ambience

Active managed Buildings with
Energy performaNce Contracting

Deliverable D5.1

Replication plan

The AmBIENCe Consortium

MAY | 2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847054.

DOCUMENT CONTROL PAGE

PROJECT ACRONYM	AmBIENCe
DOCUMENT	D5.1 Replication plan
TYPE (DISTRIBUTION LEVEL)	☒ Public ☐ Confidential ☐ Restricted
DUE DELIVERY DATE	31/5/2022
DATE OF DELIVERY	31/5/2022
STATUS AND VERSION	Final
DELIVERABLE RESPONSIBLE	ENERGINVEST
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EXECUTIVE SUMMARY

Deliverable 5.1 “Replication plan” gathers the aims and the replication strategy as for the results developed in the AmBIENCe project. It describes the market-oriented replication plan design to promote and develop the Active Building EPC concept beyond the boundaries of the consortium companies/countries. Specifically, the plan describes how the developed concept and proof-of-concept Active Building Energy Performance Modelling (ABEPeM) tool (1) can be made available for other interested parties and stakeholders across Europe, as a basis for developing new products and services with which they can grow their business and accelerate the adoption of active control in buildings for DR services.

In this deliverable, the list of the AmBIENCe project results is introduced in **Chapter 2**, including a description of each result paying special attention on the added value that these results provide.

Once results have been defined and characterised, the efforts were placed to analyse the replication potential of the AEPC concept and business model, in terms of products and services that would support it and the related business offers to the market. The aim was also to identify the market actors likely to commercialize an AEPC related business offer and to define the value proposition to be tested through a stakeholder survey. These efforts are brought together in **Chapter 3**.

The **Chapter 4** detail the replication strategy builds upon the stakeholder feedback and project results.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION AND BACKGROUND

1.1 THE CONTEXT

Energy Performance Contracting (EPC) is a mechanism for organising the energy efficiency financing which provides customers with a comprehensive set of energy efficiency, renewable energy and distributed generation measures and often is accompanied with guarantees that the savings produced by a project will be sufficient to finance the full cost of the project. A typical EPC project is delivered by an Energy Service Company (ESCO) who can unburden the client by proposing an optimal set of measures and give performance guarantees for the projected savings and pay-back time.

The activities of ESCOs and the market for EPCs emerged alongside the demand side management (DSM) programs that are primarily aimed at encouraging the consumer to use less energy during peak hours, or to move the time of energy use to off-peak times such as night-time and weekends. These modifications in energy demand could result in both energy savings and cost savings. The implementation of DSM in buildings ranges from improving energy efficiency to fully autonomous energy systems that automatically respond to shifts in supply and demand. Energy-related savings (either amount or cost) can basically be made in two ways: through Energy Efficiency (EE) or Demand Response (DR). EE relates to any program that encourages the end user to be saving energy in a long-term or permanent perspective, via EE measures such as lighting retrofits, building automation upgrades, Heating Ventilation AirConditioning (HVAC) improvements and building envelop insulation.

In contrary, DR refers to programs that encourage end users to make short-term reductions in energy demand. These short-term “responses” are triggered by price signals from the electricity hourly market or initiated by the Transmission System Operator (TSO) or Distribution System Operator (DSO). DR activations last from a couple of minutes to some hours depending on the DR program, and might include turning off or dimming lighting banks, adjusting HVAC levels, or shutting down a non-critical manufacturing process. On-site generation and storage systems can also be used to adjust loads drawn from the grid.

EPC is born from the idea that a significant part of costs and savings are concentrated on exploitation or operation phase of the building (incl. user behaviour), not only in the design and implementation part of buildings and their installation or energy saving investment. It also stems from the assessment that specialized actors (Energy Services Companies or ESCOs) may be better placed to optimize energy in buildings, including integration of advanced building control technology and monitoring, than building owners and users. The EPC model is based on outsourcing energy savings and management and shifting the risk of underperformance to a private party, i.e., the ESCO. It may be extended with the concept of ESCO financing to provide an overall integrated solution. It is a very flexible concept that is based on functional and performance driven tenders and contracts. From service contracts based on energy savings, it sometimes evolves into pure service contracts at a different level like Light-as-a-Service or Comfort-as-a-Service. In (classical) EPC, the focus is on designing and implementing various energy conservation measures (ECM) with the aim of achieving “guaranteed” energy consumption and cost savings, typically measured on a yearly basis.

They include measures on regulation/(re)commissioning of existing installations, upgrades, and replacements of existing installations by new installations (HVAC, relighting, renewable energy) and building envelope insulation measures (e.g., roof or attic insulation, floor and wall insulation, new glazing or new doors and windows). Ambition levels can vary from simple optimisation of the operations to deep

energy retrofits. EPC typically involves also more or less comprehensive maintenance, turning them de facto into Maintenance & Energy Performance Contracts.

The key actor of EPC is the ESCO who is in charge of providing the EPC to the end customer as a DB(F)MO-like service (i.e., Design (D), Build (B), Finance (F), Maintain (M) and Operate (O)). Another important actor is the EPC project facilitator, who accompanies the end customer from A to Z through the assessment, feasibility study, competitive tendering, implementation control and follow-up. EPC typically uses the principles of Measurement & Verification (M&V), supervised by one or more Certified M&V Professionals, who may sit within the ESCO and or EPC project facilitator. Public or Public-Private One-Stop-Shops may act as Project or Program Facilitator, aggregating and/or pooling projects of multiple end customers or with multiple buildings. They may also act as Market Facilitators to increase market demand and lift market development barriers. A comprehensive study on various EPC models as well as the actors involved in the EPC procedures is presented in deliverable D1.2. “Overview of actors, roles and business models related to Enhanced EPC and Building Demand Response Services” (2).

In DR/Flexibility, the aim is to change demand for energy in time, while leveraging price components (e.g., capacity-based pricing), tariff structures (e.g., time-of-use pricing), temporary storage capacity (e.g., batteries) or other demand side parameters (e.g., shifting or stopping production or energy usage temporarily) that use this temporality to reduce and optimize energy costs. The reduction is a result of energy suppliers or DSOs/TSOs may be willing to provide such dynamic pricing mechanisms to end customers (that are sufficiently big) or pay “aggregators” (that aggregate demand driven flexible consumption patterns from multiple end-customers), with the purpose of balancing the electricity network. DR/Flexibility typically uses advanced algorithms to optimize energy demand, while taking into account pricing and flexibility parameters as well as end customer constraints.

As comprehensively analysed in Deliverable D1.2 (Section 5.4 “Usage and analysis of different EPC types with demand response”, (2)), most of the EPC models do not consider flexibility. There are several barriers to be encountered for integration of flexibility and DR in EPC models such as the absence of dynamic tariffs. Moreover, the impact of this integration is highly dependent on the type of EPC and the business case considered for the EPC. Although most of the existing EPC models consider active control, they are being used for energy efficiency measures. Therefore, integrating the DR/Flexibility aspect and the active control in EPC model not only brings new value streams but also necessitates provisioning of a new EPC type.

The Active building Energy Performance Contracting (AEPC) concept aims to extend existing EPC concepts with elements for Demand Response and Flexibility. Today, most EPCs are focused on commercial and public buildings, whereas most DR services are offered towards large industrial users, although some initial implementations exist for tertiary and (multiple) residential buildings, like respectively demand driven regulation and neighbourhood batteries.

The challenge in defining the Active building EPC concept is in merging two worlds with quite different technologies, services, business models, end customer profiles and actors into a single consistent new concept that can be implemented in a broader range of buildings, while creating an interesting new business model to enhance existing business models. The ultimate goal is to invite existing actors to develop new business models or to attract new actors into a market with interesting new business potential.

1.2 METHODOLOGY FOR REPLICATION (AND EXPLOITATION)

Replication is seen as the implementation of the AEPC concept and business model beyond the boundaries of the consortium companies/countries, while exploitation takes into account future business plans and deployment for partners. The general methodology for replication is based on the following steps:

- Identification of the project results as potential replicable components;
- Identification of the AEPC concept and business model related offerings, based on the analysis of the replicable/exploitable results;
- Identification of the market players that would potentially actively commercialising an AEPC concept and business model related offerings;
- Definition of an AEPC business offer value proposition for the identified market players;
- Stakeholder survey on the AEPC business offer value proposition;
- Analysis of barriers and drivers to evaluate the main challenges for replication;
- Development of go-to-market strategies for replication (and exploitation).

Firstly, all results of the project were listed, regardless their ownership and exploitation strategy, in order to have a good understanding of the whole AmBIENCe project outputs. As for project results, two different blocks are considered based on their exploitability, key exploitable results (KERs) and other project results. KERs have been characterised in detail, explaining the problem the results address and its Unique Selling Point, this is the competitive advantage that they provide. In addition, its route to market is analysed, among others identifying the market size, the market trends, potential competitors and the time to market. For the other results, the once that, with a few exceptions, will not have a commercial exploitation, a description is also provided.

Based on the results, the consortium explored the potential AEPC concept and business model related offerings according to the AEPC market ecosystem defined in the deliverable D1.2 (2). Related to the key exploitable results (KERs), the consortium identified three key market players that would potentially actively commercialise an AEPC related business offering and elaborated further the business offer value proposition. Stakeholders were then approached in selected replication target countries to get broad insight in market feedback. Results of the analysis efforts feature go-to-market strategies to overcome barriers and evaluation of the main challenges for the AEPC business offer value proposition, that can serve the replication and exploitation efforts beyond the AmBIENCe project.

2. THE AMBIENCE PROJECT RESULTS

The first task developed under WP 5 (prior to the actual kick off of the tasks) was the identification and characterisation of the AmBIENCe project results, the outputs of the different activities developed in the tasks and work packages. This work package approach allowed us to identify with detail relevant outputs that will be used by the partners in future activities from dissemination, further research, consultancy, or services development.

Tekniker's methodology to identify results and define their exploitation strategy was implemented. This method has already been successfully applied in many H2020 projects and it's a good starting point to create a common understanding between partners, regardless of the type of organizations they are. Tekniker based on its experience lead this process with the participation of the whole consortium.

In the first place, Key Exploitable Results (KERs) were identified (see Table 1 KER EXPLOITATION STRATEGY SUMMARY

). In addition to the KER, the AmBIENCe project has developed "other results", that although the partners do not expect to exploit them commercially, they are important to extend the concept among the stakeholders and will lay the foundation for further research and dissemination activities (see Table 2).

For all the results, the KERS and the "other results", the partners involved in their development were listed, and the main owner of the result was identified (and highlighted in blue in the table). On top of that, the exploitation strategy was outlined providing the following information:

- Intellectual Property Right (IPR);
- Replicability potential;
- Commercial Exploitability:
  - **M** - Making and selling results,
  - **L** - Licensing results to 3rd parties,
  - **O** - Providing services, consultancy or training activities;
- Non-Commercial Exploitability:
  - **U** - Using results internally to enhance current portfolio on sale,
  - **R** - Results will be used as the basis for further research.

KEY EXPLOITABLE RESULTS													
Coding		EXPLOITABLE RESULTs (includes Solutions)	OWNER	IPR	Replicability	Commercial Exploitability				Non Commercial Exploitability			
						Commercial Exploitability	M	L	O	Non Commercial Exploitability	U	R	
WP2-3	KER 1	AEPC contractalization template (one for portuguese pilot, another for the belgium one)	EDP	Copyright	X	X			O				
			ENERGINVEST	Copyright	X	X			O	X	U	R	
			INESC TEC	Know how						X		R	
WP3	KER 2	Active building M&V methodology	ENERGINVEST	Copyright	X	X			O	X	U	R	
			INESCTEC	Know how						X		R	
WP2	KER 3	smartAEPC business model and methodology	ENERGINVEST	Copyright	X	X			O	X	U	R	
WP2	KER 4	Grey box module creation toolchain (1)	VITO	Trade secret	X	X	M		O	X	U	R	
WP2	KER 5	Flex value quantification module	VITO	Trade secret	X	X	M		O	X	U	R	
WP2	KER 6	ABEPEM platform	ENERGINVEST	Other	X					X	U	R	
			VITO	Trade secret	X	X	M		O	X	U	R	

(1) KER 4: Although the long-term goal is to sell it, it is envisaged that on the short term it will be offered as a service to prove its value and based on that prepare a sell.

TABLE 1 KER EXPLOITATION STRATEGY SUMMARY

OTHER RESULTS												
Coding		EXPLOITABLE RESULTs (includes Solutions)	OWNER	IPR	Replicability	Commercial Exploitability				Non Commercial Exploitability		
						Commercial Exploitability	M	L	O	Non Commercial Exploitability	U	R
WP1	R. 1	SURVEY OF DIRECTIVES, POLICIES, MEASURES AND REGULATION THAT ARE RELEVANT FOR ACTIVE BUILDING EPC CONCEPT FOR THE MEMBER STATES REPRESENTED IN THE CONSORTIUM	ENEA	Know how	X					X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X					X	U	R
			EDP	Know how						X		R
			BPIE	Know how						X		R
			VITO	Know how	X					X	U	R
			TEK	Know how						X		R
WP1	R.2	ASSESSMENT OF EPC/ESCO STATUS in European Member States	ENEA	Know how						X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X					X		R
			EDP	Know how						X		R
			BPIE	Know how						X		R
			VITO	Know how						X		R
			TEK	Know how						X		R
WP1	R.3	ASSESSMENT OF DEMAND RESPONSE SERVICES OFFERED BY (CLUSTERS OF) BUILDINGS in European Member States	ENEA	Know how						X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X	X				X		R
			EDP	Know how						X	U	
			BPIE	Know how						X		R
			VITO	Know how						X		R
			TEK	Know how						X		R
WP1	R.4	OVERVIEW OF MAIN ENABLERS AND BARRIERS in European Member States for the Active Building EPC	ENEA	Know how						X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X	X				X		R
			EDP	Know how						X		R
			BPIE	Know how						X		R
			VITO	Know how						X		R
			TEK	Know how						X		R

KEY EXPLOITABLE RESULTS												
Coding		EXPLOITABLE RESULTs (includes Solutions)	OWNER	IPR	Replicability	Commercial Exploitability				Non Commercial Exploitability		
						Commercial Exploitability	M	L	O	Non Commercial Exploitability	U	R
WP1	R.5	Analysis of FLEXIBILITY/DR BUSINESS MODELS with actors and roles	ENEA	Know how						X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X	X						R
			EDP	Know how						X	U	
			BPIE	Know how						X		R
			VITO	Know how	X					X	U	R
			TEKNIKER	Know how						X		R
WP1	R.6	OVERVIEW OF EPC CONCEPTS AND BUSINESS MODELS	ENEA	Know how						X		R
			INESC TEC	Know how						X		R
			ENERGINVEST	Know how	X	X				X	U	R
			EDP	Copyright	X	X	M		O			
			BPIE	Know how						X		R
			VITO	Know how	X					X	U	R
			TEK	Know how						X		R
WP1	R.7	Guidelines to implementation of Active Building EPC in Europe	ENEA	Know how						X		R
			INESC TEC	Copyright						X		R
			ENERGINVEST	Know how	X				O	X	U	R
			EDP	Copyright	X	X	M		O			
			BPIE	Copyright						X		R
			VITO	Know how	X					X	U	R
			TEK	Copyright						X		R
WP2	R.8	AEPC concept (Deliv 2.1)	INESC TEC	Copyright	X					X		R
			ENERGINVEST	Know how	X	X				X	U	R
			VITO	Copyright	X					X	U	R
			CEIT	Know how						X		R

KEY EXPLOITABLE RESULTS												
Coding		EXPLOITABLE RESULTs (includes Solutions)	OWNER	IPR	Replicability	Commercial Exploitability				Non Commercial Exploitability		
						Commercial Exploitability	M	L	O	Non Commercial Exploitability	U	R
WP2	R.9	AEPC concept for collection of buildings	TEKNIKER	Copyright	X					X		R
			INESC TEC	Copyright						X		R
			VITO	Know how	X					X	U	R
			ENERGINVEST	Know how	X	X				X	U	R
			ENEA	Know how						X		R
WP2	R.10	AEPC business model (Deliv 2.3)	ENERGINVEST	Copyright	X	X				X	U	R
			VITO	Know how	X					X	U	R
			INESCTEC	Know how						X		R
			EDP	Know how						X	U	
WP2	R.11	EFCM module (E&FCM (as part of ABEPEM tool)	ENERGINVEST	Trade secret	X				O	X	U	R
WP2	R.12	Static AEPC simulation tool	ENERGINVEST	Trade secret	X	X				X	U	R
WP2/3	R.13	Forecasting algorithms for solar generation, wind generation and electrical demand in different use cases oriented to operational phase	CEIT	Know how						X		R
WP3	R.14	Evaluation of the AEPC concept and business model implementation in the Portuguese pilot. (Best practices)	EDP	Know how	X					X	U	R
WP3	R.15	Evaluation of the AEPC concept and business model implementation in the Belgian pilot. (Best practices)	ENERGINVEST	Know how	X					X	U	R
WP4	R.16	Building stock database	BPIE	Copyright	X					X		R
			VITO	Copyright	X					X	U	R
WP4	R.17	Scenario development and energy system impact calculations active control adaptation	EDP	Know how	X					X	U	R
			VITO	Know how	X					X		R
			BPIE	Know how	X					X		R

TABLE 2 OTHER RESULT EXPLOITATION STRATEGY SUMMARY

2.1 KERS DESCRIPTION

The 6 KERs identified have been characterised in detail, explaining the problem each result addresses and its Unique Selling Point, this is, the competitive advantage that provides. In addition, its route to market is analysed, among other identifying the market size, the market trends, potential competitors and the time to market.

2.1.1 KER.1. AEPC CONTRACTUALIZATION TEMPLATE

KER Number	**1-A**
KER Name	**AEPC contractualisation template for a commercial building**
KER Nature	**Document**
Result Leader/Owners	**EDP;** ENERGINVEST; INESC TEC

Problem
Typically, contracts for EPCs in Portugal are custom made and take a considerable effort both from ESCOs and lawyers each time one is designed. Adding demand response to an EPC would make it even more difficult, therefore, a standard AEPC could be very useful to ESCOs offering these contracts in the future. This template should clearly state the roles and responsibilities from both counterparts and all legal, technical, operational, and financial arrangements between the two contractual parties: the building owner (and/or building user/manager). Several variations for business models of AEPCs exist, constituting a challenge in standardizing a AEPC contract, however, a template that could guarantee the definition of responsibilities as well as important operational requirements, i.e., baseline, cost savings calculation and measurement (M&V), would be of great use for ESCOs, contributing favorably to AEPCs adoption.
Alternative solution
ESCOs nowadays do not offer any AEPCs to their clients and the traditional EPCs they offer are custom made together with lawyer teams in a non-standardized way.
Unique Selling Point USP - Unique Value Proposition UVP
The contract template could ease substantially the complexity of designing an active EPC contract to a commercial client. The inclusion of demand response as predicted in an AEPC could add the advantage of increasing business viability and reducing contract timeframe. The standardization of these contracts could help to reduce up to 50% of the time spent on its preparation as a ballpark figure.
Description
The AEPC contract template is the document that, if the project can successfully include all the necessary clauses, could serve as the basis for the signing of future contracts designed by ESCOs.
"Market" – Target market
This contract template will be used by ESCOs to provide AEPC services to target clients.

"Market" – Early Adopters
EDP Comercial, currently involved in Ambience project, could be an early adopter, offering standardized AEPCs to clients on the B2B segment.
"Market" – Competitors
An AEPC template could be also developed by other companies offering classic EPCs.
Go to Market – Use model
The contract template will be used as a means to illustrate a possible extension of current commercial offerings in EDP Comercial. EDP B2B department will then evaluate its value for the company and the template could then serve as an accelerator to the first proposals made to commercial building owners.
Go to Market – Timing
6 months depending on the interest from ESCO and the ability of the AEPC concept to increase EPC contracts' value. This first template could be refined after the ESCO gains experience with AEPC contracting in the field.
Go to Market – IPR Background
AEPC contract templates build on previous experience and templates for SMEs in Europe, as well as inputs from related templates developed in other European projects. EDP Comercial past experience in traditional EPC contracts is used to leverage the development of a new AEPC contract.
Go to Market – IPR Foreground
Copyright.

KER Number	1-B
KER Name	AEPC contractualisation template for a residential building
KER Nature	Document
Result Leader/Owners	**ENERGINVEST**; INESC TEC; EDP

Problem
In order to design and implement an AEPC-project and sign the underlying AEPC contract, the use of a standard AEPC contract template is a good practice. This template can and should be the basis for future AEPC contracts, fixing the roles and responsibilities and all legal, technical, operational, and financial arrangements between the two contractual parties: the building owner (and/or building user/manager). It includes provisions on which measures are being implemented, how energy and cost savings are measured and verified (via the M&V-plan), how energy consumption is being monitored, which KPIs are included in the SLA, etc. The key issue to solve is the fact that are few or little EPC contract templates or examples available for the single home residential sector that is the scope of the Belgian pilot and that the contract template will need to be developed based on existing EPC or similar contracts for multi apartment buildings, private enterprise or public building EPC contracts. It will potentially acquire some legal check on the residential legislation too or inclusion from other private residential general conditions.
Alternative solution
There are today hardly any examples of residential EPC contracts or EPC contract templates. Most customers (or the distribution channels that ESCOs or ESCO project facilitators represent) will have no solution today. If there are, they are most likely only cover generic EPC provisions, not the AEPC specific contractual clauses.
Unique Selling Point USP - Unique Value Proposition UVP
The innovation lies in the fact that it offers a solution for a private residential building owner to engage with an ESCO for an optimised building renovation. It provides the contractual framework for an energy services-based solution, in contrast to the more classical way. It works particularly well for implicit DR as implemented through an AEPC model.
Description
The AEPC contract template is the document that will allow, when completed with all project information, data, parameters and KPIs and when signed, to become the key arrangement between the contracting parties.
"Market" – Target market
The AEPC contract can be used for residential building renovation projects were there is a potential for valorizing flexibility. The target markets are (at the demand side) residential building owners and potentially associations of co-owners (ACO) and ESCO that are active or want to become active in the residential building renovation market. In the latter case, the contract template would need to be adapted to foster for the specifics of the ACO model. They could potentially also include existing

buildings with sufficient electrical equipment with flexibility potential requiring little or new renovations.
"Market" – Early Adopters
Because of the volume required to justify AEPC transaction costs, multi-apartment co-owners may be earlier adopters compared to individual homeowners. In case there is a more interesting business case for multiple homeowner renovations (e.g., an entire street) these may also be early adopters. In general, early adopters may be people active in the energy services sector, familiar with the (A)EPC model, or people open for innovative solutions in general.
"Market" - Competitors
Today there should not be many competitors. Eventually both EPC project facilitators and ÈSCOs who would develop their own EPC contract could become competitors. In general EPC contracts (without flexibility) could compete with AEPC contracts. The main competition will probably come from entrepreneurs and architects implementing classical renovation projects, not based on performance models like EPC or AEPC. There are existing contracts and probably templates for that building renovation delivery model.
Go to Market – Use model
The contract template will be made available as part of a commercial development process that will lead to the signature of the AEPC contract. It could be protected by copyright. The innovative aspect lays both in the application in the residential sector (hardly any EPC projects today) and the integration of the active building control to manage the flexibility.
Go to Market - Timing
2 - 3 years depending on the market take-up and interest from ESCOs. This is among other things driven by the business case (AEPC vs. EPC, EPC vs. classical model) and availability of flexible pricing.
Go to Market – IPR Background
AEPC contract templates build on previous experience and templates for SMEs, public sector and multi-appartement co-owner models and projects. Some elements of Energinvest's smartEPC contract could potentially be included. Exploitation can be without other consortium partners but requires buy-in and proactive commitment from ESCOs.
Go to Market – IPR Foreground
Copyright. Other commercial partners like EDP would need it if they decide to exploit this type of contract template in the residential sector. In any case some synergies may exist between templates for residential and for commercial building use.

2.1.2 KER.2. ACTIVE BUILDING M&V METHODOLOGY

KER Number	**2**
KER Name	**Active building M&V methodology**
KER Nature	**Methodology**
Result Leader/Owners	**ENERGINVEST;** VITO; INESC TEC

Problem
A key aspect of any EPC arrangement is the ability to measure and verify energy (and cost savings) accurately and transparently. This is the basis of Measurement & Verification (M&V). Many principles of M&V in AEPC will be similar that in EPC, but the specifics of measuring and verifying the additional energy and cost savings due to the flexibility will be key here. The AEPC contract should contain a section on M&V or have an M&V-plan in annex. This is co-used by both parties, the building owner/user and the ESCO. The existence of a solid M&V-plan can be a criterium for an investor to finance the project.
Alternative solution
There are very few EPC projects and no EPC projects in the residential sector, but there are quite a lot in the public and commercial building sectors. Customers will not necessarily have an M&V methodology to their disposal and will probably be unaware of the need for or content of it. Only ESCOs and ESCO projects facilitator with so-called CMVPs (Certified M&V Professionals) will have some insight. The M&V methodology for residential use will have to be as easy as possible (to understand and to implement) and tuned to the residential context, but it's hard to imagine an AEPC without some kind of M&V methodology. For commercial and public buildings good M&V examples exist and they can be extended for M&V of the flexibility.
Unique Selling Point USP - Unique Value Proposition UVP
The first differentiator is that a solid M&V methodology will enable the AEPC contract. The advantage is that it enables shifting risk from the customer to the ESCO. It also objectives the savings calculations, adding trust to the project. It can facilitate third financing solutions as it turns uncertain cost savings into predictable cash flows. The main innovation lays in the M&V extension to include active building control to measure energy and/or cost savings from flexibility.
Description
The M&V methodology will be an adaptation or extension of the more classical EPC M&V methodologies, incorporating the M&V of extra energy and cost savings due to flexibility. It will be largely based on the International Performance Measurement and Verification (IPMVP-protocol developed by Efficiency Valuation Organisation (evo-world.org).
"Market" – Target market
The target markets are public, commercial, social housing and potentially residential building renovation markets. Customers are building owners and ESCOs.

"Market" – Early Adopters
Early adopters are probably existing public customers and pilot project customers. Social housing project pilot customers and the corresponding ESCOs may also become early adopters. Some ESCOs that are also electricity providers (currently 2 in Belgium) can be specific early adopters.
"Market" - Competitors
Other EPC project facilitators, with CMVP profiles, could become competitors. Some ESCOs may also decide to develop their own M&V methodology for AEPC, mainly in the commercial building renovation sector. In the public sector, requirements are mostly defined by the facilitator, i.e., by us.
Go to Market – Use model
This will be part of standard AEPC documents (tender documents, annex to contract). They will be protected by copyright. They can be included in the existing smart EPC M&V methodology that will require some extension to foster flexibility.
Go to Market - Timing
1 to 2 years.
Go to Market – IPR Background
This is building on existing M&V expertise and exchanges with other partners, in particular VITO. Possibly suggested to EVO for inclusion into IPMVP.
Go to Market – IPR Foreground
Copyright. It is required for other partners, in particular EDP.

2.1.3 KER.3 SMART AEPC BUSINESS MODEL AND METHODOLOGY

KER Number	3
KER Name	Smart AEPC business model and methodology
KER Nature	Methodology
Result Leader/Owners	ENERGINVEST

Problem
For ESCOs and ESCO project facilitators/consultants to sell, design and implement AEPC solutions a business model has to be defined, as it the basis for valorizing business potential through the combination of EPC and active building control. The main users will be ESCOs who need to be convinced of offering AEPC solutions into the market. They need to understand who are the other actors in the AEPC eco-system and which services they need to offer against which remuneration.
Alternative solution
They will probably only have worked with traditional non-performance-based business models and not have integrated flexibility. This has probably led to suboptimal solutions and not provided much room for third party financing.
Unique Selling Point USP - Unique Value Proposition UVP
The USP of the AEPC business model is the full integration of the building renovation based on a performance-based model, using functional specifications and contracts only. The UVP are the optimal energy, cost and CO2 savings for the lowest investment and operational costs = Optimal TOC, taking into account future (flexible) electricity price tariffs.
Description
The AEPC business model is delivered by the ESCO, and supported by ESCO project facilitators, as a delivery mechanism and tendering model for building renovation. In contrast to traditional renovation approaches, that are input driven and involve a dissociated chain of suppliers, the AEPC business model involves a single ESCO that works in an output-driven and highly performance-based manner. It relies strongly on performance-based maintenance concepts as the one used through the NEN2767 standard or equivalent. Based on the standard smartEPC model, it adds active control of various electricity consuming or producing equipment and exploits the potential of electrification of carbon-based solutions and the use of locally produced renewable electricity. The AEPC model exploits and optimizes the flexibility potential in buildings and extends the smartEPC performance based KPIs with specific active control related KPIs. It exploits dynamic pricing, where available, to reach additional cost and CO2 savings and optimize the business cases of existing smartEPC projects.
"Market" – Target market
The target markets are markets were EPC and/or flexibility in buildings are at least to some extent developed and in which there is a reasonable potential for performance-based EPC models like smartEPC. This requires at least the availability or use of performance-based maintenance models like NEN2767. This means that the current target market are mainly Belgium and the Netherlands. Other countries that could or would adopt the NEN2767 standard or equivalent could also become

potential target markets. In Belgium, Flanders has a slight advantage in the adoption of NEN2767 practices and of smartEPC.
"Market" – Early Adopters
BELESCO members.
"Market" - Competitors
Direct competitors are other EPC project facilitators. They do not offer smartEPC, nor smartAEPC, but one of them has developed a similar model called Building Performance Contracting. They also participate in the SENSEI project on Pay-4-Performance models that involve DR for EE. Their strengths are a solid technical know-how, a large EU network and ESCO experience (for SMEs). Their weaknesses are limited strategic capability, little market development expertise and less network in Belgium. ESCOs themselves could be potential competitors, but they rarely market specific EPC models, rather generic models. Also, they respond to projects put in the market by facilitators on behalf of end-customers. It is not in their interest to compete with facilitators, rather adopt and respond to projects put in the market by facilitators. They are rarely married with one business model.
Go to Market – Use model
The use model is the provision of a service, i.e., the facilitation of an EE service or building renovation project as a service. This involves and includes selecting, among several candidates, the appropriate ESCO to design, implement, maintain, operate and potentially finance the project. The main strength is the integration of flexibility and EE into a single EPC model. Another strength would be the use of the ABEPeM tool (1) in the (pre)design phase. The strengths are the level of integration and the level of performance-based features, the availability of standardized documents and templates and the building asset value model.
Go to Market - Timing
3 - 5 years.
Go to Market – IPR Background
smartEPC is an Energinvest copyrighted brand. ABEPeM tool would have a shared copyright.
Go to Market – IPR Foreground
Copyright.

2.1.4 KER.4 GREY BOX MODEL CREATION TOOLCHAIN

KER Number	**4**
KER Name	**Grey-Box model creation toolchain**
KER Nature	**Data-driven Software**
Result Leader/Owners	**VITO**

Problem
At the moment EPC contracts are often made using static calculations introducing measures such as insulation, installation of PV, change of a heating installation… In AmBIENCe however we aim to include also demand response and flexibility into the EPC to come to an active building EPC (AEPC). Grey-box model parameters characterize the dynamic thermal behaviour of the respective buildings which is needed to assess the impact of building flexibility. By simulating the dynamic thermal behaviour of a building, one can gain insight in the flexibility embedded in the thermal mass of the building under consideration. As such, parametrized grey box models contribute to the development of AEPC models.
Unique Selling Point USP - Unique Value Proposition UVP
The major feature of the grey box model is the ability to calculate/estimate/predict the inside temperature of a building as function of the thermal history (what happened in the last couple of hours) and a number of inputs (what will happen in the next couple of hours). The factors/inputs that affect the thermal behaviour of the building in this context are outdoor temperature, heat/cooling input to the building and solar irradiation incident on the building. The grey box models are very generic and can be used for long-term simulations in business case calculations or for short term thermal behaviour predictions in a real time building management system (model predictive control).
Description
The grey box modelling toolbox is a data driven toolbox. Based on time series data (typically of 1 year or more) in high resolution (e.g., 15 minutes) of indoor temperature data, climate conditions (temperature and solar radiation) and heat input (power of the heating/cooling) system, a grey box modelling toolbox selects the most appropriate grey box model and calculates the associated parameters. The grey box models will be used in Model Predictive Control (MPC) or long-term simulations (such as the flex value quantification tool, see KER5) allowing to calculate the value of flexibility. In AmBIENCe WP4 an automated python KPI calculation tool was developed to interpret the data included in a unifying database see D4.1 Database of Grey-Box Model parameter values.xlsx) (3). With this information a simple white-box model is constructed for each building defined in the database. These white-box models are simulated to generate data on the thermal behaviour of each building and to identify the grey-box model parameters.
"Market" – Target market
Target market: all markets that have an added value of using dynamic thermal behavior of a building; ESCO market for AEPC contracts -Customer segments: ESCOs

"Market" – Early Adopters
Innovative ESCOs that are willing to want to improve performance modelling beyond the capability of static calculation tools, e.g., to better address comfort issues like overheating, or include more flexibility measures into the EPC contract (to become an AEPC contract).
"Market" - Competitors
Consultancy firms specialised in building energy simulations to optimally design HVAC systems.
Go to Market – Use model
This functionality is considered primarily to be used in the ABEPEM context (see Deliverable 2.2, (1)). For a given design selection in relation to envelop measures (now) and HVAC system (future), a proper grey-box model will be created that can be used by the Flex Value Quantification module to predict performance with and without active control for DR purposes. It is envisaged that it as well gets integrated in a Building Energy Management System (BEMS) taking care of the operational control in the M&V phase. If sufficient interest, this functionality might be offered as a stand-alone component, either under the form of a SaaS or a sell/license.
Go to Market - Timing
See R6 ABEPEM platform.
Go to Market – IPR Background
The core functionality of the Grey-Box model creation toolchain has been developed in past projects and was introduced as background IP for AmBIENCe.
Go to Market – IPR Foreground
The background Grey-Box model creation toolchain was made fit to integrate in the ABEPEM tool and was used for the pilot building model creation and the WP4 activities. As part of its use in AmBIENCe, its usability and robustness has been increased. All this was done solely by the VITO tool experts.

