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Deliverable D3.3

New business models for ESCOs/aggregator for energy services in the residential sector

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Deliverable name	New business models for ESCOs/aggregator for energy services in the residential sector
Lead beneficiary	VERD
Description	Description of the business model associated to each of the energy services from D3.1, considering the involved stakeholders, their interactions, contractual relation, service provision and remuneration model. Factsheet for each business model using the CANVAS approach
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EXECUTIVE SUMMARY

The new generation of hybrid energy services for ESCOs and Aggregators combine energy efficiency measures with demand response services and they are designed with a primary focus to address the Pay-for-Performance (P4P) principle. These services are an enhanced version of the Energy Performance Contracts offered by ESCOs, but whereas P4P programs guides are already developed for commercial, industrial, or institutional segment consumers based on retrofitting equipment for more efficient types, or just improving the performance of a facility offering incentives for energy conservation measures, they have not been broadly deployed in the residential consumer sector. This is because energy consumption on residential premises is relatively low compared to other higher types of consumers and thus their investment payback period extends to a degree that renders the savings insignificant.

The new energy services proposed by frESCO and more importantly the bundles of several different energy services, aim to overcome the business case gap for domestic consumers by exploring and evaluating financial schemes for consumers that will reduce upfront investment costs and maximise the benefits from electricity market participation for the “active” consumers. The aim is to leverage the payback period to an attractive option, by moving beyond traditional subsidies or leasing for equipment.

This deliverable explores financing models that go beyond traditional energy project financing of subsidies, leasing and savings, but also focuses on electricity market participation as well as the exploitation to the maximum extent of all the technological assets (such as generation and storage), that can be used to create new and complementary revenue streams. New technology, in general, is challenging the traditional Energy Performance Contract(EPC) format as new business models need to be applied to accommodate the innovation potential.

Additionally, the distribution of the revenues across the value chain of the project among the different actors and participants is analysed according to the type of service, the type of revenue, and the stakeholders involved.

The **energy services** are **divided into three main models** according to the above-mentioned features. The first model focuses on enhanced **ESCO P4P services**, where retrofitting and optimisation procedures are widely deployed for improved efficiency. These kinds of services lead to stable and repeatable savings in the facility, by also exploiting the optimisation of DERs and storage where applicable. The second model focuses on the **demand flexibility aggregator**, where demand-side market price signals from the market operator are considered and the aggregator delivers the required flexibility to the grid. This involves both explicit or implicit services provided by consumers, that need to be also flexible enough to allow participation in the market without heavy implications in comfort levels. The third model is effectively a **combination of both ESCO and Aggregator services**, that maximises revenues from both main streams.

ABBREVIATIONS

Abbreviation	Name
ACU	Air-conditioning unit
AI	Artificial Intelligence
BACS	Building automation and control system
BOOT	Build Own Operate and Transfer
CDD	Cooling degree days
DER	Distributed Energy Resources
DR	Demand response
DSO	Distribution System operator
DSM	Demand side management
EPC	Energy Performance Contracts
HDD	Heating degree days
HVAC	Heating, ventilation, air conditioning
IAQ	Indoor air quality
IoT	Internet of Things
kWh	Kilowatthour
kWp	Kilowattpeak
M&V	Measure & Verification
P4P	Pay for Performance
PMV	Performance Measurement and Verification
PV	Photovoltaics
RT	Retrofitting
SOC	State of charge
SRI	Smart Readiness Indicator
VOC	Volatile organic compounds
wrt.	With respect too
NEi	Non-Energy Services

1 INTRODUCTION AND OBJECTIVES

The aging residential building stock in Europe together with socio-economic and environmental challenges has been driving energy efficiency policies towards reduced and more effective energy use. Energy Service Companies (ESCOs) are entities that have been driving energy efficiency upgrades utilizing appropriate measures that include modelling, deployment, and maintenance of technological solutions as well as financing such projects, typically utilizing Energy Performance Contract (EPC) schemes that take advantage of appropriate subsidies, financing and/or leasing arrangements.

Besides the traditional financing models for Energy Efficiency services, residential electricity consumers can also benefit from direct electricity market participation through demand response services, focussing on maximising their monetary benefits by amending their energy use according to direct or indirect electricity market signals. Aggregators are entities that may enable such market participation for electricity consumers through the provision of electricity demand response and flexibility services to electricity system and network operators and/or electricity suppliers.

In T3.3 of the frESCO project, the financial schemes that will reduce, contain and fairly distribute the upfront investment costs of installations that enable energy efficiency and demand response services have been explored. In this context, the objective of the task has been to build upon current EPC models for ESCOs and Aggregators towards Pay-for-Performance contracts.

The features that are expected to be relevant in these next generation services could involve charges or remuneration for (i) information regarding energy consumption as well as suggestions for consumer behaviour change services (ii) guaranteed savings through intelligent/automated personalized control (iii) flexibility utilization, aggregation and trading (iv) self-consumption optimization and (v) non-energy services.

This deliverable report aims to document the activities performed within T3.3 of frESCO and in effect consolidate the above features and further describe them with respect to the actors, their interactions, their contractual relations as well as the services themselves and the compensation schemes.

This consolidation requires a comprehensive approach utilizing a factsheet for each business model based on the business model canvas method. These business models are going to be tested in the frESCO pilot sites within WP6 for validation and feasibility purposes. For each of these models, besides the revenue streams and the operational scheme, any risks that may hinder their deployment will be assessed.

This analysis takes into account the status of the regulatory framework and the existing market procedures and capabilities, further developed in T2.2. The offered services have to be in line with national regulation as well as EU regulation regarding personal data protection. Additionally, results from the definition of the stakeholders as well as the end-user requirements and consumer preferences that have been explored in T2.3 and have already been incorporated into the services, are also relevant, since any business model that explicitly or implicitly affects user preferences or needs, has to align with the final consumer expectations.

The energy services and service bundles defined in T3.1, are at the core of the analysis, since the synergies between them can facilitate and favour the deployment of innovative business models, that combine (i) building retrofitting and investments for the installation of smart equipment (metering, sensing, actuating), together with extended offerings for the installation of distributed generation (PV) and storage (batteries) units, (ii) energy efficiency measures, spanning behavioural transformation, targeted guidance towards energy savings, along with more advanced concepts for local net metering/ self-consumption maximization through smart automation based on artificial intelligence (AI) or machine learning (ML)algorithms not only at the building but, also, at the local (energy) community level; (iii) flexibility services (with the introduction of generation storage and, if available, electric

vehicles as means for enhancing the flexibility of local communities) and (iv) non-energy services.

Finally, T3.2 provides the service value chain overview as well as the type and scale of costs in every step or activity. The anticipated revenues and the added value of each service within the relevant bundle and model are distributed among the different actors and in accordance with the cost burden they share upfront. The scope is to achieve efficient business models under the P4P principle.

This document is structured as follows: Chapter 2 comprises the description of the overall methodology of WP3 up to -and including- this task and the breakdown between the main categories of ESCO related services, the Aggregator related services and their respective features. The Canvas Business Model approach is described and presented. Taking into account the results of D3.1 (frESCO services) and the revenue streams defined in D3.2, the two main frESCO business model categories are defined: (i) the ESCO Business Model and (ii) the Aggregator Business Model. Services can eventually be deployed either individually or mixed, but can always be allocated to either Model or both at the same time. Best results in terms of saving or revenues can be found in hybrid models that combine Energy Efficiency and Demand Response services.

Chapter 3 introduces the frESCO services and the frESCO related Aggregator and ESCO business models. The frESCO services are broken down into detailed categories that have to do with the main focus of the services, such as (i) efficiency services, (ii) flexibility -or in general market participation- services, (iii) smart building retrofitting or (iv) non-energy related services. The frESCO services are subsequently clustered into service bundles that may be provided. As stand-alone services, they do not exploit the full potential of the equipment or the IT solutions. Bundled conveniently, additional revenue streams can be created. Finally, within each main business model category the main actors and their relations are defined based on their needs and interests and eventually depicted in the Canvas approach.

Chapter 4 provides some details on contract duration issues, legal issues that have to be determined as well as the breakdown of the cost components. The use and manipulation of data is also investigated as well as the settlement procedures in each case.

Chapters 5 consolidates the main features of the new and innovative business models applicable to the residential sector in comparison to traditional EPC contracts. The frESCO service package bundles are the drivers in that procedure, as revenue or savings creators. The allocation of the services to the frESCO defined business models as well as the problems that may occur in small scale residential installations at the deployment phase are delivered in the frESCO holistic management framework.

2 METHODOLOGY

This deliverable, follows the list of innovative services described in D3.1 and the definition of the relevant stakeholders and actors that participate in the delivery and provision of these services, their specific roles as well as the types and ranges of costs before and during the delivery of the service itself. These cost related issues and revenues are described in D3.2.

Distribution of the benefits across the actors and along the value chain of the services is also of paramount importance, especially those regarding flexibility services, for them to be included in the frESCO business models, a thorough renumeration model needs to be estimated. An estimation is necessary, since demand response markets are not developed evenly across the EU. Flexibility services, as a market scheme, can be modelled in both bilateral agreements between stakeholders as well as market agreements performed under the rules and supervision of market operators.

The fair distribution of revenues is a prerequisite for the success and acceptability of the services and business models and thus any implementation should ensure that the beneficiaries of the services and the service providers are equally satisfied.

The frESCO services are innovative and to a great extent have not been fully implemented. This is the reason why the revenue streams as well as the relevant costs have to be estimated at this point of the project for the business models to be designed. Their testing as well as verification with the Performance Measurement and Verification methodologies under T3.4 and in real life conditions in the pilot sites in WP6 will ensure that the acceptability and economic feasibility is sufficient for deployment.

