D10.1 Definition of novel data sharing-driven Business Models for Innovative Energy Services v1

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Big Energy Data Value Creation within SYNergetic enERGY-as-a-service Applications through trusted multi party data sharing over an AI big data analytics marketplace

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Table of contents

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

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Abbreviations and Acronyms

Acronym	Description
AI	Artificial Intelligence
BM	Business Model
BS	Business Scenario
DR	Demand Response
DSO	Distribution System Operator
EPC	Engineering, Procurement and Construction
ESCO	Energy Services Company
GPPA	Green Power Purchase Agreement
HVAC	Heating, Ventilation and Air Conditioning
IoT	Internet of Things
KPI	Key Performance Indicator
M2M	Machine to Machine
NEMO	Nominated Electricity Market Operator
OPEX	Operational Expenditure
PPA	Power Purchase Agreement
PV	Photovoltaics
RES	Renewal Energy Sources
TSO	Transmission System Operator

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1 Executive summary

This deliverable presents a novel definition focuses on the development of novel business models for energy data value chain stakeholders, which built on the principles of data and data intelligence sharing, are expected to facilitate the transition towards more digitised and data-enabled energy services. These models must enable the wide use and application of big data and AI technologies together with data sharing mechanisms by the electricity data value chain stakeholders for the more effective and evident realization of their individual and common business goals, along with the policy targets for decarbonization and resource efficiency imposed by EU and national regulations.

The main objective is to propose new business models that will be materialized in real conditions in SYNERGY pilot sites. This is important in order to understand the market value and potential of the key SYNERGY outputs and technologies, specially focusing on the value generated by the SYNERGY Big Data Platform and AI Analytics Marketplace. This is the first step towards identifying the socio-economic factors that will determine the adoption of the SYNERGY products by the electricity value chain stakeholders.

The first part of the report deals with an analysis of the state of play and the landscape analysis of the main issues that circumscribe the scope of the project. Topics addressed are (energy) data marketplaces and data hubs, new data ecosystems and big data monetization.

Opportunities and challenges identified after this study in summary are: (i) energy market stakeholders not leveraging the full potential of data as they are not yet involved in a real data-economy. (ii) lack of professional skills and also infrastructures to bear big data infrastructure and data analytics. (iii) they are reluctant on data exchange for privacy issues, or by a real fear of losing leading market positioning.

In the second part of the report an initial assessment of candidate business models for the main SYNERGY actors is provided. Our starting point is an archetype business model per each actor among the different services derived from the Horizontal Business Scenarios and Vertical Business Scenarios defined later in this document that put on value the combination of functionalities and services detailed in the Vertical Business Scenarios defined in the deliverable D2.1 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems v1'. Firstly, in this section we explain our holistic business analysis and evaluation methodology that comprises of 5 steps:

Step 1. Generic value network generation

Step 2. Economic and business analysis of SYNERGY business scenarios.

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Step 3. Creation of archetype business models properly involving the SYNERGY key outputs (Big Data Platform and Analytics Toolkit), associated energy applications and services delivered by the project, together with the respective stakeholders involved in data sharing functions and service provision.

Step 4. Cost Benefit Analysis.

Step 5. Final business models and guidelines for the successful market positioning and introduction of the SYNERGY tools.

In the context of the report we present the results of the three first steps, whereas the next two will be followed in WP10 and WP8 respectively. The generic value network in Step 1 represents the main stakeholders involved in the electricity data value chain and the likely, depending on the business case, interactions amongst them. Moreover, it introduces the main business roles involved and the contribution of each one of them in the delivery of a potential product or service, as well as the flow of information, data exchanges, service provision and money between the participants. Based on this network, the second step analysed thoroughly each business case derived from the Vertical Business Scenarios defined at D2.1 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems v1', identifying the participating business roles and which are the actors that assume them.

Through this important process all SYNERGY partners explored the different business cases that could originate from their participation in SYNERGY and gained a more business-oriented understanding of the SYNERGY ecosystem that will help them to either introduce competitive and value adding products to the market (in the case of technical partners), or adopt the SYNERGY key outputs and relevant energy applications into their everyday operations (following the validation activities of the project), at the end of the project. This analysis resulted in the creation of 17 archetype business models (BMs). These models present how the economic value is generated for the participating stakeholders stemming from the SYNERGY core technological innovations and tools. The business models are characterized as "archetype", because they aim to account for the entire set of services in which each tool may play a role. The archetype business models are presented graphically using value networks and business modelling canvas that describe the assets/products/tools (provided by the project) to be utilized for achieving the objectives and the anticipated economic gains for each core participating stakeholder.

In this context, the list of the archetype business models analysed in this report has as follows::

1. Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

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2. Data value as a service for Advanced Asset Management
3. Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants
4. Dynamic Enhancement Energy Performance Certificates
5. Synergetic Energy performance contracting (design)
6. Synergetic Energy Performance optimization (self-consumption)
7. Intelligence-Driven long-term Generation Planning and PPAs Advisory
8. RES Power Plant Optimizer for GPPA maximization
9. Transparent GPPA marketplace
10. RES Virtual Power Plant (VPP)
11. Objective Dynamic Pricing of Electricity
12. Retailers as Non-Energy Service Providers
13. Flexibility and portfolio analytics (sales of insights)
14. Flexibility VPP configuration for ancillary services
15. TSO-DSO Collaborative Network Management
16. Urban planning crowdsourcing marketplace
17. Synergetic Energy as a Service model (Retailer – ESCO & Retailer-Aggregator)

For all the above, our analysis has provided preliminary insights for the current state of efficiency in operations (in the absence of SYNERGY tools and technologies), and consequently the different stakeholders' increased costs or limited revenues due to their limited data outreach, lack of data management mechanisms and operational sophistication/ intelligence, as well as, their inability to advance service offerings into more innovative concepts such as the ones introduced in the SYNERGY project. This process is a prerequisite for identifying the "business as usual case", which will be utilized as a comparison basis during the cost-benefit-analysis of the BMs later in the project, targeting to reveal the source of the added value and to quantify the potential benefits for the stakeholders.

The report proceeds with the mapping of business models at the different pilot sites. As the active end-user and stakeholders' participation and involvement in the very beginning of the project is paramount as part of the open innovation approach introduced in the project, towards co-creating shared value and directly addressing emerging end-user needs extensively presented in D2.1, this has

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been an enabler for selecting the list of business models to be examined in the project and to allocate the business models to the different pilot sites. For the development of the business models and their mapping into the different pilot sites the business interests from the pilot partners have been carefully considered, together with the available (data) assets and the synthesis (size) of each pilot site. This information has been completed through the conduction of a poll aimed at getting feedback from the pilot sites business stakeholders to know their opinion about the business models defined in the project. As a result, it has been identified which business model will be tested in each of the pilot sites and providing also the reasons that led to this mapping.

The defined business models will be thoroughly evaluated by utilizing evidence (operational and economic) from the validation activities and real-life trials of the project in the pilot sites. This will allow for the Cost-Benefit Analysis and critical assessment of the viability of the defined business models in different contexts and under diverse business, regulatory and operational circumstances, and will reveal the need for further refining part of them to increase their attractiveness and safeguard their successful application during the post-project period. Furthermore, we will be able to examine the impact of some key assumptions on the results obtained, and study the need for incentive or subsidy mechanisms as part of the Business Models' realization not for a single pilot site, but for the rest as well. This will provide valuable inputs towards the definition of partner's final exploitation plans and producing final business plans fully exploiting the added value of SYNERGY core technological results.

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2 Introduction

2.1 Purpose of the document

The main purpose of the document is to propose new business models that will be materialized and validated under real-life and operation conditions in SYNERGY pilot sites. We present innovative business models for the electricity data value chain stakeholders which facilitate the advancement of their business operations and the evolution of their current business models within a data-driven, data-intelligence oriented and data (intelligence) sharing-enabled framework, facilitating the establishment of integrated business ecosystems and data value chains for effectively addressing emerging and complex requirements of the electricity system (both as a whole and in individual portions/ parts of it), and consequently, realize the creation of a new economy around electricity data and data intelligence that will disrupt business-as-usual not only in operational efficiency terms, but also, in economic terms by creating significant benefits for those stakeholders (and more specifically, data producers) that adopt a more open mindset (when it comes to data and intelligence sharing) and, progressively, contribute to the evidence and intelligence-based energy transition. We provide the chance for organizations to adopt the defined business models as business model innovations in their underlying business model or consider them as disruptive new ones. This is an important step in order to understand the market potential of SYNERGY technologies and the resulting interaction among the electricity value chain stakeholders.

In this document we perform an initial assessment of candidate business models for the main electricity data value chain stakeholders involved in SYNERGY. Our starting point is a list of archetype business models, involving a variety of electricity data value chain stakeholders stepping on the Vertical Business Scenarios (BS) that are briefly discussed later in this document and initially defined in the deliverable D2.1 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems v1'.

This study can be considered as the first step towards identifying the major socio-economic factors that will determine the business value that the SYNERGY Big Data Platform, Analytics Toolkit and Data Sharing Mechanisms can deliver to the variety of stakeholders involved in the electricity data value chain. Innovations and new tools developed within the SYNERGY framework supposes a significant milestone in the upscaling of smart grid, energy efficiency technologies and ICT technologies across

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the EU. These innovations are new means for electricity market stakeholders aimed at increasing their capabilities and digital skills for positioning their business activities within digital economy.

2.2 Scope of the document

This document is aimed to report the work done in the definition of new business models, stepping on the Vertical Business Scenarios (and associated Use Cases) reported in D2.1 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems v1'.

Intended readers of this document are the project partners working in the definition of specifications and in the design of the different technologies within the SYNERGY project framework, to understand how the business models might be taken as a reference to further elaborate and refine the functional and non-functional requirements of SYNERGY.

Moreover, the report intends to set the grounds for properly positioning SYNERGY and its main results (Big Data Platform, Analytics Toolkit, Data Sharing Mechanisms) in the business context of the electricity data value chain and integrated ecosystem, so as to assess the business value of the project results and offerings and facilitate their evidence-based and targeted introduction to the market once the project ends.

2.3 Structure of the document

This document is structured as follows:

After the Executive Summary, which constitutes **Section 1,** a short description about the purpose, scope and structure of the report is provided in **Section 2**. **Section 3** describes the methodology and process that has been followed for the definition of the SYNERGY data-driven business models. **Section 4** explores the SYNERGY context giving an interesting outlook of what is the 'state of play' and the current landscape of solutions in the scope of Data Marketplaces (in general), while further drilling in and analysing the status quo and the market in the area of Energy Data Hubs and Marketplaces. Both these themes will directly influence the SYNERGY business models and instruct specific aspects that need to be considered based on the analysis of current market offerings and their evolution, as well as, the level of acceptance and penetration across the electricity (and energy in whole) data value chain. **Section 5** goes primarily into the analysis of the Data Value Network, clarifying roles and stakeholders in the electricity data value chain involved in the realization of advanced data

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(intelligence)-driven energy services, and secondarily into the analysis of the Horizontal Business Scenarios and Vertical Business Scenarios defined in D2.1 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems v1', thus paving the way for the extraction of the associated business models. **Section 6** focuses on the definition and thorough analysis of all aspects involved in the SYENRGY data-driven business models. We examine whether there is a valid business case behind each BS, create a value network per BS and define business models, as a combination of various Business Scenarios taking the most value of data and intelligence exchanges among electricity data value chain stakeholders, using the Business Modelling Canvas methodology. **Section 7** performs a preliminary analysis and mapping between the defined business models and Pilot Sites of the project in which they will be applied and validated, capitalizing on the willingness and business interest of the respective demo partners of SYNERGY to experiment and validate their efficiency by jointly analysing service and data flows and assessing respective monetary flows, under the prism of the envisaged data economy introduced in SYNERGY (around electricity-relevant data), effectively complementing and advancing the, currently dominant, commodity and service economy that characterises the electricity sector. Finally, **Section 8** concludes the document by summarising the main findings of the report and addressing next steps to be done with regards to the business models' evaluation, refinement and finalization process across the different phases of project implementation.

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3 Methodology for the definition of business models

The methodology to be followed to analyse and define SYNERGY business models driven by data sharing approaches between electricity data value chain stakeholders, consists of five distinct stages in which several work packages and SYNERGY stakeholders will be involved on the definition, analysis and evaluation of the business models. Figure 1 shows the whole process, aiming for the reader's holistic view and understanding of this innovative approach to economic and business analysis and impact creation.

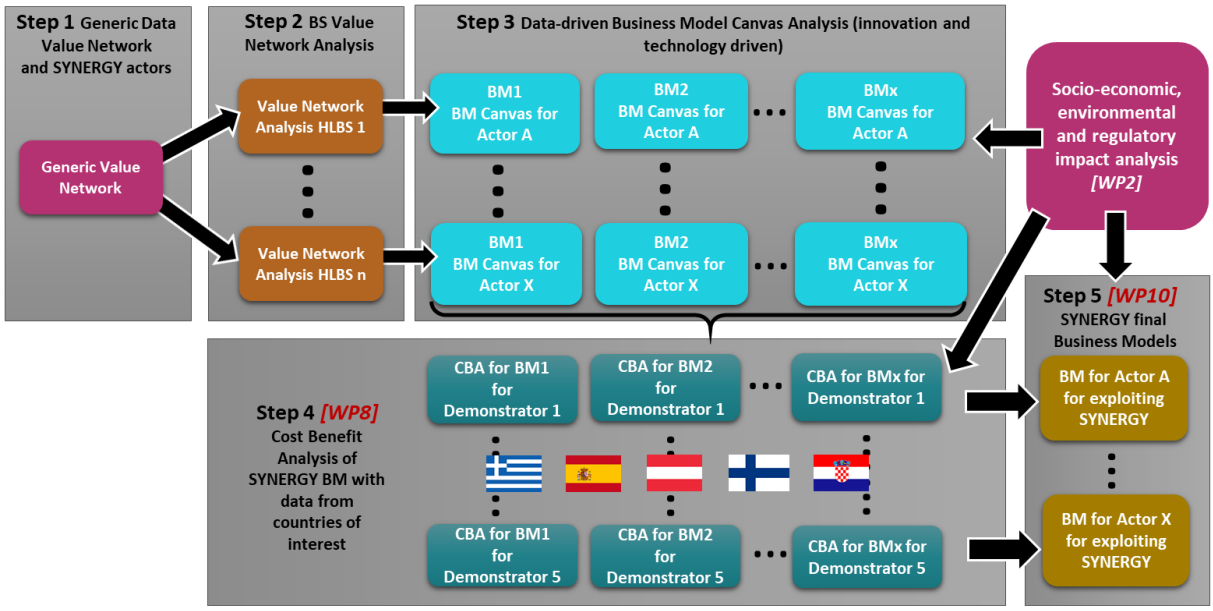

Figure 1. The Overall methodology for the SYNERGY business model and economic analysis and evaluation.

- **Step 1: Generic value network generation:**

It is the starting point of the analysis and refers to the design of the generic data value network, which will represent the main electricity data value chain stakeholders involved in data and intelligence sharing functions and, depending on the business scenario behind the business model, the interactions amongst them. This network will introduce the main business roles involved and the contribution of each one of them towards collaborative approaches for the realization of optimized business operations (at individual stakeholder level) and, subsequently, optimized and resource-efficient operation of the electricity system in whole, through well-defined business/service and data flows and interactions between the electricity data value chain stakeholders. More specifically, it will present the flow of data between the participants, which is necessary in order to create any new service (or realize existing ones in a more efficient and evident manner) and the monetary flows pertaining to their

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business and data relationships. The generic value network will represent the SYNERGY demo cases that we will analyse subsequently.

- **Step 2: Business Scenarios and data value network analysis**

The objective will be to analyse the already defined Vertical Business Scenarios, to identify the stakeholders that get a benefit, the main information flows that allow the implementation of a data-sharing approach, and the mechanisms that allow monetization of data. The generic data value network will be used to identify key interactions between electricity data value chain stakeholders and to examine whether there is a valid business case behind each business scenario. Moreover, Horizontal Business Scenarios show the data-driven perspective which will be applied in a horizontal way. Several considerations include:

  - Identifying key stakeholders from the electricity value chain but also from the data value network perspective.
  - Identifying the value each entity perceives for being actively involved.
  - Identifying the participating business roles according to the BSs and determine which role is undertaken by each of the involved actors. Depending on the scenario, a stakeholder may perform multiple roles and inversely one role may be undertaken by various stakeholders. The ultimate objective of this step is for all SYNERGY partners (and especially those involved in the electricity data value chain and those actively involved in the development of the most prominent results of SYNERGY, i.e. the Big Data Platform, the Analytics Toolkit and the Data Sharing Mechanisms) to explore the different business models that could flourish through their involvement in the SYNERGY-enabled data-driven business ecosystem and gain a more business-oriented understanding of this ecosystem and how it can facilitate their subsequent involvement in highly efficient services and in a rising economy around electricity-relevant data, by properly bringing forward the anticipated benefits for all involved stakeholders.

- **Step 3: Creation of data-driven business models**

The analysis of the HBSs and BSs of the previous step will result in several data-driven business models. These models will present how the economic value will be generated for the participating stakeholders stemming from the SYNERGY core technological innovations and tools. The BMs reflect the value that can be assigned to the data and intelligence produced and exchanged between all these stakeholders,

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therefore, the focus is primarily on data transactions and how they can complement the required business transactions within a given business context (as defined in each Business Model).

These BMs are presented graphically using data value networks and business modelling canvas' that describe the assets to be utilized for achieving the business objectives and the anticipated economic gains (operational and data-relevant) for each involved stakeholder. This step is being executed at a preliminary level (not all the details of the canvas are completed) and will be elaborated further in this task, to properly reflect the business functions and transactions enabled by SYNERGY once the different components' specifications have been crystalized and associated benefits have been (preliminary) validated by the electricity data value chain stakeholders involved in SYNERGY , to refine a complete, comprehensive and evident picture of each analysed Business Model. This will be reported in the second version of this document in M33.

As the current business practices in the electricity domain are characterised by a shift towards a service-dominant perspective which is focused on creating value-in-use for customers- creating complete service solutions-, we will extend the analysis of BMs in the Step 3 by adding a new business model design tool, the SDBMR (Service-Dominant Business Model Radar) diagram (See Figure 2) that will complement the BMC (Business Models Canvas) tool. The shift towards a service-dominant business implies for business practices, firstly, that customers expect coherent service solutions rather than stand-alone products or components. Offering these service solutions require the integration of capabilities which typically not all reside within the boundaries of a local organisation, and organisations are also required to establish and coordinate business networks in order to be able to offer these complex service solutions. As such, integrated business ecosystems, characterized by enhanced data & intelligence exchanges are expected to emerge and involve the variety of the electricity data value chain stakeholders. We will make use of the SDBM (Service-Dominant Business Model) approach which was extensively studied and refined in several works such as the BASE/X Framework, among others [1] [2] [3] [4] [5].

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Figure 2. Template SDBM Radar

At the heart of the radar is the co-created value-in-use, which describes the value of the proposed service solution for (and with) the customer. The central co-created value-in-use is encapsulated by three outer rings for which each ring is divided into slides based on the number of stakeholders involved (and as such created a network view). As such, each 'pie slice' represents the organisation-specific contributions needed or obtained to create the central value-in-use. The actor value proposition ring describes the value contribution that each stakeholder offers in order to create the central value-in-use. This value proposition may be directly related to or be part of the central value-in-use (core partner) or may enhance the value proposition of other stakeholders (enriching partner). The actor coproduction activity ring describes the activity an organisation conducts or performs in order to offer their respective value proposition. Lastly, the actor costs and benefits ring describes the specific costs and benefits which each stakeholder accrues or generates when participating in the business model. These costs and benefits can be financial, but also non-financial (for instance social or environmental benefits) in nature. The SDBM-R per Business model defined will be available in the Annex Section.

- **Step 4: Cost Benefit Analysis**

This step will be performed as part of Task 10.2: "Evaluation of new data-driven and data sharing-based business models", using evidence and information arising from the pilot trials in T8.4: "Pilot baselining, roll-out and demonstration". The evaluation of business models will utilize a variety of KPIs (as they will be defined in detail in D10.3 stepping on the initial elaboration performed in the current report) and will not only focus on defining and assessing typical business performance metrics (from

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cash flows and profitability, to ROI and IRR) but will consider the benefits and revenue streams arising from data sharing agreements and contracts with the aim to showcase extremely attractive business opportunities for the creation of parallel data-driven energy economies with pure and clear monetary benefits for the electricity data value chain stakeholders (without disregarding additional benefits stemming from the improvement of their daily operations, as achieved by the introduction of advanced big data AI analytics and innovative energy services and applications).

- **Step 5: SYNERGY final Business Models**

Considering results from Step 4 and also inputs from the socio-economic and regulatory analysis performed in WP2, which will add valuable inputs about drivers and barriers for the data-driven business models, this will be the final step to refine and fine-tune the SYNERGY BMs. The Business Model Canvas will be updated and completed with detailed and quantified information about cost structure and revenue streams.

This deliverable includes the results from the first three steps, while the remaining process will be covered extensively in the second version of this document on M33.

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4 Landscape analysis

4.1 Data Marketplaces

The unprecedented supply of data and the technological advancements in terms of storage and processing solutions, e.g. offered through on-demand computing power as a service through the cloud, are among the forces fuelling the emergence of data as a new tradable good online. Data marketplaces are the infrastructures through which this new market is realized. The market's growth however cannot be attributed solely to the technical innovations, notwithstanding their enabling role, but should be examined under the prism of demand and supply. The abundance of data created each day and the way data analysis can transform them to insights for more informed decision-making create incentives for businesses to develop a data sharing mentality and investigate data monetization approaches. Technical, motivational, economic, political, legal and ethical challenges in fostering a data sharing mentality in an industry environment are numerous, yet realising the prospective benefits from disrupting the current data siloed situation is an important first step towards seeking ways to overcome the aforementioned barriers.

A more concrete definition of a marketplace would be that of a **"multi-sided platform, where a digital intermediary connects data providers, data purchasers, and other complementary technology providers"** [6]**.** In practice, functionalities of data marketplaces extend beyond the implementation of the data trading action. Indicative examples of data marketplaces are briefly presented below in order to give a comprehensive overview of the current status and future perspectives of these platforms and outline ways in which they could create an innovation environment for new digital business models [7]:

- **Datapace** (https://datapace.io/) is a marketplace for IoT sensor data with technical and policy-based data verification, and access to a worldwide network of sensors. It supports micropayments using a custom token (namely the TAS which is native to the platform and has no use externally to it) and offers smart contracts [8] based on a permissioned enterprise blockchain. The Datapace storage encrypts and anonymizes the access to the submitted data streams. Datapace installs sensors in cooperation with network and telecom partners or sends certified equipment to various other partners for installation. Because these edge computers, IoT gateways and sensors contain known and certified hardware and firmware (often coupled with embedded GPS modules), the system considers the data trusted and verified and

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therefore partners that install and deploy this equipment have an advantage on the marketplace.

- The **DX Network** (https://dx.network/) is one of the largest blockchain-based business data marketplaces. It is API-based, therefore can be easily integrated into any data enabled services, and focuses on real-time data streams, allowing asset trading at data-point granularity which is based on its custom query language that leverages Semantic Web technologies. The DX Network uses smart contracts and has each own custom token combined with a one-to-many payment channel implementation to enable direct real-time data transactions between data providers and consumers.
- **Dawex** (https://www.dawex.com/en/) is a leading data exchange technology company and the operator of one of the largest global data marketplaces. Its global marketplace provides customizable data access control mechanisms, supports various data formats and provides visualisations to evaluate data quality and contents. Representative data samples are created through custom algorithms to support this process. Data are hosted encrypted and the platform has certification from independent data protection authorities to ensure regulatory compliance. Dawex also enables organisations to create their own data exchange platforms using its technology. Apart from the core data trading services, the platform offers machine learning algorithms to match data supply and demand, allowing for proactive suggestions to members.
- **IOTA** (https://data.iota.org/#/) is an open, feeless and scalable distributed ledger, designed to support frictionless data and value transfer. IOTA's network, called Tangle, immutably records exchanges and ensures that the information is trustworthy and cannot be tampered with or destroyed, and was designed to address blockchain inefficiencies in terms of transaction times and scalability. It is a secure data communication protocol and zero-fee microtransaction system for the IoT/M2M. The IOTA data marketplace started as a proof of concept of the IOTA protocol, is highly scalable and enables fast transactions. As it is designed to allow devices such as sensors to participate in a low-energy network and engage in seamless transactions, it has low resources requirements.
- **Qlik DataMarket** (https://www.qlik.com/us/products/qlik-data-market) offers an extensive collection of up-to-date and ready-to-use data from external sources accessible directly from within the company's data analytics platform Qlik Sense. It provides current and historical

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weather and demographic data, currency exchange rates, as well as business, economic and societal data, addressing data augmentation needs in the contextualisation and analysis of business data leveraging external sources. Integration is in this context effortless and validation, profiling, and quality measures are provided to evaluate the data available in the market.

- **Streamr** (https://streamr.network/marketplace) offers a marketplace for real time data, leveraging blockchain and Ethereum-based smart contracts for security critical operations like data transfers. It provides tools and libraries to (a) create, process, visualise and sell real-time data and (b) acquire and ingest real-time data to enable business intelligence. The marketplace is an application of the Streamr network, a massively scalable peer-to-peer network for transporting machine data in real time with the pub/sub pattern. It also offers crowdsourcing functionalities to incentivise gathering of previously unavailable data.
- **MADANA** (https://www.madana.io/vision.html) aims to create a self-governing and community-driven market for data analysis through a platform that connects data providers, data analysis providers (called plug0in providers in the platform's terminology) and consumers/ buyers for data analysis results. Beyond a marketplace, MADANA aspires to be a platform for data analysis which provides secured computation, data monetization and the outsourcing of analytics on demand. Purchases are based on smart contracts and the platform's custom cryptocurrency called MADANA PAX. Upon collection, data are encrypted and kept in a distributed storage. Access is not foreseen to be provided to raw data, so only analysis results can be purchased.

European projects have been also active in this promising field. The ICARUS [9] marketplace offers brokerage functionalities specialized in aviation data assets conforming to a common data and metadata model and provides smart contracts based on Ethereum [10]. Safe-DEED [11] explores how technology, e.g. in the fields of cryptography and data science, can foster a data sharing mentality, incentivizing businesses and innovating business models.

The examples above were selected to present some of the leading data marketplaces but also to highlight the diversity in the provided offerings, stemming from the target domain and scope and the underlying technologies. The data marketplace field is inherently interdisciplinary, in the sense that it brings together technological, legal and business knowledge in order to successfully capture and satisfy the underlying demand and supply data needs. In many cases, the marketplace services constitute an

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application of an underlying technology, built to support the data trading functionalities, but also independently exploited.

Distributed Ledger Technology (DLT) applications in particular are extremely popular, showcasing numerous additional data marketplaces, e.g.: (a) **Wibson** [12], a decentralized blockchain-based marketplace allowing members of the public to profit from securely and anonymously selling their personal data and (b) **Datum** [13]**,** which enables decentralized storage of structured data on a smart contract blockchain and data brokerage using a smart token.

Depending on the type of data, both in terms of content and formats, the prospective buyers and sellers, the target industries, the employed technologies etc., a long list of platforms offering data marketplace services, either exclusively or as a side-product of their core/other businesses, can be compiled. When traded commodities extend beyond data to other data-based assets, e.g. processed data and extracted insights, the number of platforms that can be considered relevant can easily explode. Identifying and examining all data marketplaces is not possible and would largely be out of scope for the current deliverable. The next paragraphs therefore attempt to provide a typology to formalize the classification of data marketplaces and assist in identifying differentiating features that can guide design decisions and provide insights for the SYNERGY data marketplace business models.

Data Marketplaces Aspects & Classification Schemes

A commonly agreed upon classification framework for data marketplaces does not exist, yet various dimensions that could be used to systematically group such platforms have been proposed. Notably, [14] point out that adopting a scheme with numerous grouping features could hinder the extraction of meaningful conclusions, as it becomes difficult to populate all identified dimensions for every examined marketplace, thus resulting to a less concise analysis. Yet the same report notes that merging distinct dimensions may result in disregarding important aspects. The importance of each differentiating factor can be therefore considered dependent on the motivation for attempting the classification.

Having said that, an extensive yet not exhaustive list of attributes used in literature to study and group data marketplaces is presented below and is largely based on the work presented in [15] [16] [17] [18]. The list aims to offer a broad spectrum of aspects that either need to be considered during the design of a new data marketplace or, in cases when the positioning is a priori defined, can hint towards resulting limitations and dependencies to be anticipated. The features that will be further investigated

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within SYNERGY and used to steer design decisions, will be documented in detail in the technical deliverables.

1. **Type of core product:** The term data marketplace, as previously explained, encapsulates a wider range of web platforms, than initially expected. The main commodity being traded may be raw data, but also processed data (having undergone an enrichment, tagging, or other type of analysis) or even data-enabled business intelligence, e.g. in the form of reports with insights extracted from the underlying data.

2. **Time frame:** Data marketplaces may offer support for static (also called factual) data and/or real-time data, a decision that significantly affects the platform design, but is clearly linked to the business needs and workflows to be supported. The Streamr platform that was mentioned above handles real time data, as usually required in platforms that offer IoT data brokerage functionalities.

3. **Domain:** The domain aspect denotes the existence of a broader topic shared by the data that are expected to be present in the marketplace. Data marketplaces can be generic in nature (e.g. Dawex) or serve the needs of a particular domain in the sense that assets expected/allowed to be traded through them should be relevant to the domain. This feature cannot be seen independently from the others, as imposing domain restrictions could affect and be affected by various other decisions, such as membership/participation, as well as the ability to create more targeted brokerage experience, tailored to the needs of specific industry stakeholders etc.

4. **Data origin:** Five distinct categories of data origin can be considered of interest in the SYNERGY scope, namely (a) the internet (i.e. an online resource that is freely available online), (b) self-generated data, e.g. proprietary data or results of data processing and analysis, (c) community-generated data based on wiki principles, (d) government data which are usually published as open data and (e) authority-generated data, i.e. data published by the core provider(s) of such data. A data marketplace may impose restrictions on what the origin of the traded data can be, i.e. who is allowed to sell data, or not. Obvious implications of this decision include the perception of the data quality (e.g. correctness, completeness, credibility) by prospective buyers as well as the level of transparency in data sourcing, attributes that can affect the platform's reputation and trustworthiness as a whole.

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5. **Pricing model:** Pricing models employed typically include free, freemium, usage-based, volume-based, subscription-based and flat fee schemes. It should be noted that the asset pricing models do not necessarily reflect the platform's revenue scheme(s). Apart from profit maximization for the data provider, eligible pricing schemes should take into account internal marketplace consistency and fairness, and social welfare maximization when applicable [19]. The proliferation of online data trading has resulted in alternative dynamic pricing schemes being proposed [20].

6. **Payment methods:** In order for this dimension to be relevant, an assumption is made that payments are in fact part of the data marketplace offerings, which may not always be the case. When this is the case, a meaningful distinction would be between platforms that apart from traditional methods also (or solely) adopt DLT-enabled payment solutions (cryptocurrencies).

7. **Data access:** The technical means offered to access the traded assets (which are not necessarily limited to raw data), range from file download, APIs, specialised software (e.g. pre-configured cloud computing environments where data can be directly used) to access through web interfaces. Most platforms adopt more than one of these methods, yet none was found to offer all, probably because this would entail significant implementation and maintenance costs. Deciding on the appropriate data access methods should anticipate data agreements that foresee provision of data updates, where applicable. Apart from the data access means, the granularity of the data that can be accessed is also important. For example, the DX Network offers granular access to data through a custom query language.

8. **Data output format:** The format in which the data can be obtained, the most common options being XML, JSON, CSV and pdf reports when the commodity being traded is processed data. Depending on the platform's services, it may be the case that access to raw data in a processable format to be used externally to the system, may be disallowed or discouraged.

9. **Language:** The category examines both the language of the platform and the language of the data being traded, when applicable. Even though the English language is found to be the prevalent one in both dimensions, a localization factor may be of interest depending on the domain.

10. **Marketplace and asset ownership:** A marketplace can be (a) private, i.e., owned by a single company (seller or buyer) which would make it inevitably seller- or buyer-biased respectively; (b) consortia-based, i.e., owned by a small number of companies and (c) independent, i.e.,

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acting as a brokerage enabler and not biased towards the buyer or seller side. As a side note, this type of platform independence does not guarantee trust by the participating stakeholders. Instead, independence can be safeguarded by making it impossible for the assets and the contracts to be tampered with by the platform, a requirement satisfied through data security and integrity mechanisms, e.g. end to end encryption and distributed ledgers.

11. **Seller-Buyer relationship:** Four relationship types are identified:

    - *One-to-One*: The term data marketplace here is an overstatement, as such interactions constitute bilateral relationships with ad hoc negotiation terms, common in how data brokers operate and refer usually to high value confidential data. The relationship is characterized by a low liquidity, as locating trading partners is difficult, typically high transaction costs and strong provenance.
    - *One-to-Many*: Here transactions refer to a single seller providing the same data to multiple buyers, e.g. offering APIs for data distribution. Brokerage terms are usually common and specified by the seller to limit the underlying transaction costs. Provenance and data confidentiality may vary.
    - *Many-to-One*: Transactions refer mainly to a harvesting operation of one buyer for data coming from many users, often compensated through “free” access to a service. Liquidity is high and transaction costs typically low and privacy concerns may pose a challenge, especially after the GDPR enforcement.
    - *Many-to-Many*: These refer to multilateral trading platforms connecting many buyers to many sellers and are the ones most relevant to SYNERGY. These platforms do not usually have ownership of the data but act as brokerage enablers and as already explained offer additional services, e.g. related to data discoverability. Data confidentiality and value vary (depending on the platform’s positioning in the other dimensions, particularly the domain), and transaction costs are low, whereas liquidity is usually high.

12. **Target audience & participation:** Audience types in this scope can be either businesses or customers, with most marketplaces targeting the first category, at least regarding the data consumption side. Among other reasons for this, customers’ willingness to pay for data is limited as they are accustomed to an abundance of freely available information online. When it comes to data provision, there are some platforms attempting to attract individuals, mainly

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with regard to personal data (e.g. from activity tracking devices and other sensors) that cannot be otherwise obtained. The motivation includes increased control for the data owner, transparency and more fair compensation schemes). The participation aspect refers mostly to the adoption of an open to all, limited (e.g. based on the organization type) or completely restricted (e.g. invitation only) membership scheme. The distinction makes sense mostly in many to many data marketplaces and depends on the domain, the transaction mechanisms and the nature of the traded goods. In industries with strong KYC (Know-Your-Customer) principles, for stakeholders to trust a data trading platform, participants may be limited to well-known domain players.

13. **Nature of traded data** [21]**:** Another intuitive way to categorise data asset marketplaces is in regard to the type of data they allow their stakeholders to trade, i.e:
    - Personal data (potentially sensitive) being traded through platforms that aim to help users monetize their data, e.g. Datum.
    - Business data, which are traded through platforms that support business-to-business transactions, e.g. DX Network.
    - Sensor data, traded through platforms that support IoT data streams and allow sensor owners to monetise the data produced by their devices, e.g. Streamr.

The third category is clearly not mutually exclusive with the first two, but the categorization is empirical and quite helpful in a first broad grouping. Nevertheless, when examining leading data marketplaces (e.g. DAWEX) which cover potentially all the above categories, this dimension does not offer any insights.

14. **Trustworthiness:** This is a subjective dimension, i.e. cannot be easily verified but is based on the researcher's judgement. Trustworthiness here refers both to the asset provider's trustworthiness and the ability of the prospective consumer to track and verify the original source of the traded asset.

15. **Size of vendor:** The values here range from startups to global players. The dimension is considered subjective [22], as it is difficult to obtain reliable quantifiable information regarding the vendor's number of employees or its revenue which could be indicative of its size. The importance of the vendor size in the success of the marketplace venture clearly depends on the adopted governance scheme, the data ownership, the domain etc. It should be stressed that data marketplaces have proven to be challenging even for global players [23].

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16. **Maturity:** ranging from proof-of concept projects, commonly research oriented, to full-fledged products that can be used in operational environments, this is another subjective aspect. The insights gained from an initial state of the art review indicate a clear interest in data marketplaces, especially when coupled with DLTs, yet few have managed to move beyond alpha and beta releases to production.

It should be noted that many of the above dimensions are not independent from each other, e.g. the participation, seller-buyer relationship and ownership dimensions are clearly highly correlated.

Other proposed dimensions capture more fine-grained information, e.g. the **pre-purchase testability** and **pre-purchase information**. The first is described as the ability of the consumer to test the provided assets prior to the purchase, whereas the latter describes the subjective evaluation of how informative the asset details are, again prior to the asset purchase.

For many-to-many data marketplaces, additional attributes could be selected for a more fine-grained analysis, e.g. the choice between a **centralised or decentralised design**. This architecture decision entails implementation implications and affects the overall marketplace operation in various ways. Indicatively, [24] highlight that in the centralized setting, the market intermediary trades off quality (provenance control) for lower transaction costs. In a decentralized setting, e.g. one implemented through a distributed ledger technology, transaction costs are higher and bottlenecks may emerge, yet there is increased provenance control and transparency.

There are additional dimensions integral to the design and operation of data marketplaces that were deliberately not included in the classification framework, relevant for the design of the SYNERGY data marketplace but not for the current deliverable (which is not technically oriented), which are briefly discussed below:

An important attribute not discussed above is the **contract drafting and enforcement** process, which is typically one of the services provided by such platforms and is an integral part of asset trading. Stringent enforcement of contract terms in this scope is challenging and several factors, including technical limitations and legal implications need to be examined, which is out of scope for the current analysis. Yet, the aforementioned dimensions that touch upon the data marketplace governance principles should also be examined under this prism, i.e. the formalization of data trading contracts. Technical advancements also help in this direction, often through the adoption of machine processable contracts (smart contracts), enabled by distributed ledgers, as presented above. Apart from the

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technical details of such implementations, a legal assessment of enforceability and regulatory compliance is required.

Data protection and security mechanisms, as well as **data privacy and confidentiality**, should be ensured to foster trust among the platform members and to comply with applicable regulations, e.g. the General Data Protection Regulation (GDPR). Technical advancements can also help in this direction, e.g. multi-party computation (MPC), a cryptographic technique that enables joint data analyses by multiple parties while retaining data secrecy, is explored as a way to increase industry's willingness to participate in data marketplaces. **Auditability** should also be possible in industry data trading agreements, yet anonymity in transactions may also be required. Furthermore, **licensing, ownership and IPR** of data and data-products are contentious issues requiring careful definition and adjudication, which may not be possible to capture within blanket agreements [25]. **License compatibility**, in the case of combination and derivation, e.g. data assets as a result of data integration from multiple sources and/or data analysis processes is also challenging. On a final note, for a marketplace to establish a vibrant business ecosystem that will render it sustainable, **data interoperability** achieved through agreed **data and metadata models** and common semantics is required. Especially in the case of data marketplaces connecting numerous suppliers and consumers, data discoverability, timely and secure exchange, effortless ingestion and (re-)usability across diverse data sources, all facilitated by an appropriate level of automation, will allow the marketplace to scale and foster opportunities on monetizing data [26]. These considerations, as well as the SYNERGY positioning, will be further examined in the scope of the technical activities.

4.2 Energy Data Hubs and Marketplaces

In the energy domain, the decentralization of energy markets and the installation of smart devices is taking place the last two decades and thus there is no mature state-of-the-art about the role and potential data marketplaces in the field. Therefore, the main focus of the analysis in this section is on reviewing the recently evolving **Energy Data Hubs**, providing some insights from research initiatives about the potential of the energy data marketplaces in the future.

The term of Energy Data Hub, or 'Hub', is defined as an on demand, back-end repository of historical and current energy data. The objective is to streamline energy data flows across the sector, and enable consumers, authorized agents on consumer's behalf, and other users to access energy data. While there is an increasing interest about the penetration of energy data hubs, following the increased

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installation of smart equipment and the deregulation of the market in the energy value chain, the number of the existing implementations is rather narrow. The data hubs are mainly focusing on specific business stakeholders and business processes in the energy value chain [27], and thus a business-driven taxonomy of the different Energy Hub is considered as following:

- Retail Data/Smart meter Hubs are defined as the data hubs at EU country level which are responsible for the management of smart metering data. Retail Data Hubs are introduced to address two primary issues:
    - secure equal access to data from smart metering
    - increase efficiency in the communication between market parties, especially between network operators and retails for billing and switching purposes

  There are many region-level implementations around the world considering the smart meters deployment with the most prominent examples being:
    - The **Central Market System (CMS) aka ATRIAS** started in 2018, as the centralized data hub to facilitate the data exchange between market parties in Belgium. The CMS focus on the data exchange between the DSOs and retail businesses and thus connects the databases of the network operators (who collect the data from the smart meters) with the relevant and eligible market parties. Other parties, like the transmission system operators and third-party service providers may access to the data as well.
    - In Norway [28], the **ElHub (Electricity Hub)** facilitates the data exchange between market parties in Norway. ElHub is operated by the national TSO with the smart metering data to be collected via the DSOs and stored in the ElHub together with consumer data from the retailers. The customers are in full control of their data, which they can access via an online tool and thereby manage third party access to their data sets (CEER 2016).
- Smart Market Data Hubs are defined as the data hubs at EU country level responsible for the management of energy market data. The major electricity market operators in Europe are handling energy market data hubs to share data with the different business stakeholders. Special reference can be made to the following market operators:
    - **Nord Pool** which runs the leading power market in Europe, and offers day-ahead and intraday markets to its customers. The day-ahead market is the main arena for trading

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power, and the intraday market supplements the day-ahead market and helps secure balance between supply and demand. Access on real time market data is available online, though fine grained data services (access on data per country, product, means of access etc..) are offered by the company. More specifically customized power data services may be provided to external interest parties, setting that way a market-based framework for data exchange [29] [30].

- **EPEX SPOT** [31] energy market data hub which offers a wide range of data sets covering the different market areas, available through different modalities: from running subscriptions for files that are updated daily, to access to one-shot historical data.

- Smart Grid Data Hubs: This is a step beyond the currently deployed Smart Meter Data Hubs. Through their evolving role around Europe, the network operators aim to act as data hubs providers beyond smart meter data where their data hubs will be used to provide services for the network operators (e.g. data exchange between the DSO and the TSO) as well as for new market entrants with new business models (e.g. related to behind-the-meter services). Therefore, the role of network operators as grid-related data managers is expanding. Under this category, there are some very promising initiatives, which are further presented below:
    - At country/regional level, there are state network operators responsible to publish their data required for the normal operation of the grid. Towards this direction, the **European Network of Transmission System Operators for Electricity (ENTSOE)** is operating a **Transparency platform** [32] where the data from the national TSOs are published in order to facilitate the normal operation of the transmission grid in Europe.
    - At the regional level, the distribution network operators have started making their data public to help other stakeholders and market parties with e.g. better decision making, create new services and promote synergies between different sectors. As not all DSO data are suitable to be made publicly available due to potential breaches of security or violations of privacy regulations, it is important for DSOs to have a common understanding. For that reason, E.DSO made recently available a policy brief to illustrate the possibilities of open data from each member state, in terms of meaningful use cases [33]. Key highlights of open data repositories from DSOs (**EDP in**

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Portugal [34]**, ENEDIS in France** [35]) are to be considered for the future expansion of open data repositories from EU. DSOs.

- Moving beyond the national level the **PCI project** of Data Bridge (now defined as an Alliance of Grid Operators [36]) with the goal to ensure the interoperability of exchanging different types of data between a variety of stakeholders (like system operators, market operators, flexibility providers, suppliers, ESCOs, end-customers). Types of data may include smart meter data (both low voltage and high voltage meter data), sub-meter data, operational data, market data required for functioning flexible energy market and reliable system operation, etc.

From the aforementioned analysis, it is evident that the main focus of the energy actors in the data management landscape is about establishing functional energy data hubs that will be able to provide useful information to selected stakeholders of the energy value chain in a unified way. The concept of enabling the different energy stakeholders to match and trade their energy data assets and requirements in a marketplace environment does not exist in large scale. There are some early implementations of generic data marketplaces that enable management of data from the energy sector, which include [37] (in addition to Dawex that has been already analysed in Section 4.1 and includes an energy-specific solution with focus on smart home and renewables sources data [38]):

- **Snowflake** [39] **data marketplace** is a data hub that enables data providers to leverage and monetize their data. In this platform, Yes Energy, the industry leader in North American power market data and analytic tools, acts as a data provider in the platform by collecting, managing, and continuously delivering real-time and historical power market data series including market data, transmission and generation outages, real-time generation and flow data, and load and weather forecasts.
- The **ElectriCChain** [40] is defined as an Open Solar data marketplace with an initial focus on verifying and publishing energy generation data from the ten million solar energy generators globally on an open Blockchain. The ElectriCChain project supports the development of open standards and tools to enable generation asset owners to publish solar electricity generation data and scientists, researchers and consumers to have access on the data and insights they need.

On the other hand, in the field of IoT solutions (as the wider term that covers the smart assets deployed in the electricity network spanning from network devices, smart meters, home automation solutions,

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DER data loggers etc.), there is an ongoing discussion about the importance of the data and the way to put IoT data to work and cash, offering the information to third parties through data marketplaces. There are many small scale/ proof of concept initiatives of IoT Data Marketplaces to collect sensor data which data providers source from smart home appliances and installations in people's homes and smart cities while companies looking to understand consumer behaviour can leverage this machine data directly from the marketplaces in real time [41] [42]. The most prominent solutions include: Datapace [43] (that offers blockchain powered secure transactions and automated smart contracts to sell and buy data streams from any source, physical assets, autonomous cars, drones) and the IOTA marketplace (that has been also mentioned in section 4.1).

From the aforementioned analysis, it is clear that the concept of regulated and standardized energy data marketplaces does not exist. There is an ongoing work to design and develop standards-based Data Hubs to ensure interoperability of exchanging different types of data between a variety of energy stakeholders, but still the value of such data that can be made available via data platforms and marketplaces remains largely unexplored. To this direction, the EU is strongly promoting the idea of data marketplaces [44] while the available data marketplaces (as analysed in the previous paragraphs) can pave the way for the establishment of really functional energy data marketplaces in the near future.

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5 Data Value Network

5.1 Stakeholders identification

5.1.1 Roles and stakeholders in the electricity market

- **Power Production** that is responsible for the power generation, using either fossil fuels or RES. This role may include multiple actors independently of their size, i.e. from large power plants to small residential prosumers. In the frame of SYNERGY this role will be addressed by RES Generators/operators and prosumers.
- The **Power Transmission** grid is operated by the **TSOs** and provides High-Voltage transmission from the generation units and interconnection services between the distribution grids. The TSO is responsible for the operation and maintenance of the transmission network and must also take the necessary actions (capacity development) to guarantee its ability to satisfy the evolving demand.
- The **Power Distribution** grid is operated by the **DSOs**. It is connected with the transmission grid and provides Low (or Medium) Voltage power to end users. The DSO is responsible for operating and maintaining the distribution network and planning the necessary capacity expansion which is adequate to satisfy the future demand. His role is also crucial for the incorporation of distributed generators in the smart grid.
- The **Wholesale Market Operation** combines the information of the production cost and demand forecasting, to compute wholesale prices and propagate them to the generators, the retailers and the aggregators. This role will be indirectly addressed in SYNERGY, not through direct involvement of a specific partner/stakeholder, but through the collection of relevant data from relevant repositories and data sources.
- The **Retailers** perform the final sale of power to end users. These agents try to forecast in accuracy the future demand and reserve the adequate amount in the wholesale market, which, afterwards, they resell to their customers.
- The **Balance Services** provided by the Balancing Responsible Party (BRPs), who operates as an intermediator between the Wholesale Market and the Retailers. This agent is responsible to guarantee that the quantity reserved by the retailers is actually consumed. As BRPs are not

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represented in the SYNERGY consortium, this role will be indirectly introduced in SYNERGY through specific functions introduced in the relevant apps for retailers.

- The **Aggregators** offers intermediate services between the end prosumers and Network Operators of electricity grids. They are responsible to design and provide the sophistication for the orchestration of multiple loads, such that their collective operation scheduling results to benefits for their owners and a remarkable positive effect for the grid (in the form of balancing and ancillary services). The DERs may belong to multiple individual prosumers with personal interests or to a single entity.
- **Power Consumption** refers to all electrical appliances that consume power for their real time operation. Into this market role a special mention must be made for **prosumer actors** that at the same time host the roles of power consumption and power generation.
- **The Energy Efficiency and Management Services role** may be undertaken by relevant companies or organisations, such as the **ESCOs** and RESCOs. Their mission statement is to provide dedicated energy efficiency and energy management optimization services to their customers, spanning services for energy efficient building renovation design, energy performance contracting, energy performance certification, as well as, energy management optimization (as part of end-to-end Energy Performance Contracts) in different types of buildings for minimizing energy costs or for maximizing self-consumption and reducing dependency on the grid (in the case of prosumers)..
- **Facility Management / Building management** provided by Facility Managers and Building managers parties. The main responsibility of this stakeholder type is to optimize energy management and properly balance demand and supply in a variety of facilities[1]/ buildings of either private or public ownership. Facility/ Building managers are responsible for overseeing the daily operations and maintenance of commercial, industrial, or residential properties. They may liaise with tenants and owners, coordinate and manage maintenance, housekeeping, security activities and energy management activities, and ensure the facilities meet regulatory standards and codes.
- **City Planning Authorities** encompasses a wide portfolio of responsibilities such as land use planning (land use, development, subdivision,...), urban planning (strategic or development plans,

[1] Facility means something that is built, installed or established to serve a purpose, which in general, is every tangible asset that supports an organization. Examples are real state property, buildings, technical infrastructure, lighting, HVAC, transportation, IT-services, furniture, custodial, groups of maintenance and other user-specific equipment and appliances.

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planning strategies, etc.), urban revitalization (redevelopment of an urban area), heritage and conservation/restoring of buildings and places, transportation planning, economic development by identifying the opportunities of economic growth and encourage investment in an area, environmental planning, urban design and the relationships between built form and public spaces or infrastructure planning to plan the future provision of public works infrastructure such as water supply, sewerage, electricity, telecommunications, schools, hospitals, parks or transport infrastructures.

5.1.2 Roles and actors in the data value chain towards data-driven enhanced electricity markets

According to the **data economy framework** five roles can be identified across an integrated data value chain [45]:

- Data presenters: They are the interface with the end consumer of data and aims at creating valuable user experiences. Their activity focuses on creating and performing: User interfaces, user experience, investigation and discovery, user engagement
- Insight providers: They generate value from advanced analytics such as machine learning algorithms and statistical models. Their activity focuses on creating and performing: Semantic models, Machine Learning, Analytics library, Statistical &Computational methods, Development Environment for Analytics, Algorithms/logic/rules
- Platform owners: They act as intermediaries between suppliers and users in a market. A platform is more than a mere unilateral mechanism for technically enabling data access, such as an API. Rather, platforms enable a systematic exchange of data sets and streams on a large scale between many actors. Their activity focuses on creating and performing: Device discovery, APIs for connectivity, development environment, cloud/hosts for apps
- Data Aggregators: Data aggregation is the process of gathering data from multiple data resources with the intent of combining these data sources into a summary for data analysis. Data aggregation prepares combined datasets for data processing. Their activity focuses on creating and performing: Data normalization for common transmission, heterogeneous data collection from disparate devices
- Data producers: They are a root source of data by assessing, controlling and producing data. Their activity focuses on creating and performing: Data access, data control, data collection

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Transferring the aforementioned classification into the SYNERGY context, a more refined list of roles can be defined considering also the Data Sharing principles upon the whole business ecosystem introduced in SYNERGY is built upon. In this sense, the classification can be transformed as follows:

- **Data Owners**: Primarily they are the real owners and creative brains that the copyright/ ownership of data belongs to.
- **Data provider:** Publishes open and proprietary data into the platform. Manages and maintain resources in the platform accordingly to terms and conditions
- **Data consumer:** Consumes open and proprietary data provided in the platform; Uses open and commercial data services provided in the platform; Provides feedback on data and services provision
- **Data broker:** collects data, aggregates that information with data from other sources, while facilitating data sharing between different organizations, acting as an intermediary matchmaking and transaction enabling entity.
- **Data Scientists**: perform computation and run analytics over the data they have at their disposal, independently if their organization is the data owner or if the data they perform analytics upon have resulted through data shared by another organization/ data owner.
- **Data Management and Services provider**: Deploys open and commercial data services into the platform (e.g. data visualization, data cleansing, data integration tools); Manages and maintain resources in the platform accordingly to terms and conditions
- **Platform providers**: Maintains the ecosystem of data, services and users; Defines standards, licenses and regulations and provides terms and conditions for platform usage and the commercial exploitation of data and services; decides who are allowed to join the value network and services providers.

However, and despite the adaptation and further extension the initial definition of roles provided in the Data Economy Framework performed before (and adequately addressing at a high-level the roles introduced in SYNERGY), the complex interactions and data-related functions involved in the SYNERGY platform (differing based on the perspective a stakeholder approaches the SYNERGY Platform) requires for a more fine-grained role definition and classification that follows a vertical structure, rather than an horizontal one, and enables the reflection of the different perspectives under which 3 different User Types (additional high-level classification introduced in SYNERGY, hosting a variety of roles under each

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type) will engage and get involved into the data sharing ecosystem introduced in SYNERGY. This classification has been initially elaborated and defined as part of the activities of Task 2.4 of the project ("Detailed architecture design, protocols and interfaces specifications for Big Data-enabled Energy Services") and is adopted in this report considering its suitability to properly reflect the SYNERGY ecosystem and anticipated User Types and Roles. The following table summarizes the main outcomes of the activities of T2.4 (to be included as well in D2.6: "SYNERGY Framework Architecture including functional, technical and communication specifications v1" – due for M12 of the project) which are considered as part of the business modelling activities of the project.

Type		Role	Description
Organization Perspective	Different members of an organization that are expected to use the SYNERGY Platform	Manager	The official legal representative who is authorized to act on behalf of the organization and is the signatory for all company operational activities, including the asset contracts that will be signed over the SYNERGY platform.
		Technical User	It is typically an IT manager, developer or database administrator who are knowledgeable how the data are managed, exposed and shared by their organization's back-end systems.
		Data Scientist / Analyst	The Data Scientist / Analyst has the technical skills to explore, manipulate and analyse data to solve complex problems and derive actionable insights for the organization's operations.
		Business User	Operations, marketing, business development and strategy experts who need to view the results of an analysis in order to derive meaningful insights and take proactive decisions in their everyday work.
Platform Perspective	The core SYNERGY roles that the	Administrator	The Platform Administrator is responsible for overseeing the uninterrupted availability of the SYNERGY platform, including performing software/hardware upgrades and regular backups while addressing any technical issues that arise.