2.1.5 KER.5 FLEX VALUE QUANTIFICATION MODULE

KER Number	**5**
KER Name	**Flex value quantification module**
KER Nature	**Simulation Tool**
Result Leader/Owners	**VITO**

Problem
At the moment EPC contracts are often made using static calculations introducing measures such as insulation, installation of PV, change of a heating installation… In AmBIENCe however we aim to include energy flexibility into the measures in order to support demand response in the AEPC. The Flex value quantification tool allows to analyse integrated energy performance of a building where special attention is paid to how value added by energy efficiency and demand response can be combined. As such the flex value quantification module allows to calculate a value for the flexibility offered in an AEPC contract.
Alternative solution
Typically, an excel file-based approach has been used to estimate the impact of a measure while developing an EPC contract where average energy consumption and costs per year are used. Once energy flexibility is used for demand response measures in an AEPC contract, average year values are not sufficient to calculate the cost savings, especially in indirect demand response cases. An accurate cost savings value can be achieved by means of optimization or MPC simulation with high resolution data (typically 15 minute or hour based). The solution provided is new for the customer and provides an added value.
Unique Selling Point USP - Unique Value Proposition UVP
The flex value quantification module allows to calculate all energy measures, including the ones related to flexibility and in this way offers an added value to all ESCOs that want to extend the EPC contract into an AEPC contract. Specifically, it is not limited to the quantification of the value of heating/cooling flex but can deal with multiple heterogeneous flex assets (heating/cooling, hot water production, EV charging etc.) whose operation gets coordinated in an optimal manner.
Description
Based on a grey box model (see KER4) and the data collected during the grey-box modelling a detailed optimization or MPC simulation can calculate the cost savings due to flexibility. This can be combined with traditional EPC measures and allow the ESCOs to calculate the overall operational cost savings of the AEPC project. The tool can be used in the contractual phase to define the potential saving but can also be used in the operational phase in combination with/as part of a BEMS to monitor the energy savings.

"Market" – Target market
The target market of the flex value quantification module is the innovative EPC market. The target customers of the flex value quantification module are ESCOs that want to quantify the DR valorisation potential for multiple design options including electrification, local renewable generation, flexibility, and storage. The tool support both indirect demand response measures as well as direct demand response measures.
"Market" – Early Adopters
Innovative ESCOs that are willing to include more flexibility measures into the EPC contract and in this way support introduction of renewable energy sources.
"Market" - Competitors
Not known, this is a new offer. The 'alternative' are static simulations, but they are not providing the same solutions. Static simulations are probably easier and can be done by an energy expert at the ESCO, this is not the case for the dynamic simulation with an MPC model (weakness). Despite its complexity the flex value quantification module provides a way to quantify the DR potential which seems not possible with other methods (strengths).
Go to Market – Use model
This functionality is considered primarily to be used in the ABEPEM context (see KER6). For a given and diverse set of assets (models) and scenarios, it determines the optimal coordinated control of these assets to maximize the value of active control and predict the corresponding performance. It is envisaged that it as well gets integrated in a BEMS taking care of the operational control in the M&V phase. If sufficient interest, this functionality might be offered as a stand-alone component, either under the form of a SaaS or a sell/license.
Go to Market - Timing
See R6 ABEPEM platform.
Go to Market – IPR Background
The core functionality of the Flex Value Quantification module has been developed in past projects and was introduced as background IP for AmBIENCe.
Go to Market – IPR Foreground
The background Flex Value Quantification module was made fit to integrate in the ABEPEM tool (1) and was used for the pilot building model creation and the WP4 activities, as well as numerous dissemination activities (presentations and workshops). As part of its use in AmBIENCe, its configuration functionality/front-end has been improved to facilitate the description of complex building configurations (assets and their characteristics) in a human and machine readable format (JSON) and to automatically parse such configuration information in a set of mathematical formulations for the optimisation solver. All this was done solely by the VITO tool experts.

2.1.6 KER.6 ABEPEM PLATFORM

KER Number	6
KER Name	ABEPEM platform (1)
KER Nature	Software platform
Result Leader/Owners	ENERGINVEST & VITO

Problem
It does not (yet) exist on the market a dynamic active building modelling tool that allows energy efficiency operators to model, evaluate, control, monitor and connect to the energy markets the technical and financial potential of active control of flexible assets combined with traditional energy conservation measures such as insulation, installation of PV or change in the heating or cooling system in a building retrofit project based on guaranteed savings and a total cost of ownership analysis on the length of the contract (EPC). This makes it difficult for operators (ESCOs, EPC project portfolio aggregators and EPC projects facilitators) to assess any opportunities to exploit flexibility in EPC contracts.
Alternative solution
There is no alternative solution on the market only partial solutions. Market actors can access today to well-developed Dynamic Energetic Modelling (DEM) tools/software that help them to technically model and economically evaluate a retrofit project, including flex options. Some of the modelling tools/software also offer functionalities helping the operator to commission and monitor dynamically the building when the project is implemented. Nevertheless, those modelling tools/software does not (yet): ▪ Provide modelling of actively controlled flexible assets as a dynamic component of the business case analysis in a total cost of ownership (TCO) approach; ▪ Allow to control and monitor during operations the performance of the building including the available flexibility based on the modelled design; ▪ Allow to measure and verify the guaranteed savings based on (non-)routines adjustment factors taking into account flexibility ▪ Allow to exploit the flexibility on the energy markets where dynamic pricing and aggregation services are available.
Unique Selling Point USP - Unique Value Proposition UVP
ABEPEM tool provides a comprehensive, modular and integrated set of functionalities that go well beyond the capabilities of alternative static calculations or Dynamic Energetic Modelling tools. It allows energy services providers such as ESCOs to tap the full economic potential of flexibility in active building EPC contracts (AEPC) thanks to advance features to model, evaluate, control, monitor and connect to the energy markets actively controlled flexible assets in addition to classic energy conservation measures such as insulation, installation of PV or change in the heating or cooling systems in a building retrofit project based on guaranteed savings and a total cost of ownership analysis on the length of the contract (EPC).

Description
"ABEPeM platform is a combination of six modules, including the Grey Box Module (KER 4) and the Flex value quantification module (KER 5) that serves the required calculations for designing and managing the AEPC contract. The key features of ABEPeM Platform are the following: ▪ Enables to perform dynamic active building modelling of business cases integrating timely prices or remunerative orders ▪ Enables to perform multiple active building designs evaluation and benchmarking based on forecasted scenarios ▪ Enables to perform economic and financial calculation based on forecasted scenarios ▪ Enables to set-up operational & contractual key parameters (base line definition, (non-)-routines adjustment factors, etc.) The modules composing the ABEPeM platform are fitting together in a modular and flexible platform architecture, to maximize the replication potential by enabling specific stakeholders to create their own version or flavor of specific modules and functionalities themselves, and/or include modules from specific preferred partners. Nevertheless, it is to note that currently, ABEPeM Platform is rather a “computing engine" serving as proof-of-concept and not a fully developed commercial software interface. ▪ Interface = tool (often graphical) for organizing the input data of a Dynamic Energetic Modeling tool and for organizing/visualizing the output data. ▪ Computing engine = ""real"" Dynamic Energetic Modeling software that calculates from the input data, the energy consumption and the environmental conditions in the zones."
"Market" – Target market
Key target end-users/customers are ESCOs willing to enhance their energy services offer to buildings owners by integrating the potential of native and enhanced flexibility of the buildings within their operations and particularly offer Active building EPC (AEPC) with flex options. Intermediate end-users/customers are EPC projects portfolio aggregators (e.g. public or private property/facility agency or company, a public or private one-stop-shop delivering management services including EPC contract management services) and EPC projects facilitators willing to enhance their business offer to end-customers (building owners) by integrating the potential of native and enhanced flexibility of the buildings within their operations and particularly offer Active building EPC (AEPC) aggregation and facilitation services with flex options. Entry-market end-users/customers are IT software developers and editors willing to integrate a robust “computing engine” within their suite or product offer to address the Active building EPC (AEPC) market.
"Market" – Early Adopters
Innovative ESCOs that are willing to include more flexibility measures into the EPC contract and in this way support introduction of renewable energy sources or engage in deep renovation or net-zero energy building retrofit projects.

"Market" - Competitors
Key competitors are IT software developers of Dynamic Energetic Simulation (DEM) computing engines and interfaces. Here under, a list of first players on the European market: ▪ IES-VE (ApacheSim, ApacheHVAC) ▪ Energy+ (Design Builder & ArchiWizard) ▪ TRNSYS 17 (Simulation Studio) ▪ TAS (TAS) ▪ Comfie (Comfie-Pléiades) ▪ BBS Salma (ClimaWin)
Go to Market – Use model
We identify three potential go-to-market options for introducing ABEPeM platform to the market: ▪ **Providing customers with ABEPeM platform business services at cost or license** In this go-to-market model, ABEPeM platform is not sold but exploited by the platform providers (or local partners) as a business tool to provide potential customers (ESCOs, EPC Project Portfolio Aggregators) with services at different stage of the APEC business model: ○ Pre-feasibility and feasibility study services in the pre-contracting phase ○ Contract design and deployment parameters services in the contracting phase ○ Operation & Monitoring, Measurement & Verification services in the performance phase The ABEPeM platform business services could be offered at cost per project or per man/days or under a licensing formula for a number of specific missions or projects. ▪ **Providing customers with ABEPeM platform computational engine at cost or license** In this go-to-market model, the computational engine modules of the ABEPeM platform would be provided to potential customers willing to integrate all or part of its component modules into their own Energy Efficiency software infrastructure. The services offered by the ABEPeM Platform providers would consist of training and support to adapt or integrate the computational engine within their operations. ▪ **Providing customers with ABEPeM platform full AEPC software packages at cost or license** In this go-to-market model, the computational engine modules of the ABEPeM platform would be sold or licensed to local or international software developers willing to develop and deliver complete AEPC software packages or suites to the local market. The services offered by the ABEPeM Platform providers would consist of training and support to adapt or integrate the computational engine into the developers' software suites.
Go to Market - Timing
2 to 3 years, depending on the go-to market options.

Go to Market – IPR Background
The Grey box model creation module and the Flex value quantification module were developed by VITO and rely on background IP that was available at VITO. The Economical & financial quantification module was developed by Energinvest and rely on background IP that was available at Energinvest. No background IP from other partners is needed.
Go to Market – IPR Foreground
Integration of calculation engines and supportive functionalities in a coherent ABEPEM platform.

2.1.7 OTHER EXPLOITABLE RESULTS

In addition to the KERS, the AmBIENCe project has developed other results, that although the partners do not expect to exploit them commercially, they are important to extend the concept among the stakeholders and will lay the foundation for further research, dissemination, consultancy, or services development activities. Table 3 gathers the list of the other exploitable results developed during the AmBIENCe project.

WP	R. Nº	Result Description	Main Owner
WP1	R.1	Guidelines to implementation of Active Building EPC in Europe	BPIE
WP1	R.2	Survey of directives, policies, measures and regulation that are relevant for Active Building EPC concept for the member states represented in the consortium	ENEA
WP1	R.3	Assessment of EPC/ESCO status in European Member States	ENEA
WP1	R.4	Assessment of demand response services offered by (Clusters of buildings) in European Member States	ENEA
WP1	R.5	Overview of main enablers and barriers in European Member States for the Active Building EPC	ENEA
WP1	R.6	Analysis of flexibility/DR business models with actors and roles	ENEA
WP1	R.7	Overview of EPC concepts and business models	ENERGINVEST
WP2	R.8	AEPC concept	INESC TEC
WP2	R.9	AEPC concept for collection of buildings	TEKNIKER
WP2	R.10	AEPC business model	ENERGINVEST
WP2	R.11	EFCM module (E&FCM (as part of ABEPEM tool)	ENERGINVEST
WP2	R.12	Static AEPC simulation tool	ENERGINVEST
WP2/3	R.13	Forecasting algorithms for solar generation, wind generation and electrical demand in different use cases oriented to operational phase	CEIT
WP3	R.14	Evaluation of the AEPC concept and business model implementation in the Portuguese pilot. (Best practices)	EDP
WP3	R.15	Evaluation of the AEPC concept and business model implementation in the Belgian pilot. (Best practices)	ENERGINVEST

WP4	R.16	Building stock database	BPIE
WP4	R.17	Scenario development and energy system impact calculations active control adaptation	EDP

TABLE 3 OTHER RESULTS LIST

R.1. GUIDELINES TO IMPLEMENTATION OF ACTIVE BUILDING EPC IN EUROPE

Result Number	**R1**
Result Name	**Guidelines to implementation of Active Building EPC in Europe**
Result Nature	**Guidelines**
Result Leader/Owners	**BPIE**

DESCRIPTION OF THE RESULT

The report contains policy recommendations for the implementation of Active EPCs in Europe based on the feedback from the national workshops, WP1 research, and pilot results.

The recommendations are split into regulatory, administrative, and financial barriers presented on the European level and national level (for the consortium countries – Spain, Italy, Portugal, and Belgium). The focus of the report is for policy makers at the European level, but also the national level to understand the key takeaways and recommendations for the implementation of the active energy performance contracting and associated business model.

R. 2 SURVEY OF DIRECTIVES, POLICIES, MEASURES AND REGULATION THAT ARE RELEVANT FOR ACTIVE BUILDING EPC CONCEPT FOR THE MEMBER STATES REPRESENTED IN THE CONSORTIUM

Result Number	**R2**
Result Name	**Survey of directives, policies, measures and regulation that are relevant for Active Building EPC concept for the member states represented in the consortium**
Result Nature	**Report**
Result Leader/Owners	**ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a detailed survey of directives, policies, measures and regulation that are relevant for active building EPC concept have been addressed for Italy, Belgium, Portugal and Spain. In the following, the main outcomes of the analysis are reported.

In Italy, the use of EPCs is regulated by the national Legislative Decree 102/14, which promotes the role of ESCO, as well as the use of third-party financing, and sets out the minimum information that an EPC must contain. The Decree implements the EU Energy Efficiency Directive and includes some important innovations and obligations related to energy efficiency.

The Legislative Decree 115/2008, a transposition of the 2006/32/ EC directive on energy services defines the requirements that an “energy service contract” and “energy service contract plus” must meet.

In Italy, an ESCO must demonstrate that it manages or has managed at least one EPC in order to be certified. The minimum requirements for ESCOs are defined in the national technical standard for ESCOs, the UNI CEI 11352, introduced in 2010 and re- published in 2014. The standard refers to the EN 15900 European standard on energy efficiency services. According to the standard, an ESCO acts as a quality warranty for the customer, but also for the ESCOs themselves – national and European institutions tend to promote energy efficiency of certified quality.

It is emerged that in Italy, the legal framework for consumer participation in the balancing market is not yet in place (except in some pilot projects). The only exception is the interruptible contracts programme, which is a dedicated Demand Response programme separated from the balancing market. The capacity market was launched in 2019, based on the Ministry Decree of 28 June 2019, and it anticipates the participation of demand. It uses procedures that maximize its benefits for the national electricity system, covering the necessary environmental and flexibility requirements and ensuring the participation of all useful resources – including unauthorized new capacity, demand, generation from renewable sources and capacity located abroad. The market is managed through an auction system by the Italian transmission system operator TERNA S.p.A. The regulatory framework for the participation of demand in the balancing market has been subject to substantial changes since 2017. Electricity demand reduction, and the growing share of load covered by non-programmable renewable energy sources such as wind and solar, pose key difficulties for TERNA S.p.A. in ensuring the security of the electricity system. This is why there is a need for flexible services in the ancillary service market (MSD – Mercato per il Servizio di Dispacciamento), where TERNA S.p.A. procures the resources to manage, operate, monitor and control the power system.

In Belgium, there are no specific domestic rules on EPC: only the EU directives which have been translated into regional/national law apply. Nevertheless, the Walloon region for promoting and using EPC in its Long-Term Strategy for the Renovation of Buildings EPC made a significant policy statement by including several specific measures. The Flemish region referenced EPC in its 2016 Climate and Energy Pact and its Regional Energy Efficiency Action Plan (REEAP), although without including firm targets. Existing public tendering law is well adapted to the application of EPC, and most projects use negotiated procedures within the tendering phase. In terms of policy support from national and regional governments, public authorities have mainly focused on the creation of one-stop-shops at federal level like Fedesco (although this was dissolved in 2015 for political reasons) and subsequently at regional level like Renowatt in Wallonia and the Vlaams Energiebedrijf (VEB) in Flanders. These bodies act as ESCO market and EPC project facilitators. Brussels, however, remains a blind spot in this area. When it comes to demand response regulations, the federal electricity law specifies in Art. 19bis. § 1 that end consumers are allowed to valorise their demand flexibility if this is in line with technical requirements. The transfer of energy to ensure this goes smoothly is covered by Art. 19bis. § 2. In addition, there are regional rules (for Flanders there is for instance the energy decree) which further define flexibility. However, these rules are not always clear. In this regard, the Flemish regulator VREG published two advisory documents to ensure proper interpretation of regulations ADV-2016- 1 and ADV-2017-04. With regard to the specific flexibility products, the Belgian transmission system operator Elia sets out the framework to enable participation of energy sources with different types of market players.

In Spain, the primary legislation addressing the ESCO market was the Sustainable Economy Law, Royal

Decree Law 6/2010, which included a section dedicated to the promotion of the ESCO market, while also outlining measures consistent with the European Energy Services Directive, ESD, 2006/32/ EC. With the approval of the 2008-2012 Spanish Energy Saving and Efficiency Action Plan, governmental support measures for energy efficiency include energy service companies as potential beneficiaries, with the aim of encouraging the procurement of energy efficiency services.

The national Royal Decree 56/2016 of 12 February partially transposes the Energy Efficiency Directive (2012/27/EU), mainly in relation to energy audits, accreditation systems for ESCOs, energy auditors and the promotion of energy efficiency in production processes and the use of heating and cooling.

The new Directive 944/2019, partially in place, and the new Regulation 943/2019, fully applicable from 1 January 2020, enable active customers, energy communities, aggregators and independent aggregators to play a decisive role in the electricity market. With this new regulation, the principles of a new configuration of the electricity market are established, which will provide incentives for flexible services and appropriate price signals for the energy transition. Specifically, the active customer, demand response and storage become key elements in the new regulatory framework. Regarding demand-side flexibility on the level of individual buildings, it emerges that there is no policy planned in the near future. As for the integration of energy and non-energy services the situation is more advanced, as demonstrated by the Royal Decree 107/2007 of 20 July, which approved the RITE, the Regulation of Thermal Installations in Buildings, that establishes the conditions that must be fulfilled by heating, air conditioning and hot water installations designed to meet the demand for thermal wellbeing and hygiene, in order to achieve the efficient use of energy. The adoption of Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency makes it necessary to transpose the amendments introduced by this directive into the legal system, particularly with regard to the introduction of new definitions and the modification of existing ones, such as technical installation.

In Portugal, Decree-Law nº 50/2010 of 20 May creates the Energy Efficiency Fund (EEF), aiming to finance programmes and activities to implement measures included in the National Energy Efficiency Action Plan (NEEAP). The Decree-Law creates a management structure, as already set out in the NEEAP, to support and promote the implementation of its programmes and measures, including the technical management of the Fund.

The Energy Efficiency Fund (EEF) aims to fund programmes and activities that support the measures included in the NEEAP. Under this legislative act, Ordinance nº 26/2011 was published on 10 January, defining the financial support system for measures and programmes eligible for Fund backing. This regulation is intended to coordinate the funding and support process for programmes and measures that lead to a reduction in final energy demand and help meet national energy efficiency targets.

By 2020, the Energy Efficiency Programmes in Public Administration (ECO.AP) aims to achieve a 30% improvement in energy efficiency in 32 of Portugal's public sector agencies and services. This efficiency level must be achieved without extra public expenditure, while allowing the economy to stimulate the energy services sector. The purpose of this programme is to enable the state to reduce energy consumption in its services and bodies, reduce greenhouse gas emissions and stimulate the economy, thus helping to achieve the objectives of the NEEP and the National Renewable Energy Action Plan (NREAP).

The Public Contract Regime with Energy Service Companies aims to establish a role for the public sector in the development of an energy services market, as well as to promote measures to improve end-use energy

efficiency. It regulates the use of ESCOs through a competitive tender process, allowing these companies to identify potential energy savings in buildings and public facilities and to implement procedures for enhancing energy efficiency, reducing energy bills. Decree-Law n.º 29/2011 also sets out procedures for establishing and concluding contracts between public administration bodies and ESCOs, with a clear commitment on simplified and objective models for the evaluation of proposals.

The 6th edition of Plan for Promoting Efficiency in Electricity Consumption (PPEC 2017- 2018) is now in force. Its main objective is to finance initiatives that promote energy efficiency and the reduction of electricity consumption in different consumer segments. Decree-Law 118/2013 has received the European Energy Performance of Buildings Directive (EPBD). The Decree-Law is supported with 6 ordinances and 14 orders that include the specific calculation methodology, renewable energy account, the lay-out of energy performance contracts (EPC), climate data, primary energy conversion factors and others.

R.3 ASSESSMENT OF EPC/ESCO STATUS IN EUROPEAN MEMBER STATES

Result Number	**R3**
Result Name	**Assessment of EPC/ESCO status in European Member States**
Result Nature	**Report**
Result Leader/Owners	**ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a detailed country analysis has been developed for Italy, Belgium, Portugal and Spain for investigating the current status of EPC/ESCOs, through the analysis of main regulations, directives and policies on EPC, main types of EPC implemented, and main actors involved in current EPC, and ESCO market.

Moreover, to provide a complete overview of the status of ESCO/EPC in Europe, the analysis has been extended to cover most EU Member States.

The analysis at country level for the countries represented in the consortium has allowed to identify which are the countries offering the best chances for AmBIENCe concepts and business models to succeed, what are the current gaps in legislation and market awareness that might have a significant impact in the successful deployment of the new concepts and business models, and what are the best practices in legislation and practices fostering the deployment of the proposed concepts and business models.

Six key areas have been identified for the critical assessment of the status of EPC/ESCO development, which are:

- ESCO market longevity;
- ESCO relative market size;
- ESCO market growth curve;
- ESCO relative market value;
- EPC market value;
- Implementation of EPC in various building sectors.

From the analysis, it is found that Italy is the most advanced country in the consortium related to the status of EPC/ESCO development. Indeed, thanks mainly to the strong legislative background and standards established in Italy for energy efficiency in buildings, ESCO market in Italy is still considered to be among the biggest and most developed ones in Europe.

In Italy, ESCO market development started in 2004 and today there are many associations and industry groups that serve the ESCO market in different ways. These include independent associations, such as AssoEsco and FederEsco, and representatives of utility suppliers and technology providers. In Italy, there are about 1045 Companies certified according to the UNI CEI 11352 Standard, which requires companies to have carried out at least one EPC project to be defined as an ESCO. The total turnover of the ESCOs has grown from EUR 1.3 billion in 2014 to EUR 3.7 billion in 2018. In Italy, EPCs are implemented in all the building sectors.

Italy is followed by Belgium, where the energy service market is considered stable and moderately sized, and by Spain, where the energy service market has been long awaited to boom, based on the complex set of governmental support measures.

In Belgium, real market development started in 2006 with the creation of Fedesco, the Federal Energy Services Company. The growth of turnover of EPC contracts can be estimated from a few million in 2014 to roughly 50 million euro in 2018. As the EPC market corresponds to the ESCO market for Belgium, the size is also estimated at 50 million euro. In Belgium, EPCs are implemented in many building sectors, and the public one is most developed.

In Spain, a first promotion of ESCO market was in 2010. Today, there are 1238 companies registered as ESCOs and their total turnover grew from euro 0.85 billion in 2014 to euro 1.2 billion in 2018. It is estimated that in 2018, more than 60% of the ESCOs worked with energy efficiency products different than the EPC business model and the main segment for this type of contract was characterized by offices.

Portugal is left behind the other countries represented in the consortium, with the lowest scores for the key areas investigated. Indeed, the ESCO sector in Portugal can be currently considered still underdeveloped and small. The ESCO market started to gain traction in 2010. Today, in Portugal, 30 companies are registered as ESCOs, and the total market size is estimated to be close to euro 75 million in 2018, with an annual growth rate of about 20% starting from 2014. The EPC market turnover was about of euro 30 million in 2018, and the number of companies registered as EPC facilitators or EPC providers is no more than 10.

With reference to the EPC/ESCO status in Europe, Austria, Czech Republic, Denmark, Germany and United Kingdom are characterized by a more mature market fostered by a well-developed legal framework addressing EPC contracting and a wider variety of EPC offerings and project facilitators. In detail, Germany is one of the most established markets, with strong institutional and legal frameworks.

The list of the countries with an ESCO/EPC market still in an initiation phase is much longer and, in general, it is found that these countries belong to the Eastern Europe, characterized by the lack of legal framework regarding EPCs and EPC models mainly due to policy instability and divergent political priorities. Estonia and Malta do not still have an ESCO/EPC market, whereas Finland, France, Ireland, The Netherlands, Slovakia and Sweden present a moderate-developed status for EPC/ESCO development.

R.4 ASSESSMENT OF DEMAND RESPONSE SERVICES OFFERED BY (CLUSTERS OF) BUILDINGS IN EUROPEAN MEMBER STATES

Result Number	**R4**
Result Name	**Assessment of demand response services offered by (Clusters of buildings) in European Member States**
Result Nature	**Report**
Result Leader/Owners	**ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a detailed country analysis has been developed for Italy, Belgium, Portugal and Spain for analyzing the current status of DR services, through the analysis of the implicit DR and main type of schemes implemented, explicit DR and demand access to the market to understand to which extent demand is allowed as a resource within the different national electricity markets, independent aggregators, regulations/policies supporting aggregation of distributed energy resources, etc.

Moreover, to provide a complete overview of the status of DR services offered by clusters of buildings in Europe, the analysis has been extended to cover most EU Member States.

According to the analysis, the following four key areas have been investigated:

- DR access to markets;
- Service providers access to markets;
- Product requirements;
- Measurement and verification procedures.

From the analysis at country level for the countries represented in the consortium, it is found that Belgium is the most advanced country in the consortium. Over the last years, the Belgian transmission grid operator created a new framework to enable participation of new energy sources, such as demand flexibility, with new types of market players, such as aggregators. The implementation of this framework is still ongoing, while the end-goal is to "open up the different products and services to all technologies, demand side management, storage, independently to the type of connection (TSO/DSO) and the type of provider (incl. Non BRPs)". This means that in the near future, all products will be adapted to become accessible to new future market parties.

Belgium is followed by Italy, for which the relevant regulatory framework has been subject to substantial changes starting from 2017. In fact, the Italian Regulatory Authority for Electricity, Gas and Water undertook a complete review process of the ancillary services market towards an opening to the participation of new subjects by introducing the figure of aggregator, with the aim to increase the supply of network services necessary for the national electricity system, while also integrating these new subjects more and more into the electricity system.

A totally different situation is found for Spain and Portugal, which are left behind the other countries. These countries are indeed characterized by the poorest regulatory regimes regarding DR and asset aggregation, and thus significant barriers still exist.

With reference to the development status of DR serviced offered by clusters of buildings in Europe, a specific questionnaire has been prepared by the consortium and shared with members of the European Energy Research Alliance – Joint Programme on Smart Grids (EERA JP SG), which is involved in the Advisory Board of AmBIENCe project. In detail, Greece, Cyprus, Norway, UK, Finland and France responded to the survey, whereas for the other countries, the related status of the DR services offered by buildings cluster has been constructed.

In detail, it is found that the most advanced countries in Europe are Finland and Ireland, where DR participation is allowed in multiple electricity markets thanks to the well-established regulatory framework and the positive cooperation between stakeholders (new market actors, regulators and retailers). Also in this case, the list of the countries with a development status still in an initiation phase is longer and, in general, it is found that these countries belong to Eastern Europe. These countries are indeed characterized by significant barriers such as the absence of regulation allowing the adoption of DR services, insufficient market players, the lack of economic and contractual incentives, etc. Cyprus and Estonia are closed to DR services, whereas United Kingdom, France, Norway, Sweden, Germany, The Netherlands, Austria and Denmark are partially opened. Finally, Greece, Slovenia and Poland present a preliminary development.

R.5 OVERVIEW OF MAIN ENABLERS AND BARRIERS IN EUROPEAN MEMBER STATED FOR THE ACTIVE BUILDING EPC

Result Number	**R5**
Result Name	**Overview of main enablers and barriers in European Member States for the Active Building EPC**
Result Nature	**Report**
Result Leader/Owners	**ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, the current status of European countries for implementing the Active Building EPC was assessed through a set of key areas covering aspects as ESCO/EPC status, DR services, and other factors enabling the Active Building EPC such as DER flexibility assessment for identifying the main enablers and barriers to the implementation of AmBIENCe concepts.

With reference to the countries represented in the consortium, it was found that Belgium and Italy are in a good track for receiving this enhanced EPC, being in a good position for all the key areas investigated. The main enablers found for the EPC/ESCO are the presence of a strong legislative background and standards established for energy efficiency in buildings, the very high competence of the ESCOs, the guarantee of the results making the customer reassured by the fact that the ESCO will earn only if the proposed interventions will be effective and will lead to an effective energy saving, the presence of national ESCO associations, the creation of several so-called public One-stop-shops or facilitators, etc. The main enablers for the DR services offered by (clusters of) buildings are the ongoing revision of the regulatory framework according to the concept of “technology-neutrality”, the well-established (or under revision) regulatory framework for accepting independent aggregators and for revisions of the minimum performance requirements, the standardized and clear M&V procedures for all market players with a digital meter, and the possibility of consumers’ data availability in real time. Of course, there are still some barriers to demolish for these

countries such as the contractual complexity of EPCs, the uncertainty about the type of EPC contract to be applied in the public administration, and the absence of historical monitoring data, etc.

On the other hand, Spain and Portugal need to still overcome significant barriers to receive and implement the Active EPC, mainly related to the absence of a clear regulatory framework fostering the exploitation of demand flexibility.

In general, it was found that after several years of slow growth in the EU ESCO market due to legal, financial and administrative barriers facing EPCs, there are several European efforts to support the EPC process, including the 2017 Eurostat Guidance Note and the subsequent 2018 EPC Guide to the Statistical Treatment of EPCs. However, there are still several challenges facing the ESCO market. Typically, investments that result in a meaningful emission reduction are high and show poor economic and financial KPIs (e.g., pay-back time of well over 40 year and more). Therefore, EPCs are mostly applied for public buildings, and are hardly seen with commercial or residential buildings. On the other hand, demand response has a negative impact on users' perception of comfort, especially regarding the Heating, Ventilation and Air Conditioning (HVAC) system of the building, and estimating the financial benefits is hard for non-experts. These barriers can be addressed by using innovation in several technological fields that enables improvements not only in terms of guaranteed energy cost saving, but also in terms of non-energy services such as security and comfort.

To summarize, it was found that the main barriers to implementation of AEPC are:

- Lack of flexible regulations to enable innovation and demand participation to the market;
- Low energy prices which reduce the attractiveness of EPC;
- Lack of knowledge and trust on EPC business models and providers;
- Lack of standard and enforced M&V protocols;
- Financial barriers, since there are no suitable financing schemes for the development of ESCOs and ESCO projects;
- Market barriers as:
    - limited access to the various market options for demand and DER;
    - market concentration with high entrance costs;
    - absence of a clear support scheme for fostering DER penetration in the markets;
    - no market entity, known as independent aggregator, responsible for aggregation;
- Social barriers as:
    - lack of knowledge for changing the end-user behaviour in order to provide flexibility services;
    - opacity of energy market and lack of confidence;
    - demand anaesthesia – reactive consumer.

From the analysis it is emerged that the DR programs aimed at small and medium scale customers have mostly failed to meet their expected potential. Barriers in the diffusion of DR programs, in the building sector, can come in the form of the following types of challenges.

From a political point of view, regulated utilities operate within an incentive structure that prefers building physical assets to the behaviour-dependent demand response. Incentive mechanisms are needed for the diffusion of demand response, as happens on the generation side, in order to stimulate the user to modulate withdrawals according to price changes. On the other side, wholesale markets have evolved

around supply-side resources, without giving to supply and demand equal treatment. Moreover, complex and burdensome administrative and authorisation procedures still represent an important barrier for the competitiveness of small-scale self-consumption projects for buildings.

From the technical point of view, blocks of buildings offer more flexibility in the timing of energy use, local energy generation and energy storage than single buildings, but also in this context, the potential value of DR strongly depends on the control technologies embedded in the building management systems.

Finally, the behavioural challenges depend on the awareness of the users of their own load profiles, also due to a limited adoption of monitoring systems. The lack of information of end users about the regulatory and technical framework of demand response is also a crucial barrier. Moreover, many users have no confidence in the electricity market functions because of its complexity and are quite low interested in energy related issues.

R.6 ANALYSIS OF FLEXIBILITY/DR BUSINESS MODELS WITH ACTORS AND ROLES

Result Number	**R6**
Result Name	**Analysis of flexibility/DR business models with actors and roles**
Result Nature	**Report**
Result Leader/Owners	**ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a new flexibility concept has been investigated to produce new opportunity and business for all the actors involved inside the energetic supply chain. In particular, the analysis interested the new DR business model developed in the context of building DR contracts.

The first difference relative to DR flexibility, regards the subdivision between “explicit” and “implicit” signals. When demand-side resources are negotiated on energy markets (wholesale, balancing and ancillary services and sometimes also capacity mechanisms) we talk about explicit demand, while implicit DR involves the time variation of energy prices and network tariffs since these mechanisms indicate the value and cost of energy at different points in time.

Two DR business models are actuated at different times, and both of them can involve prosumers and consumers.

In particular, for implicit DR opportunities, the prosumer can evaluate the ToU (Time of Use) tariff by itself, but also to enhance its behaviour, an ESCO support could be employed. In explicit DR, in most cases, a third party as aggregator is engaged to access to BRP (Balancing Responsibility Parties), DSO and TSO flexibility offers.

Many actors can take part in DR markets and take advantage of its beneficiary. Among the most important actors could be distinguished eight roles, which can produce important adjustments in the business model above mentioned.

- Supplier / retailer- actor are responsible for the supply of electricity to customers, thanks to the contractual agreement with the grid operator. Electricity is provided through its own generators or purchased from other producers on the wholesale market.

- Consumer - actor who employs the electricity supplied, in possession of an energy supply contract. Prosumers are defined as consumers who, possessing DER resources, can actively take part in the energetic system.
- Aggregator defined as a natural or legal individual who represents several customer loads or generated electricity for sale, in any electricity market. They also facilitate the interactions between the energy supply and consumption. Thanks to this actor function, also the DER integration is able to provide ancillary services to the grid.
- TSO represents a legal entity who operate to ensure the correct operating and maintaining of the transmission electricity grid. Among its responsibility being part also the interconnections with other system and the development of the grid in defined area. Finally, it must ensure the cooperation and the connection of all DSO belong to its area of competence.
- DSO defines the actor in charge of the operating and maintaining distribution grid, and responsible for the system interconnections and their future demand for electricity distribution.
- BRP responsible for the balance between injections and offtakes in a specific portfolio of access point.
- Energy Community is composed by several consumer and prosumer, which have benefits derived from their association. This type of aggregation could also operate in the P2P market.
- ESCO promotes and carries out energy-saving derived from renewable interventions and also provides integrated energy services to customers, to improve the energy efficiency in existing buildings and to increase the cost savings.

