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Active managed Buildings with
Energy performaNce Contracting

Deliverable Number (D2.4)

The Collective Active Building EPC concept and business model

The AmBIENCe Consortium

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EXECUTIVE SUMMARY

Deliverable D2.4 “The Collective Active Building EPC concept and business model” provides the extension of the Active Building Energy Performance Contracts (AEPC) concept, the methodology for its implementation and business models to the collection of buildings. This document focuses on the aspects of AEPC that are specifically considered for its extension to the collection of buildings and therefore require some changes in the process of developing and implementing the AEPC developed in tasks 2.1 and tasks 2.2 of the AmBIENCe project.

In this deliverable, the comprehensive extension of the definition of AEPC to cluster of buildings is introduced in **Chapter 2**, highlighting the elements that are more challenging in the case of the extension to cluster of buildings. These elements referred to among others to the technical, operational, usage, behavioural and dynamic CO2 pricing parameters and it is analysed if they provide or not an extra level of complexity.

Once the AEPC concept for the extension of building has been agreed, the definition of a collection of buildings under the scope of the AmBIENCe project is introduced in **Chapter 3** where the concepts such as ownership, facility management building typology control level as well as energy production resources have been analysed to define the concept. In addition, from a practical point of view some types of group of buildings have been analysed considering their suitability for the AEPC concept under the AmBIENCe project.

In **Chapter 4**, the extension of the development phases of an AEPC project and the methodology for its implementation that were defined on Task 2.1 are presented. In this case, the methodology that describes the three phases in the AEPC (Pre-Contracting phase, Contracting Phase, Performance phase) is analysed and modified when the extension of the collection of buildings calls for an adaptation.

Chapter 5 explains how the AEPC concept, specifically the quantification of the Demand Response valorisation potential with the ABEPeM tool can be applied to collections of buildings as well.

Chapter 6 regards to collection of building actors. While Deliverable 1.2 analysed the most important roles that can be present in demand response markets and Deliverable 2.3 has conducted an in-depth analysis of the different actors involved in an AEPC, considering the scope of this deliverable, chapter 6 focuses on those actors e.g., the aggregator and the one-stop-shop whose role is more relevant when dealing with groups of buildings rather than with a single building.

Finally**, Chapter 7** is focused on business models. As Deliverable 2.3 has conducted an in-depth analysis of the different business models suitable for the AEPC, this deliverable focuses on the collection of buildings. The generic AEPC Business Model for collective buildings applies for several buildings that have one owner but a collective occupation model with several tenants involved and implicit demand response implemented measures. These characteristics fit with the social housing business model that is analysed.

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1. INTRODUCTION AND BACKGROUND

1.1. THE CONTEXT

The purpose of this document is to define the Active building Energy Performance Contract concept and methodology for the collection of buildings.
The AEPC concept has been already defined in deliverable *D2.1 The Active Building Energy Performance Contract concept and methodology* as:
"The Active building EPC (AEPC) Concept is an enhanced modular and performance-based delivery, 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 CO_2 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."

Although the reasoning is provided in section 2, under the scope of the project, a typical collection of buildings can be 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,
- though not using a cooperative approach.

Cooperative approach allows the different buildings of a collection to not only consume energy but also generate it. Generation could be done by distributed renewable sources but also other no carbon base sources like trigeneration. The result is a combination of possibilities to share energy between buildings. It is out of the scope because it adds a level of complexity to the AEPC not considered in the original definition.
These are the main characteristics of the building collections within the scope of AmBIENCe, but not all of them should be considered restrictive since, for example, in terms of ownership, some measures can be developed to overcome these restrictive characteristics, as explained in section 2.3.

The AEPC concept abovementioned, is suitable for collections of buildings, considering the following nuances:

- They cannot be managed individually because they depend on centrally shared energy assets;
- They are managed as a group because they are not an individual entity;
- Advantage can be taken of the collections of buildings, as its application to a single building might result in a low profit for the Energy Services Company (ESCO) whereas the application to the entire collection of buildings could make the business more interesting.

1.2. PURPOSE AND SCOPE OF THE DOCUMENT

Task 2.1 – "Active Building Energy Performance Contract concept development" and task 2.2 – "Active Building Energy Performance Contract business model development" and their respective deliverables: deliverable D2.1 "The Active Building Energy Performance Contract concept and methodology", deliverable D2.2: "Proof-of-Concept of an Active Building Energy Performance Modelling framework" and deliverable D2.3: "Business Models for the Active Building EPC concept" have defined the AEPC in their globality. These tasks have taken into account the possibility of their application to collections of buildings, but they are focused on the application to single buildings for simplicity purposes. This deliverable covers the extension of the performed work in previous WP2 tasks to the collection of buildings. To do so, the first step is to define what the concept of collection of building means for the purpose of AEPC. It is also necessary to map the concept to the current collections of buildings typical taxonomies to achieve a better understanding for the reader. Additionally, this mapping will also allow a better definition of the scope of the document because theoretically a collection of buildings could be composed of any combination of buildings, but in the real life some combinations are not possible and other configurations could imply an unaffordable level of complexity.

2. AEPC CONCEPT EXTENSION ANALYSIS

The aim of this section is to analyse if the AEPC concept developed in Task 2.1 is suitable for collection of buildings.

As mentioned in the context section, "The Active building EPC (AEPC) Concept is an enhanced modular and performance-based delivery, 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 CO_2 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."

From a general point of view, the AEPC concept is suitable for collections of buildings, but some aspects need to be pointed out since they add more challenge to the extension.

TABLE 1: CONCEPT EXTENSION TO COLLECTION OF BUILDINGS

The term in the definition	Suitable for collections of buildings
The concept is ***enhanced*** providing additional services and business opportunities with regard to the current EPC model	✓
The concept is ***modular*** consisting of different building blocks or modules of services that can be included (or not) and tailored to meet customer specific requirements.	✓
The concept is ***performance-based,*** output-driven, with the ESCO taking on performance guarantees on cost or energy savings, as is the case with EPC today. Additionally, in the AEPC, Demand Response (DR) services also need to be performance-based.	✓
The concept provides a ***delivery mechanism.*** All the elements are provided to deliver full energy saving and demand response potential to the customer as an end-to-end product, including all hardware, software, and service components.	✓
The concept uses a ***financing mechanism*** This means that the business concept includes (or at least strongly leverages) a financing solution or scheme that allows for a third party to pay upfront for the necessary investments while being reimbursed over a longer period of time, allowing for a profitable business case for both the financier and the customer. Although this aspect is mainly similar to the current approach for the EPC financing, it also considers the revenue from the DR programs and effects of DR implementation in the cost/saving.	✓
The concept ***stimulates energetic renovation.*** The typical EPC services that allow for energetic building renovation (e.g., Heating Ventilation and Air-Conditioning, lighting, insulation) are included.	✓

The concept ***stimulates energetic optimisation.*** The demand side services that allow for the optimisation of energy consumption and costs are included.	✓
The concept can be used in ***existing buildings***	✓
The concept can be used in ***new buildings,*** which may require some specific Measurement and Verification (M&V) methodologies	✓
The concept leverages a comprehensive set of ***technical parameters.*** It will use the technical characteristics of installations to introduce flexibility and allow the delivery of the active building energy services, e.g. (peak) power shaving.	The set of parameters could be heterogeneous and therefore different for each building. This fact adds an extra level of complexity to the extension to collections of buildings
The concept leverages a comprehensive set of ***operational parameters.*** It will use the operational characteristics of installations to introduce flexibility and to allow the delivery of the active building energy services, e.g. temperature set points.	In the case of homogeneous collection of buildings, the operational parameters could be similar for all buildings and therefore easy to define
The concept leverages a comprehensive set of ***usage parameters.*** It will use the technical characteristics of installations to introduce flexibility and allow the delivery of the active building energy services, e.g., comfort requirements, production schedules or opening hours.	In the case of homogeneous collection of buildings definition of usage parameters could be improved by comparison between buildings and use of analytical technologies
The concept leverages a comprehensive set of ***behavioural parameters.*** It will use the technical characteristics of installations to introduce flexibility and allow the delivery of the active building energy services, e.g., manual temperature controls and energy wasting behaviour.	In the case of homogeneous collection of buildings definition of behavioural parameters could be improved by comparison between buildings and use of analytical technologies
The concept leverages a comprehensive set of ***dynamic energy pricing parameters.*** Dynamic energy pricing can occur potentially through Implicit DR (involving tariff structure parameters, including incentives in the contract between the Distribution System Operator (DSO)/Transport System Operator (TSO) and the ESCO on how to activate flexibility) and Explicit DR (based on ad hoc requests and negotiations of incentive-based prices per event)	✓
The concept leverages a comprehensive set of ***dynamic CO2 pricing parameters.*** This could be both directly (through CO_2 trading) or indirectly (by stimulating the use of renewable electricity)	Dynamic energy or CO_2 pricing can be defined in the contract between the DSO/TSO and the ESCO but could also occur between different buildings of the collection. This adds a very high level of complexity to the management and is out of the scope of this document.
✓	The AEPC concept is suitable for collections of buildings

3. COLLECTIONS OF BUILDINGS/DISTRICTS IN THE AMBIENCE PROJECT

Once the AEPC concept has been considered suitable, is time for the definition of a collection of buildings under the scope of the AmBIENCe project.