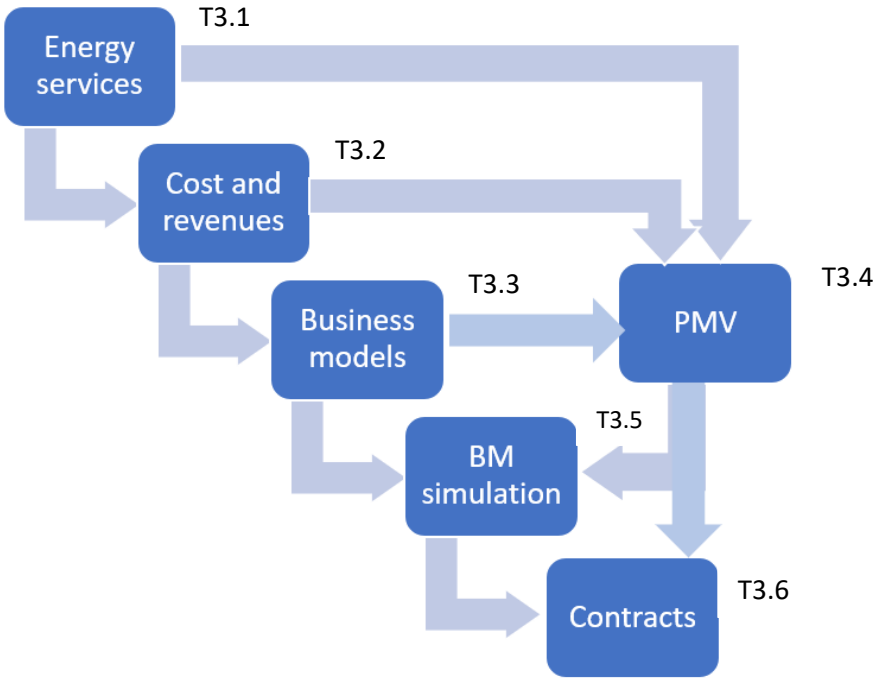

***Figure 1 WP3* flowchart**

2.1 Overall methodology

The methodology developed and used in frESCO, commenced with a review of existing business models and current market status in the EU, the relevant regulatory framework as well as identification of barriers and success factors in D2.2. Questionnaires and interviews with stakeholders were also conducted in each pilot country that are thoroughly reported in D2.3. Task 3.3, builds upon this input and the frESCO energy services are thus defined in D3.1. The revenue streams produced by these services as described in T3.2. These services are depicted in the Canvas Business Model approach in two distinct yet relevant categories. Additional feedback has been incorporated by collaboration with other relevant H2020 projects, such as SENSEI[1], during engagement established for a common presentation in

[1] https://senseih2020.eu/

Sustainable Places 2021[2] workshop. By taking into account the feedback from both the market status and the external parties, frESCO has narrowed down the relevant innovative business models to two large categories: (i) the ESCO business model and (ii) the Aggregator business model. The reason for narrowing down to two major clusters is that effectively innovation occurs in hybrid business models that combine Energy Efficiency Services (a traditional ESCO domain) with Demand Response Services (an Aggregator domain), that can deliver improved hedging and revenue maximisation through control strategies and smart equipment over non-critical but significant loads (such as Heating, Ventilation and Air Conditioning (HVAC) or Lighting).

Traditional services are also included as well as non-energy services in bundles that complement either the ESCO or the Aggregator Business Models.

2.2 Business model canvas approach

A business model is essentially a way to describe how an entity creates, delivers and captures value over a product or a service. In other words, it is the simplified description and representation of a real-world application, on how business is conducted.

Opposite to a traditional business plan, the business model canvas (originally developed by A. Osterwalder and Y. Pigneur[3]) helps companies to depict current or new business models visually. The canvas offers a holistic view of the business at hand and is especially useful when running a comparative analysis on the contributing factors of the model.

The Business Model Canvas is comprised by nine building blocks.

[2] https://www.sustainableplaces.eu/

[3] https://hbr.org/2013/05/a-better-way-to-think-about-yo

1. The Value Proposition is the core of the Canvas. It presents in a compact yet concrete narrative the actual offering that is available in the market.

On the right side lie the “Value Oriented” blocks, that are comprised of:

2. The Customer Segments, which are the target groups (people or entities) that may be primarily interested in the value proposition
3. The Customer Relationships, which include the relations that have to be developed with the target customers
4. The Distribution Channels, as the necessary means to reach the customers and offer the value proposition
5. The Revenue Streams, generated by the business model constituting the revenue model

On the left side lie the “Efficiency Oriented” blocks, that are comprised of:

6. The Key Activities to implement the business model and deliver the value proposition
7. The Key Resources needed to make the service delivery possible
8. The Key Partners including their motivations to collaborate and make the business model feasible and
9. The Cost Structure of the value propositions itself

Figure 2 presents an overview of the Business Model Canvas’s approach. Since the initial conception of the Canvas Business Model, various modifications have been deployed, but the core idea is still an all-included approach of the nine principal components that should be addressed for an enterprise’s product or service.

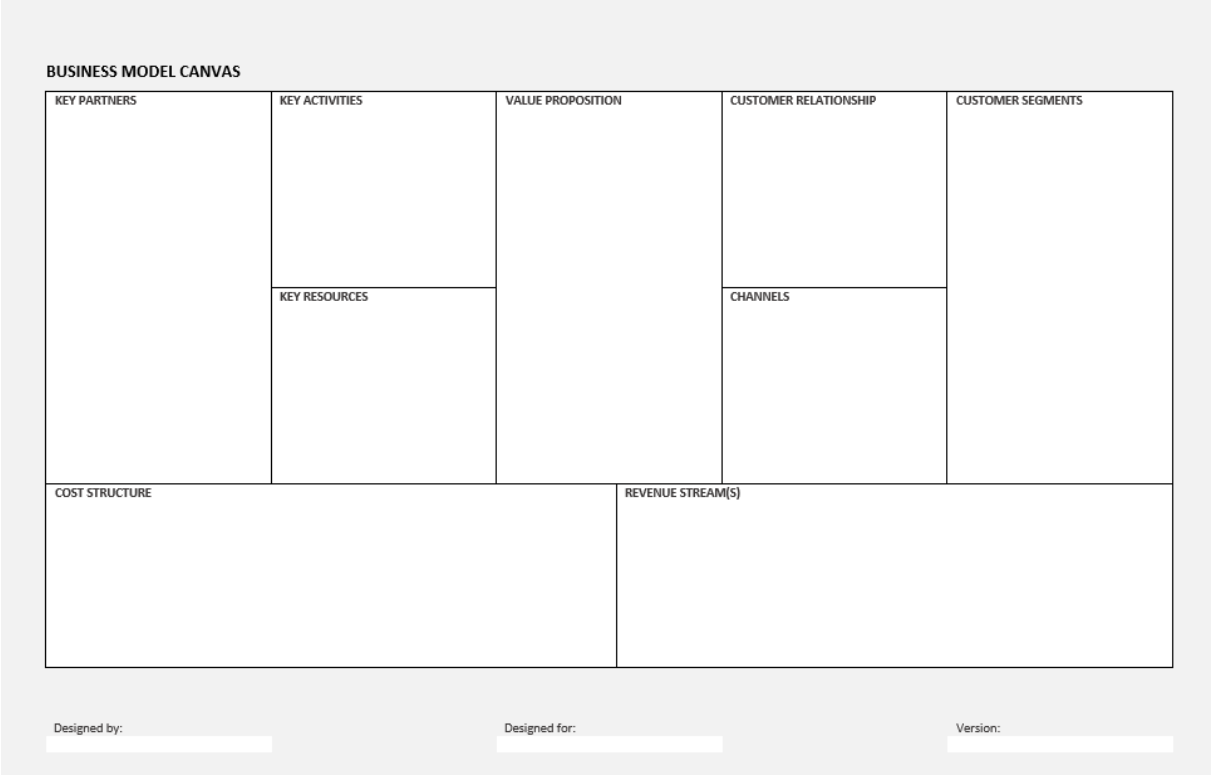

***Figure 2 Canvas Business* Model *approach*[4]**

The contents of the blocks themselves, comprise the core of the business model depiction. They help realize with simple terms the implications and complications of each fundamental item. The issues addressed in each block can be found in Table 1. The questions that the Business Model designer have to address in this context are not exhaustive.

Table 1 Canvas Blocks explanation

Block	Issues addressed
Value Proposition	What core value is delivered to customer audience? What bundles of product/services are offered to each customer segment? What jobs are customers trying to complete? What pains do they experience when trying to achieve their goals? How does the product/service help them achieve their goals/relief pains?
Customer Segments	Which groups of customers is the value created for? What are the most important customers? Why? What differentiates customer segments?

[4] The Business Model Canvas was developed by Yves Pigneur and Alexander Osterwalder at Strategyzer – This version is adapted and developed by Gary Fox www.garyfox.co

	What opportunities are there to reach new customers segments?
Customer Relationships	What relationship does the target audience expect to be established and maintained with them? Which ones are already established? How costly are they? How are they integrated with the rest of the business model?
Distribution Channels	Through which channels should the audience be reached? How is it reached now? How are the channels integrated? Which ones work best? Which ones are the most cost efficient? How are the channels integrated with customer routines?
Revenue Streams	For what value are customers really willing to pay? For what do they currently pay? How are they currently paying? How much does each revenue stream contribute to the overall revenues?
Key Activities	What key activities does the value proposition require? What activities are the most important for the distribution channels, customer relationships, revenue streams etc? What key activities are required to deliver your customer experience?
Key Resources	What key resources does the value proposition require? What key resources are needed for distribution? What key resources are needed for customer relationship management?
Key Partners	Who are the key partners/suppliers? Which key resources are being acquired from partners? Which key activities do partners perform?
Costs	What are the most important costs? Which Key Resources are the most expensive? What can be changed from a fixed cost to a variable cost?

The Value Proposition Canvas (Figure 3) was initially developed by Osterwalder et al. (2014) as a framework aiming at ensure that there is a fit between the product and the market. It provides a more detailed analysis of the relationship between two blocks of the broader Business Model Canvas, the customer segments and Value Propositions.

The various customer segments have to be defined and recognised in advance. For each segment, a detailed and more dedicated value Proposition Canvas is deployed accordingly. Each customer segment may experience different approaches even on the same services and service bundles.