Based on these descriptions, AmBIENCe investigated various Flexibility/DR Business Models.

In particular, for the implicit DR, the building contract optimization, consisting in the adaption of the behaviour active building, represents the key business model.

In this case, the most important actor is the consumer and her/his energetic behaviour, that can adapt based on the different price and tariff incentives, thanks to a direct control. The energy supplier/retailer, instead, is demanded to set up a package with more dynamic energy prices. Different retail and tariff components are examined to compare (dis)advantages and zoom in on certain countries.

In the context of explicit DR, 8 business model cases are analysed to identify the actor roles and responsibilities.

In details, for explicit DR, the major actors are TSOs, DSOs and Balancing Responsibility Parties or BRPs. Besides, the aggregator also fulfils a strategic role between the prosumer and the TSO/DSO/BRP.

Finally, both explicit and implicit DR can be integrated into the existing EPC model.

R.7 OVERVIEW OF EPC CONCEPTS AND BUSINESS MODELS

Result Number	**R7**
Result Name	**Overview of EPC concepts and business models**
Result Nature	**Report**
Result Leader/Owners	**ENERGINVEST**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a description and limited analysis has been made of different variations of Energy Performance Contracting concepts and business models.

Starting from the generic EPC model, the 2 business models corresponding to performance and payment mechanisms, that are the Shared Savings model and the Guaranteed Savings model have been described.

Subsequently, most of the known and commonly used Energy Contracting types and variations have been described. They are:

- Energy Supply Contracting (ESC), and its variation Solar Supply Contracting (SSC), which is about delivering “useful” energy.
- Energy Performance Contracting (EPC), the most generic model.
- EPC Light, covering only technical installations and quick wins.
- Comprehensive Refurbishment-EPC (CR-EPC), for deep energy renovations, with 3 variations, depending on the % of building envelope measures and/or the way the ESCO is organized:
  - General Contractor CR-EPC
  - General Planner CR-EPC
- CR-EPC light
- Integrated Energy Contracting, which combines elements of EPC and ESC, with quality insurance measures.
- Maintenance and Energy Performance Contracting, which integrates a large set of maintenance activities on other installations into the EPC.
- SmartEPC, an innovative and advanced EPC model, developed by one of the AmBIENCe partners and used mainly in Belgium, today.

For each model, key characteristics and a summary of the business model has been described.

R.8 AEPC CONCEPT

Result Number	**8**
Result Name	**The Active Building Energy Performance Contract concept and methodology**
Result Nature	**Concept**
Result Leader/Owners	**INESC TEC; ENERGINVEST; VITO; CEIT**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, the Active Building Energy Performance Contracting (AEPC) concept was introduced (4), describing the key features that are different in an AEPC in comparison to classic EPC. Benefiting from the flexibility in the buildings due to increased electrification, AEPC considers both implicit and explicit demand response programs within its business model and consequently aims for improved measures.

The AEPC Concept was defined as: “enhanced modular and performance-based delivery mechanism, using the financing mechanism for the energetic renovation and optimisation of existing and new buildings, tapping into all passive and active energy and cost-saving measures, while leveraging a comprehensive set of technical, operational, usage, behavioural and dynamic energy, or CO2 pricing parameters. The AEPC concept is an enhancement of the basic EPC concept, through a strong focus on the electrification (also of the local heat supply and including mobility) and the addition of Active Control measures.” This definition and concept provide the basis of the AEPC concept and methodology.

The existing energy services value chain from the primary to the useful energy with the respective business models was defined and described. The business model was based on savings guarantees and the addition of demand response programs/flexibility, extending the value chain. The benefits and the business value through demand response activities were discussed and it was possible to describe the main important results to the stakeholders.

AEPC follows a modular approach that makes it applicable to both existing and new buildings with or without ongoing energy performance contracting. The methodology for developing an Active Building EPC was developed and described. The main steps that are needed for undertaking an active building energy performance project were presented. In this regard, the general procedure for an AEPC project was divided into three main phases:

- Pre-Contracting Phase,
- Contracting Phase,
- Performance Phase.

The Pre-Contracting Phase is the first stage for identifying a potential project. It is performed through two main steps: Pre-feasibility study and Feasibility study. The Pre-feasibility study involves collecting and analysing data related to energy users and verifying the potential of flexibility. The Feasibility study aims to uncover the strengths and weaknesses of the existing business or proposed opportunities to prospects for success. With the results of this phase, it was possible to determine if the case should be considered for an AEPC or is better suited for a classic EPC. For an AEPC success, some crucial differences could be pointed out from the classical EPC, such as the change usage pattern of flexible devices, evaluation of demand

response options, and if the payments can be covered by the cost savings from the demand response implementation.

The Contracting Phase is particularly important for a successful EPC project. The main measures and features of the contract are calculated in this phase. The main calculations and quantifications on the terms of the contract and shaping the features of an Active Building EPC can be performed. The accuracy and adequacy of terms defined in this phase will contribute to lower risks for the ESCO as well as better performance gain for the client. For AEPC success, some crucial differences could be pointed out from the classical EPC, such as demand response integration, third party implication, flexibility estimation, and demand response scenarios.

The Performance Phase refers to the period that the operational activities under the scope of the contract start until the end of the project. After the installation of the equipment and the signing of the contract, this phase starts with two main actions: operation/monitoring and measurement/verification. These two actions are ongoing processes during the whole project. Resulting from this last phase, for an AEPC project, calculation of cost savings and reevaluating the flexibility estimation could be pointed out as the main differences from classical EPC.

The AEPC concept and methodology provides the base for other results, such as the "Proof-of-Concept of an Active Building Energy Performance Modelling framework", which developed a proof-of-concept platform with various modules that serve the required calculations for designing the AEPC contract, and the "Business Models for the Active Building EPC concept", that provides the details of calculating the performance guarantees and the details on AEPC ecosystem and business models.

R.9 AEPC CONCEPT FOR COLLECTION OF BUILDINGS

Result Number	**9**
Result Name	**AEPC Concept for collection of buildings**
Result Nature	**Concept**
Result Leader/Owners	**TEKNIKER; INESCTEC, VITO, ENERGINVEST, ENEA**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, a standard collection of buildings suitable for AEPC was defined as:

- A group of buildings,
- that have a single owner,
- whereby the energy distribution between buildings is managed centrally,
- sharing the same tariff structure,
- that could share production assets,
- but not using a cooperative approach.

From a business model1 point of view, the generic AmBIENCe AEPC Business Model for collective buildings (5) applies for several buildings that have:

- A collective occupation model,
- One owner,
- An Implicit demand response,
- Several tenants involved.

The generic AEPC Business Model (is characterised by an ESCO delivering an AEPC service, consisting of guaranteed energy cost savings - based on energy efficiency and (renewable) energy supply measures and active control of flexibility to an end customer. This beneficiary is typically the owner-occupier of a commercial, public, or individual residential building (through the Association of co-owners, ACO), who will reimburse the ESCO for the investment through a periodic payment, including interests. In this generic Business Model, the Demand Response is implicit, involving only the electricity supplier who supplies electricity based on dynamic tariffs.

Based on this generic model, several real cases where a collection of building is involved have been analysed to define the characteristics of the collections of buildings business model.

The starting point is that the involvement of a group of buildings does not imply that the business model that applies differs from that of a single building.

- In the case that an ESCO implements an AEPC for a municipality in one building or in 10 buildings, the business case does not change, since the extension to 10 buildings does not mean a collective occupation as the building owner occupies all buildings. Therefore, although the contract may rule a collection of buildings AEPC, the business model it is not modified since there is no change in the business case since the owner occupies all the buildings.
- Another business model relates to a commercial owner who rents out multiple buildings, e.g., a commercial retail center, to multiple store owners. In this case, the building owner will not engage into an AEPC contract without agreeing with the private tenants to have them at least pay part of the investment or some fee based on the savings. In this case, although a collection of buildings is involved, there is no positive business case unless tenants agree to contribute to cover part of the costs.
- On the other hand, the case related to social housing is different. Social housing is inherently characterized by a collection of buildings collectively occupied, i.e., multiple social tenants each renting a single home owned and managed by the social housing company. In addition, the split of incentives between the owner and tenant changes the business model. In order to maintain a social neutrality, the way to apply the savings to the different tenants should be uniform and therefore there is no sense to make different AEPCs with the tenants.

Social housing business Model

Social housing is inherently characterised by a collecting of buildings collectively occupied, i.e., multiple social tenants each renting a single home owned and managed by the social housing company. The split of

[1] the Business Model is a description of how an organization's activity is set-up with partners and/or stakeholders to create value by delivering (and sourcing) service or product offerings to customers, while identifying financial flows between parties.

incentives between the owner and tenant changes the business model.

Collective social housing– financed by ESCO

This AEPC Business Model for cluster of buildings is characterised by an ESCO that contracts the AEPC with a single building owner, i.e., the Social Housing Company (SHC), who has several social tenants who benefit from the energy and cost savings in a neighborhood or development. In this case on top of the contracting of the AEPC, the ESCO also finances the operation to the SHC.

The role of the ESCO is similar in this social housing business model as in the basic one. The ESCO also finances the AEPC contract to the SHC. The business case for the owner of the building, the SHC is more complicated. The energy savings from energy renovation and renewable energy or cost savings from flexibility benefit entirely the social tenant (similarly as with tenants in case of privately co-owned apartments), with no real return on investment for the SHC.

Therefore, this Business Model in order to be successful, needs to have either some level of funding from the government or public authority in charge of the social housing sector financing, or some level of retribution from the social tenants.

Social housing – financed by an Umbrella Organisation

Often, the Social Housing Company may face restriction when wanting to finance investments and may be compelled to obtain financing from some internal government managed "umbrella organisation" or financial institution.

This is a very common practice in many countries that provide either subsidies or low interest loans to finance the investment. Also, this type of financing often comes with imposed savings targets (e.g., renovation to label B or A), with a restricted budget per social housing unit. This restricted budget will limit the capacities to achieve a deep renovation or to implement the best options to improve the performance. For example, this will then limit the insulation capacity and still require a gas fired boiler for heating.

As this creates a potential strong limit on the flexibility, the Business Model in this case may be more complicated to implement and the business case may turn out not to be positive for an AEPC in comparison to a standard EPC or even a Separate Contractor Based approach.

R.10 AEPC BUSINESS MODEL

Result Number	**R10**
Result Name	**AEPC Business Model**
Result Nature	**Concept**
Result Leader/Owners	**ENERGINVEST**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, the Active building Energy Performance Contracting AEPC business model was described (6), starting from a description and analysis of the AEPC eco-system, including the different stakeholders involved and their interactions.

Subsequently, the AEPC business model has been defined, which is a description of how the AEPC activities

are set-up with partners and/or stakeholders to create value by delivering (and sourcing) the AEPC service offerings to the customers (mainly building owners and managers), while identifying financial flows between the involved parties. This was done based on the Business Model drivers.

In reality, there is no single business model, but rather a generic business model that is declined into different variations of the business model.

The generic business model is shown in Figure 1:

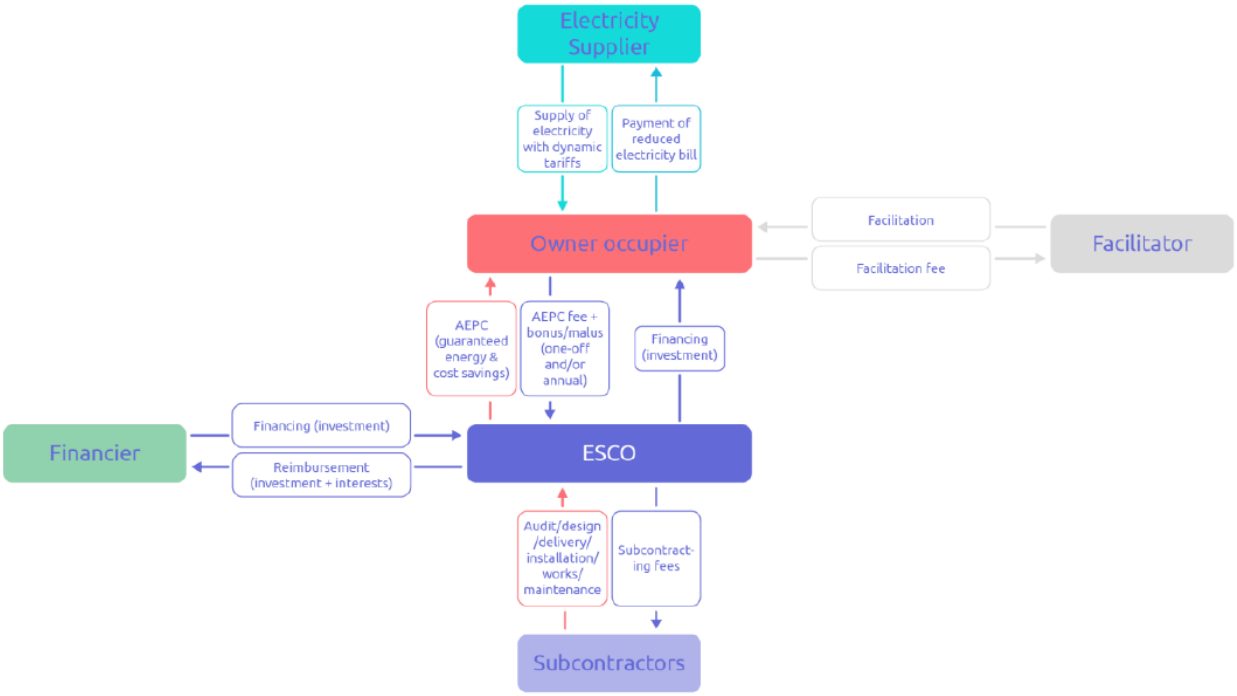


FIGURE 1 AEPC GENERIC BUSINESS MODEL

The different variations of the AEPC business model, based on different criteria, are shown in Table 4:

Building type	Occupation model	Type of DR	Owner/Tenant relation	Financing	Business Model Variations
Commercial building Public building Residential building	Individual	Implicit	Owner occupier	ESCO Financing	A.1
		Explicit (variations 1 to 5)			B.1
					B.2
					B.3
					B.4
					B.5
		Implicit		FI Financing	A.2
Residential building	Collective (ACO)			ESCO financing	C.1
					C.2
			Owner lessor & Tenant	FI Financing	C.3
				FI Financing to co-owners	C.4
Social housing	Individual Collective		Owner lessor & Social Tenant	ESCO Financing	D.1
				Umbrella Organisation Financing	D.2

TABLE 4 VARIATIONS OF THE AEPC BUSINESS MODEL

Further information can be found in Deliverable D2.3 - Business Models for the Active Building EPC concept (6).

R.11 EFCM MODULE (E&FCM (AS PART OF ABEPEM TOOL))

Result Number	**R11**
Result Name	**EFCM module (E&FCM as part of ABEPEM tool)**
Result Nature	**Calculation Tool**
Result Leader/Owners	**ENERGINVEST**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, the Economic and Financial Calculations Module (E&FCM) has been developed as an integral part of the ABEPeM, AmBIENCe's Active Building Energy Performance Modelling framework (KER 6). E&FCM builds the financial business case for an energy performance project based on AmBIENCe's Active Building Energy Performance Contracting (AEPC) concept. E&FCM's core functionality is the calculation of relevant economic and financial Key Performance Indicators (KPIs) based on the cash flows generated from investments, from changed operational expenses and changed income (savings or additional income), all resulting from quantification/estimation of energy cost cash flows. It determines thus the savings and/or revenues of the project by providing the relevant cash flows and the financial KPIs.

E&FCM supports the ESCO and other AEPC beneficiaries (Owner-Occupiers, Owner-Lessors and Lessees) in

the process of deciding whether a proposed investment in selected energy efficiency measures combined with DR flexibility makes sense from a financial and economic point of view.

The E&FCM includes the relevant cash flows, discounted to reflect the time value of money, resulting from the investment in selected energy efficiency measures and the application of active control (DR flexibility) over the analysed or observed period (usually the lifetime of the asset). It shows both the cash flows related to benefits and cost reductions such as energy savings, savings from active control, maintenance savings, additional income (when applicable) and residual building value and cash flows related to relevant expenses such as initial capital expenditures, maintenance, repairs, operating expenses, capital replacements and energy service fees.

In order to provide the additional value of DR Flexibility the E&FCM has been built on two different cash flow tables:

- the first one showing the relevant project cash flows after implementation of the Energy Efficiency Measures (EEM) only and
- the second one showing the cash flows after the implementation of DR Flexibility (active control measures), thus in addition to the first EEM only case.

The results from these two cash flow worksheets have been included in a KPI worksheet providing all financially important Key Performance Indicators of the energy efficiency project to be included in the business case of the Energy Efficiency project.
The E&FCM has been developed and implemented as an Excel workbook consisting of 12 worksheets or tabs structured in the following four groups:

- Input worksheets,
- Auxiliary worksheets,
- Cash flow worksheets,
- KPI worksheet.

Data can only be entered in the E&FCM in the different Input Worksheets. There are three input worksheets developed:

- General Input table,
- Price evolutions,
- Input Table DR_FLEXIBILITY.

The Input tabs have to be fed manually by the potential user of the E&FCM or by other ABEPeM modules such as the “Flex Value Quantification Module” (KER 5) and/or the “Configuration Form”. These Input worksheets include all necessary and required data to run the cash flow analysis in the Cash Flow worksheets and perform the calculations in the Auxiliary worksheets when the latter are applicable.

The core of the E&FCM are the two Cash flow worksheets: one showing the relevant project cash flows after implementation of the EEM only, and another showing the cash flows after the implementation of DR Flexibility (active control measures), thus in addition to the first EEM only scenario.

These two cash flow tabs feature all relevant information, on a year-on-year basis, grouped in the following cash flow groups:

- Operating income (e.g., rent income, rent charges income),
- Operating expenses (e.g., rent expense, rent charges, energy expenses and energy/DR Flexibility savings, maintenance expenses and other relevant expenses),
- Initial Outlay (e.g., capital expenditures and other initial outlays), and
- One-off Income (e.g., subsidies or grants and sales or residual value of the asset).

Both cash flow tabs also include separate financing cash flows to show the effect of the financing cash flows from ESCO (Shared Savings Agreements, First-In or First-Out agreements, …) or third-party financing, when applicable.

The data in the cash flow tabs is being obtained from the different Input worksheets and Auxiliary worksheets (for the financing cash flows) within the E&FCM tool.

The Auxiliary worksheets calculate the financing cash flows depending on the financing option chosen in the General Input table (No third-party financing, third party financing based on lending or ESCO financing) and ESCO payment models (Shared Savings, First In, First Out).

Project owners and other specific stakeholders look at KPIs and other relevant financial information when making investment decisions. E&FCM provides this relevant information in the KPI worksheet. The KPI are grouped in Investment, Energy, Financial and Other KPI.

R.12 STATIC AEPC SIMULATION TOOL

Result Number	**R12**
Result Name	**Static AEPC simulation tool**
Result Nature	**Simulation Tool**
Result Leader/Owners	**ENERGINVEST**

DESCRIPTION OF THE RESULT

Under the scope of the AmBIENCe project, and as part of the Belgian pilot project, a Static AEPC simulation tool was developed.

It allows, based on the following parameters

- Ambition level,
- Design criteria,
- Building parameters,
- Energy consumption data,
- Data on the building envelope,
- Data on the existing technical installations.

to define the energy saving measures (e.g., heat pump power, number of kWpeak PV solar panels installed, type of wall insulation, type of windows and glazing, etc.) and to statically simulate the energy savings in kWh and carbon emissions.

It allows to add investment data for the energy saving measures.

It can be regarded as a simplified energy audit model.

It would typically be complemented by a dynamic simulation, using a dynamic simulation tool like ABEPeM, integrating dynamic building consumption, comfort and pricing data, that takes as input the outputs from the static simulation tool.

R.13 FORECASTING ALGORITHMS FOR SOLAR GENERATION, WIND GENERATION AND ELECTRICAL DEMAND IN DIFFERENT USE CASES ORIENTED TO OPERATIONAL PHASE

Result Number	**13**
Result Name	**Forecasting algorithms for solar generation, wind generation and electrical demand in different use cases oriented to operational phase**
Result Nature	**Algorithms – Calculation Tool**
Result Leader/Owners	**CEIT**

DESCRIPTION OF THE RESULT

Under the scope of AmBIENCe project, different tools have been developed oriented to be used by the energy management control during the operational phase. These are:

- Very short term (10-15 minutes) forecasting algorithms, to forecast:
  - Solar irradiation and Energy generated by PV panels
  - Power generated by wind turbines
  - Electric demand.

All of them were developed based on databases of the parameters to be forecasted. The forecasting algorithms' parameters are meant to be tuned with historical data from the target location in order to increase the predictions' accuracy, although the algorithm structure can be maintained.

A tool to establish a confidence interval of the predictions made by the aforementioned forecasters.

Although several forecasting techniques have been evaluated, neural networks proved the highest accuracy and therefore this approach has been used to develop the final version of the prediction tools. Under AmBIENCe project, they have been developed in Matlab®, including its Deep Learning Toolbox. However, it would be possible to implement the resulting algorithms in a different programming language in the future, with the aim of facilitating their integration into the energy management system. It is considered that the information provided by the forecasters to the EMS would enhance the later decisions on unit commitment and dispatch, as well as demand flexibility management.

Solar irradiation and PV generation forecasting algorithm

The prognostic algorithm is a Recurrent Neural Network, with 10 hidden neurons and a 1:2 delay. It uses the irradiation values from the previous 24 h in 10 minutes intervals, the time of the day and season.

The algorithm was validated with irradiation database from Euskalmet meteorological agency. The average error for the energy generated by PV panels is 2.81% in terms of root mean square error and is below 2% on 56% of the samples.

Wind generation forecasting algorithm

The prognostic algorithm is a Recurrent Neural Network, with 10 hidden neurons and a 1:3 delay. It uses the wind power density from the previous 24 h in 10 minutes intervals, the time of the day and the month.

The algorithm was validated with irradiation database from Euskalmet meteorological agency. The average error for the energy generated is 3.75% in terms of root mean square error and is below 6% on 81% of the samples.

Energy demand forecasting algorithm

The prognostic algorithms are a Recurrent Neural Network, with 3 layers, 10 hidden neurons and a 1:3 delay. It uses the demand profile from the last 24 h in 15 minutes intervals, the time of the day and season.

The algorithm was validated with demand profile for a collection of buildings. The average error for the energy generated is 0.16% in terms of root mean square error and is below 0.5% on 97% of the samples. The accuracy of the prediction on a longer time horizon without modifying the algorithm was also evaluated.

Finally, electric demand forecasting algorithms were enhanced in order to reduce uncertainty, by combining a Feedforward Neural Network with a probabilistic interval prediction algorithm (t-Student PDF). This method provides not only the estimated demand, but also an estimation of its deviation from real value, allowing the user to choose the alpha error rate. To assess the reliability of the forecaster and the interval sharpness, different error metrics such as prediction interval coverage percentage and a skill score are computed for 0.05, 0.1 and 0.15 error rates (95%, 90%, 85% confidence intervals).

R.14 EVALUATION OF THE AEPC CONCEPT AND BUSINESS MODEL IMPLEMENTATION IN THE PORTUGUESE PILOT. (BEST PRACTICES)

Result Number	**R14**
Result Name	**Evaluation of the AEPC concept and business model implementation in the Portuguese pilot. (Best practices)**
Result Nature	**Know-how**
Result Leader/Owners	**EDP**

DESCRIPTION OF THE RESULT

Pilot results:

- A simplified dynamic thermal model of the building based on real data was developed and ran through various simulations to see how energy efficiency measures and smart control would results in cost savings;
- The ABEPeM suite of tools simulated smart heating and cooling, resulting in an additional 2% of cost savings from demand response on top of the classic energy efficiency measures;
- Data analysis from building sources highlighted potential to optimise the operation of the overall HVAC system – 3 large chillers, a heat pump, various pumps for hot and cold water and air handling units;
- The combination of energy efficiency and demand response measures result in an interesting

business model for the Portuguese ESCO to explore for future clients.

By following the Ambience and AEPC methodology in the Portuguese building context, lessons learned and best practices for future developments of the concept are developed. These mainly relate to early interventions in understanding building context and feasibility for AEPC, technical improvements for building the models that drive the contract, and stakeholder engagement activities. They can be divided into three main categories:

- Client and Stakeholder engagement activities:
  - Before the pre-contracting phase and throughout the AEPC process, client/stakeholder buy-in is key. Trust between the client and the ESCO should be established, to ensure swift communication for steps in the process and the transfer of data and information
  - Responsibilities between the ESCO, client, building manager and maintenance teams need to be clearly stipulated in the AEPC contract
  - Decision making processes can be streamlined if the potential value and benefits to all stakeholders of an AEPC is clear from the offset.
- Simplifying complex design options into clear benefits:
  - Developing a thermal model of the Portuguese pilot building is complex, with deep technical understanding of concepts required on the ESCO side. This is essential as they will be defining baselines and performance guarantees and must understand all assumptions used and associated risks to their contractual guarantees. Calculations must therefore be transparent and trustable, will all assumptions clearly have been recorded in a AEPC contract.
  - Simultaneously, the results and potential value of the proposed measures must be communicated in simplified terms and be straightforward enough for the client and associated stakeholders to understand, to streamline the contract development and signing process.
- There is potential for significant cost savings from optimising flexible building assets:
  - Implicit demand response using flexibility from smart heating and cooling and stand by optimisation of the ventilation system requires little investment cost in terms of hardware in the pilot building but can account for ~6% of annual cost savings.
  - Comparing to traditional EPCs with classic energy efficiency measures which require higher upfront investment costs, AEPCs can be more competitive, reaching new markets and decreasing payback period.

R.15 EVALUATION OF THE AEPC CONCEPT AND BUSINESS MODEL IMPLEMENTATION IN THE BELGIAN PILOT. (BEST PRACTICES)

Result Number	**R15**
Result Name	**Evaluation of the AEPC concept and business model implementation in the Belgian pilot. (Best practices)**
Result Nature	**Know-how**
Result Leader/Owners	**ENERGINVEST**

DESCRIPTION OF THE RESULT

Pilot results:

- A simplified static simulation model of the building was developed and ran to evaluate the required level of building envelope insulation, in order for the electrification of the heat supply. This includes roof, wall, door/window and floor insulation levels, size and production of roof-based PV panels and the dimensioning of an electrical heat pump for heating (and cooling) and sanitary warm water.
- A simplified dynamic thermal model of the building based on real measured data (heat production from the existing gas boiler, indoor temperatures...) was developed and ran through various simulations to see how energy efficiency measures and smart control would results in cost and CO_2 savings;
- The ABEPeM suite of tools simulated smart heating and EV charging, resulting in an additional 14.5% of (total) cost savings from demand response on top of the classic energy efficiency measures;
- The combination of energy efficiency and demand response measures result in an interesting business model for the future ESCO to explores for future clients;
- Several barriers were however identified to develop AEPC services in the residential market for this type of buildings.

By following the Ambience and AEPC methodology in the Belgian building context, lessons learned and best practices for future developments of the concept are developed. These mainly relate to early interventions in understanding building context and feasibility for AEPC, technical improvements for building the models that drive the contract, and stakeholder engagement activities. They can be divided into three main categories:

- Client and Stakeholder engagement activities:
  - Residential homeowners are difficult to engage with, without local facilitators or one-stop-shop support;
  - There is currently no ESCO-market for the residential sector. Local models like cooperative ESCOs could provide an alternative or combined offer with larger market players.
- Simplifying complex design options into clear benefits:
  - There is a need to improve the process of energy scan >> energy audit >> static simulation >> dynamic simulation;
  - Theoretical consumptions used in energy audits do not facilitate the investment decision;
  - Subsidies schemes are not well adapted to the deep renovation logic;
  - Numerous practical, esthetical and architectural constraints remain.

- There is potential for significant cost savings from optimising flexible building assets:
  - With little investment cost, an extra ~12% of annual cost savings can be achieved in the Belgian pilot building with active control: smart heating control and smart EV charging control;
  - The potential of smart EV charging, in the case of a leased employee company car is 3 times that of smart heating control.

Other learnings from the Belgian pilot are:

- The business case for a deep renovation (even with electrification) is still a large barrier for this type of building;
  - INVESTMENT = 140 k€ (probably underestimated)/ NPV = -90 k€ / PBT = 54 years / Subsidies (< 30k€) uncertain,
  - The insulation challenge is the main one;
- Without aggregation on the demand side, ESCOs will not be interested;
- The potential from flexibility/active control is interesting but seems to be more of a nice to have on top of this renovation challenge;
- This project is in competition with other functional renovation opportunities, that may create leverage for some energy measures;
  - E.g., floor insulation with change of floor, thermodynamic SWW boiler with move of electrical one;
- There is probably a need for a full accompaniment program for residential homeowners;
- Local ESCOOP models have potential but still far from coming to the market;
- ESCOs should be interrogated about their views on the residential AEPC market, knowing that today there is no EPC market;
- Focusing first on social housing or multi-apartment buildings could be a step-up strategy.

R.16 BUILDING STOCK DATABASE

Result Number	**R16**
Result Name	**Building stock database**
Result Nature	**Database**
Result Leader/Owners	**BPIE**

DESCRIPTION OF THE RESULT

The purpose of the database (3) was to describe the EU building stock by using reference buildings and to be an input for energy renovation scenarios for introducing flexible, demand response technical systems to EU buildings. The objective of the scenarios is to understand how these systems could be used for reaching the EU 2050 decarbonization goals.

The AmBIENCe's EU building stock database consists of 64 columns and more than 2000 rows. Each of these rows represent a single building stock segment and its reference building.

A reference building is a hypothetical building with different characteristics – such as size, construction

material, or energy demand – representing a single EU building stock segment, whereas a building stock segment is a part of the EU building stock defined per:

- Country, including all the 27 EU Member States
- Building use, such as apartment blocks or office buildings, and
- Building construction period, organized mostly in decades.
- For each EU building stock segment, the database provided figures for the total:
- Useful floor area,
- Number of buildings, and
- Energy demand for heating

While for each reference building, the database provides data in several groups of fields, covering:

- Building geometry (floor area, number of storeys, etc.)
- Building envelope elements details (U-Values, Thermal properties of materials, etc.)
- Results of the energy modelling and energy renovation scenario

The AmBIENCe's EU building stock database has been designed as a user-friendly tool allowing fast and intuitive analysis of the EU Building stock to anyone, especially regarding parameters such as its size, energy consumption, or energy performance of its building envelope elements.

R.17 SCENARIO DEVELOPMENT AND ENERGY SYSTEM IMPACT CALCULATIONS ACTIVE CONTROL ADAPTATION

Result Number	**R17**
Result Name	**Scenario development and energy system impact calculations active control adoption**
Result Nature	**Report and Scenario calculation tool**
Result Leader/Owners	**EDP**

DESCRIPTION OF THE RESULT

This task simulated the energy system impact of the EU-27 building stock and its decarbonization.

Different scenarios were considered in an attempt to quantify and illustrate how the adoption of active control within the building stock and its enablers contribute to successful decarbonization.

Strongly based on guidelines, the study focused on decarbonization enablers – renovation, electrification and the active control adoption. The study concluded that the associated renovation costs necessary for promoting the electrification of the building stock can amount to an accumulated value of 2.74 trillion euros. The uptake of flexibility services, such as demand response, and active control adoption within the building stock can contribute to the reduction of the European carbon intensity of around 26%, paving the way to achieve the energetic and climate targets for 2050.

3. AEPC CONCEPT AND BUSINESS MODEL BUSINESS OFFER(S)

In order to replicate the AEPC concept and business model, we need to analyse what products and services would support it and the related business offers to the market. There are several elements that were found to be key in the AEPC concept and business model.

AEPC is an EPC service in the first place and has all the characteristics of it:

- It is delivered by a (single) ESCO, in charge of design, engineering, implementation, maintenance and operations of energy saving measures;
  - An energy performance guarantee in case of underperformance;
  - Potentially a bonus in case of overperformance;
  - Use of Measurement and Verification to control the real savings in an objective and transparent way against historical savings (the "baseline"), using routine and non-routine corrections.
- The "Active control" to manage demand response (DR) or flexibility, based on some level of dynamic pricing, either implicit (through the electricity bill) or explicitly (through some remuneration arrangement triggered by DR events), defined within boundaries of comfort and/or building usage. This Active control requires a tool such as ABEPeM platform (1) or equivalent to: 1) assess and simulate the flexibility in the design phase of the project and 2) manage it in the operating phase and contribute to the Measurement and Verification of energy (cost) and CO_2 savings.
- As an opportunity to increase the flexibility potential, typically the "electrification" of heat or cold production or other non-electrical energy production or use, in combination with envelope insulation, is a key element. This will be the case in combination with local (renewable) energy production and/or local or nearby electricity storage.
- It uses methodologies, procedures and contract models to design and implement or facilitate AEPC projects, to set-up but also to advise stakeholders at various levels.

3.1 AEPC RELATED BUSINESS OFFER(S)

Based on the previous information, we can define the following AEPC related Business Offers. Figure 2 shows the different business offerings in an extended eco-system.

3.1.1 AEPC SERVICES PROVIDERS

This is the main service offering for implementing energy efficiency and cost savings in the customer's building(s) or renovating the building up to a more or less ambitious level, including the design and management of flexibility via Active control. This service is delivered by the ESCO to the building owner or building manager and sometimes to the building tenants.

3.1.2 AGGREGATION OF FLEXIBILITY/AEPC FLEX AGGREGATION SERVICES PROVIDERS

In the case of explicit DR, Aggregators or ESCOs acting as (technical) Aggregators, can offer the flexible capacity that is generated via AEPC to DSOs/TSOs, thus generating revenues that can be shared with the ESCOs and/or the building owners.

3.1.3 AEPC ADVISORY & FACILITATION SERVICES PROVIDERS

This is the service of facilitating the AEPC project set-up and contractualisation by an ESCO project facilitator to the building owner. It is often involved, particularly in the public sector, but also sometimes in the private sector, putting ESCOs into competition and selecting the ESCO that delivers the most "optimal" AEPC project following certain award criteria, like total cost of ownership or maximum CO_2 savings.

