SmartSPIN

Smart energy services to solve the **Sp**lit **IN**centive problem in the commercial rented sector

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D2.1 - REVIEW OF EXISTING BUSINESS MODELS FOR SMART ENERGY SERVICES

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List of Abbreviations

AFDD	Automated Fault Detection and Diagnostics
BEMS	Building Energy Management Systems
DR	Demand Response
EaaS	Energy-as-a-Service
EEaaS	Energy Efficiency-as-a-Service
EPC	Energy Performance Contracting
ESCO	Energy Service Company
MESA	Managed Energy Services Agreement
M&V	Measurement and Verification
MEETS	Metered Energy Efficiency Transaction Structure
OBR	On-bill repayment
P4P	Pay-for-Performance
PPA	Power Purchase Agreement
SLA	Service Level Agreement
SRI	Smart Readiness Indicator
TBS	Technical Building Systems

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EXECUTIVE SUMMARY

This deliverable reviews existing and emerging business models for smart energy and energy efficiency services. The goal of the review is to identify commonalities between the different models, as well as to generalize how successful models for the deployment of distributed energy generation could be applied to the case of energy efficiency upgrades.

The analysis in the deliverable imposes the following categorization on the reviewed business models:

- Asset-based models, where the consumer pays for the fact that an energy asset is made available;
- Output-based models, where the consumer pays for the output of the energy asset and not for the asset itself;
- Outcome-based models, the consumer pays for the management and optimization of a building's operational conditions.

For each category, selected business models are described and evaluated according to their applicability for use in commercial rented buildings. In addition, business models from relevant H2020 projects are described, and their potential relevance to the goals of SmartSPIN are highlighted.

Finally, the deliverable presents the main insights from a series of stakeholder interviews that were carried out so that to collect stakeholder perspectives on best practices for setting up contractual agreements for energy efficiency retrofits, challenges that are specific or amplified in the commercial building sector, and innovations that are needed for boosting investment in energy efficiency. The main insights gained from these interviews include:

- The combination of operational data collection and monitoring, advanced measurement and verification, and performance guarantees is a promising route towards business models that level the playing field between energy efficiency improvements and distributed renewable energy deployments.
- Green leasing is an important foundation for tenant-landlord agreements that allow the transactional structures required by the different business models for energy efficiency in commercial rented buildings.
- On-bill repayment and "*put it on the bill*" strategies are considered important by third party investors and financial institutions when evaluating the trustworthiness of energy efficiency investments.

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1 INTRODUCTION

1.1 THE MAIN BUSINESS MODEL VARIATIONS

Although a large number of business model variations for energy and energy efficiency exist, they can generally be categorized as *asset-based*, *output-based* or *outcome-based*:

- In *asset-based* models, the consumer pays for the fact that an energy asset is made available;
- In output-*based* models, the consumer pays for the output of the energy asset and not for the asset itself;
- In *outcome-based* models, the consumer pays for the management and optimization of a building's operational conditions.

Typically, asset-based models involve equipment leasing. A prominent example is the *Solar-as-a-Service* model, where a solar services company installs and maintains a solar system on a building's rooftop to supply the building with electricity. The service provider charges the customer with a monthly lease for the system. The installed solar panels provide a self-consumption capability to the building. The monthly fee does not depend on how the customer uses this capability, but it is conditional on the service provider maintaining a certain level of quality for the technical properties and the operational characteristics of the equipment.

The main paradigms for structuring output-based models are:

(a) Output Purchase Agreements. The most common case of output purchase agreement is the Power Purchase Agreement (PPA). A PPA is an arrangement, usually long-term in nature, under which a third-party provider installs, owns, and operates an energy system on the customer's property for producing energy. At the end of the contract, the customer may be able to extend it or even remove or purchase the installed equipment.

(b) Energy Performance Contracting (EPC). Under an EPC agreement, an energy service company (ESCO) upgrades existing or installs new equipment, and guarantees that the intervention will achieve a pre-specified minimum level of energy savings. The provision of guarantees protects the building owner from performance risk. On the other hand, the building owner is responsible for securing the necessary investment capital. The ESCO is incentivized to maintain the quality of the installed equipment and optimize its operation, since higher savings mean higher compensation for the ESCO.

(c) Energy Efficiency-as-a-Service (EEaaS). The EEaaS model generates value by bundling into a single offering the installation, performance monitoring, maintenance and support services. In many practical examples, the EEaaS model acts as a financing solution: the EEaaS provider contracts with the most appropriate third-party technology providers and installers to carry out the upgrades, and integrates financing into the process by paying for all upfront costs. Equipment, construction, operations, monitoring and maintenance are the responsibility of the EEaaS provider, while the customer uses a portion of the cost savings due to the avoided energy consumption to make service payments to the service provider. At the end of the contract

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duration, the customer can choose to purchase the equipment according to its residual value, extend the contract, or (less commonly) return the equipment.

Outcome-based models replicate service delivery approaches from other domains, such as telecoms. Telephone and internet are services that a consumer can acquire through a contract with a telephone service provider. The consumer expects a certain level of service from the connection, and, ideally, the fees to the provider should be linked to the extent to which this level is maintained. The more cost-effective is the way to maintain this level, the more profitable for the service provider the contract will be. The *Heat-as-a-Service* model is the most common model of this category.

1.2 The Methodology and Structure of the Deliverable

This deliverable is composed of two (2) parts. The first part (Part A) reviews the business models variations described in Section 1.1 through desk research. The focus of the review is on upgrades that target technical building systems (TBS), such as technical equipment for HVAC, on-site energy generation and storage, built-in lighting and so on. Furthermore, the presented business models have been selected and described according to their applicability for use in commercial rented buildings. In addition, business models from relevant H2020 projects are described, and their potential relevance to the goals of SmartSPIN are highlighted.

The second part (Part B) presents the main insights from a series of stakeholder interviews that were carried out in the framework of the deliverable. The goal of the interviews was to collect stakeholder perspectives on the following aspects:

- Best practices for setting up contractual agreements for energy efficiency retrofits;
- Identified challenges that are specific or amplified in the commercial building sector, and the rented commercial building sector in particular;
- Overall limitations of existing business models and practices that must be overcome for greater adoption of energy efficiency retrofits in the commercial building sector;
- Lessons learned from their own experience that SmartSPIN can benefit from;
- Innovations that are needed, either in contract structures or technologies employed, for boosting investment in energy efficiency.

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PART A: REVIEW OF BUSINESS MODELS

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2 BUSINESS MODELS FOR ENERGY EFFICIENCY

2.1 ASSET-BASED BUSINESS MODELS

2.1.1 Equipment leasing

Equipment leasing is mainly a financing option for installing new, more efficient equipment. The typical structure of a leasing scheme is depicted in Figure 1. Depending on the applicable accounting rules, it may be that:

- either the customer is the owner of the equipment for most legal and accounting purposes, and declares the equipment as an asset on its balance sheet,
- or the lessor owns the equipment and the customer rents it at a fixed monthly payment that is treated as an operating expense.

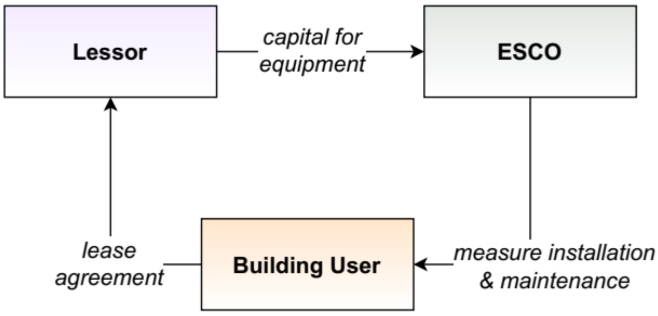

Figure 1 **Typical structure of a leasing scheme**

The most common example of equipment leasing is the solar lease, where the lessor owns the solar equipment and the customer rents it at a fixed monthly rate. However, the option of HVAC system leasing is also available in some EU countries. As an example, there are companies that offer boiler rentals in the Netherlands and heat pump leasing in Denmark. In most cases, the service provider assumes the financial and the technical risk, which incentivizes routine maintenance of the equipment. In some variations of the model the service provider couples the offering with performance guarantees.