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Type		Role	Description
		CIM Manager	The CIM Manager is responsible for handling the lifecycle of the SYNERGY Common Information Model, e.g. adding new concepts, approving the proposals received (by different organizations) and ensuring the model's consistency.
		DPO	The Data Protection Officer (DPO) is responsible for monitoring the data protection compliance of the SYNERGY platform according to the EU GDPR (General Data Protection Regulation) provisions.
		Help Desk	The SYNERGY Help Desk is intended to provide information and support on the SYNERGY platform functionalities, to the different users and organizations that access the SYNERGY platform.
Data Perspective	Different roles which any organization in the electricity data value chain that owns, wants to provide, and/or wants to consume or use data assets can assume	Asset Provider	Any organization in the SYNERGY Platform can act as an Asset Provider, providing data, AI algorithms and/or analytics results to the platform for the purpose of legitimately sharing them with other organizations (as electricity data value chain stakeholders) and / or using them for an analysis.
		Asset Owner	An Asset Owner is a legal entity or natural person creating data, AI algorithms and/or analytics results and/or executing control over them. An organization acting as Asset Owner automatically assumes the role of the Asset Provider as well in the SYNERGY platform. In cases in which the Asset Owner does not act as the Asset Provider at the same time, the Asset Owner is expected to authorize an Asset Provider to make its data, AI algorithms and/or analytics results available to be used by an Asset Consumer.
		Asset Consumer	Any organization in the SYNERGY Platform can act as an Asset Consumer, acquiring legitimate access to data, AI algorithms and/or analytics results in the SYNERGY Platform (that are typically owned by other organizations, through asset contracts) and using them for further analysis.

Table 1. Roles and user of the SYNERGY BIG DATA PLATFORM and AI MARKETPLACE

As it becomes apparent, the Electricity Data Value Chain Stakeholders (as defined in section 5.1.1) may (under different contexts) simultaneously undertake a variety of roles involved in the "Organizations" and "Data" User Types. This will become even more obvious in the following chapter, where business

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models will be analysed and detailed, while the "Platform" User Type is expected to be undertaken by the partners involved in the development of the SYNERGY platform and planning to commercially exploit the main technological outcomes of the project (Big Data Platform, Analytics Toolkit and Data Sharing Mechanisms) in the period after the finalization of the project.

5.2 Horizontal Business Scenarios business scenarios

The consortium has defined four horizontal, data-driven business scenarios. Herein it is provided a comprehensive explanation of each one of them.

5.2.1 Electricity data value chain stakeholders to attach value to their own data assets

Electricity data value chain stakeholders are currently at a crossroad in their efforts to pursue new business and revenue models while effectively leveraging data from the different assets (ranging from smart meters to DERs) which they own or are in control of. Depending on the data source and the system from which they are extracted, energy-related data are typically collected at different granularity levels, with different assumptions and with varying quality. They are managed and stored in silos complying with different modelling paradigms and standards, which makes their integration particularly challenging. In this context, any stakeholder that practically acts as a data provider is in need of appropriate data management and curation tools for:

- Properly collecting data from various sources in a timely manner
- Harmonizing their data and understanding their semantics and meaning in the broader electricity data value chain
- Cleaning their data by removing or replacing incomplete, incorrect or inaccurate data
- Ensuring compliance with privacy regulations (such as GDPR)
- Fully controlling their storage and access by different stakeholders

In this way, data providers are able to better understand their data, effortlessly reduce their integration/linking complexity and inherently increase their quality, allowing for their effective collection and maintenance over time as well as their availability for proper (re)use.

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5.2.2 Electricity data value chain stakeholders to gain new insights over their data assets

In a world that is ripe with technological advancements, the Big Data and AI paradigms have the credentials to revolutionize any industry, apart from our everyday way of living and working. Leveraging a plethora of data, data analytics are able to offer insights on what happened in the past, predict what will happen in the future, and prescribe actions that need to be taken in order to lead to a desirable situation. However, despite the indisputable benefits associated with data analytics, electricity data value chain stakeholders are lagging behind in a reaping them while still struggling to make sense of their own data.

In order to effectively respond to the challenges and opportunities brought by the Big Data era, all stakeholders from the broader electricity sector need to be able to:

- Easily manipulate the energy-related data assets which they own or have acquired in order to prepare them for further analysis,
- Apply a number of baseline, pre-trained algorithms to perform computations (that may range from basic statistics to Machine Learning and Deep Learning) over diverse data assets in order to solve a specific business problem at hand, according to their own preferences and settings.
- Acquire easily digestible intelligence extracted from the results of an analysis through intuitive visualizations and easy-to-configure reports.

Through a set of generic and targeted data-driven analytics services to the different electricity data value chain stakeholders, they are able to gain previously unattainable insights on their own business operations and status quo, which unlock the actual value of their data assets.

5.2.3 Electricity data value chain stakeholders to share and trade their own data assets in a trustful, legitimate manner

With the advent of digitalization and smart metering in the electricity sector, the network's "edge" is continuously expanding, accompanied by the exponential growth of the data assets that can potentially be at the disposal of electricity data value chain stakeholders. However, "end-to-end" coordination among different stakeholders for exchanging such data and generally energy-related data is still in an embryotic phase due to the inherent lack of trust, as well as commercial confidentiality and security-related concerns. Data sharing is currently limited to ad-hoc bilateral exchanges for specific business operations while being typically performed over low-resolution data and with significant delays (e.g. aggregated batches of data), that significantly decrease their actual value.

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In order to realistically take advantage of the paradigm shift in a data generation and data ownership in the electricity data value chain, all stakeholder need to:

- Effectively search for the energy-related data they need and understand their licensing terms.
- Establish trusted, complex collaborations with the appropriate electricity data value chain stakeholders, sealed through smart data assets contracts that are characterized by immutability and non-repudiation and are signed among multiple parties.
- Control sharing of their data assets by participating in the smart contracts preparation and anticipating negotiations over the terms of use and pricing of the data assets they own in order to conclude to mutually beneficial agreements.
- Fair remuneration of all involved stakeholders based on the pricing terms of a data asset contract.
- Secure exchanges of high-quality data at proper granularity levels in a timely manner in accordance with a valid data contract's terms.
- Trustworthy use of data assets involved in a smart asset contract, i.e. embracing datasets, trained algorithms and models, and analytics results/reports.

In this context, the electricity data value chain stakeholders will bask in the actual energy-related deluge and will improve their actual reach while they shall cease having only fragmented data at their disposal and overcome their tendency to work in silos. They will become part of a trusted ecosystem in which critical data sharing challenges have been assuaged.

5.2.4 Electricity data value chain stakeholders to enjoy the benefits of the reuse of their own data assets

In the mindset of the different electricity sector players, data sharing is typically associated with the exchange of datasets among two involved stakeholders, often disregarding the benefits that may be reaped by the analysis of such datasets by other stakeholders. Depending on whether the respective terms of a data contract allow for derivative works, the derivative data asset (that may be the outcome of a computation or an analysis by a stakeholder that has legitimate access on the original data) may be also published and potentially acquired by third parties. To date, though, such cases are only theoretical and are not encountered in the everyday operations of any stakeholders in the electricity sector.

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In their quest for a new data-oriented mentality over data sharing and data analytics, the electricity value chain stakeholders need to:

- Fully realize the network effect can be created over their data assets.
- Make appropriate provisions for derivative works in the licensing, rights and use terms that they define or accept in the data contracts they are involved.
- Effectively plan the remuneration they expect over the reuse of their data assets under certain conditions.

While embracing the novel data sharing mentality, the electricity data value chain stakeholders will leverage new data-driven revenue channels and eventually enjoy monetary compensations over the value that is extracted from the (re)use of their data assets by a series of different stakeholders. Through transparent rewards over the "combined" data value that can be acquired from their data assets, such stakeholders are further motivated to invest on the collection of high-quality data and to increase their veracity, velocity and variability.

5.3 Vertical Business scenarios

SYNERGY has selected a rich bundle of representative use cases that will drive the specifications of the technical developments and will (later on) drive the implementation of a wealth of demonstration cases in the project's large-scale demonstrators, in order to showcase and validate the value generated out of the SYNERGY framework for all involved stakeholders through advanced AI Big Data analytics, integration of the value chain through data and intelligence sharing and provision of innovative energy services and applications that directly address emerging needs of the sector.

The definition of the use cases (reported in deliverable D2.1) was based on an initial set of **15 vertical business scenarios that were extracted by analysing the project concept, the different components and services to be delivered and the actual business needs of the value chain stakeholders involved in SYNERGY**. Their full description is available in the deliverable D2.1. 'End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems'. In this chapter, each vertical business scenario is structured to show the stakeholders that get a benefit, the main information flows that allow the implementation of a data-sharing approach, and the mechanisms that allow monetization of data. This is a first step to pave the way for the next step of the process that focuses on the combination of BSs toward the definition of business models.

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BS Description	Actors that get benefit		Data assets that are involved	Monetization of data and service
	Electricity Value Chain	Data value Chain		
BS1-Aggregators to optimize their positioning in flexibility markets and hedge their risks through fine-grained flexibility segmentation, classification and clustering towards VPP configuration for human-centric demand response	Aggregators	Asset consumer (data) Asset provider (analytics)	**TSOs and DSOs**: real-time smart metering data, information regarding operational flexibility requirements and characteristics **Prosumers/DER Owners**: sub-metering data, IoT and sensing data from prosumer premises. Real-time operational data of local generation assets, local storage devices and EV charging stations **External Asset Providers**, local and fine-grained weather information and forecasts. **Aggregators**: knowledge for the clients in the form of detailed comfort profiles, context-aware demand flexibility profiles, clusters of consumers, leading to fine-grained information about optimized control schedules	**Aggregators**: Advanced demand response schemas, accurate bids in ancillary services market providing flexibility, guaranteed flexibility capacity, insight of customers portfolio characterization. New service provisioning real time operational data of local generation assets, DRES generation capacity, local storage, etc. **TSOs, DSOs**: incomes from providing real-time smart metering data, flexibility requirements and characteristics. **Prosumers:** lower energy consumption and lower energy cost. Preserved comfort habits. Maximizing self-consumption. Active participation in electricity markets – new revenue streams. Revenues from sales of data to aggregators. Revenues from selling smart metering data (being the asset owners) through Network Operators to Aggregators. **Data Analytics provider:** Revenues from data intelligence providing detailed comfort profiles and context-aware flexibility, as well as, optimized VPP configuration. **External Asset Providers:** incomes for the re-use of their data (weather information and forecasts).
	Network operators	Asset provider		
	Electricity consumers/prosumers	Asset Owner Asset provider		

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BS2-Electricity retailers to increase their profitability and improve their business sustainability through their transformation into energy service provider with the use of advanced portfolio analytics	Retailer	Asset consumer (from prosumer, DSO). Asset producer (data and analytics to Aggregator, ESCO).	**Retailers**: customer data , detailed comfort profiles, context-aware demand flexibility profiles, clusters of consumers, leading to fine-grained information about optimized control schedules **Prosumers**: sub-metering data, IoT, sensing data **ESCOs**: energy efficiency strategies. **Aggregators:** flexibility activation schedules. **Network operators:** metering data /smart meters. Flexibility requirements.	**Retailers**: Revenues from provision of prosumer demand forecasting/generation forecasting/comfort and flexibility analytics along with prosumer data re-sell to aggregators and ESCOs. New advanced and personalized energy analytics for energy efficiency service to prosumers. Revenues from Demand Response. New service on intelligent control/smart automation of consumer amenities. Hedging against imbalances. Dynamic pricing schemas. Optimized energy trading/power exchange. New services on human-centric non-energy services (security, health, well-being). **Prosumers**: Revenues from data assets provision to retailers. Revenues from flexibility provision. New cost line for enjoying advanced services concerning building automation for energy and non-energy aspects. Lower energy costs and energy consumption. Comfort preservation. Enhanced security and well-being. Revenues from sales of data to aggregators. Revenues from selling smart metering data (being the asset owners) through Network Operators to Retailers. **ESCOs**: Revenues from externalized service to retailers, advice on EU EE regulation compliance. Costs for data acquisition from retailers (referring to prosumers' profiles and data) **Aggregators**: Revenues from flexibility trading and provision through advanced DR schemas tailored to consumers' habits. Hedging against flexibility overrides. Costs for the acquisition of prosumer data and analytics from retailers. **Network operators**: Optimized operation of power grids. Minimization of losses. Security of supply. Revenues from the provision of smart metering data to retailers. Costs for flexibility services from aggregators
	Prosumer	Asset producer. Asset owner		
	ESCO	Asset consumer.		
	Aggregator	Asset consumer (data and analytics).		
	Network operators	Asset provider		

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BS3-Distribution system operators to reduce OPEX and safeguard security of supply and quality of service through improved DER forecasts and flexibility analytics in the frame of Flexibility-based network management and collaborative flexibility scheduling with TSOs.	DSO	Asset consumer (from Aggregators, from TSOs). Asset provider (to TSOs)	**DSO:** Flexibility requirements. Load flows. State estimation, reliability analysis. Demand and Generation Forecasting. Flexibility Scheduling. **TSO:** Flexibility requirements. Flexibility scheduling. **RES generator/prosumer:** DER data. **Aggregator:** flexibility capacity forecast, flexibility capacity offer, flexibility VPPs.	**DSO**: lower OPEX costs for network operation and security of supply taking the most of flexibility capacity in their influence zone. Cost in procuring availability/utilization of flexible DER. Flexible connection arrangements for DER (faster connections of DER) under which non-firm arrangements are allowed to integrate DER in constrained areas. Collaborative and coordinated scheduling with TSOs. Improved forecasting of flexibility requirements (short and long-term forecasts of DER and loads)- New tools: time series analysis and forecasting, load flows and state estimation, contingency and reliability analysis. **TSO:** collaborative and dispatch process with DSO. Flexibility requirements. Lower OPEX for network operation. Improved security of supply and national reliability constraints. **RES generator/prosumers:** new incomes from DER data provision to DSOs. Active participation in energy markets. Revenues from sales of data to aggregators. Discounts in network charges for the provision of smart metering data (being the asset owners) to DSOs. **Aggregator:** Revenues from flexibility analytics provision to DSOs. Associated revenues for activation of flexibility based on DSO requirements. DR management and strategies.
	TSO	Asset provider (to DSOs)		
	RES generator & prosumer	Asset provider		
	Aggregator	Asset provider (data and analytics).		
BS4-Transmission system operators to reduce OPEX and safeguard security of supply and quality of	TSO	Asset consumer. Asset provider (from DSOs, Aggregators).	**TSO:** flexibility requirements. Operational scheduling. Coordination plan for reliable energy supply. Flexibility scheduling **DSO:** flexibility requirements. Load flows. State estimation, reliability analysis.	**TSO:** flexibility-based network management. Collaborative and dispatch process with DSO. Avoidance of conflicting actions with DSOs. Flexibility requirements. Lower OPEX for network operation. Improved security of supply and national reliability
	DSO	Asset provider (to TSOs)		

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service through improved DER forecasts and flexibility analytics in the frame of Flexibility-based network management and collaborative flexibility scheduling with DSOs.	RES generator & prosumer	Asset provider	Demand and Generation Forecasting. Flexibility Scheduling. **RES generator/prosumer:** energy assets (DER assets) and consumption patterns. **Aggregator:** flexibility capacity forecast, flexibility capacity offer, flexibility VPPs.	constraints. Avoidance of extra costs for network updates. Maximize RES capacity in the national electricity system. **DSO**: lower OPEX costs for network operation and security of supply taking the most of flexibility capacity in their influence zone. Cost in procuring availability/utilization of flexible DER. Flexible connection arrangements for DER (faster connections of DER) under which non-firm arrangements are allowed to integrate DER in constrained areas. Collaborative and coordinated scheduling with TSOs. Improved forecasting of flexibility requirements (short and long-term forecasts of DER and loads). **RES generator/prosumers:** new incomes. Lower energy prices. Active participation in energy markets. **Aggregator:** flexibility potential analysis. DR management and strategies. Firm flexibility capacity. Real-time performance of flexible resources.
	Aggregator	Asset provider (data and analytics)		
BS5-Distribution system operators to reduce total cost of ownership and effectively safeguard network availability and resilience through advanced network asset management analytics (incl. predictive maintenance, network planning and sizing).	DSO	Asset Owner Asset consumer	**DSO:** Network infrastructure data through the utilization of IoT devices. SCADA, RTU information. GIS information. Demand forecasting, Generation forecasting **Prosumer/RES generator:** energy demand and energy generation profiles. **Aggregators:** Flexibility analytics and forecasts. **External Asset Providers**: Economic activity data, Weather Data.	**DSO:** reduced total cost of owning and operating their network. Time-based probabilistic asset management techniques. More effective asset management through dedicated toolkits extending the traditional monitoring systems (SCADA, DMS, etc.). Accurate sizing of network assets and expansion plans towards avoidance of unnecessary investments. **Prosumers:** lower electricity cost. Revenues from DER data sales **RES Generators:** Revenues from DER data sales **Aggregators:** Revenues from flexibility analytics trading **External Asset Providers**: Revenues for the re-use of their data (weather information and forecasts).
	Prosumer/RES generator	Asset provider		
	Aggregator	Asset provider		

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BS6- Transmission system operators to reduce total cost of ownership and effectively safeguard network availability and resilience through advanced network asset management analytics (incl. predictive maintenance, network planning and sizing)	TSO	Asset consumer, Asset provider	**TSO:** commercial data; seasonal data related to the performance of the network assets. Correlation of maintenance information with regard the weather conditions. **Market operators:** real-time information on electricity markets. **DSOs:** insight over non-supervised DER or network infrastructure through the utilization of IoT applications. Analysis on external useful data sources (economic activities, weather, etc.).	**TSO:** new service preventive, corrective, fault and statutory maintenance tasks as well as continuous and cyclical condition monitoring. More effective asset management through dedicated toolkits extending the traditional monitoring systems (SCADA, DMS, etc.). Accurate sizing of network assets and expansion plans towards avoidance of unnecessary investments. **DSO:** reduced total cost of owning and operating their network. Time-based probabilistic asset management techniques. **Prosumers:** lower system cost. Lower energy price. Revenues from DER data sales. **Aggregators:** Revenues from flexibility analysitcs trading. **RES generators:** revenues from DER data sales. **External Asset Providers:** Revenues for the re-use of their data (weather information and forcasts)
	DSO	Asset provider		
	Aggregators	Asset provider		
	RES generator	Asset provider		
BS7-Building managers/Facility Managers/Prosumers enjoy significant energy cost savings and reduce dependency on the grid through individual and coordinated flexibility-based control of building energy systems (generation, storage, demand) for self-consumption maximization.	Facility Manager/Building Manager	Asset provider/consumer	**Facility Manager/Building Manager**: demand, storage, generation, building characteristics. Comfort Profiles. **Aggregator**: Flexibility analytics. Flexibility control schedules. **Prosumer:** consumption and generation data to its facility manager (or aggregator directly). IoT and smart appliance data.	**Facility Manager/Building Manager:** Optimized energy costs at building level, self-consumption maximization. Revenues from sales of data to aggregators. Costs for analytics service from aggregators. **Aggregator:** Costs for data acquisition from Building/Facility Managers and prosumers. Revenues from flexibility analytics and scheduling services to Facility Managers and Prosumers. **Prosumers:** lower energy consumption and lower energy cost at dwelling level. Preserved comfort habits. Maximizing self-consumption at dwelling level.
	Prosumer	Asset provider		
	Aggregator	Asset provider (analytics) /consumer.		

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				Revenues from sales of data to aggregators. Costs for analytics service from aggregators.
BS8-Building managers/prosumers to generate new income by monetizing their flexibility in local flexibility and energy market transactions through advanced flexibility analytics and trading marketplaces	Facility Manager/Building Manager	Asset provider	**Aggregators**: Flexibility needs. Flexibility analytics **Prosumer**: consumption and generation data to its facility manager (or aggregator directly). IoT Data. **Facility Manager:** demand/generation/storage and other information about loads to the aggregator.	**Aggregator:** Achieving better deals through negotiation for flexibility provision to the grid. Receives money from the DSO (as described in BS-1) and transfer parts of this money to their clients (the facility manager or the prosumer) based on contractual agreements. **Facility Manager and the prosumer:** receives a reward for the flexibility provided. Costs for flexibility analytics provided by the aggregator to better understand flexibility (and its characteristics) that can be traded in the marketplace.
	Prosumer	Asset provider		
	Aggregator	Asset provider (data analytics) Asset consumer		
BS9-ESCOs to increase the attractiveness of renovation investments and reduce EPC risks, through enhancing the accuracy of Energy Performance Simulations at the design phase and as a means to reduce the gap between anticipated and actual energy performance of buildings	ESCO	Asset consumer. Asset producer (data analytics).	**Prosumers**: consumption, generation, IoT, building geometry and envelope data… to the ESCO in order to allow it to perform all the required analysis for the most suitable renovation design **ESCO**: consumer profiling and energy analytics	**Prosumer:** enhanced confidence in the EPC certificate. The most optimal agreement in the EPC. Energy savings. **ESCO:** Reduce EPC risk. Enhanced accuracy of energy performance simulations. In use real-time performance data of the building for computing simulations instead of traditional static models. Most optimal agreement in the EPC achieved. Secure investment payback. Enhanced engagement of prosumers in risk-averse investments and increase of clientele of ESCOs
	Prosumer	Asset producer		

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BS10-RES Plant Operator to reduce LCOE of the RES plants along with the O&M costs, while increasing RES technology reliability, availability and efficiency through advanced asset management and predictive maintenance analytics	RES generation	Asset provider (data analytics). Asset consumer	**RES generator**: data from SCADA systems, inverters, locally deployed sensors, meters, portable cameras, cameras attached to UAVs and local weather stations. Power quality indicators, probability of fault occurrence and active/reactive power forecast. **DSO/TSO:** RES installation downtimes and adapted generation forecasts	**RES generation:** lower operation and maintenance costs. Improved operational performance of the power plant (lower downtime of assets, lower unexpected failures and breakdowns) and consequently increased revenue due to increased power production (avoidance of losses in power generation). Advanced analytics and AI-based algorithms based tools performing the optimal operation, predictive maintenance and proactive avoidance of equipment faults. Power quality indicators, assessment of the probability of fault occurrence and active/reactive power forecast. Reduced LCOE. Increased RES technology reliability and efficiency. **DSOs/TSOs:** improved short-term operational scheduling.
	DSOs/TSOs	Asset consumer		
BS11-RES Plant Operators to improve their revenue stream and increase profitability in the short- and long-term through advanced generation and flexibility analytics for increasing accuracy of bids in energy markets, promoting long-term GPPAs and getting involved into flexibility market transactions.	RES plant operator	Asset producer (data and data analytics). Asset consumer.	**RES generator**: in-plant SCADA, inverter, sensing and metering data, active/reactive power forecast. Generation forecasts. **Retailer:** Demand Forecasts, Power purchase needs **Aggregator:** Flexibility analytics. VPP configuration **TSO:** historical TSO data **External Asset Providers**: market prices, weather data	**RES plant operator. RES generator:** opening their offering into new markets (flexibility, balancing, ancillary services markets). Reduced risk related to market uncertainty and energy market competition. Advanced forecasting analytics that fuse and analyse in-plant SCADA, inverter, sensing and metering data with local and regional weather data to provide more accurate active/reactive power forecasts. This forecasting result will comprise the basis for the execution of further analytics (jointly analysing forecasts with historical market and TSO data) that will enable the identification of the amount of produced energy that can be sold in wholesale market and the estimation and the quantity of production that is under the risk of not being purchased. Long-term Green Power Purchase Agreement. Reduced losses by non-sold energy. Revenues from sales of data and analytics
	Electricity retailers	Asset Producer, Asset consumer		
	Aggregators	Asset producer (analytics). Asset consumer.		
	Market Operator	Asset provider		
	TSO	Asset consumer		

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				to retailers and aggregators. Costs for the purchase of flexibility analytics from Aggregators. **Retailers**: Green energy (more competitive) energy tariffs, Social Corporate Responsibility advantages due to green power sales, Long-term engagement of clients. Revenues from sales of data and analytics to RES Generators **TSO:** Revenues from sales of historical data to RES Generators/Operators. **Aggregator:** Costs for the purchase of RES Plant data. Revenues from flexibility analytics and VPP configuration services to RES Generators.
BS12-Electricity retailers to increase competitiveness of their tariff schemes and increase revenues and profits through advanced energy analytics that facilitate the establishment of GPPAs.	Retailers	Asset provider. Asset consumer	RES generator: accurate generation forecast with regards to the energy they can securely deliver to them in the long-term. Retailers: smart metering data, accurate demand forecasting results (long-term), power purchasing needs.	Retailers: access to cheaper energy sources (green energy sources) and long-term power purchasing agreements at highly competitive prices. Green energy tariffs that improves their market competitiveness. RES generator: Increased their energy bidding offers. Lower economical losses for non-sold energy.
	RES Operators	Asset provider		
BS13-ESCOs to generate new income through improving existing Energy Performance Certification services and complement them with Smart Readiness Certification offerings on the basis of highly-granular real-time energy analytics	ESCO	Asset consumer. Asset Provider (Analytics)	**ESCO**: Energy Performance Analytics, Smart Readiness Analytics, Comfort Profiling. **Facility Manager/prosumer**: real-time data from all the energy consuming devices of the facility manager: sensors, actuators and ICT products that manage them	**ESCO**: Revenues from new services for Dynamic and Accurate Energy Performance Certification. Revenues from new service for Smart Readiness Certification **Facility Manager/prosumer**: Revenues from data sales to ESCOs. Increase attractiveness to participate in flexibility services (through certification). Increased property value through certification. Costs for the certification services provided by ESCOs
	Facility Manager/prosumer	Asset provider		

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BS14-City authorities to optimize their long-term planning and achievement of sustainability goals through accurate forecasting-driven urban planning	Public Authorities/City Authority	Asset Consumer Asset provider (analytics)	**City Authority:** Public building and public infrastructure city-wide energy-related data. (energy demand/RES generation per city zone/neighbourhood,), energy consumption in public infrastructure, etc. **Building Managers/ Facility Manager, RES Operators, Network Operators, Prosumers, ESCOs, Aggregators**: Generation, Demand, Storage, EV data from their DERs, Analytics (demand/ generation forecasts, flexibility analytics and forecasts) for their DERs	**City Authority**: Informed city planning and better investment allocation, big data analytics criteria in the prioritization process for SECAP strategy-actions. Increased public transparency and open governance. Promoting new economic activities, new jobs creation and GDP growth with new renovation activities. Costs (or subsequent investment agreements) for the acquisition of data and analytics from the variety of involved stakeholders in the city ecosystem. **Building Managers/ Facility Manager, RES Operators, Network Operators, Prosumers, ESCOs, Aggregators:** new revenue streams from data and analytics sales. Possibility for new projects through their involvement in the city ecosystem.
BS15-Prosumers to enjoy significant cost savings while safeguard their well-being through fine-grained edge analytics facilitating the deployment of personalized energy management and human-centric automation services, properly balancing energy efficiency and human comfort.	Prosumers	Asset provider. Asset consumer (data analytics).	**Prosumers**: on-site generation, demand, storage, metering, sub-metering and IoT data.. **Retailers:** Demand profiling, comfort profiling, demand/ generation forecasting. Optimized control schedules	**Prosumers:** improved use of their on-site generation and storage. Real-time balancing of demand with available supply. Personalized energy management. Flexible demand provided by HVAC appliances, lighting and electric vehicles will be used to optimise locally energy use and maximise the benefit of prosumers. Energy storage units will be used as buffers to increase self-consumption and reduce energy losses. Revenues from data sales to retailers. Costs for service provision (Personalized Analytics and Smart Home Automation for Energy Efficiency, Non-energy) from retailers. Well-being and comfort preservation. Security enhancement through relevant services. **Retailers:** Costs for the purchase of data from prosumers. Advanced portfolio knowledge and delivery of novel services to prosumers especially in the area of smart home automation. Revenues from Energy Analytics, Smart Home and Non-energy services. Possibility to hedge against imbalances by manipulating Energy Efficiency targets and, thus,
	Retailers	Asset Consumer, Asset provider (analytics)		

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				respective guidance and automated control schedules towards prosumers.

Table 2. Analysis of the Business Scenarios. Actors, Data Flows and mechanisms to monetize data

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5.4 SYNERGY Data Value Network

The SYNERGY Data Value Network defined and derived from a common agreement between the project partners within Task 10.1 is depicted in the figure below, depicting at a high-level the main business and data interactions between the electricity data value chain stakeholders involved in SYNERGY:

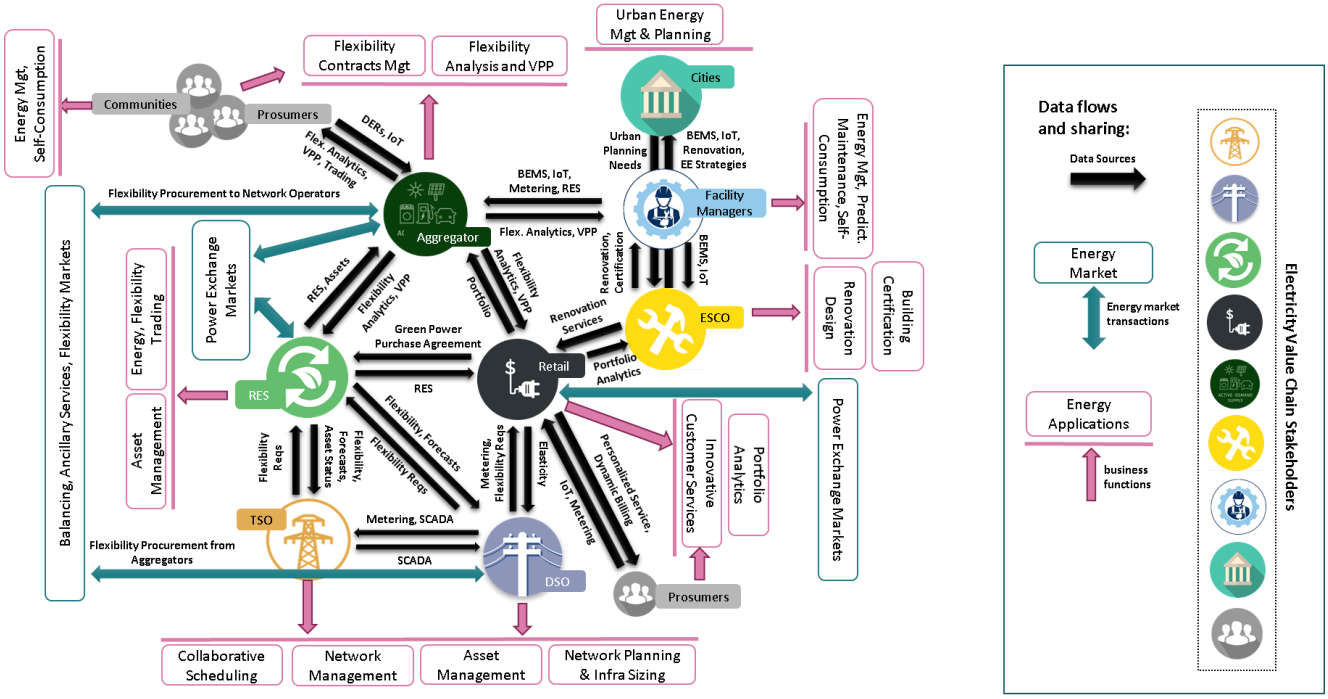

Figure 3. SYNERGY Data Value Network

In Annex C a more thorough and low-level (detailed view) of the SYNERGY Data Value Sub-Networks (reflecting aspects of each individual Business Scenario) is provided to better depict in a higher resolution and detail the data and service interactions involved in the conceptualization of such Business Scenarios.

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6 SYNERGY data-driven business models

SYNERGY aims at addressing current inefficiencies of the electricity sector stakeholders that hinder the envisaged transition to Smart Electricity/ Energy Systems, by enabling the creation of an Integrated Electricity Stakeholder Data Value Chain on the basis of data and intelligence sharing, facilitated by respective technologies for data collection, interoperability, management, analytics and secure/ transparent sharing, and associating this integration with respective business models that will enable and safeguard the business viability of the envisaged transition and the realization of really innovative and advanced energy services. Electricity market stakeholders struggle to connect data opportunities to their current product and services, since they are not directly in the business of 'doing something with data'.

Paying attention to what the state of play is with regard to emerging data-driven business models in the market today, to what value is created using data and to what is the approach to create and implement new business models with data [46], **three business approaches and six ways of doing business** might be defined deriving from the literature consulted. In what follows, we describe their main characteristics:

Solo Opportunity

From the literature consulted on topics about the data economy and new business models based on data, the two ways of doing business presented below are enclosed within the category 'Solo Opportunity' attending to the level of maturity of the data value chain[2]. Companies developing these ways of doing business usually perform all the activities of the multiple stages of the data value chain (data generation, data storage, data analytics, data usage) alone. In fact, no other players exist.

- *Data-enabled differentiation business approach*: the product is still the primary source of value but using data from the product is used to improve the product or service offering.
    - Way 1- Product Innovation. Companies doing business via product innovation are known as **Product innovators** and they enhance their products and services with data.
    - Way 2- System Innovation. Companies doing business via system innovation are known as **System innovators** and they use data to integrate multiple product types; a broader smart system offering. Different product types are architecturally related and can interact in order to deliver value to the beneficiary.

Collaborative Opportunity

[2] Data Value Chain: main stages are Data Generation, Data Storage, Data Analytics, Data Usage

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The four ways of doing business presented below are enclosed within the category 'Collaborative Opportunity' attending to the level of maturity of the data value chain. Companies developing these ways of doing business collaborate and work together with other companies to enable a data value chain (data generation, data storage, data analytics, data usage).

- *Data brokering business approach*: there are situations where company data only provides enough value when combined with other sources, or the company does not have the capabilities to fully tap the business opportunity on its own. When the opportunity cannot be tapped by a single vendor with a single product, data brokering opportunities arise.
    - Way 3- Data provision. Companies doing business via data provision are known as **Data providers** in the literature, and they gather and sell raw data without adding too much value to it. So as not to mislead readers, in compliance with the roles of the SYNERGY BIG DATA PLATFORM and AI MARKETPLACE defined in the project and detailed in Table 1, this case addresses the Asset Owner and Asset Provider roles.
    - Way 4.1- Data brokering. Companies doing business via data brokering are known as **Data brokers** in the literature, and they gather and combine data from multiple sources, create additional value with analytics and sell insights. With the aim of not misleading readers, in compliance with the roles of the SYNERGY BIG DATA PLATFORM and AI MARKETPLACE defined in the project and detailed in Table 1, this case addresses the Data Analyst role.
    - Way 4.2- Data service provision. Companies doing business via data provision are known as **Data service providers** in the literature, and they provide (trained algorithms, advanced visualization tools, analytics reports, etc.). With the aim of not misleading readers, in compliance with the roles of the SYNERGY BIG DATA PLATFORM and AI MARKETPLACE defined in the project and detailed in Table 1, this case addresses the Asset Provider role.
- *Data-based delivery networks business approach*: Multiple companies work together and share data to tap data opportunities. Companies specialize in one or two capabilities needed to enable the delivery network.
    - Way 5- Value chain integration. Companies doing business via value chain integration are known as **Value chain integrators** in the literature, and they share data with system-integrator partners to extend product offerings or reduce costs.
    - Way 6- **Delivery network collaborators** share data to drive deal making, foster collaborative services and enable radical transformation of "business-as-usual".

In SYNERGY, for the data-driven business models definition, the applied methodology is based on the fact that the **business models to be defined will be created in such a way the diverse energy stakeholders can monetize their data through the appropriate contracts and optimize their business functions**. Therefore, we focus primarily on data transactions and on intelligence exchanges and secondarily on service flows and pricing since this may be affected by the new data-driven approach introduced. The BMs reflect the value that can be assigned to the data produced between all these actors.

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In addition, we should clarify that we talk for business models, but in some cases, organizations can adopt them as business model innovations in their underlying business model, rather than considering them as disruptive new models.

A series of Business Models based on data have been defined (see *Table 4*). In line with the state of play, the 'solo differentiation' and 'collaborative opportunities' business models strategy and the six main categories of BMs based on data have been followed to define them. *Table 4* shows the list of BMs and the relationship of each one of them with the SYNERGY Business Scenarios. Additionally, BMs are derived from the combination of two or more BSs and HBSs- Horizontal data business scenarios and any "data" business models are a precondition for the realization of the different energy business models in SYNERGY. It is worth noting that HBS horizontally influence the defined BSs.

BM1	Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning
BM2	Data value as a service for Advanced Asset Management
BM3	Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants
BM4	Dynamic Enhancement Energy Performance Certificates
BM5	Synergetic Energy performance contracting (design)
BM6	Synergetic Energy Performance optimization (self-consumption)
BM7	Intelligence-Driven long-term Generation Planning and PPAs Advisory
BM8	RES Power Plant Optimizer for GPPA maximization
BM9	Transparent GPPA marketplace
BM10	RES Virtual Power Plant (VPP)
BM11	Objective Dynamic Pricing of Electricity
BM12	Retailers as Non-Energy Service Providers
BM13	Flexibility and portfolio analytics (sales of insights)
BM14	Flexibility VPP configuration for ancillary services
BM15	TSO-DSO Collaborative Network Management
BM16	Urban planning Crowdsourcing marketplace
BM17	Synergetic Energy as Service Model (Retailer – ESCO& Retailer-Aggregator)

Table 3. List of Business Models

BM1	BS1, BS5, BS6, BS10	**BM7**	BS12, BS11	**BM13**	BS1, BS2, BM8
BM2	BS5, BS6, BS7, BS10	**BM8**	BS11, BS12	**BM14**	BS1, BS2, BS3

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BM3	BS10	**BM9**	BS12; BS11	**BM15**	BS1, BS3, BS4
BM4	BS9, BS13, BS15	**BM10**	BS1, BS10, BS11	**BM16**	BS14
BM5	BS9, BS15	**BM11**	BS12, BS12	**BM17**	BS2, BS7, BS8, BS14
BM6	BS7, BS14	**BM12**	BS12		

Table 4. Relationship between Business Models (BM) and Vertical Business Scenarios (BS)

For the BM definition and analysis, the following content is provided:

- *Business model categorization*: a blue context-box where the business model is categorized according to the premises described in the beginning of this chapter.
- *Figure representing a simplified Business Model Canvas* where graphically and smoothly readers can obtain a quickly understanding of the business model. This figure is a schematic view of the key elements of the business model using the BM Canvas tool. We have inspired us by the work done by Deloitte company in business analysis reports.
- *Brief Description*: this subsection provides a briefing of the business model.
- *Raw Data/Insights*: this subsection includes the raw data and insights that are under data exchanges among the different roles and stakeholders involved in the business model.
- *Value Realized:* this subsection describes de direct value obtained by the companies/stakeholders developing the business model.
- *Value Proposition*: this subsection provides a description of the value created for the target customers.
- *Value Capture and Monetization*: this subsection describes the ways for which the value created is to be captured. Information about for what the target customers are willing to pay for.
- *Analysis of the value proposition per market role involved (electricity market roles)*: this subsection includes the analysis of the value proposition of this business model per each one of the roles involved in the business model. For this analysis the following information is provided; (i) value proposition, revenue streams, cost streams and a Business Model Canvas

Here we represent the schematic view of the infographic that is to be used per each business model analysis:

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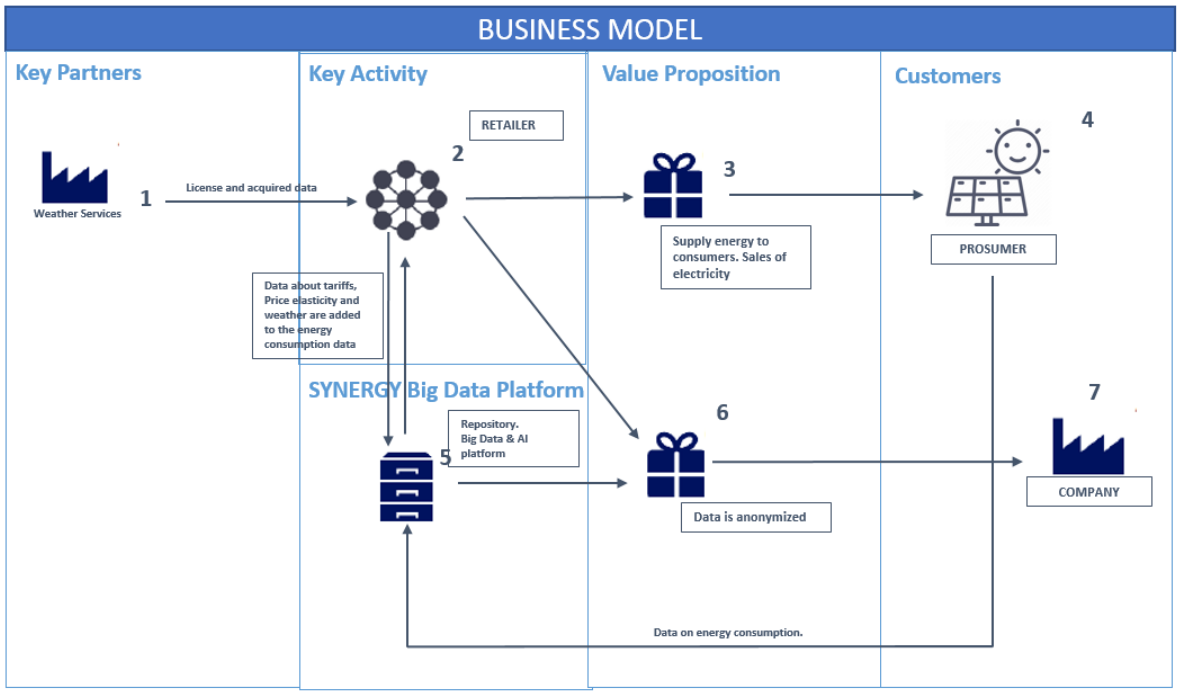

Figure 4. Template for the graphical tool for schematic representation of the BM Canvas

Symbols that are in use for the analysis are:

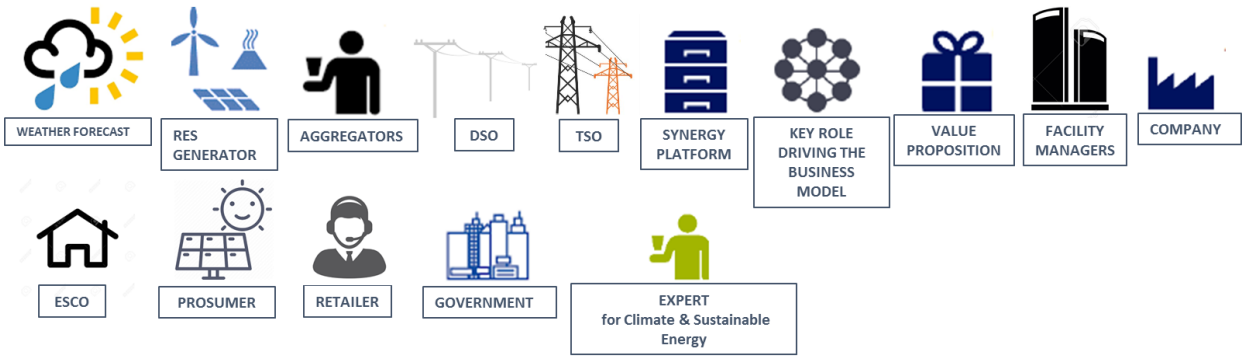

Figure 5. List of symbols used in a graphical description of the Business Models.

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6.1 BM1- Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

Business Model derived from the combination of BS1, BS5, BS6 and BS10.

Business Model categorization→ 'Data Brokering' business approach – Collaborative Opportunity. Data Broker business model type

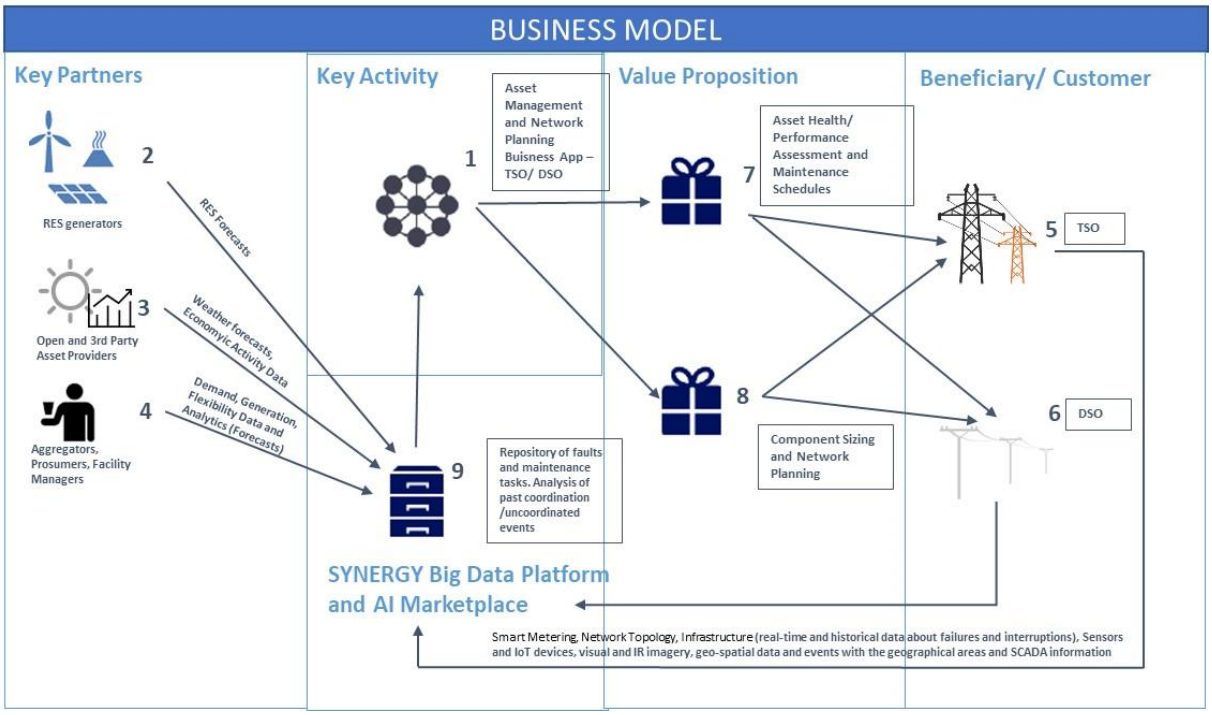

Figure 6. Business Model Description_BM1- Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

BRIEF DESCRIPTION:

This business model is based on "Coordinated maintenance works and coordinated expansion planning strategies in the operation landscape of the electricity networks". This business model is based on several infrastructure planning and asset management optimization software tools providing value-added services on top of the SYNERGY core big data platform and AI Analytics Marketplace and will provide active and reflective, time-based probabilistic asset management techniques that will aim to also reduce the whole system cost including the cost passed to network operators.

The business model commercial offer is focusing on Synergetic Data Intelligence-driven Advanced Electricity Grid Asset Management and Planning for TSOs and DSOs. This business model will be run by a Network Operator (TSO or DSO) that runs a business application for Asset Management and Network Planning (*Figure 6- 1).*

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RAW DATA and INSIGHTS:

The TSO/ DSO acquires data assets (through the SYNERGY Platform and Analytics Marketplace) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are both raw data and intelligence/insights derived from raw data (forecasts, plans, schedules, etc.). So that, services will be built from the following data:

1. Active/Reactive power forecast of RES Power Plants (*Figure 6*- 2).
2. Weather and Economic activities (*Figure 6*- 3).
3. Medium, long-term demand forecasts, local generation forecasts and flexibility forecasts (including also context-aware demand flexibility profiles) from the edge of the grid (*Figure 6*- 4).

As Data Owners, the Network Operators will also utilize data referring to their networks and infrastructures such as:

4. Smart Metering, Network Infrastructure Data (real-time and historical data about failures and interruptions), Sensors and IoT devices deployed over network components, visual and IR imagery information from cameras providing supplementary information for network assets, geo-spatial data from GIS servers correlating assets and events with the geographical areas and SCADA information (*Figure 6*- 5 and 6).

The business model encompasses data value as a service and data intelligence as a service for advanced asset management.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiaries (Network Operators) involved in its realization.

VALUE PROPOSITION:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

The Business application that will facilitate the realization of this business model will analyse historical loading profiles, overloading situations for various assets, and dig through tons of asset operational data to analyse asset loss of life. This will allow Network Operators (TSO (*Figure 6- 7*)-DSO (*Figure 6-8*)) to:

1. Assess health and criticality indexes about their assets, reduce total cost of ownership (with regards to Operation and Maintenance), and plan for predictive maintenance programs (*Figure 6-* 7). It will enable operators to define risk-based asset management strategies that include failure probabilities, criticality indexing, and device health indexing, thus gaining broader insight into the implications of their asset management decisions, improving maintenance plans.

Perform evidence-based network planning and infrastructure sizing (also considering future penetration of EVs, storage and distributed generation) (*Figure 6-* 8) towards further safeguarding network availability and resilience in the most cost-effective manner (deferral of unnecessary investments).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Data Asset Owner: RES Power Plant Operators, Weather Forecast providers, Economic Activity Data Providers, Prosumers, Facility Managers, Aggregators, DSOs, TSOs
- Data Asset consumers: DSOs, TSOs,

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace (*Figure 6- 9*)

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Network Operators and Key Partners (responsible for signing data sharing contracts)
- Technical Users: From Network Operators and Key Partners
- Data scientist/Data Analytics. TSOs, DSOs

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- Business User: TSOs, DSOs

VALUE REALIZED

- Data (Intelligence) Assets are sold to the beneficiary from Key Partners – Historical and actual data uploaded to the Platform, Analytics results provided by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data and Analytics Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (from Key Partners → Forecasting and Beneficiary→Predictive Maintenance Analytics).
- Network operators/ Beneficiary: Safe, reliable, economical and efficient transmission and distributions systems (minimization of downtime and interruptions, avoidance of equipment failures). Reduced OPEX costs. Investment costs related to extending/reinforcing lines and other assets are reduced because of informed sizing and planning of network components and utilization of flexibility potential at its most, to avoid unnecessary and costly investments.

VALUE CAPTURE AND DATA MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Finally, a data transaction fee is involved and is preserved as part of the fees paid by the Beneficiary to each Key Partner in the frame of Data Acquisition.

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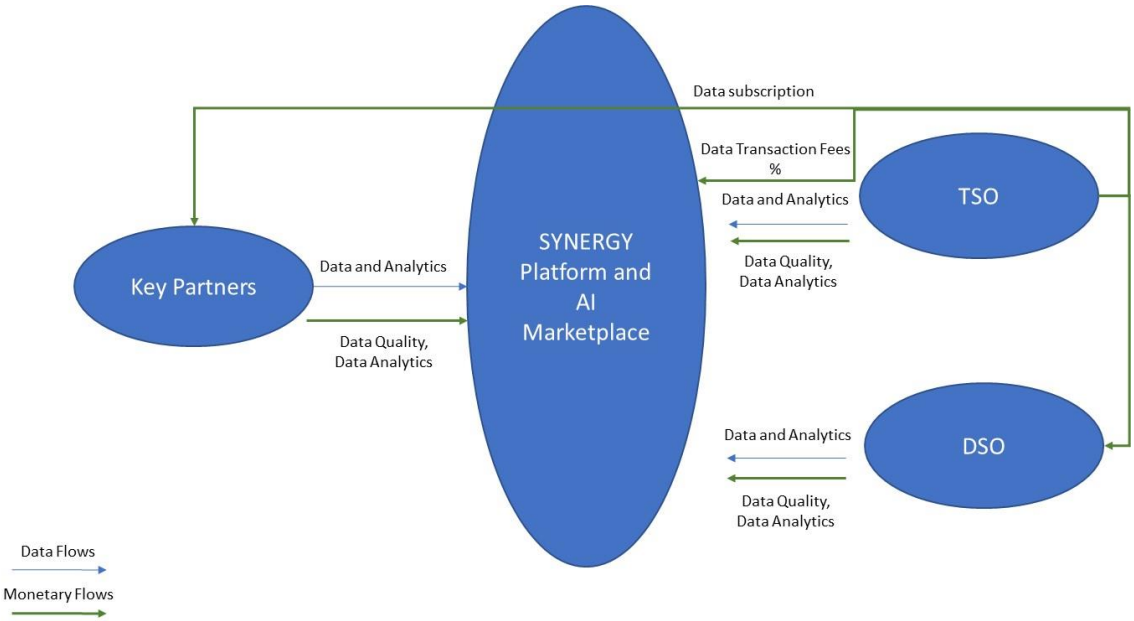

Figure 7. Money Flow Diagram BM1- Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

Network Operators (TSO/ DSO)

Revenue streams:

- Lower operation and maintenance costs.
- Lower economic investment for network expansion.
- Reduced penalties due to interruptions and local failures (Lost Load) caused by equipment health issues.
- Indirect revenues (savings) from the enhancement of the quality of power in the network (avoidance of need for additional services for frequency and voltage regulation) and the reduction of power losses (more power delivered). .

Cost Items:

- Costs for acquiring data and analytics from Key Partners
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

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The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS NETWORK OPERATORS

<table>
<tr><td colspan="2">Key Partners
• Aggregators
• Prosumers/ Building Managers
• RES Operators
• Non-electricity Data Asset Providers.</td></tr>
<tr><td colspan="2">Key Activities
• Network planning
• Asset Management and Predictive Maintenance Scheduling.</td></tr>
<tr><td colspan="2">Value Proposition
• Optimal operation, predictive maintenance and proactive avoidance of equipment faults are available by taking into account the diverse pool of plans and actions scheduled in distribution control areas.
• Forecast potential problems in their networks and perform appropriate preventive actions.
• Support in the decision-making process in O&M works.
• Informed sizing and planning of network components and utilization of flexibility potential at its most, to avoid unnecessary and costly investments
• Advanced analytics and AI-based algorithms tools performing the optimal operation, predictive maintenance and proactive avoidance of equipment faults.
• There's no need to build own big data infrastructure and analytics tools.
• Transparent, secure and objectively costed reach out to valuable external data.</td></tr>
<tr><td colspan="2">Relationships with other partners /channel
• SYNERGY Platform and AI Analytics Marketplace.</td></tr>
<tr><td colspan="2">Customer and Communication.
• TSOs and DSOs are both beneficiaries and customers.
• Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).</td></tr>
<tr><td>Costs Structure
• Costs for acquiring data and analytics from Key Partners
• Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
• Service fees for data quality enhancement.
• Service fees for Analytics Execution</td><td>Revenue Model
• Lower operation and maintenance costs.
• Lower economic investment for network expansion.
• Reduced penalties due to interruptions and local failures (Lost Load) caused by equipment health issues.
• Indirect revenues (savings) from the enhancement of the quality of power in the network (avoidance of need for additional services for frequency and voltage regulation) and the reduction of power losses (more power delivered).</td></tr>
<tr><td>Societal and Environmental Costs</td><td>Societal and Environmental Benefits</td></tr>
</table>

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• None	• Lower O&M network operation translates into lower system charges that translate into a reduction in the final price of energy. • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 5. CANVAS TSO_BM1- Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

6.2 BM2 - Data value as a service for Advanced Asset Management

Business Model derived from BS5, BS6, BS7, BS10.