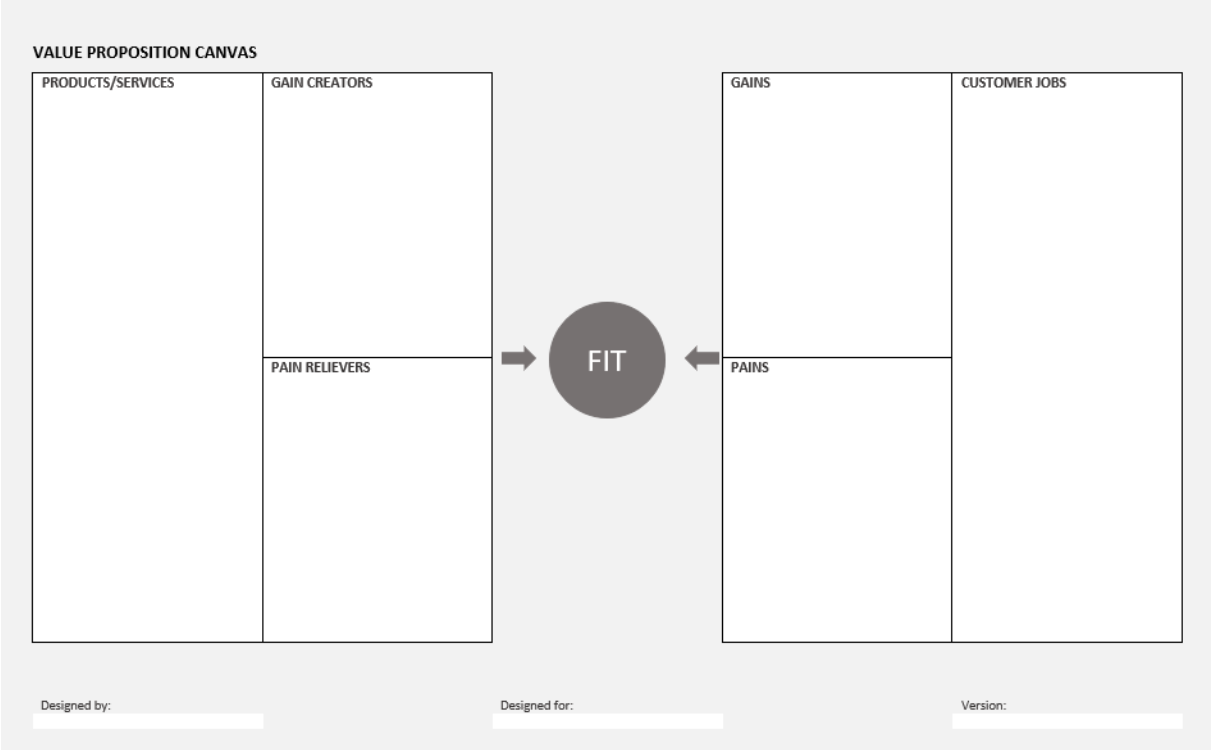

Figure 3 Value* Proposition *Canvas

The Value Proposition Canvas is also split in two parts; The right-hand part focuses on a customer segment's specific needs and expectations, by aiming at assessing the situation from the customer's point of view and on the left side an attempt to specify the value proposition towards that particular segment in a more focused manner.

The blocks within the value proposition address the following issues:

Table 2 Value Proposition Explanation

Block	Issues addressed
Products/ Services	List of all the Products and Services a value proposition is built around.
Gain Creators	How do the products and services create customer gains.
Pain relievers	How do the products and services alleviate customer pains.
Gains	What relationship does the target audience expect to be established and maintained with them? Which ones are already established? How costly are they? How are they integrated with the rest of the business model?

Pains	Bad outcomes, risks, and obstacles related to customer jobs.
Customer Jobs	What customers are trying to get done in their work and in their lives, as expressed in their own words.

3 THE FRESCO BUSINESS MODELS

In order to thoroughly assess the business models required within the frESCO context, the new and innovative frESCO services described in detail in D3.1, were eventually bundled into service packages according to consumer needs and main actors involved. Smart retrofitting services in particular should always be contracted complementary or as a prerequisite of other services as they are deemed as the minimum background for any kind of frESCO energy efficiency or flexibility service (based on data analytics). Non- Energy Services are also considered, as complementary services as well.

Whatever the service, revenues that derive from (i) a minimum charge to customer for information/behaviour change services (ii) an additional charge for guaranteed savings through intelligent/automated personalized control, (iii) a remuneration for flexibility, (iv) charges for self-consumption optimization and (v) the monetisation of non-energy services should be considered relevant and taken into account for the eventual remuneration of the service provider on a Pay-for-Performance basis. As discussed above, the Service provider in any case is an ESCO or an Aggregator or maybe both. The business models depicted in the canvas approach are described taking into account the relevant stakeholders, the main actors and their interactions and interests throughout the contract.

The frESCO energy services and energy service bundles that are defined in detail in D3.1. can be allocated to four (4) main categories:

1. **Smart retrofitting services**
2. **Energy Efficiency Services**
3. **Flexibility Services and**
4. **Non-energy Services**

Smart Retrofitting Services (RT)

The frESCO approach requires real-time data collection and continuous energy metering from each controllable load. Explicit control of devices, either for the purpose of consumption

optimization or for the provision of flexibility/demand response services to the grid/ market operators and participants, require also control over electric loads, generation and storage assets when available and other electric equipment. For that to be feasible, Internet of Things (IoT) equipment is necessary and a certain smart-readiness degree should apply for the building. Meters, sensors and actuators (even simple controllable relays) should be able to communicate with legacy equipment and commonly available, simple and reliable interfaces (wired or wireless control and monitoring protocols).

The Smart Retrofitting Services may deliver all the necessary infrastructure (hardware and software) and can lead to a smart readiness audit and certification for the premises. Additionally, equipment that can deliver or enhance these services is also included, such as storage equipment, smart HVAC systems, DER installation etc. These services are provided as "one-off", but the operation, payback and maintenance extend to the whole duration of the envisaged contract.

The smart retrofitting services defined in frESCO are:

- RT1: Smart equipment retrofitting, sensors and meters
- RT2: Data monitoring and Personalized Informative Billing
- RT3: Smart readiness assessment and Certification

Energy Efficiency Services (EE)

This set of services aims at achieving energy savings in a number of different ways. The services can be implicit, by providing adequate information to the users for them to take the final decision or action for controlling usage of electricity, or explicit, through full automation and control of loads and assets, price-based scheduling and self-consumption optimization. What the user can tangibly see as a result is energy savings compared to the seasonal baseline consumption of the installation.

The Energy Efficiency Services defined in frESCO are:

- EE1: Energy Management for Energy efficiency. Energy efficiency analytics awareness for EE management service. Use of platform data for energy management based on users' comfort choices
- EE2: Personalized Energy Analytics for Energy Behaviour optimization. Implicit EE service. Use of platform data for advice provision (recommendation) and energy management.
- EE3: Holistic self-consumption maximization service. Maximization of energy self-consumed by energy management service for prosumers.
- EE4: Automation and optimal device scheduling. Explicit automated dispatch of efficiency events stemming from EE awareness and price-based scheduling.

Flexibility Services (FL)

Flexibility Services may allow residential consumers to participate in demand flexibility markets, by providing grid management and balancing services to grid operators via Aggregators or alleviate distribution or transmission congestion issues. This flexibility can be wisely used to defer or delay costly investments in grid expansions. Alleviation of congestion is of paramount importance to the operators, since it promotes the truly necessary investments on the infrastructure. From a consumer point of view, an extra market revenue can be achieved.

The Flexibility Services are:

- FL1: Flexibility analytics services. Information and analytics towards awareness and knowledge of users' flexibility for market participation
- FL2: Explicit automatic DR services. Implementation of the scheduled DR event. Remuneration for flexibility provision.
- FL3: Virtual Power Plant and Optimal Flexibility Activation Scheduling. Schedule of flexibility activation based on the aggregated available flexibility stemming from a number of energy assets/DERs.

Non-Energy Services (NE)

Comfort is a significant parameter that needs to be considered when offering products and services to the domestic population. Services that are not directly related with energy efficiency or electricity flexibility provision can be combined within the scope of other actions (especially retrofitting services). These Non-Energy services do not generate any revenue per se, but the end consumer can benefit from them via the data management platform. They can relate to noise reduction, safety and surveillance, air quality and indoor temperature comfort.

Four non-energy services are identified and included in the frESCO solutions but the list is not exhaustive.

- NE1: Thermal Comfort services. Comfort preservation and automation at minimum energy costs. Requires comfort parameter sensors, smart controls and switches.
- NE2: Indoor air quality preservation. Preservation of Indoor air quality by means of air quality sensors. Smart ventilation.
- NE3: Noise reduction services. Noise sensors. Scheduling of noise devices and appliances at certain periods of time, smart ventilation, others.
- NE4: Security and surveillance services. Presence sensors, scheduling of lighting at night / absences to create a dissuasive security system.

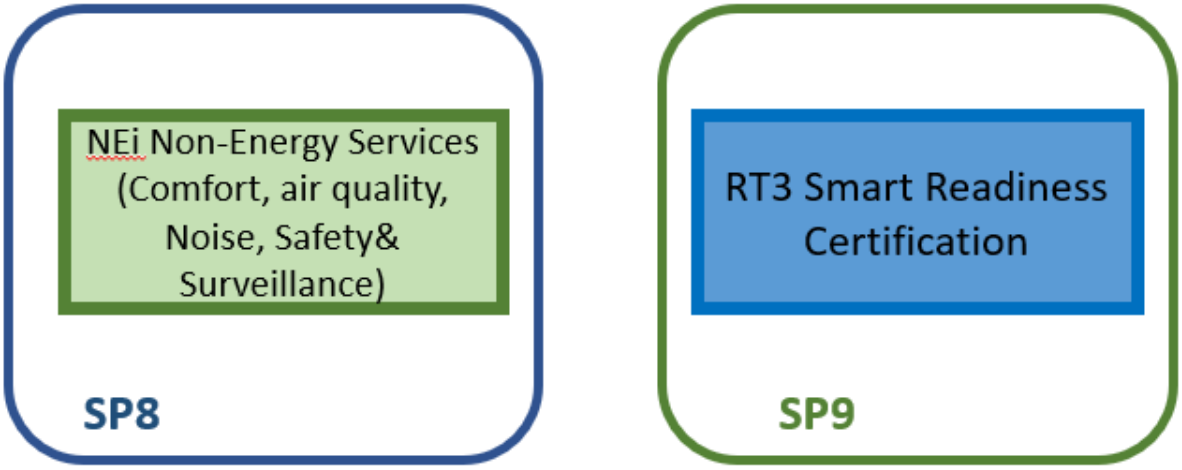

Figure 4*- frESCO *non-energy Services

Services are bundled in a manner that can cover customers with some common characteristics.

