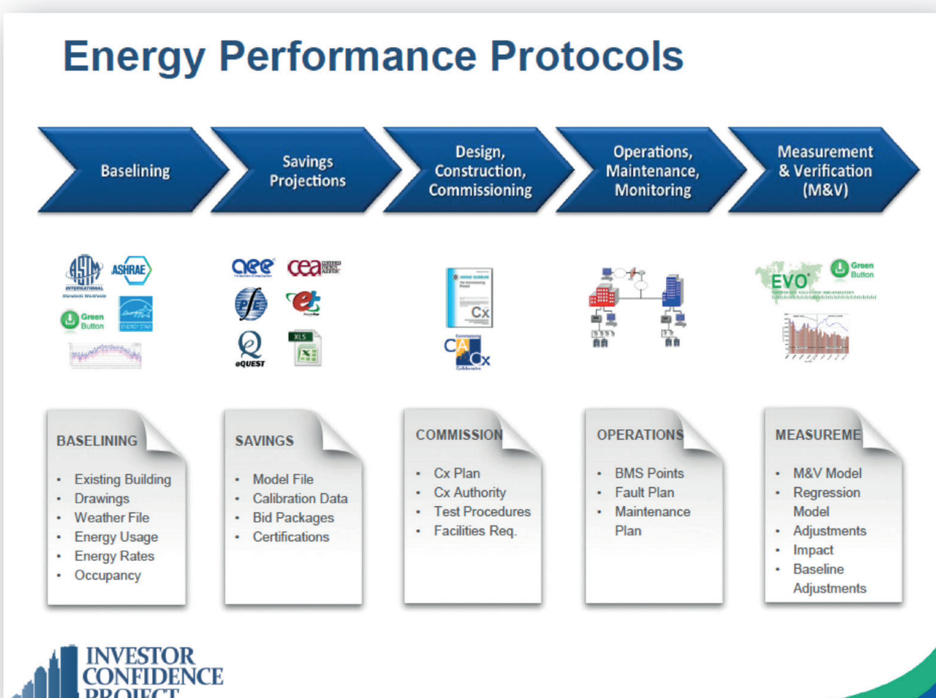


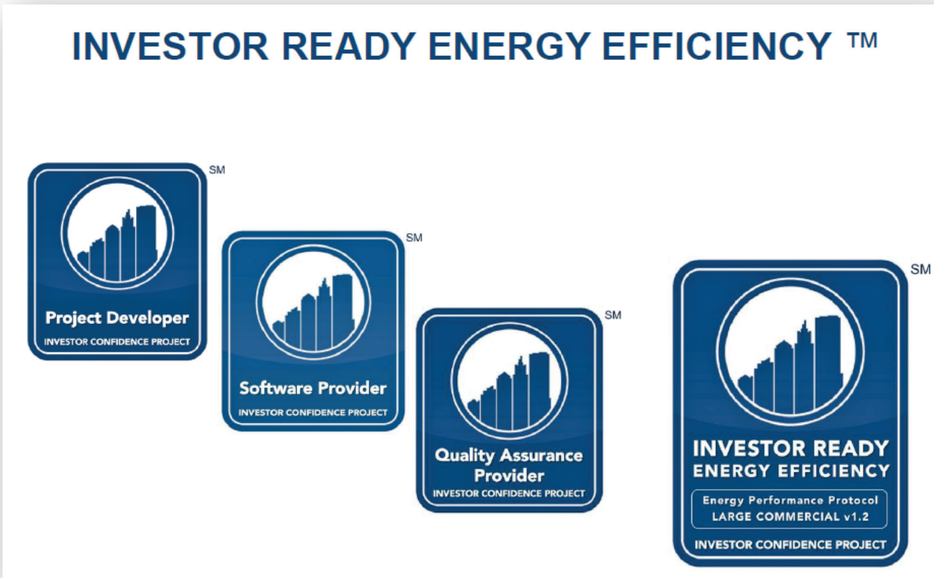
Figure 3.11: 5 steps in ICP

7 For more information on ICP see www.EEperformance.org

EE projects, aligned with the Energy performance protocol are rewarded with the INVESTOR READY ENERGY EFFICIENCY ™ label.