Business Model categorization→ 'Data Enabled Differentiation' business approach – Solo Opportunity. System Innovator business model type

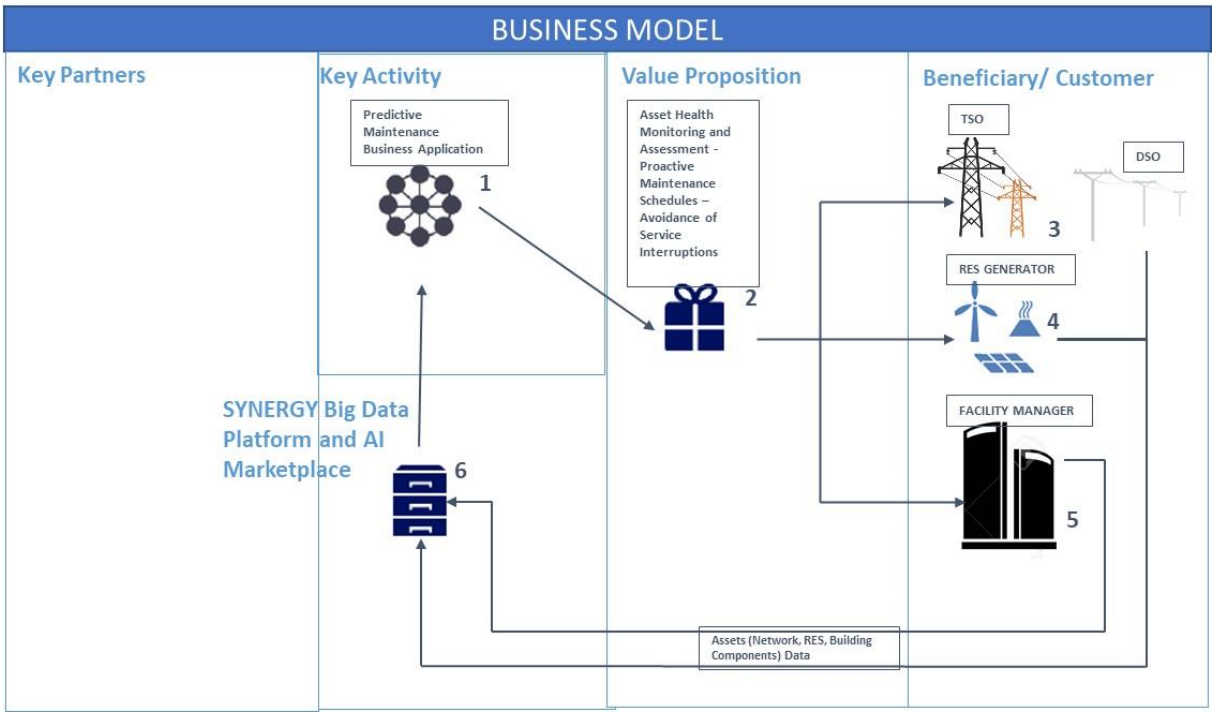

Figure 8. Business Model Description_BM2-Data Value as a Service for Advanced Asset Management

BRIEF DESCRIPTION

Real-time data streams from equipment items available in electricity system infrastructures need to feed existing Predictive Maintenance Software solutions utilized by a variety of stakeholders of the electricity data value chain, and more specifically, Network Operators, RES Plant Operators and Building/Facility Managers. Having gone through such processes, the owned data of Beneficiaries can facilitate more effective daily maintenance-related works. I.e. asset management, decision-making maintenance scheduling. Related stakeholders/ Beneficiaries will be rewarded with up to date and

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near real-time information about real-time predictive needs, proactive diagnosis of equipment faults and, probability of fault occurrence, to proceed with the timely replacement of equipment reaching end-of-life or components with high probability to fail. This service-oriented business model constructs from a compound service offer. A Business applications for predictive maintenance already operated by Beneficiaries(Figure 8- 1) obtain access to complete and high quality data through the SYNERGY Big Data Platform and AI Analytics Marketplace (Figure 8-6) to feed their existing business applications. Beneficiaries will be provided with more evident results regarding their equipment status and health, along with tailored information about failure probabilities. On this basis, they will gain the opportunity to proceed with informed maintenance scheduling, in contrast with current practices that utilize the vendor specification for planning the maintenance of equipment components.

RAW DATA and INSIGHTS:

- As Data Asset Owners, the Network Operators will utilize data referring to their networks and infrastructures such as Smart Metering, Network Infrastructure Data (real-time and historical data about failures and interruptions), Sensors and IoT devices deployed over network components, visual and IR imagery information from cameras providing supplementary information for network assets, geo-spatial data from GIS servers correlating assets and events with the geographical areas and SCADA information (Figure 8-3).
- Similarly, as Data Asset Owners, RES Plant Operators will utilize data from their SCADA, inverters, locally deployed sensors, meters, portable cameras, cameras attached to UAVs and local weather stations (Figure 8 - 4).
- Finally, Building Managers (Figure 8 – 5) will utilize and enhance the quality of their data referring to BEMS information, metering and sub-metering data from individual devices, sensing data from ambience sensors, actuators and individual loads, to perform advanced predictive maintenance actions with the use of existing business applications.

The business model encompasses data value as a service for advanced asset management.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiaries (Network Operators, RES Operators, and Building/Facility Managers) involved in its realization.

VALUE PROPOSITION:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

NETWORK OPERATORS

The Business application that will facilitate the realization of this business model will analyse historical network component profiles, overloading situations for various assets, and dig through tons of asset operational data to analyse asset loss of life. This will allow Network Operators to Assess health and criticality indexes about their assets, reduce total cost of ownership (with regards to Operation and Maintenance), and plan for predictive maintenance programs (Figure 8– 2). It will enable operators to define risk-based asset management strategies that include failure probabilities, criticality indexing, and device health indexing, thus gaining broader insight into the implications of their asset management decisions, improving maintenance plans.

RES OPERATORS

The Business application that will facilitate the realization of this business model will analyse the diverse data streams described before and deliver to RES plant operators the needed intelligence, towards ensuring RES plant optimal operation, predictive maintenance and proactive avoidance of equipment faults in their RES plants. It will enable Identification in real-time of predictive maintenance needs and significant reduction of the LCOE (Levelized Cost of Energy) of the RES plant along with the O&M costs, while increasing RES technology reliability and efficiency and improving power trading functions on the plant operator side (Figure 8 – 2). This will allow RES Operators to perform proactive diagnosis of equipment faults and their characterization, enable the continuous monitoring of key power quality indicators and assess the probability of fault occurrence.

BUILDING/ FACILITY MANAGERS

The Business application that will facilitate the realization of this business model will analyse real-time BEMS, generation and IoT information from myriads of devices in buildings and facilitate their detailed analysis to improve predictive maintenance functions, thus enabling accurate fault diagnosis and characterization over critical systems and equipment, probability assessment of fault occurrence, early prediction of faults and facilitate increased reliability and efficiency of building assets (Figure 8 – 2).

For all stakeholders, significant value is expected to be generated by removing data quality and integrity functions from their hands, thus removing the requirement for having to dedicate their own resources to qualified personnel data-related functions. At the same time, they are provided with the means to optimize their maintenance plans, reduce their O&M costs and increase the profitability of their businesses by improving the returns on their assets.

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

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DATA PERSPECTIVE

- Data Asset provider/ Data Asset Owner: RES Power Plant Operators, Facility Managers DSOs, TSOs..
- Data Asset consumers: RES Power Plant Operators, Facility Managers, DSOs, TSOs.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace

ORGANIZATION PERSPECTIVE

- Technical Users: From Beneficiaries.
- Business Users: RES Power Plant Operators, Facility Managers, DSOs, TSOs.

VALUE REALIZED

- SYNERGY Platform and AI Analytics Marketplace: Service fees for data quality enhancement.
- Network operators/ Beneficiaries: Safe, reliable, economical and efficient transmission and distribution systems (minimization of downtime and interruptions, avoidance of equipment failures). Reduced OPEX costs.
- RES Operators/ Beneficiaries: RES plant optimal operation, predictive maintenance and proactive avoidance of equipment faults in their RES generation power plants. Identification in real-time of predictive maintenance needs and significant reduction of the LCOE (Levelized Cost of Energy) of the RES power plant along with the O&M costs, while increasing RES technology reliability and efficiency and improving power trading functions. Increased cost-effectiveness of their power plants. Increased business profitability.
- Building/ Facility Managers/ Beneficiaries: Improved predictive maintenance functions, accurate fault diagnosis and characterization over critical systems and equipment, probability assessment of fault occurrence, early prediction of faults and facilitate increased reliability and efficiency of building assets. Reduced OPEX Costs. Increased confidence level by customers. Lower risk for underperformance and not accomplishing KPIs of the SLAs signed.
- All Beneficiaries can evolve to a more digitized company, by allocating value over their data.

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VALUE CAPTURE AND DATA MONETIZATION:

The Monetary flow is characterised by service fees paid to the SYNERGY Platform and AI Marketplace for enhancing the quality and integrity of owned data assets.

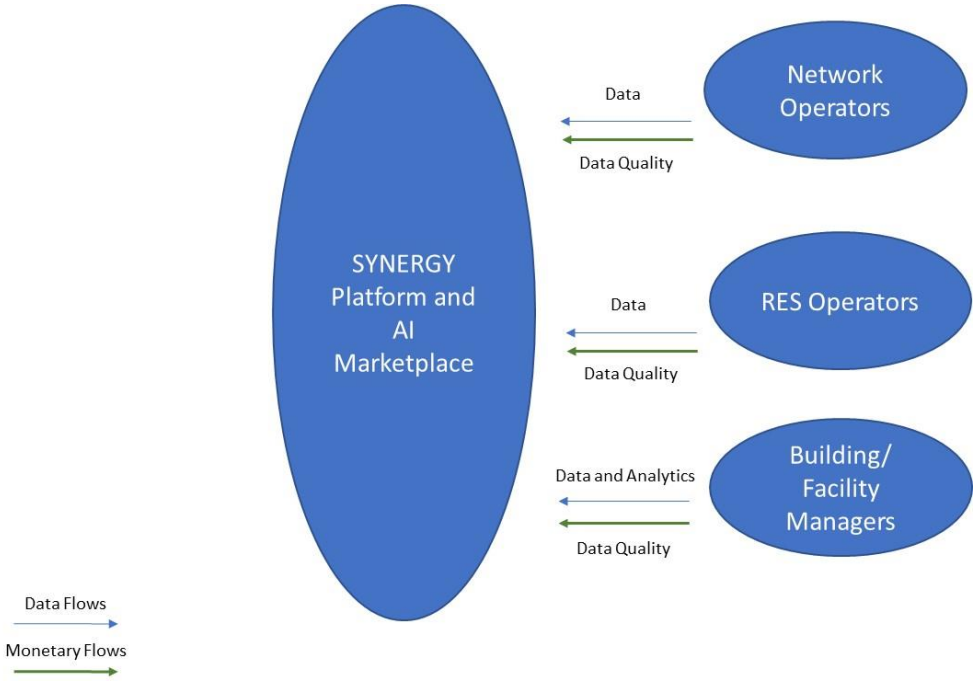

Figure 9. Money Flow Diagram BM2- Data Value as a Service for Advanced Asset Management

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

RES PLANT OPERATORS

Revenue streams:

- Lower operation and maintenance costs.
- Increased revenues due to increased power production (avoidance of losses in power generation).
- Reduce LCOE (Levelized Cost of Energy). Increasing market competitiveness.
- Indirect revenues (savings) from improved trading functions and ability to deliver their commodity in wholesale markets.

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Cost Items:

- Service fees for data quality enhancement.

NETWORK OPERATORS

Revenue streams:

- Lower operation and maintenance costs.
- Indirect revenues (savings) from the enhancement of the quality of power in the network (avoidance of the need for additional services for frequency and voltage regulation) and the reduction of power losses (more power delivered).

Cost Items:

Service fees for data quality enhancement.

BUILDING/ FACILITY MANAGERS

Revenue streams:

- Lower operation and maintenance costs.
- Indirect revenues through increase of attractiveness of their offering and SLA compliance.

Cost Items:

- Service fees for data quality enhancement

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RES PLANT OPERATOR:

Key Partners

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Key Activities • RES generation. RES Power Plant Operation. • Asset Management and Predictive Maintenance Scheduling.	
Value Proposition • Increased performance of power plant and power production. • increase RES technology reliability and efficiency, improved operational performance of the power plant. • Reduced LCOE • Increase cost-effectiveness of the RES technology and RES power plant. • Support in the decision-making process in O&M works. • There's no need to hire your own big data management experts, data engineers, and data scientists.	
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customer and Communication. • RES generators are both beneficiaries and customers. • Communication with the SYNERGY Platform 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Service fees for data quality enhancement.	**Revenue Model** • Lower operation and maintenance costs. • Indirect revenues (savings) from improved trading functions and ability to deliver their commodity in wholesale market. • Increased revenues due to increased power production (avoidance of losses in power generation). • Reduced LCOE. Increasing market competitiveness.
Societal and Environmental Costs • Suboptimal performance of RES power plants may lead to increased energy costs, and increased CO2 emissions.	**Societal and Environmental Benefits** • Renewable energy reduces emissions and reduce wholesale energy prices by avoiding generation from expensive and polluting fossil-fuel plants. • Increased cost-effectiveness of renewable generation technologies. • Increased public awareness about green energy and the energy. • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 6. CANVAS RES PLANT OPERATOR_BM2- Data Value as a Service for Advanced Asset Management

CANVAS NETWORK OPERATORS:

Key Partners
Key Activities • Manage and distribute power. • Asset Management and Predictive Maintenance Scheduling.

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Value Proposition • Optimal operation, predictive maintenance and proactive avoidance of equipment faults are available by taking into account the diverse pool of plans and actions scheduled in distribution control areas. • Forecast potential problems in their networks and perform appropriate preventive actions. • Support in the decision-making process in O&M works. • There's no need to build own big data infrastructure.	
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace	
Customers and Communication. • TSOs and DSOs are both beneficiaries and customers. • Communication with SYNERGY Platform 365/24/7 via Helpdesk (Role under the organization Perspective in the Data Value Chain).	
Cost Structure • Service fees for data quality enhancement	**Revenue Model** • Lower operation and maintenance costs. • Reduced penalties due to interruptions and local failures (Lost Load) caused by equipment health issues. • Indirect revenues (savings) from the enhancement of the quality of power in the network (avoidance of need for additional services for frequency and voltage regulation) and the reduction of power losses (more power delivered).
Societal and Environmental Costs • Lower carbon footprint due to the deferral of economic investment for network expansion.	**Societal and Environmental Benefits** • Lower system charges that translate into a reduction in the final price of energy. • Uninterrupted delivery of power. • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 7. CANVAS NETWORK OPERATORS_BM2- Data Value as a Service for Advanced Asset Management

CANVAS FACILITY MANAGER:

Key Partners
Key Activities • Asset Management and Predictive Maintenance Scheduling.
Value Propositions • Increased performance of the managed built asset. • Support in the decision-making process in O&M works. • There's no need to hire your own big data management experts, data engineers, and data scientists.
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace
Customer and Communication. • Facility/ Building are both beneficiaries and customers. • Communication with the SYNERGY Platform 365/24/7 via customer Helpdesk (Role under the Organization Perspective in the Data Value Chain).

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Cost Structure • License payments as initial investment for get access on the on-premise advanced maintenance management software and big data platform. • In case of cloud-based SaaS. Subscription fees will be paid. • Fees for ad-hoc maintenance-related analytics reports or consultancy services. • Operational expenses. • Deferral of economic investment in upgrading assets/devices.	**Revenue Model** • Lower operation and maintenance costs. Indirect revenues through increase of attractiveness of their offering and SLA compliance.
Societal and Environmental Costs • Suboptimal performance of the facility may lead to increased energy costs, and increased CO2 emissions.	**Societal and Environmental Benefits** • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 8. CANVAS FACILITY MANAGER_BM2- Data Value as a Service for Advanced Asset Management

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6.3 BM3- Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants.

Business Model derived from BS10.

Business Model categorization→ 'Data Enabled Differentiation' business approach – Solo Opportunity. Product Innovator business model type

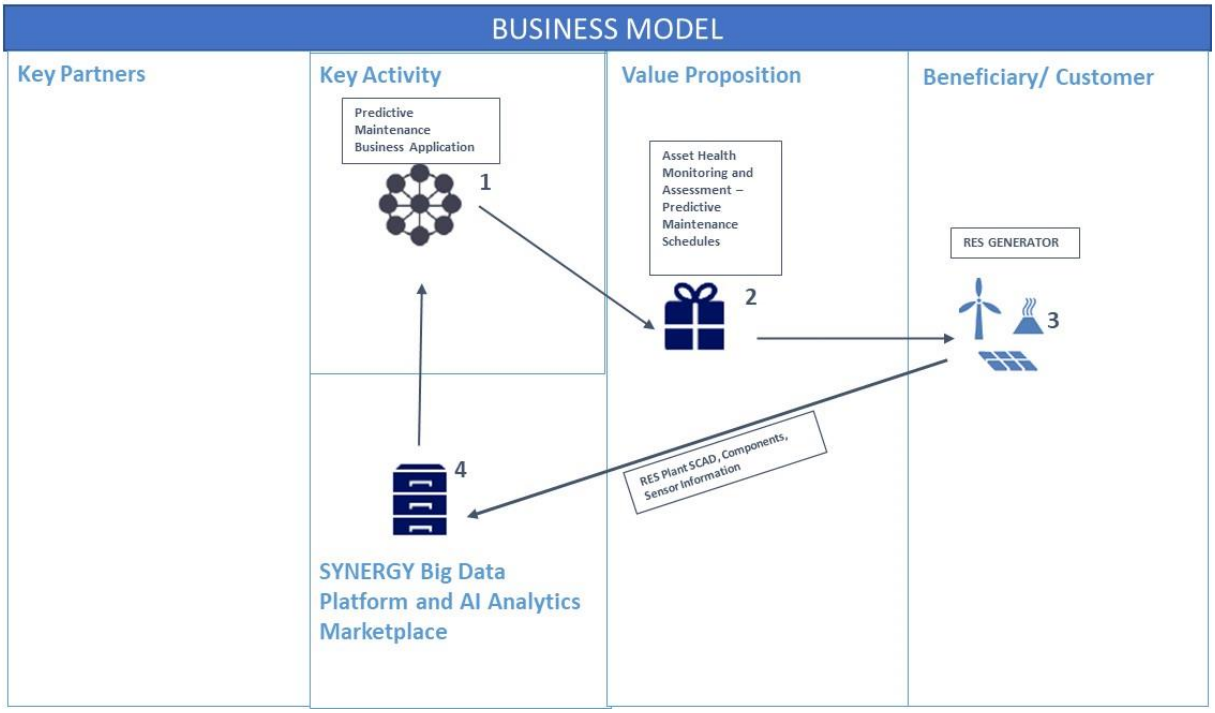

Figure 10. Business Model Description_BM3-Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants

BRIEF DESCRIPTION:

Added value capabilities and technical features stemming from AI analytics are feeding in a novel Advanced existing Predictive Maintenance Software solutions used by RES Plant Operators. More value is captured from the use of advanced analytics enhancing the daily maintenance-related works. I.e. asset management, decision-making of operation and maintenance scheduling. RES Plant Operators will be rewarded with up to date and near real-time information about real-time predictive needs, proactive diagnosis of equipment faults, probability of fault occurrence to proceed with the timely replacement of equipment reaching end-of-life or components with high probability to fail.

RAW DATA and Insights:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- As Data Asset Owners, RES Plant Operators will utilize data from their SCADA, inverters locally deployed sensors, meters, portable cameras, cameras attached to UAVs and local weather stations (Figure 10 – 3).

VALUE PROPOSITION:

The Business application (Figure 10 – 1) that will facilitate the realization of this business model will analyse the diverse data streams described before and deliver to RES plant operators (Figure 10 – 3) the needed intelligence, towards ensuring RES plant optimal operation, predictive maintenance and proactive avoidance of equipment fault in their RES plants. It will enable identification in real-time of predictive maintenance needs and significant reduction of the LCOE (Levelized Cost of Energy) of the RES plant along with the O&M costs, while increasing RES technology reliability and efficiency and improving power trading functions on the plant operator side (Figure 10 – 2)- This will allow RES operators to perform proactive diagnosis of equipment faults and their characterization, enable the continuous monitoring of key power quality indicators and assess the probability of fault occurrence.

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/Data Asset Owner: RES Power Plant Operators
- Data Asset consumers: RES Power Plant Operators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace (Figure 10 – 4).

ORGANIZATION PERSPECTIVE

- Technical Users: From RES Power Plant Operators.
- Data scientist/Data Analytics: RES Power Plant Operator.
- Business User: RES Power Plant Operators.

VALUE REALIZED:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- SYNERGY Platform and AI Analytics Marketplace: Service fees for data quality enhancement, Service fees for hosting data. Service fees for Analytics Execution (from Beneficiary->Predictive Maintenance Analytics).
- RES Operators/ Beneficiaries: RES plant optimal generation, predictive maintenance and proactive avoidance of equipment faults in their PV plants. Identification in real-time of predictive maintenance needs and significant reduction of the LCOE (Levelized Cost of Energy) of the RES plant along with the O&M costs, while increasing RES technology reliability and efficiency and improving power trading functions.

VALUE CAPTURE AND MONETIZATION:

The monetary flow is characterised by service fees paid to the SYNERGY Platform and AI Marketplace for enhancing the quality and integrity of owned data assets, as well as for the execution of predictive maintenance analytics (as-a- Service) through the AI Analytics Marketplace offered by SYNERGY.

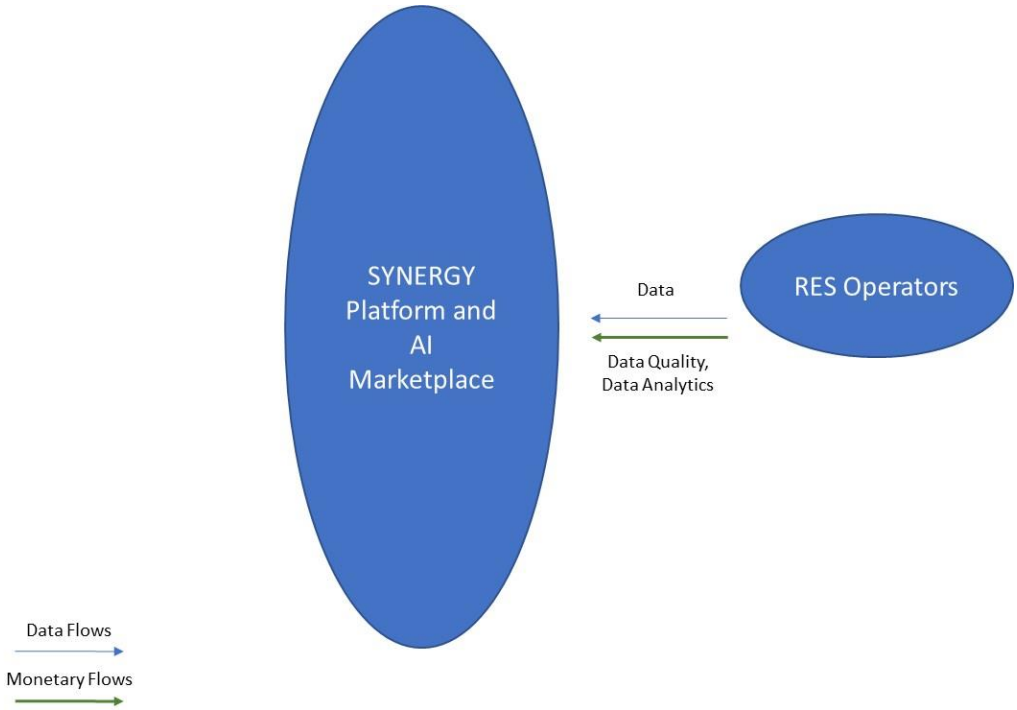

Figure 11. Money Flow Diagram BM3- Data Intelligence-Driven Advanced Predictive Maintenance for RES Power Plants

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>RES PLANT OPERATOR</u>

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Revenue streams:

- Lower operation and maintenance costs.
- Reduced Levelized Cost of Energy.
- Increased revenues due to increased power production (avoidance of losses in power generation).
- Indirect revenues (savings) from improved trading functions and ability to deliver their commodity in wholesale markets.

Cost Items:

- Service fees for data quality enhancement.
- Service Fees for Analytics Execution

CANVAS RES PLANT OPERATOR:

Key Partners
Key Activities • Asset Management and Predictive Maintenance Scheduling.
Value Propositions • Increased performance of power plant and power production • increase RES technology reliability and efficiency, improved operational performance of the power plant. • Reduced LCOE • Increase cost-effectiveness of the RES technology and RES power plant. • Support in the decision-making process in O&M works. • There's no need to hire your own big data management experts, data engineers, and data scientists.
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace
Customer and Communication. • RES Plant Operators are both beneficiaries and customers. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Cost Structure • Service fees for data quality enhancement. • Service Fees for Analytics Execution.	**Revenue Model** • Lower operation and maintenance costs. • Reduced Levelized Cost of Energy. • Increased revenues due to increased power production (avoidance of losses in power generation). • Indirect revenues (savings) from improved trading functions and ability to deliver their commodity in wholesale markets
Societal and Environmental Costs • Suboptimal performance of RES power plants may lead to increased energy costs, and increased CO2 emissions.	**Societal and Environmental Benefits** • Renewable energy reduces emissions and reduce wholesale energy prices by avoiding generation from expensive and polluting fossil-fuel plants. • Increased cost-effectiveness of renewable generation technologies. • Increased public awareness about green energy and the energy. • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 9. CANVAS RES PLANT OPERATOR_ BM3-Data Intelligence-Driven Advanced Predictive Maintenance for RES Power Plants

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6.4 BM4- Dynamic Enhanced Energy Performance Certificates

Business Model derived from the combination of BS9, BS13, BS15.

Business Model categorization→ 'Data brokering' business approach – Collaborative Opportunity. Data Service Provider business model type

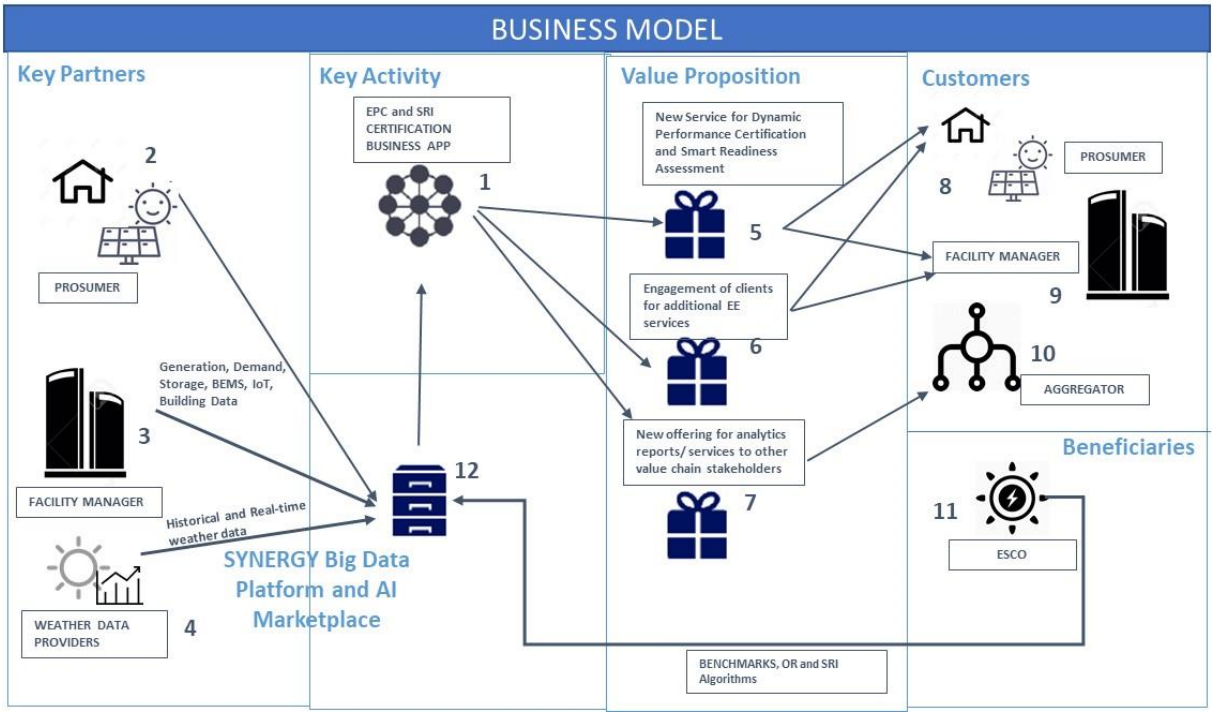

Figure 12. Business Model Description_BM4-Dynamic Enhanced Energy Performance Certificates

BRIEF DESCRIPTION:

Current offerings in the Energy Performance Certificates Market are relying on static asset information and rating of buildings, without taking into account the dynamic characteristics of buildings (actual use, occupancy flows, real-time demand and generation) and their inherent smartness, with the latter being a key factor for facilitating the entry of small prosumers/building into flexibility trading markets.

This business model aims at advancing the "Business-as-Usual" in the area of Energy Performance Certification by allowing ESCOs to access and process real-time data streams from a variety of buildings towards enabling the delivery of novel and advanced EPC services, characterised by the dynamic assessment of energy performance and enhanced with appropriate smartness indices as instructed by recent EU regulations around the Smart Readiness of buildings.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

RAW DATA and INSIGHTS:

- The ESCO (Figure 12 – 11), being the main beneficiary of the BM, acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 12 – 12) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from building such as:
    - Generation, Storage, Demand data, Energy Systems and characteristics data, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 12 -2).
    - Generation, Storage, Demand data, BEMS, Building systems and characteristics data, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 12 – 3).
    - Weather Data from 3rd parties (Figure 12 – 4).
- As Data Owners, the ESCOs will also utilize data and algorithms referring to:
    - Benchmarks of building performance and smart readiness
    - Analytics algorithms for the calculation of Operational Rating and Smart Readiness Assessment Indices

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiary (ESCOs) involved in its realization.

VALUE PROPOSITION

The Business application that will facilitate the realization of this business model will analyse real-time data from a variety of building assets (generation, demand, storage) and IoT devices to perform a real-time and dynamic rating of the Operational Energy Performance of Buildings and Assessment of their Smart Readiness towards delivering the respective certificates. In business terms, this BM will deliver the following value to ESCOs:

1. Delivery of a new service to Facility/ Building Managers and Prosumers to allow them to either comply with Energy Performance Certification requirements or increase the attractiveness of

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their assets to participate in flexibility transactions by Assessing and Promoting their Smart Readiness (Figure 12 -5).

2. Engage in additional services with customers, by gaining the opportunity to analyse the energy performance of buildings, define weak performance assets or practices and provide new services for energy performance or smart readiness enhancement (Figure 12 -6).
3. Analyse in detail the Smart Readiness of their customers' assets and selling respective reports to interested 3rd parties (electricity value chain stakeholders, such as aggregators) (Figure 12–7).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS

DATA PERSPECTIVE

- Data Asset provider/ Data Asset Owner: Prosumers, Building/Facility manager, Weather Data providers, ESCOs.
- Data Asset consumers: ESCOs.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace

BUSINESS PERSPECTIVE

- Manager: Legal Representatives from ESCOs, Key Partners and Customers (Figure 12-10) like aggregators (responsible for signing data sharing contracts).
- Technical Users: From ESCOs and Key Partners.
- Data scientist/Data Analytics: ESCOs.
- Business User: ESCOs, Prosumers (Figure 12 -8), Facility Managers (Figure 12-9) and Aggregators.

VALUE REALIZED

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Data Assets are sold to the beneficiary from Key Partners- Historical and actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key Partners). Service fees for Analytics Execution (Beneficiary-> Energy Performance and Smart Readiness analytics).
- ESCOs/ Beneficiary: New service for dynamic EPC and SRI certification and associated revenues. Further revenue increase through follow up services for Energy Performance and Smart Readiness enhancement. New product offering and new revenues, referring to reports sold to aggregators with regards to Smart Readiness of buildings (with appropriate remuneration to Key partners for re-use of their data and transaction fees paid to the platform for the data sharing contract handling).
- Prosumers/ Customers: Better understanding of energy performance and smart readiness, opportunity for energy cost savings and increased visibility for involvement in flexibility markets.
- Facility Managers/ Customer: Better understanding of energy performance and smart readiness, opportunity for energy cost savings and increased visibility for involvement in flexibility markets.
- Aggregators/ Customer: Insights about Smart Readiness of a Portfolio of buildings and opportunity to increase clientele.

VALUE CAPTURE AND MONETIZATION

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Finally, a data transaction fee is involved and is preserved as part of the fees paid by the Beneficiary to each Key Partner in the frame of Data Acquisition. Service fees by customers, are also involved in the revenue (monetary) flows towards the beneficiary.

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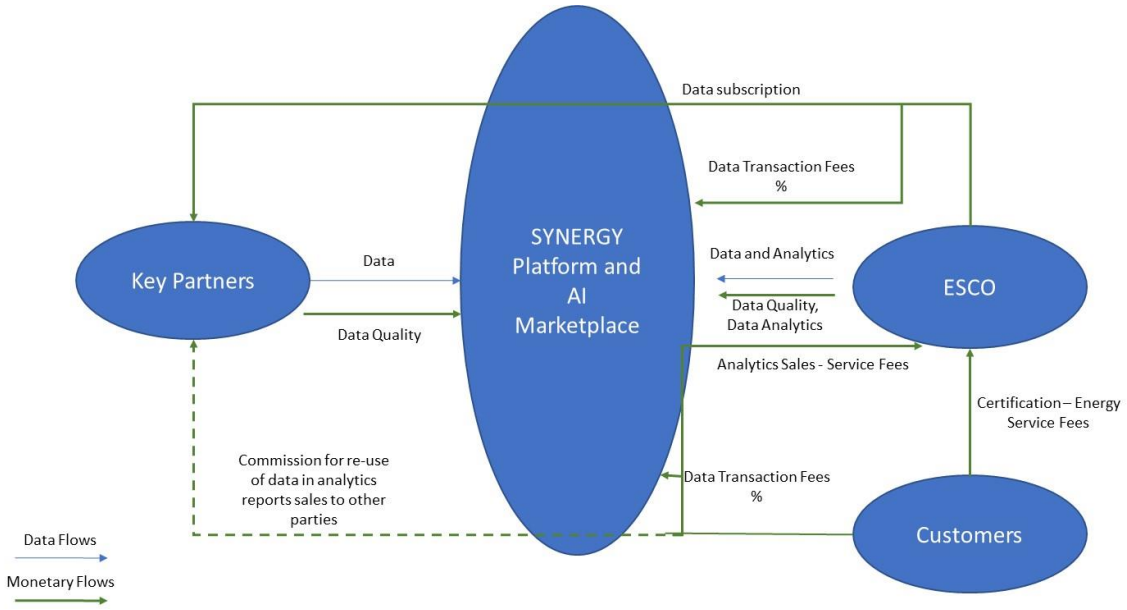

Figure 13. Money Flow Diagram BM4- Dynamic Enhanced Energy Performance Certificates

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>ESCOs</u>

Revenue streams:

- Energy Performance and Smart Readiness Certification Service Revenues.
- Revenues from further services mobilized by the identification of weak energy performance and smart readiness assets and areas.
- Revenues from analytics report sales to Aggregators.

Cost Items:

- Costs for acquiring (and re-selling in the form of reports) data and analytics from Key Partners (direct use of data+ re-use for report selling).
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace (Main Service + 3rd party Services).
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

CANVAS ESCOs:

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Key Partners • Prosumers. • Facility Managers • Weather Data Providers	
Key Activities • Energy Performance Analysis and Certification. • Smart Readiness Analysis and Certification.	
Value Proposition • Delivery of a new service to Facility Managers/ Building Managers and Prosumers. • Engage in additional EE services with customers, by gaining • New product offering (report and analytics) to aggregators.	
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace	
Customer and Communication. • Prosumers: consciousness and awareness, energy savings, flexibility transactions opportunity. • Facility Managers: Energy savings, Compliance with Performance obligations, Flexibility Transactions opportunity. • Aggregators: Outreach to a smart ready clientele. • Communication with the SYNERGY Platform 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring (and re-selling in the form of reports) data and analytics from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Energy Performance and Smart Readiness Certification Service Revenues. • Revenues from further services mobilized by the identification of weak energy performance and smart readiness assets and areas. • Revenues from analytics report sales to Aggregators.
Societal and Environmental Costs • None	**Societal and Environmental Benefits** • Lower CO2 footprint and Energy Efficiency. • Increased awareness and social recognition for performance. • Small prosumers and building gaining the opportunity to be active in markets.

Table 10. CANVAS ESCOs_ BM4-Dynamic Enhanced Energy Performance Certificates

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6.5 BM5- Synergetic Energy Performance Contracting (design)

Business Model derived from the combination of BS9, BS15.

Business Model categorization→ 'Data brokering delivery network business approach – Collaborative Opportunity. Data Broker business model type

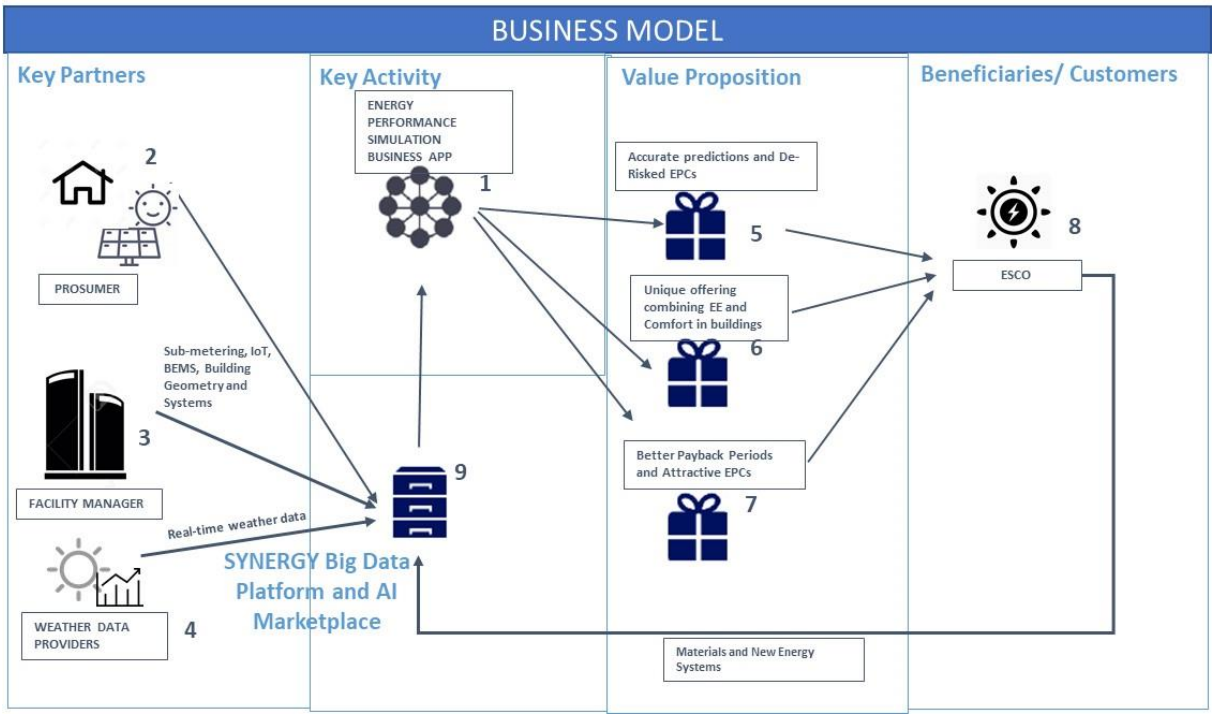

Figure 14. Business Model Description_BM5-Synergetic Energy Performance Contracting (design)

BRIEF DESCRIPTION:

The performance gap between predicted and measured energy performance of buildings has a direct negative impact on novel models of building management such as those based in Performance Contracts. Primary causes for the discrepancy between predicted and measured energy performance of buildings are *occupant behaviour, weather conditions inaccuracies and poor management and control strategies*. The first step in the calibration process of dynamic simulation tools deals with the identification and prediction of, real occupancy and comfort preferences of occupants in buildings towards reducing the gap at values below 3.% and allow this gap to be considered when an energy performance contract is put in action between an ESCO and a Prosumer or Facility Manager. By addressing occupants' behaviour, comfort preferences and real weather conditions at the Building Energy Performance Simulation (commissioning) phase, the performance gap can be reduced significantly, so that the respective contracts can accommodate acceptable hedging factors for all sides involved. Since Energy Performance Contracts are built on the principle that the ESCO (performing also

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the simulation of energy performance) finances the projects and gets paid back by the savings achieved, more accurate predictions can eliminate the risk (usually) caused by the under-performance of renovated buildings (i.e. achieved savings are much smaller than the anticipated ones) thus threatening the visibility not only of the individual projects but also for the ESCO industry itself due to increased payback periods (exceeding the duration of the contracts) and associated losses in monetary terms.

This business model is introduced towards enhancing the attractiveness of Energy Performance Contracting projects by de-risking investments in renovation on the basis of better and more accurate predictions of the anticipated energy performance of buildings. In other words, it aims at transforming current business practices followed during renovation projects, that consider generic templates for the anticipated used of a building, by relying in real-life data streams in buildings so as to introduce in Energy Performance Simulations accurate profiles of occupancy and comfort and in this way enable better prediction of energy consumption in different building spaces, as well as, in the whole building, as part of the design process.

RAW DATA and INSIGHTS:

- The ESCO (Figure 14 -9), being the main beneficiary of the BM acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 14-10) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from buildings such as:
    - Sub-metering, Building Geometry and Systems, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 14 -2).
    - Sub-metering, BEMS, Building Geometry and Systems, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 14 -3).
    - Weather Data from 3rd Parties (Figure 14 -4).
- As Data Owners, the ESCOs will also utilize data and algorithms referring to:
    - Materials and energy systems (and their performance characteristics) to be used in simulation routines.

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

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In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiary (ESCOs) involved in its realization.

VALUE PROPOSITION:

The Business application that will facilitate the realization of this business model will perform loops of iterative Building Energy Performance Simulations utilizing context-aware occupancy profiles from the buildings to b renovated, delivered in the form of analytics from the SYNERGY Platform and AI Analytics Marketplace, to populate the respective templates of the Business Application (Simulation tool), by utilizing data streams from building premises (prosumers, facility managers) and combining them with weather data provided by 3rd party data asset providers. In business terms, this BM will deliver the following value to ESCOs:

1. Accurate predictions of the energy performance of to-be renovated buildings and minimization of the risks associated to the (currently observed) inaccuracy of predictions, leading to de-risk Energy Performance Contracts (Figure 14-5).
2. Enhancement of current EPC offerings, by extending the current proposition related to energy savings towards accommodating the delivery of projects that focus on the preservation and well-being of occupants within the built environment (Figure 14-6).

   Reinforcement of the attractiveness of Energy Performance Contracts through the reduction of payback periods (during which, the ESCO enjoys the majority of energy savings to get paid for the investment they made) and the extension of periods (post-payback) during which the prosumers/ facility managers benefit from significant energy cost savings (Figure 14 -7).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Data Asset Owner: Prosumers, Building/ Facility Managers, Weather Data providers, ESCOs.
- Data Asset consumers: ESCOs.

PLATFORM PERSPECTIVE

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace

BUSINESS PERSPECTIVE

- Manager: Legal representatives from ESCO and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From ESCOs and Key Partners.
- Data scientist/Data Analytics: ESCOs.
- Business User: ESCOs.

VALUE REALIZED:

- Data Assets are sold to the beneficiary from Key Partners- Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Beneficiary-> Comfort Profiling, Context-Aware Occupancy Analytics, Occupancy and Comfort Forecasts).
- ESCOs/ Beneficiary: More accurate predictions leading to de-risked and highly attractive EPCs. Novel offering combining energy efficiency renovation with comfort and well-being. Sub-sequent revenue increase through more attractive offering. Increased profitability as part of evidence based EPCs. Evolution to a more digitized company. Moreover, ESCOs will avoid unnecessary costs and resource spending for on-site processes for auditing, since the exchange of information in a digital manner will eliminate this need.
- Prosumers and Facility Managers/ Customers (Figure 14 -8): Significant Energy Cost Savings (after the payback of the investment to ESCOs). More comfortable and liveable buildings.

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY PLATFORM and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over

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the data available. The business model also involves the initial investment made by the ESCO for the realization of the renovation project, together with agreed shares over energy cost reduction (between the ESCO and the customer) for the payback of the investment (including also consultancy services provided prior to the renovation and the profit of the ESCO).

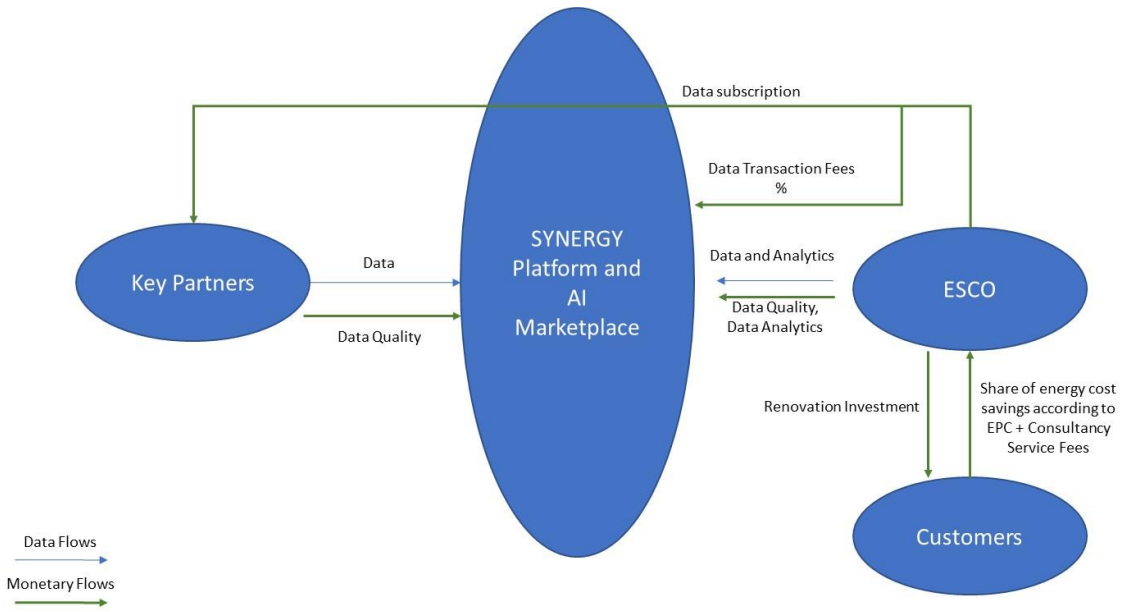

Figure 15. Money Flow Diagram BM5- Synergetic Energy Performance Contracting (design)

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>ESCOs</u>

Revenue streams:

- Shares of energy costs savings achieved from the renovation project.
- Revenues from consultancy services at the pre-renovation phase (alterative design and design optimization).
- Cost savings from the avoidance of the resources required for the conduction of on-site audits.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.

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- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS ESCOS:

Key Partners • Prosumers. • Facility Managers. • Weather Data providers.	
Key Activities • Energy Performance Simulation. • Energy Efficient Design Optimization.	
Value Proposition • Accurate predictions and De-Risked EPCs. • Unique offering combining EE and Comfort in buildings. • Better payback periods and attractive EPCs. • Transition to a more digitalized service framework not requiring costly resources for on-site costly resources for on-site auditing and services. • Opportunity for additional services for real-time energy management optimization.	
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customer and Communication. • Prosumers: Reduced energy costs, more comfortable built environments. • Facility Mangers: Reduced energy costs, more comfortable built environments. • Communication with the SYNERGY Platform 365/24/7 via Helpdesk (role under the organization perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Shares of energy costs savings achieved from the renovation project. • Revenues from consultancy services at the pre-renovation phase (alternative design and design optimization). • Costs savings from the avoidance of the resources required for the conduction of on-site audits.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Lower CO2 footprint and Energy Efficiency. • A more liveable environment for building occupants.

Table 11. CANVAS ESCOs_ BM5-Synergetic Energy Performance Contracting (design)

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6.6 BM6- Synergetic Energy Performance Optimization (self-consumption)

Business Model derived from the combination of BS7, BS14.

Business Model categorization→ 'Data-based delivery network & Data Brokering business approach – Collaborative Opportunity. Value Chain Integrator & Data Broker business model type

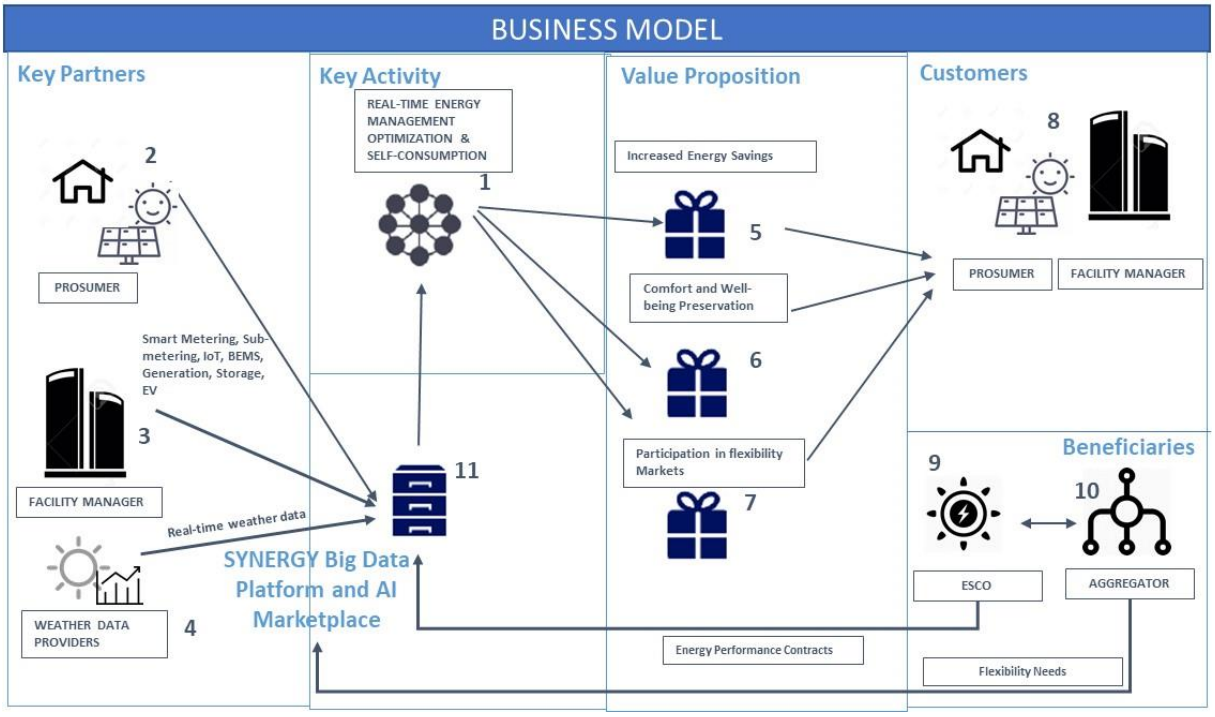

Figure 16. Business Model Description_BM6-Synergetic Energy Performance Optimization (self-consumption)

BRIEF DESCRIPTION:

Stepping on BM5 provisions, this Business Model aims at extending the offer of ESCOs to Building Managers/ Facility Managers/ Prosumers towards enabling further reduction of the performance gap (or even eliminating it) and allowing customers to enjoy additional energy cost savings and reduce dependency on the grid (reduction of network charges) through flexibility-based control of building energy systems (generation, storage, demand) for self-consumption maximization.

This business model will offer further opportunities to the ESCO, to join forces with aggregators, towards offering excess flexibility of customers towards flexibility markets, thus introducing additional revenue streams for customers and ESCOs and allowing aggregators to get access to additional customers and improve their offerings to DSOs and TSOs. As part of this business model, the Business Application operated by the ESCOs will enable customers to better match energy consumption with

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green energy production in a human-centric manner, while capitalizing excess of generation or storage capacity by trading it to flexibility markets,. The main objective of this business model is to enable the customers to maximize the usage of the power they generate, reducing costs, carbon emissions, etc. Also, by providing a mix of information and automation (e.g. activating their appliances when their PVs are producing, storage of excess electricity during high RES-output periods and utilization at periods of low generation) the ESCO ensures that customers get the best value from the renovation investment, including RES and storage (self-produced energy consumption) and transform themselves into more active energy market stakeholders.

RAW DATA and INSIGHTS:

- The ESCO (Figure *16*-9), being the main beneficiary of the BM acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 16 -11) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from building such as:
    - Smart metering, Sub-metering, Generation, Storage, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 16 -2).
    - Sub-metering, BEMS, Generation, Storage, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 16 -3).
    - Weather Data from 3rd Parties (Figure 16 -4).
- As Data Owners, the ESCOs will also utilize data referring to:
    - Existing Energy Performance Contracts and their energy savings targets to be achieved
- Moreover, the Business Model involves the participation of the Aggregator (Figure 16 -10) as an additional beneficiary, collaborating with the ESCO in order to utilize the excess flexibility of the customers in flexibility markets. In this sense, are contributing as Data Providers, by publishing their flexibility requirements and allowing for them to be considered in the Energy Management Optimization Business Application, in cases excess flexibility can be provided once self-consumption targets have been satisfied.

The business model encompasses both data value as a service and intelligence as a service for all involved beneficiaries and partners.

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In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiary (ESCOs) involved in its realization, along with a brief analysis of the value obtained for Aggregators as co-beneficiaries of this BM.

VALUE PROPOSITION:

The Business application that will facilitate the realization of this business model aims at optimizing energy flows at building/ facility level towards further enhancing the effectiveness of Energy Performance Contracts and maximizing self-consumption with the utilization of the flexibility of the different energy systems/ assets available. Excess flexibility will be made available to aggregators, to increase the business benefits for all involved stakeholders through flexibility transactions and activation. Data streams from prosumers and facility managers will be utilized in the SYNERGY Platform and AI Analytics Marketplace, to (i) enable real-time monitoring of energy performance, (ii) enabled the extraction of Context-Aware flexibility profiles (analytics) following the combination with weather data and (iii) utilize this flexibility in energy management strategies for self-consumption maximization (or even for flexibility offering to the respective markets by considering relevant requirements from aggregators). In business terms, this BM will deliver the following value to ESCOs and Aggregators:

<u>ESCOs</u>

1. Enhancement of EPC offerings by addressing the operation phase of the building and enabling the provision of additional energy services for energy cost minimization and self-consumption (Figure 16-5).
2. Provision of human-centric energy management services that enable energy savings without compromising comfort and well-being of occupants (Figure 16-6).
3. Enabling the indirect involvement of ESCOs in flexibility transactions by teaming up with aggregators and facilitating the introduction of excess flexibility of customers into flexibility markets (Figure 16-7).