It is possible that the equipment installations are financed by the building owner; either the building owner acts as a lessor or the building owner is the one to get into a contact with a lessor. In this case, a pass-through clause is included into the landlord-tenant lease so as to allow the costs of the efficiency measures to be passed through to the tenant as incremental upcharge. Examples of such clauses include:

- “*All costs of any capital improvements made to the building that reduce the building’s energy expenses, shall be cost capitalized and amortized as an annual Operating Expense under generally accepted accounting principles. Only the yearly amortized portion shall be included in*

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Operating Expenses. In no event shall the charge for yearly amortization be more than the actual reduction in Operating Expenses" (Source: Institute for Market Transformation, 2018[1])

- "*Savings associated with a capital investment that exceeds Landlord's lease obligations (i.e. beyond what is required to maintain proper functioning of the Building, such as an innovative resource efficiency project) should be shared at a ratio of x percent Landlord / y percent Tenant of (Projected/Actual) savings*" (Source: Center for Market Innovation, 2011[2]).

One aspect for the building owner and tenant to agree upon is if and how the passed-through cost will be adjusted for changes in occupancy due to long lasting non-routine events. An example of such an event is the COVID-19 pandemic; it should be clear how the operating expenses for energy efficiency upgrades are adjusted and allocated for a building that is used less due to measures to address the pandemic.

2.1.2 Continuous Commissioning

A common practice of ESCOs with respect to the measurement and verification (M&V) of energy savings is to combine post-retrofit measurements with pre-retrofit assumptions/calculations for the expected savings. The credibility of this approach can be significantly increased when there is in place a process that continuously monitors the operation of the installed equipment to verify that it operates as expected. Accordingly, there are companies that couple the installation of equipment, such as heat pumps for example, with a service that continuously monitors the equipment and intervenes when it is necessary to restore optimal operation. This process is summarized in Figure 2.

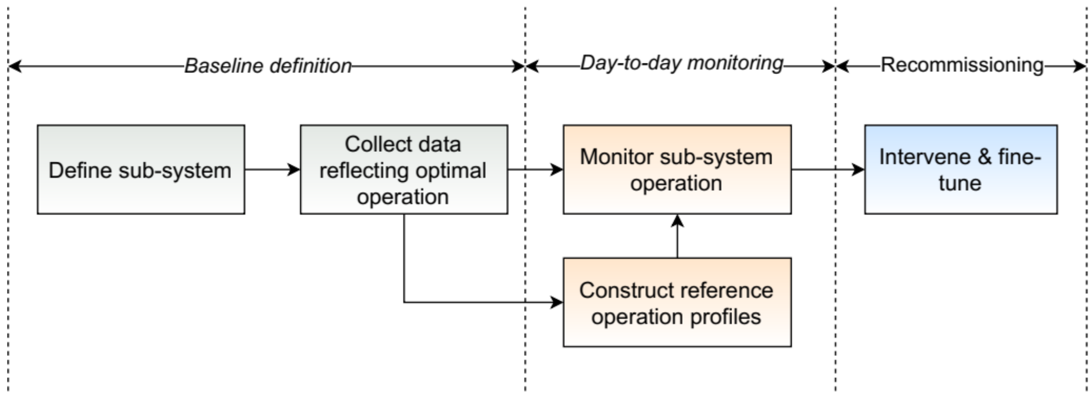

Figure 2 **The continuous commissioning process**

[1] Making Efficiency Work For You – A Guide for Empowering Landlords and Tenants to Collaborate on Saving Energy & Resources, Institute for Market Transformation, U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Better Buildings Alliance, 2018

[2] Energy Efficiency Lease Guidance, Center for Market Innovation, Natural Resources Defence Council (NRDC), 2011

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2.2 Output-Based Business Models

2.2.1 Output Purchase Agreements

The main difference between a PPA and the leasing model lies in the customers' type of monthly payments. While in a leasing contract, a fixed monthly fee applies to the customers for the “lease” in return for the system’s use, in a PPA customers pay a fixed price per kWh for the power generated. These payments can be made in advance by estimating the monthly power production and periodically adjusting customers' balance comparing the actual versus estimated system production.

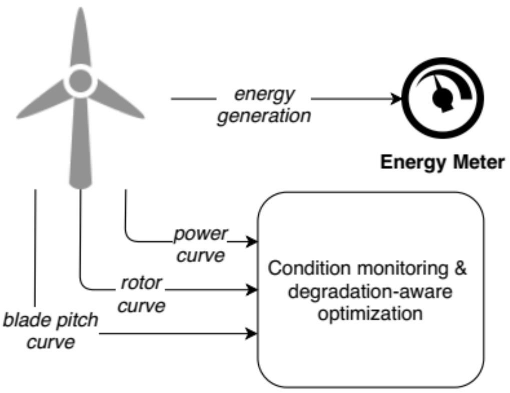
A relevant example is the one of the Landlord-Tenant PPA between Regency Centers and the Trader Joe's grocery store company. Regency Centers is an owner, operator, and developer of shopping centers in the USA. Since retailers in leased spaces are reluctant to install on-site solar PVs, Regency Centers installs and owns the solar systems, while selling the generated power directly to the retailers that rent the facility at a discount to utility prices. The building owner still needs to purchase maintenance services from a relevant service provider.

It is straightforward to extend the idea behind PPAs to include heat as an output. Instead of charging for units of fuel consumed, the service provider charges for the heat generated. In practice, the service provider leases heating appliance and supplies the consumed fuel, while customers are charged per unit of heat generated. Several German energy suppliers offer this kind of service with gas boilers.

Getting from the PPA model to a general model for energy efficiency upgrades requires ways to draw parallels between energy generation and energy savings due to improved equipment efficiency and operation. One way to highlight the potential similarities is shown below:

Energy produced by a wind turbine

The value of a PPA is monitored through the metering of the energy generation, and optimized by monitoring and maintaining the health of the equipment:



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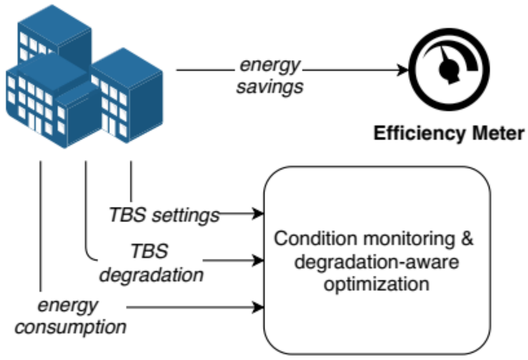
Energy savings from energy efficiency

The value of an efficiency-based output purchase agreement is monitored through the metering of the energy savings (measurement and verification), and optimized by controlling the operation of the installed technical building systems:



2.2.2 Energy Performance Contracting

The focus of this section is on the EPC with performance guarantees model, since the assumption is that the capital for the energy efficiency upgrades is provided by the building owner. The EPC with guarantees model is summarized in Figure 3 below.

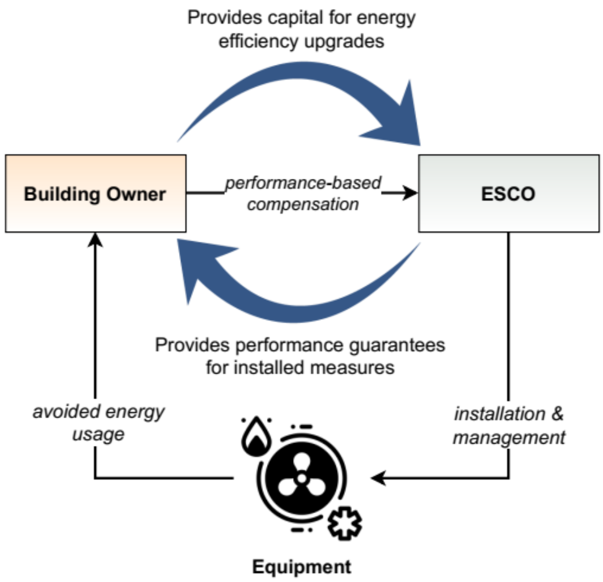


Figure 3 **EPC with performance guarantees**

A conceptual extension of the EPC model to include tenants is depicted in the diagram of Figure 4. The central ideas behind this diagram are that:

(a) The financial transactions between building owners and ESCOs are dictated by the fact that an energy efficiency upgrade is an option that can generate value for both the building owner and the ESCO (opportunity for offering maintenance and operational optimization services).

(b) The financial transactions between tenants and ESCOs are dictated by the energy savings and/or efficiency gains. The right agreement between tenants and ESCOs should incentivize systematic fine-tuning of the equipment operations and the exploitation of additional sources of revenue such as demand response.