The main characteristics to be considered for the classification of the different types of buildings regarding energy management are:

- **Ownership**: Who is the person/entity that owns the buildings?
- **Facility manager**: Who is the person/entity that manages the building?
- **Building typology**: Homogeneous building when all of them are similar, or heterogeneous buildings when all of them are different.
- **Control level**: Capacity to control energy consumption. This capacity is mainly influenced by the number of people involved in the control and the controllability of the loads, since the same loads could be dependent on aspects not controlled by the facility manager. For example, domestic appliances are controlled by the home habitants or in manufacturing companies, machines are controlled by the company production staff, not by the facility manager. Energy storage adds an extra degree of freedom in the control level because it allows to store energy because it is not necessary to consume it at the current time and use it at other times facilitating Demand Response.
- **Energy production resources**: The energy production can be central or distributed. In some collections of buildings, the design is centralized but when new buildings are added to the collection it is necessary to add some production resources.

Based on these classification criteria, an analysis was done characterising different groups of buildings, See Annex A.

The scope of this first exercise was too wide, so based on it, buildings that share the same characteristics were grouped under the same category. Therefore, a simplified group of collections of buildings has been defined, as shown in Table 2.

TABLE 2: COLLECTIONS OF BUILDINGS GROUP

Type	Description	AEPC Characteristics
Residential multi-owner	Residential multi-owner buildings or detached houses constructed by the same promoter	The ESCO must make a contract with several owners. They could be organized as a legal community. User engagement is key.
Multitenant exploitation	Office buildings, Shopping malls with several shops and leisure business, social housing, university residence	There is only one owner but multiple tenants. Homogeneous energy management. Other non-energy services are important.
Industrial park	Park including commercial and industrial companies	Multiple parts of the contract and different kinds of loads. Demand response is very dependent of the type of activity of the company, but it could offer a lot of opportunities.
Public collection of building	University campus, hospitals, sports centres	Contracting with public authorities is very demanding due to public procurement procedures. It is common practice to be supported by a facilitator. Several types of buildings with different configurations. Managed centrally.
Big infrastructures	Ports, airports, big congress fair centres	One owner but with disparate configurations and very dependent of the type of activity.

Table 3 collects the different options considered per characteristic and points out which is more suitable for the extension of the AEPC concept to the collections of buildings.

TABLE 3 CHARACTERISTICS MORE SUITABLE FOR AEPC IN COLLECTION OF BUILDINGS

Characteristics				
Ownership	Single Owner		Multiple Owner	
Building Typology	Homogeneous		Heterogeneous	
Control Level	Central		Distributed	
Energy production resources	Central		Distributed	

Suitable for AEPC — Some additional measures are required for AEPC — Not Suitable for AEPC

Based on this analysis, under the scope of the project, a standard collection of buildings suitable for AEPC is 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.

The Figure 1 illustrates the concept where a group of buildings have common assets that are relevant for energy production/distribution/demand. For the purposes of AEPC these common assets should better be managed centrally and therefore each building should not be managed independently from others.

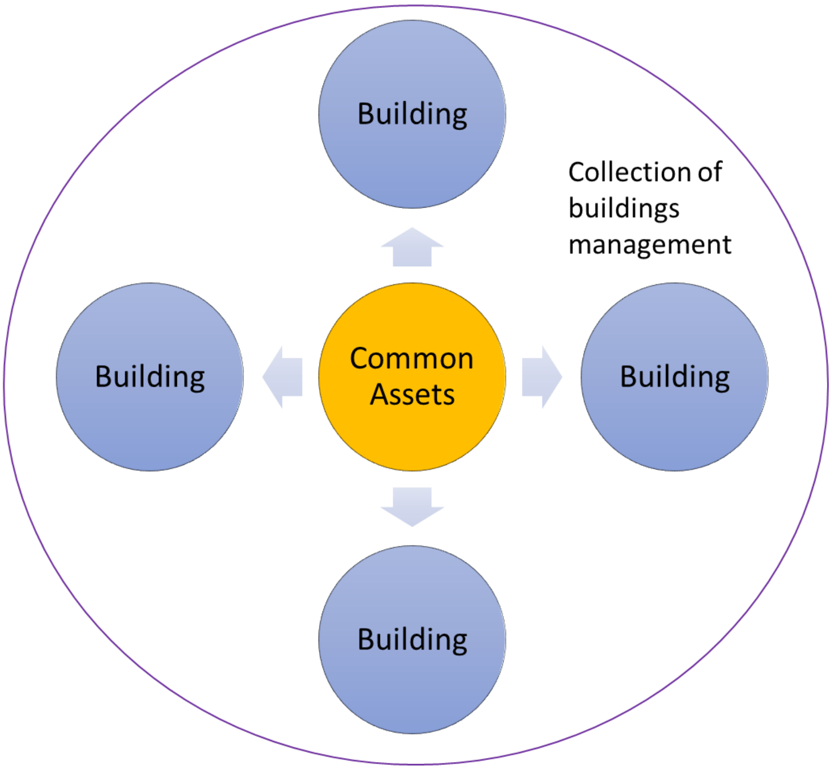


FIGURE 1 COLLECTION OF BUILDINGS WITH COMMON ASSETS RELEVANT FOR ENERGY PRODUCTION/DISTRIBUTION/DEMAND.

3.1. BARRIERS AND SYNERGIES FOR AEPC APPLICATION TO COLLECTION OF BUILDINGS

Furthermore, from a practical point of view some types of group of buildings have been analysed considering their suitability for the AEPC concept under the AmBIENCe project.

3.1.1. RESIDENTIAL MULTI-OWNER

The main characteristics of the residential sector is the low energy consumption volume managed by any owner and the heterogeneity of the energy generation and consumption. These characteristics implies that the ESCO will have a lot of different contracts with different owners and different active control measurements will have to be in place. These multiple contracts between the ESCO and each owner will imply high management effort with low margins for achieving required economical returns.
To solve this situation, the residential sector may set up communities or associations under a legal entity form that will act as a proxy or local aggregator with the ESCO. In this case, the complexity of the management will be transferred from the ESCO to the community and the AEPC could be signed by the ESCO and the community or association.

3.1.2. MULTITENANT WITH HOMOGENEOUS EXPLOITATION

This type of collections of buildings has several advantages over the residential type for applying the AEPC concept:
There is only one owner; therefore, only one client to contract with the ESCO.
The buildings are homogeneous and therefore have similar energy profiles. It is not needed to analyse each building separately in the pre-contracting phase.
Energy generation is centralized or at least is managed centrally. This management structure is very important to control and ensure the distribution of the energy in demand response actions.

3.1.3. INDUSTRIAL PARKS

Generally, in an industrial park, there is an entity responsible to manage the common services of the park. Therefore, this entity can manage energy and can be the client in the AEPC.
This type of collection of buildings will have the advantage of having the energy production managed centrally though, they have the important disadvantage of having different energy consumption profiles. This means that the profiles could be unbalanced, and one company could have a consumption higher than the sum of the rest of the companies. In this case, for example it could make sense to establish one AEPC directly with the company with the higher consumption and another AEPC with the rest of the companies.
Nevertheless, if there are different types of companies in the park with different activities, there are great opportunities for demand response because the scheduling of activities could be different, thus allowing moving a considerable amount of energy by changing the scheduling of activities of a company. This shifting, however, could be constrained by the production processes. Consequently, the optimisation of these opportunities is a very high challenge.