<u>Aggregators</u>

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1. Gaining access to new customers and flexibility sources to reinforce their participation in flexibility markets by introducing small buildings and facilities as new market entrants, through flexibility analysis, aggregation and triggering of Demand Response events (Figure 16-7).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider: Prosumers, Building/ Facility Managers, Weather Data Providers, ESCOs, Aggregators.
- Data Asset consumers: ESCOs, Aggregators.
- Data Asset Owner: Prosumers, Building/ Facility Managers, Weather Data Providers, ESCOs.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from ESCO, Aggregator and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From ESCOs, Aggregators and Key Partners.
- Data scientist/Data Analytics: ESCOs.
- Business User: Aggregators, ESCOs.

VALUE REALIZED:

- Data Assets are sold to the ESCO (Beneficiary) from Key Partners- Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (ESCO-> Comfort Profiling, Context-Aware Flexibility Analytics, Demand/ Generation Forecasts- Aggregators-> Flexibility Analytics).

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- ESCOS/ Main Beneficiary: New service and revenues for real-time energy management optimization and self-consumption maximization. Additional hedging mechanism for EPC and satisfaction of anticipated payback periods. Human-centric service offering as a social benefit to customers. Indirect revenues from opening the way to their customers to flexibility markets and involving flexibility transactions in energy management optimization objectives. Evolution to a more digitized company.
- Aggregators/ Co-Beneficiary: Access to new customers and increased flexibility volumes and respective revenues by introducing their flexibility capacity in markets.
- Prosumer and Facility Managers/ Customers (Figure 16 -8): Significant Energy Cost Savings (after the payback of the investment to ESCOs). Reduced network charges. More comfortable and liveable buildings. Revenues from flexibility trading.

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. The business model also involves data transaction fees for the provision of flexibility analytics to Aggregators (based on Key Partners' Data) paid by the Beneficiary to each Key Partner in the frame or re-using already acquired data for the purpose of selling analytics to other stakeholders. Service fees by customers, are also involved in the revenue (monetary) flows towards the beneficiary for Energy Management Optimization, while flexibility remuneration is also introduced for the direct/ indirect participation of beneficiaries and customers in the respective flexibility trading markets and Demand Response (DR) programmes.

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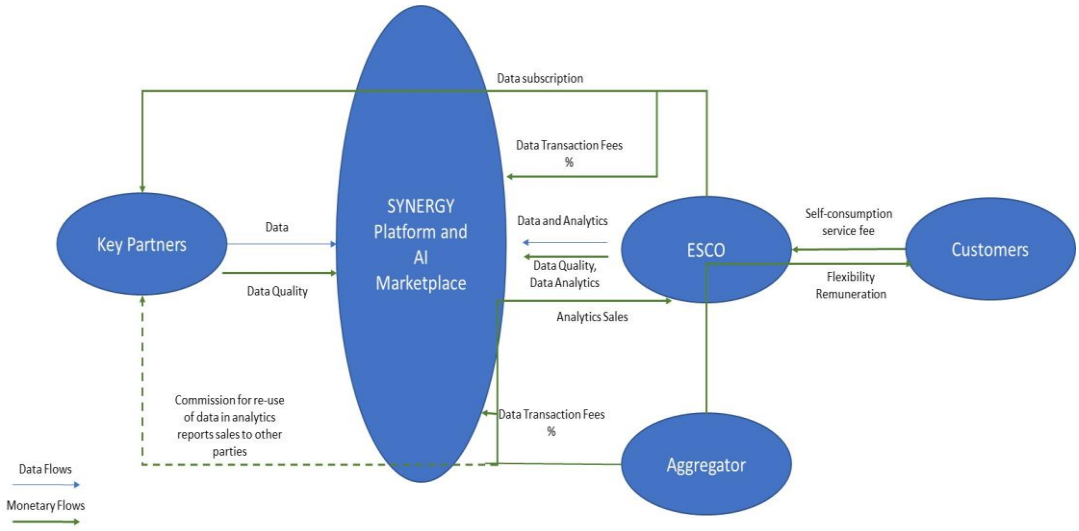

Figure 17. Money Flow Diagram BM6- Synergetic Energy Performance Optimization (self-consumption)

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>ESCOS</u>

Revenue streams:

- Service fees (portion of energy savings and network charges reduction on the customer side for energy management optimization and self-consumption maximization.
- Revenues from analytics sales to Aggregators.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

Flexibility Remuneration is not analysed above, since ESCOs are only acting as the intermediary, receiving the whole remuneration from Aggregators and allocating it to the respective customers.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during

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the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS ESCOs:

Key Partners • Prosumers. • Facility Managers. • Weather Data Providers.	
Key Activities • Real-time energy management optimization. • Self-consumption maximization (flexibility-based)	
Value Proposition • New service and revenues for real-time energy management optimization and self-consumption maximization. • Additional hedging mechanism for EPC and satisfaction of anticipated payback period. • Human-centric service offering as a social benefit to customers. • Revenues from opening the way to their customers to flexibility markets and involving flexibility transactions in energy management optimization objectives (sales of flexibility analytics). • Evolution to a more digitized company.	
Relationships with another partners /channel • SYNERGY Platform and AI Analytics Marketplace • Aggregators for the provision of Demand Response Services- Access to new clients, Flexibility remuneration from network operators.	
Customer and Communication. • Prosumers: Reduced energy costs, more comfortable built environments. Revenues from flexibility transactions. • Facility Managers: Reduced energy costs, more comfortable built environments. Revenues from flexibility transactions. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Service fees (portion of energy savings and network charges reduction on the customers side) for energy management optimization and self-consumption maximization. • Revenues from analytics sales to Aggregators.
Societal and Environmental Costs • None	**Societal and Environmental Benefits** • Lower CO2 footprint and Energy Efficiency. • A more liveable environment for building occupants. • Transparent Participation and Active Role in Energy Markets.

Table 12. CANVAS ESCOs_ BM6-Synergetic Energy Performance Optimization (self-consumption)

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6.7 BM7- Intelligence-Driven Long-term Generation Planning and PPAs Advisory

Business Model derived from the combination of BS12, BS11.

Business Model categorization→ 'Data-enabled business approach – Product Innovator business model type

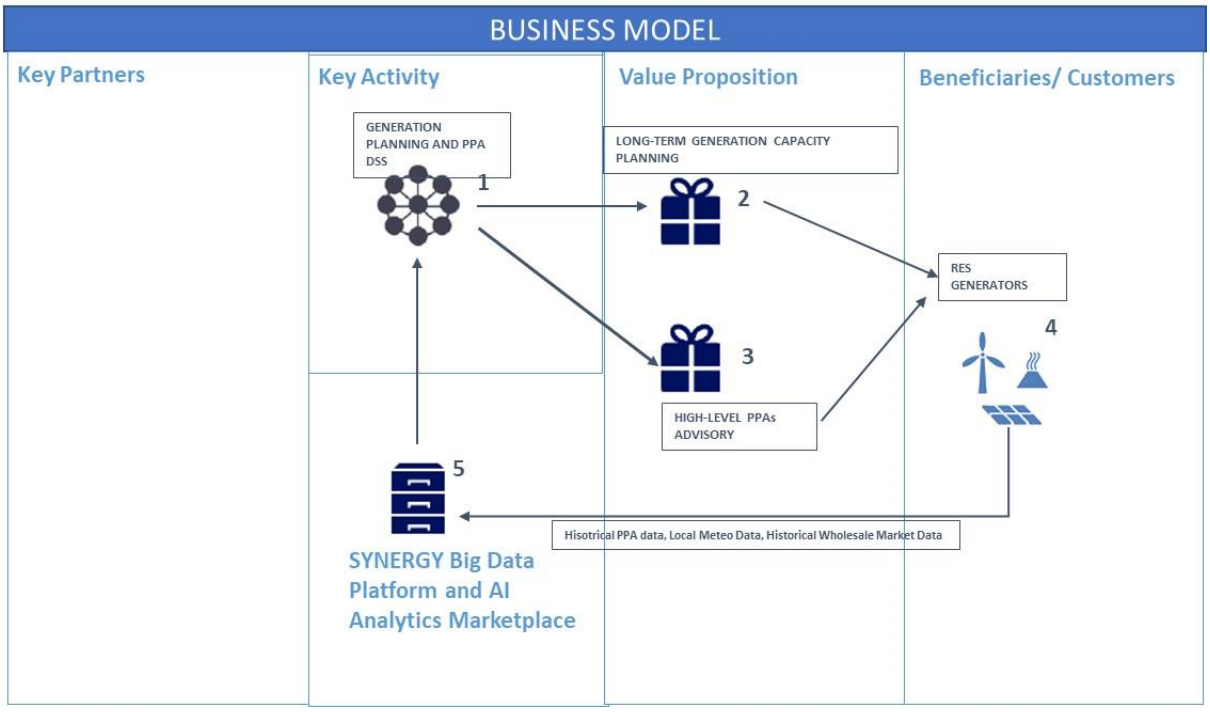

Figure 18. Business Model Description_BM7-Intelligence-Driven Long-term Generation Planning and PPAs Advisory

BRIEF DESCRIPTION:

Establishment of Green Power Purchase Agreements (Green PPAs) relies on multiple factors such as the availability of renewable generation volumes and the volatility of wholesale market prices that favour (in several cases) the creation of bilateral agreements between RES Operators and Retailers (or other stakeholders). The further penetration of PPAs though requires a better understanding on the side of RES operators on the profitability of previous PPAs, the volume they shall make available into such bilateral agreements and the correct timing of establishing them in relation to prices offered in wholesale markets. This requires the execution of advanced analytics to reveal the best strategy a RES operator shall establish with regards to generation capacity building and price and duration negotiation in the frame of the agreement.

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RAW DATA and INSIGHTS:

- The RES Operator (Figure 18- 4), being the main beneficiary and Customer of the BM. Provides data assets to the SYNERGY Platform and Analytics Marketplace (Figure 18 -5). Data assets provided are:
    - Duration, time, prices of previous PPAs.
    - Local Meteorological data from stations owned by the RES Operator.
    - Historical Market (Wholesale price data, PPAs bids from Retailers and other stakeholders, PPAs prices).

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiary (RES Operator) involved in its realization.

VALUE PROPOSITION:

The Business application (Figure 18-1) that will facilitate the realization of this business model aims at properly guiding decisions on the RES Operator side with regards to two main aspects: (i) Optimise the planning for new generation capacity building considering historical power requests and relevant prices; (ii) Decide on the capacity to make available for PPAs by jointly analysing wholesale market price forecasts and combining them with anticipated volumes required and prices offered in PPA markets. In business terms, this BM will deliver the following value to RES Operators:

- Informed Planning for new generation capacity building, enabling them to offer much bigger volumes in PPAs markets (Figure 18- 2).
- High-level advisory on the volumes of current and anticipated generation to be traded in PPA markets and the prices/ duration they should negotiate by considering at the same time prices anticipated in wholesale markets (Figure 18 -3).

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SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider, Asset Owner: RES operator.

Data Asset consumers: RES operator. PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Technical Users: RES Operator.
- Data scientist/Data Analytics: RES Operator.
- Business User: RES Operator.

VALUE REALIZED:

- SYNERGY Platform and AI Analytics Marketplace: Service fees for data quality management. Service fees for data analytics execution (RES Operator-> Long Term Generation Forecasting, Wholesale market price forecasting, Specialized Analytics for Business Functions Optimization).
- RES Operators/ Beneficiaries: Informed Planning for Generation Capacity. Risk free investment making. Long-term profitability increases through intelligence-driven high-level advisory on PPA agreement making.

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by fees or subscription to services for Data Quality enhancement and Data Analytics over the data available.

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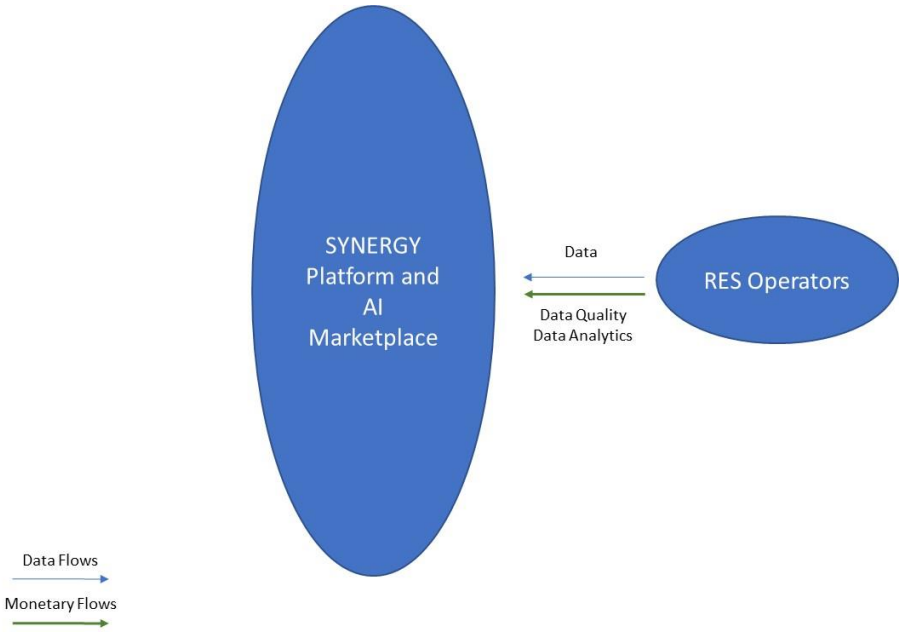

Figure 19. Money Flow Diagram BM7- Intelligence-Driven Long-Term Generation Planning and PPAs Advisory

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

RES OPERATOR

Revenue streams:

- Future Profits from increased generation and optimal volume allocation in guaranteed PPAs.

Cost Items:

- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RES OPERATORS

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Key Partners	
Key Activities • RES generation. • Long-term generation planning. • High-level PPA Advisory.	
Value Proposition • More generation capacity to be traded in PPA markets through informed capacity building planning. • Higher Profits through advice on PPA prices/ duration and proportion of total generation capacity.	
Relationships with another partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customer Segments and Communication. • Communication with SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (role under the organization perspective in the Data Value Chain).	
Cost Structure • Service fees for data quality enhancement. • Service fees fo Analytics Execution.	**Revenue Model** • Future profits from increased generation and optimal volume allocation in guaranteed PPAs.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Lower CO2 emissions. Greening the grid. • Promoting the energy transition. • Provision of access to cheaper and green energy.

Table 13. CANVAS RES OPERATORS_ BM7-Intelligence-Driven Long-Term Generation Planning and PPAs Advisory

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6.8 BM8- RES Power Plant Optimizer for GPPA maximization

Business Model derived from the combination of BS12, BS11.

Business Model categorization→ 'Data based delivery network business approach – Collaborative Opportunity. Delivery Network business model type

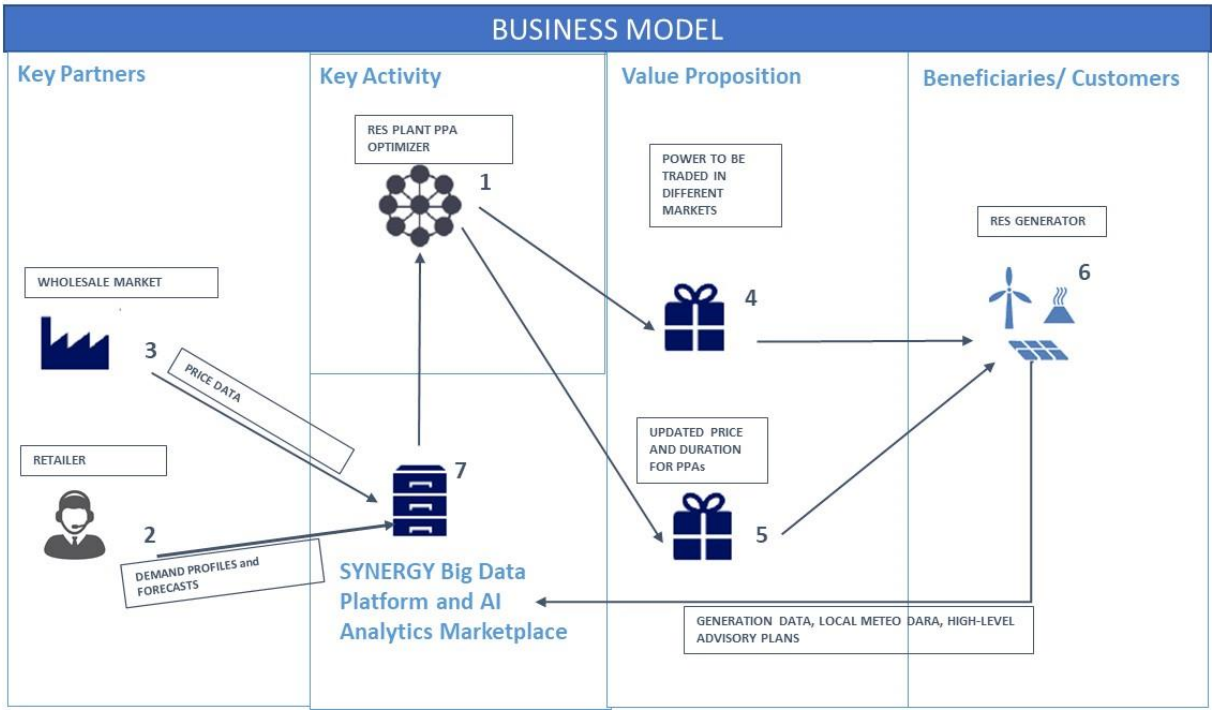

Figure 20. Business Model Description_BM8-RES Power Plant Optimizer for GPPA Maximization

BRIEF DESCRIPTION:

This BM builds on BM-7 and the initial high-level advisory provided to RES Operators and focuses on the analysis of specific retailer's power needs, as the preliminary step towards the definition of the exact amount of power to be offered to them and the contractual parameters related to price and duration.

RAW DATA and INSIGHTS:

- The RES Operator (Figure 20 -6), being the main beneficiary of the BM acquires data assets (through the SYNERGY Big Data and AI Analytics Marketplace/ Figure 20 -7) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data and analytics such as:

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- Demand profiles and forecasts from the portfolios of each individual retailer that wants to get engaged in PPAs; Existing PPAs, Volumes, Duration and Prices (Figure 20 – 2).
- Current wholesale market price data (Figure 20-3).

- As Data Owners, the RES Operators will also utilize data and algorithms referring to:
  - Generation data referring to the portfolio of RES belonging to them.
  - Local Meteorological Data from the Weather stations they own.
  - Initial high-level plans for splitting their generation capacity between wholesale and PPA markets.

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiary (RES Operator) involved in its realization.

VALUE PROPOSITION:

The Business application (Figure 20-1) that will facilitate the realization of this business model aims at properly guiding decisions on the RES Operators side with regards to evidently placing their bids in PPA markets by considering the volatility of wholesale market prices and the demand forecasts of retailers that can directly point out to their requirements for getting involved in a PPA. In business terms, this BM will deliver the following value to RES Operators:

<u>RES Operators</u>

1. Accurate volume of power that can be made available in PPA markets and trading plans so that RES operators are capable to sell the maximum volume of energy at the best possible price in a risk-averse manner (Figure 20-4).
2. Updated advise on the price to be offered, the duration and volume per each separate PPA (Figure 20-5).

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SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Data Asset Owner: RES Operator, Retailers, Energy Market Data Providers.
- Data Asset consumers: RES Operators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from RES Operators and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From RES Operators and Key Partners.
- Data scientist/Data Analytics: RES Operators.
- Business User: RES Operators.

VALUE REALIZED:

- Data Assets are sold to the RES Operator (Beneficiary) form Key Partners- Data and analytics are made available to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key Partners). Service fees for Analytics execution (RES Operator->Generation Forecasting, Wholesale Price Forecasting).
- RES Operator/ Beneficiary: Detailed trading plans to PPA and Wholesale Markets. Accurate estimation on the price to be offered, the duration and volume per each separate PPA. Increased long-term profitability from optimal trading decisions.

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VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Finally, a data transaction fee is involved and is preserved as part of the fees paid by the Beneficiary to each Key Partner in the frame of Data Acquisition.

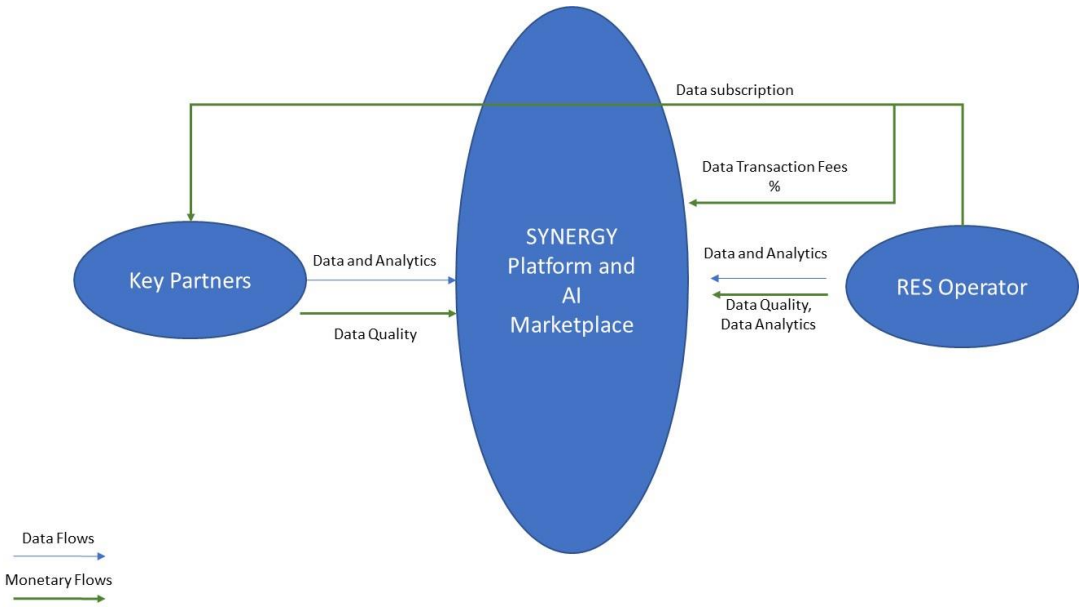

Figure 21. Money Flow Diagram BM8- RES Power Plant Optimizer for GPPA Maximization

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>RES OPERATORS</u>

Revenue Streams:

- Increased profitability through optimized bidding in wholesale and PPA markets.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

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The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RES OPERATORS

Key Partners • Retailers. • Wholesale Market Data Providers.	
Key Activities • RES generation. • Allocation of power to be traded to PPAs. • Evident analysis of price, duration and volume to be negotiated per individual PPA.	
Value Proposition • Optimized trading plan. • Accurate estimations on trading parameters.	
Relationships with another partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customer and Communication. • Communication with SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (role under the organization perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Increased profitability through optimized bidding in wholesale and PPA markets.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Lower CO2 emissions. Greening the grid. • Promoting the energy transition. • Provision of access to cheaper and green energy.

Table 14. CANVAS RES GENERATORS_ BM8-RES Power Plant Optimizer for GPPA Maximization

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6.9 BM 9- Transparent GPPA Marketplace

Business Model derived from the combination of BS12, BS11.

Business Model categorization→ 'Data based delivery network business approach – Collaborative Opportunity. Delivery Network business model type

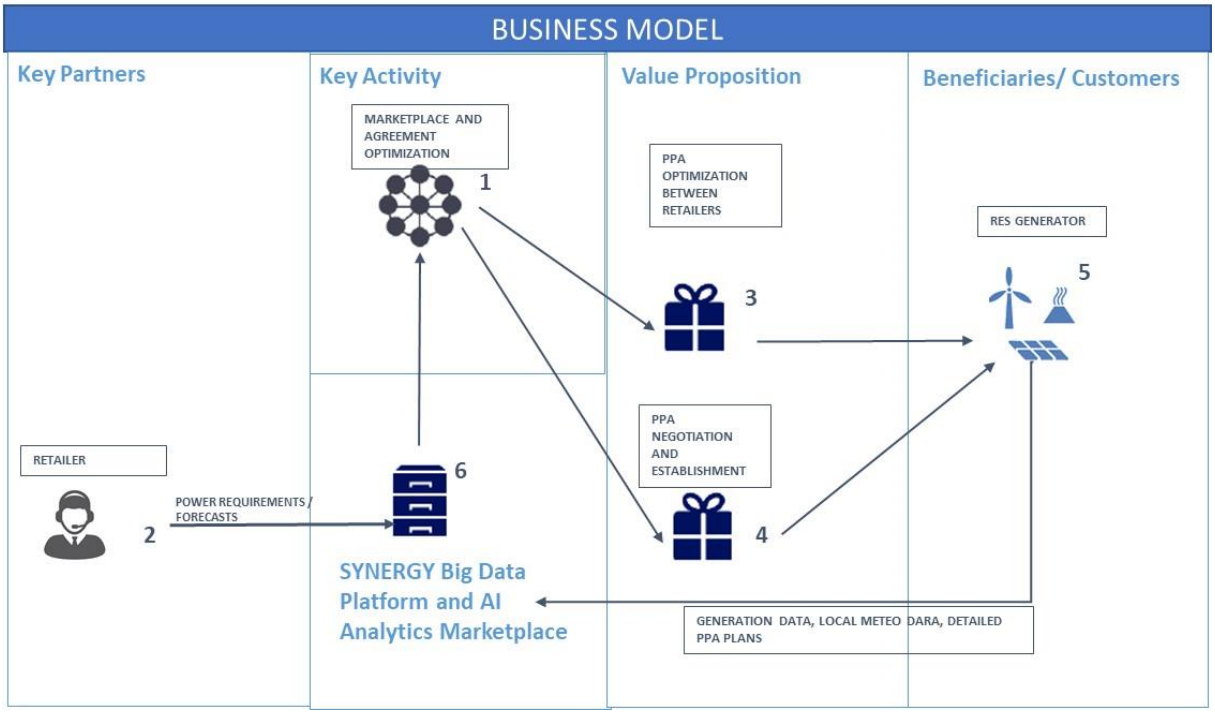

Figure 22. Business Model Description_BM9-Transparent GPPA Marketplace

BRIEF DESCRIPTION:

The current BM will step on advanced analytics in order to equip RES Operators (beneficiary) and Retailers (customer) with the required forecasts and estimations that will allow them to place accurate bids in an online marketplace environment operated by the RES Operator and get engaged in transparent, long-term PPAs.

The combination of the aforementioned analytics results will allow RES operators and retailers to get involved into a negotiation process regarding the establishment of long-term Green Power Purchase Agreements that will mutually benefit both sides, allowing RES operators to avoid losing significant revenues by non-sold energy, while increasing the competitiveness of the offering of electricity retailers by introducing green energy tariffs (lower than the conventional ones) resulting from the favourable GPPAs established between the two involved stakeholders.

RAW DATA and INSIGHTS:

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- The RES Operator (Figure 22 -6), being the main beneficiary of the BM acquires data assets (through the SYNERGY Platform and AI Analytics Marketplace / Figure 22- 7) from Retailers. Data assets acquired are mainly raw data and analytics such as:
    - Demand volume requirements and forecasts for inclusion in PPAs; (Figure 22 -2).
- As Data Owners, the RES Operators will also utilize data and algorithms referring to:
    - Generation data referring to the portfolio of RES belonging to them.
    - Local Meteorological Data from the Weather stations they own.
    - Detailed volumes for Power Volume to be made available in PPAs.

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiary (RES Operator) involved in its realization.

VALUE PROPOSITION:

The business application (Figure 22- 1) that will facilitate the realization of this business model aims at enabling RES Operators to receive bids from several retailers regarding their PPA power needs, the price and duration they propose and analyse them in combination with available power they have for PPA establishment and the anticipated price and duration they have estimated (optimized) as part of the previous Business Model.

In business terms, this BM will deliver the following value to RES Operators:

<u>RES OPERATORS</u>

- Optimized allocation of their available power for PPAs into separate agreements with several retailers (Figure 22 -3).
- The means for establishing, tracking and monitoring PPAs in a transparent and objective manner between involved parties (Figure 22 -4).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Data Asset provider/ Data Asset Owner: RES Operator, Retailers.
- Data Asset consumers: RES Operators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

BUSINESS PERSPECTIVE

- Manager: Legal Representatives form RES Operators and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From RES Operators and Key Partners.
- Business Users: RES Operators.

VALUE REALIZED

- Data Assets are sold to the RES Operator (Beneficiary) from Key Partners – Data and analytics are made available to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (RES Operator→Generation Forecasting).
- RES Operator/ Beneficiary: Specific PPAs and volumes per Retailers. Profit optimization and risk hedging.
- Retailer/ Customer (Figure 22 -5): Energy Costs reduction through access and purchase of cheaper power. Long-term agreements and avoidance of uncertainty for power delivery. More competitive commodity offering.

VALUE CAPTURE AND MONETIZATION

The monetary flows are characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data

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available. The business model also involves the cost for the purchase of energy from Retailers in the frame of the PPA, plus a minor annual subscription fee for customers/ retailers for accessing the marketplace.

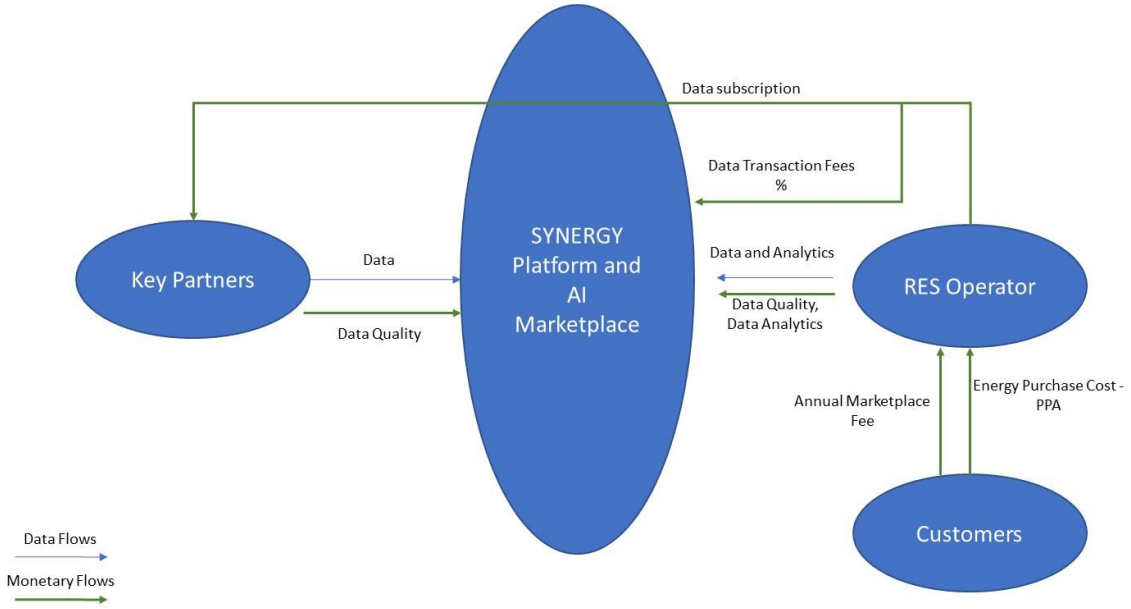

Figure 23. Money Flow Diagram BM9-Transparent GPPA Marketplace

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

RES OPERATORS

Revenue streams:

- Revenues from power purchases in the frame of GPPAs
- Service fees for operation of the Marketplace

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during

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the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RES OPERATORS

Key Partners • Retailers.	
Key Activities • RES generation. • Trading Power Optimization. • Negotiation and PPA Establishment.	
Value Proposition • Increased profitability by optimizing the share of total power to be allocated in different PPAs. • Increased trust to transactions performed through a transparent marketplace environment.	
Relationships with another partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customer and Communication. • Retailers: Energy Costs reduction through access and purchase of cheaper power. Long-term agreements and avoidance of uncertainty for power delivery. More competitive commodity offering. • Communication with SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (role under the organization perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Revenues from power purchases in the frame of GPPAs • Service fees for operation of the Marketplace.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Lower CO2 emissions. Greening the grid. • Promoting the energy transition. • Provision of access to cheaper and green energy.

Table 15. CANVAS RES GENERATORS_ BM9-Transparent GPPA Marketplace

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6.10 BM 10. RES Virtual Power Plant (VPP)

Business Model derived from the combination of, BS1, B10, BS11.

Business Model categorization→ 'Data based delivery network business approach – Collaborative Opportunity. Value Chain Integrator business model type

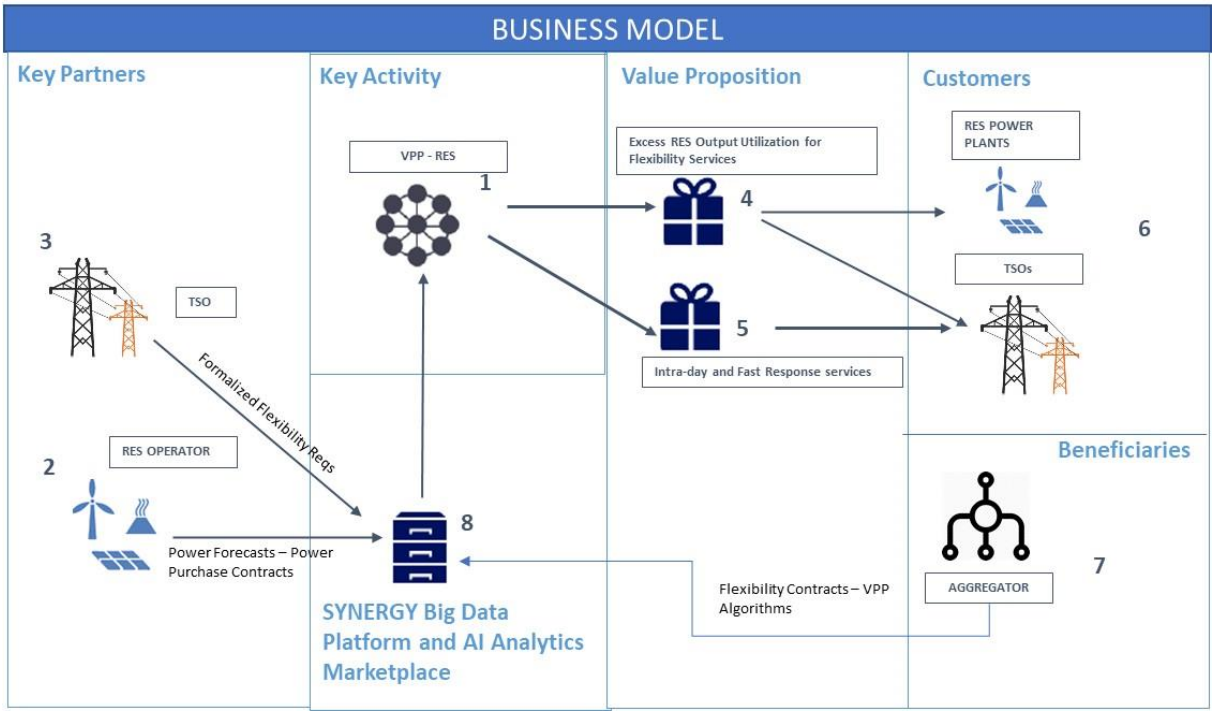

Figure 24. Business Model Description_BM10-RES Virtual Power Plant (VPP)

BRIEF DESCRIPTION:

This business model is a business proposition that aims at minimizing the curtailment of RES and utilizing their excess power output for the provision of ancillary services to TSOs. This will be performed through an aggregation process performed by Aggregators over RES available at different locations of the network (Transmission Network) towards formulating ad-hoc Virtual Power Plants as a Virtual Battery for cost-effective RES market's uptake. We propose a paradigm change, focusing on the business activities at the power generation level to provide support to TSOs and avoid "energy curtailment" in PV or Wind farms. The proposed business model is a new way to make use of this novel VPP market mechanism. The VPP defined is aimed at exploiting flexibility of both a single RES power plant or a pool of installations distributed geographically which are commonly managed and orchestrated by a single VPP operator/ Aggregator. At the aggregation level, the production capacity surplus (based on market bids) and consumption flexibility (energy consumption for power plant operation) of these resources can be pooled and the energy surplus can be utilized to offer additional

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services. In that sense, the Aggregator represents the main beneficiary of the Business Model and acts as an intermediary between the power generators and the TSOs. The Aggregator can participate in balancing markets for offering flexibility services to TSOs, with priority to be given into ancillary services that remunerate better the provided flexibility (e.g. frequency response). With the aim to maximize the revenues of its customers (RES Operators) while satisfying their convenience constraints, the Aggregator firstly analyses the forecasts of the RES production and combines it with performed agreements (wholesale and PPA) to define if there is any energy surplus to be traded in the form of flexibility. Then, the Aggregator performs the appropriate bids towards TSOs that have published their flexibility requirements. Once offers are accepted the surplus energy is provided in the frame of flexibility services, thus enabling the avoidance of curtailment, the avoidance of loss in profits due to unsold energy on the RES operator side and the obtainment of increased remuneration for providing services on that safeguard the stability and secure operation of the Transmission Network.

RAW DATA and INSIGHTS:

- The Aggregator (Figure 24-7), being the main beneficiary of the BM. acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 24-8) from various RES Operators. Data assets acquired are mainly forecasts for each individual RES Asset such as:
    - Active Reactive Power from Wind and PV plants (Figure 24 -2).
    - Contractual agreements for power purchases in the frame of the wholesale market and PPAs (Figure 24- 2).
    - Moreover, formalized requirements for flexibility from TSOs are collected towards facilitating the timely and location-based flexibility provision in the form of VPP configuration to provide appropriate services to the network (Figure 24 -3).
- As Data Owners, the Aggregators will also utilize data referring:
    - To short-term flexibility contracts established with RES Operators.
    - Algorithms for flexibility analysis, classification and clustering towards mobilizing optimal VPP configuration.

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the beneficiary (Aggregator) involved in its realization.

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VALUE PROPOSITION:

The Business application that will facilitate the realization of this business model aims properly clustering excess generation outputs available in different locations of the transmission grid (through aggregation) and enabling the "activation" of their flexibility potential towards ensuring the smooth operation of the transmission grid in the form of ancillary services. In business terms, this BM will deliver the following value to Aggregators:

1. Better positioning in intra-day flexibility markets and fast response services through utilizing the flexibility offered by RES (Figure 24 -4).
2. Increase remuneration from critical services provision to TSOs (Figure 24 -5).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider: RES Operators, TSOs, Aggregators.
- Data Asset consumers: Aggregators.
- Data brokers/Data Publisher: TSOs

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Aggregator and Key Partners (responsible for signing data sharing contracts).
- Technical Users: Aggregators and Key Partners.
- Data scientist/Data Analytics: Aggregators.
- Business Users: Aggregators.

VALUE REALIZED:

- Data Assets are sold to the Aggregator (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for

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Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.

- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Aggregators Flexibility Analytics).
- Aggregator/ Beneficiary: Offering of new and fast-responding flexibility sources to the TSOs. Increased remuneration for the provision of highly critical services to the grid.
- RES Operators/ Customers (Figure 24-6): Avoidance of RES curtailment and unsold energy. Remuneration for the provision of services to TSOs.
- TSOs/ Customers (Figure 24 -6): Secure stable operation of grids. Access to cheap flexibility sources.

VALUE CAPTURE/MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Flexibility remuneration is also introduced for the direct/ indirect participation of beneficiaries and customers in the respective flexibility trading markets.

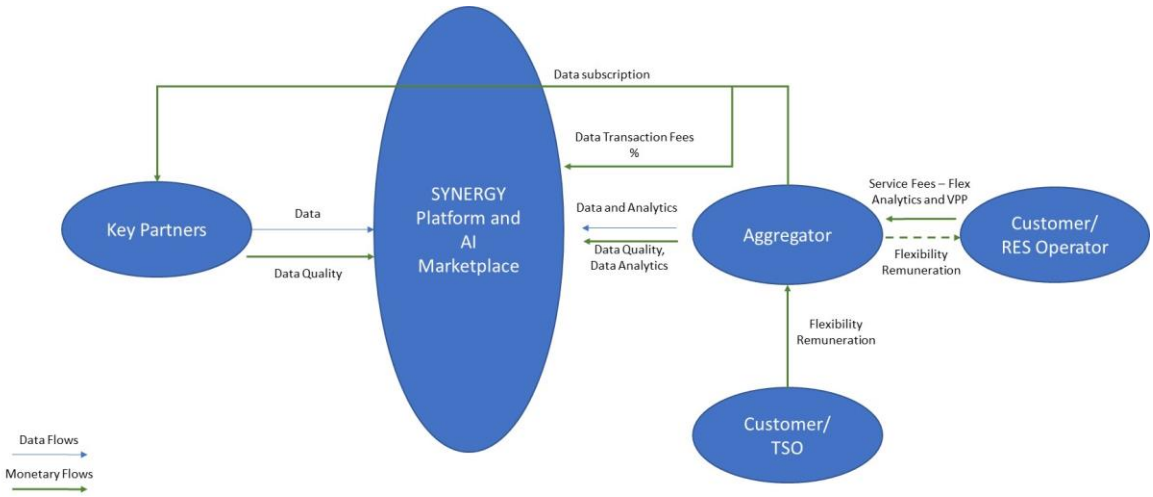

Figure 25. Money Flow Diagram BM10-RES Virtual Power Plant (VPP)

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>AGGREGATORS</u>:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Revenues streams:

- Service fees (for flexibility analytics and VPP formulation).
- Revenues for flexibility services to TSOs.

Cost Items:

- Costs acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.
- Portion of flexibility remuneration to be paid to RES Operators.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS AGGREGATORS

Key Partners • TSO • RES Operators.
Key Activities • Operates as an intermediate between RES Operators and the TSO. • Provides the optimal bids on behalf of RES Operators for the utilization of their assets at the aggregation level (VPP) for flexibility services. • Local RES flexibility forecasting.
Value Propositions • Better positioning in intra-day flexibility markets and fast response services through utilizing the flexibility offered by RES • Increase remuneration from critical services provision to TSOs.

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Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace .	
Customers and Communication. • TSO/ Customer: Secure and stable operation of grids. Access to cheap flexibility sources. • RES Operator/ Customer: Avoidance of RES curtailment and unsold energy. Remuneration for the provision of services to TSOs. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution. • Portion of flexibility remuneration to be paid to RES Operators	**Revenue Model** • Service fees (for flexibility analytics and VPP formulation). • Revenues flexibility services to TSOs.
Societal and Environmental Costs • VPPs are in competition with conventional power plants which might be pushed out of the market affecting employees working in this business area.	**Societal and Environmental Benefits** • Increasing renewable capacity in the electricity system. • Promoting RES Operators as active market stakeholders in flexibility markets. • New jobs creation thanks to the setup of VPPs. • Lower network charges by avoiding flexibility from expensive and polluting fossil-fuel plants.

Table 16. CANVAS AGGREGATORS_ BM10-RES Virtual Power Plant (VPP)

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6.11 BM 11 – Objective Dynamic Pricing of Electricity

Business Model derived from the combination of BS2, BS12.

Business Model categorization→ 'Data brokering differentiation business approach – Collaborative Opportunity. Data Broker business model type

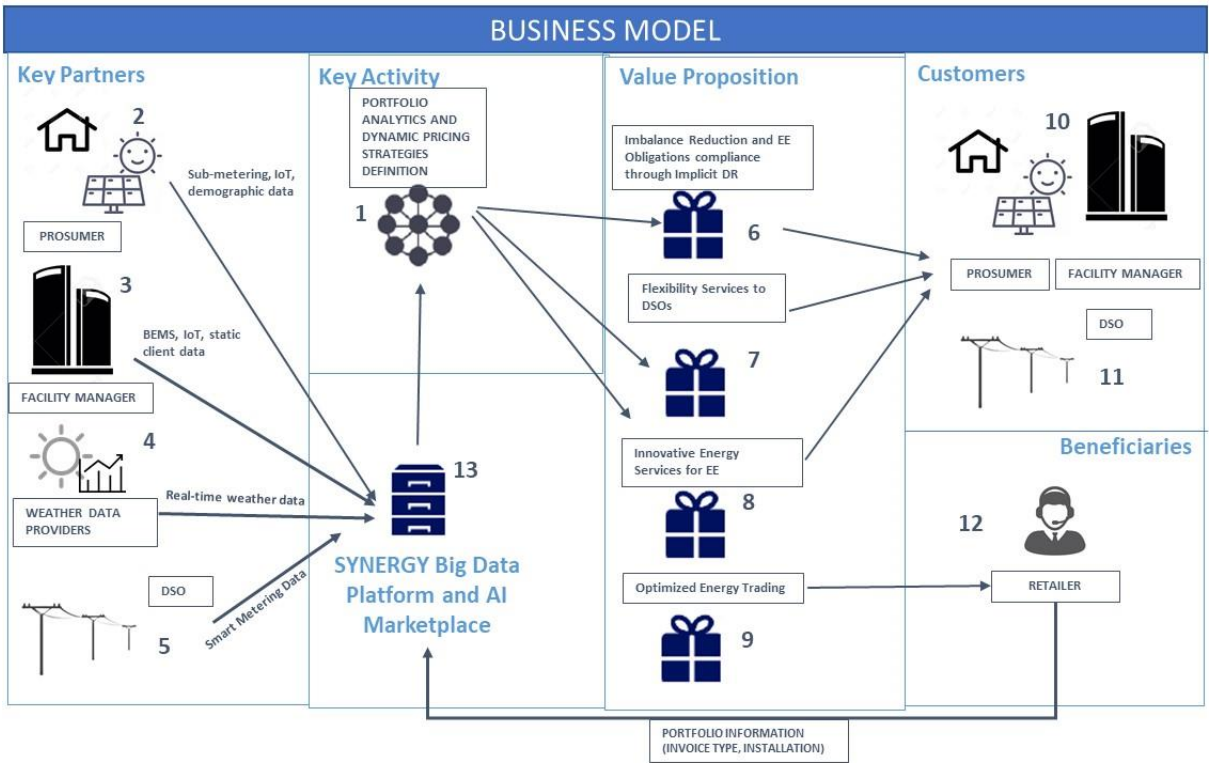

Figure 26. Business Model Description_BM11-Objective Dynamic Pricing of Electricity

BRIEF DESCRIPTION

This business model aims at enabling Retailers to apply Dynamic Pricing Schemes over their portfolio to satisfy a variety of business goals by properly extracting and analysing the price-based flexibility (elasticity) of their consumer portfolio as a first step towards the definition of alternative pricing strategies.

Significant value is expected to be generated for the retailer itself which will be able to setup an internal analytics environment for optimizing their portfolio performance in terms of energy efficiency and, thus, achieving in (i) effectively hedging against imbalances and reducing respective charges through improved demand forecasting and mobilization of dynamic pricing schemes for short-term performance corrections, (ii) optimizing their energy trading/ power exchange functions through

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improved demand forecasting and avoidance of purchasing additional electricity volumes in highly expensive spot markets, and (iii) complying with Energy Efficiency Obligations imposed at the EU and national level, thus avoiding unnecessary penalties.

This business model implements effectively implicit DR mechanisms. The business model shows the added value obtained by the retailer towards, meeting its obligation of a balanced portfolio by means of implicit DR events. Recall that the implicit DR refers to the propagation of dynamic prices by the retailer to its clients aiming to incentivize them to reform their consumption pattern. Thus, the business model investigates also the added value provided by the tools that manage at the local level the consumption and production of the prosumers, in terms of mitigating the risk of high electricity bills due to their exposure in dynamic pricing schemes. Through this new service retailers encourage consumers to move on consumption at certain periods of time, so that they both get benefits under an economical perspective (retailers for committing with the bidding offer released to avoid peak demand situations that may cause imbalances and for accomplishing the requirements coming from network operators, and customers by shifting consumption in periods with no peak pricing).

It is assumed that the retailer handles by its own the balancing responsibility (does not delegate it to another company). It is also considered that the retailer does not manage generation units and consequently has not the option of production rescheduling. Thus, a balanced position consists to the equalization of its clients' consumption with the volume of energy purchased (reserved) in the wholesale market. In what follows we consider the case when the retailer's forecast about the demand of its clients and consequently the volume of energy purchased in the day ahead wholesale market does not match the actual consumption. In the case of a negative imbalance, i.e., when the reserved energy is not adequate to cover the actual demand, the retailer may purchase further energy in the intra-day market, but such a choice may be particularly costly. In the opposite case, the retailer must pay an imbalance penalty to the TSO for its inaccurate estimation.

The business model assumes that the retailers' customers have already signed contracts that expose them to dynamic pricing schemes The retailer's tool has gathered all the necessary data from each individual prosumer (by means of the communication between the relevant tools) that let this agent know how they adapt their consumption with respect to the prices, environmental conditions, activities, and comfort preferences. Utilizing this information, the retailer will be allowed to know the appropriate level of the prices, which should cause the desired collective modification in the demand profile of its clients (load shifting/shedding) and will result in a balanced energy portfolio. The calculation may refer to personalized prices for each individual client according to their elasticity

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profiles. The dynamic prices are propagated to prosumers, together with information about the optimal consumption schedule at local level, according to the price sensitivity of the prosumer and their habits.

From the retailer's perspective better demand side management will be performed, in terms of reducing or eliminating the cost that is related with an imbalanced portfolio. From the prosumer's perspective a candidate contract between the retailer and a prosumer may combine dynamic pricing scheme in the form of critical peak pricing during the peak periods, and flat rates for the rest of the time. Then, the prosumer may accept such a contract if the level of the flat prices is lower than those in a contract that does not include any dynamic scheme. The optimal consumption-suggestions should guarantee that such a choice will result in reduced total energy costs for prosumers (within a given period, e.g. a year).

RAW DATA and INSIGHTS:

- The Retailer (Figure 26-12), being the main beneficiary of the BM. acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 26-13) from several stakeholders in the electricity value chain and other external sources. Data assets acquired involve:
    - Sub-metering, IoT Device Data, Sensing and Occupancy data and Demographics from Prosumers (Figure 26 -2).
    - Sub-metering, BEMS, IoT Device data, Sensing and Occupancy data, along with static client data from Facility Managers (Figure 26-3).
    - Weather Data from 3rd Parties (Figure 26-4).
    - Smart metering data from DSOs (Figure 26-5).
- As Data Owners the Retailers will also utilize data referring to:
    - Detailed Portfolio Information referring to Invoice Types, Energy Tariffs, Installation information about each individual client.

VALUE PROPOSITION:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

The Business application (Figure 26-1) that will facilitate the realization of this business model aims at enabling the comprehensive portfolio analysis of retailers, towards optimizing a series of business objectives and delivering significant value to the Retailers through a variety of associated services to be provided to their Customers.

In business terms, this BM will deliver the following value to Retailers:

Retailers

1. Optimization of their energy transactions through more accurate demand forecasting thus allowing to better position themselves in day-ahead and intraday electricity markets (Figure 26-9)
2. Significant reduction imbalances caused by forecasting errors, thus avoiding extremely high imbalance charges (Figure 26-6)
3. Examination of advanced and novel billing concepts (e.g. dynamic electricity pricing) by segmenting, clustering and analysing consumption behaviours, inferring the elasticity of specific clusters against varying electricity pricing levels and deploying highly effective implicit demand response strategies, towards optimizing the performance of their portfolio, hedging against non-anticipated imbalances and providing services to network operators (Figure 26-6 and 7)
4. Achieving compliance to Energy Efficiency obligations imposed by the European Commission and adopted by the Member States by designing appropriate portfolio management/ energy efficiency strategies and campaigns to achieve the anticipated targets (Figure 26-6)

Provision of innovative services bundles through the analysis of spatial-temporal patterns of their portfolio, identification of trends and outliers and obtainment of valuable knowledge for the design and delivery of added value services per individual customer or clusters of them to satisfy their needs for energy cost reduction through targeted innovative energy service bundles (e.g. retrofitting or renovation, personalized energy efficiency guidance, energy performance certification, demand response, smart home automation and non-energy services for security, comfort and well-being) to be provided in collaboration with external stakeholders (Figure 26-8).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Data Asset provider/ Asset Owner: Prosumers, Facility Managers, DSOs, Weather Data Providers, Retailers.
- Data Asset consumers: Retailers.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

BUSINESS PERSPECTIVE

- Manager: Legal Representatives from Retailer and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From Retailers and Key Partners.
- Data scientist/Data Analytics: Retailers.
- Business User: Retailers.

VALUE REALIZED:

- Data Assets are sold to the Retailer (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Retailers Demand Forecasting, Elasticity Analytics, Comfort Analytics, Energy Analytics).
- Retailer/ Beneficiary: Reduction (or even avoidance) of Imbalance charges, Elimination of penalties for non-compliance with EE obligations, Avoidance of costly energy purchases in intra-day markets, Subscription fees to new service offerings (personalized analytics, remote control, automation), Remuneration for Services to the DSO.
- Prosumers/ Customers (Figure 26-10): Avoidance of high energy prices and network charges, Energy Savings, Comfortable and Liveable buildings.
- Facility Managers/ Customers (Figure 26-10): Avoidance of high energy prices and network charges, Energy Savings, Comfortable and Liveable buildings.

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- DSOs/ Customers (Figure 26-11): Access to cheap flexibility sources, Secure operation of networks (avoidance of congestions and peaks).

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Service Fees for the Innovative Energy Services provided by the Retailer, along with Remuneration from DSOs for the provision of flexibility services to the grid are also involved in the monetary flows presented in the following figure:

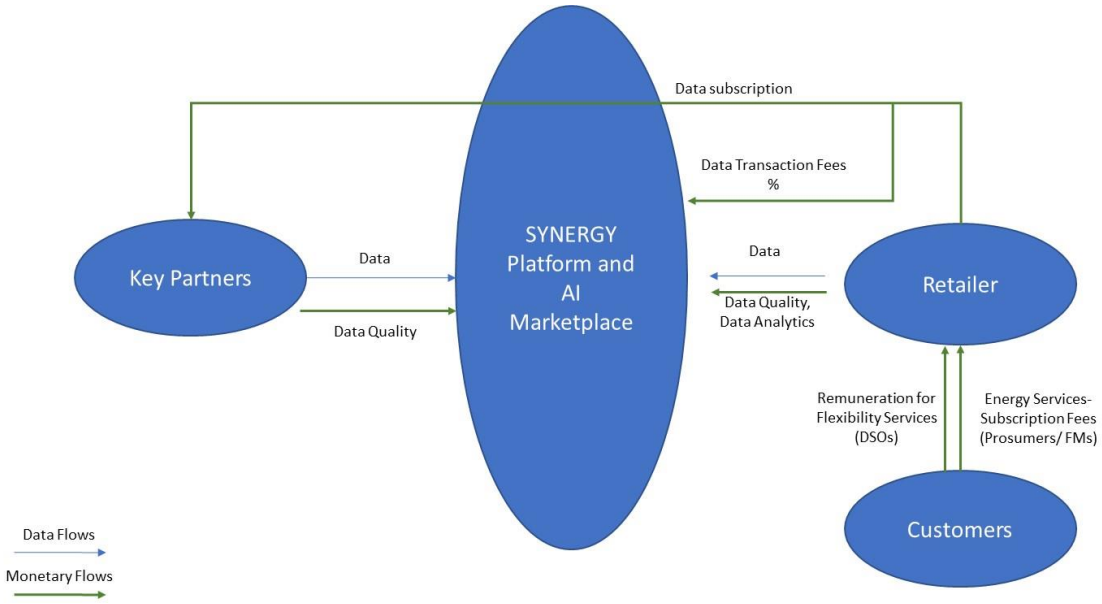

Figure 27. Money Flow Diagram BM11-Objective Dynamic Pricing of Electricity

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

RETAILERS

Revenue streams:

- Revenues from Subscriptions of Prosumers and Facility Managers in Innovative Services
- Revenues from Flexibility Services provision to the DSO

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- Monetary savings from the avoidance of imbalance charges
- Monetary savings from the avoidance of penalties for non-compliance to EE obligations.
- Savings from avoidance of intra-day energy purchases (costly trading).
- Opportunity for additional services (and respective fees) in collaboration with other partners
- Increase of market share (sales volumes) due to enhanced consumer engagement and brand reputation.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RETAILERS

Key Partners • Prosumer. • Facility Manager. • Weather Data Providers. • DSOs.
Key Activities • Portfolio demand forecasting. • Portfolio Analytics. • Dynamic Pricing Strategies for EE and Implicit DR.
Value Propositions • Optimization of their energy transactions. • Significant reduction imbalances. • Involvement in flexibility markets through Implicit DR. • Achieving compliance to Energy Efficiency obligations. • Provision of innovative services bundles.