Table 3- frESCO Service Bundles (Service Packages - SP)

SP number	Service pack name	Services	Revenues
SP 1	Implicit EE and user-driven energy management	RT1, RT2, EE1, EE2	Savings from implicit energy management
SP 2	Explicit EE and automation	RT1, RT2, EE1, EE4	Savings from explicit energy management
SP 3	Full EE and automation	RT1, RT2, EE1, EE2, EE4	Savings from implicit and explicit energy management
SP 4	Full EE and PhotoVoltaic (PV) self-consumption optimisation	RT1, RT2, EE1, EE2, EE3, EE4	Savings from energy management and PV optimization
SP 5	DR explicit automation and participation	RT1, RT2, FL1, FL2, FL3	Remuneration for flexibility trading
SP 6	Energy efficiency and flexibility services	RT1, RT2, EE1, EE2, EE3, EE4, FL1, FL2, FL3	Savings from implicit and explicit energy management + Remuneration for flexibility trading
SP 7	Energy efficiency, PV optimisation and flexibility services	RT1, RT2, EE1, EE2, EE4, FL1, FL2, FL3	Savings from energy management + PV optimization + Remuneration for flexibility trading
SP 8	Non-Energy services (comfort, air quality, noise, safety)	RT1, RT2, NEi	Service fee per unit of service delivered
SP 9	Smart readiness assessment and certification	RT3	Service charge

SP1 for example is likely to be selected by users who prefer to maintain control over the offered system and respond to its recommendations at their will. SP2 on the other hand is an opt-in to explicit and automated system management, in which consumers are willing to hand-over control to automations with larger saving expectations. SP3 is a combination of both approaches, where the user allows automation, but can take own initiative as well. When

prosumers are regarded, SP4 offers the optimization of self-consumption as an additional revenue (or savings) stream. These services are traditionally offered by ESCOs.

In case markets are efficiently developed and Demand/Response services are available to consumers, depending again on the level of automation they allow, the flexibility Service Packages come to the forefront. SP5 provides all the necessary information for the active user to proceed to actions, but also requires some degree of automation as well. As it is expected it relies heavily on the awareness and flexibility of the consumers to be able to deliver tangible results for the explicit part. SP6 combines flexibility with energy efficiency measures and SP7 focuses more on the prosumer and the self-consumption optimization solutions on top of the flexibility mechanisms.

These services require an Aggregator to bridge the gap between consumer/prosumer and Market or Grid Operators.

Table 4 -Service packages according to consumer preferences

SP number	Type of users
SP 1	Closed flexibility markets, does not accept remote operation
SP 2	Closed flexibility markets, does **only** accept remote operation
SP 3	Closed flexibility markets, does accept remote operation
SP 4	Prosumer that accepts remote operation in closed DR markets
SP 5	Consumer that accepts remote operation in open DR markets
SP 6	Consumer that accepts remote operation in open DR markets with efficiency
SP 7	Prosumer that accepts remote operation in open DR markets
SP 8	Consumers/prosumers that want non-energy additional services
SP 9	Consumers/prosumers that want smart readiness assessment and certification

The frESCO services value chain, can be separated in four distinct phases. Each phase will produce its own costs that have to be claimed further down the value chain and the revenue streams.

The initial phase is the in-premise assessment and the service offer according to customer specifications. This phase is important to assess the efficiency and flexibility potential of the dwelling / building and personalise the commercial energy service offer. Some user profiles may not be eligible for frESCO energy services. Once the energy service contract is signed, the second phase has to do with the procurement and installation of the equipment as well as the frESCO platform calibration and setup. Naturally the extent of the costs depends on the pre-conditions of the building and the overall smart readiness index of the premises. The third phase refers to the actual service delivery, where the flexibility and energy efficiency actions take place within the contract frame. During the service delivery a real time Performance Measurement and Verification (PMV) protocol is applied to evaluate the energy impact of the relevant actions and to establish the actual monetary gains. In this phase the majority of administratively relevant costs are expected to take place. Finally, at the end of the contract - and depending on the initial agreement- a final clearing takes place that can be accompanied by hardware uninstallation and dismantling if that is provided by the contract. Various clauses regarding premature termination may also apply.

Table 5- frESCO service value chain activities and associated costs.

Phase	Service	Who	Type of Cost	Cost Description
Business opportunity and personalised offer	Energy and smart readiness pre audit	ESCO	Audit cost	Usually remote preaudit with data provided by customer
	P4P service proposal	ESCO	Commercial costs	commercial costs
	P4P contract negotiation and signing	ESCO / User	Commercial costs	commercial costs
	Upfront cost financing	ESCO / User / Financing institution	Upfront costs	CAPEX and potential interest if external financing needed
Commissioning and Installation	Smart readiness assessment	ESCO	Audit cost	May include on-site audit if requested by end user or deemed necessary by ESCO
	Hardware commissioning and procurement	ESCO	Upfront cost	smart meters, sensors, clamps, actuators, other smart equipment
	Hardware manufacturing	manufacturer	Upfront cost	Energy box
	Retrofitting element procurement	ESCO	Upfront cost	smart equipment, envelope insulation, PV facility, other retrofitting

	System integration	ESCO	Upfront cost	Energy box connections
	System installation. Connection and testing	ESCO / Installer	Upfront cost	On-site installation
	Smart readiness certification	ESCO	Audit cost	Only if requested by end user
Service delivery	Energy efficiency services and PMV	ESCO	Operation cost	It includes EE service delivery
	Flexibility services to the grid and PMV	Aggregator	Operation cost	May include Virtual Power Plant (VPP) configuration, aggregation, market participation costs, bidding, penalties,
	P4P Service settlement and remuneration	ESCO / Aggregator	Operation cost	Includes PMV, reports, billing and remunerating
	Non-energy service provision	ESCO	Operation cost	It includes non-energy service delivery
	System maintenance	ESCO / Installer	Maintenance cost	May include Hardware and IT platform maintenance costs.
	Periodic service adjustments and adaptation	ESCO / Installer	Maintenance cost	Variable. Triggered by either ESCO / Aggregator or end user
End of contract	System dismantling	ESCO / Installer	Maintenance cost	Low, or none
	Final settlement. End of contract.	ESCO / User	Commercial costs	Low, or none
	New service proposal	ESCO	Commercial costs	commercial costs

In general, the related costs are divided to audit, upfront, commercial, operation and maintenance costs. Upfront costs, are related to interventions at the premises and are dependent on a number of factors such as:

- Number of services under the contract
- Number and nature of DERs involved
- Standing smart readiness index
- Data collection and action controller gateway
- Sensors deployed
- Smart metering equipment
- Smart plugs and actuators
- Hardware installation
- System setup and calibration

Operational and maintenance costs are relatively small in comparison. Once the system is procured and set up, there are some recurrent costs that are related to equipment replacement in case of faults, but usually there are guarantees that come with sensors, meters and any other kind of hardware equipment. The data platform, will be set up by an ICT provider. Data storage and simple cloud computing are relatively small costs that may be absorbed by the ESCO or Aggregator service provider if economies of scale are taken into account.

The revenue streams are enjoyed primarily by the end-user directly and are subject to verification, validation, management and settlement by the service provider.

There exist primarily three main sources of revenue, totally in-line with the service categories:

Energy Efficiency Services (EE)

EE services are expected to provide direct savings from consumption. Self- consumption optimisation enhances the results for prosumers.

The benefit is enjoyed directly by the user as a reduction of the monthly energy bills and shared at a second stage with the ESCO service provider according to the proportion stated in the contract.

Flexibility Services (FL)

Flexibility services are expected to provide indirect revenues to the consumer. The Aggregator represents the consumer in the markets, aggregates the required flexibility, handles all transactions with the Grid or market operators and is the initial beneficiary of the compensation.

On a second level, the aggregator shares the benefit with the consumer according to the proportion stated in the contract.

Non-Energy Services (NE)

Non-Energy services function on a fuzzier logic, since many aspects of the services are subjective in nature. Consumers may pay a fixed amount per a specified period with the expectation of a certain degree of measurable comfort with potential discounts in case of deviations, depending on the contract. Under a P4P approach, the performance in terms of comfort parameters, noise level, air quality or security is measured and compared with the targets, to infer a proportional service payment according to the level of service compliance.

In every revenue stream, the contract dictates the sharing scheme between the end-user and the service provider. The party that bears the upfront costs has priority to the revenue to ensure a feasible payback period.

As so far analysed, frESCO energy services focus on consumers or prosumers. Depending on the final selection of the service bundles explained above, the service providers can eventually be narrowed down to either an ESCO or an Aggregator.

3.1 The ESCO business model

Energy Efficiency Services are offered and operated by an ESCO or in some occasions, by facility managers or building owners. Regardless of the services or bundles selected, the ESCO as a service provider is typically under EPC arrangements expected to bear the upfront costs of the installation and receive the relevant remuneration over the time of the contract. For that to take place, a number of requirements have to be met that occasionally are conflicting between the service provider and the end user. For example, while an ESCO would prefer explicit services with automatic operation of DERs to ensure both control and optimization, this may not be the optimal selection for the end users who in most cases would like to have options to by-pass automated control. Additionally, the former EPC traditional contracts should always be an option, and need to still remain compatible with the new and innovative services designed in frESCO.

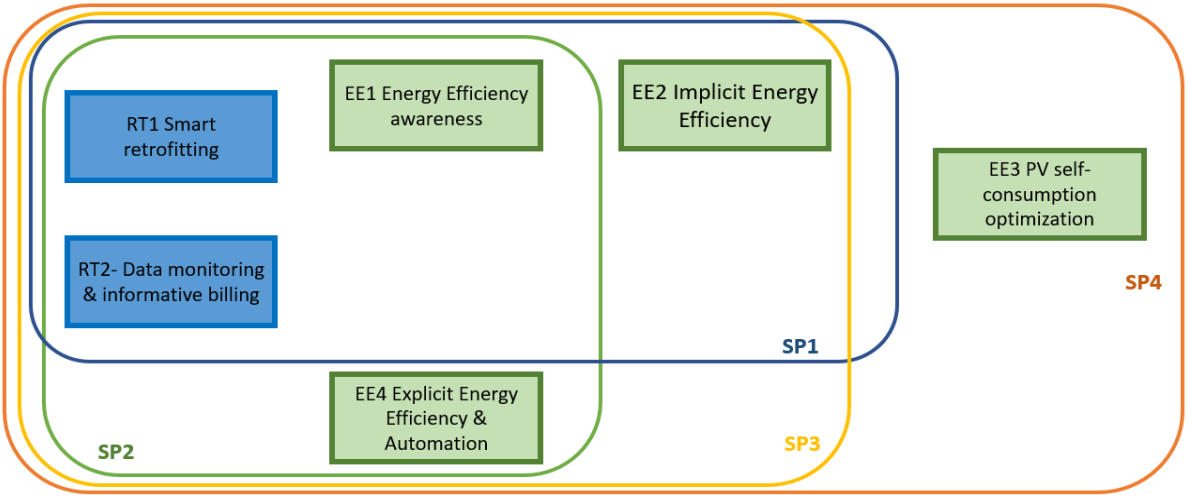

Figure 5 - The ESCO Service bundles

The primary ESCO business model, dictates that the ESCO bears the initial investment, develops and deploys an energy management system and performs the necessary audits to the building to gauge the savings potential. The ESCO should be able to monitor the consumption of the facility, provide suggestions or consulting services and in a number of occasions automatically control loads or DERs for maximization of the savings and the relevant revenue.