3.1.4. PUBLIC COLLECTION OF BUILDINGS

This type of collection of buildings has two beneficial characteristics for AEPC since, they have only one owner as they are public, and they are managed centrally. This type of collections of buildings has also another degree of flexibility because they could group buildings that are located in different places in one AEPC.

However, one of the main constraints for AEPC for this type of buildings is the demanding procedures that public contracts must follow that may limit their application.

3.1.5. BIG INFRASTRUCTURES

Big infrastructures as ports, airports or fair congress centres are very promising because they have one owner and are managed centrally by one facility manager. In this sense monitoring and control ICT infrastructure is designed to cover the whole infrastructure. The integration of management tools facilitates the actions when the decisions need to be executed.

The collection could include buildings with disparate characteristics and uses that imply different analysis. The pre-contracting phase entails more effort because differences between buildings imply that the analysis from one building cannot be applied/translated to other buildings and therefore each individual building should be fully analysed .

This heterogeneity is a very good facilitator for demand response because the different consumption profiles could be adapted to take advantage of possible synergies. Due to the different activity of each building, they could have different power peak times. This fact helps enables to distribute the loads in the time to avoid high power peaks.

The activity is managed by the owner, enhancing the possibility to move lightly the time periods of some activities to schedule the global activity, and therefore the energy consumption, to achieve a smooth energy profile and to adapt the energy profile according to DR signals.

Summing up,Table 1 Table 4 collects the characteristics and the suitability of several types of buildings for the application of the AEPC concept under the AmBIENCe project.

TABLE 4: COLLECTION OF BUILDINGS SUITABILITY TO AEPC

Type	Description	AEPC characteristics	AEPC Suitability
Residential	Residential multi-owner buildings or detached houses constructed by the same promoter	The ESCO must make a contract with several owners. These could be organised as a community in a legal entity.	
Rented buildings with homogeneous exploitation	Office buildings, Shopping malls with several shops and leisure business, social housing, university residence	There is only one owner but multiple tenants. Homogeneous buildings. Centralised energy distribution management	
Industrial park	Park including commercial and industrial companies	Multiple parts of the contract and different kinds of loads. Demand response is very dependent of the type of activity of the company, but it could offer a lot of opportunities. Very complex	
Public collection of building	University campus, hospitals, sports centres.	One owner Centralised energy distribution management. Heterogeneous: Several types of buildings with different configurations. Managed centrally	
Big infrastructures	Ports, airports, big congress fair centre	One owner Heterogeneous: Several types of buildings with different configurations. Managed centrally. Very dependent of the type of activity	

 Suitable for AEPC  Some additional measures are required for AEPC  Not Suitable for AEPC

4. EXTENDING THE AEPC CONCEPT AND METHODOLOGY TO COLLECTIONS OF BUILDINGS/DISTRICTS

Following the methodology defined in deliverable D2.1, there are three main phases in AEPC:

- Pre-Contracting phase,
- Contracting phase,
- Performance phase.

Each of these phases includes further steps during each phase which are described in detail in the following sections.

4.1. PRE-CONTRACTING PHASE

4.1.1. PRE-FEASIBILITY STUDY

The pre-feasibility study will be done for every building in the collection. The pre-feasibility study must take into account the volume of internal energy production and how the energy is distributed between buildings. The common assets should be analysed considering the service that they provide to the whole collection of buildings. This analysis will have to take into account the needs of the complete collection of buildings in order to decide on the necessity to scale or change the technology.

In this study, depending on the relevance of the common assets and the buildings heterogeneity, it has to be defined if it is better to contract an AEPC for the collection of buildings or to contract an AEPC for each building separately.

4.1.2. FEASIBILITY STUDY

The feasibility study aims to objectively and rationally uncover the strengths and weaknesses of the existing business or proposed opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success.

This study is done in the same way as for one building, but it should consider how to size the common assets to optimize the global energy distribution between buildings. A possible outcome could be to substitute some common assets by individual assets located in each building or the other way round where individual building assets are replaced by a central common asset.

The final decision should consider, as defined in D2.1, the following:

- Technical feasibility study,
- Economic and financial analysis,
- Social and environmental sustainability analysis.

4.2. CONTRACTING PHASE

As been described in D2.1, the contracting phase for an AEPC project has two main steps:

- Contract design, where the main calculations and quantifications on the terms of the contract and the shaping of the features of an Active Building EPC are performed;
- Deployment phase, where the selected project design options are being installed and

performed.

4.2.1. CONTRACT DESING

In the AEPC concept, the support for contract design developments is being to support the development of these tasks the Active Building Energy Performance Modelling (ABEPeM) platform has been developed. The detailed features of this platform are being described in deliverable D2.2. An example of how this platform could be used is shown in chapter **Error! Reference source not found.**.
The contractual clauses are an important part of the contract design. Those contractual clauses that could be affected by the extension of the AEPC to a collection of buildings are:

- ***Energy records and data management.*** In addition, to the data necessary to calculate the building consumption, data about the energy production, storage, and consumption of the common assets should be included.
- ***Payment to the ESCO.*** This clause should consider besides the payment of the ESCO services, how the energy delivered by the common assets is going to be remunerated to the client.
- ***Equipment service.*** This clause should specify explicitly the responsibilities for the maintenance of the common assets.
- ***Upgrading or altering the equipment.*** This clause should distinguish between building assets and common assets when considering upgrading or altering the equipment.
- ***Ownership.*** This clause should consider that the ownership of the common assets could be different from the ownership of the building assets. Ownership could also differ between common assets depending on the existence of pre-existing assets or the deployment of new assets and the business model in place.

4.2.2. DEPLOYMENT PHASE

No differences are foreseen in the deployment phase compared to single building AEPC.

4.3. PERFORMANCE PHASE

The performance phase is divided into two main group of activity:

- Operation and monitoring,
- Measurement and verification.

4.3.1. OPERATION AND MONITORING

The operation and monitoring activities during the performance phase should be extended to two levels. At the lower level, the operation and monitoring of each building is performed separately.
The monitoring of each single building will follow the same rules as for the monitoring followed in the AEPC concept but in this case, it should generate net values at building level from the energy demand. These aggregated values should be the inputs for the second, higher level, this is the monitoring of the global collection of buildings. In some types of collection of buildings this level could be integrated directly in the global EMS (Energy Management System).

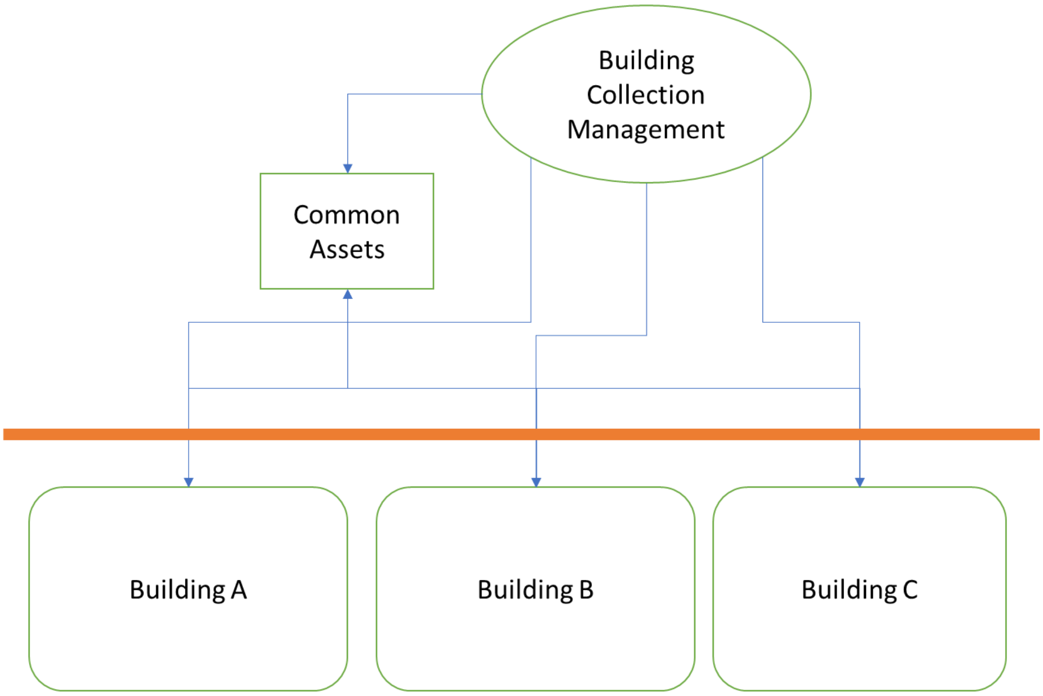


FIGURE 2 TWO LEVEL OPERATION AND MONITORING APPROACH

Following the two-level strategy, the global collection of buildings EMS will aggregate the data from the different buildings of the collection and will manage the common assets of the collection of buildings. The global EMS will be the interface of the collection of buildings with the facility manager.
Additionally, the global monitoring system should monitor the energy production as well as the energy provided from the grid for the corresponding measurement and verification activity.