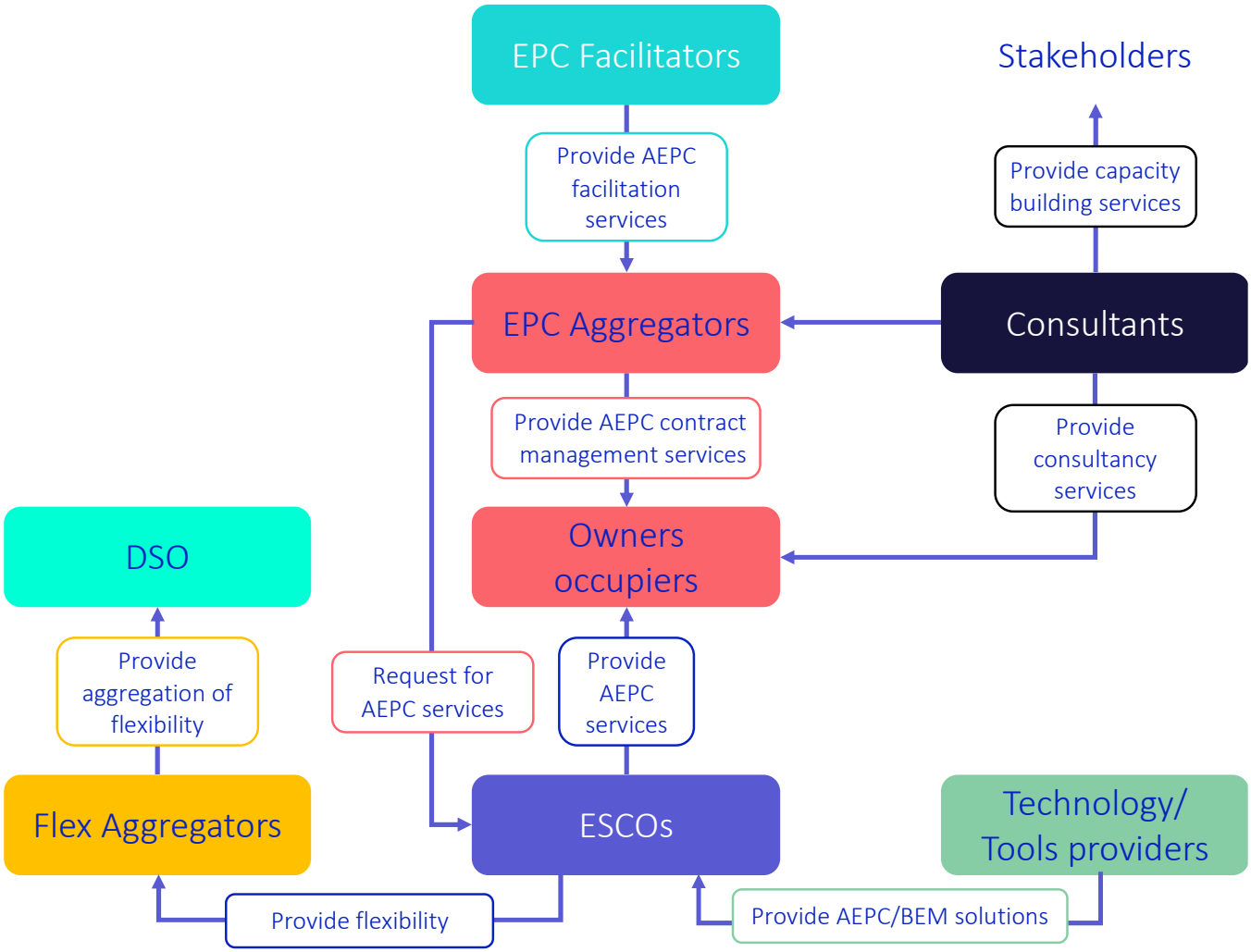


FIGURE 2: AEPC BUSINESS ECO-SYSTEM

3.1.4 AEPC CONTRAT MANAGEMENT SERVICES PROVIDERS

This is the service of contracting ESCOs for AEPC services and managing the contract on behalf of the building owner/occupier. It is generally provided by EPC project aggregators, typically, either: (i) a public property/facility management agency managing large public buildings portfolio, (ii) a property/facility management unit in large private companies or real estate investment fund, (iii) a property/facility management company delivering services to public and/or private building owners, and (iv) a public or private one-stop-shop delivering technical assistance services for energy management and building retrofit

to public and/or private building owners. This includes also property/building management agencies/units from the social and affordable housing sector delivering services to social housing facilities/companies. They generally provide contract management services for the procurement of works and services to the building owner/occupier, alongside technical assistance (in-house or third parties). They are also likely to manage budgets for structural and operational expenditure related to the building portfolio they manage.

3.1.5 AEPC TOOLS/TECHNOLOGY PROVIDERS

Various options could exist, from a stand-alone tool to a web-based tool. ABEPeM-tool (or equivalent) can be delivered by the IP holders (VITO/Energinvest in case of ABEPeM) to ESCOs. It would include some level of training in the set-up, configuration and use. It could also include the services of a tool operator in case the configuration or use requires specialized know-how that cannot be easily transferred.

3.1.6 AEPC ADVISORY AND CONSULTANCY SERVICES PROVIDERS

Consultants (often being also AEPC project facilitators) can offer various types of consultancy services to a variety of stakeholders (governments, One-stop-shops, ESCOs, large building owners), varying from strategic to technical, operational, organizational over legal or financial advice. This can be at the level of an AEPC project, an entire program on valorizing flexibility in buildings or at the level of a service portfolio or go-to-market strategy of an ESCO.

3.1.7 AEPC CAPACITY BUILDING SERVICES PROVIDERS

Capacity Building services are a specific set of consultancy services or advice aimed at supporting the market take-up or development for AEPC services, typically at a European, national, or regional level. They can include training and support to policy makers, to market actors (ESCOs, facilitators, aggregators, DSOs/TSOs) and other stakeholders (associations, federations, administrations, education sector, etc.).

Table 5 provides some key parameters for each of the AEPC related Business Offerings.

TABLE 5: KEY PARAMETERS FOR EACH OF THE AEPC RELATED BUSINESS OFFERINGS

AEPC related Business Offering	Type of offering	Type of Flexibility/DR (Implicit vs. Explicit)	Provider	Customer	Revenue type
AEPC services	Service	Implicit & Explicit	ESCO	Building owner	One-off + annual fee
AEPC Flex Aggregation services	Service	Explicit only	Aggregator (potentially ESCO)	TSO/DSO	Not yet defined
AEPC advisory & facilitation services	Service		Project facilitator	Building owner	Fixed or hourly fee
AEPC contract management services	Service		Project aggregator	Building owner	Fixed or hourly fee
AEPC Tools/Technology providers	Software & Service	Implicit & Explicit	Technology/ Tool provider	ESCO	Fixed, monthly or performance-based fee?
AEPC capacity building services	Service		Consultants	Public and private stakeholders	Fixed or hourly fee
AEPC consultancy services	Service		Consultants	Various stakeholders and market actors	Fixed or hourly fee

3.2 PLAYERS POTENTIALLY ACTIVELY COMMERCIALIZING AEPC RELATED BUSINESS OFFER(S)

There are potentially three types of players that would commercialize AEPC related business offerings: ESCOs, EPC project facilitators and EPC project aggregators. AEPC project facilitators and AEPC project aggregators need of course ESCOs to deliver the AEPC services, but since they are often the primary customer focusing entity, it makes sense to consider them separately. One can say that ESCO project facilitators "sell" the AEPC concept to the customer (building owner), but also "sell" their capacity to put it in place in an efficient way, adding facilitation services on top of it. They need to sell the underlying AEPC services or take away key barriers that ESCOs face when selling (A)EPC services. EPC project aggregators on the other hand generally provide their contract management services to building owners alongside the EPC facilitators, relying on their facilitation services to implement AEPC services. They play a key role in deciding on the implementation of AEPC services in the portfolio of buildings they manage. They could also "sell" the flexibility that is made possible by AEPC services to Transmission and Distribution System Operators (TSOs/DSOs) or become "distribution channels" for the ESCOs that want to do explicit DR. This diversity of players seems to indicate that there is no single AEPC business offering but several "related" business offerings.

3.3 ABEPEM PLATFORM AS A PRODUCT

ABEPeM platform is a dynamic active building modelling tool that allows the technical and financial potential of actively controlled flexible assets in an EPC project to be modelled, evaluated, controlled, monitored and connected to the energy markets, based on guaranteed savings and TCO business cases. Thanks to the ABEPeM platform, the energy services market is able to offer customers AEPC integrating active control and building flexibility.

The ABEPeM platform enables forecasting the performance impact of a given design option compared to the baseline building's performance, including the quantification of additional DR savings and value streams from active control of flexible assets from a scenario-based model. This is combined with IPMVP-based M&V functionality to support performance guaranteeing and AEPC contractual settlements, based on efficient and transparent (non-)routine adjustment factors.

The Deliverable D2.2 "Proof-of-Concept of an Active Building Energy Performance Modelling framework" documents the proof-of-concept version of the ABEPeM (Active Building Energy Performance Modelling) platform that supports the Active Building Energy Performance Contracting (AEPC) concept and methodology (1).

3.3.1 DESCRIPTION OF THE ABEPEM PLATFORM

The ABEPeM platform is composed of a number of well-defined modules that serve the required calculations for designing the AEPC contract. The main methodology deployed by AEPC is enhanced by effective methods that are implemented in the ABEPeM platform. The detailed description of the platform is described in deliverable D2.2 – Proof-of-Concept of an Active Building Energy Performance Modelling (ABEPeM) framework (1). However, in this chapter, the main modules of this platform and how they are used in the process of AEPC are briefly presented. The interactions between the modules of the ABEPeM

are shown in Figure 3.

The main modules of the ABEPeM platform are:

- Energy Cost Cashflow Quantification module;
- Configuration Form;
- Flex Model creation modules;
- Economic/financial calculation module;
- Scenario Creation module;
- Scenario-based forecast creation module.

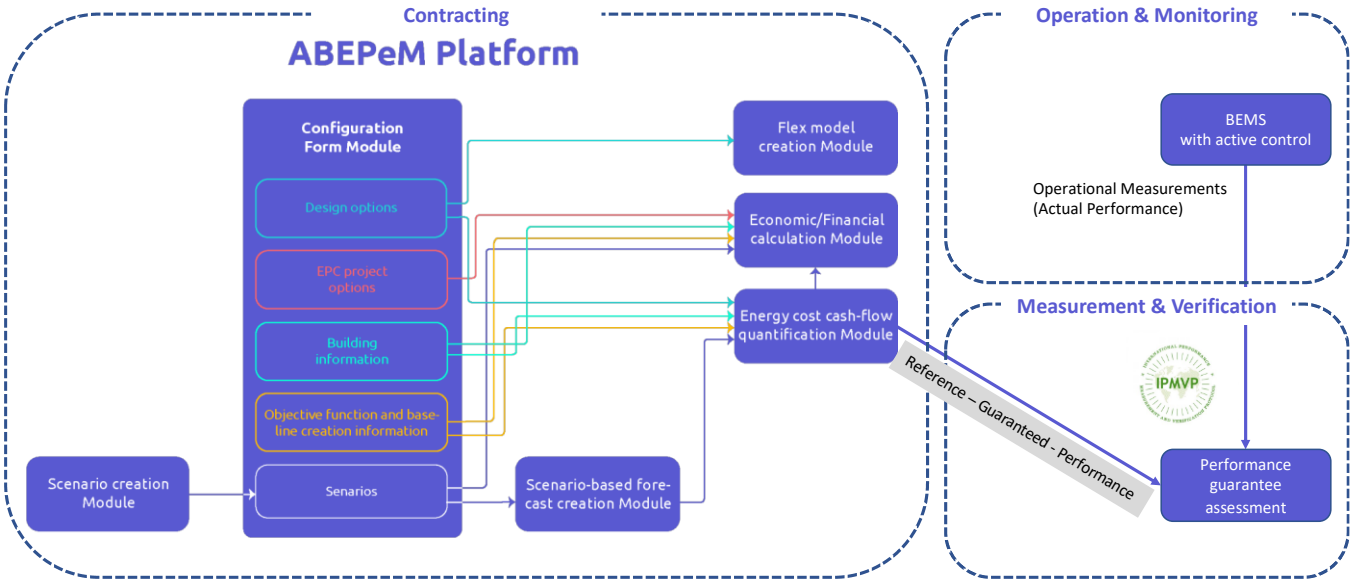


FIGURE 3: ABEPEM PLATFORM KEY MODULES/FUNCTIONALITIES AND ITS PLACE IN THE AEPC PROCESS

1. The Energy Cost Cash-flow Quantification Module

The Energy Cost Cash Flow Quantification module performs the scenario-driven model-based performance quantification. It provides a scenario-driven model-based quantification of a building's energy cost through optimization using a model predictive control (MPC) method. This module gives the optimal power consumption profile with appropriate temporal resolution. The temporal resolution mainly assumes high resolution as the objective of the optimization is to manage the energy consumption in the building considering the flexibility requirements/availability as well as the DR activities. This module supports the ESCO in calculating the energy consumption profile according to the energy efficiency measures and DR/Flexibility measures and its outputs are considered as inputs for calculating the energy cost profile and emission profile calculations.

2. Configuration form

The configuration form collects all relevant project information including design options and scenarios. It provides the template for acquiring the required inputs for the energy cost cash flow quantification module, the Flex Model Creation module, and the Economic/Financial KPI Calculation module.

It includes several excel sheet forms gathering several information including:

- The EPC project options information including beneficiaries, contract duration, total investment, etc.;
- Building information;
- Measures information including associated investment costs;
- Optimization objective;
- Scenario information including price scenarios.

3. Flex model creation module

The Flex Model creation module creates the necessary building and asset models that are required for the scenario-driven model-based performance quantification. The purpose is to determine relevant flex-characterization parameters of the building and selected flexible assets.

4. Economic/financial calculation module

The Economic/Financial Calculation module determines the relevant financial and economic KPIs to compare the impact of selected design options. It supports the ESCO and other AEPC beneficiaries in the process of decision-making for investment in the selected energy efficiency measures, combined with DR flexibility from a financial and economic point of view. This module has a key role in the process of AEPC development, because it determines the savings and revenues of the project by providing the relevant cash flows and the financial KPIs.

5. Scenario creation module

The Scenario Creation module provides the scenario that will be used in the performance quantification and for which the performance could be guaranteed.

6. Scenario-based forecast creation module

The Scenario-based Forecast Creation module creates, from the selected scenario a forecast that will be used for the performance quantification. It provides forecasts of the scenarios created in the above-mentioned module. These forecasts are being used in the optimization model, to avoid over-optimistic performance results. The forecast categories are the following:

- In the contracting phase, scenario-based forecasts are created from scenarios and are used as forecast inputs to the scenario-based model-driven MPC optimization. The scenarios themselves are used as forecasts of actual future conditions in the not all-knowing digital twin simulation.
- In the operational phase, operational forecasts are created by forecasting algorithms/models as input for the active control decisions.

3.3.2 KEY FEATURES OF ABEPEM PLATFORM

In addition to existing modelling tools traditionally used in Energy Performance Contracting, the ABEPeM platform offers the following advanced features, see Table 6.

TABLE 6: FUNCTIONALITIES OF THE ABEPEM PLATFORM

Functionalities	Description
Dynamic active building modelling integrating DR timely prices or remunerative orders	ABEPeM enables modelling the design of EPC building retrofit projects integrating the energy cost-benefit (€ & CO_2) of actively controlled flexible assets into business cases based on a total cost of ownership approach with the objectives of linking the business case to guaranteed savings. This allows designing AEPC building retrofit projects combining energy savings (kWh) from classic demand-side energy efficiency measures, including passive envelope measures, with additional energy/CO_2 cost savings and earnings (€) resulting from the operational active control of existing or newly installed flexible assets leveraging price-based incentive energy supply contracts (Implicit Demand Response), price-based incentive modulation orders (Explicit Demand Response) or trading of CO_2 emissions.
Multiple active building designs evaluation & benchmarking based on forecasted scenarios	ABEPeM enables to evaluate multiple building retrofit scenarios-based forecast to predict AEPC business cases from various design and flexible assets activation options and compare them not only with the (adjusted) baseline performance (i.e., before measures), but also with each other: e.g., compare a deep renovation versus a mild renovation with electrification and Demand Response (DR).
Economic & financial calculation based on forecasted scenarios	ABEPeM enables to determine the relevant financial and economic Key Performance Indicators (KPIs) to compare the impact of selected design options and assess the different options to finance the project's costs, including options that allow for a third party to pay upfront for the necessary investments while being reimbursed over the contractual time.
Setting-up of operational & contractual key parameters for the chosen scenario	ABEPeM enables to set-up key parameters based on the technical and operational characteristics of installations as well as efficient and transparent (non-)routine adjustment factors to define contractual clauses like external demand response activities and price-based agreements and adapt existing ones according to the AEPC. Key parameters are also used for controlling the flexible assets during operations and adjusting the performance guarantee in the M&V procedure, allowing the delivery of active building energy services based on modelling.
Operational forecasts to support active control of flexible	ABEPeM enables to create operational forecasts of energy consumption and flexibility loads as inputs for the implementation of active control of flexible assets, aiming to take advantage of the full economical potential of flexibility

assets during operations	during AEPC operations. The forecasts are created by a forecasting algorithm/model using the key parameters set-up in the contractual phase.
Measurement & Verification of AEPC guaranteed savings	ABEPeM enables monitoring the performance of the active building operations based on the M&V parameters set-up in the contractual phase.
Integration to energy & CO_2 markets	ABEPeM enables the integration of the operations of the buildings to the energy & CO_2 markets by activating the dynamic pricing and aggregation services based on timely prices or remunerative orders.

3.3.3 REPLICATION POTENTIAL AND LIMITATIONS OF THE ABEPEM PLATFORM

The modules composing the ABEPeM platform fit together in a modular and flexible platform architecture, to maximize the replication potential by enabling specific stakeholders to create their own version or flavour of specific modules and functionalities themselves, and/or include modules from specific preferred partners. Nevertheless, it is to note that currently, ABEPeM Platform functionalities are being tested in pilot projects and are still to be submitted for validation. Another limitation for replication is that ABEPeM Platform is rather a “computing engine" serving as proof-of-concept and not a fully developed commercial software interface, as:

- Interface is a tool (often graphical) for organizing the input data of a Dynamic Energetic Modeling tool and for organizing/visualizing the output data.
- Computing engine is a "real" Dynamic Energetic Modeling software that calculates from the input data, the energy consumption and the environmental conditions in the zones.

3.4 TARGET MARKETS OF ABEPEM PLATFORM

3.4.1 ENERGY SERVICES COMPANIES OFFERING GUARANTEED AND SHARED SAVINGS CONTRACTS TO BUILDING OWNERS

The key target end-users/customers of the ABEPeM platform are ESCOs that want to quantify the DR valorisation potential for multiple design options including electrification, local renewable generation, flexibility and storage, and combine these results with an economic and financial analysis, embedded in an energy performance contracting concept. ABEPeM platform would allow them to enhance their energy services offer to buildings owners, by integrating the potential of native and enhanced flexibility of the buildings within their operations and particularly offer AEPC with flex options.

Unique Selling Point (USP) - Unique Value Proposition (UVP)

ABEPeM platform allows energy services operators to tap the full economic potential of flexibility in buildings thanks to advanced features to model, evaluate, budget, finance, control, monitor and integrate actively controlled flexible assets in building retrofit design projects, based on guaranteed savings and TCO. The competitive advantages are the following, see Table 7:

TABLE 7: ABEPEM PLATFORM COMPETITIVES ADVANTAGES FOR ESCOS

Design phase	Operational phase
▪ Modelling: enables to model active control of flexible assets in the design of a retrofit project at a building level or group of buildings. ▪ Evaluating: enables to evaluate several buildings retrofit scenarios and compare their payback time. ▪ Budgeting: enables to evaluate costs, savings and financing options of several building retrofit scenarios with a view to optimizing the TCO for the client. ▪ Setting up: enables to set the key parameters for establishing the contractual agreements, controlling the flexible assets during operations, and adjusting the performance guarantee in the M&V procedure.	▪ Forecasting & controlling: enables to produce forecasts of energy consumption and flexibility loads in view to support active control of flexible assets during operations. ▪ Measurement, reporting & Verification: enables to measure, report and verify energy savings based on the M&V parameters set-up in the design phase. ▪ Energy markets integration: enables to contract dynamic pricing, modulation orders (DR) and selective load shedding on external requests.

3.4.2 EPC PROJECTS AGGREGATORS OFFERING CONTRACT MANAGEMENT SERVICES TO BUILDING OWNERS

Intermediate end-users/customers of the ABEPeM platform are EPC project aggregators that want to evaluate the DR valorisation potential within their project's portfolio in view to optimize their capital investment in assets upgrade and renovation and thereby the related cost of ownership for their customers (occupants and tenants).

Unique Selling Point (USP) - Unique Value Proposition (UVP)

ABEPEM platform allows EPC projects aggregators to assess, for contracting and management purposes, the economic potential of flexibility in buildings or groups of buildings thanks to advanced features to model, evaluate, budget, monitor and integrate actively controlled flexible assets in building retrofit design projects based on guaranteed savings and TCO. The competitive advantages are the following (see Table 8):

TABLE 8: ABEPEM PLATFORM COMPETITIVES ADVANTAGES FOR EPC PROJECT AGGREGATORS

Assessment phase	Operational phase
▪ Modelling: enables to model active control of flexible assets in the design of a building retrofit project. ▪ Evaluating: enables to evaluate several buildings retrofit scenarios and compare their payback time. ▪ Budgeting: enables to evaluate costs, savings and financing options of several building retrofit scenarios with a view to optimizing the TCO for the client. ▪ Setting up: enables setting the key parameters for establishing the contractual agreements and adjusting the performance guarantees in the M&V procedure. This could serve to prepare an AEPC tendering.	▪ Forecasting & controlling: enables to produce forecasts of energy consumption and flexibility loads in view to support active control of flexible assets during operations. ▪ Measurement, reporting & Verification: enables to measure, report and verify energy savings based on the M&V parameters set-up in the design phase. ▪ Integrating: enables to contract dynamic pricing, modulation orders (DR) and selective load shedding on external requests.

3.4.3 EPC PROJECTS FACILITATORS OFFERING CONTRACT FACILITATION TO BUILDING OWNERS/EPC PROJECTS PORTFOLIO AGGREGATORS

Intermediate end-users/customers of the ABEPeM Platform are EPC project facilitators willing to enhance their business offer to end-customers (building owners) by integrating the potential of native and enhanced flexibility of the buildings within their operations and particularly offer advanced EPC facilitation services with flex options. The competitive advantages are the following (see Table 9):

TABLE 9: ABEPEM PLATFORM COMPETITIVES ADVANTAGES FOR EPC PROJECT FACILITATORS

Assessment phase	Operational phase
▪ Modelling: enables to model active control of flexible assets in the design of a building retrofit project. ▪ Evaluating: enables to evaluate several buildings retrofit scenarios and compare their payback time. ▪ Budgeting: enables to evaluate costs, savings and financing options of several building retrofit scenarios with a view to optimizing the TCO for the client. ▪ Setting up: enables setting the key parameters for establishing the contractual agreements and adjusting the performance guarantees in the M&V procedure. This could serve to prepare an AEPC tendering.	▪ Forecasting & controlling: enables to produce forecasts of energy consumption and flexibility loads in view to support active control of flexible assets during operations. ▪ Measurement, Reporting & Verification: enables to measure, report and verify energy savings based on the M&V parameters set-up in the design phase. ▪ Integrating: enables to contract dynamic pricing, modulation orders (DR) and selective load shedding on external requests.

3.5 AEPC/ABEPEM PLATFORM BUSINESS OFFER VALUE PROPOSITION

As described, AEPC concept and business model is a methodology and a tool to implement AEPC services. It builds on an enhanced methodology for developing active building EPC projects and ABEPeM Platform, an advanced dynamic active modelling tool allowing to quantify, value, predict, control, monitor, measure and verify the flow of electrical flexibility financial savings (and associated CO_2 financial savings) combined to savings from other passive (envelope insultation) and active (technical systems) energy conservation measures in the design and contracting of an EPC project. The following sections describe the AEPC & ABEPeM Platform value propositions for the three key target markets: ESCOs, EPC project facilitators and EPC project aggregators.

3.5.1 AEPC/ABEPEM PLATFORM BUSINESS OFFER VALUE PROPOSITION FOR ESCOS

By combining both demand-side energy efficiency and DR measures to maximise the revenues that are available from the active control of flexible energy assets, AEPC projects provide improved Return On Investment (ROI) and thereby reduce the payback times of the investment, making EPC projects more attractive to a wider range of building owners. In a similar way, projects that were rejected due to long payback times would become more bankable, thanks to the additional revenues linked to the active control of flexible assets. Dynamic ABEPeM feasibility simulation performed in the Belgian Pilot project (deep retrofit of a residential house with integration of heat pumps, smart charging and smart heating assets) show that cost savings could potentially increase up to 20%, when integrating demand response flexible assets in addition to energy efficiency measures. These financial improvements could help ESCOs to engage more and diversified customers in performance and guaranteed energy savings contracts. In the case of

ESCO financing, higher returns also increase the ability of ESCOs to finance more projects, while the ABEPeM platform, by accurately allocating costs and revenues, offers the possibility of attracting third party investors to finance the capital cost for the whole project or the additional investments in flexible assets. At a larger scale, the aggregation of flexibility loads on an AEPC projects portfolio level offers ESCOs the perspective to become active players on the electricity markets, as technical aggregators. This offers new opportunities to increase ESCOs profit margins and reduce risk, by developing a new commercial revenue stream.

In addition to these financial benefits, ESCOs will also improve their technical skills and operational efficiency, designing more advanced and reliable projects, thanks to the ABEPeM platform modelling functionalities without investing significant resources or funds. They will be also able to actively control the flexible energy assets during operations using the forecasting functionalities of ABEPeM platform as well as easily monitor and adjust the performance guarantee thanks to the accurate definition of the baseline and key parameters for the M&V procedure provided by the ABEPeM algorithms. This allows them to offer a wider range of services to their customers, including the expertise to engage into deep renovation or net-zero energy building markets, where integration of renewable energy and electric mobility, electrification of heat and cooling, and flexibility are standard requests and will further become the growing markets in the years to come.

TABLE 10: AEPC/ABEPEM PLATFORM BUSINESS OFFER BENEFITS FOR ESCOS

Categories	Benefits
Technical	▪ Integrate active control and flexibility into the services portfolio with minimal investments ▪ Optimizing overall performance of the building retrofit design to maximize all energy assets revenues ▪ Reliable method to establish the baseline & M&V procedures with flexible assets
Commercial	▪ Increased market potential, including development in the deep renovation and net-zero-energy-building markets ▪ Offering a wider range of services through AEPC ▪ Potential access to the aggregation market
Financial	▪ Improved ROI ▪ Shorter contract terms thanks to shorter pay-back times ▪ Improved access to third parties' investors ▪ Increased financial revenues through potential access to the aggregation market

3.5.2 AEPC/ABEPEM PLATFORM BUSINESS OFFER VALUE PROPOSITION FOR EPC PROJECT AGGREGATORS

From a financial point of view, property and building managers have substantial gains from moving to the AEPC business model with active control of flexible assets for upgrading their buildings portfolio. Not only will they improve the cost of ownership for their customers (occupants or tenants) through reducing energy bills, reducing CO_2 tax liability and accessing revenues from demand response markets, but they will also help them to improve the sustainability of their operations and fulfil their corporate social responsibility obligations by being part of the energy transition. The financial benefits translate also to shorter payback times making more projects bankable in the same budget envelope and the ability to allocate capital to most promising projects while being able to call for third party financing for the whole or partial funding of the projects.

In the long-term objectives for greener buildings, AEPC also offers a clear pathway to engage efficiently with in-deep renovations and net-zero energy building projects for which integration of renewable energy and electric mobility, electrification of heat and cooling, and flexibility are standard requirements and will further become mandatory in the years to come. For property managers, the ability to provide customers with greener buildings with optimized ownership costs over time is a key competitive advantage in an increasingly demanding property market. AEPC would allow them to preserve the building value over time and avoid brown discounts when having to renew their rent or occupation agreements or to sell the property.

In addition to these financial benefits, property and building managers will also improve their technical skills and operational efficiency, having the possibility to integrate within their operations the assessment process to upgrade their building portfolio with actively controlled flexible assets thanks to the ABEPeM platform modelling and evaluation functionalities, without investing significant resources or funds. The ability to perform multiple design evaluations for a single building or group of buildings allows them to speed up the development and selection process of bankable projects to be undertaken, while optimizing the limited capital resources available for upgrading and renovating their property portfolio. The economic and financial functionalities of the ABEPeM platform can also help them to better assess the CAPEX and OPEX of projects and the capital and budgetary resources required before committing to these projects. They can also assess the possibility of using third-party financing for all or part of the required investment and the impact on the business case. Furthermore, when moving from AEPC assessment to AEPC contracting with potential ESCOs, ABEPeM platform algorithms also provide property and building managers with an accurate definition of the baseline and the key parameters to use for the M&V procedures in view to support the tendering and negotiation of the contract value and terms with the ESCOs. This improves the speed and quality of the tendering process and the ability to negotiate the best offer. Finally, when operating the AEPC contract, property and building managers can also monitor the performance of the ESCO through the forecasting capabilities of the ABEPeM platform and partner up with the ESCO to leverage maximum value from the flexible assets over time without affecting the comfort and health conditions for the occupants or tenants.

At a larger scale, the aggregation of flexibility loads on an AEPC projects portfolio level offers the property and building managers the potential perspective to become active players on the electricity markets, as flexible loads providers to market aggregators, with there again the use of the ABEPeM platform to determine the key parameters required for the contractual settlements. This offers new opportunities to

increase the financial return of the flexible assets and further reduce the cost of ownership (see Table 11).

TABLE 11: AEPC/ABEPEM PLATFORM BUSINESS OFFER BENEFITS FOR EPC PROJECT AGGREGATORS

Categories	Benefits
Technical	▪ Integrate active control and flexibility into the services portfolio with minimal investments ▪ Optimizing overall performance building design to maximize all energy assets revenues ▪ Support long term renovation objectives ▪ Agreeing on the method to do baseline and M&V
Commercial	▪ Offering a wider range of services through AEPC ▪ Potential access to the aggregation market
Financial	▪ Improved ROI of projects ▪ Shorter contract length ▪ Improved global capacity to finance projects ▪ Increased financial benefits through potential access to the aggregation market

3.5.3 AEPC/ABEPEM PLATFORM BUSINESS OFFER VALUE PROPOSITION FOR EPC PROJECT FACILITATORS

From a commercial point of view, EPC project facilitators have substantial gains from moving to the AEPC business model with active control of flexible assets for supporting their customers when upgrading their buildings portfolio. Simply, the ability to provide customers with a new contracting methodology and supportive services delivering greener buildings with optimized ownership costs over time is a key competitive advantage in a demanding energy services market. Not only will they support customers to improve the cost of ownership of their buildings through reducing energy bills, reducing CO2 tax liability and accessing revenues from demand response markets, but they will also help them to improve the sustainability of their operations and fulfil their corporate social responsibility obligations by being part of the energy transition. The financial benefits of the AEPC business model translate also for their customers to shorter payback times making more projects bankable in the same budget envelope and the ability to allocate capital to most promising projects while being able to call for third party financing for the whole or partial funding of the projects.

In the long-term objectives for greener buildings, AEPC also offers a clear pathway to engage efficiently with in-deep renovations and net-zero energy building projects for which integration of renewable energy and electric mobility, electrification of heat and cooling, and flexibility are standard requirements and will further become mandatory in the years to come. AEPC business model and ABEPeM Platform would allow them to preserve the building value over time and avoid brown discounts when having to renew their renting or occupation agreements or to sell the property.

This is made possible by AEPC's business model which offers higher returns on investment to the customer compared to traditional EPC and the ability to provide customers with robust business cases built and managed on the ABEPeM platform. Building on the integration within their services of the assessment process to upgrade building portfolios with actively controlled flexible assets thanks to the ABEPeM platform modelling and evaluation functionalities, EPC project facilitators will be able to provide customers with full AEPC services without investing significant resources or funds. The ability to perform multiple design evaluations for a single building or group of buildings allows them to speed up the development and selection process of bankable projects to be undertaken while optimizing the limited capital resources available for upgrading and renovating customer property portfolio. The economic and financial functionalities of the ABEPeM platform can also help them to better assess the CAPEX and OPEX of projects and the capital and budgetary resources required before committing to them. They can also assess the possibility of using third-party financing for all or part of the required investment and the impact on the business case. Further, when moving from AEPC assessment to AEPC contracting with potential ESCOs, ABEPeM platform algorithms also provides EPC project facilitators with an accurate definition of the baseline and the key parameters to use for the M&V procedure in view to support the tendering and negotiation of the contract value and terms with the ESCOs. This improves the speed and quality of the tendering process and the ability to negotiate the best offer. Finally, when operating the AEPC contract, EPC project facilitators can also monitor the performance of the ESCO through to the forecasting capabilities of the ABEPeM platform and partner with it to leverage maximum value from the flexible assets over time without affecting the comfort and health conditions for the occupants or tenants of their customers.

At a larger scale, the aggregation of flexibility loads on an AEPC projects portfolio level offers the EPC project facilitator the potential perspective to support its customers in becoming active players on the electricity markets, as flexible loads providers to market aggregators, with there again the use of the ABEPeM platform to determine the key parameters required for the contractual settlements. This offers new opportunities to EPC project facilitators to increase the financial return of the flexible assets and further reduce the cost of ownership for their customers (see Table 12).

TABLE 12: AEPC/ABEPEM PLATFORM BUSINESS OFFER BENEFITS FOR EPC PROJECT FACILITATORS

Categories	Benefits
Technical	▪ Integrate active control and flexibility into the services portfolio with minimal investments ▪ Optimizing overall performance building design to maximize all energy assets revenues ▪ Speed up the tendering process ▪ Support long term renovation objectives ▪ Agreeing on the method to do baseline and M&V ▪ Monitoring the performance along the contract
Commercial	▪ Offering a wider range of services through AEPC ▪ Support customers to engage in deep renovation
Financial	▪ Generate new and higher revenues

3.5.4 SWOT ANALYSIS FOR THE DIFFERENT ACTORS

Table 13 offers a summary of the value propositions for the different actors.