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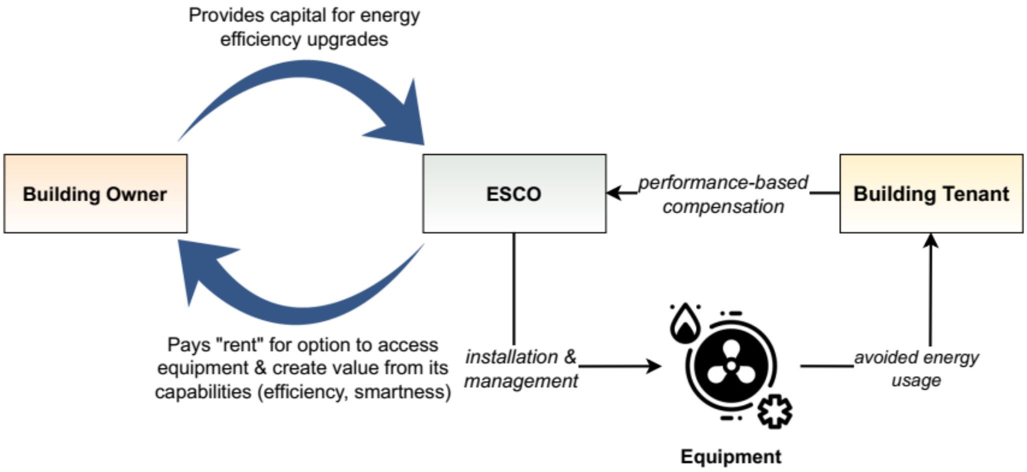

Figure 4 Template for including building tenants in EPC with performance guarantees

The involvement of the tenants in this scheme requires an agreement from their side, and for this agreement tenants need an estimation of the savings and a way to mitigate the risk that the predicted savings might not match actual ones. One approach to solve this challenge is through the right lease clauses. As an example, the Energy Aligned Clause proposed by the New York City's sustainability plan limits building owners' capital expense pass-through to 80% of the predicted savings in any given year. This is called the 20% performance buffer, and it is based on the observation that actual savings are generally +/- 20% of the predicted savings. Such a clause reduces risk for the tenants, while extending the payback period for building owners.

A source of risk for the building owners in the above model is that both the building owners and the ESCOs are compensated by the tenants (compensation in Figure 4 flows from right to left); if the tenants leave the building, no cash flows can be generated. In principle, efficiency upgrades can boost property value and provide opportunities for higher rents. Accordingly, it is important that while the model is operational, enough data is collected so that the added value of the upgrade is evident to any prospective tenant later on.

2.2.3 Energy Efficiency as a Service

The EEaaS model is based on the idea that the promotion and up-scaling of energy efficiency requires treating all relevant costs as operational costs. The rationale is that buildings are assets and most building owners have already borrowed against them. As a result, the balance sheets of the building owners are already too crowded to add new liabilities for energy retrofit capital.

In its most basic form, an EEaaS model has the structure of Figure 5. The EEaaS provider has an EPC with performance guarantees agreement with an ESCO/contractor, while receiving payments from the building user according to the achieved energy savings. Pay-for-performance rules and transactions govern the relationships of all the involved parties in the model.

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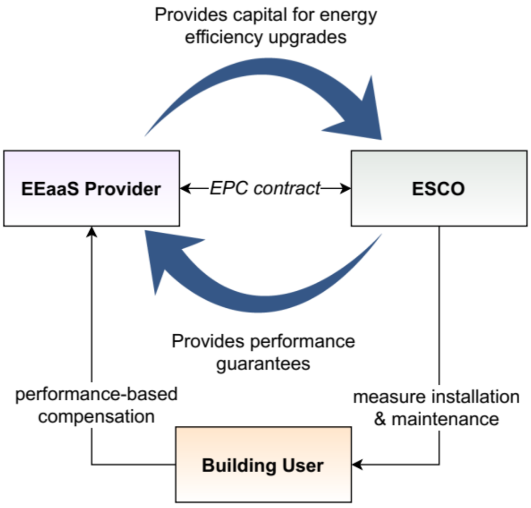

Figure 5 The basic structure of an EEaaS model

Since energy efficiency is determined by the characteristics of the equipment as much as by the way it is operated, it makes sense to link the consumers' payments to the overall performance of the service, quantified as the difference between the actual energy consumption and the energy consumption had the relevant intervention and optimizations not taken place. This is particularly relevant when the energy retrofit includes upgrades for improved monitoring and control of the systems' operation. EEaaS models incentivize active management and optimization: the greater the performance of the service, the higher the added value for the consumer and the payments to the service provider.

A particular variation of the EEaaS model is the *Managed Energy Services Agreement* (MESA) model. Under a MESA agreement, the service provider acts as an intermediary between the consumer and the utility by assuming the responsibility for the utility bills and charging the customer for both the actual energy consumed and the estimated energy savings due to the energy efficiency measures. This variation is particularly relevant for rented buildings because it allows the service provider to directly pass charges through to tenants (Figure 6).

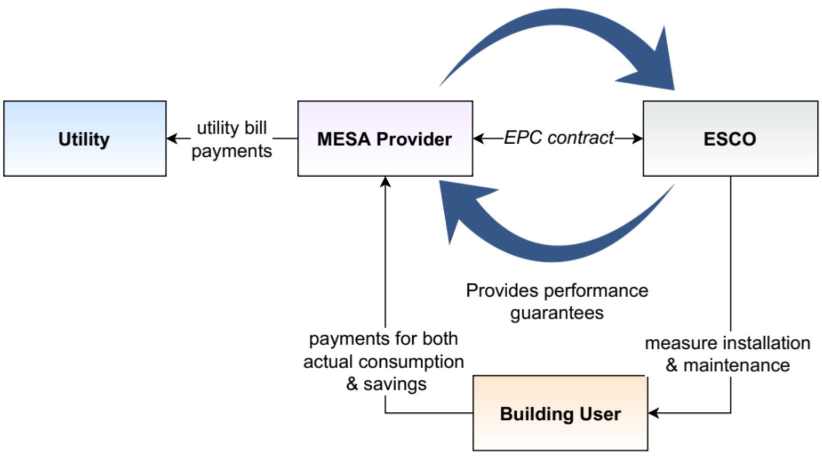

Figure 6 The structure of a Managed Energy Services Agreement

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Since the EEaaS providers pay for and own the equipment, they face the risk of the building being left without tenancy. One way to mitigate this risk is by treating an energy efficiency upgrade as an option that has both a cost to acquire (the cost of the upgrade) and the capability to produce value when utilized by the tenant. When the model is operational, the added value that is generated for the tenant should cover the cost to acquire. In the case of tenancy interruption, the building owner must have agreed to pay to the provider a minimum fee for making the efficiency upgrade available in the first place.

2.2.4 On-bill repayment

On-bill repayment (OBR) is a financing scheme in which a third-party lender supplies capital to a customer to fund energy efficiency upgrades and is repaid through regular payments on an existing utility bill (the utility acts as repayment service provider). OBR enables utilities for benefit from energy efficiency: while energy efficiency means revenue loss for utilities, OBR provides them with an opportunity to generate revenue through billing services.

The H2020 project RenOnBill[3] has produced a thorough explanation of the OBR schemes and their characteristics[4]. A relevant observation from the RenOnBill project is that while the "tied to user" structure is more familiar and standardized, it is difficult to be accepted in cases of rented buildings. An alternative option is the "meter attached" one, where the payment can be transferred from previous to new tenants. Furthermore, the perceived risk level for investors may be lower, since the meter attached option may mean that the building owner has to step in should payment default by the tenant occur.

2.2.5 The Metered Energy Efficiency Transaction Structure

A Metered Energy Efficiency Transaction Structure[5] (MEETS) model consists of the following transactions:

- The building owner offers the building spaces and functions for the installation of the energy efficiency measures.
- The MEETS service provider pays for and maintains the measures in the building, and in return, has a long-term agreement to exploit the value of the energy savings. MEETS uses the term *energy tenant* to highlight the acquired right to harvest the added value of the energy efficiency upgrades. For this right, the service provider pays the building owner rent for use of the site. These payments are additional rental income for the building owner.
- The service provider delivers to the utility the yield from the metered energy efficiency (energy savings due to the upgrades).