Within this concept, and building on top of the traditional models, frESCO energy services provide:

- Consumer awareness and informative billing as an instrument towards energy savings
- Increase of the overall value of the facility by smart readiness certification
- Real time automation and scheduling
- Retrofitting opportunities
- Data control, storage and monitoring

All these aspects are coefficients of the revenue stream, that is essentially savings measured and verified by a robust, fair and transparent Pay-For-Performance methodology. Consumers are interested primarily in reducing their energy cost but are not usually willing to sacrifice their acceptable comfort levels. Additionally, a typical residential consumer while eager to

reduce the overall energy cost, is usually unaware of the opportunities that have to do with the electricity prices volatility and is usually unable to constantly monitor consumption or production in case of existing DERs to make the proper decisions alone.

The frESCO services and solutions step in to fill that gap, by providing centralized information and control to the end-user, optimization of self-consumption, storage or grid consumption according to market signals, awareness over potential energy savings and informative billing, transparent valorisation of the energy savings and cash flow monitoring and control.

frESCO energy efficiency services place the consumer at the centre of the business as the main actor, but also apply an educational approach, for the consumer to be able to realize the potential of energy savings and finally relies deeply on customer engagement by transparent and robust data sharing.

3.1.1 Involved stakeholders in the ESCO business model and their interactions

In the Energy Efficiency Services the main stakeholders are:

- The ESCO

The ESCO as the main stakeholder provides a range of solutions and services that can include studies and implementation of energy savings projects, retrofitting know-how and implementation, energy conservation and DER optimization. ESCOs provide or arrange financing for the upfront costs of the project of the end-user. The provided services also include energy audits, feasibility studies, equipment procurement, Measurement & Verification and Operation & Maintenance services.

- The Facility Manager

The facility manager can be the owner of the building or a third party responsible for the maintenance and operations of the building (e.g. heating, lighting, common bills etc). The Facility Manager is primarily interested in monitoring the energy use, deciding on equipment investments, identifying problems and solving issues. Their goal is to reduce energy bills without disturbing the comfort of the residents. To this end (especially in case of a third party

or an owner who is not the end user), the facility manager can also provide recommendations and consulting services. In case the facility manager is also the building owner, financing may also be part of the relevant actions.

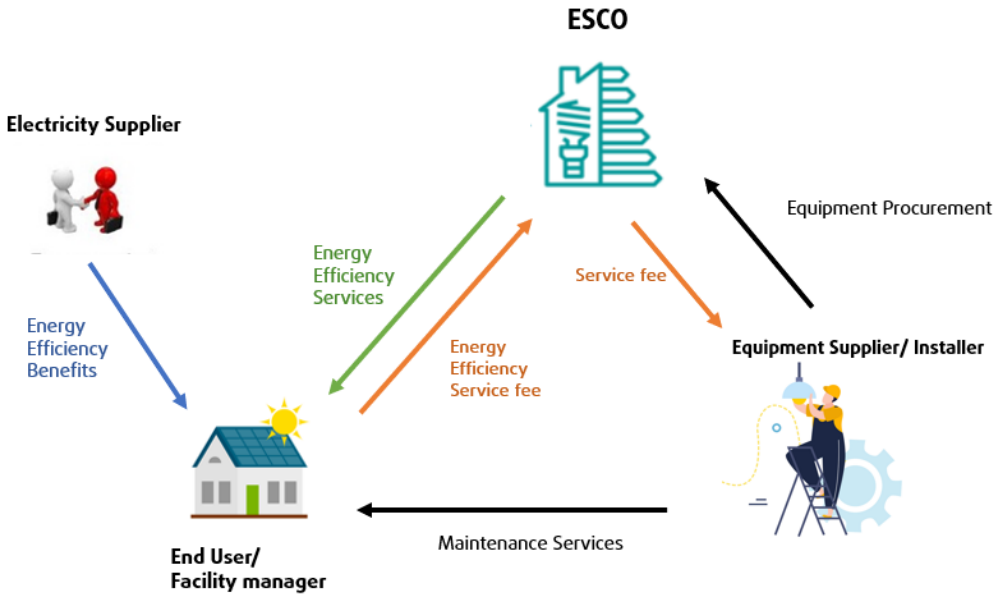

Figure 6- The ESCO BM Stakeholders

- Equipment suppliers

Unlocking the flexibility of consumption for energy efficiency solutions, as well as producing energy in case of prosumers, requires specialized equipment and intelligent devices. In any kind of energy efficiency project, the technology suppliers are a key-partner to the ESCO for the latter to be able to provide the necessary equipment, or even Information and Communication Technology (ICT), vital to the project.

- Construction/ installer and Maintenance companies

The construction related companies, are responsible for the procurement of the equipment, the proper installation, repairs and preventive maintenance. Their main interest is in performing the corrective actions in case of faults and periodic controls to avoid equipment failures and warranty invocations. In some occasions it can be the service provider itself.

- End User

The end user is a vital component of the ESCO Business Model. He is the service beneficiary, the saving maker for the efficiency services and the flexibility provider for the demand flexibility services. Sometimes it is the facility manager or building owner. The end user is the main beneficiary of the savings as they are reflected on the energy bill, but also the most sensitive party since the engagement and participation of the end user is of vital importance for the maximization of the savings. As such they are directly responsible for the effectiveness of the solutions.

An additional stakeholder could be also the financing entities. Upfront cost may be borne by the end users/ owners, the ESCO or a third-party financing entity.

3.1.2 ESCO business model factsheet

BUSINESS MODEL CANVAS – ESCO Service Pack

<table>
<tr>
<td rowspan="2">KEY PARTNERS

Who are your key partners/suppliers?
ESCO, Building/ facility manager, User, Equipment suppliers/ installers and technicians

Which key resources are we acquiring from partners?

Financial resources, Equipment, infrastructure (Communications gateway, meters, sensors, actuators, EMS, application, IT storage and computing services), Infrastructure (network and market)

Which key activities do partners perform?
ESCO: Offers, analyses, delivers and manages finances.
B/F manager: Contracts, maintains, finances.
User: Contracts, finances, saves, acts if prompted.
Installers and technicians: Commissioning, deployment, Operation &Manintenance.
IT service provider: provides and maintains data computing and data storage capabilities</td>
<td>KEY ACTIVITIES
What key activities does your value proposition require?
Real-time data for the provision of automated energy management services for efficiency based on users' comfort choices,
Potential DER control and automation
Short- and long-term generation and demand forecasts
Weather forecasting for adjusting loads (HVAC)
What activities are the most important for your distribution channels, customer relationships, revenue streams etc?
P4P contract signing, savings measurement, service pitching, live demos
What key activities do you need to deliver your customer experience?
Efficiency awareness and event triggering, market signal management, equipment monitoring, visualisation of metrics and EE strategies, comfort preservation</td>
<td rowspan="2">VALUE PROPOSITION
What core value do you deliver to your audience(description)?
SP3 offers to residential building owners complete services towards monitoring and controlling manually or automatically their local loads, IoT devices as well as generation and storage units towards optimizing the energy efficiency of their facility, reducing their energy costs while preserving or further enhancing comfort and smart automation.

What bundles of product/services are we offering to each customer segment?
HVAC and DHW control
Lighting control
Battery control, EV charging
RES generation and self-consumption optimization
Smart Home Automation and scheduling
What jobs are our customers trying to complete?
Minimise energy bills.
Increase energy efficiency, reduce CO_2 footprint.
Automate energy management.

What pains do they experience when trying to achieve their goals?
Unawareness of market prices and efficiency opportunities
Unawareness of real time RES generation and demand matching
Manual load micromanagement</td>
<td>CUSTOMER RELATIONSHIP
What relationship does the target audience expect you to establish and maintain with them?
Maintain concrete information flow through end user visualization kit.
Trigger valid alerts and automatic actions.
Ensure trust on sensitive data privacy
Informative billing
direct customer support

Which ones have we established?
Equipment installation, monitoring and battery control.
How costly are they?
TBD
How are they integrated with the rest of our business model?
TBD</td>
<td rowspan="2">CUSTOMER SEGMENTS
Which groups of customers are you creating value for?
Residents, facility managers and owners, energy communities, municipalities.

What are our most important customers?
Residents, facility managers and owners
Why?
The service allows savings on energy bills, while maintaining user preferences

What differentiates our customer segments?
Preferences cannot be addressed completely in energy communities.
Aggregated savings or income may be significant but is also dispersed.
What opportunities are there to reach new customers segments?
Potential subsidies on large-scale building energy efficiency upgrades could open the way to industrial consumers</td>
</tr>
<tr>
<td>KEY RESOURCES
What key resources does your value proposition require?
Smart and controllable DERS and loads such as HVAC and DHW systems, EV charging systems, PV, Batteries
Data: real time load/generation profiles, DER modelling parameters such as indoor T, humidity,
Weather data
Active consumers
What key resources do you need for distribution?
Retailers, installers and maintenance companies,</td>
<td>CHANNELS
Through which channel does your audience want to be reached?
Public media, social media,
Through constructors, Dedicated retrofitting services, energy supplier facility managers
How are we reaching them now?
Flyers, banners, web advertising, commissions
Which ones work best?
Constructors, Dedicated retrofitting services, energy suppliers, Utilities
Which ones are the most cost efficient?
Constructors, Dedicated retrofitting services</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>What key resources do you need for customer relationship management?
Web interface, mobile apps, visualization toolkits (for ESCOs and for end users, account manager, legal support, technical support</td>
<td colspan="2">How does our product/service help them achieve goals/relieve pains?
Centralised information and control
Optimisation of RES self-consumption
Awareness of EE potential for behavioural change
Automation and smart control for explicit load management towards efficiency
Informative billing and continuous cash flow monitoring</td>
<td>How are we integrating them with customer routines?
Newsletters, Billing notes</td>
<td></td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE
What are the most important costs?
Hardware costs at dwelling level
Operations Cost at ESCO level
Maintenance costs at dwelling and ESCO levels
End of life/contract decommissioning/recycling costs
Which Key Resources are the most expensive?
Hardware costs
What can be changed from a fixed cost to a variable cost?
Maintenance cost, IT platform cost.</td>
<td colspan="3">REVENUE STREAM(S)
For what value are customers really willing to pay?
Energy savings measured and verified by means of fair and transparent P4P methodologies.
For what do they currently pay?
Consumption of energy
How are they currently paying?
Usually in an EPC upfront basis
How much does each revenue stream contribute to the overall revenues?
To be defined during trials</td>
</tr>
</table>

VALUE PROPOSITION CANVAS- ESCO Service Pack

PRODUCTS/SERVICES

List of all the Products and Services a value proposition is built around.