TABLE 13: SWOT ANALYSIS FOR THE DIFFERENT ACTORS

Stakeholders	S	W	O	T
ESCOs	▪ Possibility to enlarge the business with DR services ▪ Limited or positive impact on the core business ▪ Pivotal role in the DR market in buildings ▪ To leverage on the existing customer basis	▪ Necessity to invest for acquiring adequate know-how in AEPC ▪ They may lack resources (marketing staff or IT systems or M&V support) to offer AEPC services. ▪ Lack of awareness of end-users	▪ To increase client revenues ▪ Get new clients ▪ Possibility to enter new market niches ▪ Competencies, skills and knowledge are already there	▪ New competitor could appear ▪ Necessity to manage more complex processes ▪ They may not have a proper access to DR offering on the market, which may lead to greater difficulties to design projects with a positive business case.
EPC Project Facilitators	▪ Possibility to enlarge the business with DR services ▪ Limited or positive impact on the core business ▪ To leverage on the existing customer basis	▪ Necessity to invest for acquiring adequate know-how in AEPC ▪ They may lack resources (marketing staff or IT systems or M&V support) to offer AEPC services.	▪ Get new clients ▪ Possibility to enter new market niches ▪ Competencies, skills and knowledge are already there ▪ It can constitute a way to differentiate themselves from others	▪ New competitor could appear ▪ Necessity to manage more complex processes
EPC Project Aggregators	▪ Possibility to enlarge the business with DR services ▪ Limited or positive impact on the core business ▪ To leverage on the existing customer basis	▪ Necessity to invest for acquiring adequate know-how in AEPC ▪ They may lack resources (marketing staff or IT systems or M&V support) to offer AEPC services.	▪ To reduce operational costs of buildings while increasing the building value ▪ Part of competencies, skills and knowledge are already there.	▪ Disinterest of building owners and occupants ▪ Necessity to manage more complex processes

4. REPLICATION OF THE AEPC CONCEPT AND BUSINESS MODEL

4.1 MAIN BARRIERS TO THE IMPLEMENTATION OF ACTIVE BUILDING EPC

This document aims at identifying the main barriers to the implementation of AEPC based on key findings of project results mostly related to WP1 and WP2.

In detail, WP1 "Assessment of (enhanced) Energy Performance Contracts and Building Demand Response services in Europe," has the main goal to identify and analyse EU and member state directives, policies, measures and regulation (what is allowed, what not, what is encouraged, what is penalized) that are relevant for the proposed concept and business models and analyse to which extent they either would be supportive for the proposed ideas, or whether they would constitute a barrier. On the other hand, it aims at collecting information and analysing information of best practices for Enhanced EPC concepts and business models, as well as for using building level flexibility for offering demand response services thereby valorising the value of flexibility and storage.

During the first stage of the AmBIENCe project, activities in WP1 tried to answer the following two questions:

- Which countries in Europe have the best legislative practices and offer the best environment for AmBIENCe concepts and business models to succeed,
- What are the current barriers in legislation and market awareness that might have a significant impact on the successful deployment of the new concepts and business models proposed in AmBIENCe?

The current status of European countries for implementing the Active Building EPC was then assessed through a set of key areas covering aspects as ESCO/EPC status, DR services, and other factors enabling the Active Building EPC such as DER flexibility assessment. This critical assessment allowed the identification of the main enablers and barriers to the implementation of AmBIENCe concepts. With reference to the countries represented in the consortium, it was found that Belgium and Italy are in a good track for receiving this enhanced EPC, being in a good position for all the key areas investigated. The main enablers found for the EPC/ESCO are the presence of a strong legislative background and standards established for energy efficiency in buildings, the very high competence of the ESCOs, the guarantee of the results reassuring the customer by the fact that the ESCO will earn only if the proposed interventions will be effective and will lead to an effective energy saving, the presence of national ESCO associations, the creation of several so-called public One-stop-shops or facilitators, etc. The main enablers for the DR services offered by (clusters of) buildings are the ongoing revision of the regulatory framework according to the concept of "technology-neutrality", the well-established (or under revision) regulatory framework for accepting independent aggregators and for revisions of the minimum performance requirements, the standardized and clear M&V procedures for all market players with a digital meter, and the possibility of consumers' data availability in real time. Of course, there are still some barriers to be demolished for these countries such as the contractual complexity of EPCs, the uncertainty about the type of EPC contract to be applied in the public administration, and the absence of historical monitoring data, etc.

On the other hand, Spain and Portugal need to still overcome significant barriers to receive and implement the Active EPC, mainly related to the absence of a clear regulatory framework fostering the exploitation of demand flexibility.

In general, it was found that after several years of slow growth in the EU ESCO market due to legal, financial and administrative barriers facing EPCs, there are several European efforts to support the EPC process, including the 2017 Eurostat Guidance Note and the subsequent 2018 EPC Guide to the Statistical Treatment of EPCs. However, there are still several challenges facing the ESCO market. Typically, investments that result in a meaningful emission reduction are high and show poor economic and financial KPIs (e.g., pay-back time of well over 40 years and more). Therefore, EPCs are mostly applied for public buildings, and are hardly seen with commercial or residential buildings. On the other hand, demand response has a negative impact on users' perception of comfort, especially regarding the Heating, Ventilation and Air Conditioning (HVAC) system of the building, and estimating the financial benefits is hard for non-experts. These barriers can be addressed by using innovation in several technological fields that enables improvements not only in terms of guaranteed energy cost saving, but also in terms of non-energy services such as security and comfort.

To summarize, it was found that the main barriers to implementation of AEPC are:

- lack of regulations flexibility to enable innovation and demand participation to the market;
- low energy prices which reduce the attractiveness of EPC;
- lack of knowledge and trust on EPC business models and providers;
- lack of standard and enforced M&V protocols;
- financial barriers, since there are no suitable financing schemes for the development of ESCOs and ESCO projects;
- market barriers as:
    - limited access to the various market options for demand and DER;
    - market concentration with high entrance costs;
    - absence of clear support schemes for fostering DER penetration in the markets;
    - no market entity, known as independent aggregator, responsible for aggregation;
- social barriers as:
    - lack of knowledge about changing the end-user behaviour in order to provide flexible services;
    - opacity of energy market and lack of confidence;
    - demand anaesthesia – reactive consumer.

As already mentioned, activities in WP1 also focused on analysing the actors, roles and business models related to extended EPC business models and the use of flexibility at the demand-side form buildings.

It was found that today only a limited number of ESCOs deliver DR services, either explicit or implicit DR. The main reasons given by the interviewed stakeholders for not offering DR services are related to the following perceived obstacles:

- difficulty in clearly identifying positive business cases;
- lack of demand for DR from the customers/the market. Currently there are not always dynamic tariffs available in all member states;
- need to drastically redesign the Capacity auctions in order to let DR or energy efficiency play a role in it. This task is expected to take a long time before being accomplished due to its technical complexity;
- current focus of DR is on industrial applications (and production process in particular), rather than

on buildings, which consequently need to change the regulatory scheme and the incentives/tariffs in the future (e.g.: energy communities, etc.). Several ESCOs still consider the regulatory and market conditions insufficiently mature to start offering demand-response services;

- technical inadequacy of building systems' design for implicit DR, because of the current focus on energy efficiency.

In general, the DR programs aimed at small and medium scale customers have mostly failed to meet their expected potential. Barriers in the dissemination of DR programs, in the building sector, can come in the form of the following types of challenges.

- From a political point of view, regulated utilities operate within an incentive structure that prefers building physical assets to the behaviour-dependent demand response. Incentive mechanisms are needed for the diffusion of demand response, as happens on the generation side, in order to stimulate the user to modulate withdrawals according to price changes. On the other side, wholesale markets have evolved around supply-side resources, without giving equal treatment to supply and demand. Moreover, complex and burdensome administrative and authorisation procedures still represent an important barrier for the competitiveness of small-scale self-consumption projects for buildings.
- From the technical point of view, blocks of buildings offer more flexibility in the timing of energy use, local energy generation and energy storage than single buildings, but also in this context, the potential value of DR strongly depends on the control technologies embedded in the building management systems.
- Finally, the behavioural challenges depend on the lack of awareness of the users of their own load profiles, also due to a limited adoption of monitoring systems. The lack of information of end users about the regulatory and technical framework of demand response is also a crucial barrier. Moreover, many users have no confidence in the electricity market functions because of its complexity and are quite low interested in energy related issues.

4.2 STAKEHOLDER FEEDBACK

This section provides findings from the stakeholder survey that was conducted to enrich the analysis with the feedback from relevant stakeholders operating in the field. Stakeholder feedback was obtained using structured interviews to get a broad overview of the value drivers and key barriers identified by the market players and to get a general reflection on the AEPC/ABEPeM business offer value proposition. Abstracted results are included in the following sections. Detailed results are included in Appendix A. Results have been used in Deliverables D5.1, D5.2 (7) and D5.3 (8).

In detail, the scope of the survey was to collect information to:

- better understand what the conditions are to offer or to call for services based on the AEPC business model;
- better understand the potential of AEPC business model and the interest for an AEPC/ABEPeM Platform Business Offer;
- learn what the barriers to and drivers for providing or calling for AEPC services are.

The survey focused in priority on the three key players potentially actively commercialising AEPC related business offer(s):

- ESCOs as that want to provides customers with AEPC services;
- EPC Project Facilitators that want to provide customers with AEPC facilitation services;
- EPC Project Aggregators that want to provide customers with AEPC contract management services.

The stakeholders were identified and selected in different European Countries based on the analysis performed in WP1 and WP2 and were contacted via email and/or telephone and/or skype. The obtained results, that are analysed in the next sections, relate to the elaboration and assessment of the feedback obtained by those stakeholders that actually replied and participated to the survey. In total, we collected relevant information from the following six countries: Belgium, Ireland, Italy, the Netherlands, Portugal and Spain. Table 14 provides an overview of the countries for which we received completed questionnaires (marked in red) and the number of questionnaires collected.

TABLE 14: COUNTRIES COVERED BY THE STAKEHOLDER SURVEY

Country	ESCOs	EPC Project Facilitators	EPC Project Aggregators	Others
Belgium	7	2	3	
Ireland	1	2	1	
Italy	3	2		
Netherlands	1	1	1	
Portugal		2		5
Spain	1		1	1

4.2.1 FAMILIARITY WITH THE AEPC CONCEPT AND BUSINESS MODEL

Almost 84% of the respondents are familiar with DR flexibility in buildings and AEPC concept and business model. The key benefits of the AEPC concept and business model are the following, in order of importance:

- Reduce CO_2 emission;
- Increase saving revenues from EPC projects;
- Bring savings without impacting health and comfort;
- Increase the value of buildings in the rental & sales markets;
- Provide protection against rising and/or volatile energy prices;
- Bring new customers to EPC contracting;
- Pave the way for deep renovation and net-zero energy buildings EPC;
- Speed up the take-off of the EPC market.

The market seems to be quite confident about the positive DR business case and flexibility in the short term, with almost a third of respondents already making use of flexibility in their operations:

- Dynamic tariffs are a positive business case for 97% of respondents, but only 32% currently use it in their operations. 90% believe it could be a regular business case in 3 to 5 years.
- Different injection/consumption tariffs are a positive business case for 89% of respondents, but only 39% currently use it in their operations. 86% believe it could be a regular business case in 3 to 5 years.
- Capacity tariffs are a positive business case for 76% of respondents and there are only 21% that currently make use of it. 86% believe it could be a regular business case in 3 to 5 years.
- Explicit DR (on-request services) is a positive business case for 89% of respondents, but only 32% currently use it in their operations. 96% believe it could be a regular business case in 3 to 5 years.

4.2.2 KEY BARRIERS FOR AEPC SERVICES

Table 15 provides an overview of the feedback from the survey on the three main barriers to AEPC services that stakeholders were asked to specify. The results were compiled and structured into categories of barriers, for each category the results are presented according to the number of times they were mentioned and classified into three level of importance categories (high, medium, low). By order of importance, the key learnings are the following:

- All stakeholders indicate awareness, confidence, and capacity of end-users as a critical barrier for the development of AEPC services.
- Uncertainty about profitability is a high-level barrier for ESCOs and a medium one for EPC Aggregators while EPC Facilitators are not spotting it as a potential barrier.
- Contractual and technical complexity is a high-level barrier for EPC Facilitators and a medium one for ESCOs, while it is a lower-level barrier for EPC Aggregators.
- Availability of flexibility on the market and the regulatory framework are medium-level barriers to ESCOs while they are low-level barriers for EPC Facilitators and EPC Aggregators, probably as they are less concerned by the issue.
- Market and technology readiness is a medium-level barrier for EPC Aggregators meaning they must trust the market and technology effectiveness before engaging in AEPC services.

TABLE 15: RESULTS FROM BARRIERS' IDENTIFICATION

Type of barriers	ESCOs	EPC Facilitators	EPC Aggregators	Others
Awareness, confidence & capacity of end-users	9	4	6	4
Uncertainty about profitability	8		2	1
Contractual and technical complexity	4	4	2	
Regulatory framework	3	1	1	2
Availability of flexibility on the market	4	1		1
Market and technology readiness	1	1	3	1
Risks management issues	2			

Red = High – Yellow = Medium – Green = Low

The collection of information on barriers within the survey consisted of two parts: one structured on a tick-box basis and one free-form, focusing on the identification of the three main barriers according to the respondents. Table 16 provides a description of the barriers identified by the stakeholders.

TABLE 16: KEY BARRIERS DESCRIPTION

Profile	Barrier's description
Awareness, confidence & capacity of End-Users	
ESCOs	▪ Acceptance of ACTIVE control ▪ Already limited market size of standard EPC contracts ▪ Client awareness ▪ Distrust to new business model ▪ Lack of know-how at customers ▪ Lack of vision of opportunities ▪ Long sales cycle / customer awareness ▪ Market size ▪ The habit of turning to the existing provider
Aggregators	▪ Case studies to present ▪ Consumer acceptance of the concept ▪ Lack of Expertise + Market Power of Traditional 'system' ▪ Lack of information about how it goes about the impact of such services to end-users ▪ No knowledge about business cases & success stories ▪ Not well informed about feasibility
Facilitators	▪ Commercial real estate is no market (yet) for EPC. ▪ Governments don't tender. ▪ Not on the agenda of customer ▪ Trust (new product)
Others	▪ Dissemination of good practices and positive results within service providers and consumers ▪ Knowledge and information of consumers ▪ Lack of information and knowledge about the advantages/disadvantages ▪ Lack of trust
Uncertainty about profitability	
ESCOs	▪ Creating positive business plans ▪ Finance ▪ Limited value of these flexible services ▪ Operating income ▪ Payback time (absence of granting schemes) ▪ ROI - cost vs benefit ▪ Service costs ▪ Splitting economic benefits between people living in the building
Aggregators	▪ Uncertain returns ▪ Cost effectiveness (cost/effort ratio <-> benefits)
Facilitators	▪ startup costs vs revenue
Others	▪ Hardware cost

Contractual and technical complexity	
ESCOs	▪ Complexity ▪ Complexity of the contracting vs the client but also vs financing party of the ESCO project ▪ Link with energy supply contracts ▪ Technical limits to optimize flexibility
Facilitators	▪ Combining DR delivery streams with internal asset optimization ▪ Complexity ▪ Creating a DR baseline and forecast ▪ Perceived difficulty to contract AEPC
Aggregators	▪ Combination of 2 incumbent markets (OEPC and Demand Response) ▪ Difficult add-on to an already complex contracting structure
ESCOs	▪ Lack of legislation ▪ Moving regulatory framework (or not moving enough) ▪ Regulation restricting ESCO/Demand Response services on the local market
Aggregators	▪ Uncertainty in evolution of regulation
Facilitators	▪ Regulatory framework
Others	▪ Regulation ▪ Lack of appropriate regulation and market structure
Market and technology readiness	
ESCOs	▪ Delivery capacity
Aggregators	▪ Maturity of the ESCO-market ▪ Maturity of products on the market ▪ Technical solutions
Facilitators	▪ There is no clear cooperation / go to market strategy between AEPC and EPC providers.
Others	▪ Management Tools
Availability of flexibility on the market	
ESCOs	▪ Lack of implicit and/or explicit DR products offered on the local market ▪ Limited access to the aggregation markets or entry barriers such as high entry costs that prevent access aggregation services ▪ Lack of infrastructure ▪ Lack of standard price packages
Facilitators	▪ lack of bi-directional EV's
Risks management issues	
ESCOs	▪ Risk management (occupants' comfort) ▪ Risk profile

Considering this dual approach, we have carried out a mapping of the main barriers that have been identified by stakeholders. Firstly, the barriers were divided into two main categories: relevant barriers that affect the decision-making processes on the part of the end-users (building owners and EPC Aggregators) and barriers that affect the implementation process of AEPC services by market actors (ESCOs, CPE facilitators). Then, barrier typologies for each category were established along with the identified and analysed barriers composing each typology. Table 17 provides the synthesis of the key barriers identified.

TABLE 17: BARRIERS FOR AEPC SERVICES

Barrier category	Barrier typology	Barriers
Barriers that prevent ESCOs and EPC Facilitators taking part in the AEPC business process to easily implement successful AEPC business models.	Organization and structure of the DR market	▪ Lack of implicit and/or explicit Demand Response products offering on the local market ▪ Limited access to the aggregation markets or entry barriers such as high entry costs that prevent aggregation services
	Regulatory	▪ Regulation restricting ESCO/Demand Response services on the local market ▪ Lack of regulation or continuity in regulation
	Technical	▪ Contractual and technical complexity ▪ Lack of appropriate tools to design and manage flexibility in AEPC projects ▪ Risks management issues due to complex business model
	Knowledge-informative based	▪ Lack of expertise to establish and manage AEPC M&V protocols
	Financial	▪ Uncertainty about profitability ▪ Challenge to design effective AEPC projects with positive business cases ▪ Revenue volatility of Demand Response that might be difficult to integrate into long term EPC business models
Barriers that limit uptake of AEPC at the decision-making level for building owners and EPC Aggregators.	Technical	▪ Contractual and technical complexity ▪ Lack of appropriate tools to design and manage flexibility in AEPC projects ▪ Risk management issues with more complex contractual agreements that might affect customer acceptance
	Informative	▪ Lack of awareness and confidence about the benefits of Active EPC ▪ Difficulties in communicating the benefits of Active EPC
	Financial	▪ Uncertainty about profitability

4.2.3 KEY DRIVERS FOR AEPC SERVICES

Table 18 provides an overview of the feedback from the survey on the three main drivers to AEPC services that stakeholders were asked to specify. The results were compiled and structured into categories of drivers, for each category the results are presented according to the number of times they were mentioned and classified into three level of importance categories (high, medium, low).

By order of importance, the key learnings are the following:

- Almost all stakeholders indicate that rising and volatile energy prices as well as regulation enforcement and incentives would play a key role for the development of AEPC services;
- Strengthening the (A)EPC business model and raising awareness & building trust of End-users are a key driver for ESCOs.
-

TABLE 18: RESULTS FROM DRIVERS' IDENTIFICATION

Type of drivers	ESCOs	EPC Facilitators	EPC Aggregators	Others
Strengthening the (A)EPC business model	7	1	1	1
Rising and volatile energy prices	4	2	2	2
Regulation enforcement & incentives	4	2	2	
Raising awareness & building trust of End-Users	4		2	
PV solar & decentralized RES development	2			3
Greening/electrification of heating & cooling	2	1	1	1
Electric vehicle market development	2	2		1
DR market development	2	1	1	
CSR & Real estate market pressure	3			1

Red = High – Yellow = Medium – Green = Low

The collection of information on drivers within the survey consisted of two parts: one structured on a tick-box basis and one free-form, focusing on the identification of the three main drivers according to the respondents. Table 19 provides a description of the barriers identified by the stakeholders.

TABLE 19: KEY DRIVERS DESCRIPTION

Actors	Drivers' description
Rising and volatile energy	
ESCOs	▪ Difference between high and low energy prices on the market (and not the absolute high prices) ▪ Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business ▪ Energy and CO02 pricing models ▪ Price increases
Aggregators	▪ Energy prices ▪ Increasing volatility due to RES
Facilitators	▪ Energy prices
Others	▪ High energy costs (push consumers into promote savings and efficiency) ▪ Increasing energy prices
Strengthening the (A)EPC business model	
ESCOs	▪ "A" Becoming part of integrated EPC offers ▪ Active savings guarantees, based on robust contractual agreements and M&V protocols

	▪ Build customer loyalty in the medium/long term ▪ Customization EPC formula ▪ Increase company profitability with high value-added services ▪ Revenues, cost savings ▪ Risk profile mitigation
Aggregators	▪ Integration into larger renovation projects (pooling of customers)
Facilitators	▪ Offering an integrated management possibility
Others	▪ Building efficiency continuous management
Regulation enforcement & incentives	
ESCOs	▪ Development and simplification of energy regulation ▪ Granting schemes ▪ Regulatory changes ▪ Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems
Aggregators	▪ Regulatory changes ▪ Regulatory support / incentives
Facilitators	▪ Governmental obligations ▪ Promotion by central government
Raising awareness, building trust and capacity of End-Users	
ESCOs	▪ Capitalize on transversal expertise's ▪ Customers' and/or end-users' demand ▪ Increase customer awareness of dynamic management ▪ Market size
Aggregators	▪ Dissemination of success stories and business cases ▪ Pilot project
PV solar & decentralized RES development	
ESCOs	▪ Optimization of PV production capacity ▪ PV optimization, increasing self-consumption
Others	▪ Increase on the deployment of decentralized RES ▪ Proliferation of decentralized unpredictable consuming loads that contribute for the network instability (e.g., EVs) ▪ PV Solar
Electric vehicle market development	
ESCOs	▪ Electric vehicles ▪ Electrical Mobility
Facilitators	▪ Electrification of vehicles and climatization ▪ EV market development
Others	▪ EV Charging
Greening/electrification of heating & cooling	
ESCOs	▪ Exit from gas markets = opportunity for heat pumps and heat networks ▪ Heat pumps to replace fossil fuel-based heating
Aggregators	▪ Electrification
Facilitators	▪ Electrification of heating demands
Others	▪ Electrification
DR market development	

ESCOs	▪ DR optimal tariff definition in order to share the maximum value with customers ▪ Extra source of savings on a more global level (power production capacity...)
Aggregators	▪ Development of flexible applications
Facilitators	▪ New local flexibility markets
CSR & Real estate market pressure	
ESCOs	▪ Green agenda/CO2 savings ▪ Reassurance to be future proof ▪ Green image
Others	▪ Differentiation of real estate offers (for greener buildings, efficiency)

Considering this dual approach, we have carried out a mapping of the main drivers that have been identified by stakeholders. Firstly, the drivers were divided into two main categories: relevant drivers that support the decision-making processes on the part of the end-users (building owners and EPC Aggregators) and drivers that support the implementation process of AEPC services by market actors (ESCOs, CPE facilitators). Then, driver typologies for each category were established along with the identified and analysed drivers composing each typology. Table 20 provides the synthesis of the key barriers identified.

TABLE 20: DRIVERS FOR AEPC SERVICES

Driver category	Driver typology	Barriers
Drivers that enable ESCOs and EPC Facilitators taking part in the AEPC business process to easily implement successful AEPC business models.	Organization and structure of the DR market	▪ DR market development
	Regulatory	▪ Regulation enforcement & incentives
	Technical	▪ Strengthening the (A)EPC business model ▪ PV solar & decentralized RES development ▪ Greening/electrification of heating & cooling
	Knowledge-informative based	▪ Raising awareness & building trust of End -Users
	Financial	▪ Rising and volatile energy prices
Drivers that promote uptake of AEPC at the decision-making level for building owners and EPC Aggregators.	Market based	▪ CSR & Real estate market pressure ▪ Electric vehicle market development ▪
	Technical	▪ PV solar & decentralized RES development ▪ Greening/electrification of heating & cooling
	Regulatory	▪ Regulation enforcement & incentives
	Financial	▪ Rising and volatile energy prices

4.2.4 INTEREST IN ABEPEM PLATFORM-LIKE TOOLS

Almost 89% of the respondents are familiar with the tools needed to simulate and manage Demand Response flexibility and active building control for AEPC projects such as ABEPeM Platform. They are 93% claiming such a tool is essential (41,5%) or useful but not essential (41,5%). The key features of such a tool are by order of importance the following:

- Setting-up of operational & contractual key parameters (definition of base line, (non-routine adjustment factors for M&V, etc.).
- Dynamic active building modelling integrating DR timely prices or remunerative orders (thermal behaviour, production flexibility, usage flexibility).
- Operational forecasts of energy consumption and flexibility load to support active control of flexible assets during operations.
- Economic and financial calculations (energy savings and investments calculations, financing options simulations, etc.).
- Measurement & Verification of AEPC guaranteed savings.
- Multiple active building designs evaluation & benchmarking based on forecasted scenarios.
- Integration into energy & CO_2 markets.

In case they would be using or willing to implement such a tool, the most appropriate, interesting or acceptable acquisition or usage model are the following (by order of importance):

- A tool as a service delivered by an authorized operator who configures the tool and runs technical & financial simulations, operational forecasts and M&V on request (85% of the respondents).
- A stand-alone software that can be used fully autonomously to run technical & financial simulations, operational forecasts and M&V, with any help from the developer, other than basic training (81% of the respondents).
- A customizable computational engine that can be integrated in an existing own tool or in a bespoke solution from a software developer to run technical & financial simulations, operational forecasts and M&V (73% of the respondents).
- An algorithm that can be integrated in an existing computational engine (65% of the respondents).

In case they would be using a financial and economic calculation model, such as the ABEPeM Platform module developed under the AmBIENCe project, the most appropriate level of integration of underlying software are the following (by order of importance):

- A customizable stand-alone Excel based tool (37% of the respondents).
- A tool integrated in the overall simulation tool (26% of the respondents).
- A stand-alone web-based tool (15% of the respondents).
- A customized stand-alone software tool (11% of the respondents).

Almost 70% of respondents show interest in commercial collaboration with AmBIENCe project partners, with different potential forms of collaboration as follows (by order of importance):

- a commercial collaboration to develop an AEPC Business offer (29,6% of respondents);
- both commercial collaboration opportunities (25,9% of respondents);
- a commercial collaboration to acquire of further develop a simulation and/or operational flexibility tool (14,8% of respondents).

4.3 REPLICATION STRATEGY

Besides the existence of implicit or explicit DR business offers available on the local market, developing the AEPC business model relies on methodologies and advanced intelligent tools to implement and perform AEPC projects. Although the market survey of stakeholders shows that they are preparing to introduce the use of flexibility in energy performance contracts, there is not yet a specific AEPC related business offering on the market which therefore needs to be developed, taking into account the business needs of each category of players potentially commercializing AEPC related services:

- ESCOs that provide AEPC services to building owners: in order to provide such AEPC services, ESCOs would have to develop an AEPC business offering comprising an AEPC contract model, procedures and methodologies to implement APEC services and an appropriate BEM solution to design and manage AEPC project in a proper way.
- EPC project facilitators that provide AEPC services facilitation: in order to provide such AEPC facilitation services, EPC project facilitators would have to develop an AEPC facilitation business offering comprising an AEPC contract model, procedures and methodologies to facilitate the tendering, implementation and follow-up of APEC services and, potentially, an appropriate BEM solution to assess/structure AEPC projects for tendering and to monitor them when implemented.
- EPC Project aggregators that provide AEPC management services to building owners/occupants: in order to provide such AEPC management services, EPC project aggregators would have to develop an AEPC contract management business offering comprising an AEPC contract model, procedures and methodologies to tender and manage the implementation of APEC services and, potentially, an appropriate BEM solution to assess/structure AEPC projects for tendering and to monitor them when implemented.

Taking into account the market needs, the consortium identified three potential go-to-market options for introducing an AEPC/ABEPeM Business Offering detailed in Figure 4.

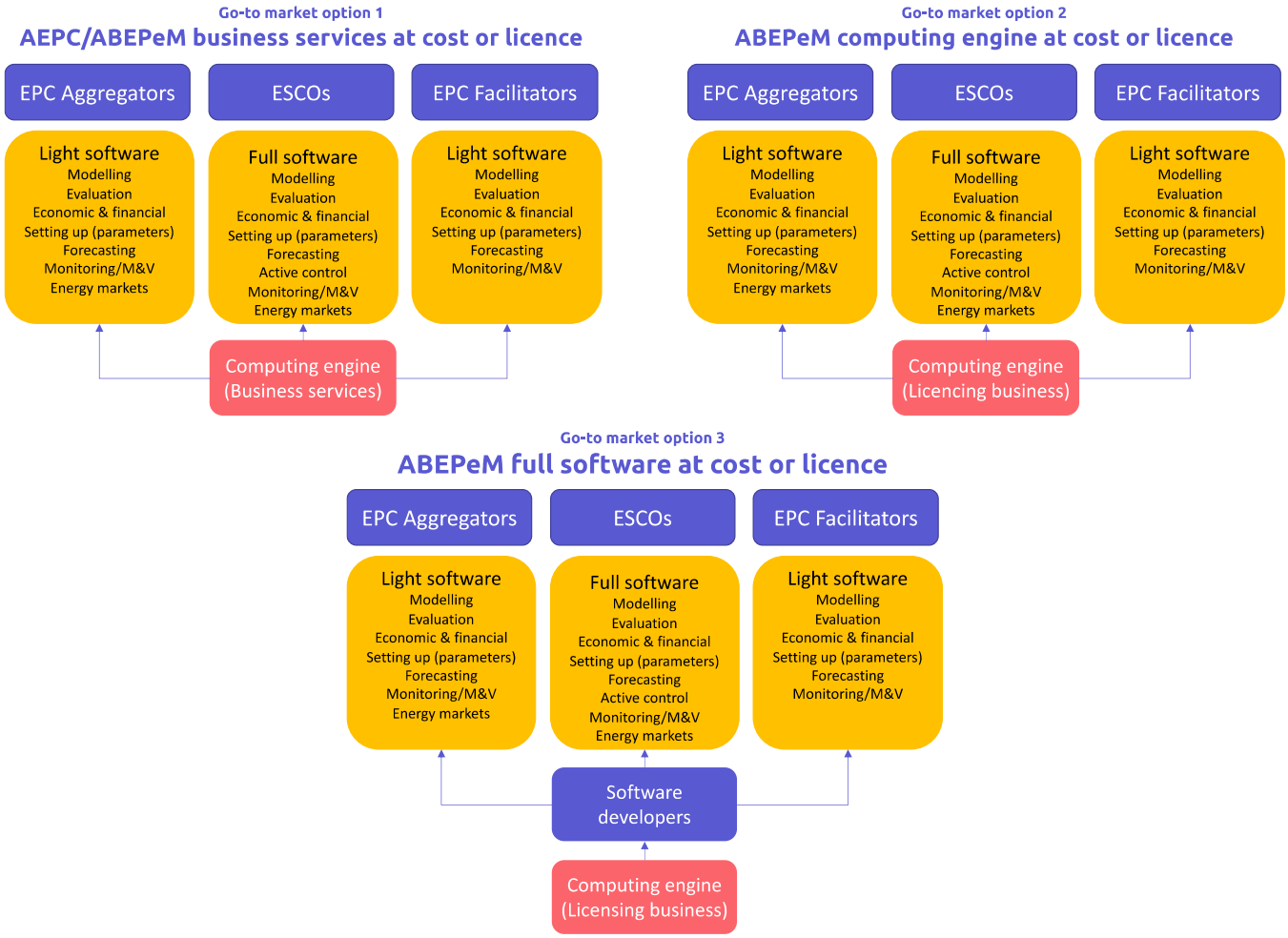


FIGURE 4: AEPC/ABEPEM BUSINESS OFFER GO-TO-MARKET OPTIONS

4.3.1 AEPC/ABEPEM PLATFORM BUSINESS SERVICES AT COST OR LICENSE

In this go-to-market model, the ABEPeM platform is not sold but exploited by the platform providers (or local partners) as a business tool alongside the AEPC business model and methodologies to provide potential customers (ESCOs, EPC Project Facilitators, EPC Project Portfolio Aggregators) with services at different stages of the AEPC business model:

- **Pre-feasibility and feasibility studies services in the pre-contracting phase**: The pre-feasibility study services provide a general analysis on the potential of a building and its adaptability to AEPC, while the feasibility study services provide more in-depth calculations on the savings and investment required based on energy projects outline design.
- **Contract design and deployment parameters services in the contracting phase**: Based on the defined energy project outline design, the contract design services provide quantitative measures and guarantee numbers to define the building energy baseline with flexibility, confirm AEPC energy savings and complete the financial analysis and project costs. The deployment parameters services provide key parameters to be used for implementing installation projects with the installation of

sensors and flexibility sources enabling the active control.

The ABEPeM platform business services to customers could be offered at cost per project or per man/days or under a licensing formula for a number of specific missions or projects, depending on the market conditions and the agreements between ABEPeM platform IP owners.

This is the option chosen by Energinvest, in collaboration with VITO, in its plan to exploit the Belgian market (7).

4.3.2 ABEPEM PLATFORM COMPUTATIONAL ENGINE AT COST OR LICENSE

Composed of a number of well-defined modules brought together in modular and flexible platform architecture, the ABEPeM platform enables potential customers to create their own version or flavour modules and functionalities themselves, and/or include modules from other specific third parties. In this go-to-market model, the computational engine modules of the ABEPeM platform would be provided to potential customers willing to integrate all or part of its component modules into their own Energy Efficiency software infrastructure. The services offered by the ABEPeM Platform providers would consist of training and support to adapt or integrate the computational engine within their operations. The ABEPeM platform modules could be adapted to each of the specific customer's needs, either ESCOs, EPC project aggregators or EPC project facilitators.

The ABEPeM platform computing engine and the tailoring, training and support related services to customers could be offered at cost per project or per man/days or under a licensing formula for a number of specific missions or projects, depending on the market conditions and the agreements between ABEPeM platform IP owners.

This is the option chosen by EDP Commercial in its plan to exploit the Portuguese market (7).

4.3.3 ABEPEM PLATFORM FULL AEPC SOFTWARE PACKAGES AT COST OR LICENSE

In this go-to-market model, the computational engine modules of the ABEPeM platform would be sold or licensed to local or international software developers willing to develop and deliver complete AEPC software packages or suites to the local market. The services offered by the ABEPeM Platform providers would consist of training and support to adapt or integrate the computational engine into the developers' software suites.

The ABEPeM platform computing engine and the tailoring, training and support related services to software developer could be offered at cost per project or per man/days or under a licensing formula for a number of specific missions or projects, depending on the market conditions and the agreements between ABEPeM platform IP owners.

5. CONCLUSIONS

This deliverable introduced the identification and characterisation of the AmBIENCe project results, the outputs of the different activities developed in the tasks and work packages.

Firstly, all the results were listed, the KERS and the "other results", the partners involved in their development were identified, and the main owner of the result was highlighted. On top of that, the exploitation strategy was outlined providing information about the IPR strategy, the replicability potential, the commercial exploitability and the Non-Commercial Exploitability.

Once results were defined and characterised, an analysis of the replication potential of the AEPC concept and business model was conducted, in terms of products and services that would support it and the related business offers to the market. It was concluded that three types of players would potentially commercialize an AEPC related business offerings: ESCOs, EPC project facilitators and EPC project aggregators. Based on the Key Exploitable Results (KERs), AEPC business offering value propositions have been defined for the key target markets (ESCOs, EPC project facilitators and EPC project aggregators) and tested through a stakeholder survey.