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Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace • Opportunity for partnership with ESCOs and Aggregators for additional service bundles.	
Customers and Communication. • Prosumers and facility managers: Avoidance of high energy prices and network charges, Energy Savings, Comfortable and Liveable buildings. • DSOs: Access to cheap flexibility sources, Secure operation of networks. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Revenues from Subscriptions of Prosumers and Facility Managers in Innovative Services • Revenues from Flexibility Services provision to the DSO • Monetary savings from the avoidance of imbalance charges • Monetary savings from the avoidance of penalties for non-compliance to EE obligations. • Savings from avoidance of intra-day energy purchases (costly trading). • Opportunity for additional services (and respective fees) in collaboration with other partners • Increase of market share (sales volumes) due to enhanced consumer engagement and brand reputation
Societal and Environmental Costs • Suboptimal computing of the level of dynamic prices may lead to increased energy costs, if another demand peak appears due to consumption shifting. • Dynamic prices may lead a subset of prosumers/consumers to condition of energy poverty if they can't efficiently adjust their consumption patterns.	**Societal and Environmental Benefits** • Lower CO2 emissions. Flexible loads can reduce wholesale energy prices by avoiding expensive power generation and minimize power generation from polluting fossil-fuel power plants. • Increased public awareness about green energy, the energy transition and the internal energy market due to visibility of end users to wholesale market dynamics. • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders. • Satisfaction of comfort and well-being requirements of customers and balancing them with energy costs.

Table 17. CANVAS RETAILERS_ BM11-Objective Dynamic Pricing of Electricity

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6.12 BM 12 – Retailers as Non-Energy Service Providers

Business Model derived from the combination of BS12.

Business Model categorization→ 'Data Brokering business approach – Solo Opportunity. Data Broker business model type

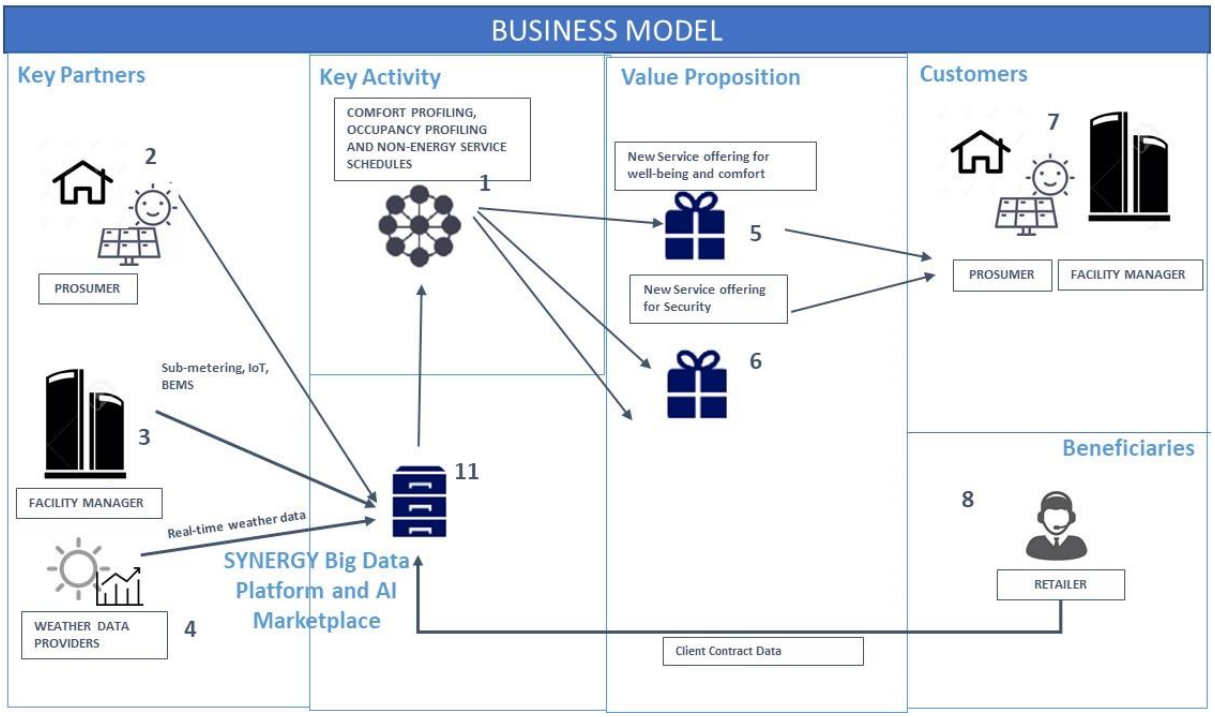

Figure 28. Business Model Description_BM12-Retailers as Non-Energy Service Providers

BRIEF DESCRIPTION:

Derived from the previous business model, in this case having access to large datasets coming from their clientele (prosumers, facility mangers), will allow retailers to perform advanced personal analytics functions over each client's data and return back (under specific service provision contracts) novel services (security, health, well-being and comfort) that are highly valued and can create significantly increased profitability, especially when compared to traditional commodity sales business practices.

RAW DATA and INSIGHTS:

- The Retailer (Figure 28-8), being the main beneficiary of the BM. acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 28-11) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from buildings such as: ESCOs: energy efficiency measures, consumption patterns from consumers.

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- A Sub-metering, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 28-2).
- Sub-metering, BEMS, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 28-3).
- Other data from Weather Data Providers (Figure 28-4).

- As Data Owners, the Retailers will also utilize data referring to:
  - Established contracts with their clients to ensure that specific service bundles are eligible to be delivered to them.

The business model encompasses both data value as a service and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiary (Retailer) involved in its realization.

VALUE PROPOSITION:

The Business application (Figure 28-1) that will facilitate the realization of this business model aims at enabling the accurate profiling of building occupants' comfort preferences and occupancy schedules, so as to deliver appropriate control strategies (either through remote controls or automation) for the realization of high value non-energy services. In business terms, this BM will deliver the following value to Retailers:

<u>RETAILERS</u>

1. New service offering for the evidence-based preservation of comfort, well-being and health of occupants through appropriate controls applied over heating/ cooling and lighting loads in buildings (Figure 28-5).
2. New service offering for the optimal scheduling of lighting loads (especially during night-time or in cases of absence) for the enhancement of security in the built environment (Figure 28-6).

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SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Asset Owner: Prosumers, Prosumers, Facility Managers, Weather Data Providers, Retailers.
- Data Asset Consumers: Retailers.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Retailer and Key Partners (responsible for signing data sharing contracts)
- Technical Users: From Retailers and Key Partners
- Data scientist/Data Analytics. Retailers
- Business User: Retailers.

VALUE REALIZED:

- Data Assets are sold to the Retailer (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Retailers Comfort Analytics, Occupancy Flow Analytics, Energy Analytics).
- Retailer/ Beneficiary: Provision of 2 new novel service offerings (health/ well-being/ comfort – security) and revenues from subscription fees of their customers.
- Prosumers/ Customers (Figure 28-7): Comfortable and Liveable buildings. Security feeling enhancement.
- Facility Managers/ Customers (Figure 28-7): Comfortable and Liveable buildings. Security feeling enhancement.

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VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Service Fees for the Innovative Energy Services provided by the Retailer, focusing on either guidance (for remote control) or automated control schedules over heating/ cooling and lighting devices of customers, are also involved in the monetary flows presented in the following figure.

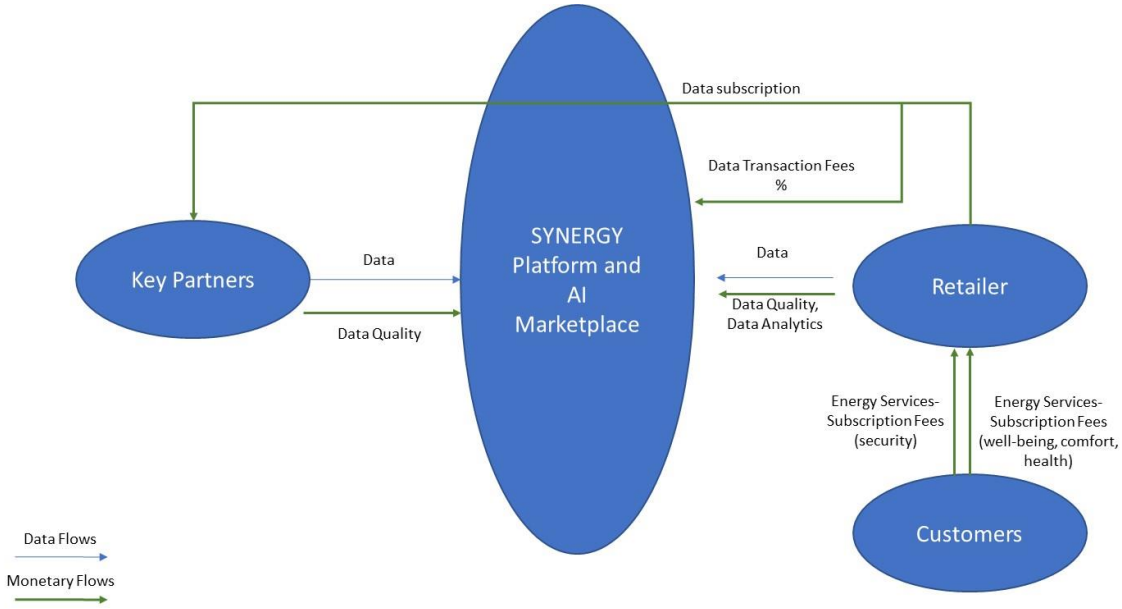

Figure 29. Money Flow Diagram BM12- Retailers as Non-Energy Service Providers

ANALYSIS OF THE VALUE PROPOSITION:

RETAILERS

Revenue streams:

- Revenues from Subscriptions of Prosumers and Facility Managers in Comfort, Health, Well-being services
- Revenues from Subscriptions of Prosumers and Facility Managers in Security services
- Increase of market share (sales volumes) due to enhanced consumer engagement and brand reputation

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Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RETAILERS

Key Partners • Prosumer. • Facility Manager. • Weather Data Providers.
Key Activities • Personal Comfort Analytics. • Occupancy Flow Profiling. • Optimal control strategies for heating/cooling and lighting devices as part of non-energy service provision.
Value Propositions • New service offering for the evidence-based preservation of comfort, well-being and health of occupants. • New service offering for the optimal scheduling of lighting loads (especially during night-time or in cases of absence) for the enhancement of security in the built environment.
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace.
Customers and Communication. • Prosumers and facility managers: Comfortable and Liveable buildings. Security feeling enhancement • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).

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Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	**Revenue Model** • Revenues from Subscriptions of Prosumers and Facility Managers in Comfort, Health, Well-being services • Revenues from Subscriptions of Prosumers and Facility Managers in Security services • Increase of market share (sales volumes) due to enhanced consumer engagement and brand reputation.
Societal and Environmental Costs • Suboptimal profiling may lead to increased energy costs. • Suboptimal profiling may affect comfort and well-being.	**Societal and Environmental Benefits** • Satisfaction of comfort and well-being requirements of customers and balancing them with energy costs. • Increased security in urbanized contexts • Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.

Table 18. CANVAS RETAILERS_ BM12-Retailers as Non-Energy Service Providers

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6.13 BM13- Flexibility and portfolio analytics (sales of insights)

Business Model derived from the combination of BS1, BS2, BS8.

Business Model categorization→ 'Data brokering business approach – Collaborative Opportunity. Data provision business model type

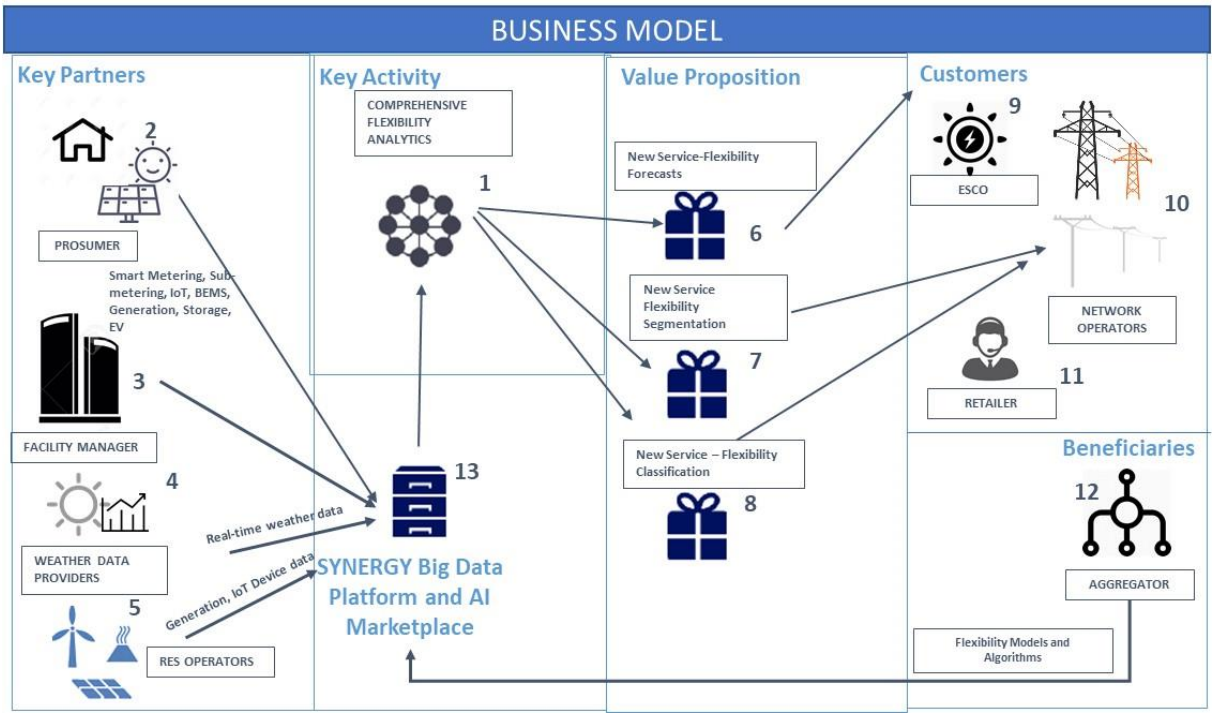

Figure 30. Business Model Description_BM13-Flexibility and portfolio analytics (sales of insights)

BRIEF DESCRIPTION:

This business model aims at the development and promotion of an new service from Aggregators for the delivery of pre-trained analytics and insights to other stakeholders of the electricity data value chain, towards facilitating their understanding about flexibility (flexibility profiles, flexibility forecasts) and how flexibility could be utilized as part of the realization of their individual business objectives.

In this context, Aggregators will collect data from different stakeholders of the electricity data value chain, owning and operating flexible resources (RES, Demand, Storage, etc.), will perform detailed analytics considering the capacity of flexibility, the duration it can be provided, its suitability for different types of services and will sell the results of this analysis (in the form of analytics and insights) to Network Operators, ESCOs and Retailers, so that they can step on it in order to satisfy different business goals referring either to the Scheduling and Planning of Networks (for Network Operators), to the maximization of self-consumption of their clients (for ESCOs) or to the efficient management of

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their portfolio performance in terms of Energy Efficiency (for Retailers, through the provision of innovative energy services for energy savings).

RAW DATA and INSIGHTS:

- The Aggregator (Figure 30-12), being the main beneficiary of the BM. acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 30-13) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from buildings flexible resources such as:
    - Smart Metering, Sub-metering, Generation, Storage, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 30-2).
    - Smart Metering, Sub-metering, BEMS, Generation, Storage, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 30-3)
    - Generation Metering, IoT Device data from RES Operators (Figure 30-4)
    - Weather Data from 3rd Parties (Figure 30-5).

  As Data Asset Owners, the ESCOs Aggregators will also utilize data referring to achieved models and algorithms that will facilitate the analysis of flexibility in the Business Application involved in the realization of the Business Model.

The business model encompasses both data value as a service and data intelligence as a service. In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiary (Aggregator) involved in its realization.

VALUE PROPOSITION:

The Business application (Figure 30-1) that will facilitate the realization of this business model aims at enabling the accurate profiling, analysis and forecasting of the flexibility capacity and characteristics of individual flexibility resources available at the Key Partners side, so as to enable the provision of a bundle of Data Analytics Services (insight sales) on the aggregator side towards ESCOs, Retailers and Network Operators. In business terms, this BM will deliver the following value to Aggregators

1. New service for sales of insights on flexibility forecasts to the Customers (Figure 30-6).
2. New service for sales of insights on Flexibility Segmentation to Network Operators (Figure 30-7).

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3. New service for sales of insights on Flexibility Classification to Network Operators (Figure 30-8).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Asset Owner: Prosumers, Building/ Facility Managers, Weather Data providers, RES Operators, Aggregators.
- Data Asset consumers: Aggregators, ESCOs, Retailers, Network Operators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Aggregator, Key Partners and Customers (responsible for signing data sharing contracts).
- Technical Users: From Aggregators and Key Partners.
- Data scientist/Data Analytics: Aggregator.
- Business User: Aggregators, ESCOs, Retailers, Network Operators.

VALUE REALIZED

- Data Assets are sold to the Aggregator (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary. Additional revenues (commissions) from the sales of analytics (Aggregator to Customers) resulting from the use of their raw data.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Aggregators→ Flexibility Analytics).
- Aggregator/ Beneficiary: New service and revenues for flexibility analytics sales to ESCOs, Retailers and Network Operators. Additional hedging mechanism for EPC and satisfaction of anticipated payback periods. Human-centric service offering as a social benefit to customers.

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Indirect revenues from opening the way to their customers to flexibility markets and involving flexibility transactions in energy management optimization objectives. Evolution to a more digitized company.

- ESCOs/ Customer (Figure 30-9): Access to Flexibility Analytics and Forecasts towards facilitating the provision of Self-Consumption services to buildings. Revenues from self-consumption services and Energy Performance Contracts.
- Retailers/ Customer (Figure 30-11): Access to Flexibility Analytics and Forecasts towards facilitating the provision Innovative Energy Services to buildings. Revenues from Energy Optimization Services. Avoidance of penalties from imbalances and non-compliance with EE obligations. Better flexibility forecasting leads to optimizing power trading and hedging.
- Network Operators/ Customer (Figure 30-10): Access to Flexibility Analytics and Forecasts towards improving Network Management and Network Planning functions. Reduction of OPEX for Network Operation. Access to cheap flexibility sources. Better scheduling of network operation. Improved network planning and avoidance of future investments.

VALUE CAPTURE AND MONETIZATION

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. The business model also involves data transaction fees for the provision of flexibility analytics to Customers (based on Key Partners' Data) paid by the Beneficiary to each Key Partner in the frame or re-using already acquired data for the purpose of selling analytics to other stakeholders.

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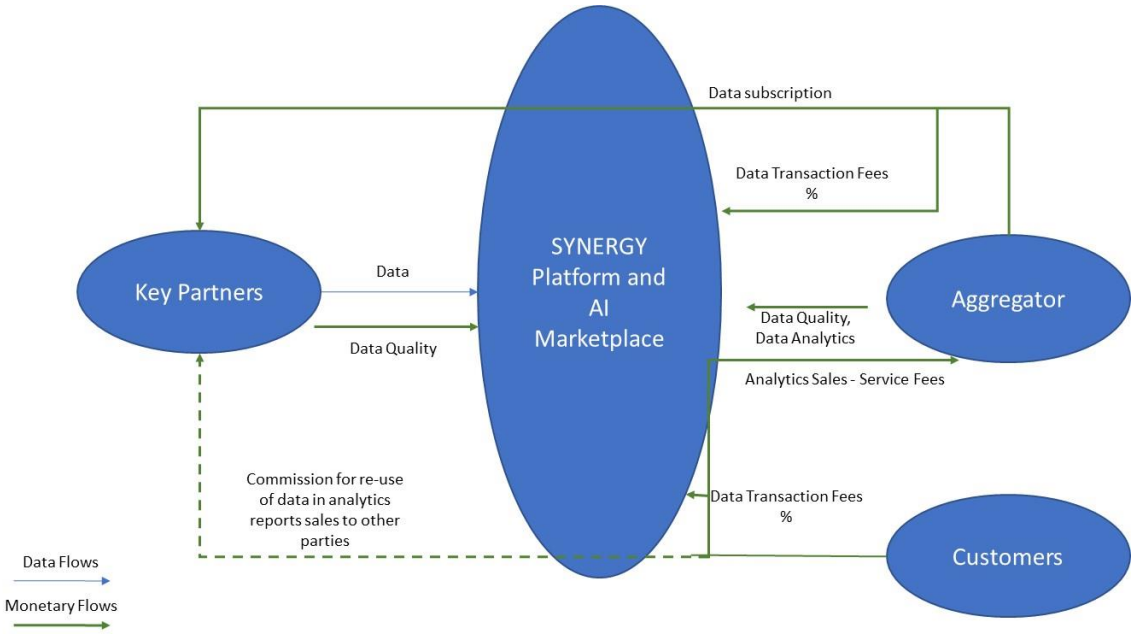

Figure 31. Money Flow Diagram BM13- Flexibility and portfolio analytics (sales of insights)

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

Aggregator

Revenue streams:

- Revenues from New Service Offerings (Insights sales) to ESCOs, Retailers and Network Operators.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS AGGREGATOR

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Key Partners • Prosumers • Facility Managers • Weather Data Providers • RES Operators.	
Key Activities • Comprehensive Flexibility Analytics	
Value Propositions • New service and revenues for sales of insights on flexibility forecasts to the Customers. • New service and revenues for sales of insights on Flexibility Segmentation to Network Operators • New service and revenues for sales of insights on Flexibility Classification to Network Operators	
Relationships with other partners /channel • SYNERGY Platform and AI Analytics Marketplace.	
Customers and Communication. • ESCOs: Access to Flexibility Analytics and Forecasts. Revenues from self-consumption services and Energy Performance Contracts. • Retailers/ Customer: Access to Flexibility Analytics and Forecasts. Revenues from Energy Optimization Services. Avoidance of penalties from imbalances and non-compliance with EE obligations. Better flexibility forecasting leads to optimizing power trading and hedging. • Network Operators/ Customer: Access to Flexibility Analytics and Forecasts Reduction of OPEX for Network Operation. Access to cheap flexibility sources. Better scheduling of network operation. Improved network planning and avoidance of future investments. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).	
Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution.	• **Revenue Model** • Revenues from New Service Offerings (Insights sales) to ESCOs, Retailers and Network Operators.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Enabling CO2 footprint reduction and Energy Efficiency through a variety of services • Enabling more liveable environments for building occupants through relevant services by the Customers • Enabling Network Charges reduction and enhancement of security of supply through a variety of instruments mobilized by Network Operators

Table 19. CANVAS AGGREGATORS_ Flexibility and portfolio analytics (sales of insights)

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6.14 BM 14- Flexibility VPP configuration for ancillary services

Business Model derived from the combination of BS1, BS2, BS3.

Business Model categorization→ 'Data-based delivery network business approach – Collaborative Opportunity. Delivery Network business model type

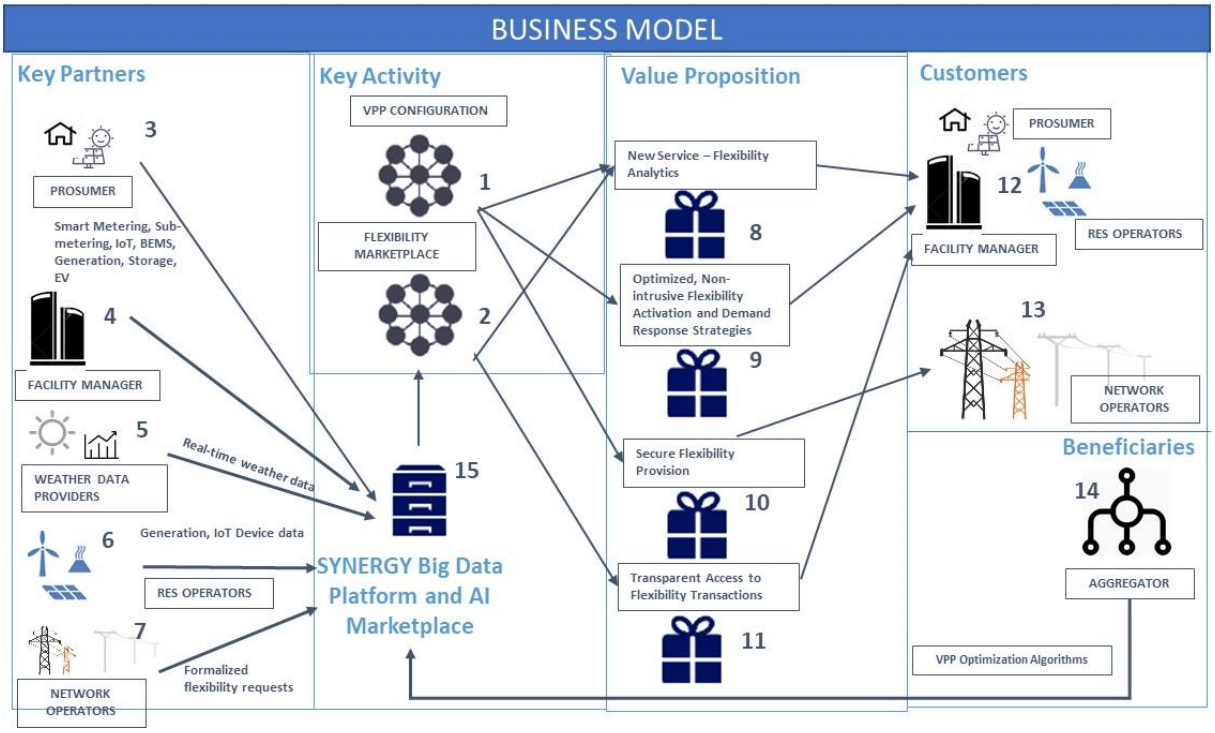

Figure 32. Business Model Description_BM14-Flexibility VPP configuration for ancillary services

BRIEF DESCRIPTION:

The involvement of aggregators into flexibility markets and trading requires the continuous optimization of their bidding activities in the respective markets in order to increase their revenues and profits while avoiding unnecessary penalties related to the inability to deliver the contracted flexibility in the frame of ancillary services to electricity grid operators.

To achieve this, aggregators need to reach out to cheap flexibility sources (small residential and tertiary prosumers) and exploit their unleashed and vast flexibility potential in a reliable manner (through accurate forecasting and clustering/ VPP formulation), by introducing them as a competitive flexibility source against traditional ones, in the respective markets.

In this context it is of utmost importance for aggregators to get involved and utilize advanced big data analytics tools that can ensure accurate forecasting of demand and flexibility in the short- and mid-term, thus allowing for the placement of accurate bids that can be easily validated by the service

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receivers (network operators). The delivery of such intelligence features, though, requires access to a wealth of data owned by external actors. This pushes aggregators to get involved into data sharing functions and business with such external actors, namely:

- TSOs and DSOs: for purchasing real-time smart metering data but also for receiving information regarding operational flexibility requirements and characteristics
- Prosumers: for getting access into sub-metering data, IoT and sensing data from prosumer premises
- DER Owners: for purchasing real-time operational data of local generation assets, local storage devices and EV charging stations
- Weather data service providers, for getting access into highly local and fine-grained weather information.

This business model is addressed to aggregators (as beneficiaries) that will be allowed to optimize VPP configuration based on flexibility resources and capacities made available in a flexibility trading marketplace operated by them and involving all possible flexibility providers in transaction processes

RAW DATA and INSIGHTS:

- The Aggregator (Figure 32-14), being the main beneficiary of the BM. acquires data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 32-15) from several stakeholders/ flexibility providers in the electricity value chain and other external sources. Data assets acquired are mainly raw data from flexible resources such as:
    - RES Smart Metering, Sub-metering, Generation, Storage, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 32-2).
    - Smart Metering, Sub-metering, BEMS, Generation, Storage, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 32-3)
    - Generation Metering, IoT Device data from RES Operators (Figure 32-4)
    - Weather Data from 3rd Parties (Figure 32-5).
    - Formalized flexibility requests and characteristics (capacity, duration, location, service needs) from TSOs and DSOs (Figure 32-6).

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- As Data Asset Owners, the Aggregators will also utilize data referring to VPP optimization algorithms that will facilitate the analysis of flexibility in the Business Application involved in the realization of the Business Model.

The business model encompasses both data value as a service and data intelligence as a service.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiary (Aggregator) involved in its realization.

VALUE PROPOSITION:

The realization of the business model involves two different types of activities and associated Business Applications to be operated by the Aggregator.

The Flexibility Marketplace Business application (Figure 32-2) aims at allowing different flexibility providers (currently excluded from the market) to get engaged into a process of better understanding their flexibility (through flexibility analytics) and offering the capacity they have available to aggregators, so as for the latter, to enrich its offering to Network Operators by exploiting the unleashed potential offered by the Key Partners.. In this way the following value is expected to be delivered to the Beneficiary of this Business Model (Aggregators):

1. New service offering opportunity for flexibility analytics and understanding to Prosumers, Facility Managers and RES Operators (Figure 32-8).
2. Access to a huge flexibility capacity pool, so as to enhance their bids to Network Operators and hedge against unexpected events that may hinder the delivery of the contracted flexibility during specific service provision cases (Figure 32-11).

The marketplace will be complemented with a Virtual Power Plant configuration Business Application (Figure 32-1) that will enable the formulation of optimal flexibility VPPs to address evolving flexibility requirements coming from DSOs and TSOs, by utilizing the flexibility that has been made available through the marketplace. In Business terms, this application will allow Aggregators to obtain the following business value:

1. A novel offering for non-intrusive flexibility activation and demand response programmes to flexibility providers by stepping on advanced context-aware profiles of flexibility sources and activating them without creating any disturbance to the respective owners (Figure 32-9).

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2. Optimized and risk-averse aggregation of flexibility sources into (dynamic) VPPs to accurately, timely and effectively address flexibility requirements of DSOs/ TSOs for the provision of ancillary services to their networks, enabling also the continuous monitoring of the VPP performance and the launch of hedging countermeasures in cases of deviations (Figure 32-10)

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset provider/ Asset Owner: Prosumers, Building/ Facility Managers, RES Operators Weather Data providers, Network Operators, Aggregators.
- Data Asset consumers: Aggregators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Aggregator and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From Aggregators and Key Partners.
- Data scientist/Data Analytics: Aggregators.
- Business Users: Aggregators.

VALUE REALIZED:

- Data Assets are sold to the Aggregator (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (Aggregators→ Flexibility Analytics and Forecasting).

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- Aggregator/ Beneficiary: New service and revenues for flexibility analytics sales to Key Partners. Revenues from Flexibility Services to Network Operators (VPP). Revenues from innovative context-aware Flexibility Activation and Human-Centric Demand Response Services to RES Operators, Facility Managers and Prosumers. Appropriate hedging mechanisms in VPP service provision through continuous monitoring and dynamic re-configuration and avoidance of costly penalties from Network Operators. Increased market share and revenues from opening access of small customers to flexibility transactions (large volumes of flexibility). Evolution to a more digitized and highly intelligent company.
- Facility Managers, Prosumers, RES Operators/ Customers (Figure 32-12): Transparent access to flexibility markets and objective remuneration for flexibility provision. Optimized participation in Flexibility Activation through non-intrusive context-aware programmes launched by aggregators. Human-centric demand response programmes, properly combining flexibility provision with comfort preservation in buildings. Better understanding of flexibility and accurate offerings to flexibility marketplaces and aggregators. Significant Energy Cost Savings and Revenues from Flexibility transactions.
- Network Operators/ Customer (Figure 32-13): Access to Flexibility Analytics and Forecasts towards improving Network Management. Reduction of OPEX for Network Operation. Safe, reliable, economical and efficient transmission and distributions systems (minimization of downtime and interruptions, avoidance of equipment failures) through) receiving flexibility VPP services by aggregators. Reduced OPEX costs. Access to cheap flexibility sources. Better scheduling of network operation.

VALUE CAPTURE/MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement. Service Fees for the services provided by the Aggregator to the different customers, are also involved in the monetary flows presented in the following figure, while flexibility remuneration flows are also presented between Network Operators, Aggregators and Flexibility Providers/ Customers.

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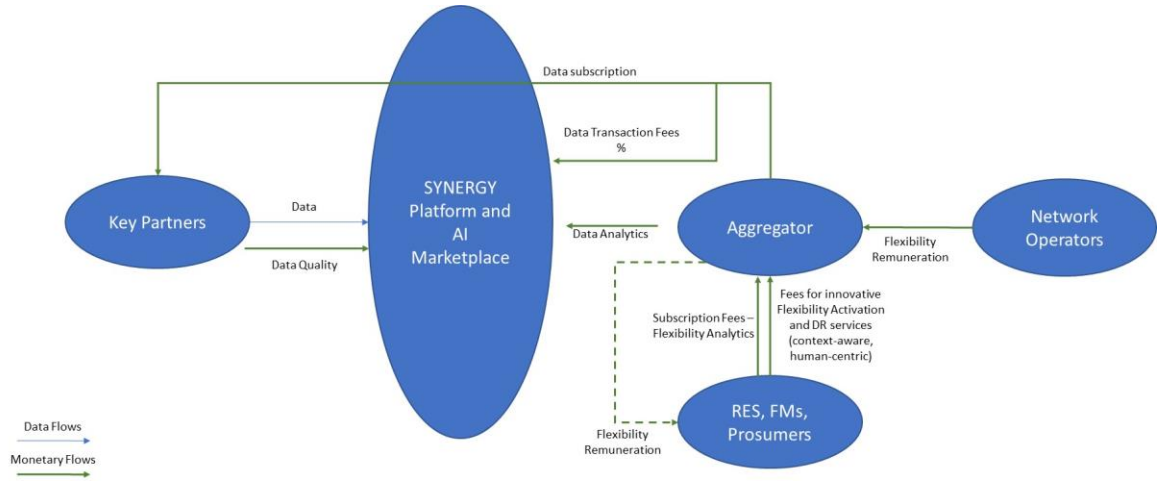

Figure 33. Money Flow Diagram BM14- Flexibility VPP configuration for ancillary services

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

AGGREGATORS

Revenue streams:

- Service fees (for flexibility analytics)
- Service Fees for Demand Response and Flexibility Activation services.
- Revenues from flexibility services to Network Operators.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for Analytics Execution.
- Portion of flexibility remuneration to be paid to RES Operators

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS AGGREGATORS

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Key Partners
- Prosumers.
- Facility Managers.
- RES Operators.
- Network Operators.
- Weather Data providers.

Key Activities
- Flexibility trading marketplace and associated analytics.
- VPP dynamic configuration for service provision to Network Operators.
- Definition of Flexibility Activation and Demand response schedules.

Value Propositions
- New service offering opportunity for flexibility analytics to Prosumers, Facility Managers and RES Operators.
- Access to a huge flexibility capacity pool, so as to enhance their bids to Network Operators and hedge against unexpected events that may hinder the delivery of the contracted flexibility during specific service provision cases.
- A novel offering for non-intrusive flexibility activation and demand response programmes to flexibility providers.
- Optimized and risk-averse aggregation of flexibility sources into (dynamic) VPPs.

Relationships with other partners /channel
- SYNERGY Platform and AI Analytics Marketplace.

Customer and Communication.
- Facility Managers, Prosumers, RES Operators/ Customers: Transparent access to flexibility markets and objective remuneration for flexibility provision. Non-disturbance of daily operation schedules in buildings and avoidance of losses. Comfortable and liveable buildings. Better understanding of flexibility and accurate offerings to flexibility marketplaces and aggregators. Revenues from flexibility provision. Energy Cost Savings.
- Network Operators/ Customer: Access to Flexibility Analytics and Forecasts towards improving Network Management. Reduction of OPEX for Network Operation. Safe, reliable, economical and efficient transmission and distributions systems. Access to cheap flexibility sources. Better scheduling of network operation.
- Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).

Cost Structure
- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for Analytics Execution.
- Portion of flexibility remuneration to be paid to RES Operators.

Revenue Model
- Service fees (for flexibility analytics)
- Service Fees for Demand Response and Flexibility Activation services.
- Revenues from flexibility services to Network Operators.

Societal and Environmental Costs
- VPPs are in competition with conventional power plants and flexibility sources which might be pushed out of the market affecting employees working in this business area.

Societal and Environmental Benefits
- Reducing the dependence of the electricity network on fossil-fuel powered plants and sources.
- Promoting small prosumers and buildings as active market stakeholders in flexibility markets.
- Lower network charges by avoiding flexibility from expensive and polluting fossil-fuel plants.
- Lower CO2 footprint
- Enhanced security of supply and self-sufficiency
- Openness of Energy Markets and Transparent Transactions

Table 20. CANVAS AGGREGATORS_ BM14-Flexibility VPP configuration for ancillary services

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6.15 BM 15-TSO-DSO Collaborative Network Management

Business Model derived from the combination of BS1, BS3, BS4.

Business Model categorization→ 'Data-based delivery network business approach – Collaborative Opportunity. Value Chain Integrators business model type

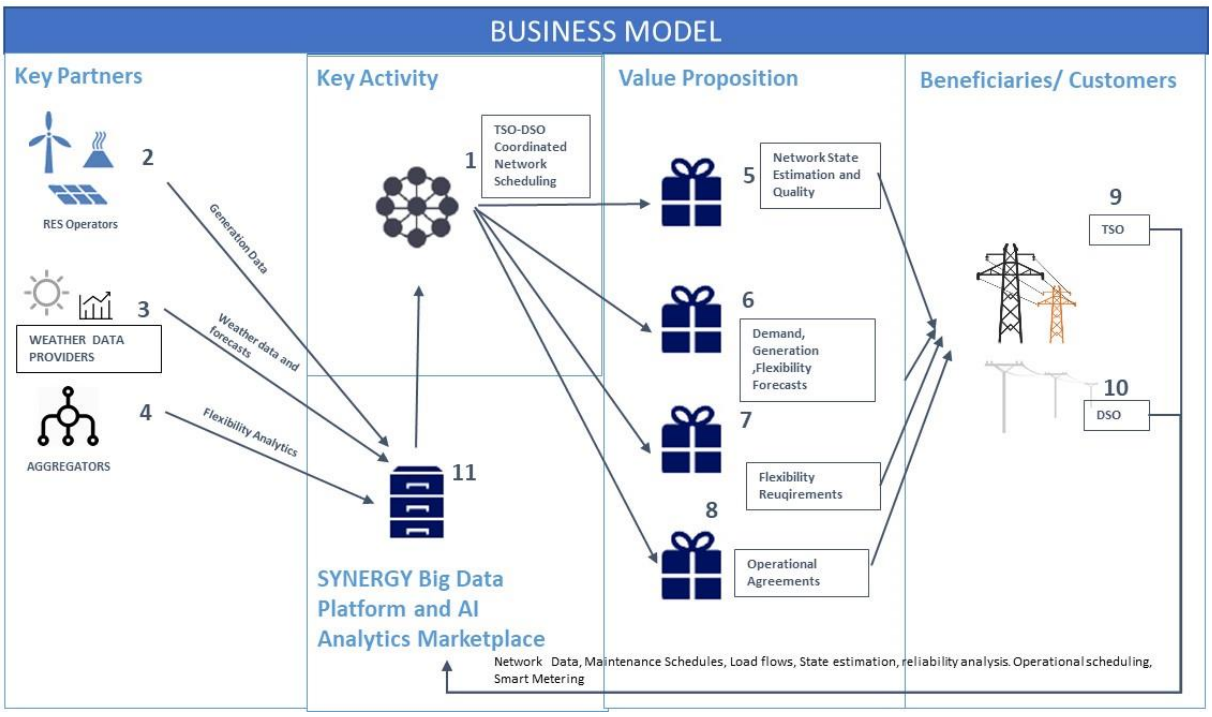

Figure 34. Business Model Description_BM15-TSO-DSO Collaborative Network Management

BRIEF DESCRIPTION:

This business model targets TSO-DSO collaboration addressing balancing and flexibility issues during actual operation of their networks. This business model is aimed at making the maximum use of the concept of flexibility when it comes to ensuring efficient operation of the electrical system and the highest quality in the power supply most cost-effectively (taking the most profit of the flexibility potential instead of purchasing additional capacity or activate market mechanisms in order to solve supply-demand imbalances). For tackling this, a coordination platform needs to be established where the TSOs and DSOs will apply advanced simulations to estimate at the local level and in each local DSO zone -and in a coordinated manner between all of them- the level of flexibility required for each of them, in advance. Furthermore, predictive coordination strategies will be issued so that TSOs will be able to recognize current situations, forecast the short-term occurrence of feasible problematic events and exchange maintenance schedules to increase transparency and knowledge on both sides on

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possible cases where enhanced flexibility may be required for ensuring the smooth operation of network at both levels.

In market terms through the realization of this BM, TSOs will access the required data to run a prequalification process for balancing services and compute and publish balancing capacity needs based on forecasts considering day-ahead and congestion management results. TSOs also receive capacity bids and communicate to DSOs. After that, they will receive limits for balancing capacity bids from DSOs (after performing forecast and identifying possible temporary limits on balancing capacity bids). After TSOs' clearing, they communicate their balancing capacity results to all DSOs and (subsequently) to aggregators and send them activation signals considering the flexibility analytics they have provided to them (and dynamic configurations of VPPs). Once they receive balancing capacity results, they will directly inform their managed DER portfolio.

RAW DATA and INSIGHTS:

- The TSO and the DSO (Figure 34-9 and 10), being the main beneficiaries of the BM acquire data assets (through the SYNERGY Platform and Analytics Marketplace / Figure 34-11) from RES operators and Data Analytics Assets from Aggregators, so as to be able to estimate in the short-term the status of their networks and define flexibility requirements and service provision schedules.. Such data assets include:
    - Generation Metering from RES Operators (Figure 34 -2).
    - Flexibility Analytics and VPP offerings from Aggregators (Figure 34-3)
    - Weather Data and Forecasts from 3rd Parties (Figure 34-4).
- As Data Asset Owners, the Network Operators will also utilize data referring to Maintenance Schedules, Load flows, State estimation, reliability analysis. Operational scheduling. Moreover, they will act as Data Providers of data assets owned by Prosumers, Facility Managers and other stakeholders of the electricity data value (EV charging stations, Storage, etc) chain referring to Owners of Smart Metering Data.

The business model encompasses both data value as a service and data intelligence as a service.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiaries (Network Operators) involved in its realization.

VALUE PROPOSITION:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

The realization of the business model involves a Business Application/ Coordination Platform (Figure 34-1) accessible by both TSOs and DSOs so as to transparently estimate and exchange their flexibility requirements and jointly schedule the flexibility sources they will utilize to avoid conflicts or service failures, through evidence-based operational agreements for the optimal utilization of the available flexibility.

In this way the following value is expected to be delivered to the Beneficiaries of this Business Model (Network Operators – TSOs/ DSOs):

1. Accurate short-term estimations of network status and power quality indices at both levels of the electricity network (Figure 34-5), considering advanced demand and generation forecasts based on data delivered from all ends of the networks (Figure 34-6).
2. Informed flexibility requirements' definition for optimizing the operation of networks and ensuring security of supply (Figure 34-7).
3. Common prioritization on flexibility activation and establishment of on-the-fly operational agreements (Figure 34-8) with the subsequent acceptance of VPP offerings made by aggregators.

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

DATA PERSPECTIVE

- Data Asset providers: RES Operators Weather Data providers, Aggregators, TSOs, DSOs
- Data Asset consumers: TSOs, DSOs
- Data Asset Owners: All Data Asset Providers and Smart Metering Data Owners (facility managers, prosumers, EV, Storage assets) offering their data through TSOs and DSOs.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from TSOs/ DSOs and Key Partners (responsible for signing data sharing contracts)
- Technical Users: From TSOs/ DSOs and Key Partners
- Data scientist/Data Analytics. TSOs/ DSOs

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- Business User: TSOs/ DSOs

VALUE REALIZED:

- Data Assets are sold to the TSO/DSO (Beneficiary) from Key Partners – Actual data uploaded to the Platform by the variety of Key Partners and Analytics. A predictable revenue stream is generated for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data (from Key partners). Service fees for Analytics Execution (TSO/DSO→ Demand/ Generation Forecasts and Flexibility Analytics and Forecasts).
- TSOs and DSOs/ Beneficiaries: Safe, reliable, economical and efficient transmission and distributions systems (minimization of downtime and interruptions, avoidance of equipment failures). Reduced OPEX costs. Access to cheap flexibility sources. Better scheduling of network operation and avoidance of conflicts based on transparent communication and prioritization. Accurate flexibility requirements based on informed state estimation forecasts. Postponement of investment costs for extending/reinforcing lines and other assets because of the flexibility capacity usage to the maximum. Reduced balancing costs. Effective means to avoid constraints that might result in DSO networks when the activation of energy resources including DER providing balancing services to the TSO increases. Alleviation of constraints in the DSO networks (congestion problems).

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the Data Assets and Analytics made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. Fees for Data Exchange between TSOs and DSOs are not involved, since they are characterized by equal volumes and amounts, thus following the Peer-to-Peer paradigm and not involving any actual monetary flows (torrent-like exchange of Operators' data). Finally, the diagram does not involve money flows for Network Operators towards Aggregators for the remuneration of flexibility services upon acceptance of flexibility bids and available VPP offerings from aggregators

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since the focus is on the flexibility scheduling part (flexibility activation in the form of VPP offerings acceptance is part of the previously analysed BM14).

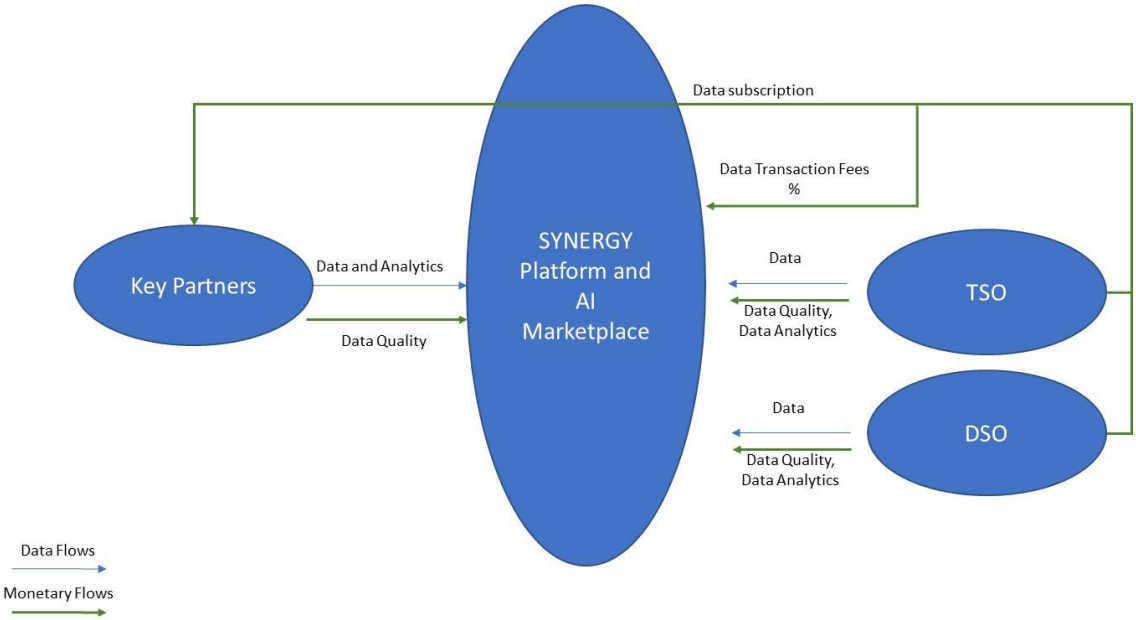

Figure 35. Money Flow Diagram BM 15-TSO-DSO Collaborative Network Management

PRELIMINARY BUSINESS MODEL EVALUATION METRICS

<u>TSOs</u>

Revenues Streams:

- Reduced balancing costs.
- Reduced penalties for capacity allocation.
- Lower energy losses.
- Lower economic investment for network expansion.
- Resource savings from better operational efficiency.

Cost Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.

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- Service fees for Analytics Execution.

DSOs

Revenues Streams:

- Reduced balancing costs.
- Reduced penalties for capacity allocation and congestion events.
- Lower energy losses
- Postpone investment for network expansion and reinforcement to manage an ever-increasing number of DER.

Cost Streams:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for Analytics Execution.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/ cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

The following BM canvas summarizes the BM simultaneously for DSOs and TSOs due to the similarity of the value propositions, benefits and monetary streams (through whenever needed, a distinction is made to highlight key aspects that are specially applying to each of the two types of operators).

T

CANVAS NETWORK OPERATORS

Key Partners
- RES Operators.
- Aggregators.
- Weather Data Providers.

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Key Activities
- Decision making process in operation scheduling for their networks, considering available flexibility.
- Power quality estimation and optimization.

Value Proposition
- Support in the decision-making process in O&M works.
- Run processes for balancing management and ancillary services.
- Coordination between operators. Dual exchange of data.
- Predictive coordination strategies.

Relationships with another partners /channel
- SYNERGY Platform and AI Analytics Marketplace.
- TSO<- ->DSO.

Customer Segments and Communication.
- TSO: Safe, reliable, economical and efficient transmission system. reduced OPEX/Balancing costs. Access to cheap flexibility sources. Better scheduling of network operation and avoidance of conflicts based on transparent communication and prioritization. Accurate flexibility requirements based on informed state estimation forecasts. Postponement of investment costs for extending/reinforcing lines and other assets because of the flexibility capacity usage to the maximum. Effective means to avoid constraints that might result in DSO networks when the activation of energy resources including DER providing balancing services to the TSO increases.
- DSO: Safe, reliable, economical and efficient distribution systems. Reduced OPEX/Balancing costs. Access to cheap flexibility sources. Better scheduling of network operation and avoidance of conflicts based on transparent communication and prioritization. Accurate flexibility requirements. Alleviation of constraints in the DSO networks (congestion problems).
- Communication with the SYNERGY Platform and AI Marketplace 365/24/7 via Helpdesk (role under the Organization Perspective in the Data Value Chain).

Cost Structure
- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for Analytics Execution.
-

Revenue Model

TSO
- Reduced balancing costs.
- Reduced penalties for capacity allocation.
- Lower energy losses.
- Lower economic investment for network expansion.
- Resource savings from better operational efficiency.

DSO
- Reduced penalties for congestion failures.
- Increased revenues by incentives related to availability and quality of supply KPIs.
- Lower energy losses.
- Lower economic investment for network expansion.
- Redispatching cost decrease.

Societal and Environmental Costs
- Lower carbon footprint due to the deferral of economic investment for network expansion.

Societal and Environmental Benefits
- Less power losses
- Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.
- Security of supply and quality of power.
- Reliable operation and networks and lower social disturbance due to reduced service losses.
- Lower network charges due to the utilization of cheap flexibility resources.

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Table 21. CANVAS TSOs_ BM15-TSO-DSO Collaborative Network Management

6.16 BM16- Urban Planning crowdsourcing marketplace

Business Model derived from the combination of BS14.

Business Model categorization→ 'Data-based delivery network business approach – Collaborative Opportunity. Delivery Network business model type

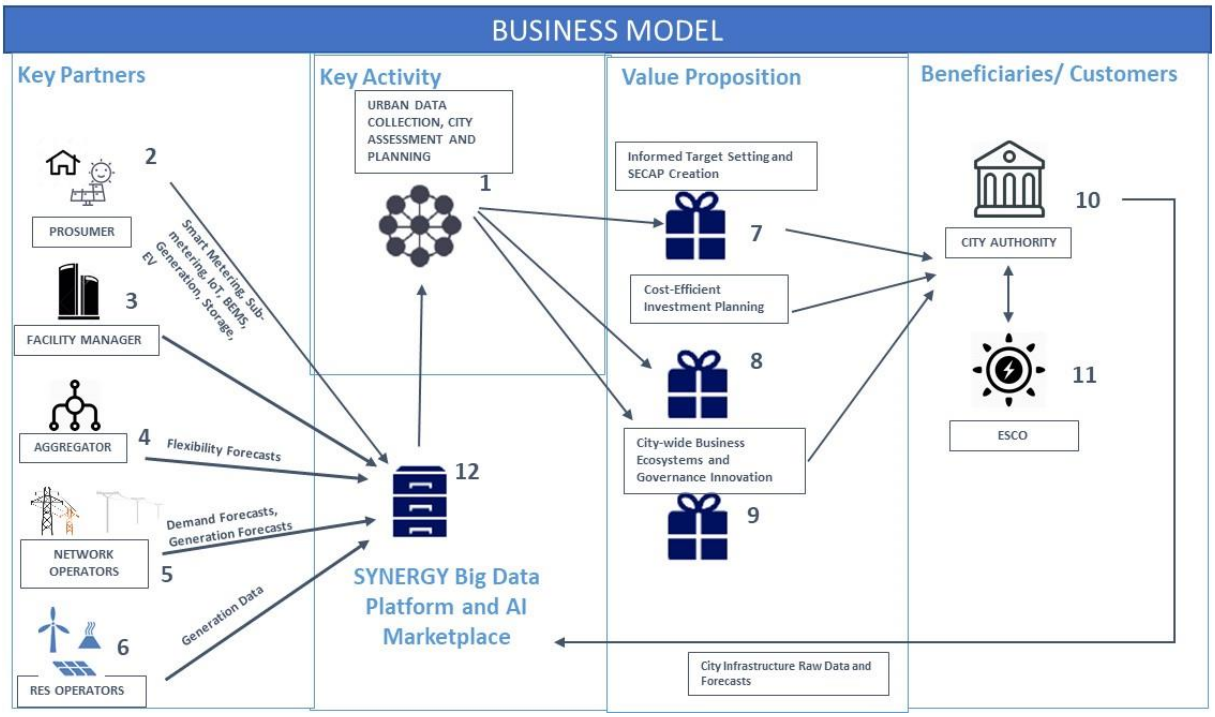

Figure 36. Business Model Description_BM16-Urban Planning Crowdsourcing Marketplace

BUSINESS MODEL BRIEF DESCRIPTION

Growing awareness on environmental sustainability, carbon emissions and a host of other factors is making city authorities realise the importance of building resource-efficient and people-centred cities, i.e. cities that can effectively address and satisfy their energy needs in an efficient manner while focusing on the convenience of their citizens, rather than on the infrastructure itself. In this context modern cities and local governments have been bound to very ambitious sustainability goals as part

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of their targets for transforming into smart cities and offering a liveable and sustainable environment to the people that live and move within their boundaries.