Automated energy management services based on user comfort choices.

Real time condition monitoring and adjusting of loads.

Optimisation of RES production.

Weather forecast integration.

Alerts/ suggestions.

Price signal integration.

GAIN CREATORS

Describe how your products and services create customer gains.

Load control according to price signals.

- Energy savings obtained from user behavioural change
- Energy Savings obtained from automatic operation of loads
- Economic savings by price-based optimal scheduling

Same level of comfort with less demand

Optimisation of RES production

PAIN RELIEVERS

Describe how your products and services alleviate customer pains.

Minor disturbance in terms of time

Option to delete

Partial control option

SA incentives.

P4P contract

GAINS

Describe the outcomes customers want to achieve or the concrete benefits they are seeking.

Energy savings by reducing eventually the energy consumption, implicitly or explicitly
Economic savings by price-based optimal scheduling

Increased revenues from optimal self-consumption management

PAINS

Describe the bad outcomes, risks, and obstacles related to customer jobs.

Onsite domestic access

Data sharing

Partial or total automated control over loads or DER

There have to be significant loads (EV, storage, DWH etc for the savings to have an impact

There has to be a minimum smart readiness level

CUSTOMER JOBS

Describe what customers are trying to get done in their work and in their lives, as expressed in their own words.

Energy bills are one of the major concerns of dwellers. The market is open to incorporate technology to make energy savings. However, not all users are willing to lose control of their decisions and mistrust new technology. Many want to keep the control of their decisions or, at least, be informed of automated events and be able to override them at will.

3.2 The Aggregator business model

Flexibility Services are executed on demand and are usually based on events or requests from the Grid operators that send price signals to available open markets. In general, they can be distinguished among Explicit and Implicit demand response (DR) schemes and potentially direct energy ingestion to the grid in cases where the respective flexibility markets are established.

Explicit DR schemes ("incentive-based") results of demand/response actions and load shifts are "sold" within the balancing, capacity or wholesale markets. Consumers receive direct payments for these services to shift their consumption (upwards or downwards) after triggers activated from balancing services, price fluctuations or network constraints. Explicit DR is a valuable operational tool for System or Grid Operators to adjust loads and resolve congestion or System stability issues.

Implicit DR schemes ("price-based") on the other hand has to do with consumers being exposed to electricity or network prices that vary according to time of use and their actions are based on that information. Consumers in Implicit DR schemes have no commitments to act in contrast with the Explicit schemes, but react and receive a benefit in the form of reduced electricity costs.

These two schemes are not conflicting. A consumer may participate in Explicit DR schemes via an Aggregator and at the same time take part in implicit programs as well. The schemes are activated at different times, serve different purposes and are remunerated in a totally different manner (reduced cost in implicit and direct payment in explicit schemes). Implicit demand response schemes are not tradeable and hence, are not offered as a service in the frESCO business models.

In the case of explicit DR the presence of an Aggregator is vital. The Aggregator is the market participant that allows consumption shifts to be aggregated and represented in the markets and be valued accordingly. In addition, a consumer usually lacks the capacity to be a direct market participant on their own; neither is the consumer directly regarded as a Balance

Responsible Party in market terms. In case of residential consumers, the role of the Aggregator is even more important, as the impact of consumption shifts by individual residential consumers is rather insignificant from a System (or Grid) Operator perspective, but a significant number of consumers under an aggregator can have the necessary impact, provide the necessary services and receive the appropriate market compensation.

From the Aggregator point of view, DR must be performed in real time. For that to take place additional forecasting models (of production in case of DERs or market prices) need to be deployed. A Virtual Power Plant (VPP) configuration must be deployed as well as an asset registry within the Aggregator system. An asset may be a DER or a controllable load. A user interface for the aggregator and the end user also has to be present. The aggregator prefers individual settlements and remuneration per event or DER in this concept, if it is technically possible. On the other hand, the end customer requires a periodic report of activity that will complement billing procedures.

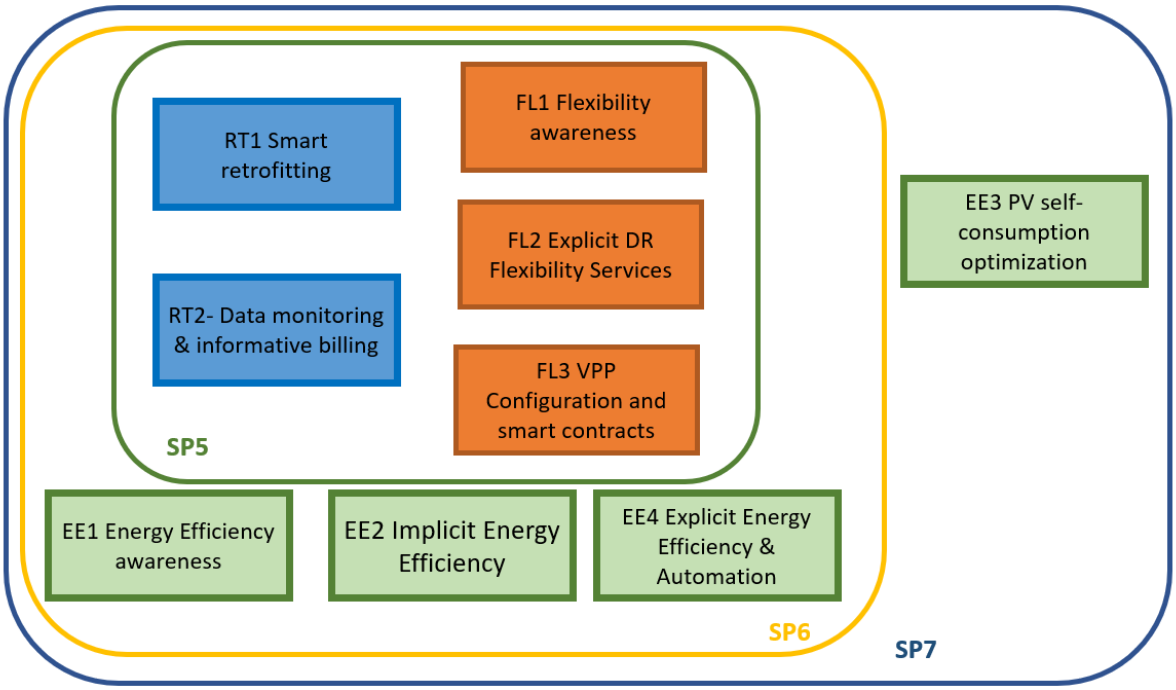

Figure 7- The Aggregator* Service *bundles

The primary objective of the Aggregator is to effectively transform peak-load management to active energy market assets that can compete against traditional energy assets (such as fuel powered stations) and provide services to the market and Grid operators. The frESCO Energy

Services for Aggregators imply hybrid models, that combine Demand Response Services with Energy Efficiency Services to buildings or even energy communities that improve hedging and maximize revenues through control over small, but significant loads (such as lighting or HVAC when aggregated). These services include:

- Predictive flexibility awareness and analytics for buildings
- Optimal peak demand management
- Demand Side Management framework for market participation and VPP configuration

Flexibility awareness allows consumers/prosumers to become aware and understand their flexibility potential. It is a preparatory step prior to getting engaged in flexibility contract negotiation and (finally) participation in DR schemes. In Explicit DR, the calculated demand flexibility is automatically dispatched, in response to a grid operator or market operator request. It also includes the verification of the actual flexibility dispatched and the correspondent remuneration of the flexibility providers (building users) proportionally to their flexibility contribution to the DR event.

The final revenue paid by those markets is transferred to the flexibility providers (consumers and prosumers) after deducting a percentage for the aggregator as a payment of the flexibility management, aggregation and market trading services. This stream is also relevant in a VPP configuration for load management, where the Aggregator is responsible for the coordinated optimization of all the energy assets in the relevant portfolio.

3.2.1 Involved stakeholders in the Aggregator business model and their interactions

In the Demand Response Services the main stakeholders are:

- The Aggregator

The Aggregator, combines a number of energy end-users and creates a portfolio of a competent market participant. In this way, end users are enabled to participate in energy markets, by offering flexibility services. The Aggregator efficiently gathers residential or small in general consumers (small businesses, agricultural, commercial or even small manufacturing

loads), and manages them according to Grid or Market operator requests. By managing DERs, Storage facilities as well as non-vital loads during a flexibility event, the end consumer is entitled to a flexibility fee via the Aggregator, by participating in the market. The participation requires the end users to be able to reduce or increase energy demands on a relatively short notice. This usually happens through automation and the Aggregator acts as the representative of all these combined loads within the market.

- The Facility Manager

The facility manager can be the owner of the building or a third party responsible for the maintenance and operations of the building (e.g. elevators, heating, lighting, common bills etc). The Facility Manager is primarily interested in monitoring the energy use, deciding on equipment investments, identifying problems and solving issues. The goal is to reduce energy bills without disturbing the comfort of the residents or in the flexibility schemes to create energy revenues. To this end (especially in case of a third party or an owner who is not the end user), the facility manager can also provide recommendations and consulting services. In case the facility manager is also the building owner, financing may also be part of the relevant actions.