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[3] Residential Building Energy Renovations with On-Bill Financing – RenOnBill, https://cordis.europa.eu/project/id/847056
[4] D2.1 Overview of On-Bill Building Energy Renovation Schemes, https://www.renonbill.eu/knowledge-sharing/overview-of-on-bill-buildings-energy-renovation-schemes?language=any&reports=on&page=1
[5] https://www.meetscoalition.org/

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- The utility bills the building, at retail, for both actual consumption and metered efficiency. As in the OBR case, the utility is actively involved by offering its billing system for the charging the tenants and redistributing the value to the service provider.

  The main reason for utilities to participate in a MEETS scheme is the opportunity to buy energy savings (like a PPA for energy efficiency) and comply with energy efficiency obligations that are imposed on them in the framework of Article 7 of the Energy Efficiency Directive.
- Part of the financial benefits can be used for incentivizing the tenants to avoid behaviours that lead to the deterioration of the energy efficiency measures.
- The building owner treats the energy efficiency improvements the same way other conventional tenant improvements are treated. At the conclusion of the agreement with the service provider, the improvements become property of the building owner, free of debt or other financial liability.

The MEETS model is summarized in Figure 7.

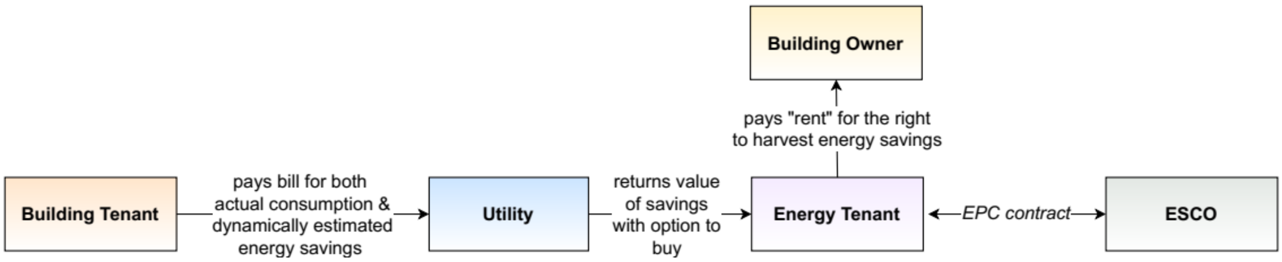

Figure 7 **The Metered Energy Efficiency Transaction Structure model**

An important observation from MEETS initiatives in the USA is that third-party lenders are willing to engage only if the utility is a proper counterparty, instead of it just passing through the collected payments for metered efficiency. In other words, the utility should treat consumption and metered efficiency in the same way: if any of the respective parts of the bill are not paid, the utility has the right to stop the energy supply to the building.

2.2.6 The Integrative nature of the output-based models

The output-based models bring the added benefit of unifying, under the same retrofit service contract, the following three (3) aspects of an energy service:

(a) Evaluation and compensation, based on performance indicators, measurement and verification (M&V) of achieved results, and rules linking results to compensation;

(b) Monitoring and maintenance of the equipment operation;

(c) Adaptability and optimization of operation, based on making best use of the installed capabilities given the occupants' needs and existing opportunities for income generation (such as demand response).

The interaction of the aforementioned aspects is summarized in Figure 8 below:

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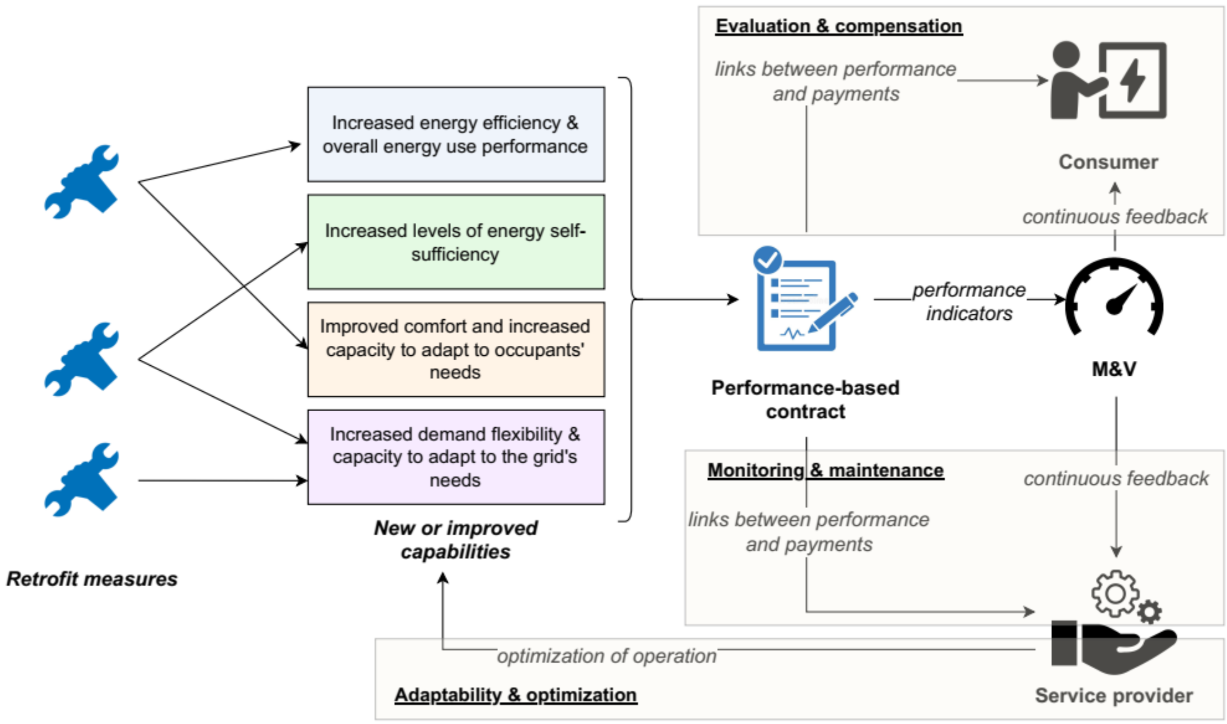

Figure 8 **The integrative nature of output-based models for energy efficiency delivery**

Their integrative nature makes output-based models well suited for upgrades that improve the Smart Readiness Indicator (SRI) of a building. The SRI is a common EU methodology that rates the smart readiness of buildings (or building units) for their capability to perform three (3) key functionalities: (a) optimize energy efficiency and overall in-use performance, (b) adapt their operation to the needs of the occupants, and (c) adapt their operation according to signals from the grid (to provide demand response services). In practical terms, the SRI rates the controllability of a building, i.e. the extent to which the technical capabilities that are installed can improve energy efficiency and operational flexibility if utilized correctly. Output-based models provide the incentives to both improve the SRI of a building and make best use of its new capabilities so that to maximize the added value for the building users.

2.3 Outcome-Based Models

2.3.1 The Chauffage model

The Chauffage model, also known as “Comfort Contracting”, is a contract that is focused on the management and optimization of a building’s operational conditions. As an example, there are energy suppliers that trial charging customers for warmth rather than generated heat, such as “heat plans” to pay a fixed price to keep a building at constant temperature for a number of “warm hours” instead of kWh.

The Chauffage model can be part of a more diverse scheme where service providers are responsible for the efficient day-to-day operation of a building’s technical systems. The providers monitor the performance of the systems and systematically improve the systems’ control strategies and

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sequences. Since providers take over the systems' operation, the interface between them and the customers can be a Service Level Agreement (SLA) for the outcome of the systems' operation (for instance, the desirable indoor conditions) and a fee structure for the achievement of this outcome. This provides an incentive for service providers to improve efficiency since as long as the SLA terms are honored, increased efficiency means increased margin.

2.4 The role of ICT and Data Analytics

The SmartSPIN model focuses on *smart services* for energy efficiency. A *smart service* for energy efficiency is defined as a service that:

- provides energy efficiency improvements and on-site energy generation and storage capabilities, and
- uses contractual arrangements facilitated by rigorous data collection and analytics methods to improve the quality, performance and trustworthiness of the service, and overcome existing barriers in market adoption.

The following subsections present the areas where data collection and analytics can support business models for energy efficiency.

2.4.1 Automated Fault Detection and Diagnostics (AFDD)

The detection of faults at equipment level is a valuable service not only because it can identify and correct causes of inefficiency, but also because it enables the deployment of infrastructure and the collection of data that are necessary for identifying opportunities for further efficiency upgrades. AFDD is accompanied by the capability to combine data streams from different sources into a common repository to allow for visualization and definition of baselines (what is normally expected in a piece of equipment's operation). This capability can be also utilized to determine what can be achieved, in terms of energy savings and demand flexibility, by upgrading the efficiency and/or smartness of different technology packages.