Although the stakeholder survey shows that there are many barriers preventing the market from taking off, a number of drivers supports its development in the short and medium term, with almost all actors predicting AEPC services would become positive business cases in 3 to 5 years. The stakeholder survey shows a strong interest from market players in developing AEPC related services and particularly in the use of an appropriate tool such as ABEPeM Platform, supported by methodologies and procedures. Taking into account the market needs, the consortium has identified three potential go-to-market options for introducing an AEPC/ABEPeM Business Offering.

REFERENCES

1. **Caerts C, Verbeeck J, Casas M.** *Deliverable D2.2 - Proof-of-Concept of an Active Building Energy Performance Modelling framework.* https://ambience-project.eu/wp-content/uploads/2020/12/AmBIENCe_D2.2_Proof-of-Concept-of-an-Active-Building-Energy-Performance-Modelling-framework-for-publication.pdf., 2020.
2. **Vanstraelen L, Vanschoenwinkel J, Di Somma M,.** *Deliverable 1.2 – Overview of actors, roles and business models related to Enhanced EPC and Building Demand Response services.* https://ambience-project.eu/wp-content/uploads/2020/12/AmBIENCe_D1.2_Overview-of-actors-roles-and-business-models-related-to-Enhanced-EPC-and-Building-Demand-Response-Services.pdf, 2020.
3. **database, AmBIENCe.** https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fambience-project.eu%2Fwp-content%2Fuploads%2F2022%2F03%2FAmBIENCe_Deliverable-4.1_Database-of-greybox-model-parameter-values.xlsx&wdOrigin=BROWSELINK, 2021.
4. **Neyestani N.** *Deliverable D2.1 - The Active Building Energy Performance Contract concept and methodology.* https://ambience-project.eu/wp-content/uploads/2020/12/D2.1-The-Active-Building-Energy-Performance-Contract-concept-and-methodology.pdf, 2020.
5. **Diez F, Alonso I, Caerts C, Cancro C, Di Somma M.** *Deliverable 2.4 - The Collective Active Building EPC concept and business model.* https://ambience-project.eu/wp-content/uploads/2021/05/AmBIENCe_D2.4_The-Collective-Active-Building-EPC-concept-and-business-model.pdf, 2021.
6. **Vanstraelen L, Casas M, Ramos R, Caerts C.** *Deliverable D2.3 - Business Models for Active Building EPC Concept.* https://ambience-project.eu/wp-content/uploads/2021/05/AmBIENCe_D2.3_Business-Models-for-the-Active-Building-EPC-Concept.pdf., 2021.
7. **Lacerda G, Castanho A, Figueiredo R, Harvey C, Vanstraelen L.** *Deliverable 5.2 - Exploitation plan for commercial partners.* AmBIENCe confidential report, 2022.
8. **Alonso I et al.** *Exploitation plan for non-commercial partners.* confidential document, 2022.

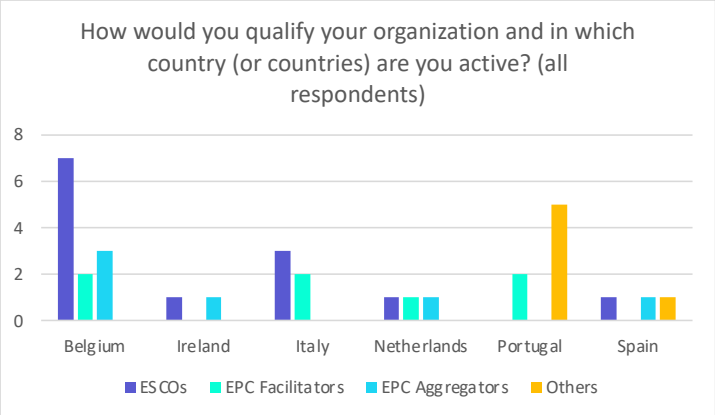
ABBREVIATIONS AND ACRONYMS

ABEPeM	Active Building Energy Performance Modelling
ACO	associations of co-owners
AEPC	Active building Energy Performance Contract
BEM	Budling Energy Modelling
BEMS	Building Energy Management System
CR-EPC	Comprehensive Refurbishment-EPC
DEM	Dynamic Energetic Modelling
DSM	Demand Side Management
DSO	Distribution System Operator
DR	Demand Response
EPC	Energy Performance Contract
EEM	Energy Efficiency Measures
EE	Energy Efficiency
ECM	Energy Conservation Measures
E&FCM	Economic and Financial Calculations Module
ESCO	Energy Services Company
FS	Feasibility Study
HVAC	Heating Ventilation AirConditioning
IPMVP	International Performance Measurement and Verification Protocol
IPR	Intellectual Property Right
KER	Key Exploitable Result
KPI	Key Performance Indicators
M&V	Measurement and Verification
MPC	Model Predictive Control
ROI	Return On Investment
SHC	Social Housing Company
TCO	Total Cost of Ownership
TSO	Transmission System Operator
USP	Unique Selling Point
UVP	Unique Value Proposition

APPENDIX A – STAKEHOLDER FEEDBACK

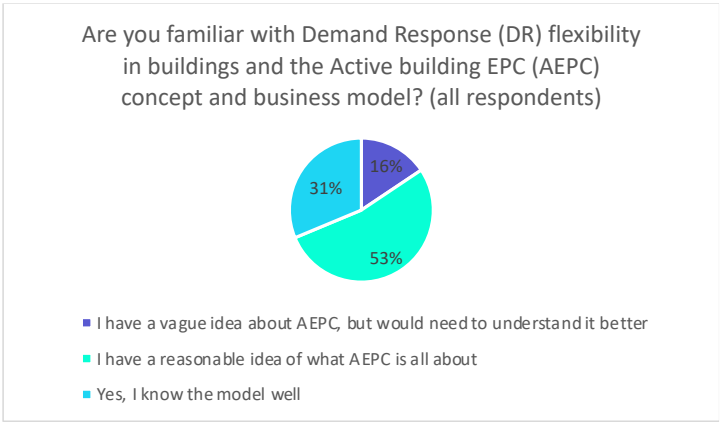
COUNTRY & STAKEHOLDER PROFILE

How would you qualify your organization and in which country (or countries) are you active?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Belgium	7	2	3	0	12
Ireland	1	0	1	0	2
Italy	3	2	0	0	5
Netherlands	1	1	1	0	3
Portugal	0	2	0	5	7
Spain	1	0	1	1	3
Total	**13**	**7**	**6**	**6**	**32**



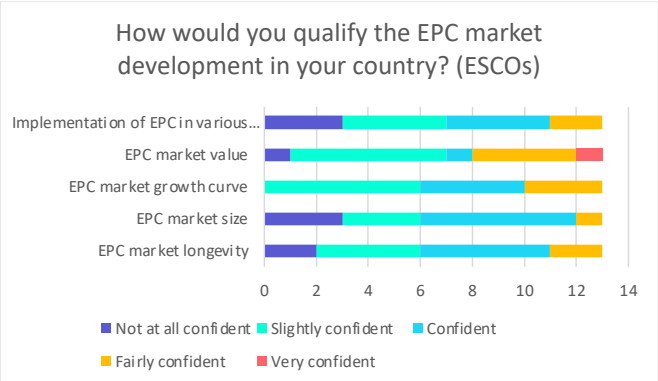
AEPC CONCEPT & BUSINESS MODEL KNOWLEDGE

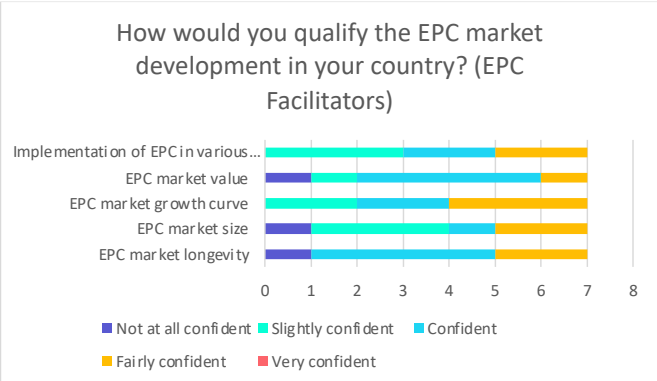
Are you familiar with Demand Response (DR) flexibility in buildings and the Active building EPC (AEPC) concept and business model?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
I have a vague idea about AEPC, but would need to understand it better	2	1	0	2	5
I have a reasonable idea of what AEPC is all about	6	5	3	3	17
Yes, I know the model well	5	1	3	1	10

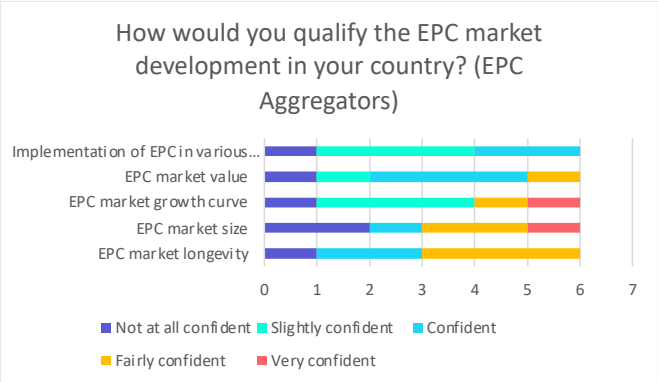


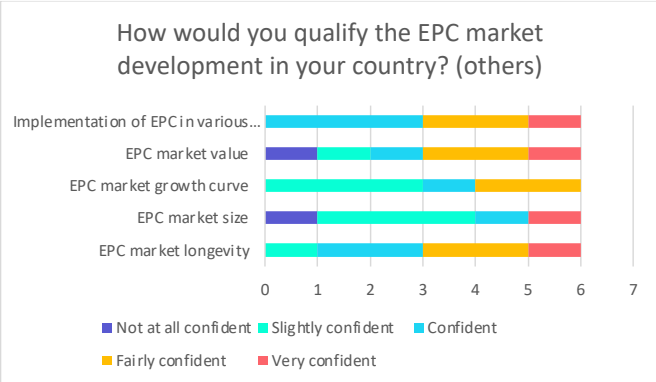
EPC MARKET EVALUATION

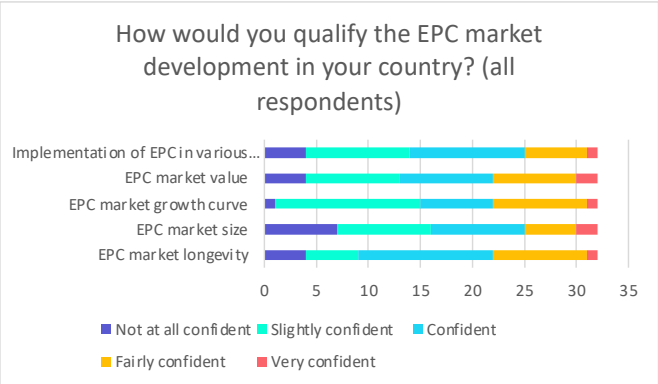
How would you qualify the EPC market development in your country?	Not at all confident	Slightly confident	Confident	Fairly confident	Very confident	Scoring
ESCOs						
EPC market longevity	2	4	5	2		**33**
EPC market size	3	3	6	1		**31**
EPC market growth curve		6	4	3		**36**
EPC market value	1	6	1	4	1	**37**
Implementation of EPC in various building sectors	3	4	4	2		**31**
EPC Facilitators						
EPC market longevity	1		4	2		**21**
EPC market size	1	3	1	2		**18**
EPC market growth curve		2	2	3		**22**
EPC market value	1	1	4	1		**19**
Implementation of EPC in various building sectors		3	2	2		**20**
EPC Aggregators						
EPC market longevity	1		2	3		**19**
EPC market size	2		1	2	1	**18**
EPC market growth curve	1	3		1	1	**16**
EPC market value	1	1	3	1		**16**
Implementation of EPC in various building sectors	1	3	2			**13**
Others						
EPC market longevity		1	2	2	1	**21**
EPC market size	1	3	1		1	**15**
EPC market growth curve		3	1	2		**17**
EPC market value	1	1	1	2	1	**19**
Implementation of EPC in various building sectors			3	2	1	**22**

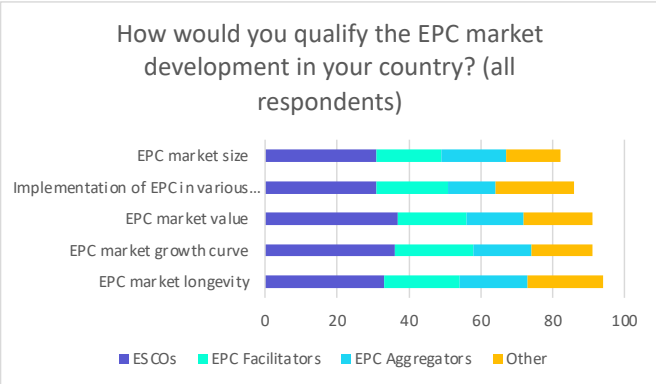






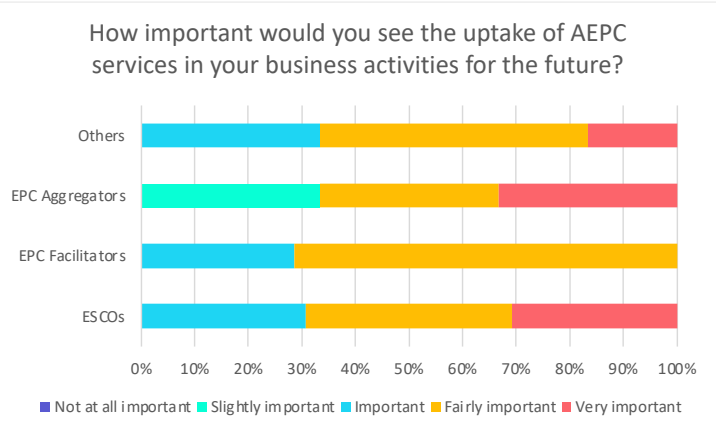






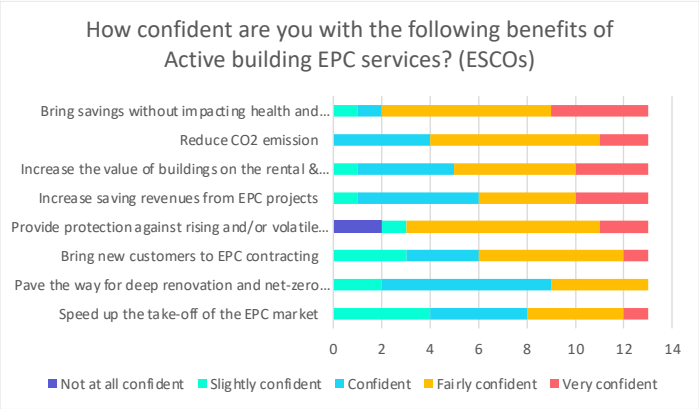
AEPC SERVICES UPTAKE EVALUATION

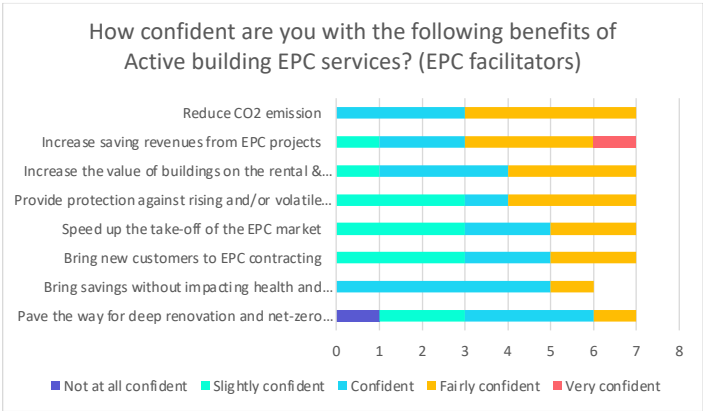
How important do you see the uptake of Active building EPC services in your business activities for the future?	ESCOs	EPC Facilitators	EPC Aggregators	Others
Not at all important				
Slightly important			2	
Important	4	2		2
Fairly important	5	5	2	3
Very important	4		2	1

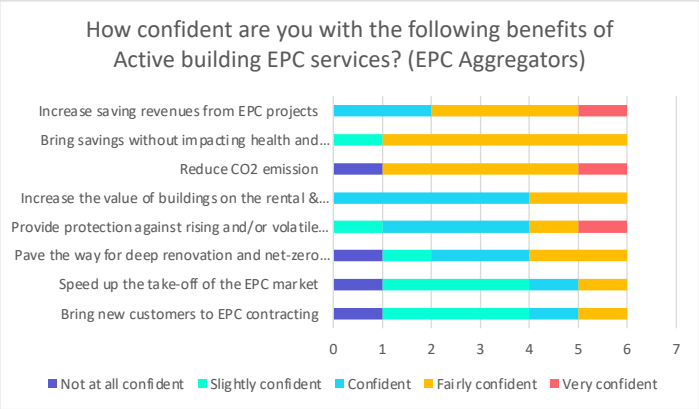


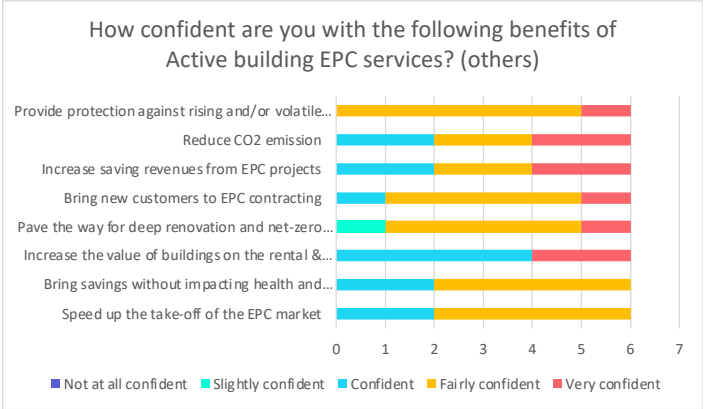
AEPC SERVICES BENEFITS EVALUATION

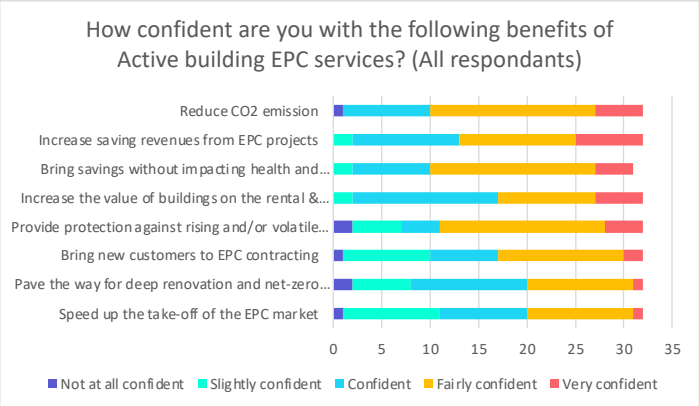
How confident are you with the following benefits of Active building EPC services?	Not at all confident	Slightly confident	Confident	Fairly confident	Very confident	Scoring
ESCOs						
Speed up the take-off of the EPC market		4	4	4	1	**41**
Pave the way for deep renovation and net-zero energy buildings EPC		2	7	4		**41**
Bring new customers to EPC contracting		3	3	6	1	**44**
Provide protection against rising and/or volatile energy prices	2	1		8	2	**46**
Increase saving revenues from EPC projects		1	5	4	3	**48**
Increase the value of buildings on the rental & sales markets		1	4	5	3	**49**
Reduce CO2 emission			4	7	2	**50**
Bring savings without impacting health and comfort		1	1	7	4	**53**
EPC Facilitators						
Pave the way for deep renovation and net-zero energy buildings EPC	1	2	3	1		**18**
Bring savings without impacting health and comfort			5	1		**19**
Bring new customers to EPC contracting		3	2	2		**20**
Speed up the take-off of the EPC market		3	2	2		**20**
Provide protection against rising and/or volatile energy prices		3	1	3		**21**
Increase the value of buildings on the rental & sales markets		1	3	3		**23**
Increase saving revenues from EPC projects		1	2	3	1	**25**
Reduce CO2 emission			3	4		**25**
EPC Aggregators						
Bring new customers to EPC contracting	1	3	1	1		**14**
Speed up the take-off of the EPC market	1	3	1	1		**14**
Pave the way for deep renovation and net-zero energy buildings EPC	1	1	2	2		**17**
Provide protection against rising and/or volatile energy prices		1	3	1	1	**20**
Increase the value of buildings on the rental & sales markets			4	2		**20**
Reduce CO2 emission	1			4	1	**22**
Bring savings without impacting health and comfort		1		5		**22**
Increase saving revenues from EPC projects			2	3	1	**23**
Others						
Speed up the take-off of the EPC market			2	4		**22**
Bring savings without impacting health and comfort			2	4		**22**
Increase the value of buildings on the rental & sales markets			4		2	**22**
Pave the way for deep renovation and net-zero energy buildings EPC		1		4	1	**23**
Bring new customers to EPC contracting			1	4	1	**24**
Increase saving revenues from EPC projects			2	2	2	**24**
Reduce CO2 emission			2	2	2	**24**
Provide protection against rising and/or volatile energy prices				5	1	**25**

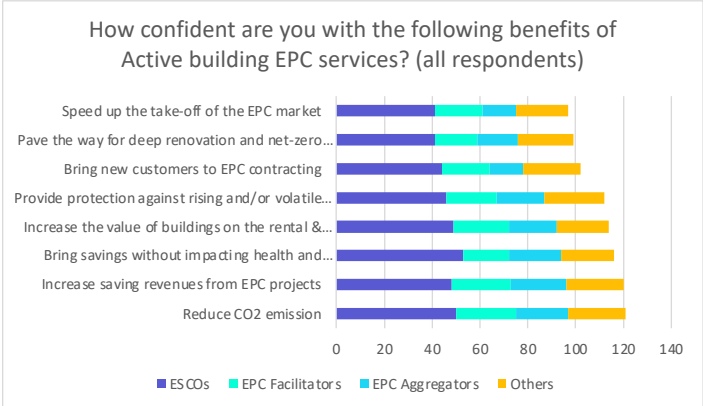

How confident are you with the following benefits of Active building EPC services? (ESCOs)
Bring savings without impacting health and...
Reduce CO2 emission
Increase the value of buildings on the rental &...
Increase saving revenues from EPC projects
Provide protection against rising and/or volatile...
Bring new customers to EPC contracting
Pave the way for deep renovation and net-zero...
Speed up the take-off of the EPC market
0 2 4 6 8 10 12 14
Not at all confident
Slightly confident
Confident
Fairly confident
Very confident


How confident are you with the following benefits of Active building EPC services? (EPC facilitators)
Reduce CO2 emission
Increase saving revenues from EPC projects
Increase the value of buildings on the rental &...
Provide protection against rising and/or volatile...
Speed up the take-off of the EPC market
Bring new customers to EPC contracting
Bring savings without impacting health and...
Pave the way for deep renovation and net-zero...
0 1 2 3 4 5 6 7 8
Not at all confident
Slightly confident
Confident
Fairly confident
Very confident


How confident are you with the following benefits of Active building EPC services? (EPC Aggregators)
Increase saving revenues from EPC projects
Bring savings without impacting health and...
Reduce CO2 emission
Increase the value of buildings on the rental &...
Provide protection against rising and/or volatile...
Pave the way for deep renovation and net-zero...
Speed up the take-off of the EPC market
Bring new customers to EPC contracting
0 1 2 3 4 5 6 7
Not at all confident
Slightly confident
Confident
Fairly confident
Very confident


How confident are you with the following benefits of Active building EPC services? (others)
Provide protection against rising and/or volatile...
Reduce CO2 emission
Increase saving revenues from EPC projects
Bring new customers to EPC contracting
Pave the way for deep renovation and net-zero...
Increase the value of buildings on the rental &...
Bring savings without impacting health and...
Speed up the take-off of the EPC market
0 1 2 3 4 5 6 7
Not at all confident
Slightly confident
Confident
Fairly confident
Very confident


How confident are you with the following benefits of Active building EPC services? (All respondants)
Reduce CO2 emission
Increase saving revenues from EPC projects
Bring savings without impacting health and...
Increase the value of buildings on the rental &...
Provide protection against rising and/or volatile...
Bring new customers to EPC contracting
Pave the way for deep renovation and net-zero...
Speed up the take-off of the EPC market
0 5 10 15 20 25 30 35
Not at all confident
Slightly confident
Confident
Fairly confident
Very confident


How confident are you with the following benefits of Active building EPC services? (all respondents)
Speed up the take-off of the EPC market
Pave the way for deep renovation and net-zero...
Bring new customers to EPC contracting
Provide protection against rising and/or volatile...
Increase the value of buildings on the rental &...
Bring savings without impacting health and...
Increase saving revenues from EPC projects
Reduce CO2 emission
0 20 40 60 80 100 120 140
ESCOs
EPC Facilitators
EPC Aggregators
Others

DEMAND RESPONSE BUSINESS CASES EVALUATION

What Demand Response (DR) business cases are possible for your buildings and which ones are you leveraging today?		Which positive business cases are possible according to you?	Are you making use of this business case?	Could this business case be possible in 3 to 5 years?		Would you use it as a pilot or a commercial project?
ESCOs						
Dynamic tariffs (Day/Night, more complex)	Yes	11	3	11	Pilot	11
	No	1	9	1	Commercial	9
Different Injection/Consumption tariffs	Yes	9	4	9	Pilot	8
	No	2	7	2	Commercial	8
Capacity tariffs	Yes	6	3	8	Pilot	8
	No	5	8	3	Commercial	3
Explicit DR (on-request services)	Yes	8	3	11	Pilot	9
	No	3	8	0	Commercial	7
EPC Facilitators						
Dynamic tariffs (Day/Night, more complex)	Yes	7	2	6	Pilot	6
	No	0	5	1	Commercial	4
Different Injection/Consumption tariffs	Yes	4	2	5	Pilot	3
	No	1	3	0	Commercial	3
Capacity tariffs	Yes	5	1	5	Pilot	3
	No	1	5	0	Commercial	2
Explicit DR (on-request services)	Yes	6	0	5	Pilot	3
	No	0	6	0	Commercial	2
EPC Aggregators						
Dynamic tariffs (Day/Night, more complex)	Yes	6	2	5	Pilot	5
	No	0	4	1	Commercial	4
Different Injection/Consumption tariffs	Yes	6	2	6	Pilot	5
	No	0	4	0	Commercial	4
Capacity tariffs	Yes	6	1	5	Pilot	4
	No	0	5	1	Commercial	3
Explicit DR (on-request services)	Yes	6	3	5	Pilot	4
	No	0	3	1	Commercial	4
Others						
Dynamic tariffs (Day/Night, more complex)	Yes	6	3	6	Pilot	5
	No	0	3	0	Commercial	5
Different Injection/Consumption tariffs	Yes	6	3	6	Pilot	5
	No	0	3	0	Commercial	5
Capacity tariffs	Yes	5	1	6	Pilot	6
	No	1	5	0	Commercial	4
Explicit DR (on-request services)	Yes	6	3	6	Pilot	6
	No	0	3	0	Commercial	4

Business case	Explanation	Respondants
Dynamic tariffs (Day/Night, more complex)	Not enough informed about the way to organize it. It depends also of the capacity of the market to offer such tariffs	EPC Aggregators
Dynamic tariffs (Day/Night, more complex)	Trialled a demand response situation but need more available power to be effective.	EPC Aggregators
Dynamic tariffs (Day/Night, more complex)	If advanced monitoring and automation is installed, then the next step to DR is small, especially compared to the possible gains.	EPC Aggregators
Dynamic tariffs (Day/Night, more complex)	Les pouvoirs publics ont des processus décisionnels lents et sont peu enclin (en général) à implémenter des solutions innovantes sans retour d'expérience. Par contre, ils sont généralement intéressés à la participation à des projets pilotes (impacts citoyens, image).	EPC Aggregators
Dynamic tariffs (Day/Night, more complex)	BC for active buildings should always be based on value-stacking / multi-use case... one of them is price optimization	EPC Aggregators
Dynamic tariffs (Day/Night, more complex)	Italian market is not enough mature for such innovative business model (we are still working hard for ordinary EPC to be spread out and be adopted by public bodies).	EPC Facilitators
Dynamic tariffs (Day/Night, more complex)	Spread between low and high tariff is increasing making it a more attractive use case	EPC Facilitators
Dynamic tariffs (Day/Night, more complex)	We do, but small effects.	EPC Facilitators
Dynamic tariffs (Day/Night, more complex)	Currently EPC only with KPI's and Supply contracting GJ only seasonal GJ pricing	EPC Facilitators
Dynamic tariffs (Day/Night, more complex)	What i understood from the regulator is that day/night tariff structure is under discussion. Value of this day/night is also dependent on the actual energy prices. For MS clients this difference is relatively limited compared to LS customers.	ESCOs
Dynamic tariffs (Day/Night, more complex)	We would like to use it in a hospital building. This DR solution can be a upskill of the total EPC project	ESCOs
Dynamic tariffs (Day/Night, more complex)	For the moment, the majority of the budget is dedicated to the enveloppe works (insulation, new windows, roof renovation) and the majority of the energy savings is done by these works and by the increased efficiency of the HVAC, lighting, ventilation assets. So not so much budget left to implement the Demand Response on top of that and for the moment, the balance between investment/gain is not so high compared with the first action listed.	ESCOs
Dynamic tariffs (Day/Night, more complex)	Not making use today but could be in the future	ESCOs
Dynamic tariffs (Day/Night, more complex)	In line with current EPC offerings.	ESCOs
Dynamic tariffs (Day/Night, more complex)	Market maturity is low / Split of responsibilities / contract with supplier	ESCOs
Dynamic tariffs (Day/Night, more complex)	This offering is usually decides by the Client directly in consultation with their energy provider. More often though now we are carrying out assessment on the technical side of electrical storage and its effect on cost and building carbon intensity.	ESCOs
Dynamic tariffs (Day/Night, more complex)	The cost of Engery Storing infrastructure not being sufficiently subsidised to lower the investment cost and pay-back period	ESCOs
Dynamic tariffs (Day/Night, more complex)	All'interno del nostro portafoglio Clienti dove sono attivi EPC, abbiamo implementato su tre clienti un progetto di energy management system che gestisce impianti di co/trigenerazione, pompe di calore, gruppi frigo e centrali termiche insieme a dei buffer per lo stoccaggio dei fluidi energetici che, partendo da una curva tipica del consumo di energia nelle 24 ore, sceglie la miglior integrazione energetica ed economica delle tecnologie disponibili.	ESCOs
Dynamic tariffs (Day/Night, more complex)	We make use of it on our Energy Communities.	Others
Dynamic tariffs (Day/Night, more complex)	No support from the regulator to implement this in a way that the results measured are useful	Others
Dynamic tariffs (Day/Night, more complex)	Differentiated tariffs for commercial/services consumers are currently available with 4 periods to whomever choses it. To improve demand response through the network tariffs, a pilot project was conducted (June-2018 – May-2019). Directive no. 6/2018, of 27th of February defined the rules (https://www.erse.pt/media/kefjghll/0630006321.pdf). The project aimed the study of reinforced price signal for super peak and normal peak hours, locational signals across 6 grid areas. Dynamic network tariffs still require more study, especially if combined with flexibility procurement, and during the next two years, other pilot projects will follow as well as the creation of workgroups with stakeholders.	Others
Dynamic tariffs (Day/Night, more complex)	This model is not yet in force in municipal buildings given that for proper operation requires equipment to enable such management. In this case, unless in pilot projects, I believe that immediately hiring this type of service is still a barrier. Outside pilot projects, similar to what is already done today, will be the use of management platforms for example for electric mobility under municipal management, which allow to identify the most economical periods and adapt the charging needs.	Others
Dynamic tariffs (Day/Night, more complex)	I'm not making use of this business case, but it looks very interesting. Maybe in the future!	Others

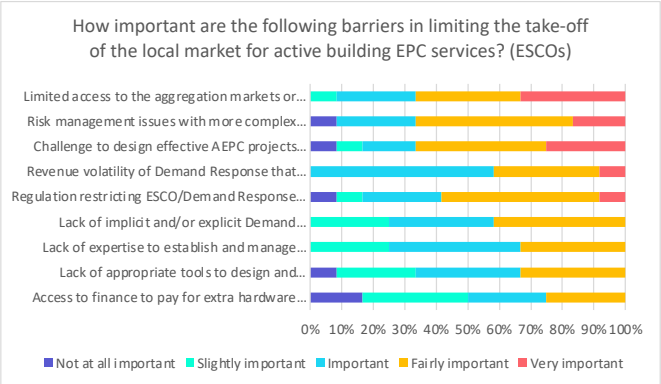
Business case	Explanation	Respondants
Different Injection/Consumption tariffs	Not enough informed about the way to organize it. It depends also of the capacity of the market to offer such tariffs	EPC Aggregators
Different Injection/Consumption tariffs	Trialled a demand response situation but need more available power to be effective.	EPC Aggregators
Different Injection/Consumption tariffs	If advanced monitoring and automation is installed, then the next step to DR is small, especially compared to the possible gains.	EPC Aggregators
Different Injection/Consumption tariffs	Exemple : communauté d'énergie à Bruxelles	EPC Aggregators
Different Injection/Consumption tariffs	Regulation issue - in cases where we are energy supplier this is part of portfolio optimization. If we are not the supplier, then it is not a business case.	EPC Aggregators
Different Injection/Consumption tariffs	Even much more innovative for the Italian market of the dynamic tariff model.	EPC Facilitators
Different Injection/Consumption tariffs	Tariffs currently promote self-consumption, so objective is typically to minimize energy flows to the grid	EPC Facilitators
Different Injection/Consumption tariffs	Self-consumption (renewables) is an important parameter.	EPC Facilitators
Different Injection/Consumption tariffs	ESCO 's are providing energy savings in kWh, energy contract is standard the responsability of the client since this party takes the price risk.	ESCOs
Different Injection/Consumption tariffs	We would like to use it in a hospital building. This DR solution can be a upskill of the total EPC project	ESCOs
Different Injection/Consumption tariffs	Not so relevant as probably the Renewable Energy Community wil rise up and create a virtual autoconsumtion of the energy injected.	ESCOs
Different Injection/Consumption tariffs	Few ongoing projects with different injection/consumption tariffs	ESCOs
Different Injection/Consumption tariffs	In line with integration of PV in existing EPC projects	ESCOs
Different Injection/Consumption tariffs	Case of maximizing autoconsumptions of local electrical production.	ESCOs
Different Injection/Consumption tariffs	Usually negotiated direct with Energy provider.	ESCOs
Different Injection/Consumption tariffs	All'interno del nostro portafoglio Clienti dove sono attivi EPC, abbiamo implementato su tre clienti un progetto di energy management system che gestisce impianti di co/trigenerazione, pompe di calore, gruppi frigo e centrali termiche insieme a dei buffer per lo stoccaggio dei fluidi energetici che, partendo da una curva tipica del consumo di energia nelle 24 ore, sceglie la miglior integrazione energetica ed economica delle tecnologie disponibili.	ESCOs
Different Injection/Consumption tariffs	We make use of it on our Energy Communities.	Others
Different Injection/Consumption tariffs	No support from the regulator to implement this in a way that the results measured are useful	Others
Different Injection/Consumption tariffs	The prices for consumption depend on the offers of suppliers. The prices for injection in the grid follow wholesale market prices either by bilateral contract or by selling to the last resort aggregator with a variable price (wholesale market monthly average minus a parcel which represents the costs of representation of the agent in the market), surplus of self-consumption for example.	Others
Different Injection/Consumption tariffs	at the current date, the capacity to inject energy into the grid in the dimensioned projects is minimal, and the objective is always to reduce the use of energy in buildings through self-consumption	Others
Different Injection/Consumption tariffs	I'm not making use of this business case, but it looks very interesting. Maybe in the future!	Others