This Business Model aims at facilitating the realization of ambitious goals set by City Authorities by optimizing urban planning and transforming it into a crowdsourcing (collective data-driven) process where all city-relevant stakeholders are incentivized to provide their data for achieving important sustainability targets.

To this end, city authorities need to reach out to different stakeholders and the data they possess with regards to Smart metering data from buildings, properly combined with low-level sensing and IoT data from a wealth of data points in buildings and comprehensive BEMS information, Local generation data for city-wide sources, along with long-term forecasts of demand, generation and flexibility. Such data need to be combined with city-owned data (public buildings, transportation, urban infrastructure) to jointly facilitate the analysis of energy performance along individual buildings, whole districts and the city in total, identify outliers and weak points and design optimal energy strategies for the realization of short-term, mid-term and long-term objectives and commitments with regards to energy and environmental sustainability, in collaboration with Key Collaborators, i.e. ESCOs that hold the domain expertise on specific solutions that can address high-level energy performance targets. Increased data outreach and availability, enabled by advanced data sharing functions with all relevant stakeholders will enable the realization of advanced functionalities that complement Smart City platforms/services, such as informed decision support for optimized urban planning towards the fulfilment of the city's SECAP (Sustainable Energy and Climate Action Plan) goals.

RAW DATA/INSIGHTS:

The City Authority (Figure 37-10), being the main beneficiary of the BM acquires data assets (through the SYNERGY Platform and Analytics Marketplace/ Figure 37-12) from several stakeholders in the electricity value chain (city ecosystem). Data assets acquired are both raw data and analytics (long-term forecasts) such as:

- Smart Metering, Sub-metering, Generation, Storage, IoT Device data, Sensing and Occupancy data from Prosumers (Figure 37-2).
- Smart Metering, Sub-metering, BEMS, Generation, Storage, IoT Device data, Sensing and Occupancy data from Facility Managers (Figure 37-3).

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- Generation Metering (Figure 37-4).
- Long Term flexibility forecasts from Aggregators (Figure 37-4).
- Long-term demand and generation forecasts from Network Operators (Figure 37-5).

As Data Assets Owners, the City Authorities will also utilize data referring to public buildings, transportation, urban infrastructure, associated forecasts and formalized expansion/ asset penetration plans, that will facilitate on the one hand the monitoring and assessment of the current situation, the definition of weak points and outliers and the revelation of the main areas where action shall be taken and respective performance improvement targets with view to achieving the SECAP goals. The high-level targets will be in turn shared with ESCOs (Collaborators and Co-beneficiaries in the business model- Figure 37-11) towards proposing detailed actions to be implemented (stepping on data already purchased by the City Authority and providing significant discounts for project implementation considering the free sharing of data from the city to them but also the common governance model to be applied over the implemented projects in the form of EPCs). Such actions will be transparently assessed by City Authorities (in a competitive process) from an impact but also cost-efficiency perspective. Successful ESCOs will be selected for the implementation of their proposed actions (preferential prioritization and selection).

The business model encompasses both data value as a service and data intelligence as a service.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value proposition for the main beneficiaries (City Authorities and ESCOs) involved in its realization.

VALUE PROPOSITION

The Business application (Figure 37-1) that will facilitate the realization of this business model (complemented by the SYNERGY Big Data Platform and Analytics Marketplace that will act as the crowdsourcing means described in this BM) aims at providing the urban planning capabilities of city authorities on the basis of informed decision-making and promote strong collaborations and new governance models between cities and ESCOs that step on evidence-based action planning (through data sharing) and “win-win” implementation of projects. In business terms, this BM will deliver the following value to City authorities (Main beneficiary):

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1. Informed Evaluation and Action Planning for the realization of ambitious targets set in the SECAP of cities (Figure 37-7).
2. Cost-efficient investment planning through transparent procedures that promote and rewards best value for money projects (Figure 37-8).
3. Promotion of innovative governance models in the city context by teaming up with ESCOs for action planning and implementation and promoting long-term Energy Performance Contracting Schemes that are characterized by high risk aversity (Figure 37-9).

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS

DATA PERSPECTIVE

- Data Asset provider/ Asset Owner: Prosumers, Building/ Facility Managers, RES Operator Network Operators, Aggregators, City Authorities.
- Data Asset consumers: City Authorities (and indirectly ESCOs).

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representative from City Authorities and Key Partners (responsible for signing data sharing contracts).
- Technical Users: From City Authorities and Key Partners.
- Data scientist/Data Analytics: City Authorities, ESCOs.
- Business User: City Authorities, ESCOs.

VALUE REALIZED

- Data Assets are sold to the City Authority (Beneficiary) from Key Partners- Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream (in the form of tax reliefs) is generated for Key Partners by offering subscription services to their Data and Analytics Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.

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- SYNERGY Platform and AI Analytics Marketplace: Commissions for data transactions. Service fees for data quality enhancement. Service fees for hosting data. Service fees for Analytics Execution (City Authorities- Long Term forecasting, Energy Performance Analytics).
- City Authority/ Main Beneficiary: Realization of sustainability goals. Significant improvement in allocation of investments. Promotion of EPC and related governance models with ESCOs and increase of cost efficiency. Increased public transparency and open governance. Enhancement of economic activities, new jobs creation and GDP growth with new urban re-creation activities. Liveable cities and improved air quality. Sustainability enhancement and societal welfare.
- ESCOs/ Co-beneficiary: Long-term contractual relations with city authorities and associated revenue streams from energy performance improvement project in public infrastructures. Increased visibility and opportunity for new project with private stakeholders. EPC optimization and increased profitability with improved payback periods.

VALUE CAPTURE AND MONETIZATION

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement (all covered by the City Authority) and Data Analytics to facilitate decision-making for urban planning in an evidence-based manner.

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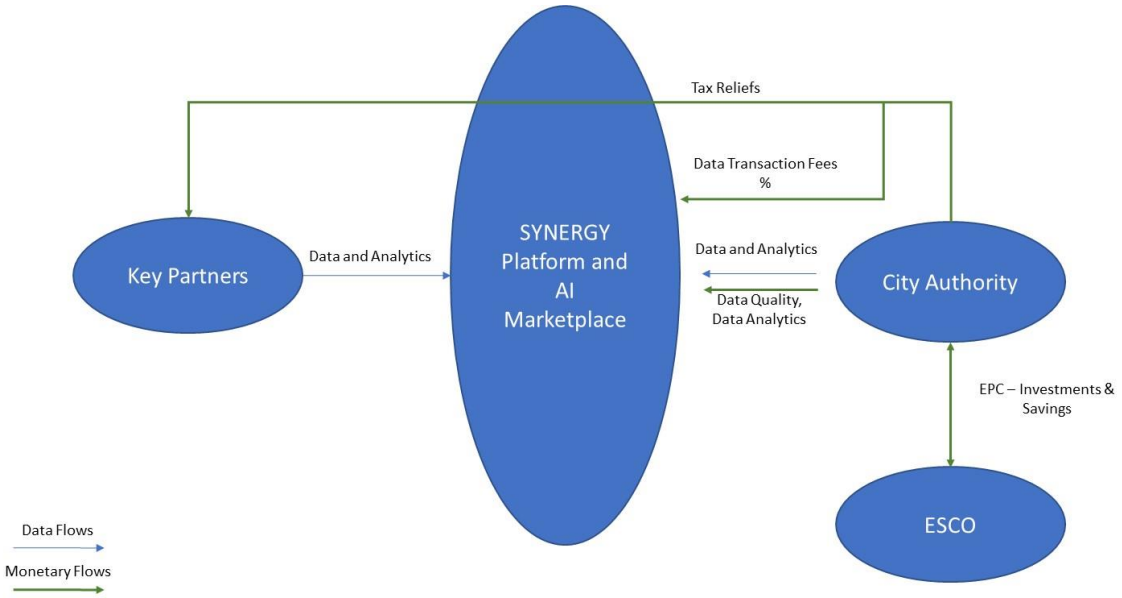

Figure 37. Money Flow Diagram BM16- Urban Planning crowdsourcing marketplace

ANALYSIS OF THE VALUE PROPOSITION

CITY AUTHORITIES

Revenue Streams:

- Savings from better investment planning.
- Increased energy cost savings (after the EPC period).

Cost Items:

- Costs for acquiring data from Key Partners (reduction of city tax revenues).
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.

The aforementioned metric will be linked to specific individual KPIS delivered as part of WP8 activities to enable the quantification of the monetary value of each individual revenue stream/cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS CITY AUTHORITY

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Key Partners
- Prosumers.
- Facility Managers.
- RES Operators.
- DSOs/TSOs.
- Aggregators.

Key Activities
- Urban Energy Performance Monitoring and Assessment.
- Urban planning for SECAP Realization.

Value Propositions
- Informed Evaluation and Action Planning for the realization of ambitious targets set in the SECAP of cities.
- Cost-efficient investment planning through transparent procedures that promote and reward best value for money projects.
- Promotion of innovative governance models in the city context by teaming up with ESCOs for action planning and implementation and promoting long-term Energy Performance Contracting Schemes that are characterized by high risk aversity.

Relationships with other partners /channel
- SYNERGY Big Data Platform and AI Analytics Marketplace.
- ESCOs.

Customer and Communication.
- City authorities/ Main Beneficiary: Realization of sustainability goals. Significant improvement in allocation of investments. Promotion of EPC and related governance models with ESCOs and increase of cost efficiency. Increased publics transparency and open governance. Enhancement of economic activities, new jobs creation and GDP growth with new urban re-creation activities. Liveable cities and improved air quality. Sustainability enhancement and societal welfare.
- ESCOs/Co-beneficiary: Long-term contractual relations with city authorities and associated revenue streams from energy performance improvement project in public infrastructures. Increased visibility and opportunity for new projects with private stakeholders. EPC optimization and increased profitability with improved payback periods.
- Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain.

Cost Structure
- Costs for acquiring data from Key Partners (reduction of city tax revenues).
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancement.
- Service fees for Analytics Execution.
-

Revenue Model
- Savings from better investment planning.
- Increased energy cost savings I(after the EPC Period).

Societal and Environmental Costs
- None.

Societal and Environmental Benefits
- Lower CO2 footprint
- Promoting digitized economy. Evolve the digital skills and capabilities of electricity market stakeholders.
- Increased public transparency and open governance.
- Enhancement of economic activities, new jobs creation and GDP growth with new urban re-creation activities.
- Liveable cities and improved air quality.
- Sustainability enhancement and societal welfare.

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Table 22. CANVAS CITY AUTHORITIES_ BM16-Urban Planning Crowdsourcing Marketplace

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6.17 BM17- Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)

Business Model derived from the combination of BS2, BS14, BS7, BS8.

Business Model categorization→ 'Data-based delivery network business approach – Collaborative Opportunity, Value Chain Integrator business model type

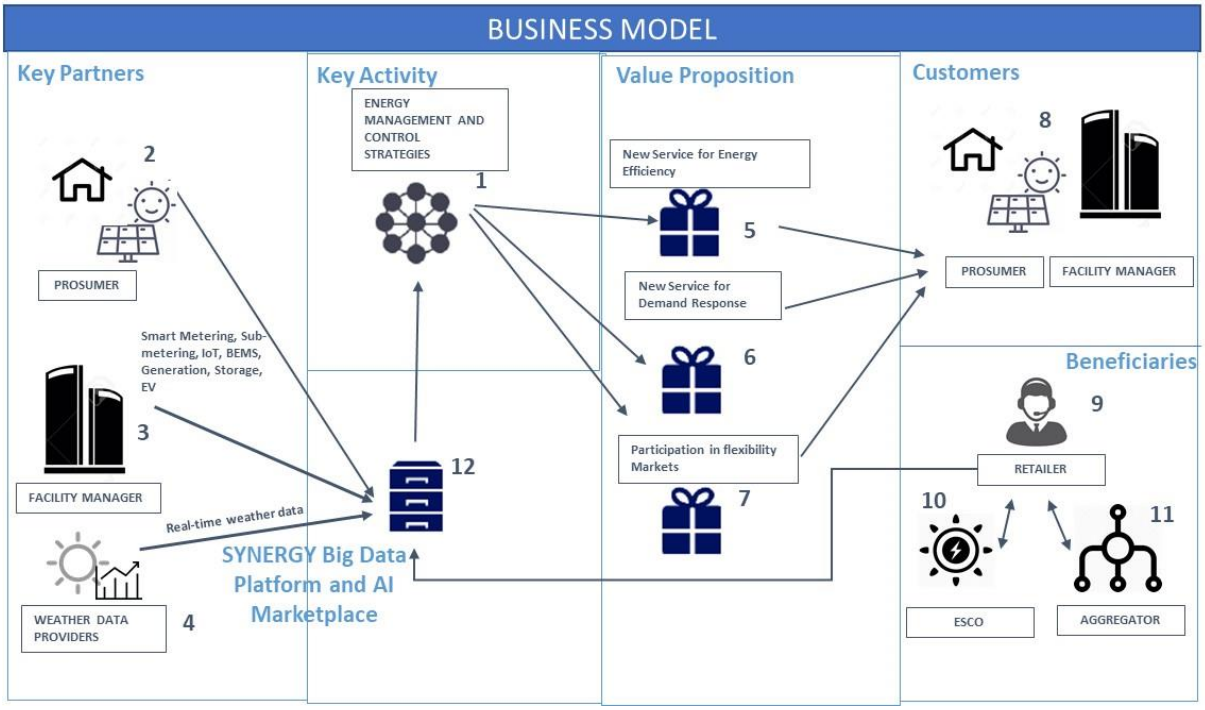

Figure 38. Business Model Description_BM17-Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)

BRIEF DESCRIPTION:

Electricity retailers are currently faced with a new business reality where traditional business and revenue models based on the increase in energy sales (at the lowest cost) run counter to society's drive towards energy efficiency. The global trend towards greenhouse gas emissions elimination endangers current energy generation and supply models and threaten utilities bottomline. To sustain growth, improve competitiveness and drive business value, the industry must transform and take advantage of business opportunities that arise from a low-carbon energy system. Such business opportunities require a major shift away from the traditional commodity sales business model and adoption of a more profitable business orientation that is based on EaaS (Energy as a Service) offering towards their clients, spanning advanced and personalized energy analytics for energy efficiency, flexibility trading, but also service for intelligent controls and (where possible) smart automation of consumer amenities.

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To realize this new business environment and service framework, retailers require access to a wealth of data coming from the prosumers' side, to analyse them in detail, extract the required intelligence in terms of flexibility and team up (share analytics) with ESCOs and Aggregators, so that they can step on it and jointly provide added value services for energy efficiency and flexibility provision, having in mind that the new service reality will allow them to get involved into flexibility trading functions and ancillary services provision.

RAW DATA and INSIGHTS:

The Retailer (Figure 38-9), being the main beneficiary of the BM, acquires data assets (through the SYNERGY Platform and Analytics Marketplace/ Figure 38-11) from several stakeholders in the electricity value chain and other external sources. Data assets acquired are mainly raw data from building such as:

1. Smart Metering, Sub-metering, IoT Device data, Sensing and Occupancy data, together with Storage, Generation data from Prosumers (Figure 38-2).
2. Smart Metering, Sub-Metering, BEMS, IoT Device data, Sensing and Occupancy data, together with Storage, Generation data from Facility Managers (Figure 38-3).
3. Other data from Weather Data Providers (Figure 38-3).

As Data Owners, the Retailers will also utilize data referring to:

1. Established contracts with their clients to ensure that specific service bundles are eligible to be delivered to them.

The business model encompasses both data value and data intelligence as a service for all involved beneficiaries and partners.

In order to evaluate whether this business model might lead to a viable business case, in the following paragraphs we analyse the value preposition for the main beneficiary (Retailer) involved in its realization.

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VALUE PROPOSITION:

The business application (Figure 38-1) that will facilitate the realization of this business model aims at enabling the accurate profiling of building occupants' comfort preferences and occupancy schedules, subsequently analysing, profiling and forecasting the flexibility of their individual assets properly introducing them into added value innovative services for energy efficiency and flexibility provision with the support and collaboration of ESCOs and Aggregators. The output of the services will be provided in the form of appropriate control strategies (either through remote controls or automation) for the realization of significant energy savings and opening the way for small buildings to get introduced in flexibility transactions. In business terms, this BM will deliver the following value to Retailers.

RETAILERS

- Provision of human-centric energy management services that enable energy savings without compromising comfort and well-being of occupants, in collaboration with ESCOs holding the energy management expertise (Figure 38-5).
- New service offering, for flexibility provision and demand response, in collaboration with Aggregators (Figure 38-6).
- Enabling the involvement of Retailers in flexibility transactions by teaming up with aggregators and facilitating the introduction of excess flexibility of customers into flexibility markets (Figure 38-7).

Aggregators and ESCOs (Figure 38- 10 and 11) as co-beneficiaries in this specific BM, will obtain the opportunity to gain access to new customers and flexibility sources and in this way enhance their clientele and profitability through the provision of properly tailored bundles of EE and DR services to small buildings and facilities.

SYNERGY ENERGY DATA VALUE NETWORK ROLES AND ACTORS:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

DATA PERSPECTIVE

- Data Asset provider/ Asset Owner: Prosumers, Facility Managers, Weather Data Providers, Retailers.
- Data Asset consumers: Retailers, ESCOs, Aggregators.

PLATFORM PERSPECTIVE

- Platform (all roles): SYNERGY Big Data Platform and AI Analytics Marketplace.

ORGANIZATION PERSPECTIVE

- Manager: Legal Representatives from Retailer and Key Partners (Responsible for signing data sharing contracts).
- Technical Users: From Retailers and Key Partners.
- Data scientist/Data Analytics: Retailers, ESCOs, Aggregators.
- Business User: Retailers, ESCOs, Aggregators.

VALUE REALIZED:

- Data Assets are sold to the Retailers (Beneficiary) from Key Partners- Actual data uploaded to the Platform by the variety of Key Partners. A predictable revenue stream is signed for Key Partners by offering subscription services to their Data Assets (through the SYNERGY Platform and AI Analytics Marketplace) to the Beneficiary.
- Retailer/ Beneficiary: Provision of novel energy service bundles for EE and DR associated revenues. Transformation from commodity provider to energy service provider and enhancement of corporate viability. Effective hedging against imbalances and reduction of respective charges through improved demand forecasting and mobilization of Energy Management Services. Optimization of energy trading/power exchange functions through improved demand forecasting and avoidance of purchasing additional electricity volumes in highly expensive spot markets. Compliance with Energy Efficiency Obligations imposed at EU and national level, thus avoiding unnecessary penalties.

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- ESCOs/Co-Beneficiary: Access to highly populated clienteles and increase of revenues and profitability by offering their know-how and expertise in the provision of added value services for EE.
- Aggregators/ Co-Beneficiary: Access to new customers and increased flexibility volumes and respective revenues by introducing their flexibility capacity in markets.
- Prosumers and Facility Managers/Customers (Figure 38-8): Significant Energy Cost Savings Reduced Network Charges. More comfortable and liveable buildings. Revenues from flexibility trading.

VALUE CAPTURE AND MONETIZATION:

The monetary flows are mainly characterised by subscription quotas for accessing the information made available to the SYNERGY Platform and AI Analytics Marketplace by the Key Partners. Additional fees include subscription to services for Data Quality enhancement and Data Analytics over the data available. The business model also involves data transaction fees for the provision of flexibility analytics to Aggregators and ESCOs (based on Key Partners' Data) paid by the Main Beneficiary to each Key Partner in the frame of re-using already acquired data for the purpose of selling analytics to other stakeholders. Service fees by customers, are also involved in the revenue (monetary) flows towards the beneficiary for Energy Management Optimization Services (a commission out of these revenue is allocated to ESCOs for the expertise they offer), while flexibility remuneration is also introduced for the direct/indirect participation of beneficiaries and customers in the respective flexibility trading markets and Demand Response (DR) programmes.

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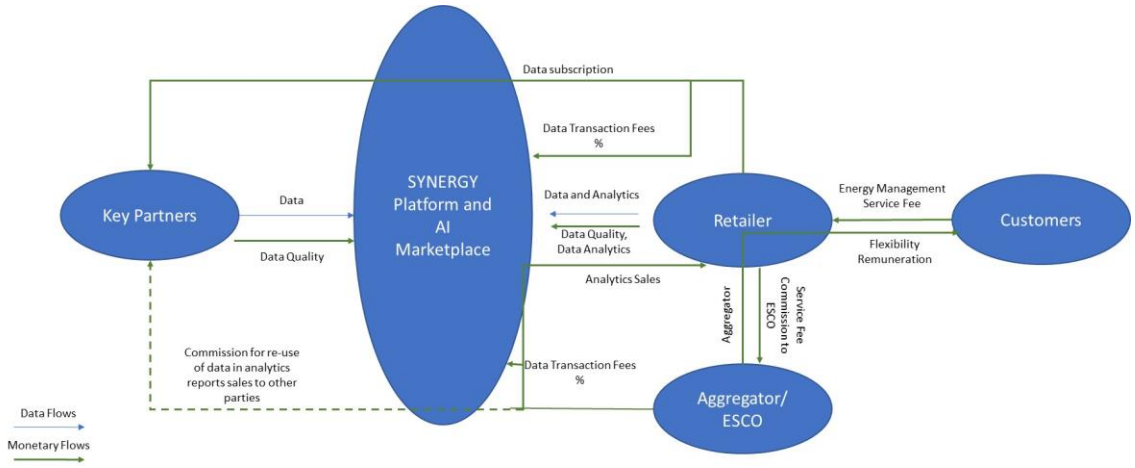

Figure 39. Money Flow Diagram BM17- Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)

ANALYSIS OF THE VALUE PROPOSITION:

RETAILERS

Revenues Streams:

- Service fees for energy management optimization and self-consumption maximization.
- Revenues from analytics sales to Aggregators and ESCOs.
- Portion of flexibility remuneration from Aggregator for offering access to their customers and using equipment that has been incentivized by retailers.

Costs Items:

- Costs for acquiring data from Key Partners.
- Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace.
- Service fees for data quality enhancements.
- Service fees for Analytics Execution.
- Fees (commission of revenues from Energy Management Services) for expertise acquisition to ESCOs.

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- Investment for equipment installation in the form of subsidies for facilitating innovative energy service concepts.

The aforementioned metrics will be linked to specific individual KPIs delivered as part of WP8 activities, to enable the quantification of the monetary value of each individual revenue stream/cost item during the evaluation of the defined business model in T10.2 (utilizing data from the demonstration activities of the project).

CANVAS RETAILERS

Key Partners • Prosumer. • Facility Managers. • Weather Data Providers.
Key Activities • Real-time energy management optimization. • Demand Response schedule definition and flexibility market offerings.
Value Propositions • New service and revenues for real-time energy management optimization. • Human-centric service offering as a social benefit to customers. • Revenues from opening the way to their customers to flexibility markets and involving flexibility transactions in energy management optimization objectives. (sales of flexibility analytics). • Evolution to a more digitized company. • Enhancement viability through transforming from commodity provider to energy service provider. • Effective hedging against imbalances and reduction of respective charges. • Optimization of energy trading/power exchange functions through improved demand forecasting and avoidance of purchasing additional electricity volumes in highly expensive spot markets. • Compliance with Energy Efficiency Obligations imposed at EU and national level, thus avoiding unnecessary penalties.
Relationships with another partners /channel • SYNERGY Platform and AI Analytics Marketplace. • Aggregators for the provision of Demand Response Services- Access to new clients, Flexibility remuneration from Network Operators. • ESCOs for the acquisition of added value expertise for energy management optimization and self-consumption.
Customer and Communication. • Aggregator/Co-beneficiary: Access to new customers and increased flexibility volumes and respective revenues by introducing their flexibility capacity in markets. • ESCO/ Co-beneficiary: Access to highly populated clienteles and increase of revenues and profitability by offering their know-how and expertise in the provision of added value services of EE. • Prosumers/ Customer: Reduced energy costs. More comfortable built environments. Revenues from flexibility transactions. • Communication with the SYNERGY Platform and AI Analytics Marketplace 365/24/7 via Helpdesk (Role under the Organization Perspective in the Data Value Chain).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Cost Structure • Costs for acquiring data from Key Partners. • Fees for data transactions through the SYNERGY Big Data Platform and Analytics Marketplace. • Service fees for data quality enhancement. • Service fees for Analytics Execution. • Fees (commission of revenues from Energy Management Services) for expertise acquisition to ESCOs. • Possible Investments for equipment installation in the form of subsidies for facilitating innovative energy service concepts. •	**Revenue Model** • Service fees for energy management optimization and self-consumption maximization. • Revenues from analytics sales to Aggregators and ESCOs. • Portion of flexibility remuneration from Aggregator for offering access to their customers and using equipment that has been incentivized by retailers.
Societal and Environmental Costs • None.	**Societal and Environmental Benefits** • Lower CO2 footprint and Energy Efficiency. • A more liveable environment for building occupants. • Transparent Participation and Active Role in Energy Markets.

Table 23. CANVAS RETAILERS as an ESCO_ BM17- Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)

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7 Business models and services in SYNERGY pilot sites

Future work will consist in the validation of the innovative business models in the large-scale demonstration pilot sites, located in Spain, Greece, Austria, Finland and Croatia involving diverse actors and data sources, heterogeneous energy systems/assets, areas characterized by varied energy densities (from cities to small communities), varied voltage levels (HV, MV, LV) and network conditions (including local energy systems with weak grid connection and geographic islands) and spanning different climatic, demographic and cultural characteristics.

	Greece	Spain	Austria	Finland	Croatia
TSO	IPTO		GUS		
DSO	HEDNO	CUE			
Electricity Retailer	EPA	CUE	ENES		
RES Operator		COBRA	EEE		
Aggregator		URB			
ESCO	VERD				KRK
Facility/Building Manager				CAV	KRK
City Management/Strategies				FVH	

Table 24. List of partners and their market roles in SYNERGY demonstrators

All pilot sites are characterized by enhanced data exchanges, real-time data flows and management of big data volumes and velocities to realize significant impact achievements. The table below represents a high-level image from the DoA, but a detailed data analysis has been performed in the deliverable D2.5 ‘’.

Data Type	Partner Contributing	Format	Volume	Variety	Velocity	Veracity
Primary Energy Data – Buildings/ Consumers (BEMS, Sensors, IoT Devices)	VERD, FVH, CAV, GUS, ENES	Structured Unstructured Sensory	✓	✓	✓	✓

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Data Type	Partner Contributing	Format	Volume	Variety	Velocity	Veracity
Primary Energy Data - Smart Metering	HEDNO, VERD, GUS, ENES, CUE, FVH, KRK	Structured Unstructured	✓	✓	✓	✓
Primary Energy Data - Power Grid (RTU, SCADA, Imagery, GIS)	HEDNO, IPTO, GUS, ENES, CUE	Structured Unstructured Sensory	✓	✓	✓	✓
Primary Energy Data - Renewable Generation	HEDNO, IPTO, GUS, ENES, CUE, COBRA, VERD, FVH, CAV, KRK	Structured Unstructured Sensory	✓	✓	✓	✓
Primary Energy Data - Other DER (Storage, EVs)	VERD, GUS, EEE, CUE, FVH, KRK	Structured Unstructured Sensory	✓	✓	✓	✓
Extra Energy Data (weather, market, ambience, environment, material, contracts, transportation)	HEDNO, COBRA, EPA, VERD, GUS, ENES, CUE, COBRA, FVH, KRK	Structured Unstructured Sensory	✓	✓	✓	✓

Table 25. Data types to be exchanged and partners delivering this data

The **Spanish pilot site** involves key market roles in demonstration activities. According to electricity markets they are specifically RES operators, aggregators, retailers and DSOs. Furthermore, the following demo cases will be addressed: (i) Enhanced PV Plant Asset Management; (ii) Advanced RES Forecasting for improved market positioning and optimized flexibility activation for the provision of services to network operators; (iii) Optimising Power Purchase Agreement between RES Operators and Electricity Retailers towards greening electricity supply and reducing associated tariffs and costs; (iv) Transformation of the Retailer business model from commodity to EaaS providers for the implementation of energy efficiency campaigns; (v) Enhanced Distribution Network Asset Management and Reinforcement; (vi) Innovative Flexibility-based Distribution Network Management.

The **Greek pilot site** involves a group of involves key market roles in demonstration activities. According to electricity markets they are specifically TSOs, DSOs, retailers and ESCOs. Furthermore, the following demo cases will be addressed: (i) Innovative Flexibility-based Network Management; (ii) Common Operational Scheduling of power grids (D&T) for TSOs and DSOs; (iii) Enhanced Network

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Asset Management and Planning; (iv) Retailer portfolio and elasticity (price-based flexibility estimation for the provision of services to network operators; (v) Flexibility segmentation, classification and clustering towards VPP configuration for demand response; (vi) Local Flexibility Sharing for Self-Consumption Optimization at Local Community Level.

The **Austrian pilot site** involves a group of key market roles in demonstration activities. According to electricity markets they are specifically TSOs, retailers and RES operators. Furthermore, the following demo cases will be addressed: (i) Innovative Flexibility-based Distribution Network Management; (ii) Local Energy System Optimization and Enhancement of Security of Supply through Islanding; (iii) Flexibility segmentation, classification and clustering towards VPP configuration for flexibility activation and explicit demand response; (iv) Local Flexibility Market for network services and self-consumption through blockchain-enabled smart contract establishment and handling.

The **Finnish pilot site** involves a group of key market roles in demonstration activities. According to electricity markets they are specifically facility/building managers and city managers. Furthermore, the following demo cases will be addressed: (i) Optimized Urban Energy Performance Monitoring and Optimization; (ii) Advanced Urban Planning for long-term sustainability targets realization; (iii) Evidence-based renovation support for optimized and accurate energy-efficient design of buildings; (iv) Holistic real-time Facility Energy Management Optimization.

The **Croatian pilot site** involves a group of key market roles in demonstration activities. According to electricity markets they are specifically ESCOs and Facility/Building managers. Furthermore, the following demo cases will be addressed: (i) Self-Consumption Optimization for Energy Poverty Alleviation and Sustainable Local Energy Communities.

Taking into account the characteristics of each pilot site and the definition of business models as presented above, we proceed with the prioritization of business models at the different pilot sites.

The active enrolment of the business stakeholders from the very beginning of the project (through the living labs establishment as roughly described in D9.1 and will be extensively presented in D9.2) enable us to primarily select the list of business models to be examined in the project and, secondarily to allocate the business models to the different pilot sites. To achieve this goal a live survey/ live poll was performed in the Plenary Meeting that was held 23rd October 2020, in online format. The survey aimed at getting feedback from the pilot business stakeholders to know their opinion about the business models defined in the project. The results of the survey together with the high-level methodology for business stakeholders' engagement in Living Lab are available in Annex B.

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ANALYSIS OF THE RESULTS EXTRACTED FROM THE VALIDATION POLL TO BUSINESS STAKEHOLDERS ABOUT BUSINESS MODELS

The Figure 40 shows the aggregated result for each pilot site. As can be seen in the survey template that is accessible in the Annex B, each partner scored the business models according to their main business activity. For the evaluation of each business model by pilot site, the average score obtained from the results of the poll and the individual scores of each partner has been calculated, weighing each individual score according to whether the business model falls directly on its market role, if within the business model the partner's market role is indirect or lastly if the partner's role is not directly related to the business model. The weighting factors applied to the scores according to the above criteria are 1, 0.5 and 0.1 respectively.

		GREECE	SPAIN	AUSTRIA	FINLAND	CROATIA
ID	Business Models					
1	Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning	X	X	X		
2	Data value as a service for Advanced Asset Mgt	X	X	X	X	X
3	Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants	X	X	X	X	
4	Dynamic Enhancement Energy Performance Certificates				X	X
5	Synergetic Energy Peformance Contracting (design)				X	X
6	Synergetic Energy Performance Optimization (self-consumption)	X	X	X	X	X
7	Intelligence-Driven long-term Generation Planning and PPAs Advisory	X	X	X		
8	RES Power Plant Optimizer for GPPA maximization	X	X	X		
9	Transparent GPPA marketplace	X	X	X		
10	RES Virtual Power Plant (VPP)	X	X	X	X	
11	Objective Dynamic Pricing of Electricity	X	X	X	X	
12	Retailers as Non-Energy Service Providers	X		X		
13	Flexibility and portfolio analytics (sales of raw data)	X	X	X		
14	Flexibility VPP configuration for ancillary services	X	X	X	X	X
15	TSO-DSO Collaborative Network Management	X	X	X		
16	Urban Planning crowdsourcing marketplace				X	X
17	Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)	X	X	X	X	X

Figure 40. Elicitation of Business Models per pilot site

Figure 40 summarizes which business model will be tested in each of the pilot sites and is followed by a description of the reasons that led to this allocation.

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Some remarks about the elicitation of business models and allocation to the different pilot sites are provided:

1) Energy audits and EPC certification are anchor points of European legislation. Towards this direction "Synergetic Energy Performance Contracting (design)" and "Synergetic Energy Performance Optimization (self-consumption)" are business models of interest for pilot sites focused on ESCO and facility management activities.

2) The ESCO oriented business model named 'EPCs, Data and Intelligence provision for certification' is focused on novel and innovative ways of consulting services and on the performance of project studies by taking advantage of the benefits derived from the exchange of data and knowledge in energy efficiency and renovation areas/themes. Towards these direction end users from countries with more advanced regulatory frameworks and digitized economies present the highest willingness to implement it.

3) "Data Value as a Service for Advanced Asset Management" business model is going to be tested in all pilot sites. All partners are interested in the predictive and advanced maintenance tasks.

4) In all pilot sites will be tested business models targeting to exploit and put in value the potential capability of flexibility capacity. Network operators will optimize cross-collaboration and will coordinate activities and plans, defining a common planning that uses the most all the flexibility capacity coming from demand. Retailers will study the flexibility profiles of their customer base, the customer's elasticity level on prices and their adherence to DR programs to design new tariffs, dynamic prices and to decrease the probability of supply-demand imbalances; thus enjoying better management of imbalances.

5) VPPs related business models are of great interest for all pilot sites and its members whatever their business role. The VPP business model focused on the provision of ancillary services will be tested in all pilot sites; that's why it is of great interest to demonstrate the benefits derived from the small consumers. The other VPP business model will be tested in pilot sites to take the most advantage on aggregation activities and renewable generation.

6) GPPAs related business models will be tested in all pilot sites with an exception in the Croatian pilot site where there is no retailers nor RES generators involved. As in other cases and by following the current market trends in decarbonizing energy, greening the power supply activities and promoting RES generation, this business models will promote a twofold

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objective. Firstly, pushing forward the investment rate in renewable generation capacity and secondarily, favouring lower energy prices and more cost-effectiveness in the electricity systems that all together have a direct impact on the most disadvantaged consumers at a risk of energy poverty.

7) TSO-DSO collaboration is of great interest and will be test in all pilot sites with network operators. Not only for taking most of the flexibility capacity in their respective control areas but also developing a collaborative network operation favouring the local electricity markets, collaboratively solve grid congestion management issues and effectively manage an ever increasing DER share in distribution grids.

8) EaaS business model (retailers) will be demonstrated in all pilot sites. Demonstrating the trend today in businesses in the energy landscape to offer a service-dominant business offer/commercial offer.

We must point out that as we are at the very beginning of the project, slight modifications may apply in order to optimally address SYNERGY project business objectives. Therefore, this is considered as a living document to set the foundations for the development, demonstration and evaluation of the holistic framework.

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8 Conclusions and next steps

In this deliverable we performed an initial assessment of the economic viability of candidate business models for the main SYNERGY actors, namely ESCOs, Facility/Building Managers, City Managers, ESCOs, Aggregators, Retailers, DSOs, TSOs, RES operators and prosumers. This analysis can be considered as the first step towards identifying the major socio-economic factors that will determine the adoption of SYNERGY products by providers, as well as, consumers' engagement in Demand-Response strategies.

In order to accomplish this, we describe a generic value network for electricity markets taking into account the distinction between roles and actors. Then, we defined business scenarios (BSs) for these actors that involves several SYNERGY products and provides value to at least one actor. We analysed these BSs in order to detail the key actors and products involved and then prepared candidate value networks for presenting the main interactions between the roles in a comprehensive way, highlighting the exchanged information, information flows and money flows between these roles.

While these value networks are essential means for getting knowledge under an industrial services point of view of what strategy is set for achieving the business model goals, we have enriched the analysis by providing means to assess the attractiveness of each scenario to each actor involved. For this purpose, and in line with the established methodology, we utilized both the BMC (Business Model Canvas) methodology together with the SDBM (Service Defined Business Model) methodology so that beyond cost and revenue streams, other aspects were considered (sustainability, innovation, social costs, financial benefits, and non-financial benefits) as well. In that way, the main value proposition and the value-in-use, infrastructure used, customers and finances for each business case and for each one main SYNERGY actor can be easily documented, which allows decision makers to quickly understand the business case. In particular, the above business model analysis will allow us to develop a business plan for each actor by taking also into account the key differences among the pilot sites.

Quantification of the financial aspects, namely the costs and revenues for each actor's business model is a pending question to be addressed in the mid-term. The exercise will be made per single location and geographical area, and after that an estimate of 'correction factors' will be agreed for calculating the costs and revenues for each specific pair business case- actor for the rest of pilot sites. The goal is to getting knowledge about the business case attractiveness for replication in different geographical areas.

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ANNEXES

I. ANNEX A- Initial List of Datasets to be used in the SYNERGY platform and demonstrators

the following list contains an indicative preliminary set of identified datasets that are considered for use in the SYNERGY project. This list contains both open and proprietary datasets (of partners and third parties). During WP2 of the project, this list will be revised and significantly extended, as all stakeholders will explicitly identify their datasets and their licenses, and the consortium, based on the use case requirements, the licenses and the data quality requirements will select the ones that will be used in the demonstrators.

Dataset	Open/ Proprietary	Volume	Velocity	Relevance for Demonstrators				
				EL	ES	AT	FI	HR
Smart Metering Data	Proprietary	Data from 71,500 smart meters/ **1.2 TB per month**	From 5 sec to 15 min	✓	✓	✓	✓	✓
Distribution Grid Sub-station RTU data	Proprietary	Data from 224 RTUs in Distribution Substations / **2.1 TB per month**	1-5 sec	✓	✓	✓	✓	✓
GIS DB data - MV lines drawings and distribution network equipment status	Proprietary	**330 GB**	Static	✓				
Smart Grid / Substation Monitoring Equipment - Events and alerts in distribution grid substation equipment	Proprietary	Data from end-points in sub-stations and imagery data/ **>1 GB per month**	Event-based	✓	✓	✓		
IR and portable cameras for network inspection (including cameras attached in drones)	Proprietary			✓				
Detailed Meteorological Data and Forecasts	On request	**>15 TB/ per month**	daily	✓	✓	✓	✓	✓
Transmission Grid Sub-station RTU data	Proprietary	Data from circa 300 RTUs in Transmission Grid Substations / **1.5 TB per month**	5 sec	✓				
Data from RES plants connected to transmission grid substations	Proprietary	**>100GB per month**	5 sec	✓	✓			
Historical Smart Meter Data and Electricity	Proprietary	Historical for over 85,000	Static	✓	✓	✓		

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Retailer Customer Information		electricity consumers / **50 GB**						
RES Meter, SCADA and Inverter Data (including imagery IR data)	Proprietary	**>1 TB per month**	1 sec	✓	✓	✓	✓	✓
BEMS Data	Proprietary	From 50 large commercial and public buildings/ > **100 GB per month**	15 sec				✓	
IoT Sensing Data from Buildings (Temperature, Humidity, CO2, Luminance, VOC, Sub-metering, Smart Devices)	Proprietary	From over 20,000 end-points in the buildings involved/ **200 GB per month**	1 sec	✓		✓	✓	
EV and Battery Data	Proprietary	From circa 75 charging stations and 2 large batteries/ **5 GB per month**	5 sec to 1 min		✓	✓		✓
European Transmission Grid Data https://transparency.entsoe.eu/dashboard/show	Open	**35 GB**	Static	✓	✓			
Additional Weather forecasts and historical data https://openweathermap.org/	Open	**30 GB per month**	1 sec	✓	✓	✓	✓	✓
European Distribution Grid Data https://data.enedis.fr/explore/?sort=modified https://opendata.edp.com/explore/?refine.keyword=visible&sort=modified https://lokaal-bestuur.fluvius.be/nl/thema/nutsvoorzieningen/open-data	Open	**30 GB**	Static	✓	✓	✓		
Helsinki City Open Energy Data https://hri.fi/fi/ https://hri.fi/data/en_GB/dataset/helsingin-3d-kaupunkimalli	Open	depending on the demonstrator's specific requirements					✓	
Helsinki RES Generation data https://hri.fi/data/en_GB/dataset/auringon-sateilyenergian-maara-katoilla-paakaupunkiseudulla	Open	depending on the demonstrator's specific requirements					✓	

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Helsinki Air Quality Data https://hri.fi/data/en_GB/dataset/paakaupunkiseudun-ilmanlaatuindeksit	Open	depending on the demonstrator's specific requirements				✓	
Helsinki Transportation Data https://hri.fi/data/en_GB/dataset/hsl-n-joukkoliikenteen-pysakit https://hri.fi/data/en_GB/dataset/paakaupunkiseudun-liikennemeluvyohykkeet -	Open	depending on the demonstrator's specific requirements				✓	

II. ANNEX B – Results from the survey on business models

ID	Business Models	HEDNO	IPTO	EPA	VERD	COBRA	CUE	URB	GUS	EEE	ENES	FVH	CAV	KRK
1	Data exchange and COMMs framework for Advanced Electricity Grid Manageme	9	9	1	1	2	5	0	4	0	8	3	0	2
		9	9	1	1	3	7	1	8	3	8	4	0	8
							0					2	0	5
2	Data value as a service for Advanced Asset Mgt	9	7	1	1	7	7	2	7	0	2	9	8	8
		9	7	3	1	7	8	0	8	3	7	9	6	5
							0					8	6	10
3	Advanced Predictive Maintenance for RES Power Plants	7	2	1	2	8	3	3	1	6	2	7	0	9
		7	2	2	1	9	0	0	1	4	6	7	0	5
							0					8	0	9
4	EPCs, Data and Intelligence provision for certification	5	1	6	4	1	2	0	0	1	2	8	8	10
		5	1	6	1	0	0	3	1	2	7	8	7	10
							5					8	8	10
5	Synergetic Energy Peformance Contracting (design)	3	1	3	4	3	3	1	1	1	2	9	8	5
		3	1	2	1	2	0	0	1	1	5	9	5	10
							0					9	10	10
6	Synergetic Energy Performance Optimization (self-consumption)	3	1	9	6	6	8	3	5	8	2	9	2	3
		3	1	8	8	4	7	1	6	5	5	9	5	10
							8					9	2	7
7	PPAs history platform	7	6	7	5	6	3	4	1	5	1	3	0	7
		7	6	7	5	6	0	9	1	6	2	3	3	3
							7					3	2	5
8	RES Power Plant Optimizer for GPPA maximization	7	2	6	4	6	2	1	2	6	2	1	1	5
		6	2	6	2	7	0	1	1	4	7	2	2	2
							6					2	3	2
9	Transparent GPPA marketplace	6	6	9	8	7	3	9	1	6	4	4	0	5
		6	6	10	8	7	0	10	2	5	7	5	0	7
							6					5	0	5
10	RES VPP	8	2	6	9	5	7	8	5	7	2	3	8	3
		8	2	5	9	6	7	7	7	9	7	3	3	8
							6					3	8	2
11	Objective Dynamic Pricing of Electricity	6	3	10	3	9	7	7	4	5	8	8	0	0
		6	3	10	6	8	6	10	5	3	8	8	0	6
							9					8	0	3
12	Retailers as Non-Energy Service Providers	1	1	9	1	1	6	2	1	2	2	6	7	1
		1	1	8	2	0	0	0	2	4	6	8	8	5
							6					4	5	5
13	Flexibility and portfolio analytics (sales of raw data)	5	1	9	5	6	8	8	4	5	5	2	2	2
		5	1	9	10	6	8	9	5	8	8	6	5	6
							8					4	5	6
14	Flexibility VPP configuration for ancillary services	8	2	6	6	6	8	9	5	5	2	2	4	2
		9	2	6	10	6	8	8	7	8	7	7	5	8
							0					6	5	6
15	TSO-DSO collaboration	9	10	2	6	4	6	6	4	0	1	2	2	0
		9	10	2	6	5	6	5	7	1	2	2	2	1
							0					2	4	2
16	Urban Planning crowdsourcing marketplace	1	2	1	2	0	6	0	0	2	2	7	5	10
		1	2	1	2	0	0	2	0	8	8	8	2	7
							0					6	5	8
17	EaaS business model (retailers + ESCOs)	1	1	9	1	1	0	1	1	2	4	6	8	3
		1	1	9	2	1	0	0	0	4	8	6	5	10
							9					6	8	6

SCORES PER CATEGORY/PUNCTUATION: Punctuation goes from 0 to 10 scale.

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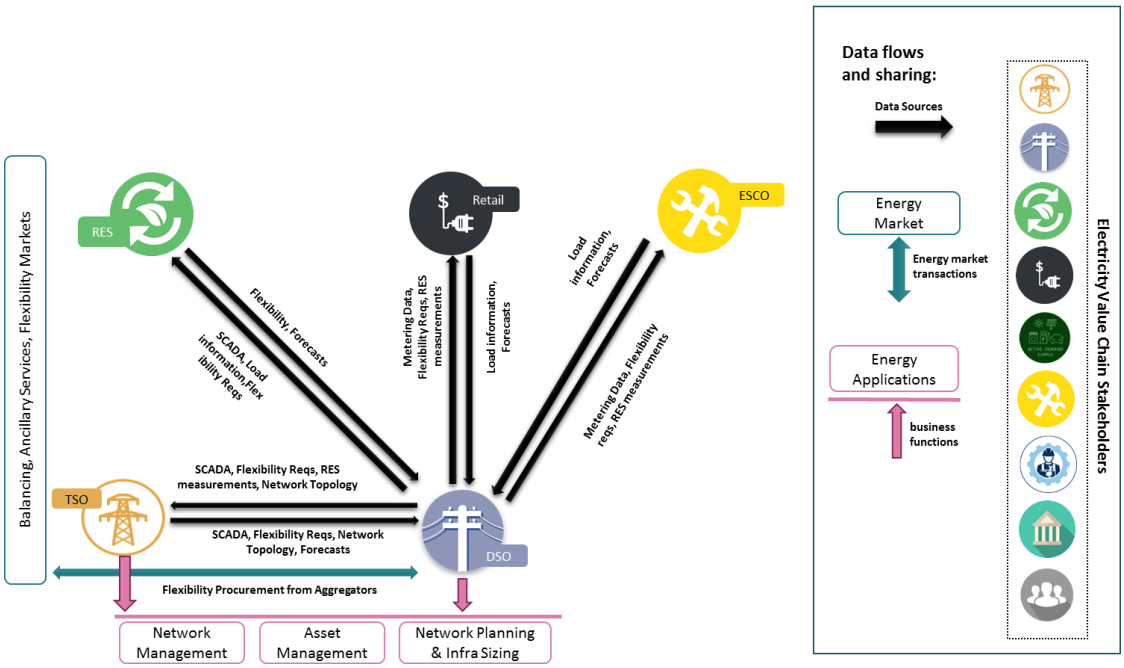
III. ANNEX C- SYNERGY Data Value Networks performed per Business Scenario and Pilot site.