2.4.2 Monitoring-Based Commissioning

The primary goal of commissioning is to ensure that the building systems operate as designed. The commissioning process installs the new or upgraded equipment, fine-tunes its settings according to the actual operating conditions, and verifies that the equipment operates correctly and in the most efficient way. Continuous data collection and monitoring enables the timely identification of equipment installation faults and/or suboptimal control sequences to be corrected as soon as possible and avoid performance degradation over time. This makes monitoring-based commissioning a useful tool for achieving the performance and savings objectives of EPC models.

2.4.3 Measurement and Verification (M&V)

Measurement and verification (M&V) services can: (a) make the data on the realized energy savings transparent and easily accessible to all actors involved in a business/transaction model, and (b) monitor and identify trends in the performance of the installed measures. As a result, M&V is a central component of all output-based models: it quantifies the added value of the model, dictates the

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financial flows between the involved parties and guides the optimal usage of the equipment. Furthermore, the capability to continuously estimate the impact of an energy efficiency upgrade makes it possible to treat M&V as an additional signal into the process of monitoring-based commissioning and equipment control (Figure 9).

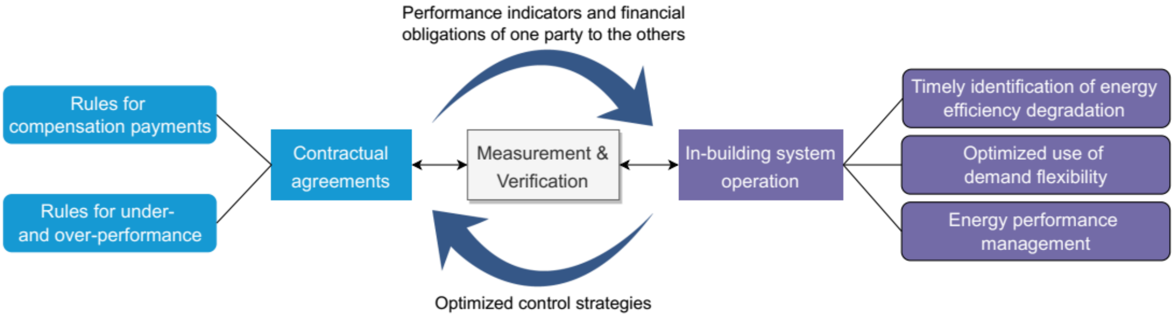

Figure 9 The central role of M&V in output-based models

2.4.4 Intelligent control of equipment operation

Cloud-connected Building Energy Management Systems (BEMS) provide the opportunity for continuous optimization of a building's technical systems. The main premise behind cloud-based applications is that they separate the functionality that should run locally at the consumer level (applying the control policy) from the functionality that can run on a cloud-based platform (learning and adapting the control policy) and enjoy the scalability and increased computational power of this approach to service provision.

In an SLA-based approach, the intelligent control of the building's technical systems is placed at the center of the model, while M&V is responsible for: (a) continuously evaluating the impact of the applied control strategies, and (b) improving the service providers' capability to design competitive SLA terms (Figure 10).

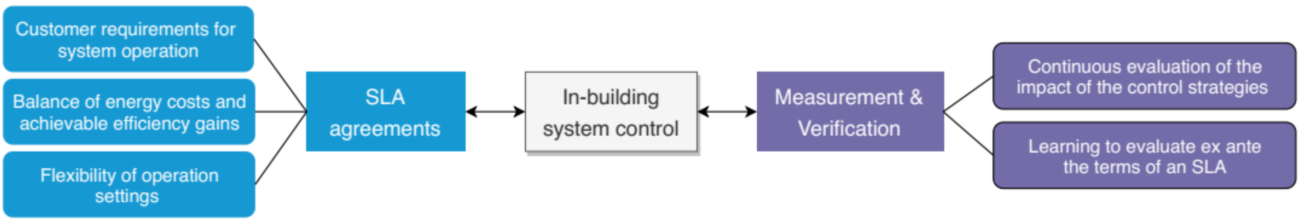

Figure 10 SLA-based approach to energy efficiency service delivery

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033744.

3 SMART ENERGY BUSINESS MODELS IN H2020

3.1 THE NOVICE PROJECT

The H2020 project NOVICE[6] developed and demonstrated an innovative business model for ESCOs that provided energy savings to buildings and demand response (DR) services to the grid after renovating buildings or blocks of buildings. The main idea is that the upgrade of equipment – in terms of efficiency and smartness – is an opportunity to both increase demand flexibility and incorporate the ability to respond to DR signals so that this flexibility can be utilized by the grid. In this way, a dual revenue stream can be enabled to reduce payback period for investments in buildings renovations and accelerate the market uptake of the EPC model.

The ESCOs in the NOVICE model are responsible for identifying the potential interactions between energy efficiency and demand flexibility measures, such as when energy efficiency leads to lower amounts of shiftable load or when the rebound after a DR event leads to higher overall levels of consumption. Based on these interactions and the demand for flexibility, the mix of measures with the highest value is determined. Furthermore, the ESCO is responsible for contracting with a DR aggregator and managing demand flexibility so that to optimize the value of the EPC agreement with the customer.

NOVICE project goal	Innovation	Relevance for SmartSPIN
The development and demonstration of an innovative business model for ESCOs to provide energy savings and demand response (DR) services	New revenue streams	A dual revenue stream is enabled for both energy savings and demand response
	New financing schemes	A new EPC template based on value and risk optimization
	Intermediaries and 3rd parties	Aggregators for facilitating the provision of demand response to the grid
	New value creation schemes	Dual energy services model, providing efficiency and flexibility along the appropriate ICT systems, in one a single offering.

[6] New Buildings Energy Renovation Business Models incorporating dual energy services (NOVICE), https://cordis.europa.eu/project/id/745594

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033744.

3.2 THE SENSEI PROJECT

The starting point of the H2020 project SENSEI[7] has been the observation that energy efficiency upgrades can have an impact on the power grid. Energy efficiency measures may increase electricity consumption due to fuel substitution or create a large block of reduced electricity consumption with a specific temporal and spatial profile that enables a System Operator to better utilize the existing grid capacity and defer investments to reinforce the grid while demand increases – due to electric mobility, electrification of heating, or new connection points. This potential synergy means that an energy retrofit project can be valuable for the grid, and this value depends on the operational characteristics of the grid (e.g. time and seasonality of peaking, load factor), as well as on the time periods during which the consumption changes from the project occur.

Accordingly, the SENSEI model aims at extending the adoption of the main aspects of an EPC contract (performance-based compensation and performance guarantees) into the transactions that compensate energy efficiency as a grid service through national programs for energy efficiency support. To this end, SENSEI promotes the pay-for-performance (P4P) model as the universal interface between all involved parties and their transactions. The SENSEI model is summarized in Figure 11.