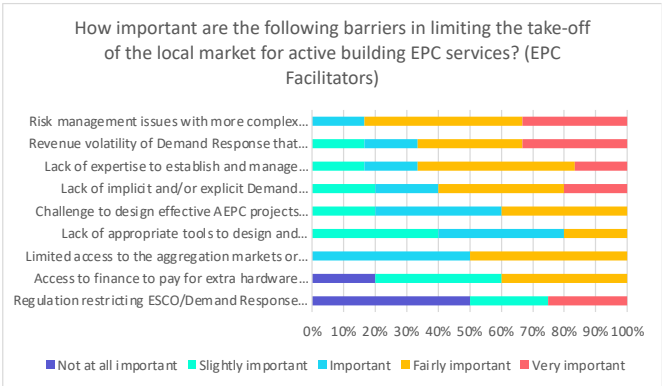
Business case	Explanation	Respondants
Capacity tariffs	Far from the business case of the Ministry.	EPC Aggregators
Capacity tariffs	Further analysis required	EPC Aggregators
Capacity tariffs	Capacity tariffs will be implemented in the summer of 2022.	EPC Aggregators
Capacity tariffs	existant	EPC Aggregators
Capacity tariffs	Regulation evolves very slowly - DSO's are starting research to answer questions they have been asking for 15 years now.	EPC Aggregators
Capacity tariffs	Even much more innovative for the Italian market for the 2 previous models.	EPC Facilitators
Capacity tariffs	Capacity tariffs will see a big evolution in the coming years, as capacity becomes an issue in dense urban areas	EPC Facilitators
Capacity tariffs	We will do this soon.	EPC Facilitators
Capacity tariffs	With Supply Contracting >> price/GJ	EPC Facilitators
Capacity tariffs	see previous answer, wrt capacity tariffs it's more easy to link this to an EPC since it can be measured in a straightforward way.	ESCOs
Capacity tariffs	We would like to use it in a hospital building. This DR solution can be a upskill of the total EPC project	ESCOs
Capacity tariffs	Already in place (for injection) but it will depend strongly of the amount of the tariffs.	ESCOs
Capacity tariffs	Few ongoing projects with capacity tariffs	ESCOs
Capacity tariffs	Capacity tariffs (not) yet used by our customers	ESCOs
Capacity tariffs	Complexity of capacity tariffs grant Vs pratical/technical implementation in buildings	ESCOs
Capacity tariffs	Sorry may not be understanding this completely. Is this the the business case for load management to stay within certain capacity thresholds. We'd normally set site threshold close to operational needs and review based on excess / capacity billing charges. So there tend to be no active load management to avoid capacity charges.	ESCOs
Capacity tariffs	se riferito alla capacità di generazione elettrica, nei servizi di Demande Response Side previsti da Terna SpA, riteniamo che alle condizioni di remunerazione attualmente previste, il case sia interessante in presenza di unità di cogenerazione ad alto rendimento che utilizzino MCI con capacità di generazione superiore a 500 kWe	ESCOs
Capacity tariffs	We are not yet using this.	Others
Capacity tariffs	No support from the regulator to implement this in a way that the results measured are useful	Others
Capacity tariffs	Besides reducing costs, capacity control may allow more load to be connected withou having to incrase the grid capacity and infrastructure. With the increase of electric vehicles being connected to the grid it becomes an essencial issue, making this one of the subjects being studied currently.	Others
Capacity tariffs	At the present date, storage systems still have high costs that are not covered by the tariffs	Others
Capacity tariffs	I'm not making use of this business case, but it looks very interesting. Maybe in the future!	Others

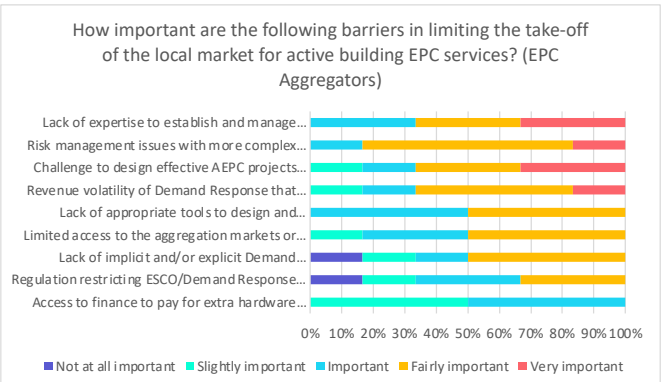
Business case	Explanation	Respondants
Explicit DR (on-request services)	Lack of information about market's offers	EPC Aggregators
Explicit DR (on-request services)	Further analysis required	EPC Aggregators
Explicit DR (on-request services)	This is the easiest business case, since it is rather well predictable.	EPC Aggregators
Explicit DR (on-request services)	existant	EPC Aggregators
Explicit DR (on-request services)	Local flex initiatives do pop-up, explicit flex market has a role in local communities.	EPC Aggregators
Explicit DR (on-request services)	The Italian market is not mature according to our opinion for such business case.	EPC Facilitators
Explicit DR (on-request services)	This is the most complex mechanism to exploit. Ancillary services markets where DR can participate are gaining shape as most conventional markets pose difficult challenges for DR. They are, however, changing at an interesting pace and may become commercially feasible in the 3-5 year horizon.	EPC Facilitators
Explicit DR (on-request services)	We need a full implementation of digital AMR metering first	EPC Facilitators
Explicit DR (on-request services)	Consultancy on energy label improvement Not our specialty	EPC Facilitators
Explicit DR (on-request services)	it's already challenging to "sell" a standard EPC. By integrating flexibility this will increase the complexity of the contracting, roles/responsibilities of different parties and thus probably more difficult to sell. Especially since the value for money of this flexibiliy is rather limited so far.	ESCOs
Explicit DR (on-request services)	DR business is already running successful in Belgium and believe that it will be growing the next years	ESCOs
Explicit DR (on-request services)	Possile only for Electrical mobility when the wharging power will be big enough to create problems and to be one of the solutions at the same time.	ESCOs
Explicit DR (on-request services)	Is our core business	ESCOs
Explicit DR (on-request services)	Would require significant volume.	ESCOs
Explicit DR (on-request services)	with automated APIs	ESCOs
Explicit DR (on-request services)	On many sites the load thresholds are too high to create site viability / aggregator interest. Dynamic tariff is not available and tiering still somewhat limited but developing. Demand response events are increasing and feedback is that some participants are 'opting-out' of schemes due to operational disruption. In terms of EPC revenue because of revenue uncertainty DR is not being considered as a fundable revenue stream by lenders	ESCOs
Explicit DR (on-request services)	i servizi cui stiamo pensando riguardano il monitoring degli impianti tecnologici del Cliente mediante istituzione di sala operativa attiva 24/24 e 7/7 e servizio di reperibilità & pronto intervento entro un lasso temporale definito. fino ad oggi non abbiamo avuto successo per la reticenza del Cliente che attualmente gestisce in autonomia il proprio impianto con chiamata diretta per le emergenze grazie all'utilizzo di piccole ditte di manutenzione impianti che sono composte spesso dal titolare e pochi collaboratori, spesso apprendisti che riescono ad intervenire solo per interventi di blocco degli impianti ma con Know How molto limitato in presenza di integrazioni impiantistiche complesse. Esempio: trigenerazione, pompe di calore, generatori di calore, gruppi frigo, fotovoltaico.	ESCOs
Explicit DR (on-request services)	We make use of it on our pilot Energy Communities.	Others
Explicit DR (on-request services)	No support from the regulator to implement this in a way that the results measured are useful	Others
Explicit DR (on-request services)	A pilot project is still ongoing was conducted for the participation of consumers in the regulation reserve market. During the pilot project, individual consumers that can offer more than 1 MW of “regulation reserves” and pass prequalification procedures are allowed to participate on equal conditions with current players. For this service consumers will be entitled to the same payments as generators. Directive no. 4, of January 15th, approved the rules for the project (https://dre.pt/application/conteudo/117821525). The objective now is to implement the lessons learnt and to open the system services market to other consumers. Also, other projects will certainly follow for different services. Storage and distributed generation are good solutions to work with such services. Although the rules do not allow, they will certainly be used as pilot projects.	Others
Explicit DR (on-request services)	At the current date, I would not use this model as a commercial project given the lack of sensitivity that exists, especially in the municipalities. Only after projects are implemented and results are presented I think this step can be taken.	Others
Explicit DR (on-request services)	I'm not making use of this business case, but it looks very interesting. Maybe in the future!	Others

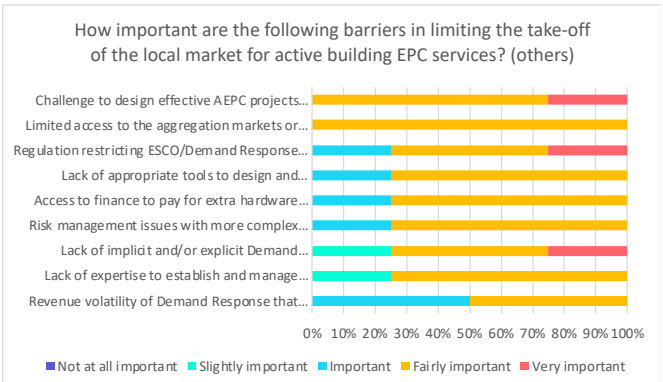
BARRIERS TO AEPC SERVICES

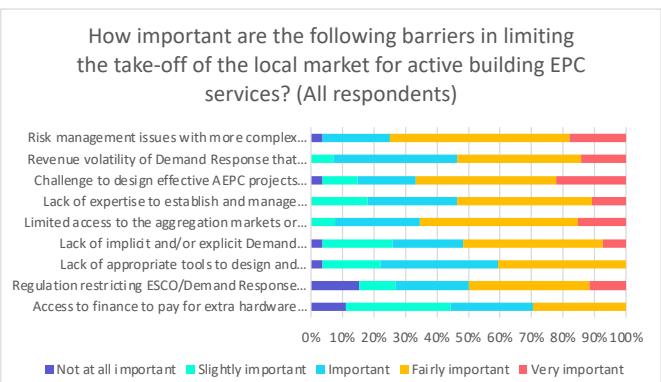
How important are the following barriers in limiting the take-off of the local market for active building EPC services?	Not at all important	Slightly important	Important	Fairly important	Very important	Scoring
ESCOs						
Access to finance to pay for extra hardware cost and active control capex	2	4	3	3		**31**
Lack of appropriate tools to design and manage flexibility in AEPC projects	1	3	4	4		**35**
Lack of expertise to establish and manage AEPC M&V protocols		3	5	4		**37**
Lack of implicit and/or explicit Demand Response products offer on the local market		3	4	5		**38**
Regulation restricting ESCO/Demand Response services on the local market	1	1	3	6	1	**41**
Revenue volatility of Demand Response that might be difficult to integrate into long term EPC business models			7	4	1	**42**
Challenge to design effective AEPC projects with positive business cases	1	1	2	5	3	**44**
Risk management issues with more complex contractual agreements that might affect customer acceptance	1		3	6	2	**44**
Limited access to the aggregation markets or entry barriers such as high entry costs that prevent to access aggregation services		1	3	4	4	**47**
EPC Facilitators						
Regulation restricting ESCO/Demand Response services on the local market	2	1			1	**9**
Access to finance to pay for extra hardware cost and active control capex	1	2		2		**13**
Limited access to the aggregation markets or entry barriers such as high entry costs that prevent to access aggregation services			2	2		**14**
Lack of appropriate tools to design and manage flexibility in AEPC projects		2	2	1		**14**
Challenge to design effective AEPC projects with positive business cases		1	2	2		**16**
Lack of implicit and/or explicit Demand Response products offer on the local market		1	1	2	1	**18**
Lack of expertise to establish and manage AEPC M&V protocols		1	1	3	1	**22**
Revenue volatility of Demand Response that might be difficult to integrate into long term EPC business models		1	1	2	2	**23**
Risk management issues with more complex contractual agreements that might affect customer acceptance			1	3	2	**25**
EPC Aggregators						
Access to finance to pay for extra hardware cost and active control capex		3	3			**15**
Regulation restricting ESCO/Demand Response services on the local market	1	1	2	2		**17**
Lack of implicit and/or explicit Demand Response products offer on the local market	1	1	1	3		**18**
Limited access to the aggregation markets or entry barriers such as high entry costs that prevent to access aggregation services		1	2	3		**20**
Lack of appropriate tools to design and manage flexibility in AEPC projects			3	3		**21**
Revenue volatility of Demand Response that might be difficult to integrate into long term EPC business models		1	1	3	1	**22**
Challenge to design effective AEPC projects with positive business cases		1	1	2	2	**23**
Risk management issues with more complex contractual agreements that might affect customer acceptance			1	4	1	**24**
Lack of expertise to establish and manage AEPC M&V protocols			2	2	2	**24**
Others						
Revenue volatility of Demand Response that might be difficult to integrate into long term EPC business models			2	2		**14**
Lack of expertise to establish and manage AEPC M&V protocols		1		3		**14**
Lack of implicit and/or explicit Demand Response products offer on the local market		1		2	1	**15**
Risk management issues with more complex contractual agreements that might affect customer acceptance			1	3		**15**
Access to finance to pay for extra hardware cost and active control capex			1	3		**15**
Lack of appropriate tools to design and manage flexibility in AEPC projects			1	3		**15**
Regulation restricting ESCO/Demand Response services on the local market			1	2	1	**16**
Limited access to the aggregation markets or entry barriers such as high entry costs that prevent to access aggregation services				4		**16**
Challenge to design effective AEPC projects with positive business cases				3	1	**17**

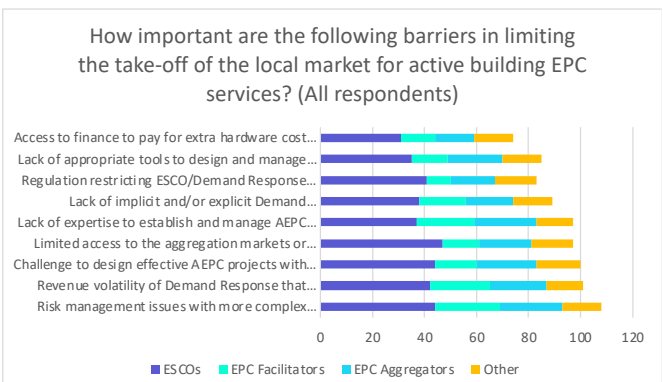

How important are the following barriers in limiting the take-off of the local market for active building EPC services? (ESCOs)
Limited access to the aggregation markets or...
Risk management issues with more complex...
Challenge to design effective AEPC projects...
Revenue volatility of Demand Response that...
Regulation restricting ESCO/Demand Response...
Lack of implicit and/or explicit Demand...
Lack of expertise to establish and manage...
Lack of appropriate tools to design and...
Access to finance to pay for extra hardware...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following barriers in limiting the take-off of the local market for active building EPC services? (EPC Facilitators)
Risk management issues with more complex...
Revenue volatility of Demand Response that...
Lack of expertise to establish and manage...
Lack of implicit and/or explicit Demand...
Challenge to design effective AEPC projects...
Lack of appropriate tools to design and...
Limited access to the aggregation markets or...
Access to finance to pay for extra hardware...
Regulation restricting ESCO/Demand Response...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following barriers in limiting the take-off of the local market for active building EPC services? (EPC Aggregators)
Lack of expertise to establish and manage...
Risk management issues with more complex...
Challenge to design effective AEPC projects...
Revenue volatility of Demand Response that...
Lack of appropriate tools to design and...
Limited access to the aggregation markets or...
Lack of implicit and/or explicit Demand...
Regulation restricting ESCO/Demand Response...
Access to finance to pay for extra hardware...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following barriers in limiting the take-off of the local market for active building EPC services? (others)
Challenge to design effective AEPC projects...
Limited access to the aggregation markets or...
Regulation restricting ESCO/Demand Response...
Lack of appropriate tools to design and...
Access to finance to pay for extra hardware...
Risk management issues with more complex...
Lack of implicit and/or explicit Demand...
Lack of expertise to establish and manage...
Revenue volatility of Demand Response that...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Not at all important
Slightly important
Important
Fairly important
Very important

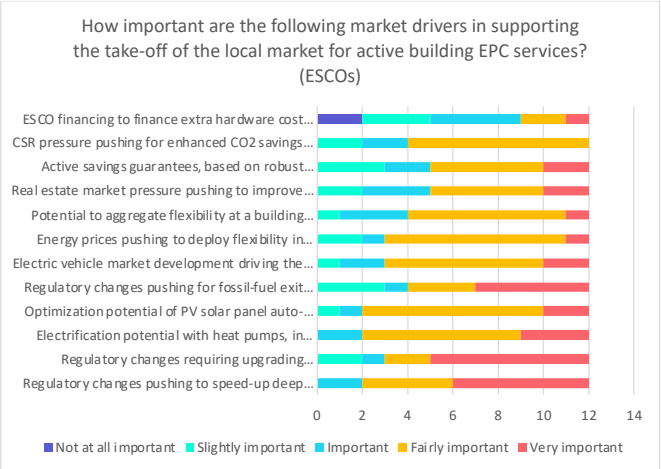

How important are the following barriers in limiting the take-off of the local market for active building EPC services? (All respondents)
Risk management issues with more complex...
Revenue volatility of Demand Response that...
Challenge to design effective AEPC projects...
Lack of expertise to establish and manage...
Limited access to the aggregation markets or...
Lack of implicit and/or explicit Demand...
Lack of appropriate tools to design and...
Regulation restricting ESCO/Demand Response...
Access to finance to pay for extra hardware...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Not at all important
Slightly important
Important
Fairly important
Very important

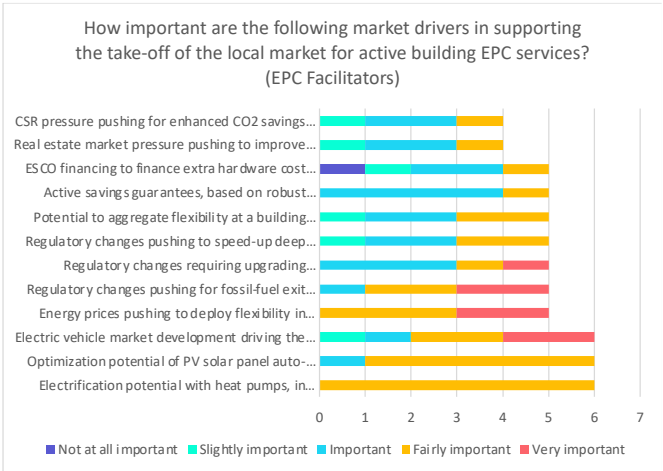

How important are the following barriers in limiting the take-off of the local market for active building EPC services? (All respondents)
Access to finance to pay for extra hardware cost...
Lack of appropriate tools to design and manage...
Regulation restricting ESCO/Demand Response...
Lack of implicit and/or explicit Demand...
Lack of expertise to establish and manage AEPC...
Limited access to the aggregation markets or...
Challenge to design effective AEPC projects with...
Revenue volatility of Demand Response that...
Risk management issues with more complex...
0 20 40 60 80 100 120
ESCOs
EPC Facilitators
EPC Aggregators
Other

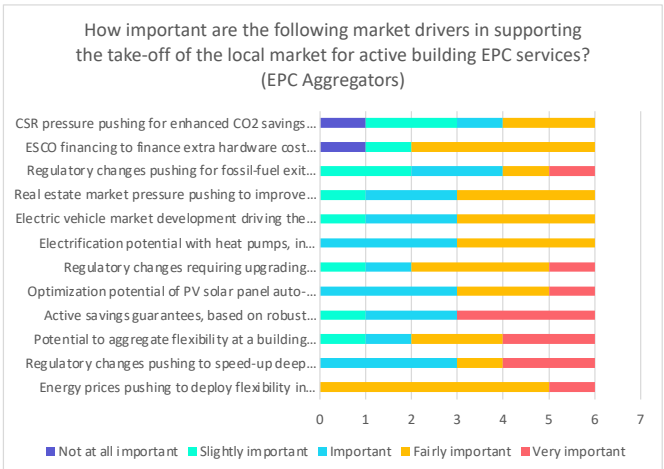
What are the 3 main barriers that you face in offering AEPC services to your customers or end-users (tenants and occupants)?		
Type of barrier	**Barrier description**	**Respondants**
Market and technology readiness	There is no clear cooperation / go to market strategy between AEPC and EPC providers.	Facilitators
Market and technology readiness	Management Tools	Others
Market and technology readiness	Maturity of the ESCO-market	Aggregators
Market and technology readiness	Maturity of products on the market	Aggregators
Market and technology readiness	Delivery capacity	ESCOs
Market and technology readiness	Technical solutions	Aggregators
Availability of flexibility on the market	Lack of implicit and/or explicit DR products offer on the local market	ESCOs
Availability of flexibility on the market	Limited access to the aggregation markets or entry barriers such as high entry costs that prevent access aggregation services	ESCOs
Availability of flexibility on the market	Lack of infrastructure	ESCOs
Availability of flexibility on the market	Lack of standard price packages	ESCOs
Availability of flexibility on the market	lack of bi-directional EV's	Facilitators
Availability of flexibility on the market	Limited access or high costs for consumers participation in demand response	Others
Awareness, confidence & capacity of End-Users	Case studies to present	Aggregators
Awareness, confidence & capacity of End-Users	Consumer acceptance of the concept	Aggregators
Awareness, confidence & capacity of End-Users	Lack of Expertise + Market Power of Traditional 'system'	Aggregators
Awareness, confidence & capacity of End-Users	Lack of information about how it goes, about the impact of such services to end-users	Aggregators
Awareness, confidence & capacity of End-Users	No knowledge about business cases & success stories	Aggregators
Awareness, confidence & capacity of End-Users	Not well informed about feasability	Aggregators
Awareness, confidence & capacity of End-Users	Acceptance of ACTIVE control	ESCOs
Awareness, confidence & capacity of End-Users	Already limited market size of standard EPC contracts	ESCOs
Awareness, confidence & capacity of End-Users	Client awareness	ESCOs
Awareness, confidence & capacity of End-Users	Distrust to new businessmodel	ESCOs
Awareness, confidence & capacity of End-Users	Lack of know-how at customers	ESCOs
Awareness, confidence & capacity of End-Users	Lack of vision of opportunities	ESCOs
Awareness, confidence & capacity of End-Users	Long sales cycle / customer awareness	ESCOs
Awareness, confidence & capacity of End-Users	Market size	ESCOs
Awareness, confidence & capacity of End-Users	The habit of turning to the existing craftsman	ESCOs
Awareness, confidence & capacity of End-Users	AEPC providers focus on commercial real estate. Commercial real estate is no market (yet) for EPC.	Facilitators
Awareness, confidence & capacity of End-Users	Governments don't tender.	Facilitators
Awareness, confidence & capacity of End-Users	Not on the agenda of customer	Facilitators
Awareness, confidence & capacity of End-Users	Trust (new product)	Facilitators
Awareness, confidence & capacity of End-Users	Dissemination of good practices and positive results within service providers and consumers	Others
Awareness, confidence & capacity of End-Users	Knowledge and information of consumers	Others
Awareness, confidence & capacity of End-Users	Lack of information and knowledge about the advantages/disadvantages	Others
Awareness, confidence & capacity of End-Users	Lack of trust	Others
Contractual and technical complexity	Complexity	ESCOs
Contractual and technical complexity	Link with energy supply contracts	ESCOs
Contractual and technical complexity	Technical limits to optimize flexibility	ESCOs
Contractual and technical complexity	Complexity of the contracting vis a vis the client but also vis a vis financing parties of the esco project	ESCOs
Contractual and technical complexity	Complexity	Facilitators
Contractual and technical complexity	Perceived difficulty to contract AEPC	Facilitators
Contractual and technical complexity	Creating a DR baseline and forecast	Facilitators
Contractual and technical complexity	Combining DR delivery streams with internal asset optimization	Facilitators
Contractual and technical complexity	Difficult add-on to an already complex contracting structure	Aggregators
Contractual and technical complexity	Combination of 2 incumbent markets (OEPC and Demand Response)	Aggregators
Regulatory framework	Moving regulatory framework (or not moving enough)	ESCOs
Regulatory framework	Regulation restricting ESCO/Demand Response services on the local market	ESCOs
Regulatory framework	Lack of legislation	ESCOs
Regulatory framework	Regulatory framework	Facilitators
Regulatory framework	Regulation	Others
Regulatory framework	Lack of appropriate regulation and market structure	Others
Regulatory framework	Ucertainty in evolution of regulation	Aggregators
Risks issues	Risk management (occupants' comfort)	ESCOs
Risks issues	Risk profile	ESCOs
Uncertainty about profitability	Creating positive business plans	ESCOs
Uncertainty about profitability	ROI (Return on Invsetment) - cost vs benefit	ESCOs
Uncertainty about profitability	Service costs	ESCOs
Uncertainty about profitability	Operating incomes	ESCOs
Uncertainty about profitability	Splitting economic benefits between people living in the building	ESCOs
Uncertainty about profitability	Payback duration (absence of granting schemes)	ESCOs
Uncertainty about profitability	Limited value of these flexibility services	ESCOs
Uncertainty about profitability	Finance	ESCOs
Uncertainty about profitability	startup costs vs revenue	Facilitators
Uncertainty about profitability	Hardware cost	Others
Uncertainty about profitability	Uncertain returns	Aggregators
Uncertainty about profitability	Rentabilité (rapport coûts/efforts <-> bénéfices)	Aggregators

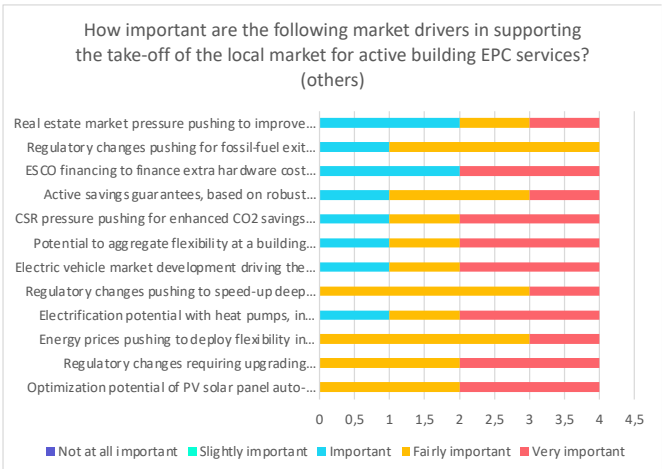
DRIVERS TO AEPC SERVICES

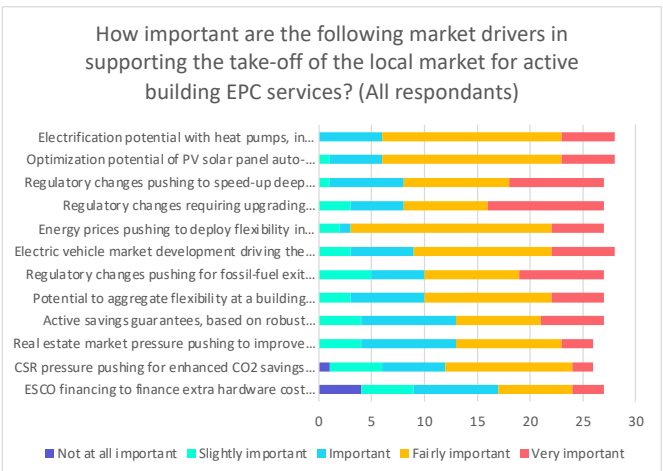
How important are the following market drivers in supporting the take-off of the local market for active building EPC services?	Not at all important	Slightly important	Important	Fairly important	Very important	Scoring
ESCOs						
Regulatory changes pushing to speed-up deep renovation and net-zero energy buildings			2	4	6	**52**
Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems		2	1	2	7	**50**
Electrification potential with heat pumps, in combination with envelope insulation as an energy efficiency game changer			2	7	3	**49**
Optimization potential of PV solar panel auto-consumption linked to local injection/supply market conditions		1	1	8	2	**47**
Regulatory changes pushing for fossil-fuel exit for heating		3	1	3	5	**46**
Electric vehicle market development driving the need for the installation of EV charging equipment in buildings		1	2	7	2	**46**
Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business		2	1	8	1	**44**
Potential to aggregate flexibility at a building portfolio level to access the DR aggregation market and generate further additional revenues		1	3	7	1	**44**
Real estate market pressure pushing to improve the property value with greener and more efficient buildings		2	3	5	2	**43**
Active savings guarantees, based on robust contractual agreements and M&V protocols		3	2	5	2	**42**
CSR pressure pushing for enhanced CO2 savings to serve greener agenda and commitments		2	2	8		**42**
ESCO financing to finance extra hardware cost and active control capex	2	3	4	2	1	**33**
EPC Facilitators						
Electrification potential with heat pumps, in combination with envelope insulation as an energy efficiency game changer				6		**24**
Optimization potential of PV solar panel auto-consumption linked to local injection/supply market conditions			1	5		**23**
Electric vehicle market development driving the need for the installation of EV charging equipment in buildings		1	1	2	2	**23**
Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business				3	2	**22**
Regulatory changes pushing for fossil-fuel exit for heating			1	2	2	**21**
Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems			3	1	1	**18**
Regulatory changes pushing to speed-up deep renovation and net-zero energy buildings		1	2	2		**16**
Potential to aggregate flexibility at a building portfolio level to access the DR aggregation market and generate further additional revenues		1	2	2		**16**
Active savings guarantees, based on robust contractual agreements and M&V protocols			4	1		**16**
ESCO financing to finance extra hardware cost and active control capex	1	1	2	1		**13**
Real estate market pressure pushing to improve the property value with greener and more efficient buildings		1	2	1		**12**
CSR pressure pushing for enhanced CO2 savings to serve greener agenda and commitments		1	2	1		**12**
EPC Aggregators						
Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business				5	1	**25**
Regulatory changes pushing to speed-up deep renovation and net-zero energy buildings			3	1	2	**23**
Potential to aggregate flexibility at a building portfolio level to access the DR aggregation market and generate further additional revenues		1	1	2	2	**23**
Active savings guarantees, based on robust contractual agreements and M&V protocols		1	2		3	**23**
Optimization potential of PV solar panel auto-consumption linked to local injection/supply market conditions			3	2	1	**22**
Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems		1	1	3	1	**22**
Electrification potential with heat pumps, in combination with envelope insulation as an energy efficiency game changer			3	3		**21**
Electric vehicle market development driving the need for the installation of EV charging equipment in buildings		1	2	3		**20**
Real estate market pressure pushing to improve the property value with greener and more efficient buildings		1	2	3		**20**
Regulatory changes pushing for fossil-fuel exit for heating		2	2	1	1	**19**
ESCO financing to finance extra hardware cost and active control capex	1	1		4		**19**
CSR pressure pushing for enhanced CO2 savings to serve greener agenda and commitments	1	2	1	2		**16**
Others						
Optimization potential of PV solar panel auto-consumption linked to local injection/supply market conditions				2	2	**18**
Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems				2	2	**18**
Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business				3	1	**17**
Electrification potential with heat pumps, in combination with envelope insulation as an energy efficiency game changer			1	1	2	**17**
Regulatory changes pushing to speed-up deep renovation and net-zero energy buildings				3	1	**17**
Electric vehicle market development driving the need for the installation of EV charging equipment in buildings			1	1	2	**17**
Potential to aggregate flexibility at a building portfolio level to access the DR aggregation market and generate further additional revenues			1	1	2	**17**
CSR pressure pushing for enhanced CO2 savings to serve greener agenda and commitments			1	1	2	**17**
Active savings guarantees, based on robust contractual agreements and M&V protocols			1	2	1	**16**
ESCO financing to finance extra hardware cost and active control capex			2		2	**16**
Regulatory changes pushing for fossil-fuel exit for heating			1	3		**15**
Real estate market pressure pushing to improve the property value with greener and more efficient buildings			2	1	1	**15**


How important are the following market drivers in supporting the take-off of the local market for active building EPC services? (ESCOs)
ESCO financing to finance extra hardware cost...
CSR pressure pushing for enhanced CO2 savings...
Active savings guarantees, based on robust...
Real estate market pressure pushing to improve...
Potential to aggregate flexibility at a building...
Energy prices pushing to deploy flexibility in...
Electric vehicle market development driving the...
Regulatory changes pushing for fossil-fuel exit...
Optimization potential of PV solar panel auto-...
Electrification potential with heat pumps, in...
Regulatory changes requiring upgrading...
Regulatory changes pushing to speed-up deep...
0 2 4 6 8 10 12 14
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following market drivers in supporting the take-off of the local market for active building EPC services? (EPC Facilitators)
CSR pressure pushing for enhanced CO2 savings...
Real estate market pressure pushing to improve...
ESCO financing to finance extra hardware cost...
Active savings guarantees, based on robust...
Potential to aggregate flexibility at a building...
Regulatory changes pushing to speed-up deep...
Regulatory changes requiring upgrading...
Regulatory changes pushing for fossil-fuel exit...
Energy prices pushing to deploy flexibility in...
Electric vehicle market development driving the...
Optimization potential of PV solar panel auto-...
Electrification potential with heat pumps, in...
0 1 2 3 4 5 6 7
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following market drivers in supporting the take-off of the local market for active building EPC services? (EPC Aggregators)
CSR pressure pushing for enhanced CO2 savings...
ESCO financing to finance extra hardware cost...
Regulatory changes pushing for fossil-fuel exit...
Real estate market pressure pushing to improve...
Electric vehicle market development driving the...
Electrification potential with heat pumps, in...
Regulatory changes requiring upgrading...
Optimization potential of PV solar panel auto-...
Active savings guarantees, based on robust...
Potential to aggregate flexibility at a building...
Regulatory changes pushing to speed-up deep...
Energy prices pushing to deploy flexibility in...
0 1 2 3 4 5 6 7
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following market drivers in supporting the take-off of the local market for active building EPC services? (others)
Real estate market pressure pushing to improve...
Regulatory changes pushing for fossil-fuel exit...
ESCO financing to finance extra hardware cost...
Active savings guarantees, based on robust...
CSR pressure pushing for enhanced CO2 savings...
Potential to aggregate flexibility at a building...
Electric vehicle market development driving the...
Regulatory changes pushing to speed-up deep...
Electrification potential with heat pumps, in...
Energy prices pushing to deploy flexibility in...
Regulatory changes requiring upgrading...
Optimization potential of PV solar panel auto-...
0 0,5 1 1,5 2 2,5 3 3,5 4 4,5
Not at all important
Slightly important
Important
Fairly important
Very important