GREEK DEMO SITE

DEMO CASE 1- Innovative Flexibility-based Network Management

HEDNO (DSO)



IPTO (TSO)

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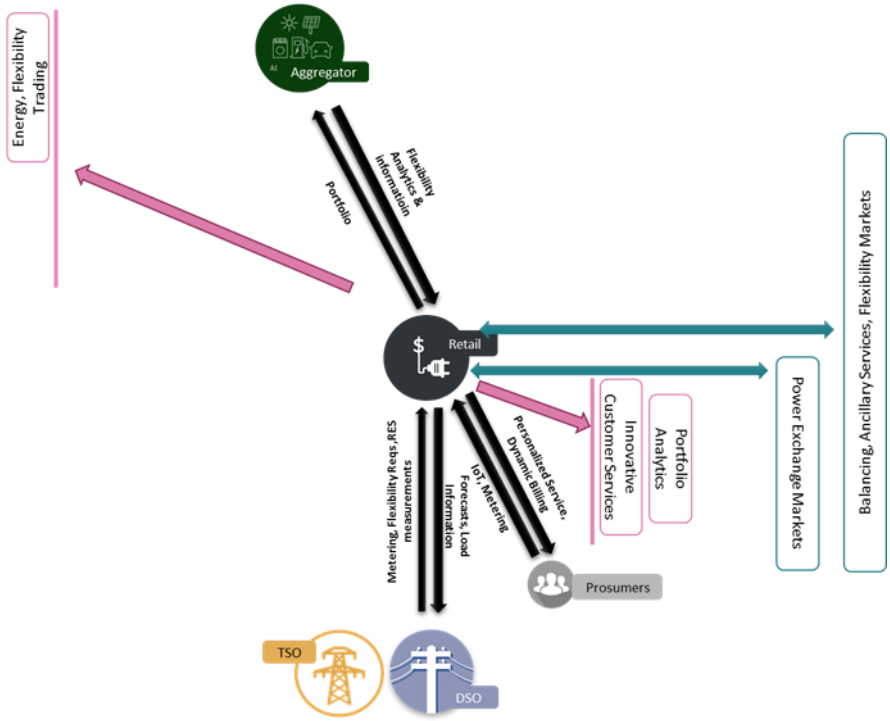
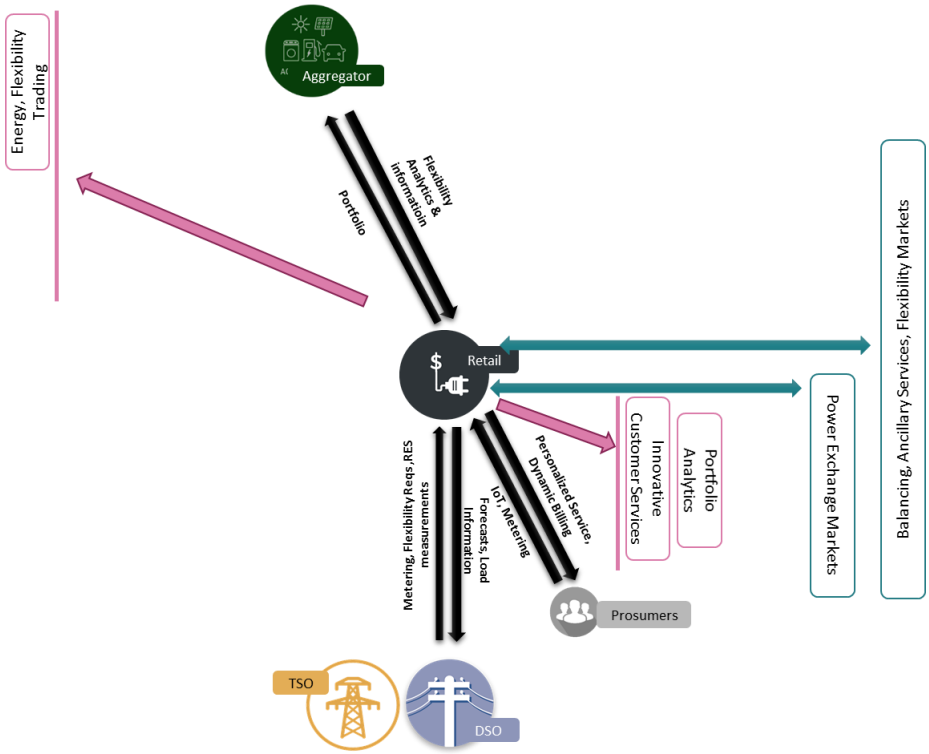


EPA (RETAILER)



VERD (AGGREGATOR)

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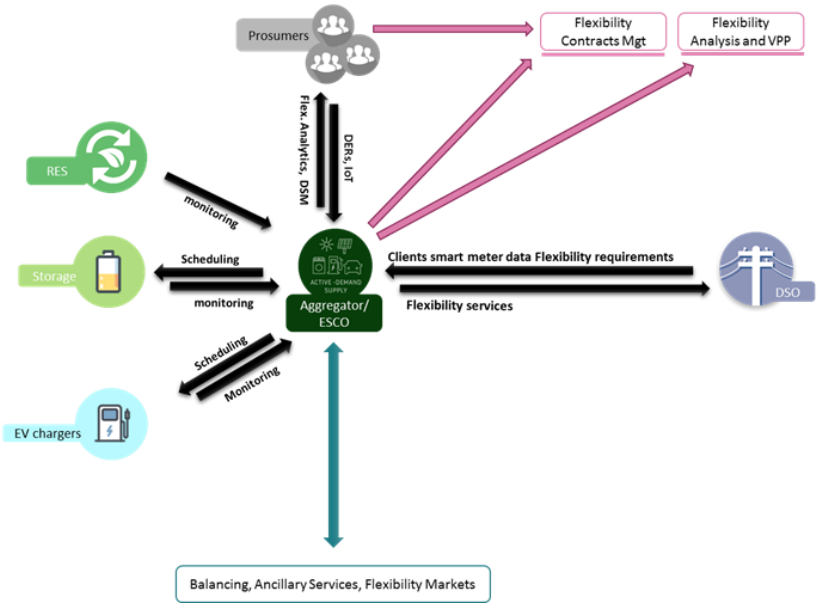
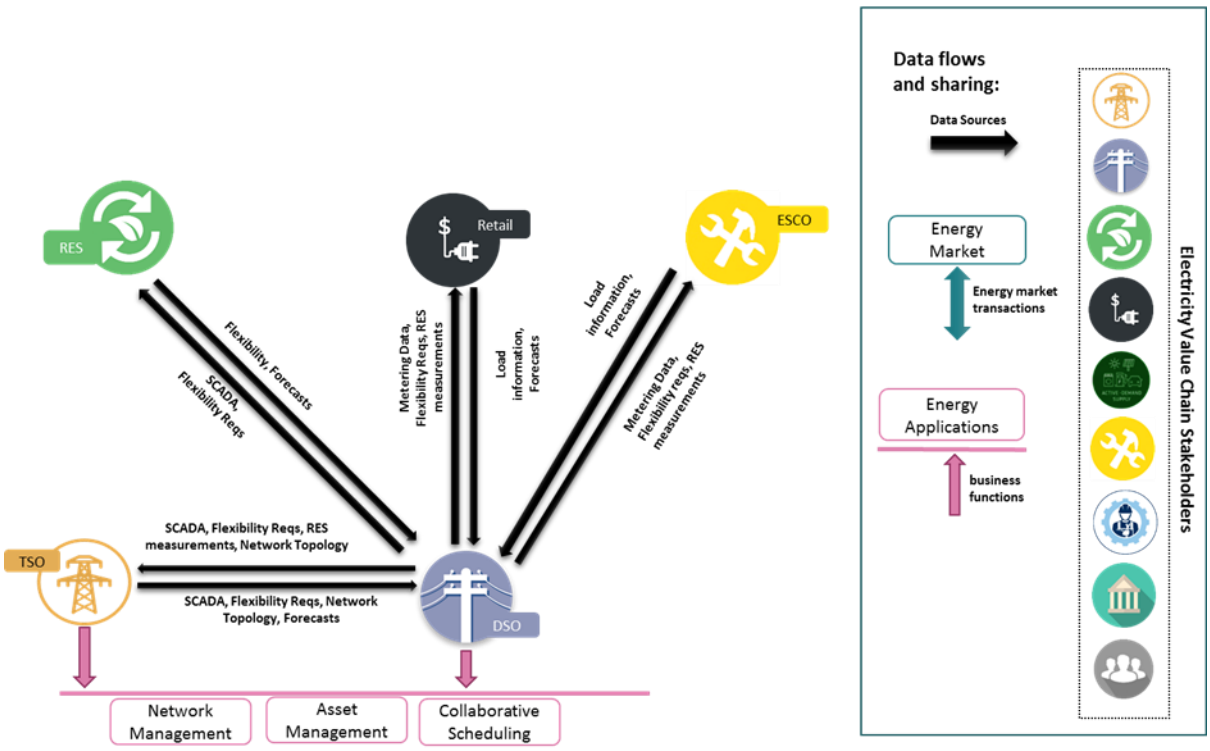


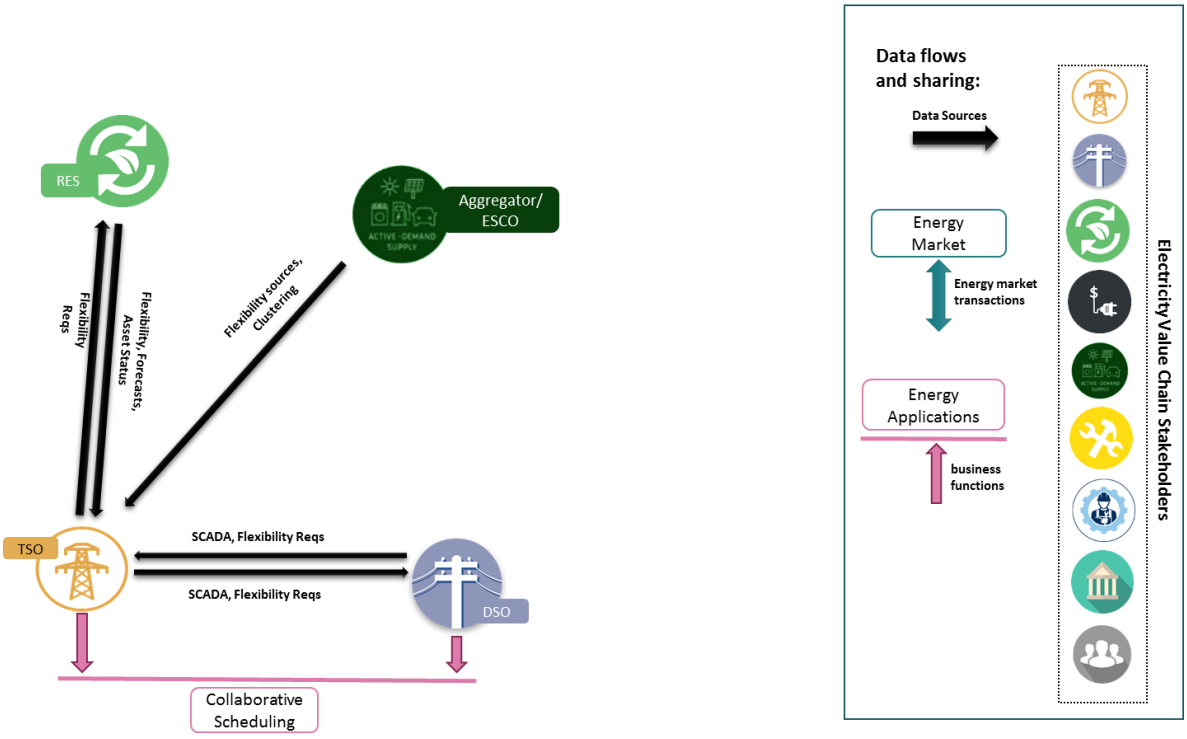
DEMO CASE 2- Common Operation Scheduling for power grids for TSOs and DSOs

HEDNO (DSO)

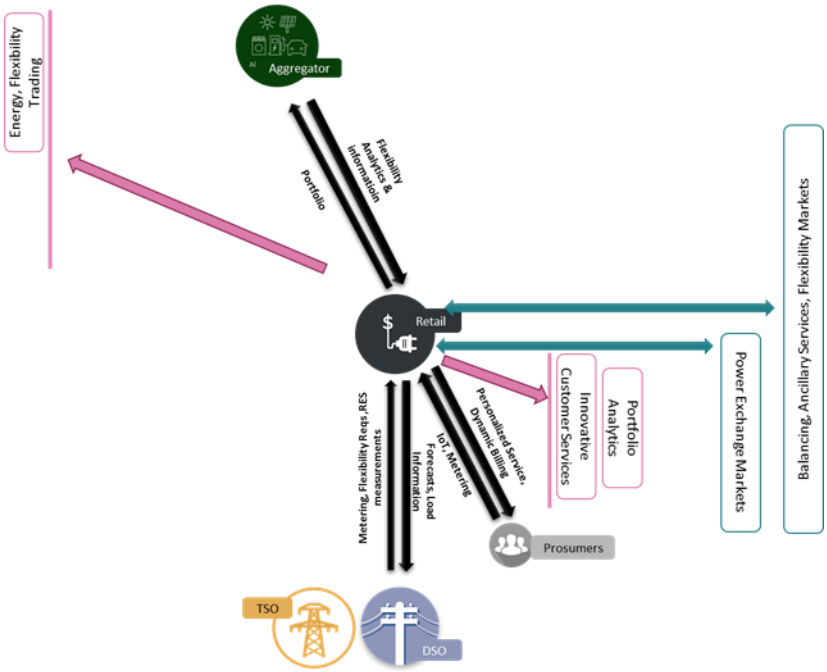


IPTO (TSO)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

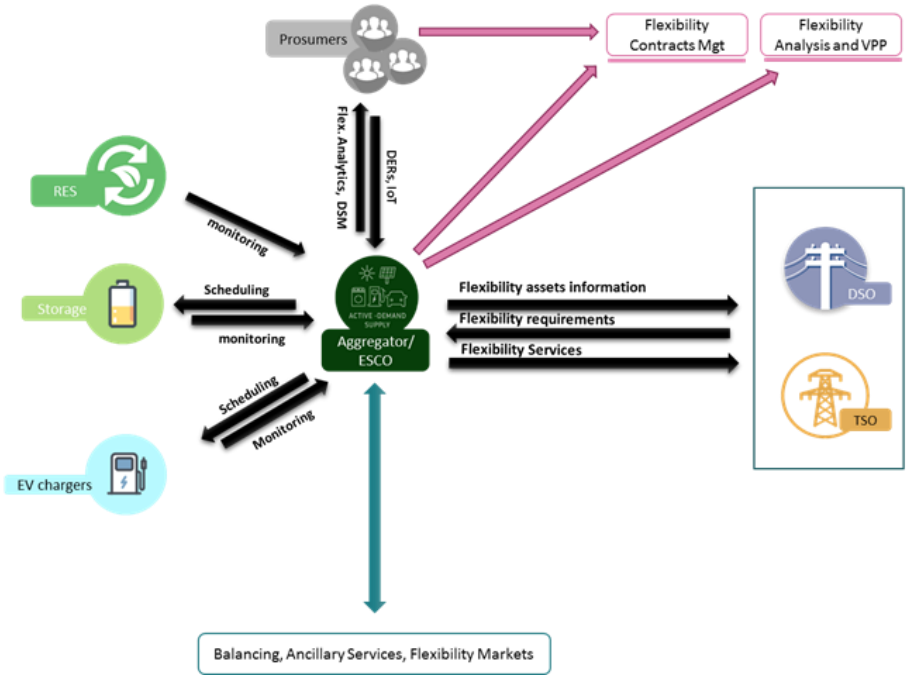


RETAILER (EPA)



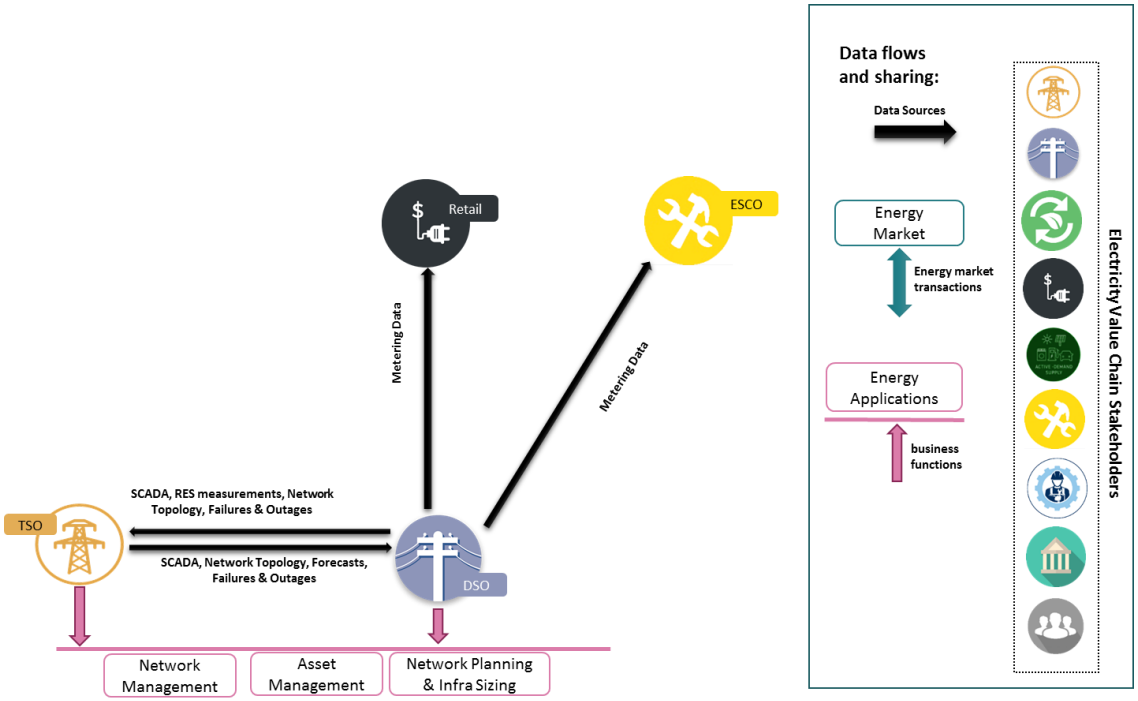
VERD (AGGREGATOR)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



DEMO CASE 3- Enhanced Network Asset Management and Planning

HEDNO (DSO)



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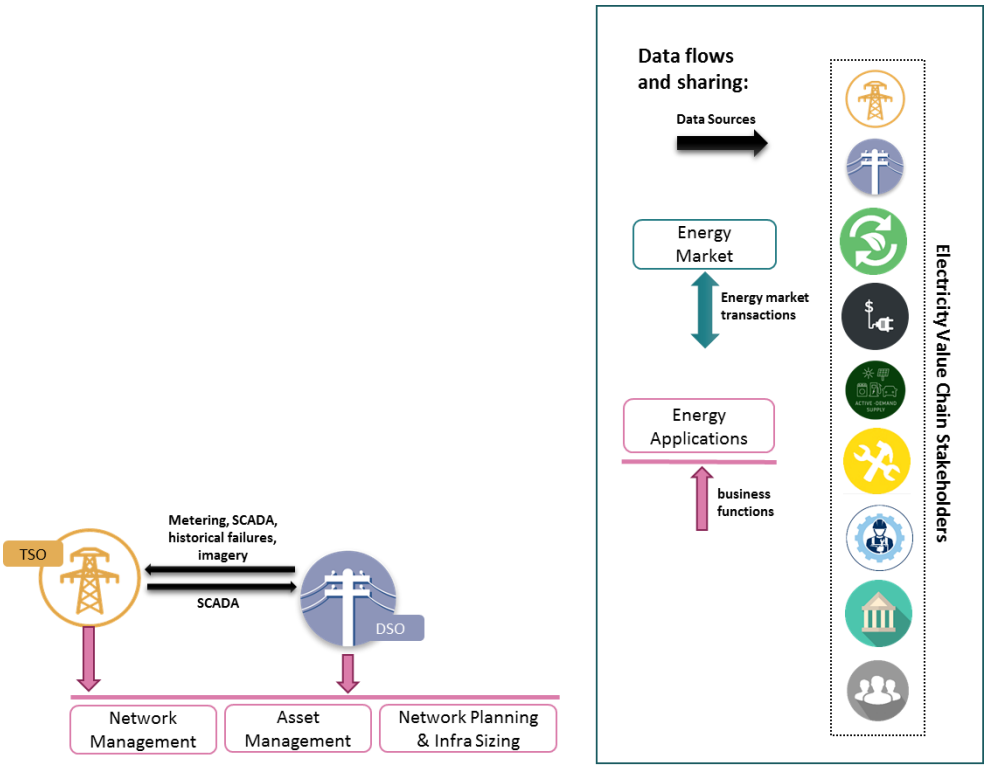
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



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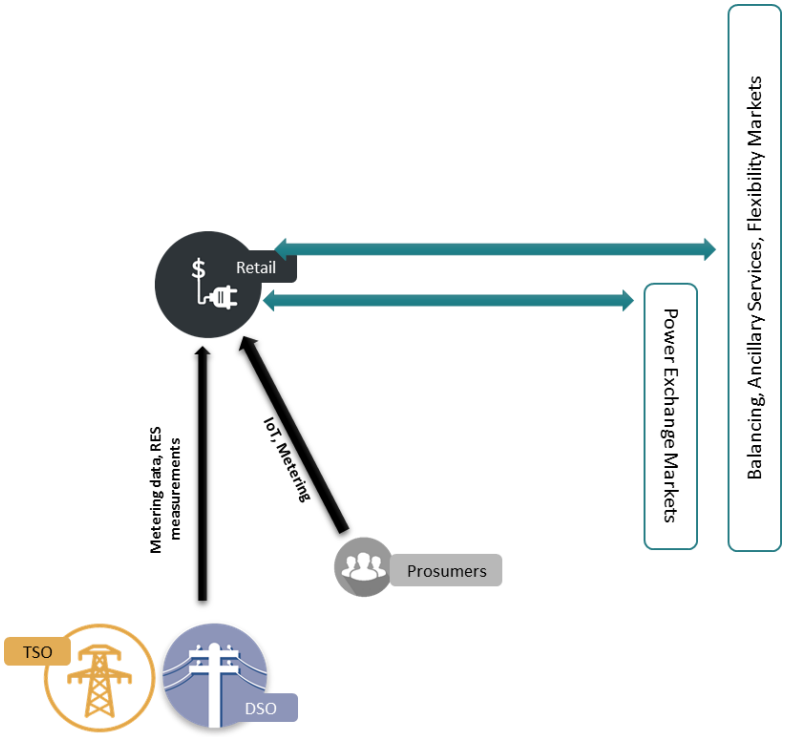
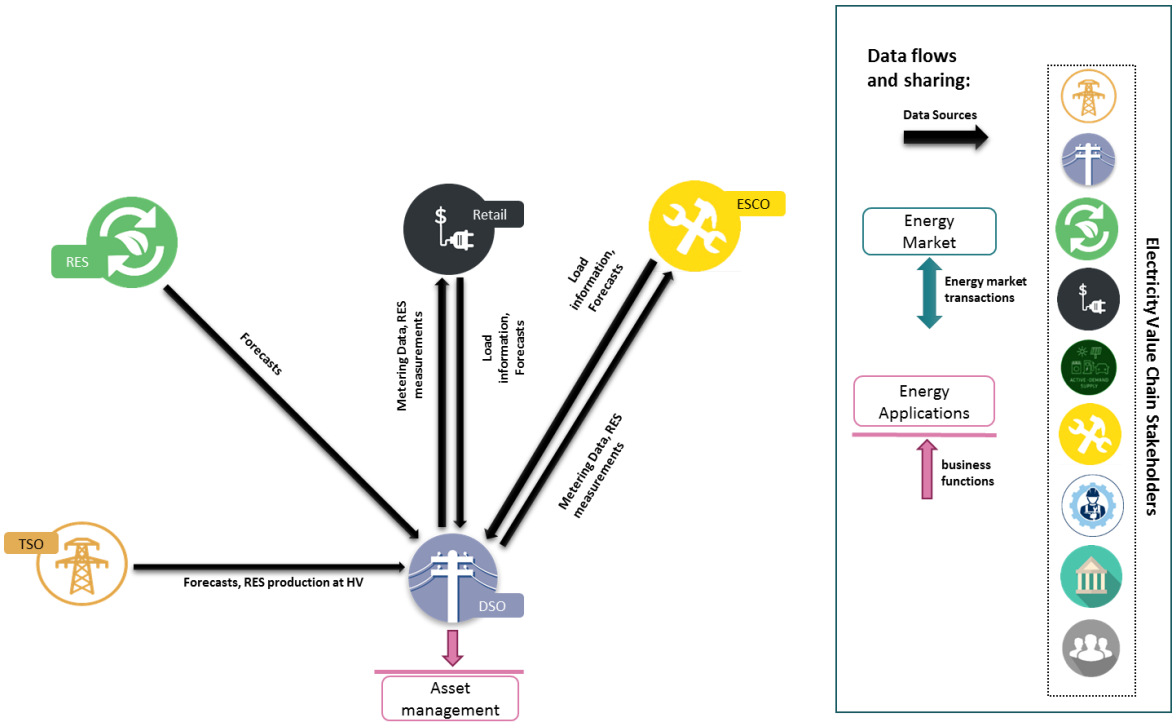


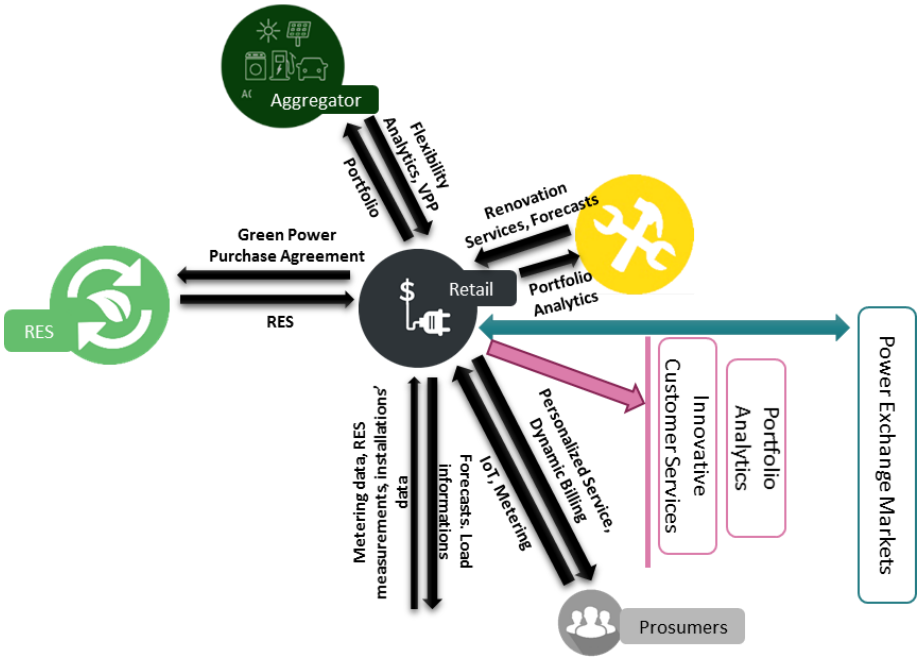
DEMO CASE 4- Retailer portfolio analytics and elasticity estimation for the provision of services to network operators

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

HEDNO (DSO)



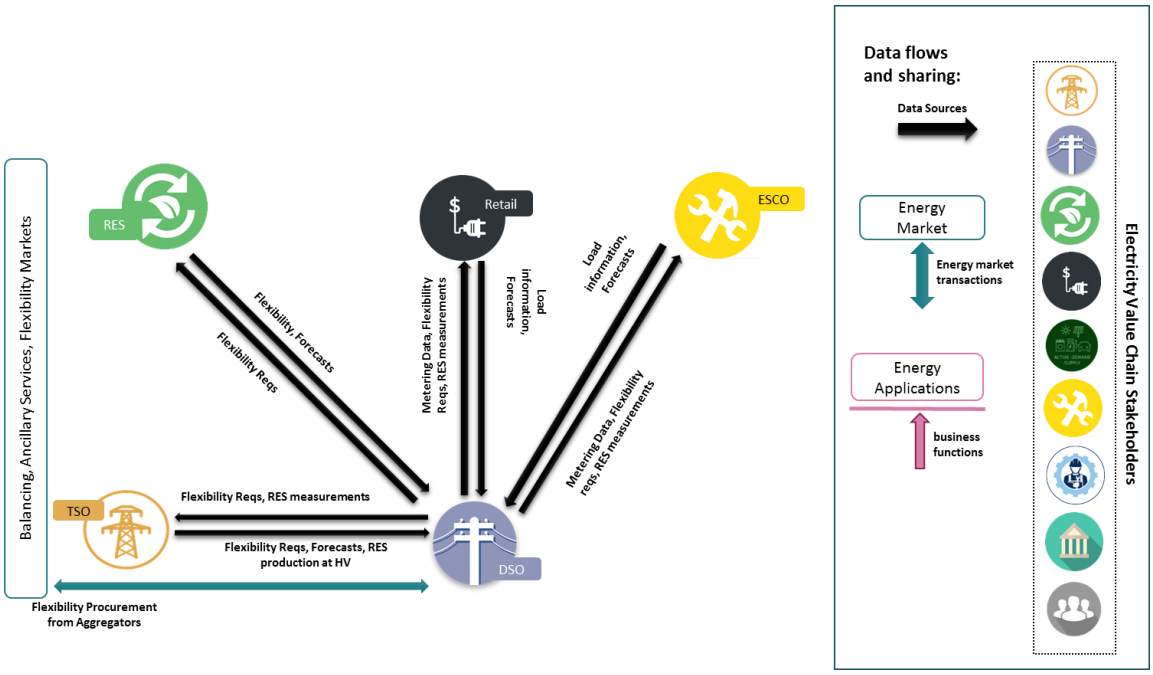
EPA (RETAILER)



DEMO CASE 5- Flexibility Segmentation, classification and clustering towards VPP configuration for Demand Response

HEDNO (DSO)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



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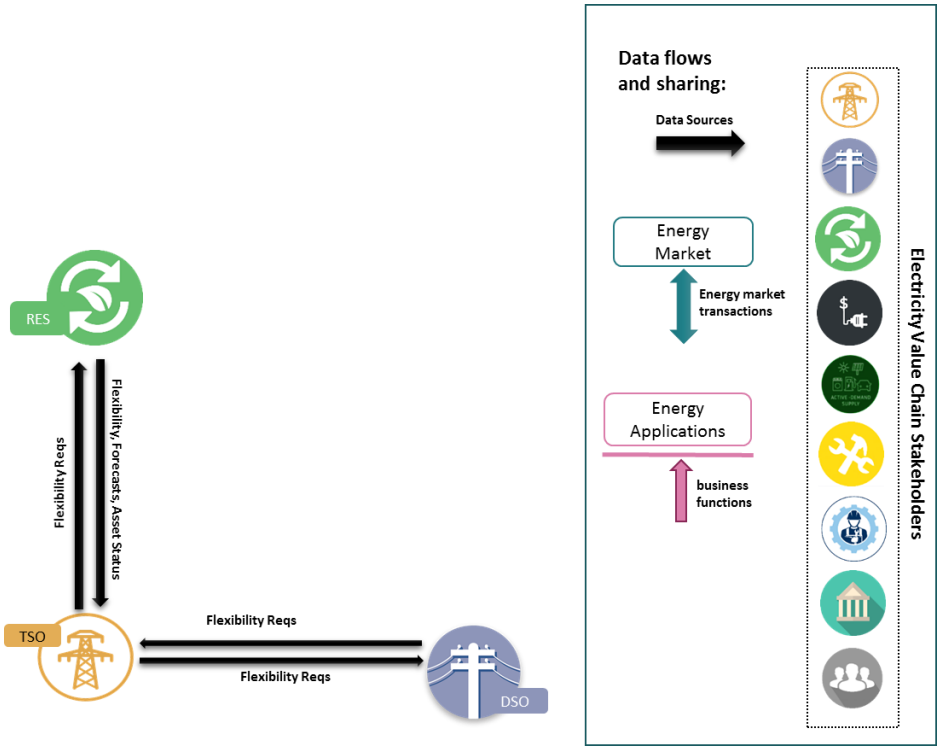

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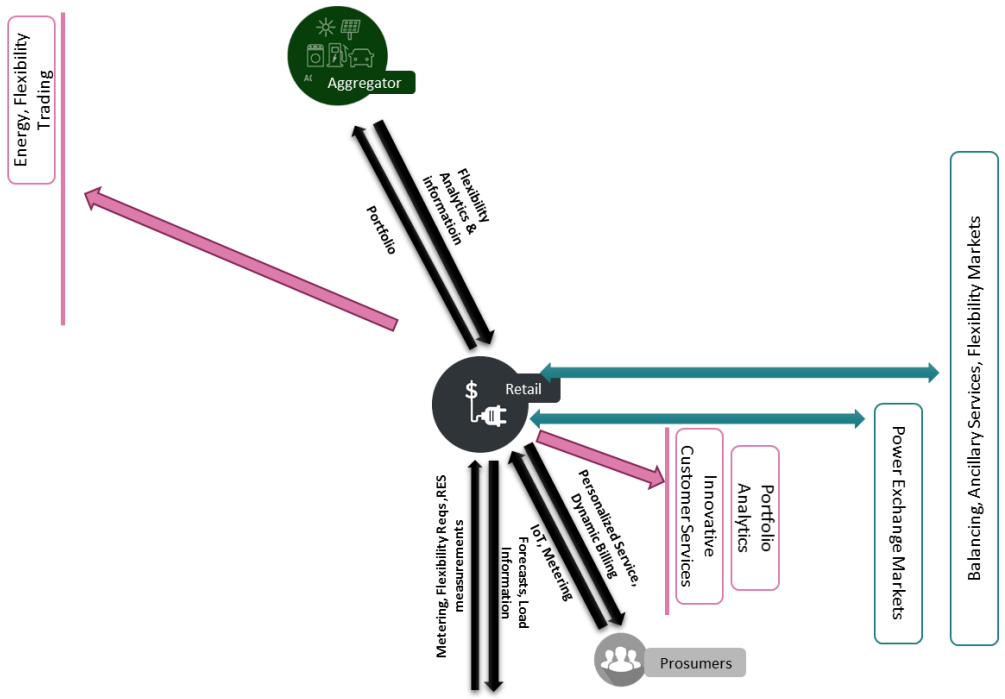
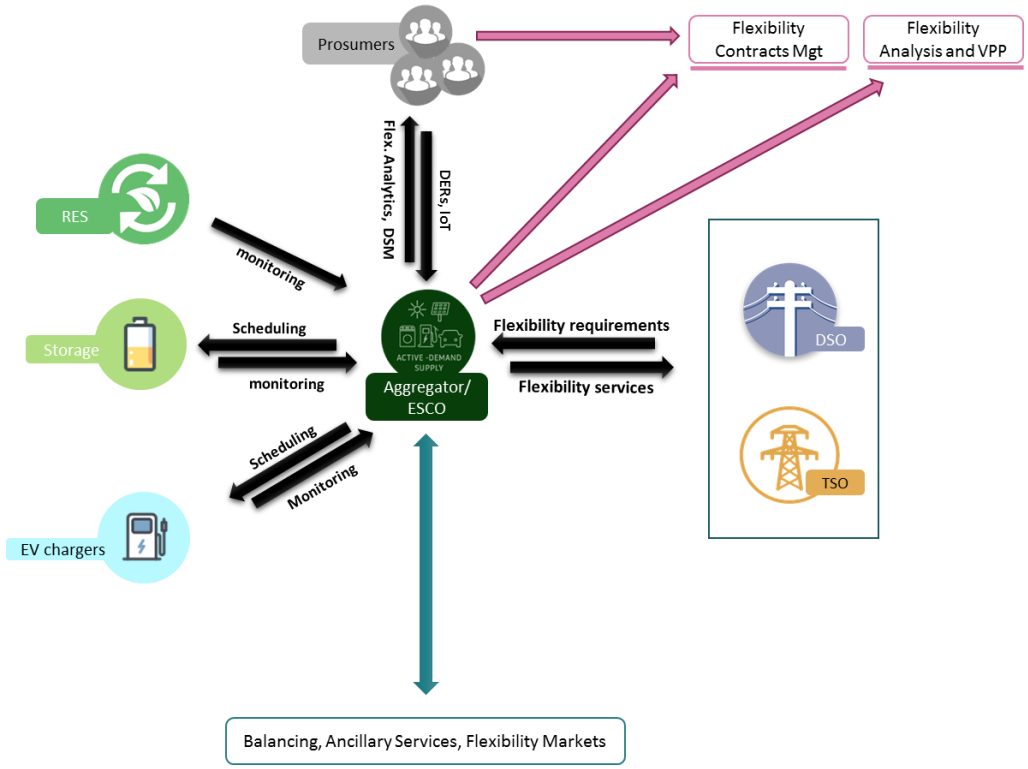
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



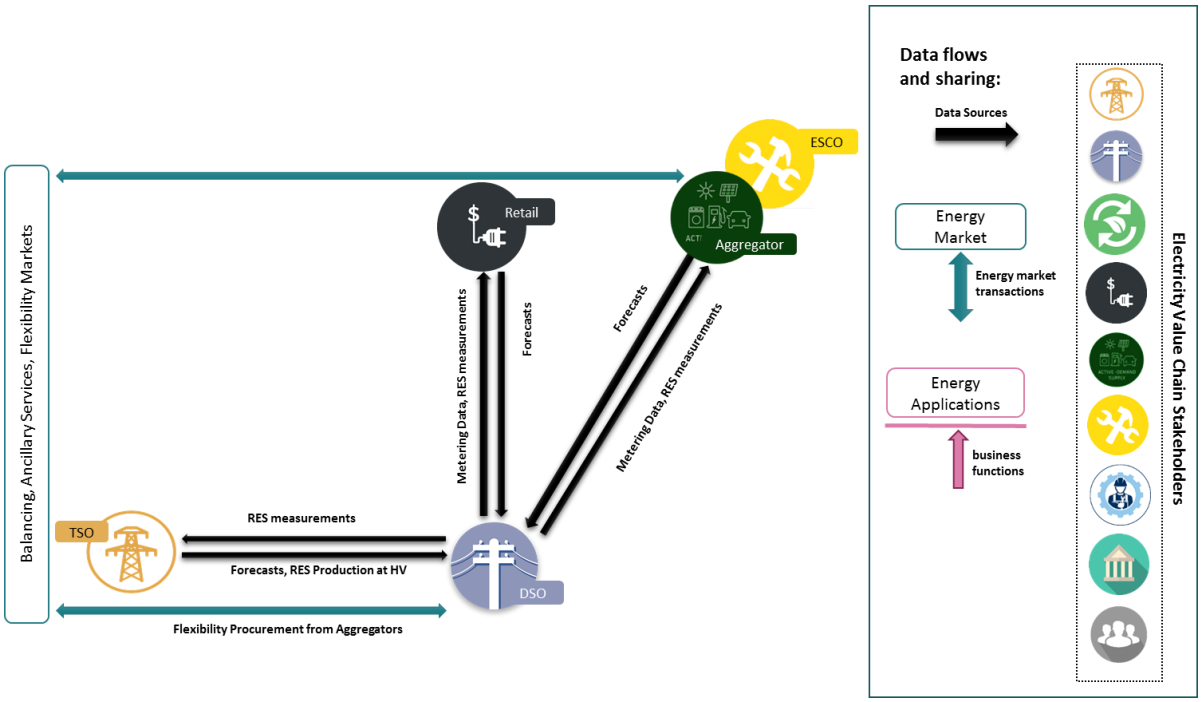
VERD (AGGREGATOR)



DEMO CASE 6- Local Flexibility Sharing for Self-Consumption Optimization and local community level

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

HEDNO (DSO)



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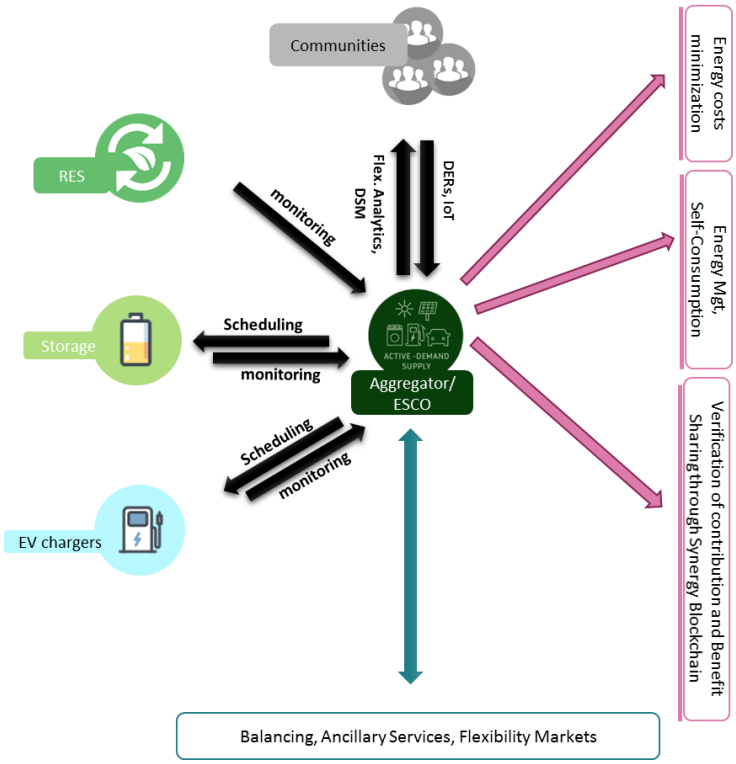
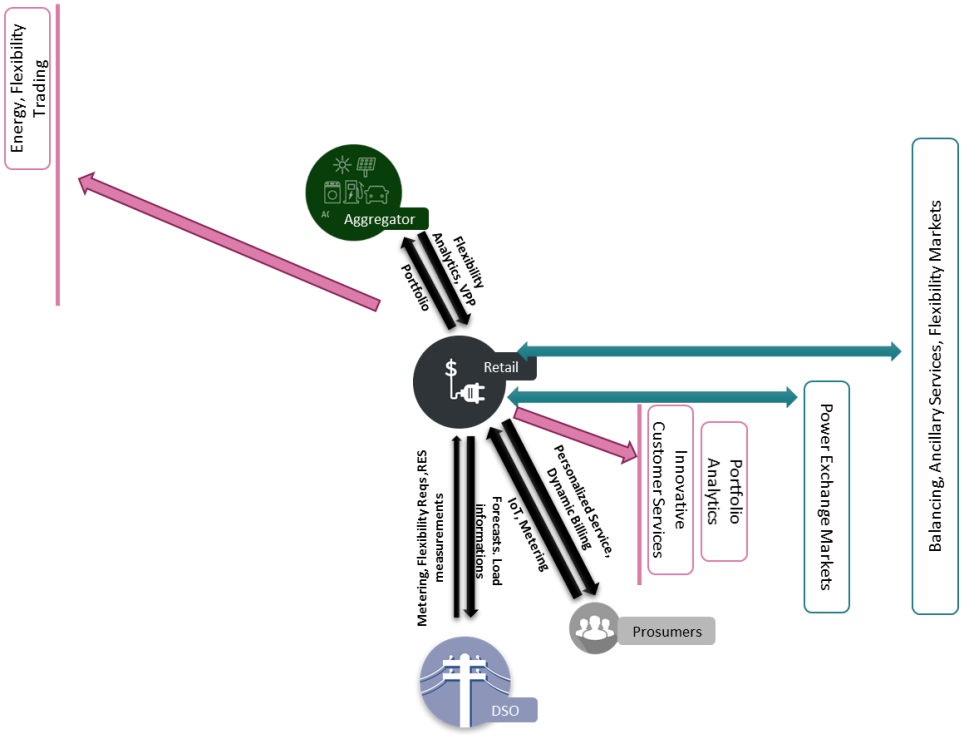


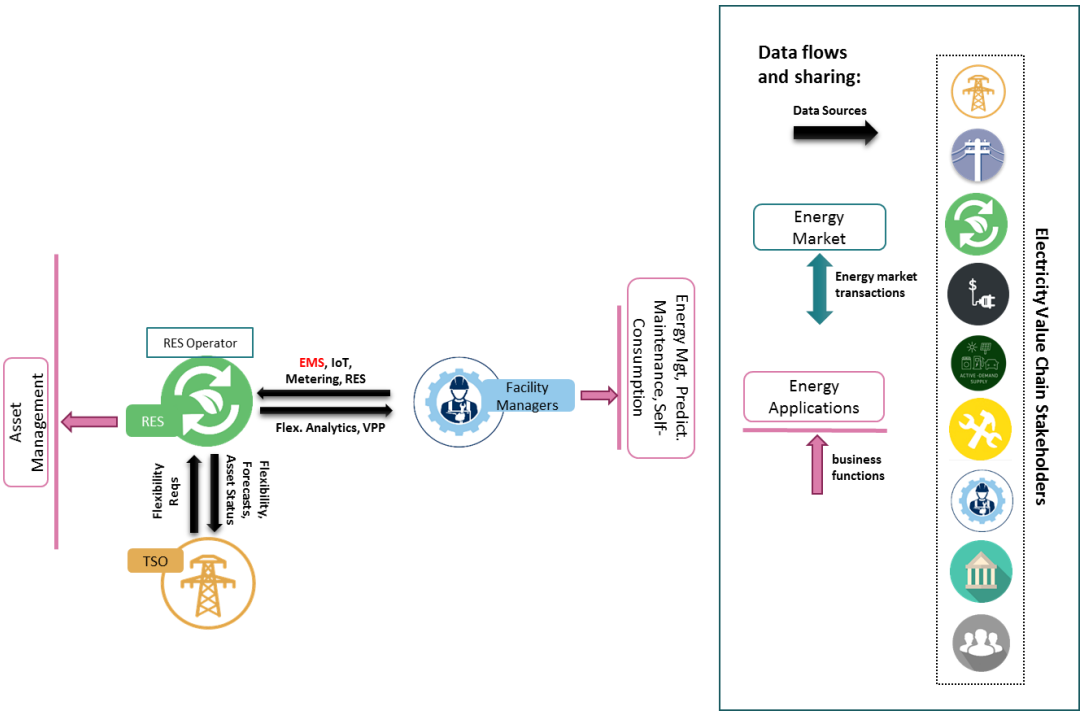
EPA (RETAILER)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



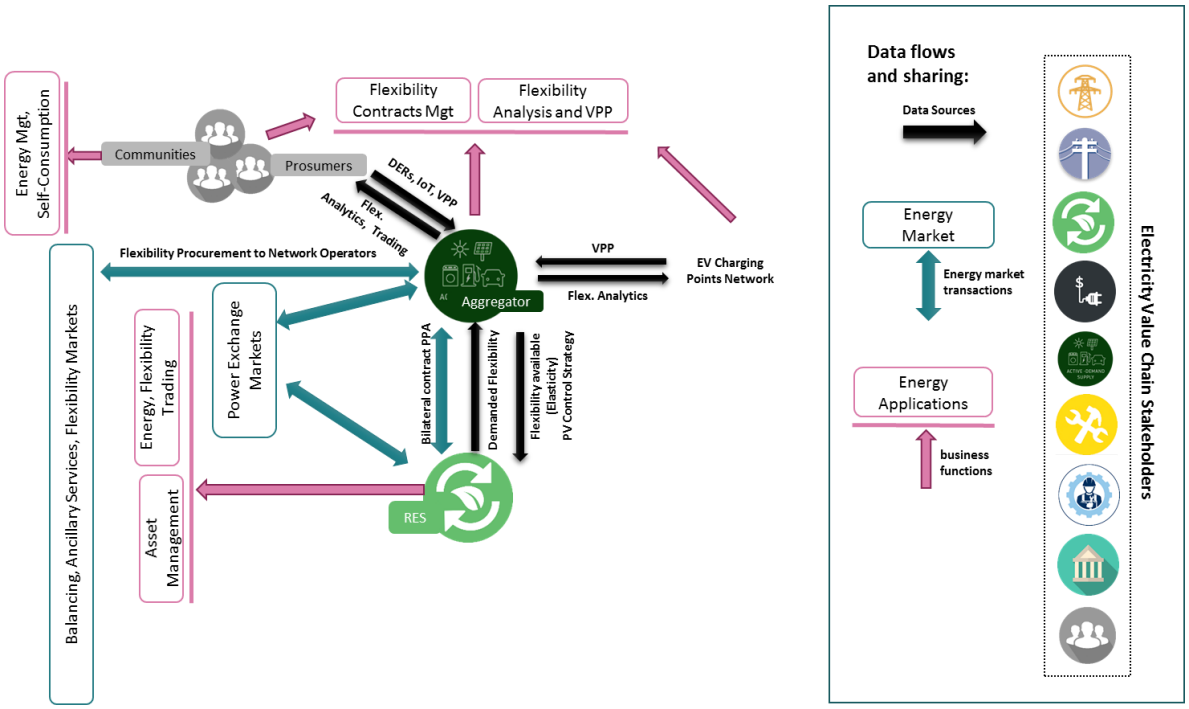
SPANISH DEMO SITE

DEMO CASE 7- Enhanced PV Plant Asset Management

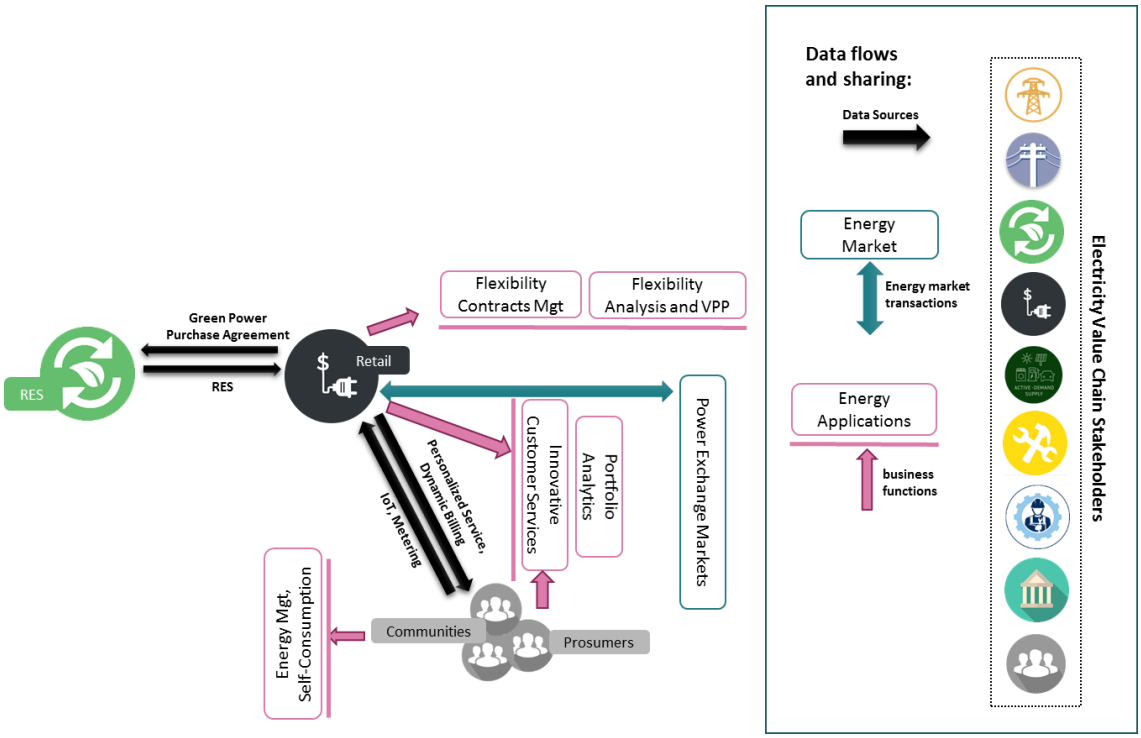


DEMO CASE 8- Advanced RES Forecasting for improved market positioning and optimized flexibility activation for the provision of services to network operators

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

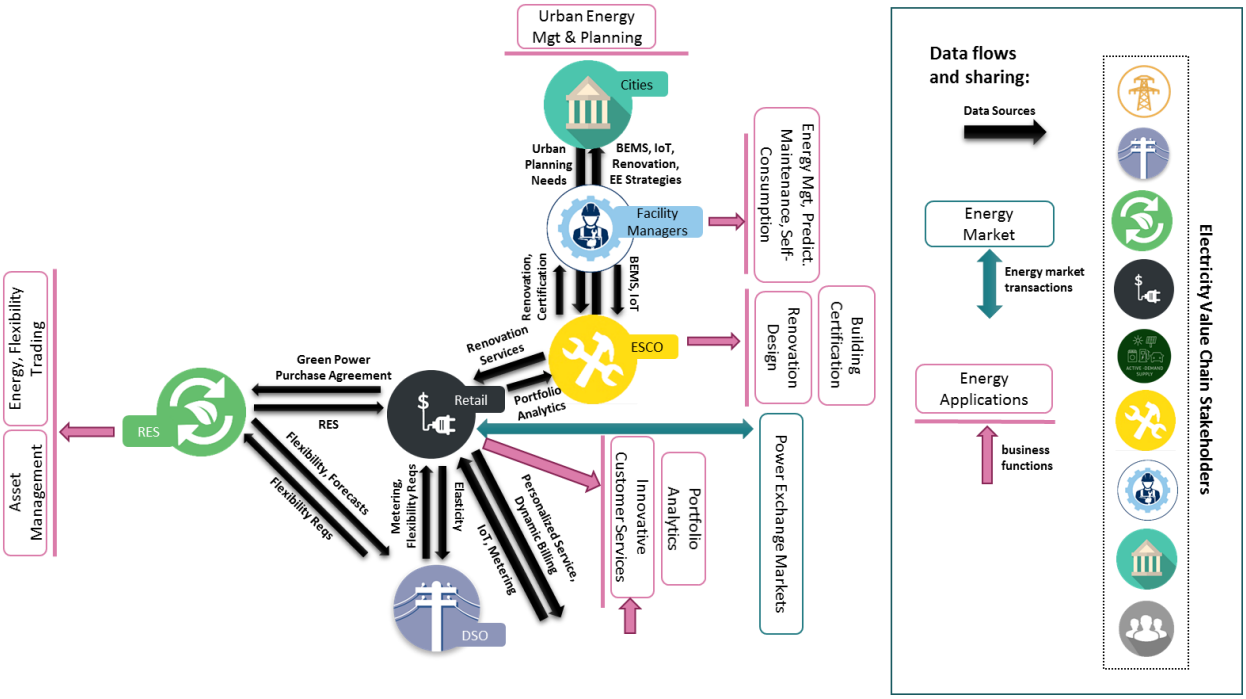


DEMO CASE 9- Optimising PPA between RES operator and Electricity Retailers towards Greening Electricity Supply and reduced associated tariffs and costs

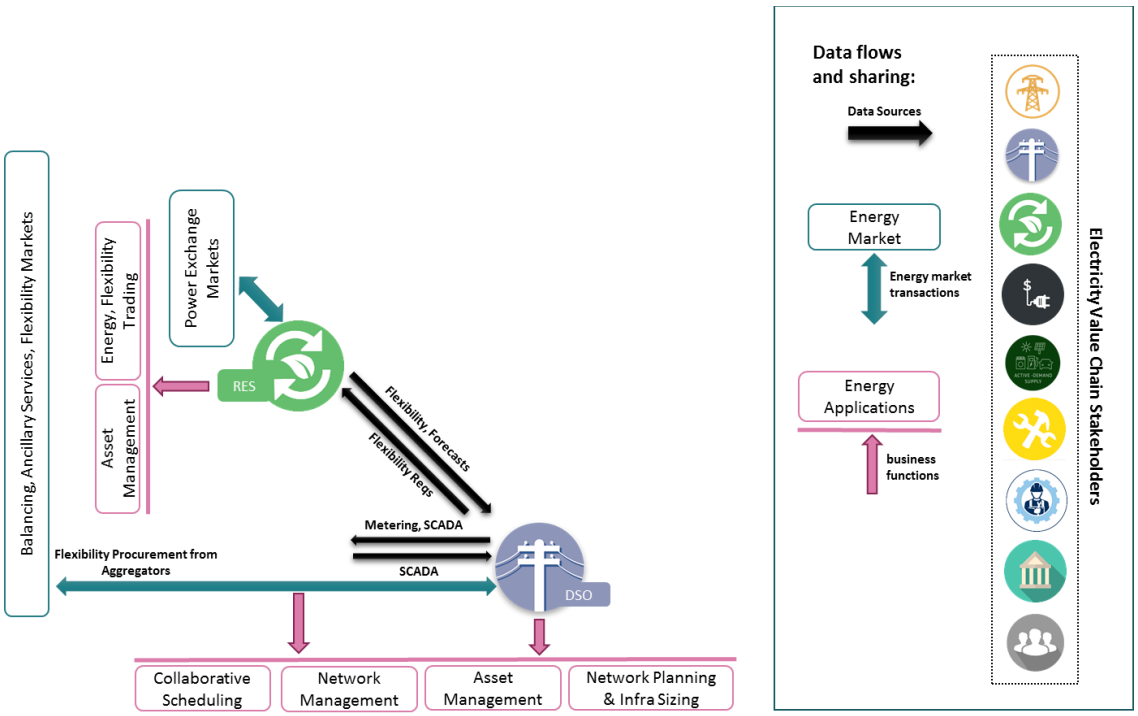


DEMO CASE 10- Transformation of the Retailer business model from Commodity to EaaS providers for the implementation of energy efficiency campaigns

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

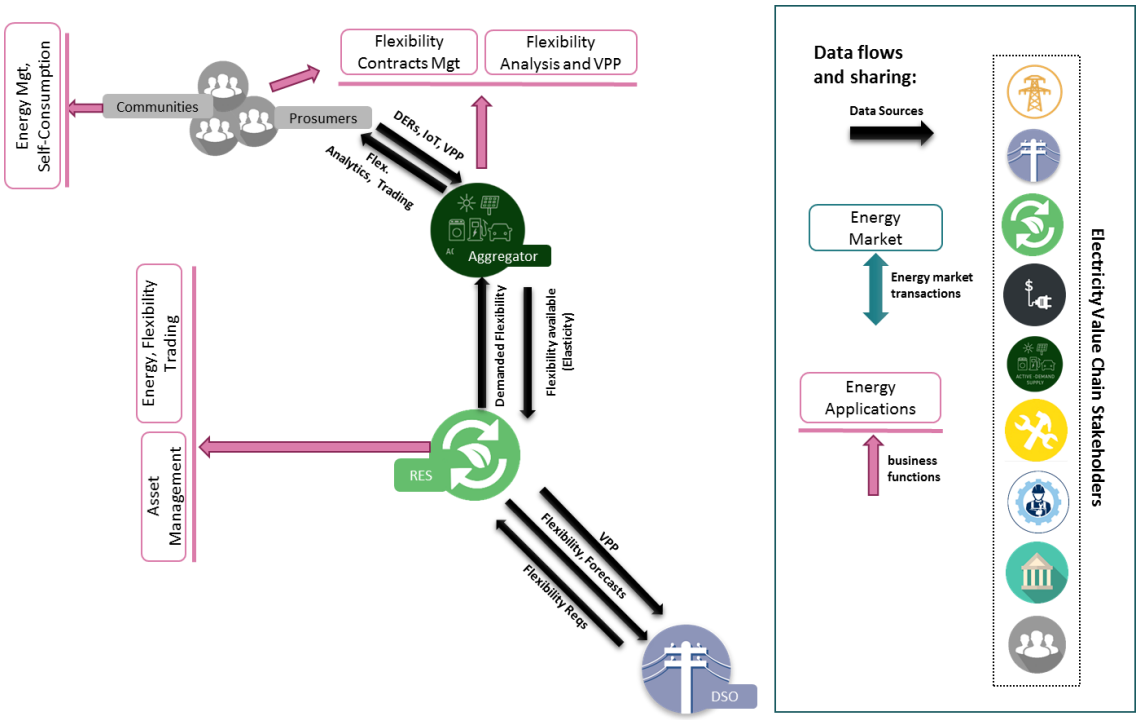


DEMO CASE 11- Enhanced Distribution Network Asset Management and Reinforcement



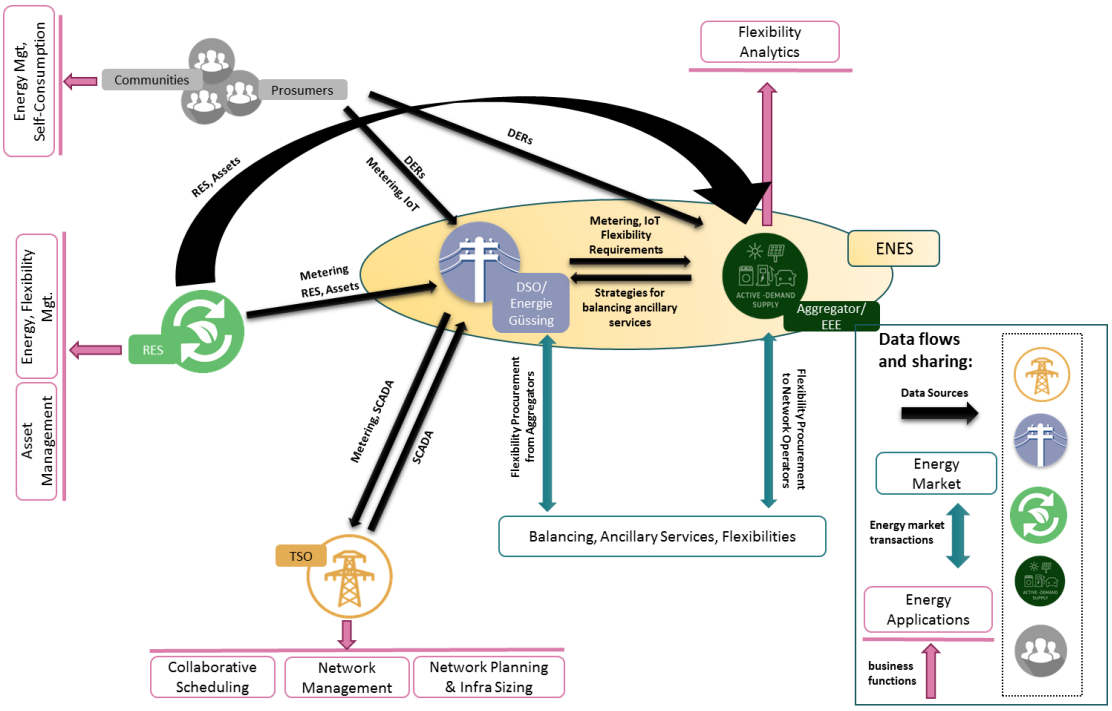
DEMO CASE 12- Innovative Flexibility-based Distribution Network Management