ICP also offers professional accreditation to project developers, software providers and quality assurance providers for work on INVESTOR READY ENERGY EFFICIENCY ™ projects.

Figure 3.12



ICP prepares adapting to the EU market

This does not mean that labeled projects are 100% sure. However, it does serve as a basis for an investor's risk assessment and will therefore help to reduce risk add-ons.

ICP is an initiative that began in the United States and that is now being prepared for adaptation to the European market. The objective of Investor Confidence Project Europe is to standardize the EE origination process to create Investment ready projects. The project will not invent new approaches, but will gather best practices from across Europe to achieve a sensible level of standardization. ICP Europe is structured in the same way as it has been in North America. The outcomes, however, will most likely be different, since the initial starting point, the legislation, and the stakeholders are different from the United States.

As it did in the United States, ICP aims to stimulate the market for EE in Europe. This includes the EE market for buildings, both deep energy retrofits and "shallow" refurbishments, which, due to a lesser degree of complexity, might be more suitable for investors in gathering experience in financing EE and thereby in building trust.

ICP Europe began in autumn 2014. It represents a platform for a dialogue between the stakeholders in Energy Efficiency in Europe. Stakeholders who want to make a contribution are welcome. [8]

Both Pan-European and National Steering groups will be meeting to create European Energy Project Protocols that can be used to deliver Investment Ready projects that will increase investor confidence in project returns and reduce complexity in bringing projects to market. Through these efforts, ICP Europe hopes to help facilitate significantly more private capital to Europe´s renovation market.

8 For more information see www.eeperformance.org/europe

3

Conclusions

The discussion with some 80 participants from EU commission, funding entities, ESCOs, energy agencies, manufacturers concludes that:

- Deep energy retrofit (DER) strategies are needed to comply with political targets. Presentations from IEA and BPIE have shown that the deployment of DER strategies is essential to reach EU 2030 goals. The IEA has called for a major paradigm shift by leaving the business as usual scenario, documenting and replicating cost effective deep energy renovation, and establishing business models that account for energy- and non-energy related benefits and that establish mitigation costs for early renovation.

- Use retrofit opportunities consequently. A consequent DER strategy can ramp up a significant part of the DER potential, which BPIE estimates to require an € 600-900 bn investment and will yield € 1,000 -1,300bn in savings potential in the EU building stock.

- New business models are needed. A significant advancement and change of parameters must be put in place within the business models currently in use for EE measures, and particularly, for DER. Energy performance contracting projects offer better incentives to foster cost and energy efficiency of DER projects. Also EPC models create additional accountable value by including performance guarantees. Current research, as conducted in IEA EBC Annex 61, will create advanced EPC models that will be able to cover DER measures in the future. DER EPCs must consider all valuable benefits created by DER projects, such as increased building value, comfort benefits and other bankable benefits. The creation of additional value streams will minimize the impact on the debt burdens of the building owners.

- More confidence is needed among participants. To direct private money into DER projects, the investor, ESCO and building owner must share confidence. In Europe, efforts to assess the problem of credibility by standardization of processes and structures has, as yet, focused on only a few projects; this capability is not well developed so the processes are still costly. In the United States, the Investor Confidence Project provides a structure that allows the preparation, assessment, and approval of EE projects.

- Facilitators are needed to develop complex DER project structures. EPC and DER facilitators act as intermediates between the financiers, who are mostly unable to develop EE projects, and building owners, who are often not familiar with the processes. Facilitators are needed to develop complex DER project structures for building owners, to prepare decision making processes, and to establish performance-related innovative business models. Best practice examples from Lithuania, the United States, and Belgium show that despite numerous challenges, innovative EPC solutions can arise (e.g., SmartEPC, ICP, RenEsco).

- Create innovative funding sources. Large amounts of private money are needed to supplement scarce public funds, and ultimately to provide the investments needed to initiate a DER strategy. To achieve this end, more reliable data from accomplished DER projects are needed to provide the essential information to make precise predictions and to help foster DER projects' credibility. This can only be achieved through extensive research and evaluation projects.

Foster better communication between building participants. Multiple barriers exist for example in the communication between building owners, financing entities, and ESCOs. Best practice examples from Lithuania and Belgium show that innovative EPC solutions arise (e.g., SmartEPC, ICP, and RenEsco).

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EBC

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