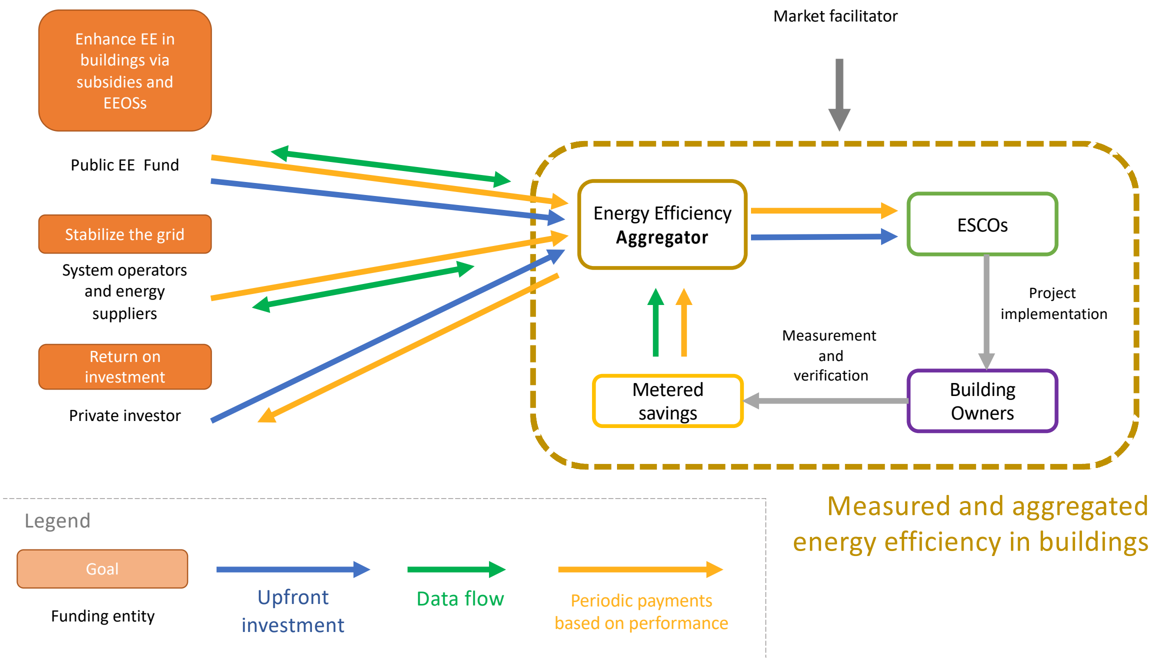

Figure 11 **The SENSEI model for aggregating energy efficiency projects**

[7] Smart Energy Services Integrating the Multiple Benefits from Improving the Energy Efficiency of the European Building Stock (SENSEI), https://cordis.europa.eu/project/id/847066

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033744.

The SENSEI model introduces the role of the P4P program aggregator. The aggregator aggregates guaranteed energy savings, offers these savings to investors so that to get capital for the energy efficiency upgrades, receives payments from the ESCOs that correspond to the value of the avoided energy usage, and is responsible for distributing both the payments from the ESCOs and the P4P subsidies to all involved parties according to pre-arranged percentages that reflect the costs and risks undertaken by each party.

SENSEI project goal	Innovation	Relevance for SmartSPIN
The development of an innovative transaction model for boosting energy efficiency delivery as an grid resource, while increasing the value of a building energy retrofit project and generating new sources of benefits for building owners and investors	New revenue streams	Using energy efficiency as a transactable asset. A focus is also put on DR as an additional source of revenue to manage the risk-return profile of a portfolio of energy efficiency projects
	New financing schemes	P4P schemes to valorize energy efficiency based on its actual impact on the grid, and steer energy efficiency measures into ones that are beneficial for both building owners and the power system
	Intermediaries and 3rd parties	Energy efficiency aggregators for facilitating the implementation of P4P energy efficiency programs by aggregating individual energy efficiency projects into portfolios
	New value creation schemes	P4P transactions at portfolio level combined with EPC contracts at the building level.

3.3 The AMBIENCE Project

The H2020 project AMBIENCE[8] aims to extend the concept of EPC for active building by:

- Extending energy performance guarantees related to energy efficiency to include the valorization of flexibility through demand response (DR);
- Tailoring EPCs to a broader scope of building type;

[8] Active Managed Buildings with Energy Performance Contracting (AMBIENCE), https://cordis.europa.eu/project/id/847054

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033744.

- Extending the scope of EPCs to groups/clusters of buildings under the concept of (local) energy communities.

In the AMBIENCE model, ESCOs deliver guaranteed energy cost savings – based on energy efficiency, (renewable) energy supply and active control of flexibility. They also provide maintenance and other services (energy management, energy monitoring) against a periodical operational fee, as well as pre-financing of the energy efficiency and DR investments. End users, typically the owners/occupiers of the building, reimburse ESCOs for the energy efficiency investment through a periodically calculated payment based on the energy cost savings and the value gained from selling demand flexibility to the grid.

AMBIENCE project goal	Innovation	Relevance for SmartSPIN
To extend the concept of energy performance contracting for active buildings	New revenue streams	Flexibility/DR services are treated as a new energy service that can bring new value streams yet necessitate the development of a new type of EPC
	New financing schemes	Active Energy Performance Contracting (AEPC) that provides performance guarantees, leveraging DR and flexibility
	Intermediaries and 3rd parties	The role of the market aggregator is introduced, acting as a third party and trade the prosumers' flexibility on the markets. By integrating DR in the contract, ESCOs can assume more active role acting either as an actuator or as an aggregator.
	New value creation schemes	Merging different models, services and actors into a single new concept that can be implemented in a broader range of buildings, while creating a novel business model to enhance existing ones and attract new players into the market.

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PART B: STAKEHOLDER INTERVIEWS

4 STAKEHOLDER INTERVIEWS

4.1 INTRODUCTION

In the framework of this deliverable, six (6) interviews with relevant stakeholders were carried out. The goal of these interviews was to determine the challenges and drivers for the promotion of energy efficiency and smart energy services. The interviewed stakeholders were:

(1) City of Dublin Energy Management Agency Limited (CODEMA). CODEMA is Dublin's Energy Agency. It aims at accelerating Dublin’s low-carbon transition to mitigate the effects of climate change and improve the lives of citizens.

(2) FACTOR 4 BVBA (FACTOR4). FACTOR4 is an ESCO and EPC facilitator specialized in realizing comfort, energy efficiency and renewable energy in existing non-residential buildings, industrial plants and apartment buildings.

(3) Carbon Minded (CARBON MINDED). CARBON MINDED is an energy and carbon consultancy working with both public and private sector organizations to deliver sustainable solutions.

(4) ANESE. ANESE is the National Association of ESCOs in Spain and counts more than 120 members specialized in energy services, technologies and investments.

(5) Klépierre S.A. (KLEPIERRE). Klépierre is a real estate investment trust focusing on shopping centers assets, which are owned and managed by the company. The headquarters are in France and the company’s activity is well established in 16 European countries (Belgium, France, Scandinavian countries, Germany, Netherlands, Poland, Greece, Portugal, and Spain).

(6) MEETS Accelerator Coalition (MEETS AC). MEETS AC is an organization that aims at promoting the Metered Energy Efficiency Transaction Structure (MEETS) model.

The main outputs of each interview are summarized in the following sections.

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4.2 CODEMA

Aspect	Dimensions	Details
Identified best practices	Role of EPC facilitators	EPC facilitators can bring together companies and different actors to make an EPC project happen. It is possible that EPC facilitators can help coordinate the different parties in an energy retrofit that concerns rented commercial spaces, and help build trust between all involved parties.
	Challenges for EPC facilitators	To explain the EPC process in a simple language to the end client (both tenants and landlords), as they do not have the time or expertise to get in and fully understand it, especially when it comes to M&V.
	Existing contract templates (from the Sustainable Energy Authority of Ireland)	They mainly refer to maintenance options or cover works such as PVs, lighting or heat pumps. They do not address the rented building cases explicitly / they only consider a single client for an ESCO. There is a need for new updates on the standard contracts, taking into account also the building owners' perspectives (i.e. contracts to deal with the whole system performance, including more complicated metrics in the buildings).
	Performance Guarantee Contracts	Simple type of contracts based on the Irish Construction Framework Contracts (CWMF) for construction/equipment procurement reform. They are used for equipment installation (such as boiler installation), including the design option, and involve 10% payment on the design and 10% contractual fee for the 1st year. At the end of the year, an M&V process is taking place and includes reward payments if the savings achieved are higher or penalty payments if savings are lower.
	Maintenance contracts by ESCOs (along with existing agreements	Although it depends on the agreement already in place, a good practice is that the ESCO can assume the responsibility of fine-tuning all the

Aspect	Dimensions	Details
	between buildings and other service providers)	systems installed and their operation to achieve greater savings.
	M&V	A current trend is to rely on a combination of post-retrofit measurements and pre-retrofit assumptions / calculations.
Challenges in the private / commercial sector	Contract period	Commercial and private sectors do not favor long-term contracts.
	Contract clauses	Need to take into account situations where there are new tenants entering the building or buildings become unoccupied.
Overall limitations	Market status	The market is primarily driven by ESCOs or the financing actors, who typically prepare the contracts. The end-client or the building owner is always the less informed (i.e. on risks), yet they have to deal directly with the ESCOs or financing parties.
	Contracts	Still the most popular contracts are the straightforward contracts with no guarantees. This implies that there is still a need to promote the output procurement approach instead of the traditional deemed savings one.
Lessons learned	Contacts	Solutions to the spit dilemma tend to stuck when trying to deal upfront with all aspects of an EPC project. ESCOs would prefer to deal directly with the tenants rather than building owners. However, this requires a lot of trust between the involved parties, and leads to a more complex process.
	M&V	Well-designed M&V plans (typically based on IMPVP) should be the cornerstone in all EPC cases.
Need for innovations	Contracts	Need for one big contract covering all services (i.e. maintenance, equipment installation, equipment operation and equipment replacement) on an ongoing basis, instead of a

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Aspect	Dimensions	Details
		short equipment contract and several supplementary services contracts. Need for contracts focusing on the whole system/ building, in a more realistic way rather than trying to do everything upfront. Need for a continued investment model under the initial agreement to define a performance path (i.e. the targets to be achieved, for example 50% carbon reduction) and include annual ongoing measures, with potential break clauses.
	Technology	Technology options such as trusted central platforms for M&V data that can act as automated facilitators. Solutions that automate and simplify the M&V process; they would foster transparency between actors and facilitate private investment.