How important are the following market drivers in supporting the take-off of the local market for active building EPC services? (All respondants)
Electrification potential with heat pumps, in...
Optimization potential of PV solar panel auto-...
Regulatory changes pushing to speed-up deep...
Regulatory changes requiring upgrading...
Energy prices pushing to deploy flexibility in...
Electric vehicle market development driving the...
Regulatory changes pushing for fossil-fuel exit...
Potential to aggregate flexibility at a building...
Active savings guarantees, based on robust...
Real estate market pressure pushing to improve...
CSR pressure pushing for enhanced CO2 savings...
ESCO financing to finance extra hardware cost...
0 5 10 15 20 25 30
Not at all important
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Important
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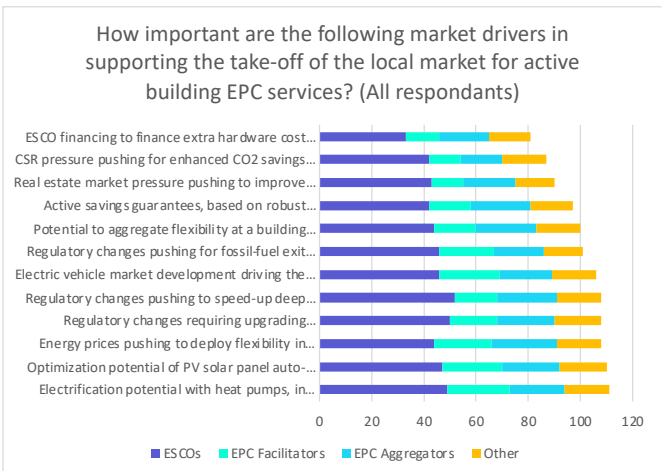
Very important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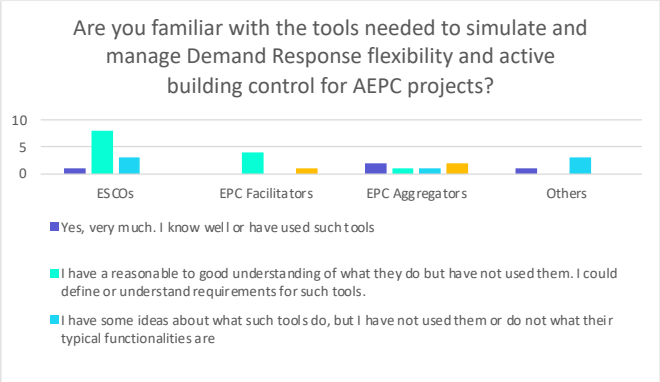
Regulatory changes pushing to speed-up deep...
Regulatory changes requiring upgrading...
Energy prices pushing to deploy flexibility in...
Optimization potential of PV solar panel auto-...
Electrification potential with heat pumps, in...
0 20 40 60 80 100 120
ESCOs
EPC Facilitators
EPC Aggregators
Other

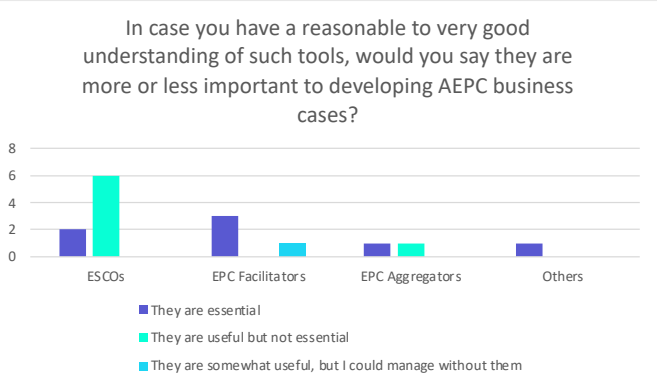
What are the 3 main drivers or opportunities for your organization to offer AEPC services to your customers or end-users (tenants and occupants)?		
Drivers	**Driver description**	**Respondants**
CSR & Real estate market pressure	Green agenda/CO2 savings	ESCOs
CSR & Real estate market pressure	green image	ESCOs
CSR & Real estate market pressure	Reassurance to be future-proof	ESCOs
CSR & Real estate market pressure	Differenciation of real estate offers (fro greener buildings, efficiency)	Others
Development of decentralized RES	Increase on the deployment of decentralized RES	Others
Development of decentralized RES	Proliferation of decentralized unpredictable consuming loads that contribute for the network instability (e.g., EVs)	Others
DR market development	Development of flexible applications	Aggregators
DR market development	DR optimal tariff definition in order to share the maximum value with customers	ESCOs
DR market development	Extra source of savings on a more global level (power production capacity...)	ESCOs
DR market development	New local flexibility markets	Facilitators
Electric vehicle market development	Electric vehicles !	ESCOs
Electric vehicle market development	Electrical Mobility	ESCOs
Electric vehicle market development	Electrification of vehicles and climatization	Facilitators
Electric vehicle market development	EV market development	Facilitators
Electric vehicle market development	EV Charging	Others
Greening/electrification of heating & cooling	electrification	Aggregators
Greening/electrification of heating & cooling	Exit from gas markets = opportunity for heat pumps and heat networks	ESCOs
Greening/electrification of heating & cooling	heat pumps to replace fossil fuel based heating	ESCOs
Greening/electrification of heating & cooling	electrification of heating demands	Facilitators
Greening/electrification of heating & cooling	Electrification	Others
PV solar market development	Otimization of PV production capacity	ESCOs
PV solar market development	PV optimisation, increading self consumption	ESCOs
PV solar market development	PV Solar	Others
Raising awarness, building trust and capacity of End-U	Dissemination of success stories and business cases	Aggregators
Raising awarness, building trust and capacity of End-U	Pilot project	Aggregators
Raising awarness, building trust and capacity of End-U	Capitalize on transversal expertises	ESCOs
Raising awarness, building trust and capacity of End-U	Customers' and/or end-users' demand	ESCOs
Raising awarness, building trust and capacity of End-U	Increase customer awareness of dynamic management	ESCOs
Raising awarness, building trust and capacity of End-U	Market size	ESCOs
Regulation enforcement & incentives	Regulatory changes	Aggregators
Regulation enforcement & incentives	Support régulatoire / incentives	Aggregators
Regulation enforcement & incentives	Development and simplification in energy regulation	ESCOs
Regulation enforcement & incentives	Granting schemes	ESCOs
Regulation enforcement & incentives	Regulatory changes	ESCOs
Regulation enforcement & incentives	Regulatory changes requiring upgrading buildings with active control equipment and Building Management Systems	ESCOs
Regulation enforcement & incentives	governmental obligations	Facilitators
Regulation enforcement & incentives	promotion by central government	Facilitators
Rising and volatile energy prices	Energy prices	Aggregators
Rising and volatile energy prices	Increasing volatility due to RES	Aggregators
Rising and volatile energy prices	Difference between high and low energy prices on the markt (and not the absolute high prices)	ESCOs
Rising and volatile energy prices	Energy prices pushing to deploy flexibility in buildings for additional revenues to offset the increasing costs of running the business	ESCOs
Rising and volatile energy prices	Enery and CO02 pricing models	ESCOs
Rising and volatile energy prices	Price increases	ESCOs
Rising and volatile energy prices	E-prices	Facilitators
Rising and volatile energy prices	prices of energy	Facilitators
Rising and volatile energy prices	High energy costs (push consumers into promote savings and efficiency)	Others
Rising and volatile energy prices	Increasing energy prices	Others
Strengthening the AEPC business model	Integration into larger renovation projects (pooling of customers)	Aggregators
Strengthening the AEPC business model	"A" Becoming part of integrated EPC offers	ESCOs
Strengthening the AEPC business model	Active savings guarantees, based on robust contractual agreements and M&V protocols	ESCOs
Strengthening the AEPC business model	Build customer loyalty in the medium/long term	ESCOs
Strengthening the AEPC business model	Customization EPC formula	ESCOs
Strengthening the AEPC business model	Increase company profitability with high value-added services	ESCOs
Strengthening the AEPC business model	Revenues, cost savings	ESCOs
Strengthening the AEPC business model	Risk profile mitigation	ESCOs
Strengthening the AEPC business model	Offering an integrated management possibility	Facilitators
Strengthening the AEPC business model	Building efficiency continuous management	Others

AEPC TOOLS KNOWLEDGE & IMPORTANCE

Are you familiar with the tools needed to simulate and manage Demand Response flexibility and active building control for AEPC projects?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Yes, very much. I know well or have used such tools	1		2	1	4
I have a reasonable to good understanding of what they do but have not used them. I could define or understand requirements for such tools.	8	4	1		13
I have some ideas about what such tools do, but I have not used them or do not what their typical functionalities are	3		1	3	7
I do not know what the purpose or scope of such tools is	0	1	2		3

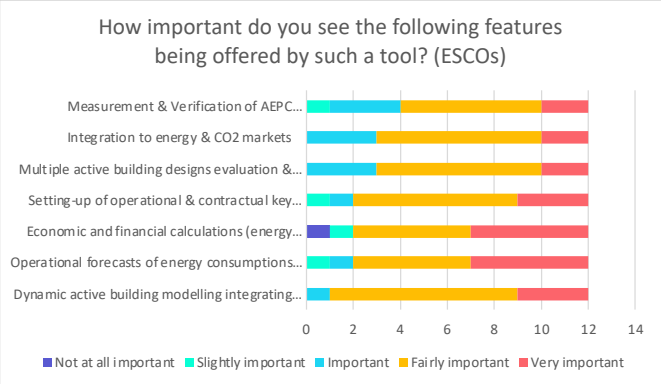
In case you have a reasonable to very good understanding of such tools, would you say they are more or less important to developing AEPC business cases?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
They are essential	2	3	1	1	7
They are useful but not essential	6		1		7
They are somewhat useful, but I could manage without them		1			1
They are not useful					0
I am not familiar with such tools or have no opinion					0

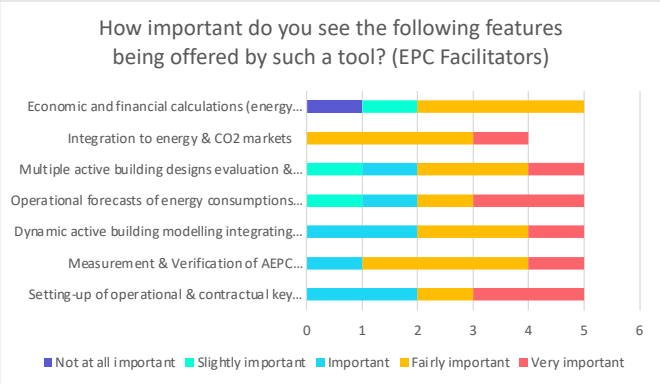


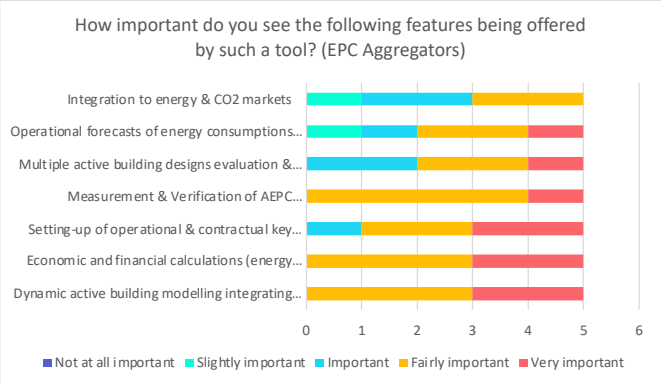


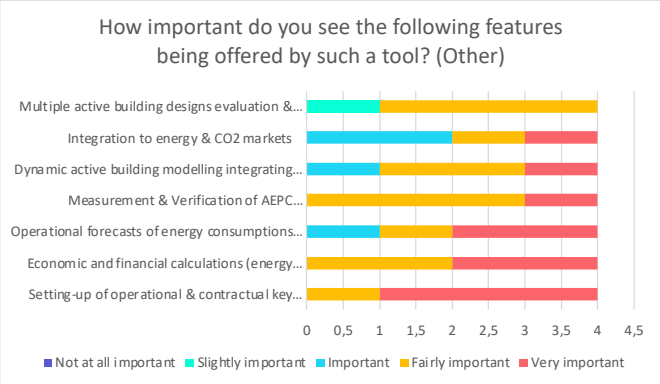
AEPC TOOLS FEATURES EVALUATION

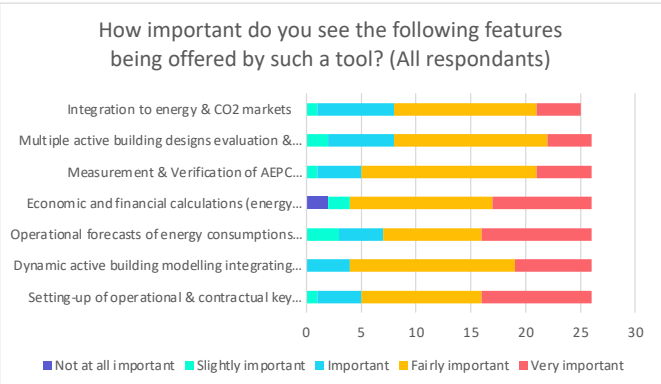
How important do you see the following features being offered by such a tool?	Not at all important	Slightly important	Important	Fairly important	Very important	Scoring
ESCOs						
Dynamic active building modelling integrating DR timely prices or remunerative orders (thermal behaviour, production flexibility, usage flexibility)			1	8	3	**50**
Operational forecasts of energy consumptions and flexibility loads to support active control of flexible assets during operations		1	1	5	5	**50**
Economic and financial calculations (energy savings and investments calculations, financing options simulations, etc.)	1	1		5	5	**48**
Setting-up of operational & contractual key parameters (definition of base line, (non-)routine adjustment factors for M&V, etc.)		1	1	7	3	**48**
Multiple active building designs evaluation & benchmarking based on forecasted scenarios			3	7	2	**47**
Integration to energy & CO2 markets			3	7	2	**47**
Measurement & Verification of AEPC guaranteed savings		1	3	6	2	**45**
EPC Facilitators						
Setting-up of operational & contractual key parameters (definition of base line, (non-)routine adjustment factors for M&V, etc.)			2	1	2	**20**
Measurement & Verification of AEPC guaranteed savings			1	3	1	**20**
Dynamic active building modelling integrating DR timely prices or remunerative orders (thermal behaviour, production flexibility, usage flexibility)			2	2	1	**19**
Operational forecasts of energy consumptions and flexibility loads to support active control of flexible assets during operations		1	1	1	2	**19**
Multiple active building designs evaluation & benchmarking based on forecasted scenarios		1	1	2	1	**18**
Integration to energy & CO2 markets				3	1	**17**
Economic and financial calculations (energy savings and investments calculations, financing options simulations, etc.)	1	1		3		**15**
EPC Aggregators						
Dynamic active building modelling integrating DR timely prices or remunerative orders (thermal behaviour, production flexibility, usage flexibility)				3	2	**22**
Economic and financial calculations (energy savings and investments calculations, financing options simulations, etc.)				3	2	**22**
Setting-up of operational & contractual key parameters (definition of base line, (non-)routine adjustment factors for M&V, etc.)			1	2	2	**21**
Measurement & Verification of AEPC guaranteed savings				4	1	**21**
Multiple active building designs evaluation & benchmarking based on forecasted scenarios			2	2	1	**19**
Operational forecasts of energy consumptions and flexibility loads to support active control of flexible assets during operations		1	1	2	1	**18**
Integration to energy & CO2 markets		1	2	2		**16**
Others						
Setting-up of operational & contractual key parameters (definition of base line, (non-)routine adjustment factors for M&V, etc.)				1	3	**19**
Economic and financial calculations (energy savings and investments calculations, financing options simulations, etc.)				2	2	**18**
Operational forecasts of energy consumptions and flexibility loads to support active control of flexible assets during operations			1	1	2	**17**
Measurement & Verification of AEPC guaranteed savings				3	1	**17**
Dynamic active building modelling integrating DR timely prices or remunerative orders (thermal behaviour, production flexibility, usage flexibility)			1	2	1	**16**
Integration to energy & CO2 markets			2	1	1	**15**
Multiple active building designs evaluation & benchmarking based on forecasted scenarios		1		3		**14**

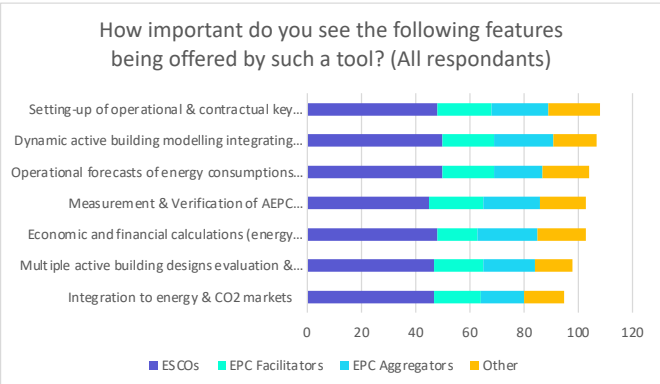

How important do you see the following features being offered by such a tool? (ESCOs)
Measurement & Verification of AEPC...
Integration to energy & CO2 markets
Multiple active building designs evaluation &...
Setting-up of operational & contractual key...
Economic and financial calculations (energy...
Operational forecasts of energy consumptions...
Dynamic active building modelling integrating...
0 2 4 6 8 10 12 14
Not at all important
Slightly important
Important
Fairly important
Very important


How important do you see the following features being offered by such a tool? (EPC Facilitators)
Economic and financial calculations (energy...
Integration to energy & CO2 markets
Multiple active building designs evaluation &...
Operational forecasts of energy consumptions...
Dynamic active building modelling integrating...
Measurement & Verification of AEPC...
Setting-up of operational & contractual key...
0 1 2 3 4 5 6
Not at all important
Slightly important
Important
Fairly important
Very important


How important do you see the following features being offered by such a tool? (EPC Aggregators)
Integration to energy & CO2 markets
Operational forecasts of energy consumptions...
Multiple active building designs evaluation &...
Measurement & Verification of AEPC...
Setting-up of operational & contractual key...
Economic and financial calculations (energy...
Dynamic active building modelling integrating...
0 1 2 3 4 5 6
Not at all important
Slightly important
Important
Fairly important
Very important

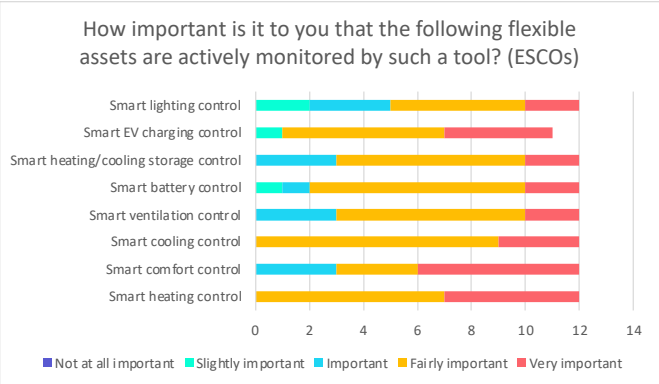

How important do you see the following features being offered by such a tool? (Other)
Multiple active building designs evaluation &...
Integration to energy & CO2 markets
Dynamic active building modelling integrating...
Measurement & Verification of AEPC...
Operational forecasts of energy consumptions...
Economic and financial calculations (energy...
Setting-up of operational & contractual key...
0 0,5 1 1,5 2 2,5 3 3,5 4 4,5
Not at all important
Slightly important
Important
Fairly important
Very important

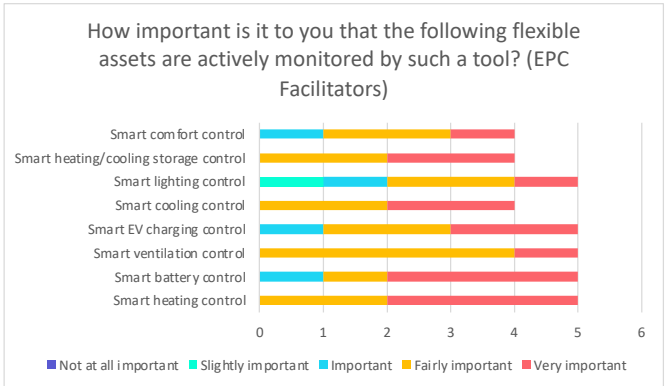

How important do you see the following features being offered by such a tool? (All respondants)
Integration to energy & CO2 markets
Multiple active building designs evaluation &...
Measurement & Verification of AEPC...
Economic and financial calculations (energy...
Operational forecasts of energy consumptions...
Dynamic active building modelling integrating...
Setting-up of operational & contractual key...
0 5 10 15 20 25 30
Not at all important
Slightly important
Important
Fairly important
Very important

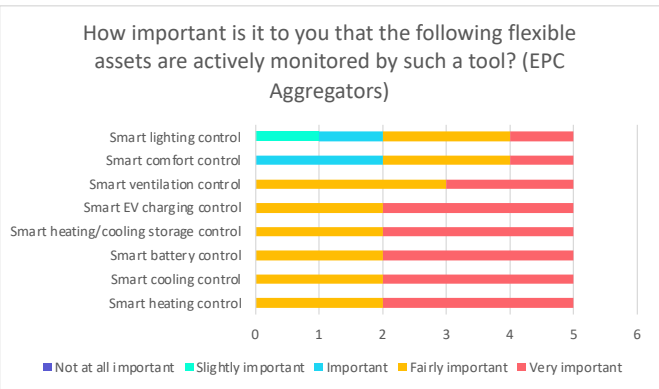

How important do you see the following features being offered by such a tool? (All respondants)
Setting-up of operational & contractual key...
Dynamic active building modelling integrating...
Operational forecasts of energy consumptions...
Measurement & Verification of AEPC...
Economic and financial calculations (energy...
Multiple active building designs evaluation &...
Integration to energy & CO2 markets
0 20 40 60 80 100 120
ESCOs
EPC Facilitators
EPC Aggregators
Other

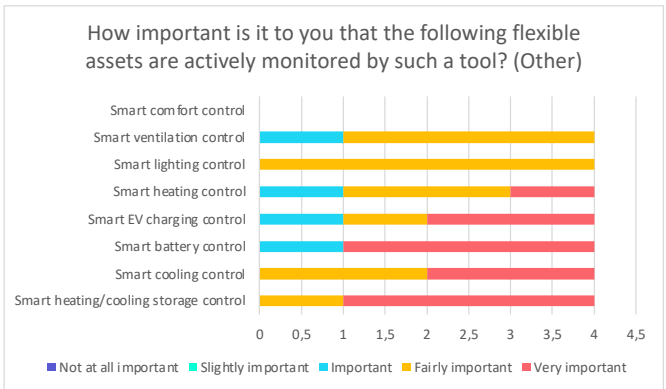
AEPC TOOLS FLEXIBLE ASSETS MONITORING

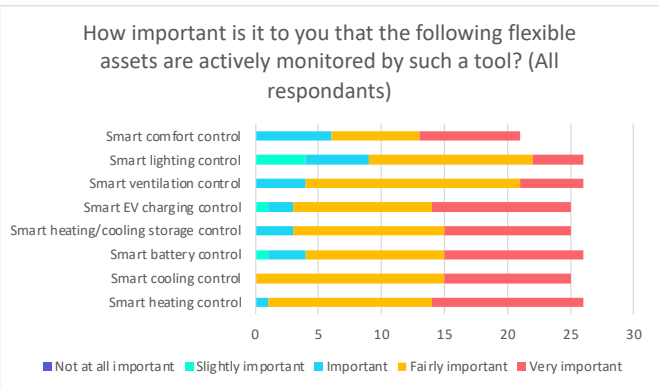
How important is it to you that the following flexible assets are actively monitored by such a tool?	Not at all important	Slightly important	Important	Fairly important	Very important	Scoring
ESCOs						
Smart heating control				7	5	**53**
Smart comfort control			3	3	6	**51**
Smart cooling control				9	3	**51**
Smart ventilation control			3	7	2	**47**
Smart battery control		1	1	8	2	**47**
Smart heating/cooling storage control			3	7	2	**47**
Smart EV charging control		1		6	4	**46**
Smart lighting control		2	3	5	2	**43**
EPC Facilitators						
Smart heating control				2	3	**23**
Smart battery control			1	1	3	**22**
Smart ventilation control				4	1	**21**
Smart EV charging control			1	2	2	**21**
Smart cooling control				2	2	**18**
Smart lighting control		1	1	2	1	**18**
Smart heating/cooling storage control				2	2	**18**
Smart comfort control			1	2	1	**16**
EPC Aggregators						
Smart heating control				2	3	**23**
Smart cooling control				2	3	**23**
Smart battery control				2	3	**23**
Smart heating/cooling storage control				2	3	**23**
Smart EV charging control				2	3	**23**
Smart ventilation control				3	2	**22**
Smart comfort control			2	2	1	**19**
Smart lighting control		1	1	2	1	**18**
Others						
Smart heating/cooling storage control				1	3	**19**
Smart cooling control				2	2	**18**
Smart battery control			1		3	**18**
Smart EV charging control			1	1	2	**17**
Smart heating control			1	2	1	**16**
Smart lighting control				4		**16**
Smart ventilation control			1	3		**15**
Smart comfort control						**0**

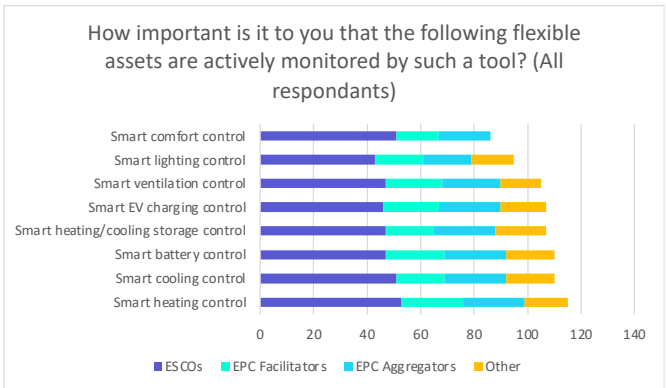

How important is it to you that the following flexible assets are actively monitored by such a tool? (ESCOs)
Smart lighting control
Smart EV charging control
Smart heating/cooling storage control
Smart battery control
Smart ventilation control
Smart cooling control
Smart comfort control
Smart heating control
0 2 4 6 8 10 12 14
Not at all important
Slightly important
Important
Fairly important
Very important


How important is it to you that the following flexible assets are actively monitored by such a tool? (EPC Facilitators)
Smart comfort control
Smart heating/cooling storage control
Smart lighting control
Smart cooling control
Smart EV charging control
Smart ventilation control
Smart battery control
Smart heating control
0 1 2 3 4 5 6
Not at all important
Slightly important
Important
Fairly important
Very important


How important is it to you that the following flexible assets are actively monitored by such a tool? (EPC Aggregators)
Smart lighting control
Smart comfort control
Smart ventilation control
Smart EV charging control
Smart heating/cooling storage control
Smart battery control
Smart cooling control
Smart heating control
0 1 2 3 4 5 6
Not at all important
Slightly important
Important
Fairly important
Very important


How important is it to you that the following flexible assets are actively monitored by such a tool? (Other)
Smart comfort control
Smart ventilation control
Smart lighting control
Smart heating control
Smart EV charging control
Smart battery control
Smart cooling control
Smart heating/cooling storage control
0 0,5 1 1,5 2 2,5 3 3,5 4 4,5
Not at all important
Slightly important
Important
Fairly important
Very important


How important is it to you that the following flexible assets are actively monitored by such a tool? (All respondants)
Smart comfort control
Smart lighting control
Smart ventilation control
Smart EV charging control
Smart heating/cooling storage control
Smart battery control
Smart cooling control
Smart heating control
0 5 10 15 20 25 30
Not at all important
Slightly important
Important
Fairly important
Very important


How important is it to you that the following flexible assets are actively monitored by such a tool? (All respondants)
Smart comfort control
Smart lighting control
Smart ventilation control
Smart EV charging control
Smart heating/cooling storage control
Smart battery control
Smart cooling control
Smart heating control
0 20 40 60 80 100 120 140
ESCOs
EPC Facilitators
EPC Aggregators
Other

ABEPEM ACQUISITION MODEL EVALUATION

In case you would be using or willing to implement such a tool, what would be the most appropriate, interesting or acceptable acquisition or usage model?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
A stand-alone software that can be used fully autonomously to run technical & financial simulations, operational forecasts and M&V (with any help from the developer, other than basis training)					
Appropriate	9	4	4	4	21
Not appropriate	3	1	1	0	5
A customizable computational engine that can be integrated in an existing own tool or in a bespoke solution from a software developer to run technical & financial simulations, operational forecasts and M&V					
Appropriate	7	5	4	3	19
Not appropriate	5	0	1	1	7
An algorithm that can be integrated in an existing computational engine					
Appropriate	8	3	4	2	17
Not appropriate	4	2	1	2	9
A tool as a service delivered by an authorized operator who configures the tool and runs technical & financial simulations, operational forecasts and M&V on request					
Appropriate	9	4	5	4	22
Not appropriate	3	1	0	0	4

FINANCIAL & ECONOMIC MODULE ACQUISITION MODEL EVALUATION

What would be your preference for the level of integration or underlying software for a Financial or Economic Calculation module?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
A customizable stand-alone Excel based tool	4	3	1	2	10
A stand-alone web-based tool	2		1	1	4
A customized stand-alone software tool			2	1	3
A tool integrated in the overall simulation tool	4	2	1		7
I do not need a financial tool	2				2
I am not familiar with this type or tool or have no opinion			1		1

CUSTOMERS & SITES PROFILING

How important are the following customer profiles in terms of their potential for developing EPC projects?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Multiple site clients					
Not at all important					
Slightly important		1			
Important			2		
Fairly important		2	1	3	
Very important		2	3	1	
Single site clients					
Not at all important		1			
Slightly important		1		1	
Important				1	
Fairly important		2	5	2	
Very important		1	1		
Private sector					
Not at all important			1		
Slightly important					
Important					
Fairly important		4	4	3	
Very important		1	1	1	
Public sector					
Not at all important					
Slightly important					
Important			2		
Fairly important		4	1	2	
Very important		1	3	2	
Social & affordable Housing sector					
Not at all important			1		
Slightly important		1			
Important			2	2	
Fairly important		2	2	2	
Very important		1	1		
Residential sector					
Not at all important			2		
Slightly important		1			
Important		1		2	
Fairly important		2	2	1	
Very important			2	1	

How important are the following building typologies in terms of their potential for developing EPC projects?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Office					
Not at all important					
Slightly important					
Important			3		
Fairly important		4	1	3	
Very important			2	1	
Residential					
Not at all important			2		
Slightly important		1			
Important		1	1	2	
Fairly important		1	1		
Very important		1	2	2	
Educational					
Not at all important			1		
Slightly important		1			
Important		1	3		
Fairly important		2		3	
Very important		1	2	1	
Healtcare					
Not at all important					
Slightly important		1	2		
Important			1	1	
Fairly important		1		2	
Very important		3	3	1	
Hotels and restaurants					
Not at all important			1		
Slightly important					
Important		1	2		
Fairly important		1	1	2	
Very important		3	2	2	
Sports and leisure facilities					
Not at all important		1			
Slightly important		1	1		
Important		1	2	1	
Fairly important		2	1	3	
Very important			2		
Retail					
Not at all important					
Slightly important		1	1		
Important		1	3		
Fairly important		3		1	
Very important			2	3	
Warehouses					
Not at all important					
Slightly important		1	1		
Important		2	2		
Fairly important		2	1	3	
Very important			2	1	
Industrial/Production					
Not at all important					
Slightly important			1		
Important					
Fairly important		1	1	2	
Very important		4	4	2	

How important are the following building technologies for upgrading the equipment of buildings in respect of your current practices?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Heat Pumps					
Not at all important					
Slightly important					
Important			1		
Fairly important		1		2	
Very important		4	5	2	
Thermal Energy Storage					
Not at all important					
Slightly important					
Important		1		1	
Fairly important		1	4	1	
Very important		3	2	2	
Standalone generators					
Not at all important		1			
Slightly important		2	3	1	
Important		2	2	2	
Fairly important			1		
Very important				1	
Backup generators					
Not at all important		1			
Slightly important		2	3		
Important		1	1	3	
Fairly important		1	1	1	
Very important			1		
Combined Heat and Power (CHP)					
Not at all important		1			
Slightly important					
Important		2	3	1	
Fairly important		2	1	3	
Very important			2		
Photovoltaics					
Not at all important					
Slightly important			1		
Important			1		
Fairly important		4	2		
Very important		1	2	4	
Batteries					
Not at all important					
Slightly important			1		
Important			2		
Fairly important		3	2	1	
Very important		2	1	3	
Electric Vehicles Charging infrastructure					
Not at all important					
Slightly important					
Important		1	2		
Fairly important		1	1	1	
Very important		3	3	3	
HVAC Systems					
Not at all important					
Slightly important					
Important		2	1		
Fairly important		1	1	1	
Very important		2	4	3	
Chillers					
Not at all important					
Slightly important			1		
Important		2	2		
Fairly important		1	1	3	
Very important		2	2	1	

POSSIBLE COMMERCIAL COLLABORATION EVALUATION

Some AmBIENCe partners are working on developing AEPC offers and/or simulation and Active control tools. Would you be interested in entering into discussions about a possible commercial collaboration or acquisition of expertise or tools? Do you agree to have a follow-up contact to explore such possibility?	ESCOs	EPC Facilitators	EPC Aggregators	Others	Total
Yes, I am interested in a commercial collaboration to acquire of further develop a simulation and/or operational flexibility tool	1		1	2	4
Yes, I am interested in both commercial collaboration opportunities	5		1	1	7
Yes, I am interested in a commercial collaboration to develop an AEPC Business offer	5	2	1		8
No, I am not interested in such a commercial collaboration opportunity or follow-up	1	3	3	1	8