4.3.2. MEASUREMENT AND VERIFICATION

The main difference of the measurement and verification protocol applied to a collection of buildings compared to the one applied to a single building is the possibility to measure and verify the amount of energy exchanged between the common assets and each single building.
Applying the proposed two-level approach enables this measurement strategy, as the flow of common assets with each building is monitored.
In the same way, any control action performed by the global control system on common assets is monitored and therefore the impact on each building can be tracked and verified.

High-level measurement and verification should include the overall management of the energy supply and its transmission.

The following adjustment factors are to be considered in AEPC in relation to collection of buildings:

- Weather conditions. They will affect to all buildings in general and will be used in the M&V low-level. The effects at low level will be propagated to the high-level. In the case of heterogeneous buildings weather conditions could affect the buildings in a different way and should be analysed independently.
- Energy price conditions. These will follow the inverse path, affecting the high-level strategy and then propagated to the low-level strategy of each building depending on the DR actions generated.
- Occupancy and other activity related conditions. They are specific for each building and changes will be propagated from the low-level strategy to the high-level one.

5. ABEPEM APPLICATION TO COLLECTION OF BUILDINGS/DISTRICTS

The AEPC concept, specifically the quantification of the Demand Response valorisation potential with the ABEPeM tool, can be applied to collections of buildings as well. For both local collections of buildings in a neighbourhood/district, as well as for distributed collections of buildings.
As to the quantification of the Demand Response valorisation potential, three main collection of buildings cases can be distinguished:

1. the buildings only share generation or storage assets (on top of optional building-level generation or storage assets);
2. the buildings engage in a coordinated control to leverage the aggregated flexibility and increase thereby the Demand Response valorisation potential;
3. the combination of shared assets and coordinated control.

TABLE 5: APPLICATION OF ABEPEM TO DIFFERENT COLLECTION OF BUILDING

		Shared generation/storage assets	
		No	**Yes**
Coordinated control	**No**	(treat as single building)	(1) (current ABEPeM)
	Yes	(2) (future ABEPeM)	(3) (future ABEPeM)

When only shared generation/storage assets (1) are in place, optionally in addition to building level generation/storage assets, but without coordinated control, the Demand Response valorisation potential quantification can be done with the ABEPeM tool on a per building level as described in D2.2, and the per-building results are summed up. The per-building quantification takes into account the for the building decided/agreed portion of the shared assets as if it were attached to the building itself and adds this to the optional building level generation/storage. In this case, the collection only benefits from the economy of scale and/or solutions to installation constraints. The virtual distribution of the shared assets over the buildings in the collections is done in a (semi-)static manner and this distribution is a necessary input to the ABEPeM tool. This distribution can be done on the basis of equal sharing, or each building's willingness/capability to invest, or it can be the result of a preliminary ABEPeM analysis that quantifies for each building its optimal generation/storage dimensions and taking this into account for the shared asset dimensioning.

When there are no shared generation/storage assets in place but there is a coordinated control (2), the aggregated flexibility can be used to increase the Demand Response valorisation for Implicit Demand Response: the valorisation at cluster level can be higher than the sum of the individual valorisations of each building.

Besides, the Explicit Demand Response valorisation can be facilitated and increased by leveraging the **aggregated** flexibility. All additional valorisations can be redistributed to the individual buildings. This coordinated control with value sharing in fact requires an Energy Community or peer-to-peer (P2P) trading like operation (either local or distributed) and associated regulatory framework to make it possible. The quantification for this case will require an extension to the ABEPeM tool to add functionality to aggregate flexibility, optimise at aggregated level and disaggregate the collection level flex activations to the individual buildings.

When there are shared generation/storage assets as well as coordinated control (3), the ABEPeM functionality as described for (2) is used, where a portion of the shared assets are attributed to each individual building as virtual building level assets (1).

6. COLLECTIONS OF BUILDING ACTORS

While Deliverable 1.2 analysed the most important roles that can be present in DR markets, Deliverable 2.3 has conducted an in-depth analysis of the different actors involved in an AEPC.
Considering the scope of this deliverable, in this case, the focus is on those actors whose role is more relevant when dealing with groups of buildings rather than with a single building.

TABLE 6 COLLECTION OF BUILDING ACTORS

Actor	Description	Role in the AEPC for Collection of Buildings vs Single Building
TSO	Actor responsible for operating and maintaining the transmission grid in a given area. Potentially, it is also responsible for the development of the grid in a given area and for the interconnections with other systems. The TSO is also responsible for connecting all DSOs in its control area and must ensure future demand for transmission of electricity.	=
DSO	Actor responsible for operating and maintaining the distribution grid in a given area. If applicable, it is also in charge of developing the distribution grid in specific areas and responsible for the interconnections with other systems. The DSO must also ensure the ability of the system to meet future demand for distribution of electricity	=
Supplier / retailer	Actor that provides electricity to end consumers. The supplier has a contractual agreement with the grid operator. Suppliers have their own generators or buy electricity from other producers on the wholesale market.	=
Aggregator	Grouping of agents in a power system (i.e., consumers, producers, prosumers) to act as a single entity when engaging in power system markets (both wholesale and retail) or selling services to the operator. An aggregator can help in better integration of renewable energy resources by providing both demand- and supply-side flexibility services to the grid. It is also defined as Balancing Service Provider (BSP) and it is the Subject responsible for the provision of ancillary services and the holder of the related contract with the TSO.	↑
One-stop-shop	A one-stop-shop is a virtual and/or physical place where building owners can find all information and services, they need to implement an ambitious global energy renovation project.	↑

Balance Responsible Party	Actor responsible for a specific portfolio of access points. It must ensure balance between injections and offtakes in its portfolio.	=
ESCO	Actor that aims to offer fully integrated energy services to its customers. Generally, it focusses on energy savings and energy efficiency solutions in existing buildings.	=
Consumer/Prosumer	Actor that consumes the delivered electricity. In case that it takes active part in the grid system as it possesses its own DER (such as solar panels) it is also called prosumer. In the flexibility market it is also defined as Asset Owner, meaning the owner of the resources who are able to offer flexibility services replying to the requests of a BSP	=
Energy Community	Actor that can take up the role of a consumer/prosumer as such and sell to Balance Responsible Parties (BRPs), aggregators… like normal consumers/prosumers would do. Given the fact that they are larger than traditional consumers/prosumers, they should have scale benefits. On the other hand, energy communities could change existing market models in the sense that they provide opportunities for P2P supply.	=

=	Actors whose role is equal when dealing with groups of buildings rather than with a single building.	↑	Actors whose role is more relevant when dealing with groups of buildings rather than with a single building.

As already highlighted, aggregation entails **grouping** the energy consumption or generation of several consumers. When it comes to consumers, aggregators can set up an agreement with several consumers, allowing them to temporarily reduce the consumers' electricity consumption when there is high demand for electricity. Aggregators then sell this flexibility i.e., the 'avoided' electricity consumption, in electricity markets. An aggregator could also be operating the reverse action and could increase the consumption of an electricity consumer when electricity prices are favourable. Aggregation can be carried out by traditional energy businesses such as suppliers, or by new entrants such as independent aggregators.

Independent aggregators are, thus, electricity service providers. In practice, when consumers engage with them, they have one contract with the supplier and a separate one with the aggregator. An aggregator can also operate on behalf of a group of consumers engaging in self generation by selling their excess electricity.

Focusing on specific roles that aggregators are to play in the energy market in relation with the other actors, 4 different models are explained in Figure 3.