4.3 FACTOR4

Aspect	Dimensions	Details
Identified best practices	Role of EPC facilitators	EPC experts responsible for defining the EPC project/ and writing good tenders for EPC projects taking into account the energy to be saved and guarantees to be kept. Facilitators have already succeeded in standardizing the tendering process, including the documents, metrics, KPIs of a project.
	Challenges for EPC facilitators	EPC facilitators cannot create a market. If one considers the commercial rented building market for energy efficiency as a significantly immature one, market facilitators may be necessary. Market facilitators are independent semi-public energy agencies/energy companies responsible for promotion and communication activities in a captive market (they have the monopoly of promoting energy efficiency within a region).

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Aspect	Dimensions	Details
	M&V	Working with data and estimating the impact of several parameters on energy consumption is important in commissioning and re-commissioning of a building. The M&V plan is a key discussion point of an EPC agreement between and ESCOs and Building Owners. It is usually dealt with assumptions that are contractually fixed before the beginning of the contract.
Challenges in the private / commercial sector	Market demand	In the commercial sector, high energy consumption affects demand for commercial office spaces and vacancy rates. Energy performance of the rented spaces needs to be optimal.
	Regulatory actions	Market alone or the energy crisis cannot boost energy efficiency. Political decisions can trigger EPC deployment and push building owners towards implementing energy efficiency interventions.
Overall limitations	Market preferences	Requirements of private actors are often unrealistically short. An EPC contract that gives guarantees on a certain amount of savings cannot be organized on a very short time of period. Usually, on the building owners' side, EPCs or sustainability issues are not of top priority. Especially when dealing with technical companies, ESCOs or outsourcing a project is seen as a kind of threat (i.e. if maintenance contracts are about to change into performance-based contracts).
Lessons learned	Contracts	EPC contract by proxy to overcome the split incentive barrier: energy cost savings passed to the one doing the investment.
	Financing mechanisms	On-bill financing/repayment needs to be a future direction. Private financial institutions show interest in the on-bill financing/ repayment scheme.
	Incentives	Need to look also at additional benefits for the building owners.

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Aspect	Dimensions	Details
		For example, the increased value of the real estate can be financially quantified in relation to the achieved savings and the type of installations that are placed. This value goes to the owner and makes it more interesting for building owners to get motivated. From the tenants' perspective, energy efficiency increases comfort, and comfort increases productivity.
Need for innovations	Technology	Need for software platforms that analyze minute by minute the energy consumption of a building and how it is influenced by various parameters. Automated collection and validation of many different sources and resolutions of data, compared to the traditional EPC that focuses only on energy consumption data at the end of the month or on an annual basis.

4.4 CARBON MINDED

Aspect	Dimensions	Details
Identified best practices	ESCO models	Currently working on asset-based models: if there is a business park, owned by a landlord, having a large roof area that could be used for installing PV systems, there is an opportunity for third party investments (since most likely there is no financing capability or interest by the landlord in investing). This model implies a type of ESCO that provides the financing for the installations in the first place, along with the necessary technology and business model to manage the energy flows and financial transactions between: the business park and the grid, and/or the business park and the other tenants on the estate.
	The ESCO as a project aggregator	Acting as aggregators, ESCOs assume the responsibility to look for and engage with landlords owning a large portfolio of buildings. An ESCO can also be responsible for finding the financing provider (a large bank or fund): the later will offer the capital provided that the ESCO will offer the buildings and carry out the installations.

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Aspect	Dimensions	Details
	The value of aggregating energy efficiency projects	Through aggregation: ▪ landlords can attract more favorable interest rates, ▪ finance providers can be involved in much bigger projects, with potentially lower risk (because it does not matter if some people/tenants will drop out).
	Contracts	Energy management should move to a service based offering, so that it might be outsourced to a company providing the full services. This approach requires selling services rather than just talking to clients about energy. EPCs can be adapted to taking into consideration flexibility services, and take advantage of dynamic tariffs or any flexibility tariff that might be suitable for any particular country.
Challenges in the private / commercial sector	Incentives	Local authorities are obliged to achieve reduced carbon emissions, whereas private sector (i.e. owner of a business park) does not have the same obligation.
	Contacts	Still ESCOs working on energy efficiency, use the traditional contract model that locks the landlord for the contract duration, which might be 10-15 years, and looks the savings over the whole lifetime of the project, taking an annual fee for that. This works well for cases such as social housing, where local authorities are the owners, having also the full control of the installed equipment. As they cannot actually control how tenants are using the equipment, they are responsible for making sure that the most efficient equipment is installed. In the commercial sector, contracts and business models must be tailored and quite specific to the situation, as there is no a specific solution that works for every single case. For example: ▪ In cases where landlords control everything, from the installation to the management of the equipment, ESCOs can engage only with them.

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Aspect	Dimensions	Details
		▪ In cases where landlords just own the space and tenants are allowed to install the desired measures, ESCOs can engage with tenants. But appropriate risk and value sharing agreements must be in place.
Overall limitations	Services	Most ESCOs are focusing on RES and solar PV at the moment, because it is an easier business case than other services, such as energy efficiency. Limited availability of actors willing or able to undertake the full energy management control on a regular basis.
	Contract period	Long-term contact periods is a challenge for the private sector's side
Lessons learned	Transparency	Clients should be provided with clarity on what actually their baseline is and how the energy savings are estimated against the baseline.
	Services	Integrating DR elements in the ESCO projects can foster and open up the market and the business cases.
Need for innovations	Business models	There is a need for business models that combine energy monitoring and energy management consultancy. The most successful ESCOs will be those who will undertake all the responsibility, taking all the hassle away from the clients and making everything easier for them. Value to be assigned on benefits that are not necessarily related to energy or easy to measure (such as, from landlord perspective, value of the building, internal comfort and tenant services, attractiveness of the building). These benefits can incentivize and facilitate retaining tenants.
	M&V	Recent developments in energy monitoring platforms can be a solution, along with the installation of sensors that supplement the main metering. All data gathered should allow the energy manager to become aware of the energy consumption evolution, including actions or patterns that may have a positive impact on the energy use or not.

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Aspect	Dimensions	Details
	Services	Organizations that build energy management platforms should team up with consultants or energy managers to provide a full package for outsourcing energy management activities, including installing the equipment and sensors, monitoring energy, giving advice on the energy consumption management, monitoring the project's implementation and performance.

4.5 ANESE

Aspect	Dimensions	Details
Identified best practices	Fostering collaboration	Create a cluster/hub of different actors involved in an EPC project, under the application of specific energy service models. Synergies between different actors will help the market growth and facilitate the dialogue between different market sectors.
	Utilize the concept of energy communities	Local energy communities could boost the uptake of EPCs. All the parties involved in the contract can be members of the community.
	Services	Promote the "as-a-service" approach for energy efficiency through the use of equipment and its corresponding pay-per-use. The model and the contract is known as Comprehensive Energy Contract or 5Ps, because of the 5 benefits it includes: (1) Energy management (2) Maintenance (3) Total guarantee of the equipment (4) Improvement works (5) Improvement of energy efficiency For now it is more common in the public sector.
Challenges in the private / commercial sector	Contracts	Despite being the most common type of contact in general and a good mechanism of financing, maybe EPC is not the best solution for the commercial rented sector and the split incentive. EPCs may make more sense to the building owners because of the ownership potential (owning the installation).