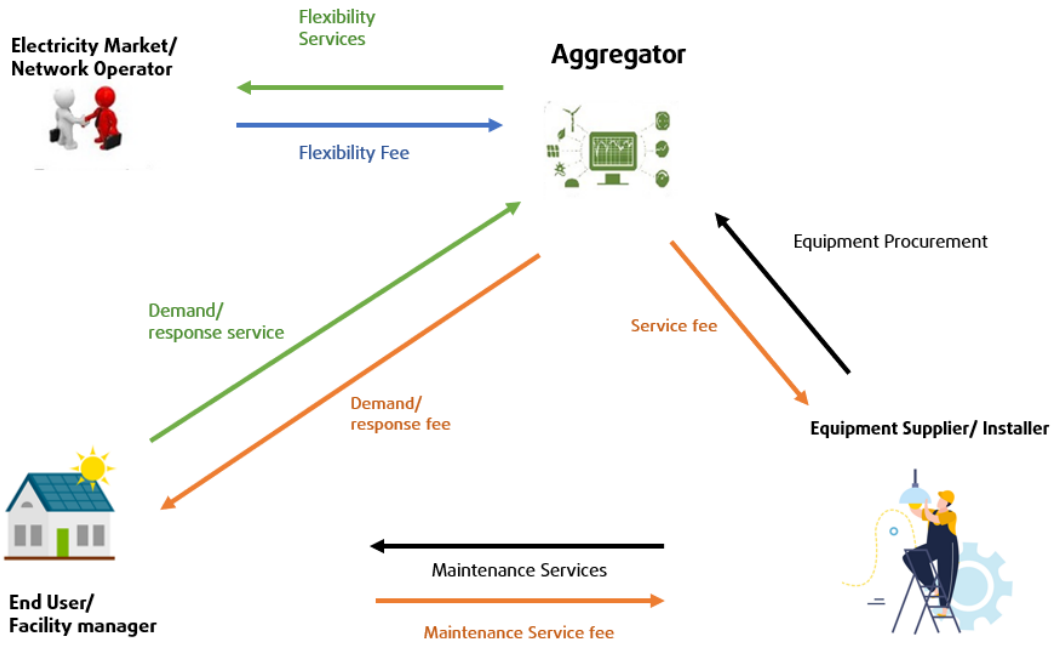

Figure 8- The Aggregator BM Stakeholders

- Equipment suppliers

Unlocking the flexibility of consumption for load flexibility services, as well as producing energy in case of prosumers, requires specialized equipment and intelligent devices. In any kind of Demand Response project, the Technology suppliers are a key-partner to the Aggregator for the latter to be able to provide the necessary equipment, or even Information and Communication Technology (ICT), vital to the project.

- Construction/ installer and Maintenance companies

The construction related companies, are responsible for the procurement of the equipment, the proper installation, repairs and preventive maintenance. Their main interest is in performing the corrective actions in case of faults and periodic controls to avoid equipment failures and warranty invocations. In some occasions it can be the same entity as the service provider itself.

- End user

The end user is a vital component of the Aggregator Business Model. In some occasions, it is the same entity with the facility manager or building owner. The end user is the main beneficiary of the revenues from the flexibility services, but also the most sensitive party, since the engagement and participation of the end user is of vital importance for the maximization of the revenues. As such they are directly responsible for the effectiveness of the solutions.

An additional stakeholder could also be the financing entities. Upfront cost may be borne by the end users/ owners, the Aggregator or a third-party financing entity.

3.2.2 Aggregator business model factsheet

BUSINESS MODEL CANVAS – Aggregator Service Pack

<table>
<tr>
<td rowspan="2">KEY PARTNERS

Who are your key partners/suppliers?
ESCO, Building/Facility manager, User, Equipment suppliers/ installers and technicians, Aggregators, Network Operator, Market Operator, System Operator

Which key resources are we acquiring from partners?

Financial resources, Equipment, infrastructure (Communications gateway, meters, sensors, actuators, EMS, application, flexibility analytics, comfort profiling, IT storage and computing services), Infrastructure (network and market)

Which key activities do partners perform?
ESCO: Offers, analyses, delivers manages, finances
B/F manager: Contracts, maintains, finances
User: Contracts, finances, saves, acts if prompted
Installers and technicians: Commissioning, deployment, O&M
IT service provider: provides and maintains data computing and data storage capabilities</td>
<td>KEY ACTIVITIES
What key activities does your value proposition require?
Real-time data for the provision of automated energy management services for market revenues
Potential DER control and automation
Short- and long-term generation and demand forecasts
Response to market signals and instructions

What activities are the most important for your distribution channels, customer relationships, revenue streams etc?
Service pitching, live demos, P4P contract signing, evaluation of flexibility provision by user, market revenues measurement
What key activities do you need to deliver your customer experience?
Market revenue awareness and event triggering, market signal management, equipment monitoring, visualisation of metrics and EE strategies,</td>
<td rowspan="2">VALUE PROPOSITION
What core value do you deliver to your audience(description)?
SP5 offers to residential building owners complete services towards monitoring and controlling manually or automatically their local loads to participate in the market by offering Flexibility Services to the Grid and earn revenue, utilizing IoT devices as well as generation and storage units towards optimizing the energy value of their facility, improving their income while preserving or further enhancing comfort and smart automation.

What bundles of product/services are we offering to each customer segment?
HVAC and DHW control
Lighting control
Battery control, EV charging
RES generation and self-consumption optimization
Smart Home Automation and scheduling
What jobs are our customers trying to complete?
Gain an overview of their residential energy flows.
Earn extra revenue.
Increase energy efficiency, reduce CO_2 footprint.
Automate energy management.

What pains do they experience when trying to achieve their goals?
Manual load micromanagement</td>
<td>CUSTOMER RELATIONSHIP
What relationship does the target audience expect you to establish and maintain with them?
Maintain concrete information flow through end user visualization toolkit.
Trigger valid alerts and automatic actions.
Ensure trust on sensitive data privacy
Informative billing
direct customer support

Which ones have we established?
Equipment installation, monitoring and battery control.
How costly are they?
TBD
How are they integrated with the rest of our business model?
TBD</td>
<td rowspan="2">CUSTOMER SEGMENTS
Which groups of customers are you creating value for?
Residents, facility managers and owners, energy communities, municipalities.

What are our most important customers?
All
Why?
The service allows extra revenues from the market

What differentiates our customer segments?
Preferences cannot be addressed completely in energy communities. Aggregated savings or income may be significant but is also dispersed.
What opportunities are there to reach new customers segments?
Extreme Market prices, in combination with existing or under development RES or storage installations. As the Smart Grid deploys so will the relevant opportunities</td>
</tr>
<tr>
<td>KEY RESOURCES
What key resources does your value proposition require?
Smart and controllable DERS and loads such as HVAC and DHW systems, EV charging systems, PV, Batteries
Data: real time load/generation profiles, DER modelling parameters such as indoor T, humidity,
Market signals and smart grid infrastructure
Active consumers
What key resources do you need for distribution?</td>
<td>CHANNELS
Through which channel does your audience want to be reached?
Public media, social media,
Through constructors, Dedicated retrofitting services, energy supplier facility managers
Which ones work best?
Constructors, Dedicated retrofitting services, energy suppliers, Utilities, Aggregators
Which ones are the most cost efficient?
Constructors, Dedicated retrofitting services</td>
</tr>
</table>

Aggregator: Handles market signals and cash flows, performs flexibility analytics, pushes energy behaviour suggestions (implicit DR), scheduling/dispatching DR (explicit) Network: Provides infrastructure Market: Provides price signals	Aggregators, installers and maintenance companies, **What key resources do you need for customer relationship management?** Web interface visualization toolkits (for Aggregators and for end users), account manager, legal support, technical support	Non-access to flexibility markets without an aggregator. Unawareness of market prices and efficiency opportunities Unawareness of real time RES generation and demand matching **How does our product/service help them achieve their goals/relief pains?** Centralised information and control Optimisation of RES self-consumption Awareness of FL potential for behavioural change Automation and smart control for explicit load management towards flexibility Informative billing and continuous cash flow monitoring	**How are we integrating them with customer routines?** Newsletters, Billing notes	

COST STRUCTURE **What are the most important costs?** Hardware costs at dwelling level Operations Cost at Aggregator level Maintenance costs at dwelling Smart Grid infrastructure at dwelling level **Which Key Resources are the most expensive?** Operations costs **What can be changed from a fixed cost to a variable cost?** Maintenance cost, IT platform cost. Aggregator platform cost (according to market participation and energy exchanged)	**REVENUE STREAM(S)** **For what value are customers really willing to pay?** Market participation revenues measured and verified by means of Network operator data **For what do they currently pay?** Consumption of energy **How are they currently paying?** Through their bill **How much does each revenue stream contribute to the overall revenues?** To be defined during trials

VALUE PROPOSITION CANVAS- Aggregator Service Pack

PRODUCTS/SERVICES

List of all the Products and Services a value proposition is built around.

Automated energy management services based on user comfort choices.

Real time condition monitoring and adjusting of loads.

Optimisation of RES production.

Weather forecast integration.

Alerts/ suggestions.

Price signal integration.

Adjust of loads and production (via storage) to meet FL demands

GAIN CREATORS

Describe how your products and services create customer gains.

Load control according to price signals.

- Revenue obtained from user behavioural change
- Revenue obtained from automatic operation of loads
- Economic savings by price-based optimal scheduling and responsiveness

PAIN RELIEVERS

Describe how your products and services alleviate customer pains.

Minor disturbance in terms of time

Option to delete

Partial control option

Market incentives.

P4P contract

GAINS

Describe the outcomes customers want to achieve or the concrete benefits they are seeking.

Revenue by providing FL services to the network operator, implicitly or explicitly
Economic savings by price-based optimal scheduling

Increased revenues from optimal market allocation of DER production

PAINS

Describe the bad outcomes, risks, and obstacles related to customer jobs.

Onsite domestic access

Data sharing

Partial or total automated control over loads or DER

There have to be significant loads (EV, storage, DWH etc for the FL services to have an impact

There has to be a minimum smart readiness level

CUSTOMER JOBS

Describe what customers are trying to get done in their work and in their lives, as expressed in their own words.

The market is open to incorporate technology to make energy savings but also energy revenues as well. However, not all users are willing to lose control of their decisions and mistrust new technology. Many want to keep the control of their decisions or, at least, be informed of automated events and be able to override them at will.

4 DISCUSSION

The majority of energy service contracts are not regulated at the EU level. They depend heavily on the interest of consumers and ESCOs. Yet, in the case of residential consumers, the potential for stand-alone savings or revenues is deemed low in most cases and while consumers might be interested, it may not be the case for the service provider, a situation that in turn creates financing problems. On the other hand, even if the household consumption, savings or flexibility services revenue are small in absolute terms, they need to be incorporated in the energy markets or savings business as they play a significant role in the overall energy consumption levels across the EU.

Digital technology and means to handle big data nowadays allow addressing these issues and create new data-driven energy services that are appealing to both ESCOs and Aggregators as well as the end-users, the residential consumers, that can benefit from them, either directly in case of flexibility services or indirectly in case of energy efficiency services that reduce the final bill.

frESCO energy services provide data-driven energy services to residential consumers (or prosumers) under a Pay-for-Performance scheme that ensures accurate measuring, eventually leading to a fair distribution of the benefits between the household and the service provider. This is aligned with the need to incorporate better understanding from the demand side, the participation in the market of huge and heterogeneous data streams as well as the incorporation of storage and production capabilities at a residential level.