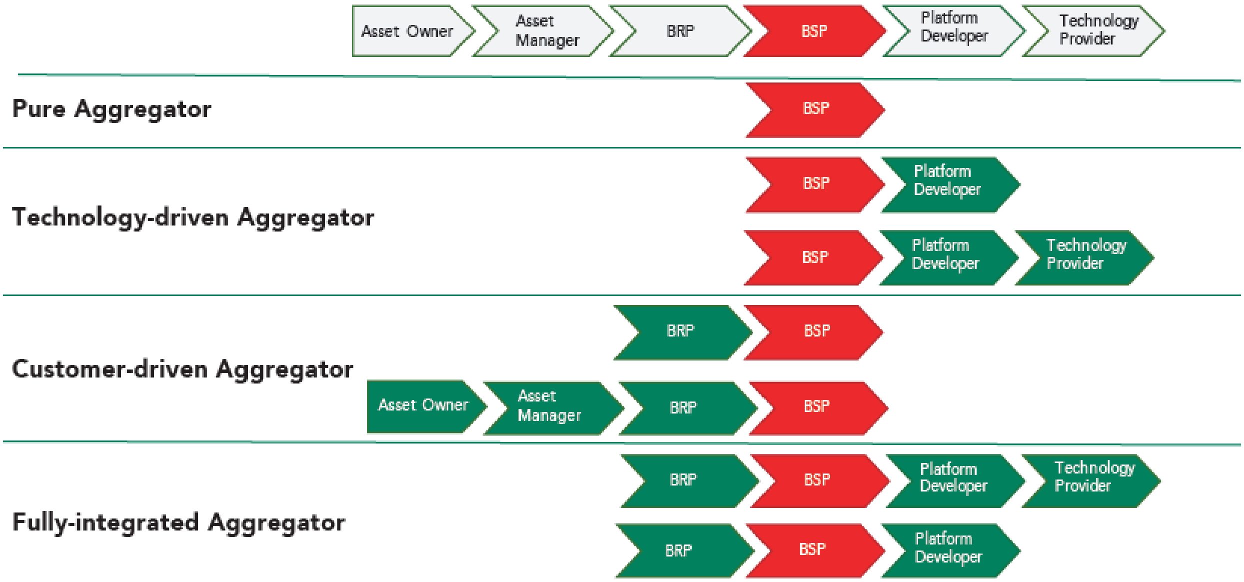


FIGURE 3 SCHEME OF THE POSSIBLE AGGREGATOR BUSINESS MODELS WITHIN THE FLEXIBILITY MARKET [1]

The “**Pure Aggregator**” model provides that the aggregator will only play the role of a Balancing Service Provider (BSP).
This determines the need, on the one hand, to create the "relationship" with end customers and on the other hand to identify the suppliers of the technological infrastructure and of the management platform (which can be a single entity or different entities). The two main contractual forms existing between BSP and the technology suppliers provide for the purchase or payment of an annual fee ("fee"). The creation of the "relationship" with customers is typically promoted through the internal commercial structure or through partnerships with third parties.

The “**Technology-driven Aggregator”** model provides that the aggregator plays the role of BSP together with the role of platform developer[2] or platform developer and technology provider[3] too. The strategic choice of overseeing the development of a management platform "in-house", also through the acquisition of companies that have developed a platform, and to "internalise" the production of the technological infrastructure necessary for creation of an energy community aims to create a competitive advantage

1 Picture from Electricity Market Report 2019, Technical handbook by Politecnico di Milano ISBN 9788864930497

[2] Subject that offers a platform on the market that the aggregator uses for management of the plants within an energy community.

[3] Set of entities that provide the aggregator with the necessary technological infrastructure for the creation and management of a community.

over to competitors. It also represents a "signal" of a "long-term" strategy. The need to create the "relationship" with end customers also remains in these business models, typically through the creation of an ad hoc commercial structure or through partnerships with third parties.

The "**Client-driven Aggregator**" cluster, which sees the presence of two business models, provides that the aggregator oversees both the role of BSP and (in various forms) the relationship with the final customer. The competitive advantage lies in the existing commercial / contractual relationship between customers and the aggregator. This allows the aggregator to have a priority channel through which to involve customers in the community project.
In model 1, the aggregator is already the customer's BRP. A "special case" refers to the 2nd model, in which the BSP is also the owner of the asset, which makes it unnecessary to establish a commercial / contractual relationship between BSP and customer.

The "**Fully-integrated Aggregator**" cluster, which sees the presence of two business models represents a combination of the models belonging to the "Technology-driven Aggregator" and "Client-driven Aggregator" Cluster, in which therefore the BSP "oversees" both the technological side and the one referring to the relationship with the customer. As for this point, it refers to the fact that in both models the BSP also plays the role of BRP.
At the moment there is no operator on the market that covers all the roles of the aggregation chain.

The **One-stop-shop** as said above is a virtual and/or physical place where building owners can find all information and services, they need to implement an ambitious global energy renovation project.
The main features of nine business models that were selected for their potential interest in terms of buildings and districts energy renovation related to One-stop-shop are reported in Annex B.

7. COLLECTIONS OF BUILDINGS/DISTRICTS BUSINESS MODELS

As in the case of the actors' analysis, Deliverable 2.3 has performed an in-depth analysis of the different Business models when implementing an AEPC.
As stated in Task 2.2. Active Building Energy Performance Contract business model development, 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.

The table below, collects the taxonomy of the AEPC business models based on configurations per building/type or beneficiary and based on implicit versus explicit DR defined in Deliverable 2.3.

TABLE 7: SUMMARY OF BUSINESS MODEL VARIATIONS

<table>
<tr><th>Building type</th><th>Occupation model</th><th>Type of DR</th><th>Owner/Tenant relation</th><th>Financing</th><th>Business Model Variations</th></tr>
<tr><td>Commercial building
Public building
Residential building</td><td rowspan="7">Individual</td><td>Implicit</td><td rowspan="8">Owner occupier</td><td rowspan="6">ESCO Financing</td><td>A.1</td></tr>
<tr><td rowspan="5">Public building</td><td rowspan="5">Explicit (variations 1 to 5)</td><td>B.1</td></tr>
<tr><td>B.2</td></tr>
<tr><td>B.3</td></tr>
<tr><td>B.4</td></tr>
<tr><td>B.5</td></tr>
<tr><td>Residential building</td><td rowspan="7">Implicit</td><td>FI Financing</td><td>A.2</td></tr>
<tr><td rowspan="4">Residential building</td><td rowspan="4">Collective (ACO)</td><td rowspan="2">ESCO financing</td><td>C.1</td></tr>
<tr><td rowspan="3">Owner lessor & Tenant</td><td>C.2</td></tr>
<tr><td>FI Financing</td><td>C.3</td></tr>
<tr><td>FI Financing to co-owners</td><td>C.4</td></tr>
<tr><td rowspan="2">Social housing</td><td rowspan="2">Individual
Collective</td><td rowspan="2">Owner lessor & Social Tenant</td><td>ESCO Financing</td><td>D.1</td></tr>
<tr><td>Umbrella Organisation Financing</td><td>D.2</td></tr>
</table>

The generic AEPC Business Model (A1) as described in D.2.3, 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.

This business model is an improvement of the classical EPC or Maintenance and Energy Performance Contract (M-EPC) business model with the flexibility potential being added, allowing – in combination with the electrification potential – to potentially improve the overall environmental and economic value.