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Aspect	Dimensions	Details
		Singing an EPC requires a lot of time, approximately 9 months, because of the different actors involved and their different expertise. However their main benefit lies in the savings guarantees that an EPC can provide. Yet this may work well for landlords and ESCOs, but for the tenants other type of contracts are more suitable (what final users want to see in the end is a reduced energy bill).
Overall limitations	Incentives	Despite their strategic goal to reduce CO_2 and improve sustainability, most companies, mainly SMEs, primarily focus on reducing energy bills, because this is the possibility they are provided.
Lessons learned	M&V	Measurement method is the key for an EPC project, so is setting up the baseline, using the most suitable protocols, both international and tailored protocols.
	Services	Facilitate or “translate” the technical EPC vocabulary to a more causal one, to be easily comprehended by clients.
	Business models	PPAs and leasing: A common model especially in shopping centers and in the industrial sector, because it is simpler than the EPC. Although the equipment ownership is not transferred to the end users, they are well-established models because they mitigate the risk for all stakeholders, not only for the investment fund. EaaS: Probably the best solution for rented buildings. As in the PPAs, users pay per use on a monthly basis, but EaaS agreements are rather shorter than the PPAs.
Need for innovations	M&V	Need of platforms that allow more transparent measurement and verification of the savings that are guaranteed.

4.6 KLEPIERRE

Aspect	Dimensions	Details
Identified best practices	Ownership of the equipment	Big clients (tenants) that rent more than 500 m_2 are allowed to install their equipment that is connected to the central system (cooling towers). They are more independent compared to small

Aspect	Dimensions	Details
		clients (tenants) that rent smaller spaces (up to 500 m_2). For them, the HVAC system is provided by the shopping center. Cooling towers (central system) are owned by Klepierre.
	Equipment installation	Big clients are allowed to choose, install and own their equipment, but they should follow the guidelines and instructions provided by the building owner, who conducts the technical analysis of the area. During the design phase, the building owner (Klapierre) estimates system dimensions taking into account how many clients (tenants) is possible to be connected to the central system/cooling tower (and how many are not – for instance, cinemas are always out of the main design). Then HVAC systems are designed accordingly, based on each client's business activity and the surface. The shopping center has always the responsibility to maintain the air flow, which is constant (not variable). Tenants may choose their equipment, combining also RES installations. They own their equipment, but they cannot modify the central settings.
	RES equipment implementation	In some shopping centers, solar panels are also installed. The installations have been made directly by Klapierre and it is a self-financed investment.
	Payments	Monthly invoices that include common charges, the rent and private costs that concern energy and water consumption. Invoices are directly issued by Klepierre, the building owner, who interacts directly with the energy provider. No other entities are interfering between the building owner and the tenants. Invoices are issued for each tenant, taking into account the rented space (m_2) and the business activity.
	Incentives	Tax property reduction incentives are offered (i.e. for the council of Madrid), which may limit the payback period estimation to approximately 1-2 years.

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.nd innovation programme under grant agreement No 101033744.

Aspect	Dimensions	Details
Challenges in the private / commercial sector	Contracts	Improving tenants' efficiency is a challenge because it often means that tenants are offered the possibility to pay less energy fees and a larger rent to the building owner.
	Technology	In theory, there are meters installed in each shopping center for each tenant and thus it is possible to verify each tenant's consumption. In practice, meters are difficult to utilize due to the different systems' settings during different seasons of the year: ▪ In summer, cooling towers are used and this involves both water and electricity ▪ In winter, boilers are used. As a result, meters are not used in all cases and the payments are proportional to the rented space surface (m_2).
Overall limitations	Market preferences	Klapierre is a financial company, so what matters most are the payback period and the money recovery. Interventions that offer a short payback period are more possible to be approved immediately rather than proposals presenting a longer period for money recovery. A good payback period is approximately 3 years.
Lessons learned	Business models	Equipment leasing: In general, equipment and installations are recorded in the financial books and an early replacement may have negative effects on the buildings value. However, if equipment is about to be replaced and the lessor offers a short payback period, leasing may be taken into consideration.
	Contracts	The challenge is to find a good and stable price for electricity, boiler fuel and water, independently of the season. Also, to explain to the tenants the differences in the energy prices during the different seasons of the year.
	M&V	Measurement errors may arise because typically there is no one-way flow. As an example, in shopping centers measurement should involve a large number of flows and this may lead to accumulation of measurement error.

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Aspect	Dimensions	Details
Need for innovations	Technology	Klarierre is looking at tools to receive metered flow information for each tenant. The goal is to invoice tenants directly via the meter.

4.7 MEETS AC

Aspect	Dimensions	Details
Identified best practices	Services	The first step for a successful business model is achieving to treat energy efficiency as a transactable output. The next step is to "put it on the bill". On-bill repayment increases the flexibility and trustworthiness of the business model.
	Incentives	In general, saving energy is not a priority for commercial buildings, since energy represents a small percentage of their operating costs. The rising cost of energy in Europe is an opportunity to promote energy efficiency as a way to mitigate the risk of rising prices, but attention should also be given to the fact that energy efficiency can help in improving indoor conditions and decarbonizing the power grid. Energy efficiency projects that benefit the power grid should be incentivized either through dynamic tariffs or through financial support that valorizes the reductions in the cost of the power grid's operation.
Challenges in the private / commercial sector	Contracts	Historically, the barrier to energy efficiency was financing, i.e. lack of investment capital for the upgrades. Financing is not a major constraint any more: There is significant demand in the investment community for long-term, stable investment vehicles, based on energy efficiency improvements. The challenge is that the cash flows needed to reward these investments are usually lost to tenants in the form of reduced energy bills. Even if the "split incentive" problem is absent, cash flows remain dependent on the building owner's

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Aspect	Dimensions	Details
		willingness to pay the investor back a portion of the savings.
Lessons learned	Business models	Renewable energy-based models work well because they produce long-term reliable cash-flows from a stable, asset-based investment. This is also what an energy efficiency-based model should strive to be.
	Contracts	The adoption of a business model requires using well-understood instruments. Instead of devising completely new arrangements, capitalize on what already exists and works (such as adapting PPAs to the energy efficiency case).
	M&V	M&V is always a source of uncertainty and difficulty when implementing output-based models for energy efficiency, and this leads to focusing only on short-term opportunities (one can trust an M&V model for 2-3 years after an intervention, but not for longer time horizons). One way to improve trust in M&V is to introduce causality in the underlying model. In other words, the involved parties in a business model tend to trust more a model that can identify what has (probably) changed in a building in comparison to a statistical model that detects only that something indeed changed.
Need for innovations	M&V	There is a need for methods that combine physics-based and statistical models so that to decrease the strong reliance on baselines, since baselines tend to become irrelevant sooner or later.

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5 CONCLUSIONS

A major insight of the analysis that was carried out in this deliverable is that business models for energy efficiency improvements in rented commercial buildings should be based on transactions around the respective equipment, its measured/estimated output, or a combination of both. Focusing on equipment requires a clear structure of ownership (who owns what), whereas focusing on output requires a clear mechanism for measurement and invoicing.

In almost all cases, business models for energy efficiency tend to replicate models for financing and deployment of distributed and renewable energy generation assets. Renewable energy generation has measurable output, whereas energy efficiency improvements can only be estimated through counterfactual analysis, which leads to increased uncertainty and potential for disputes. The combination of operational data collection and monitoring, advanced measurement and verification, and performance guarantees is the most promising route to mitigate this discrepancy between renewable energy generation and energy efficiency business models:

- A technical infrastructure that allows data collection and monitoring helps in decreasing uncertainty in M&V results. This means that such infrastructure has value in an energy efficiency project, and this value must be quantified and compensated appropriately.
- Performance guarantees and the ability to control the equipment's operation are interlinked. If a system provider cannot directly optimize operation, guarantees on operational characteristics may lower the perceived risk from the provider's perspective. On the other hand, if operation can be influenced, output-based guarantees are more appropriate.

Green leasing and on-bill repayment are regarded favorably by market stakeholders:

- Green leasing sets the foundation for tenant-landlord agreements that allow the transactional structures required by the different models for energy efficiency. It makes sense to first ensure that specific types of agreements are feasible and, then, proceed with creating and enforcing new agreements.
- On-bill repayment is aligned with the "put it on the bill" mantra that is commonly adopted when discussing EaaS models. The main idea is that energy efficiency can be transactable as long as energy efficiency gains/outputs and energy consumption are treated similarly in terms of measurement and invoicing.

Finally, there is significant scope for M&V innovations that go beyond the statistical treatment of baselines and towards providing insights on how a building's energy consumption changes and to which aspects of its daily operation these changes should be attributed. These innovations should utilize as much as possible any existing infrastructure for data collection and monitoring in a building, but it must also be clearly communicated what the minimum data requirements are for their operation.

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