Service packages are proposed with different Pay-for-Performance approaches:

- Energy Efficiency Services are offered through both implicit and explicit activation processes to achieve energy savings. Prosumers may also benefit from a self-consumption optimisation strategy that ensures the appropriate or relevant levels of comfort.
- Demand flexibility services provide for responding to a market or grid operator request and receiving the relevant market (wholesale, spot or balancing) revenue and

compensation. These should also be designed according to end-consumer needs and preferences.

- Non-energy (NE) Services are deemed complementary to end users, but also play a significant role in the overall revenue stream of the service provider. Besides, the equipment necessary for the Flexibility and Energy Efficiency services can also be used for the delivery of the NE services and add real or perceived value to the end user.

The scope within frESCO is to present and deliver a holistic management framework as well as an equally important behavioural triggering framework. Residential consumers are relatively unaware of the potential they have for significant savings or revenues and as such, the frESCO business models aim to both educate the average consumer on his potential as well as deliver the solutions in a way that does not affect comfort levels. In this direction, personalised data are combined with robust forecasting algorithms for market prices as well as RES production. This data handling is vital for both an ESCO and an Aggregator but to the end-user as well, whose engagement is necessary for the maximisation of benefits.

Cost for these interventions remains at a relatively high up-front level and usually consists of:

- Installation of the relevant equipment (gateways, sensors, meters, clamps and actuators), their setup and calibration.
- Data platform upfront costs
- Recurring costs such as platform operation, storage, cloud computing and maintenance.

Energy bills are one of the major concerns of residential consumers. The market is open to incorporate technology to achieve not only energy savings but energy revenues as well. However, not all users are willing to ultimately lose control of their energy habits and may also mistrust new technology. Many want to keep control of their decisions or, at least, be informed of automated events and be able to override them at will.

Estimation of costs, allows for frESCO services to be economically viable, yet still the payback period is projected to be about 10-11 years. To shorten the payback time, as many services as possible have to be deployed (efficiency, optimisation, flexibility and non-energy services), since there is common ground for costs and necessary infrastructure and in that way revenues or savings can be maximised. Additionally for the service provider it is of vital importance to have contracts with a large number of end-users to leverage on the fixed cost (data platform, storage and computing). Furthermore, participating households should have high electricity consumption for the energy efficiency and flexibility services to have a visible impact.

A number of issues that have to be addressed for a P4P scheme in contrast to the traditional EPC schemes have to do with the contract duration as well as the cash flows between the actors (mostly the ESCO or Aggregator and the end-user). These issues should also be addressed in the contract that accompanies the interventions. With that relevant period of time (10-11 years) as a baseline requirement for the payback period, the time frame of the contract is of vital importance, and should potentially be accompanied with certain warranties for the capital deployer. Within the P4P scheme, it should be directly linked to the savings and revenues (or percentage thereof) that in turn point to the actual contract duration.

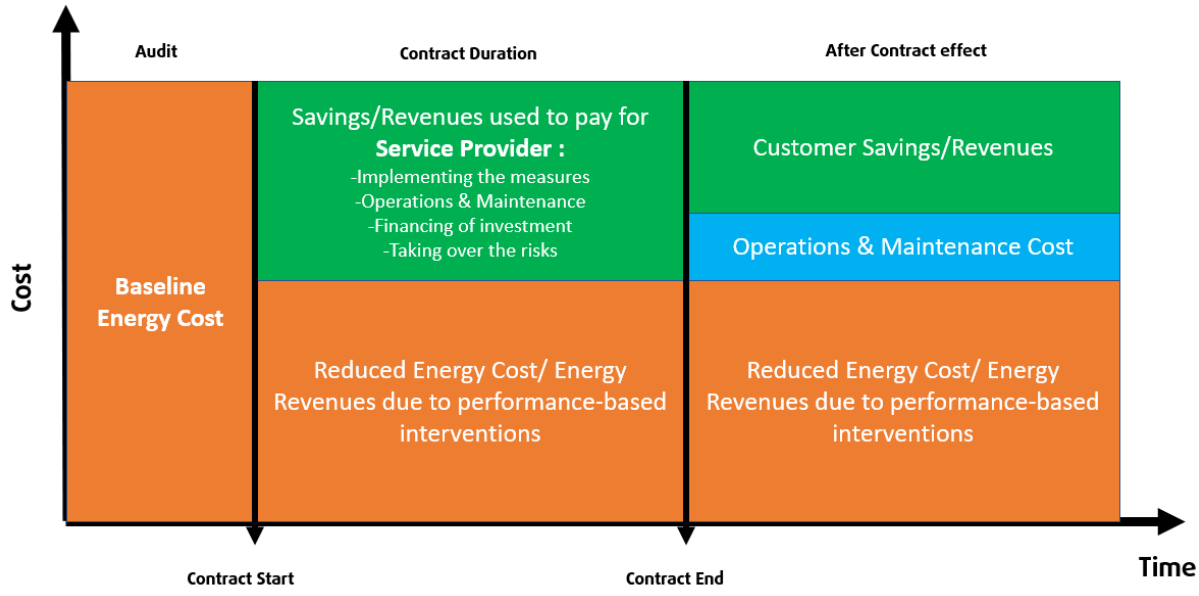

Figure 9 - Revenues and savings vs* contract *duration

The actual success of the interventions and subsequently the value produced, are linked to the duration of the payback period (plus the service providers reasonable margins) rather than a strictly defined time period. On the other hand, distinct precautions have to take place within the contract for premature annulment either by the service provider or the end user. The equipment ownership should be strictly defined as well as a compensation for reasonable economic losses or equipment deterioration.

Savings directly benefit the end user by reducing energy bills (via the supplier). In that case, the settlement between the end user and the service provider may practically follow a monthly payment from the end user to the ESCO or a charge on the electricity bill by the supplier on behalf of the ESCO. The later scheme usually complicates transactions unless the supplier is also the ESCO entity.

On the other hand, flexibility services are compensated by the TSO/DSO or Market Operator to the aggregator. Then the aggregator, in turn withholds the service fee and passes through the remaining flexibility income to the end user as a direct payment. This can also be done through the electricity bill and is easier when the supplier and the aggregator are the same entity as well.

In any case, in the event of both kinds of services offered at the same time (EE services and DR services), settlements should make sure that there is enough visibility for the end user to be able to understand the source of the cash flows (be it an upwards or downwards flexibility or efficiency payment). The relevant information should always be accompanied with a detailed notification statement that justifies the total settlement amounts.

Further to the above, a number of contractual and legal arrangements need to be considered, with a primary scope to enable the P4P market scheme but also ascertain the viability of the scheme. To that end, issues related to GDPR, consent for data usage, overriding rights as well as warranties for the capital deployer in parallel to the protection of the end-user, need to be

studied. T3.6 of the frESCO project will be devoted to the detailed analysis of contractual and legal considerations aiming at creating the P4P contract templates for the frESCO business models.

5 CONCLUDING REMARKS

The new business models presented in this report, describe a new and innovative approach for ESCO and aggregator business models in the residential sector. So far, enterprises have not focused on the residential sector since the benefits and relevant revenues are deemed small and thus considered unattractive for investments from ESCOs and Aggregators. The scarce per capita consumption and the reluctance of energy end-users to defer control to third parties, in conjunction with energy usage and consumption fragmentation have presented a difficulty in aggregating energy consumption and building a reliable and viable Pay-for-Performance contract. Yet, EU overall final energy consumption is about 25% residential and needs to be considered in energy service developments.

The main issue with traditional EPC contracts for residential consumers lies with the inability to adequately assess the impact of both energy savings and flexibility options in a manner that ensures a fair remuneration of all parties involved, while not demanding excess investments from the final consumer.

While the EPC is an established scheme and is successfully used to reduce cost, it is deemed insufficient in an overall level to have any kind of environmental impact, which is the ultimate goal. Energy Service companies prefer public or commercial buildings, since the financial impact of savings is measurable and easily defined in contrast to the residential sector. The main driver is the fact that business actors (ESCOs or Aggregators), have through interviews and questionnaires, established their position about the problem that end-users require an implicit service provision without automatic operation that in turn hinders the potential savings. Additionally, the business actors require a close to real time monitoring of both the energy consumption and the availability of demand flexibility assets, missing currently in the domestic sector. Direct communication and control are paramount to the effectiveness of the solutions and the maximisation of revenue streams. On the other hand, household users require a control, or an opt-out option in whatever system is installed in order for them to not jeopardise their comfort level.

The main business actors in the frESCO Business Models are service providers (ESCOs and Aggregators). Often, a single actor can play both roles and the frESCO business models provide for such a situation. The usual stakeholders involved include: (i) the Facility Manager, (ii) equipment suppliers, (iii) construction/ installer and Maintenance companies and (iv) the end-users. In fact, energy efficiency services and especially the retrofitting part are a prerequisite for savings, optimisation of consumption or revenues by direct market participation. Additional non-energy services that have to do with comfort level or security issues are offered as stand-alone or add-on to either type. The incorporation of non-energy parameters as well as the certification process can also create value for the dwellings and can be undertaken by an ESCO or an Aggregator ad-hoc.

Other actors are vital to the process of providing the frESCO energy services. Retailers are a vital part of the process, since they are the market participants more closely related to the consumer. Significant savings can be obtained through the energy retailers and utilities via energy efficiency services or revenues through flexibility services. Retailers are not likely to undertake the role of either the ESCO or the Aggregator, but can facilitate the process as retailers and suppliers in particular are obliged to achieve energy savings from their customers according to their size (D2.2). Facility managers, are also a significant factor, since their activeness can facilitate either energy or flexibility services. While they pursue the goal of building or district energy management, the activation of new cost reduction or revenue creation streams is a means to that end. Constructors or installers and maintenance companies may also provide a means to reaching and convincing the end consumer of the feasibility of the project and the actual and measurable benefits.

The effective application and deployment of frESCO business models will be tested in the pilot sites within the scope of WP6. The main factor that may affect the services is the potential gap between predicted and actual energy performance of each building. Real time monitoring of loads and real time simulated demand flexibility events are of paramount importance for the validation of the expected revenues and business models' viability. The goal is to trigger

accurate and precise energy management strategies, to facilitate the establishment of novel, more robust and attractive business models while keeping the comfort choices of the end-user, with attractive payback periods and increased utility for all stakeholders involved. In the pilot sites, critical and non-critical loads will be examined and their financial impact measured in accordance with the frESCO PMV methodology.

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