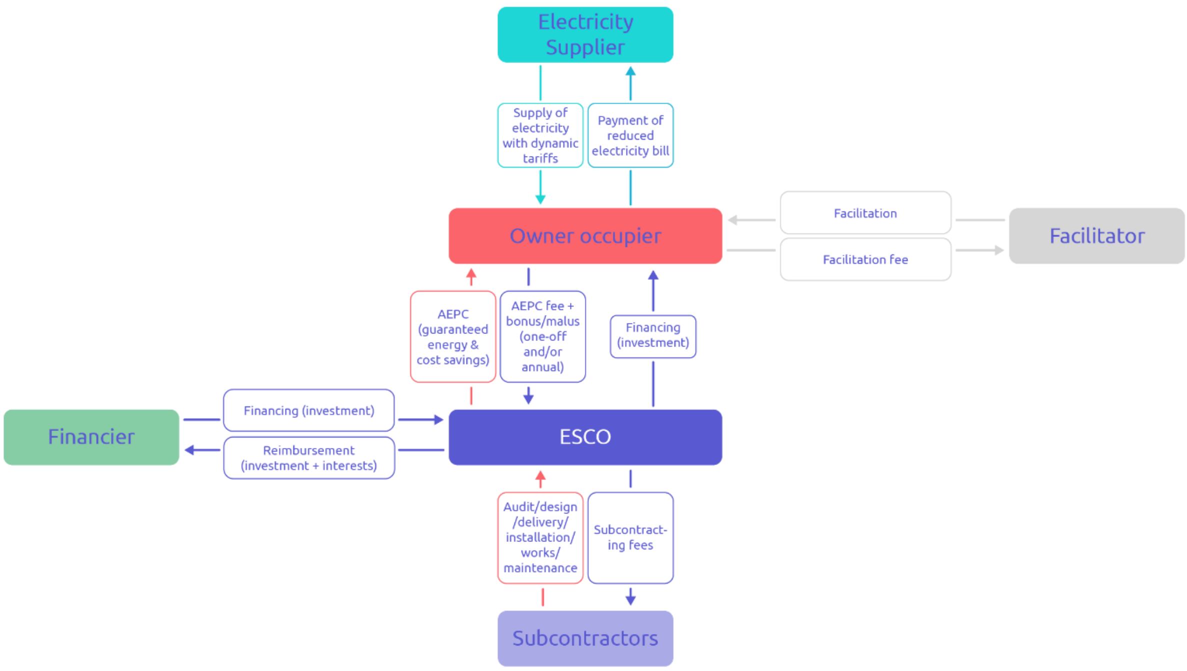


FIGURE 4 GENERIC AEPC BUSINESS MODEL WITH IMPLICIT DR AND ESCO FINANCING DEFINED IN D.2.3

Considering the scope of this deliverable, the focus is placed on those business models that come into play when implementing AEPC in collections of buildings.

Therefore, 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 centre, 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. This said, 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.

Based on these cases, for the scope of this deliverable, the generic AEPC Business Model for collective buildings applies for several buildings that have:

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

7.1. 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 incentives between the owner and tenant changes the business model.
These characteristics fit with the social housing business model that have been described in Deliverable 2.3 where two different variations are analysed with the sole difference of the financing source that may come from an ESCO or an umbrella organisation. The case that the social housing company get financing from financial institutions could be considered as an umbrella organisation because it is a third-party entity.

TABLE 8 SOCIAL HOUSING CHARACTERISATION

Building type	Occupation model	Type of DR	Owner/Tenant relation	Financing	Business Model Variations
Social housing	**Collective**	Implicit	Owner lessor & Social Tenant	ESCO Financing	D.1
				Umbrella Organisation Financing	D.2

7.1.1. 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 neighbourhood or development. In this case on top of the contracting of the AEPC, the ESCO also finances the operation to the SHC.
The next figure coming from Deliverable 2.3 shows the collective social housing AEPC Business Model relationships.

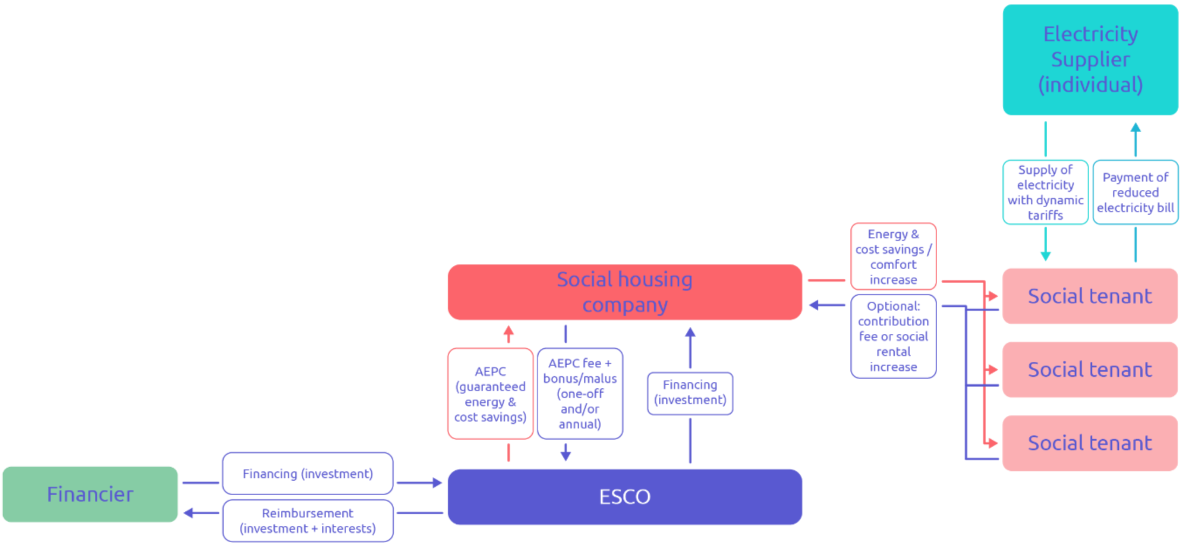


FIGURE 5 AEPC BUSINESS MODEL FOR SOCIAL HOUSING WITH ESCO FINANCING

Making a comparison with the general business model drafted in Figure 4 to highlight its main characteristics, it can be highlighted that:

- 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 Social Housing Company,
- The business case for the owner of the building, the Social Housing Company, 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.

7.1.2. SOCIAL HOUSING – FINANCED BY 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.

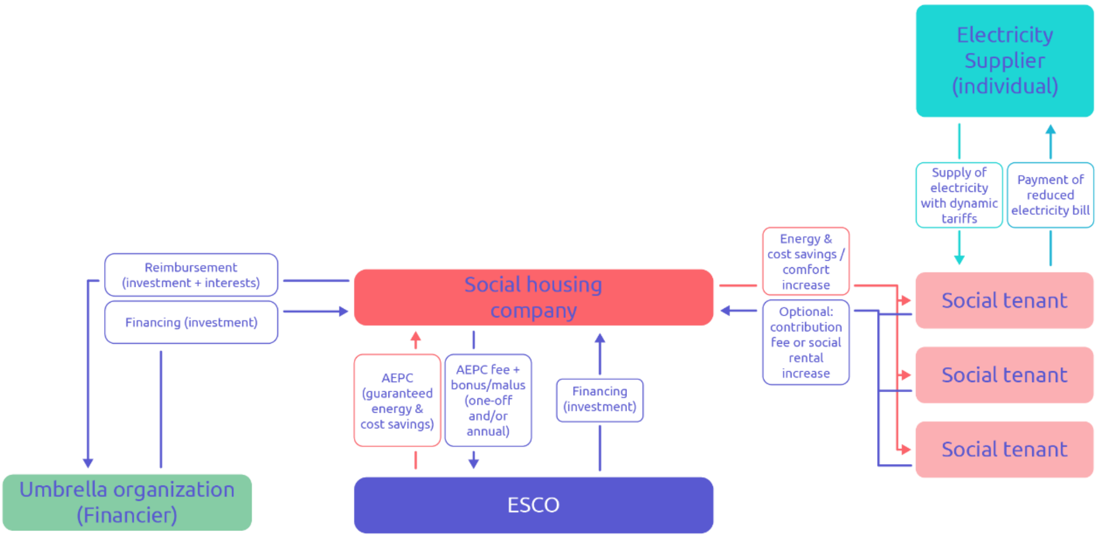


FIGURE 6 AEPC BUSINESS MODEL FOR SOCIAL HOUSING UNDER UMBRELLA ORGANISATION FINANCING

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.

8. CONCLUSIONS AND KEY FINDINGS

The AEPC concept has been developed in tasks 2.1 and tasks 2.2 of the AmBIENCe project. One of the pillars of the AEPC concept is based on a good characterisation of the building from the energy performance point of view. This makes it possible to define measures, both at the operational level but also at the measurement and verification level, that are very precise and customised for each building. The result is a great efficiency in the actions to be performed but a great difficulty in applying those same actions to another building and therefore to a collection of buildings as a whole.

In this deliverable we have started from the premise that the AEPC concept can be applied to a collection of buildings by applying it to each building separately. From the characterisation of the typology of existing building collections it has been seen that in many cases it is the only solution given the heterogeneity of the buildings, and therefore the impossibility of applying the characterisation made for one of them to the others. Another element that makes its application complex is the existence of several building owners. In this case it is necessary the existence of some entity such as a community that allows grouping all these owners in the application of the AEPC.

The case where the extension of AEPC to a collection of buildings presents the clearest benefits at a technical level is the case of a set of homogeneous buildings such as groups of dwellings or offices that have centralized energy production assets that are managed jointly. In this case this management can take advantage of the flexibility in the demand of each building together with central storage facilities to distribute the demand of the buildings in an optimal way that significantly improves the management of each building separately.

From a business model point of view, the case in which the extension of AEPC to collections of buildings can have the most benefits is social housing. In this case, one entity manages a collection of buildings that are generally quite homogeneous. The support of an ESCO through an AEPC allows the managing entity to carry out an integral management that optimises the energy performance of the collection of buildings under its responsibility and improves the social service it pursues.

ANNEXES

ANNEX A- EXTENDED VIEW OF COLLECTION OF BUILDINGS

The main characteristics that have been considered for the classification of the different types of buildings regarding energy management are:

- **Ownership**: The person or the entity that owns the buildings
- **Facility manager**: The person or the entity that manages the building
- **Building typology**: Homogeneous building when all of them are similar, or heterogeneous buildings when all of them are different.
- **Control level**: Capacity to control energy consumption. This capacity is mainly influenced by the number of people involved in the control and the controllability of the loads, since the same loads could be dependent on aspects not controlled by the facility manager. For example, domestic appliances are controlled by the home habitants or in manufacturing companies, machines are controlled by the company production staff, not by the facility manager. Energy storage adds an extra degree of freedom in the control level.
- **Energy production resources**: The energy production can be central or distributed. In some collections of buildings, the design is centralised but when new buildings are added to the collection it is necessary to add some production resources.

Based on these classification criteria, the following analysis was done characterising different groups of buildings.

TABLE 9: EXTENDED VIEW OF COLLECTION OF BUILDINGS

Group of Buildings	Description	Owner	Manager	Typology	Control level	Production
Residential Multitenant	Residential multitenant buildings constructed by the same promoter	Multiple	Community ESCO	Homogeneous	Low	Central
Residential district	Group of single-family detached houses	Multiple	Community Aggregator	Homogeneous	Low	Distributed
University Campus	University campus with several faculties and tertiary services	Single Public	ESCO	Heterogeneous	High	Central Distributed
University residence	University students' rooms	Single Public	Owner ESCO	Heterogeneous	Medium	Central
Hospital	Big hospital with several buildings	Single Public	Owner ESCO	Heterogeneous	High	Central Distributed

Social Housing	Group of dwellings for renting to special groups of people	Single Public	Owner ESCO	Homogeneous	Low	Central
Airport	Airport facilities	Single	Owner ESCO	Heterogeneous	High	Central Distributed
Port	Port facilities	Single	Owner ESCO	Heterogeneous	High	Central Distributed
Congress Fair centre	Big fair or congress centres with several buildings for different type of events	Single	Owner ESCO	Heterogeneous Homogeneous	Medium	Central Distributed
Shopping mall	Big shopping malls with several types of shops and leisure business	Single Multiple	Owner ESCO Renters	Heterogeneous	Low	Central Distributed
Industrial park	Park including commercial and industrial companies	Multiple	Owner ESCO Renters	Heterogeneous	Low	Central Distributed
Office park	Group of buildings dedicated to offices	Multiple	Owner ESCO Renters	Homogeneous Heterogeneous	Medium	Central Distributed
Sports centre	Big sport centres with several buildings dedicated to different sports	Single	Owner Public ESCO	Heterogeneous	High	Central Distributed

ANNEX B- ONE-STOP-SHOP BUSINESS MODELS

Each model was preliminarily assessed in terms of its coherence with the AmBIENCe focus on flexibility mechanisms as well as for its exploitation potential for collections of buildings and districts. Specifically, this evaluation was performed by defining three levels for measuring the so called "AmBIENCe Impact":

- **Low**: although the model shows some interesting potentials, its impact is poor because of structural limitations of the model and/or of barriers in regulatory contexts which hamper its application and/or low coherence with the AmBIENCe focus;
- **Medium**: the model is potentially applicable and useful for fostering flexibility mechanisms in collection of buildings. However, some drawbacks may limit its real impact and some key features and technologies underpinning demand response mechanisms are not specifically addressed.
- **High**: the model perfectly fits with the AmBIENCe target and demand response needs are specifically addressed.

The main business models analysed are:

- One-stop-shop supported by digital tools, see Table 10;
- One-stop-shop supported by a step-by-step approach, see Table 11;
- One-stop-shop provided by multi-disciplinary team, see Table 12;
- One-stop-shop provided by semi-public entities, see Table 13;
- One-stop-shop provided by joint venture of retailers with industry and contractors, see Table 14.

TABLE 10 MAIN FEATURES OF ONE-STOP SHOP SUPPORTED BY DIGITAL TOOLS

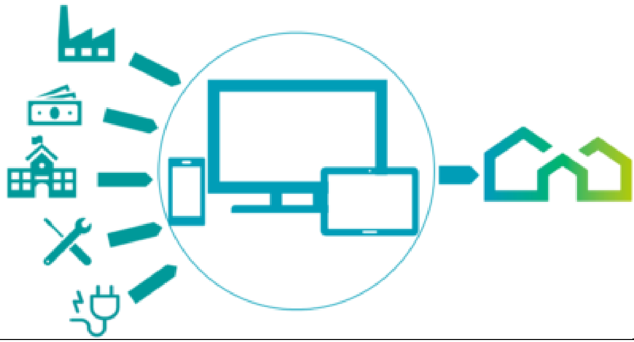
Name/Title	One-stop-shop supported by digital tools
A picture	
Short description	In this business model, the key players are supported by digital tools guiding home-owners as well as designers (or contractors) in the initial planning of the renovation work. The ICT tool processes the information gathered and suggests an optimized approach to the renovation project.
Advantages	The main advantage is the possibility to effectively manage the whole process in a comprehensive way. The automation of the design process via the ICT tool supports the identification of the best technical solutions and interventions to be implemented.
Target	The business model specifically targets private buildings' owners in the need of renovation and in particular single and multi-family buildings. Other possible buildings are private office buildings.
Value chain	The ICT tool supports the key player (designer, contractor) in order to map the main project objectives and to suggest an optimized plan of renovation. This key player needs to be adequately trained. Other involved stakeholders include banks, providing the financing. The One-stop-shop and its ICT tool can be provided by manufacturers of renovation solutions, public authorities or energy utilities.
Cost structure	For the service providers saved costs and increased profit are achieved with the help of well-structured and well managed processes. In addition, more efficient sales and thus increased profit are possible with the help of effective client profiling, initial data management and well-focused offering
Suitability to flexibility mechanisms and AmBIENCe impact	This model is useful for properly addressing the renovation of building, which in turn represents the prerequisite for the necessary innovation for activating demand response mechanisms. However, it is limited in mainly dealing with the design phase only. AmBIENCe Impact: **Low**

TABLE 11 MAIN FEATURES OF ONE-STOP-SHOP SUPPORTED BY A STEP-BY-STEP APPROACH

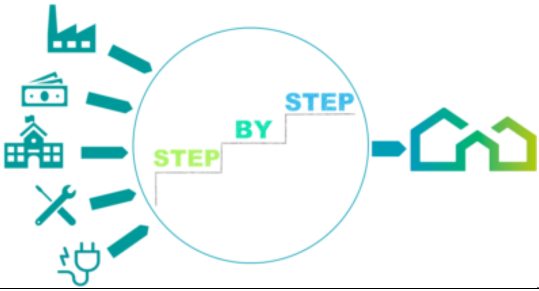
Name/Title	One-stop-shop supported by a step-by-step approach
A picture	
Short description	The Step-by-Step renovation model is a widely spread model of building refurbishment that consists of the replacement of different building components according to their life duration.
Advantages	One of the benefits of such an approach is that it gets the most out of each building component so that the initial investment is taken advantage of to its fullest. It allows to spread the investment costs for renovation measures over a longer period of time, which is easier to bear for the building owner. The need for replacements of various components arises at different points in time which means that in the case of a complete building retrofit, components that are still intact are renewed unnecessarily before their due time, leading to sub-optimal investments. With the step-by-step approach this can be avoided.
Target	The customer segments targeted are public or private building owners that intend to renovate their property over a long period of time, targeting high levels of energy efficiency and a certification of the achieved results.
Value chain	The public or private building owner defines, in collaboration with the designer (planner), a plan for the renovation measures to be carried out and a timeline of their implementation. The designer (planner) is the key player in this business model, because he/she is in charge of the whole renovation plan, including the different steps to be carried out and the time schedule. The owner maintains an important role being responsible, in collaboration with an optional project manager, of the entire project. The different contractors are involved by the owner (or possibly by the project manager) in successive phases, according to the initial plan of the renovation project. The design risk is shared between the owner and the designer, while different contractors assume the construction risks associated with each of their tasks.
Cost structure	The main costs for the designer are those associated with the training for the use of the tool and accreditation, along with standard design activity costs (salaries, administration and support costs, marketing costs, etc.). The designer (planner) is remunerated for the service provided. Additional revenues are related to the certification procedure (optional).
Suitability to flexibility mechanisms and AmBIENCe impact	This model is in principle suitable for flexibility mechanisms. The step-by-step approach could allow to meet different building's needs. However, flexibility could imply the substitution of some devices. This substitution will imply a big step and, in this case, could not be fitted in this approach. This fact lowers the specific impact of a step-by-step approach. AmBIENCe Impact: Low **Medium**

TABLE 12 MAIN FEATURES OF ONE-STOP-SHOP PROVIDED BY MULTIDISCIPLINARY TEAM

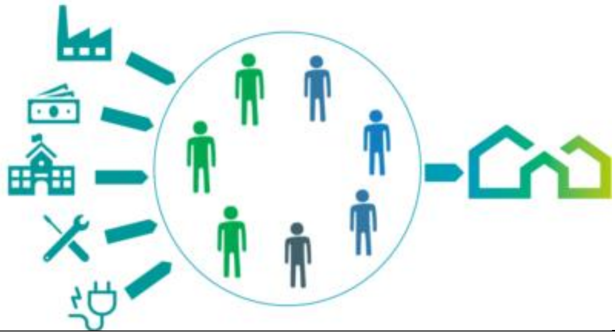
Name/Title	One-stop-shop provided by multi-disciplinary team
A picture	
Short description	In this model the project is carried out by a multi-disciplinary team in a cooperative manner, consisting of partners with complementary competences, such as architects and designers, constructors, energy-efficiency experts, market and financial experts, technology suppliers, strategy and operations planners. Starting from the initial design phase, the team works together, in strict collaboration with the building owner, in order to select the optimal renovation measures to adopt, planning the whole renovation project according to customers' needs.
Advantages	The cross-fertilisation of gathering different actors together in an early phase of the renovation project permits to define a holistic approach to the renovation intervention. In this way sustainable and energy–efficient retrofitting solutions can be deployed, with an optimal control over the total costs of the renovation project and guaranteed efficiency performances. Responsibilities and risks are shared between the members of the team.
Target	The customers' segments targeted are large buildings (offices) with private owners, or multi-family buildings and terraced houses, with private or public owners, with a specific focus on social housing.
Value chain	The model covers the complete chain of players of the renovation sector, involving them in a collaborative approach of design, aiming at defining the renovation project, merging a range of expertise and professional capabilities. This leads to a more integrated and innovative result, with an improved quality of implementation.
Cost structure	For the service provider, saved costs and increased profit are achieved with the help of well-structured and well managed processes.
Suitability to flexibility mechanisms and AmBIENCe impact	This model appears adequate to fit the flexibility mechanisms. The multidisciplinary needed is appropriately taken into account. The collaborative approach makes this model potentially suitable for a network of buildings. AmBIENCe Impact: **Medium**

TABLE 13 MAIN FEATURES OF ONE-STOP-SHOP SUPPORTED BY SEMI-PUBLIC ENTITIES

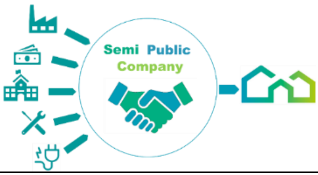
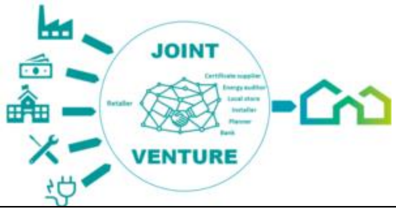
Name/Title	**One-stop-shop provided by semi-public entities**
A picture	
Short description	In this model the project is carried out by a multi-disciplinary team in a cooperative manner, consisting of partners with complementary competences, such as architects and designers, constructors, energy-efficiency experts, market and financial experts, technology suppliers, strategy and operations planners. Starting from the initial design phase, the team works together, in strict collaboration with the building owner, in order to select the optimal renovation measures to adopt and planning the whole renovation project.
Advantages	The business model provides the following advantages for the customer: • Holistic and owner-centric approach to the renovation project, with the support of the renovation platform team • Effective process management – the renovation platform team provides technical assistance and administrative support. It acts as a facilitator and, if asked by the owner(s), as a general contractor • Support of a network of trained and referenced workers and contractors • Pre-financing of incentives and in some cases third-party financing of the initial investment • Comprehensive renovation intervention (not limited to energy), including correct evaluation from the life-cycle perspective of energy-efficiency and overall costs. This also enables to better assess the financial risk and support the application for a loan.
Target	The market segments targeted by this business model are residential buildings, mostly owner-occupied single-family houses. Condominiums are also targeted.
Value chain	The "renovation platforms" providing the OSS are semi-public companies jointly owned by local governments/ authorities and private entities such as banks. They develop a network of trained contractors / installers as well as key partnerships with banks (in some cases they can themselves provide third-party financing). The renovation platform acts as a facilitator between all involved stakeholders, and for specific project – if requested by the owner(s), it can itself be the general contractor.
Cost structure	The costs of the renovation platform are mostly related to staff and marketing costs. Liquidities are also required to cover the pre-financing of investments and, when relevant, the loans to customers. Revenue types vary from one platform to the other and may include annual fees from the registered contractors / installers (who benefit from training and referencing) and fixed fees from customers (depending on the level of service requested). Usually public funding (regional, national or European – e.g. ELENA) is required to ensure the financial sustainability of the platform.
Suitability to flexibility mechanisms and AmBIENCe impact	This model is in principle suitable for demand response mechanisms as well as for a plurality of buildings. AmBIENCe Impact: **Medium**

TABLE 14 MAIN FEATURES OF ONE-STOP-SHOP PROVIDED BY JOINT VENTURE OF RETAILERS WITH INDUSTRY AND CONTRACTORS

Name/Title	**One-stop-shop provided by joint venture of retailers with industry and contractors**
A picture	
Short description	The model is based on a joint venture of retailers with industrial organizations (materials and product manufacturers / suppliers) and contractors, to set up a one-stop-shop model to refurbish existing buildings. Consortium of industrials with complementary products provides a full-service package.
Advantages	Easy access to refurbishment building services under one roof, getting all from one trusted vendor (nationwide single-point contact retailers) providing knowledge on global renovation and energy efficiency use of the house; Flexible funding and frequent customer benefits based on different purchasing ways: all installed, partly installed, just products or flexible project schedules; Project management (help obtaining approvals from local authorities and apply for subsidies, quality assurance, energy certificate, etc.).
Target	Target clients are owners of single-family houses built around 60's or 80's, that urgently need renovation, which can be attracted by the physical network of retailers having their own retail stores.
Value chain	A key partner is the retailer (or a building product supplier), which activities like marketing, selling of all products needed in house renovation as well as most of the services requested in house renovation (e.g. planning, installation, etc.). This partner has specific contracts with local retail stores (for insulation, heat pumps, heating systems, ventilation systems, doors, etc.) and various partners with expertise on planning, installations, energy audit, certificate suppliers, banks, energy supply of buildings.
Cost structure	**For the main contractor:** Material and product costs, labour costs as salaries and overheads, marketing costs, travel costs, subcontracting of the renovation work. **For the main service provider:** Payment from customers from the services and products purchased, commission from products suppliers.
Suitability to flexibility mechanisms and AmBIENCe impact	The model can successfully help to address the needs of several buildings thanks to its flexibility characteristics. AmBIENCe Impact: **Medium**

ABBREVIATIONS AND ACRONYMS

ABEPeM	Active Building Energy Performance Modelling
ACO	Association of Co-Owners
AEPC	Active Building EPC
BRP	Balance Responsible Party
BSP	Balancing Service Provider
DR	Demand Response
DSO	Distribution System Operator
EMS	Energy Management System
EPC	Energy Performance Contract
ESCO	Energy Services Company
M&V	Measurement and Verification
M-EPC	Maintenance and Energy Performance Contract
P2P	peer-to-peer
SHC	Social Housing Company
TSO	Transport System Operator