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



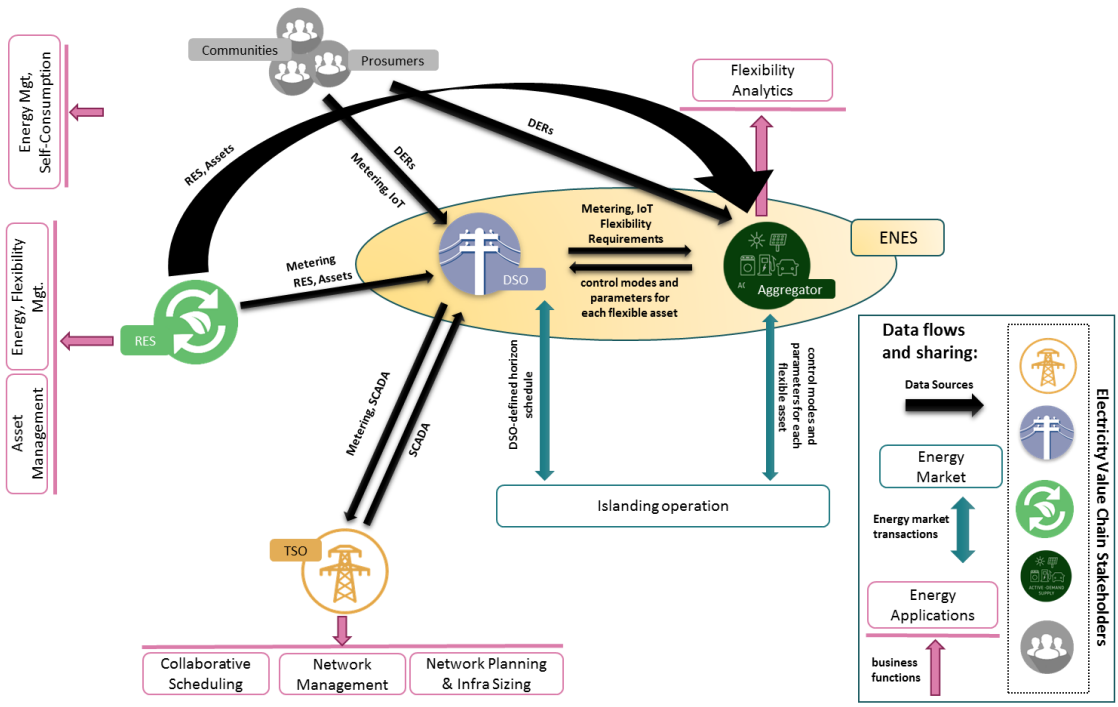
AUSTRIAN DEMO SITE

DEMO CASE 13- Innovative Flexibility-based Distribution Network Management

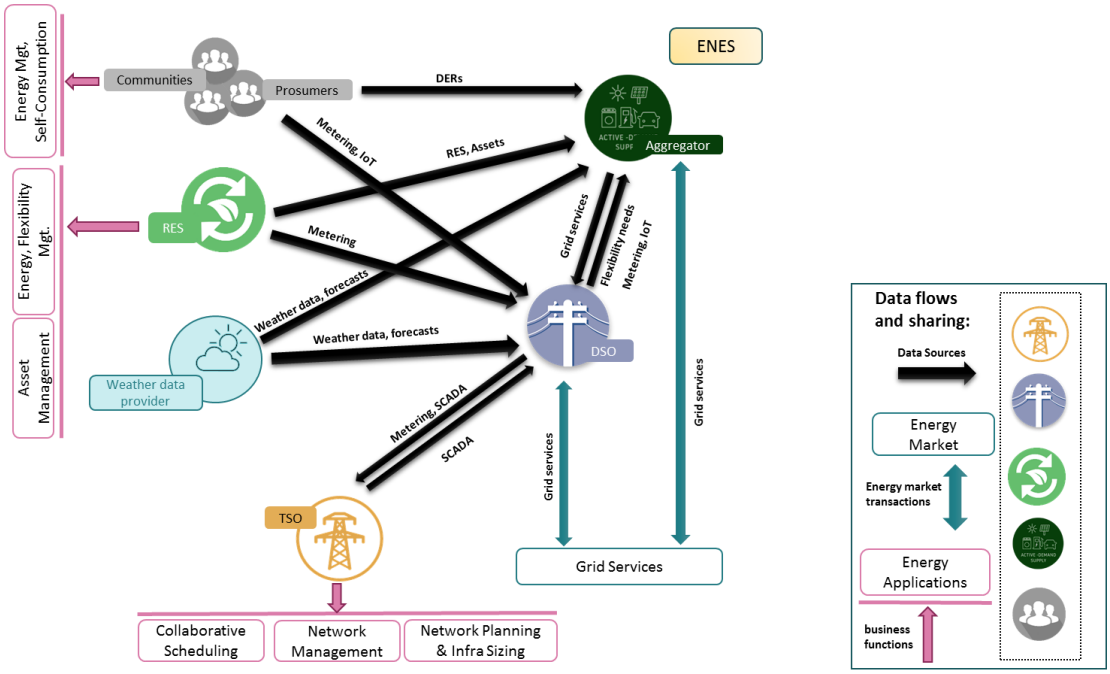


DEMO CASE 14- Local Energy System Optimization and Enhancement of Security Supply through Islanding

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

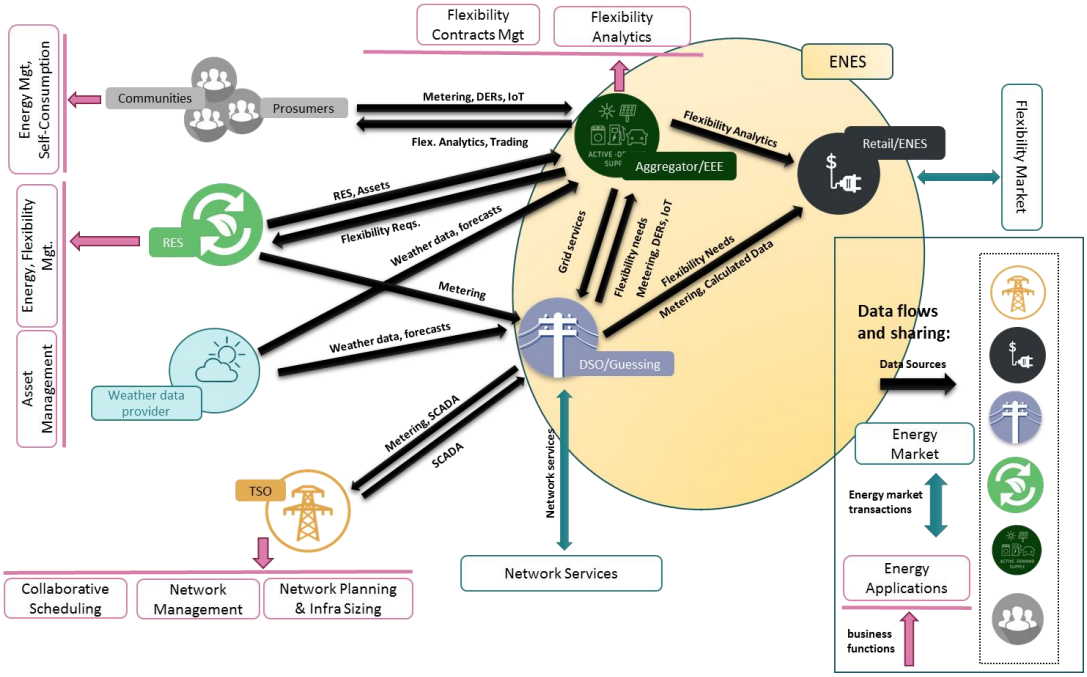


DEMO CASE 15- Flexibility segmentation, classification and clustering towards VPP configuration for flexibility activation and explicit demand response



DEMO CASE 16- Local Flexibility Market for network services and self-consumption through blockchain-enabled smart contract establishment and handling

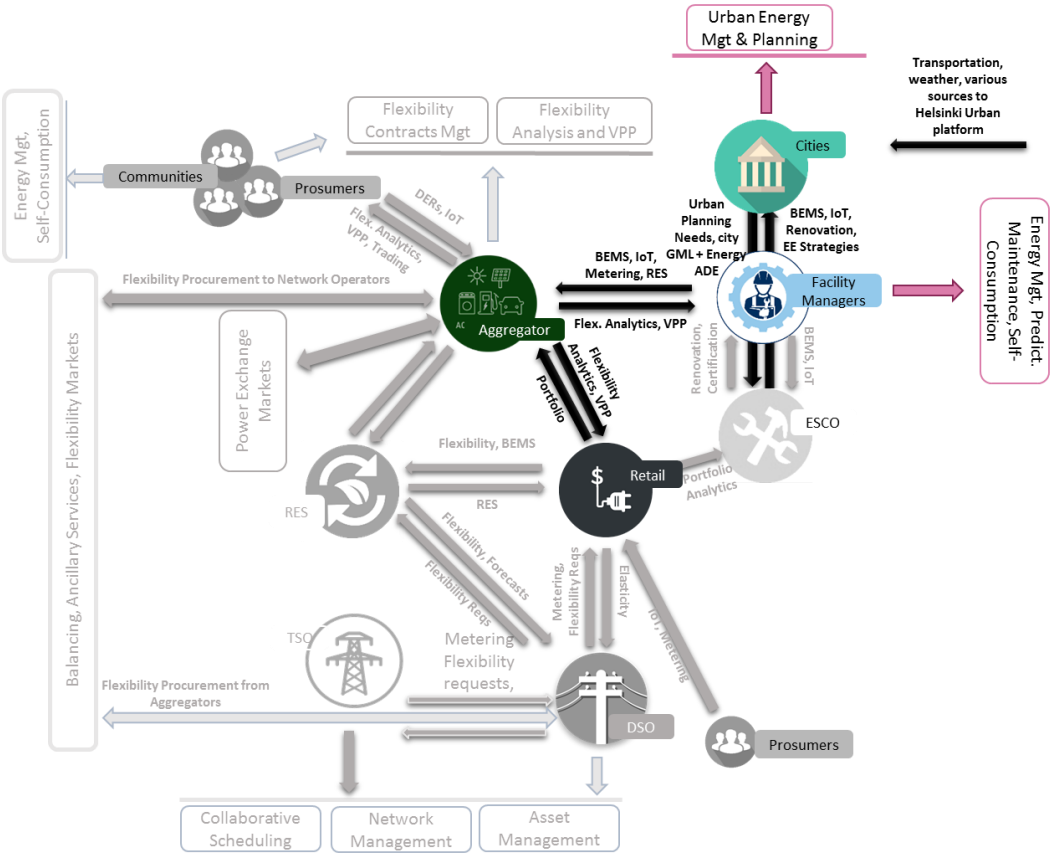
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



FINNISH DEMO SITE

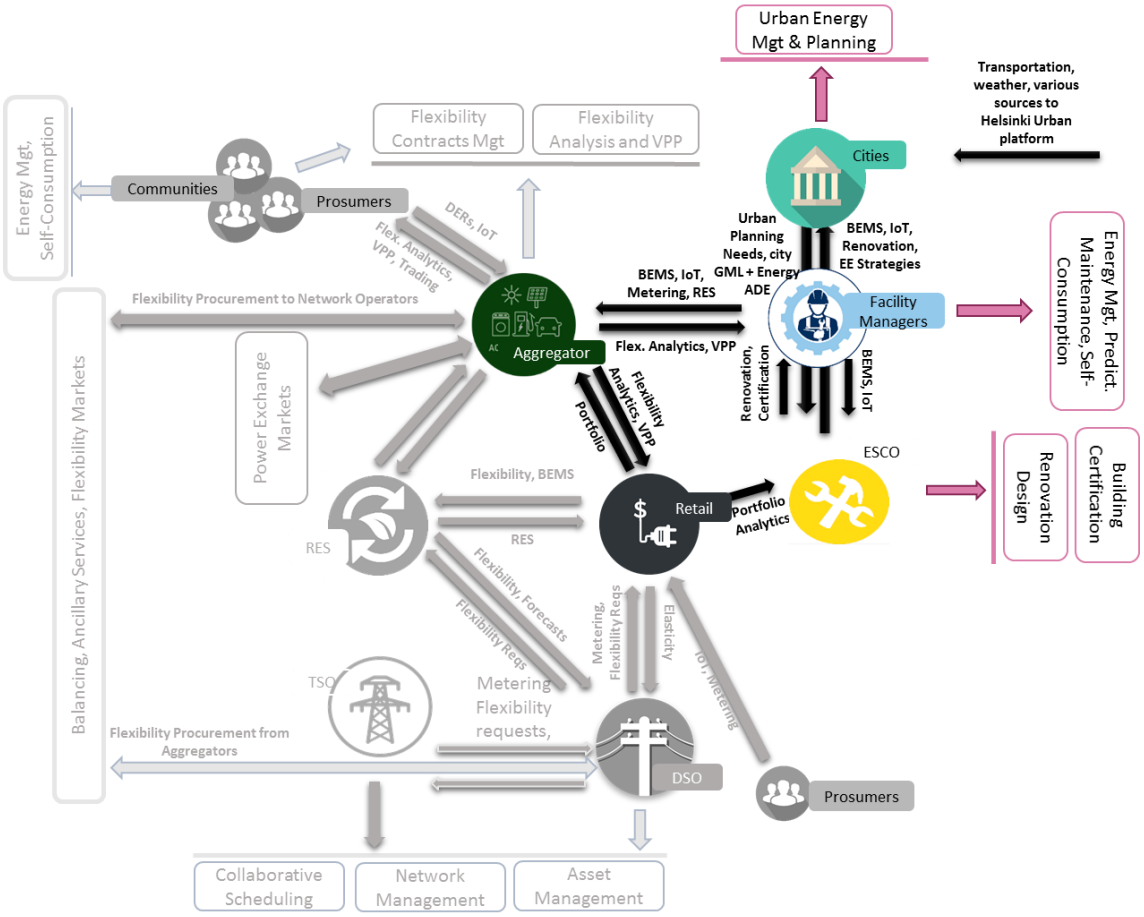
DEMO CASE 17- Optimized Urban Energy Performance Monitoring and Optimization

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



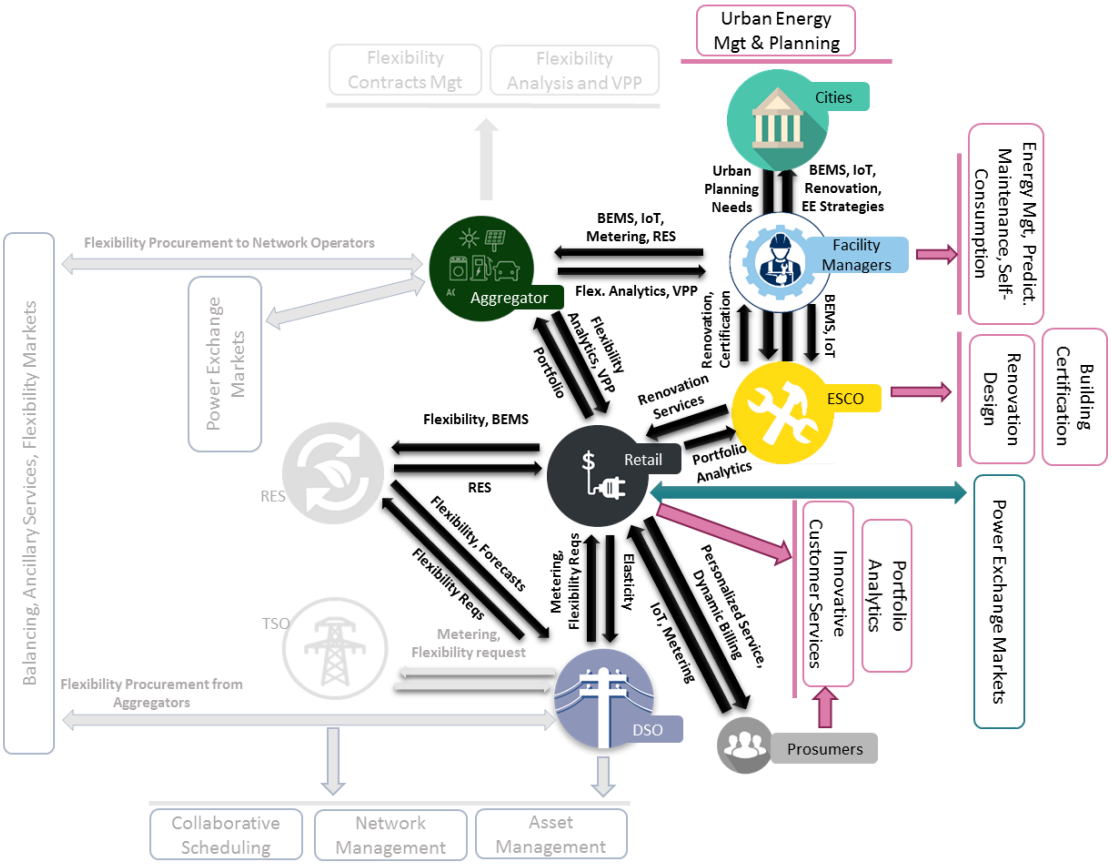
DEMO CASE 18- Advanced Urban Planning for long-term sustainability targets realization

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



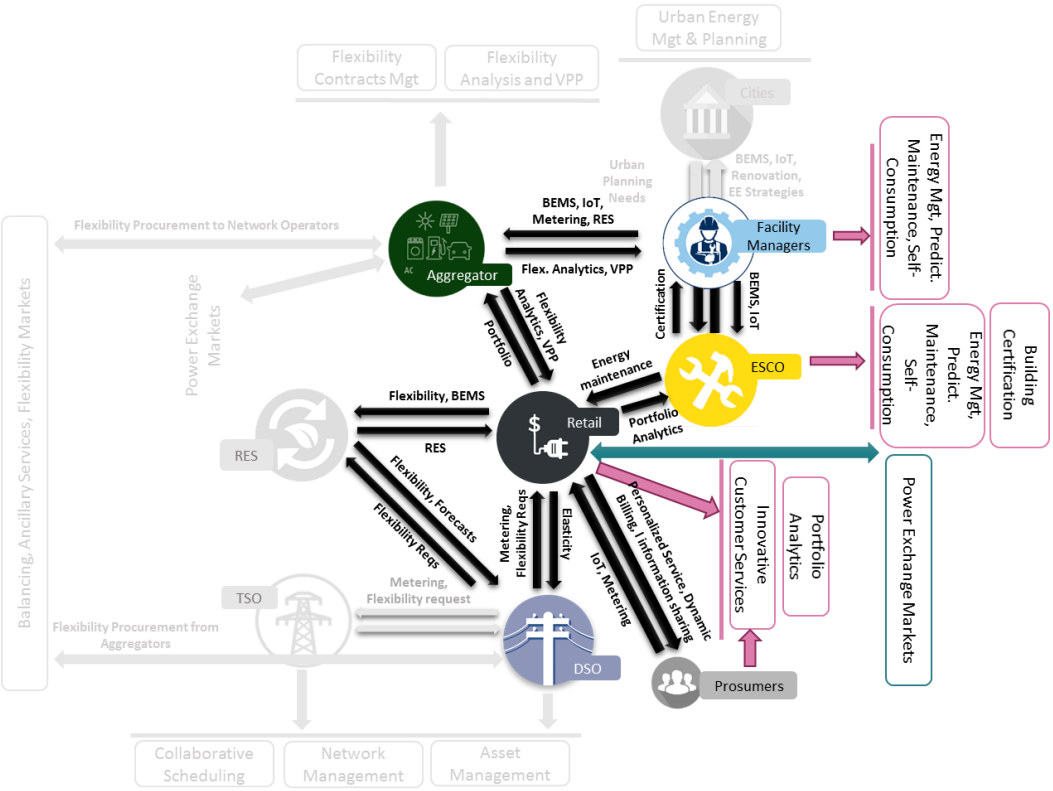
DEMO CASE 19- Evidence-based renovation support for optimized and accurate energy-efficient design of buildings

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



DEMO CASE 20- Holistic Real-time Facility Energy Management Optimization

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



IV. ANNEX D- SDBM RADAR DIAGRAMS

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

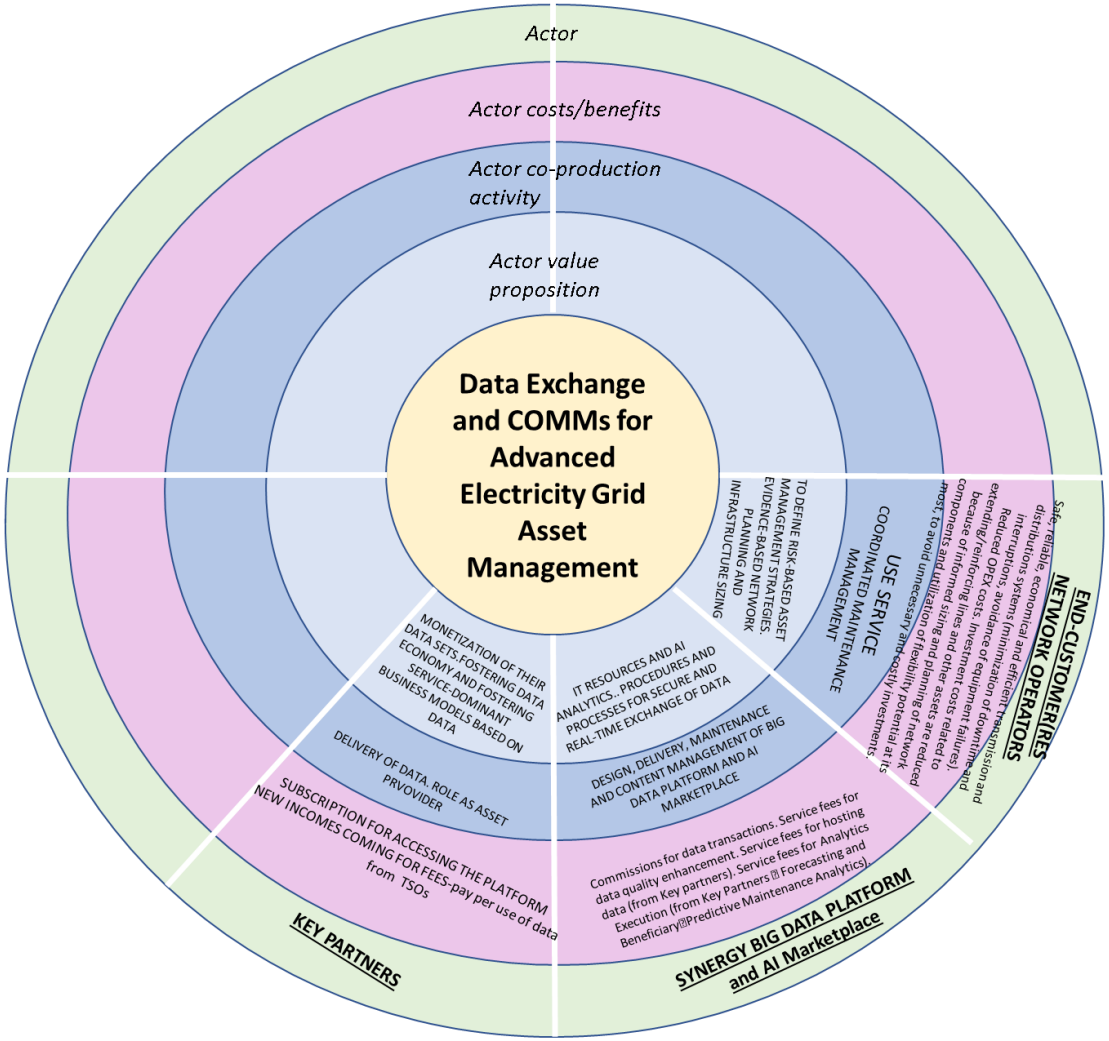


Figure 41. BM1- Data Intelligence as a Service for Advanced Electricity Grid Asset Management and Planning

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

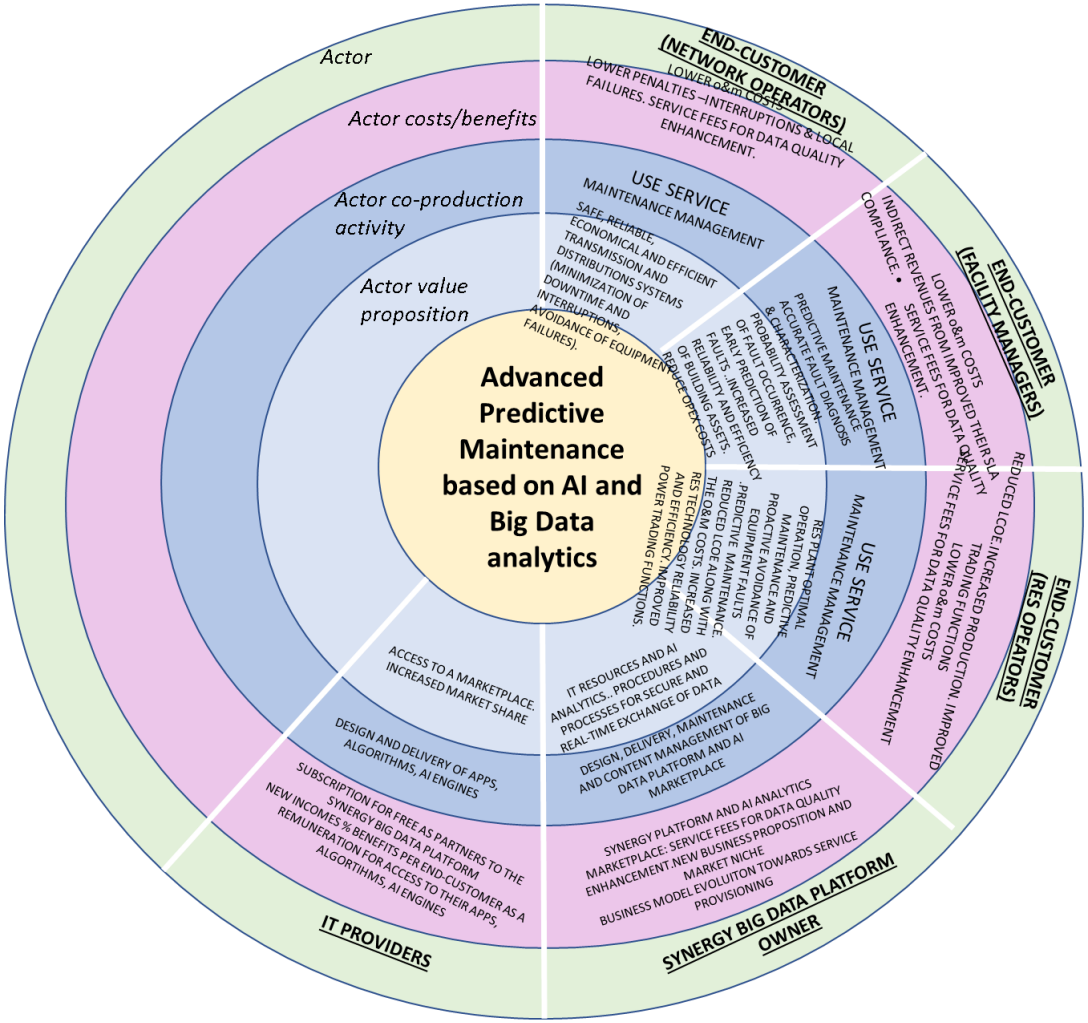


Figure 42. BM2- Data Value as a Service for Advanced Asset Management

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

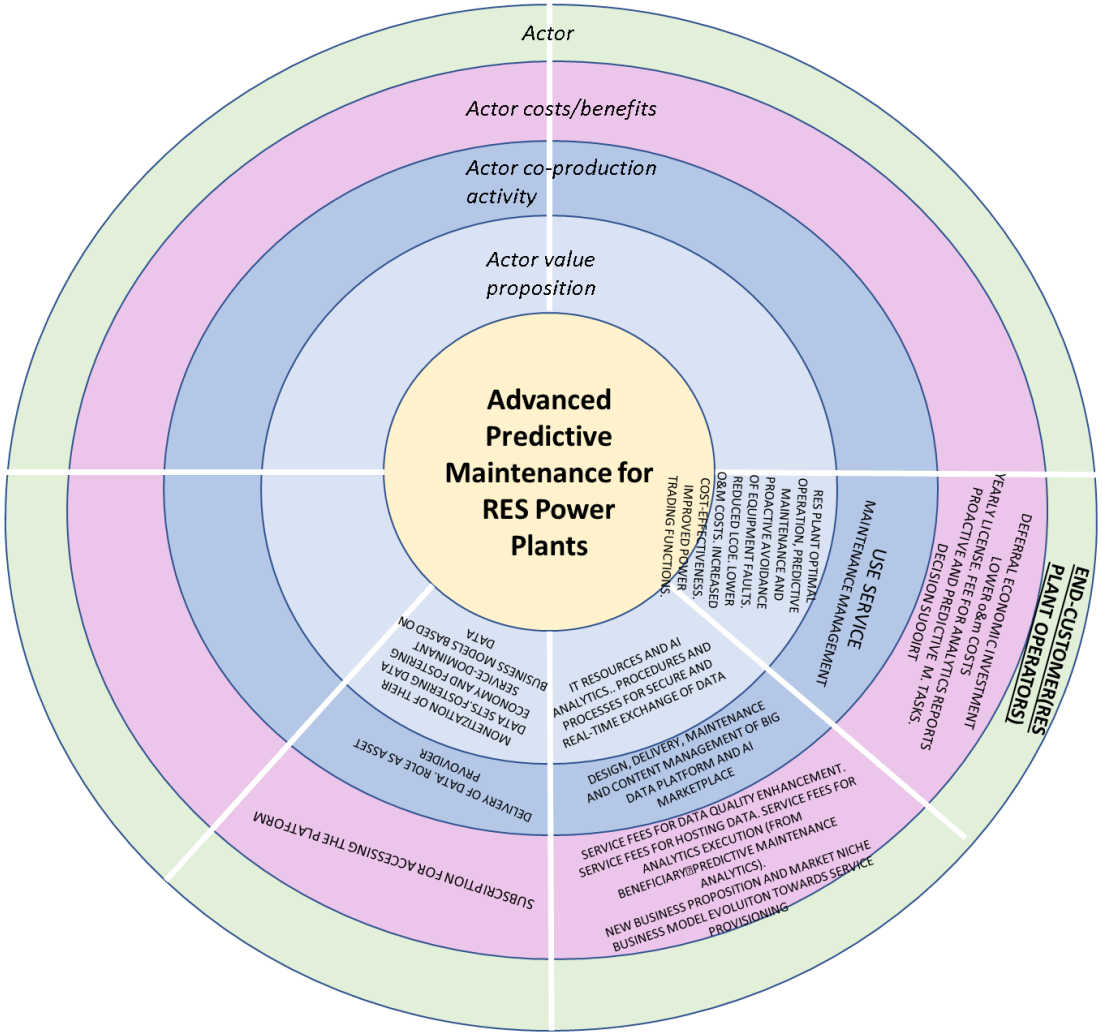


Figure 43. BM3- Data Intelligence-driven Advanced Predictive Maintenance for RES Power Plants

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

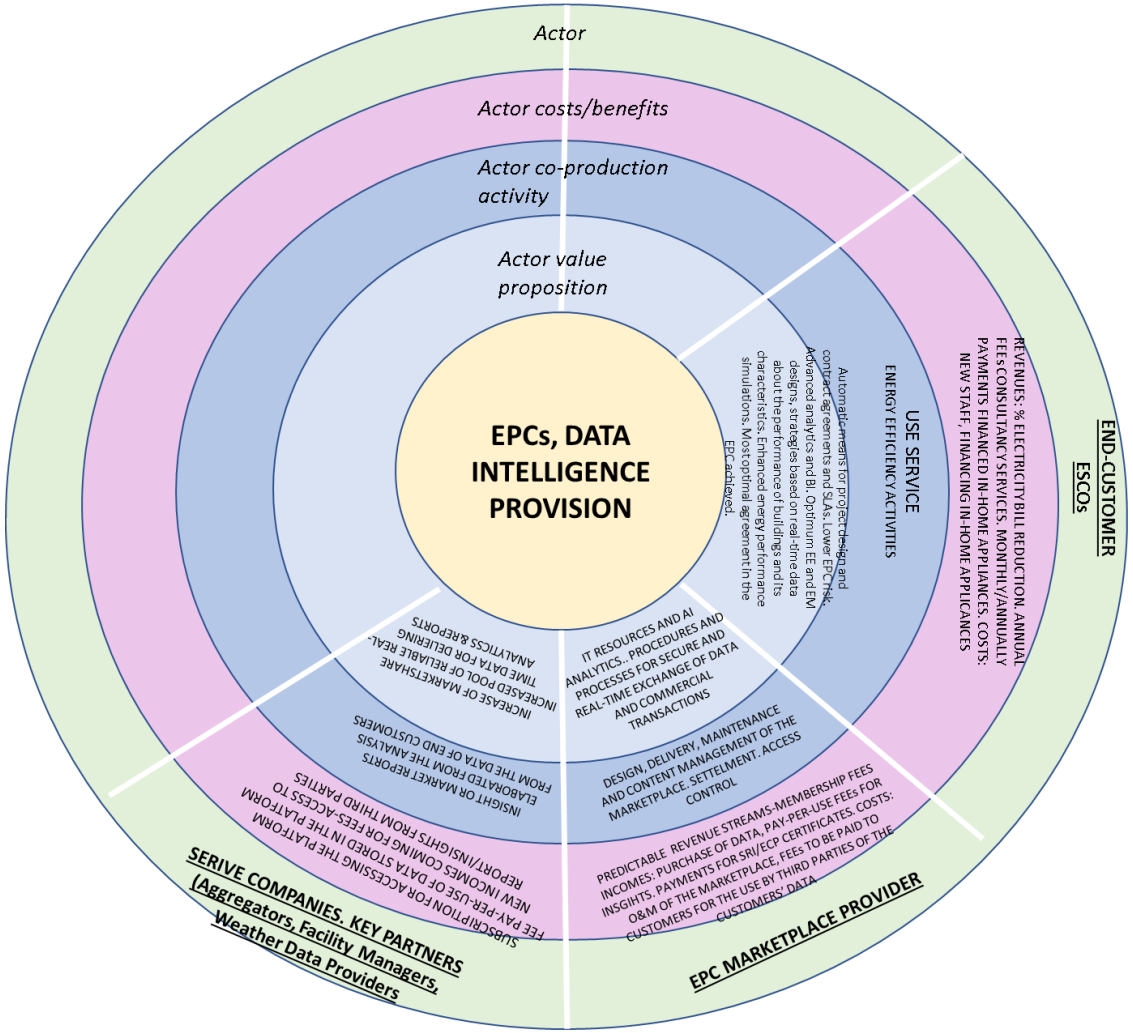


Figure 44. BM4- Dynamic Enhancement Energy Performance Certificate

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

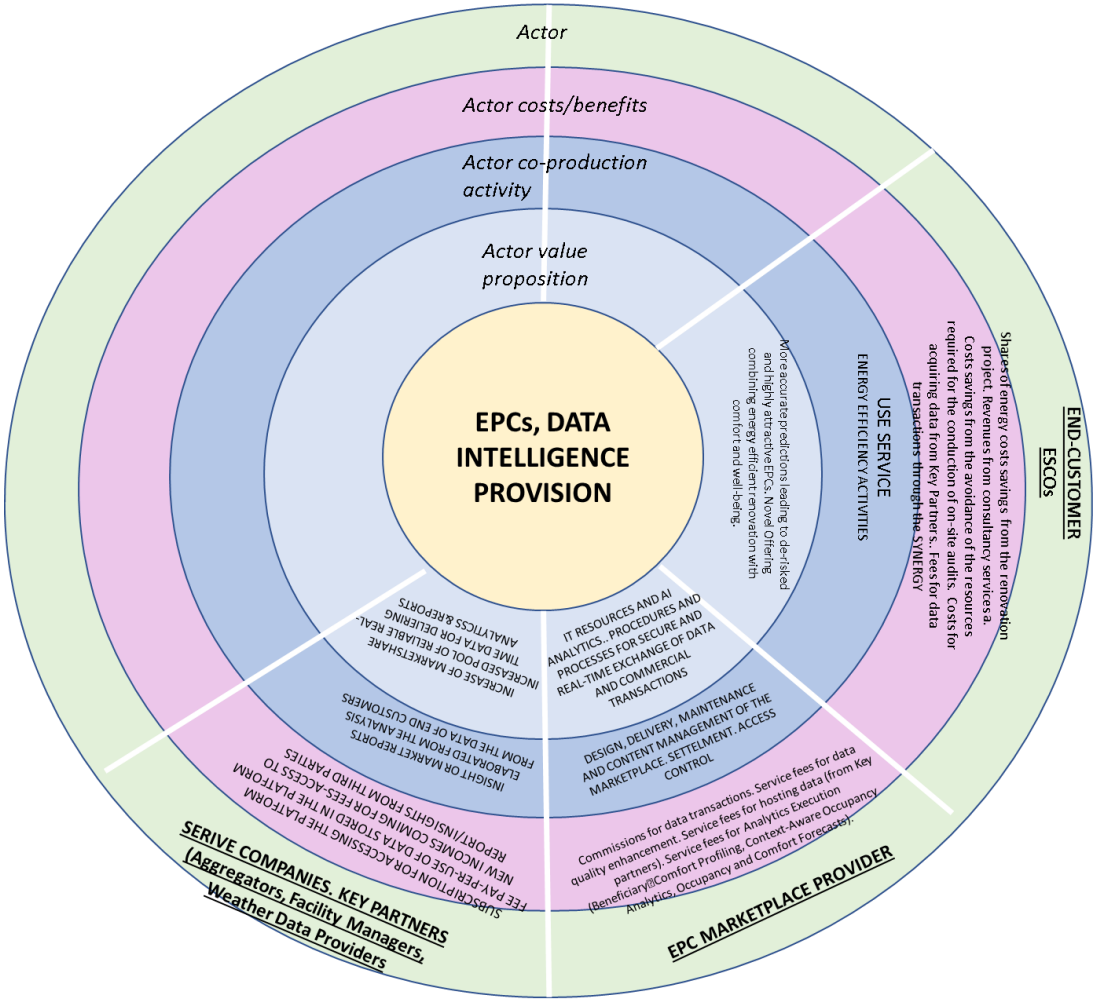


Figure 45. BM5- Synergetic Energy Performance Contracting (design)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

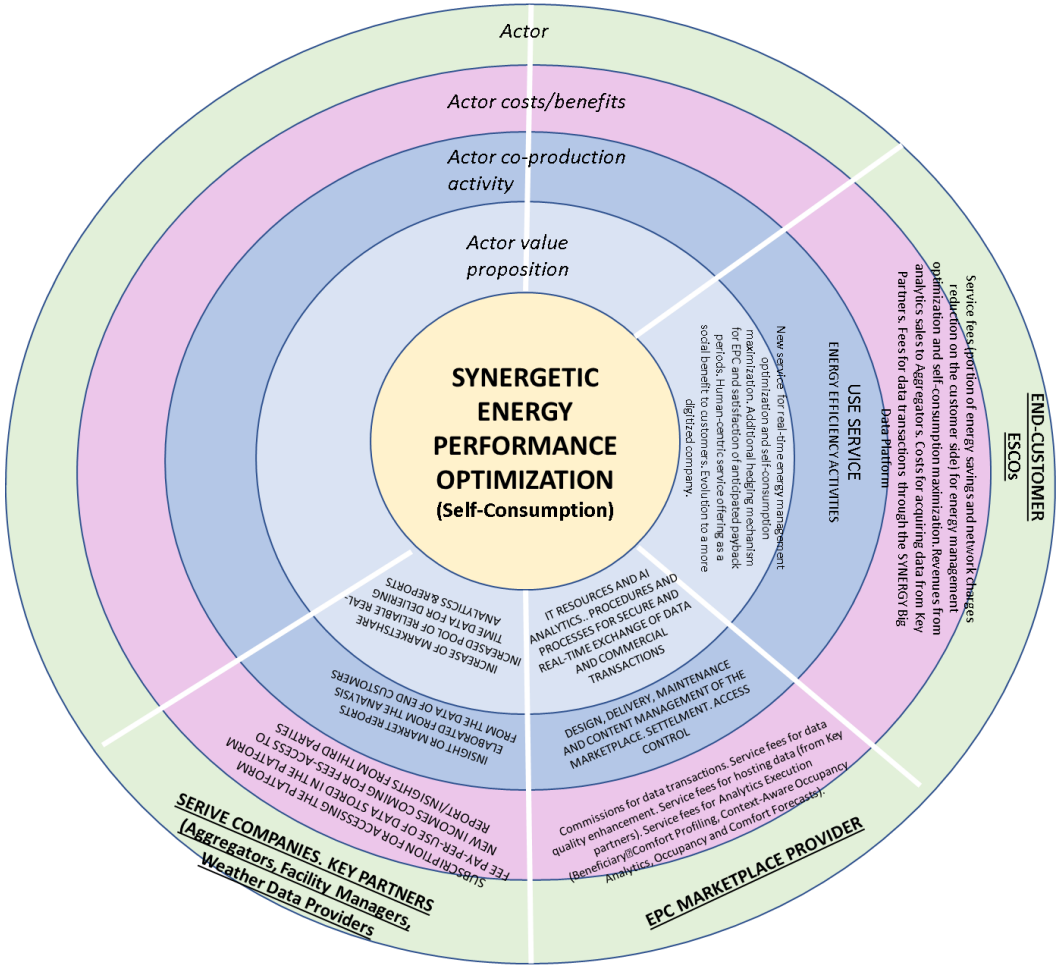


Figure 46. BM6- Synergetic Energy Performance Optimization (self-consumption)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

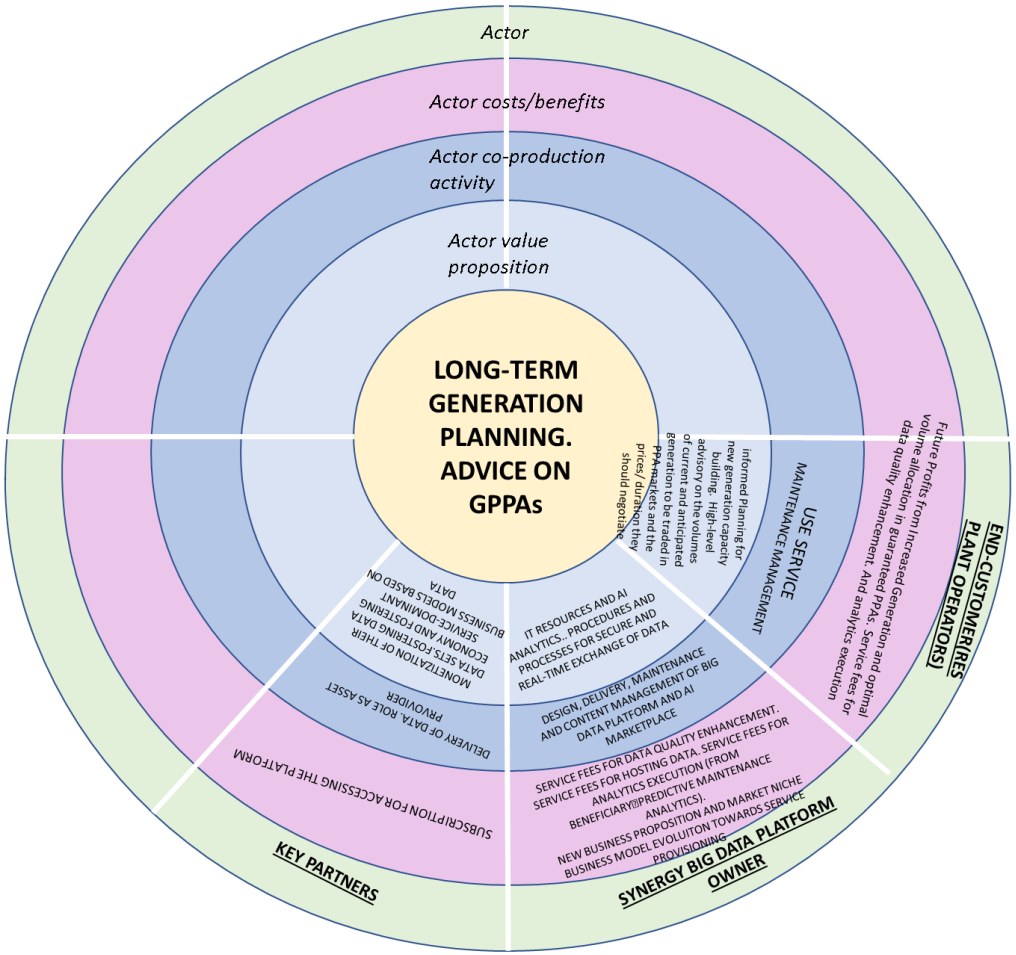


Figure 47. BM7- Intelligence-Driven long-term Generation Planning and PPAs Advisory

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

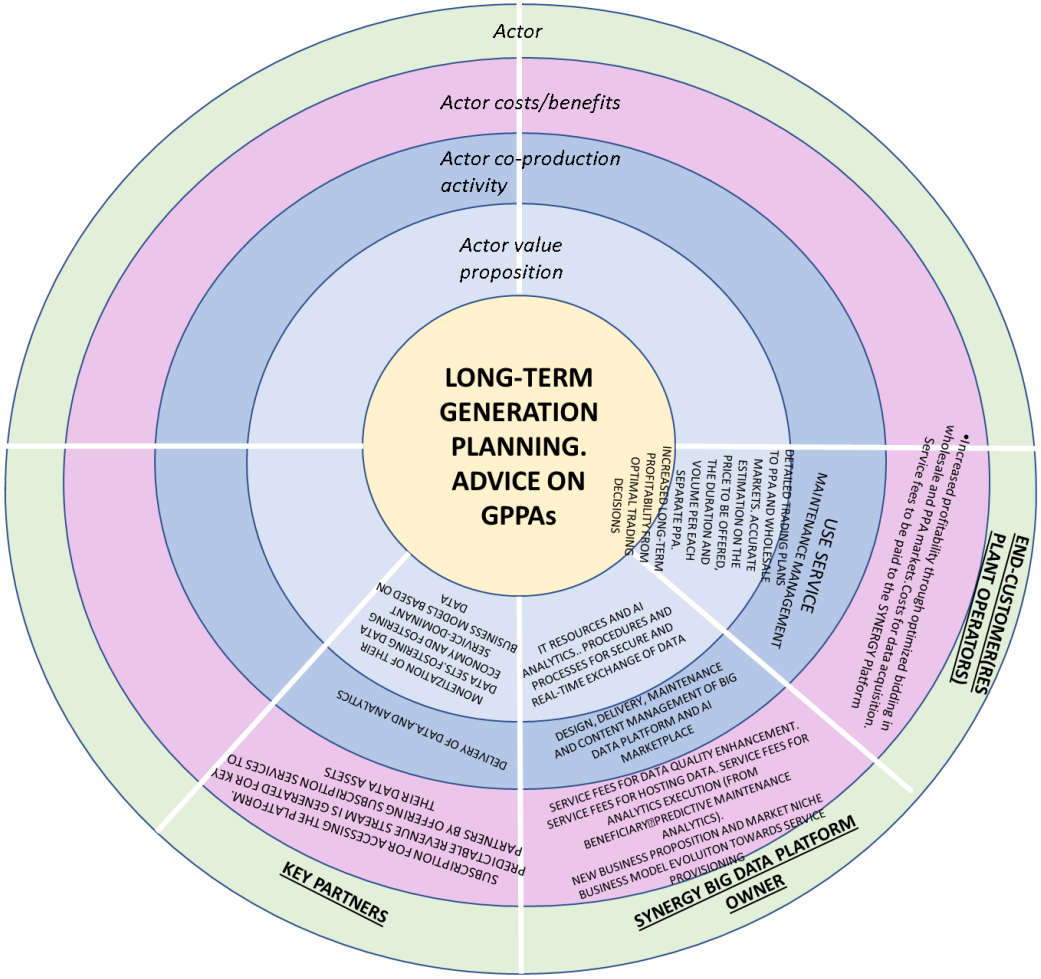


Figure 48. BM8- RES Power Plant Optimizer for GPPA Maximization

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

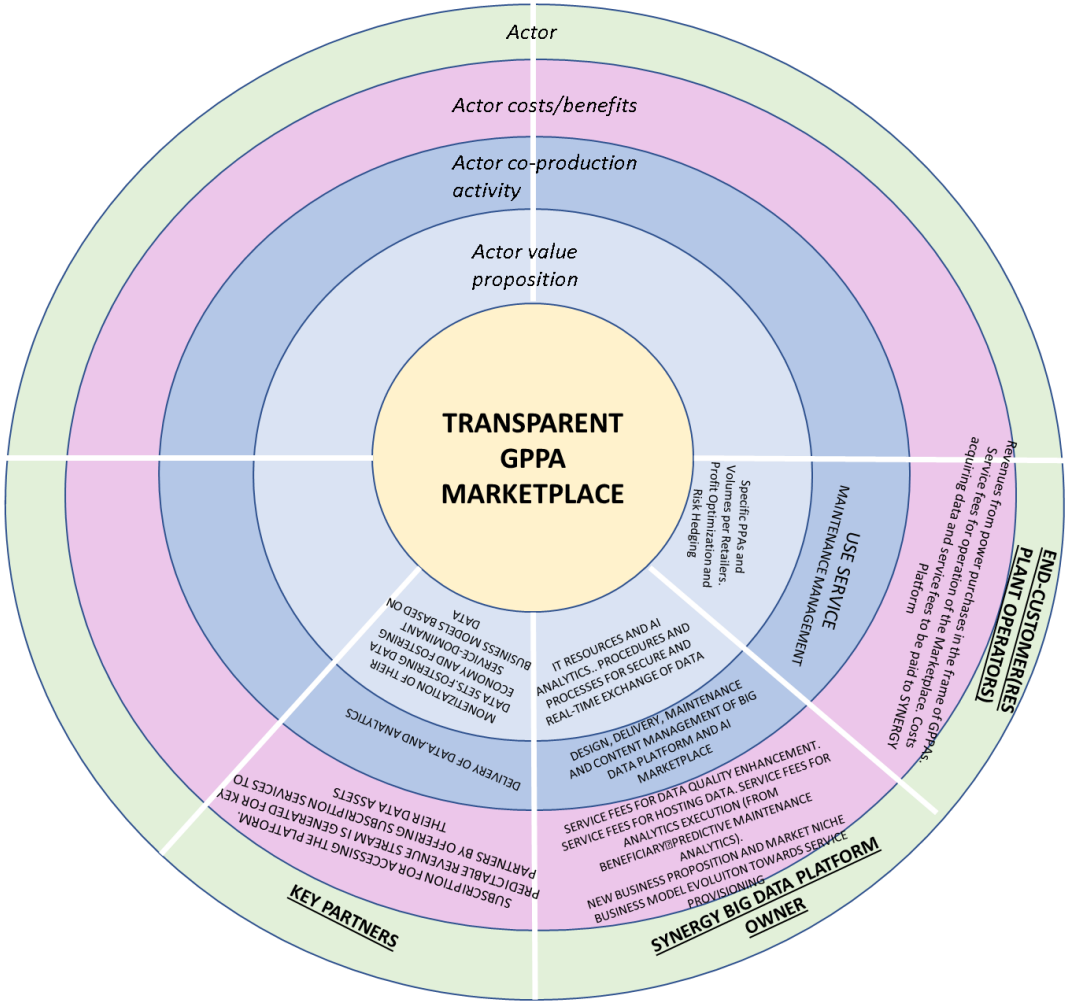


Figure 49. BM9- Transparent GPPA Marketplace

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

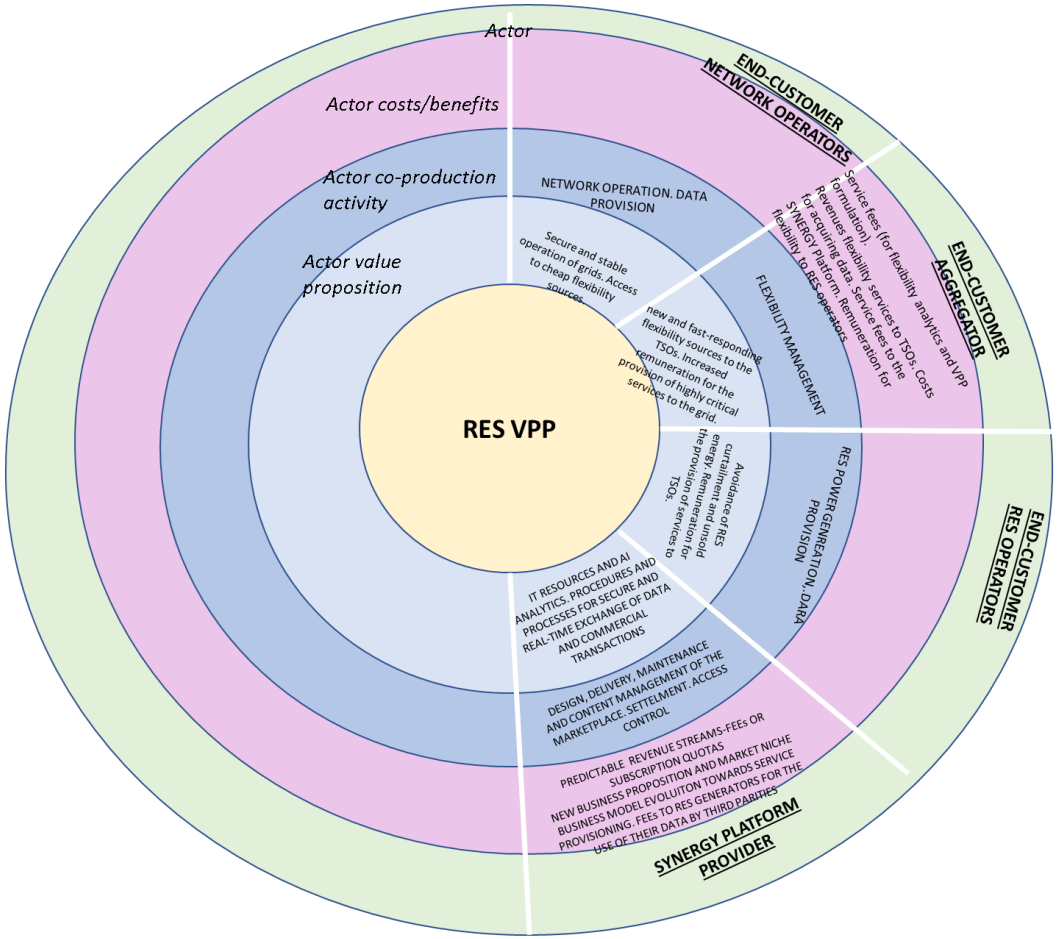


Figure 50. BM10- RES Virtual Power Plant (VPP)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

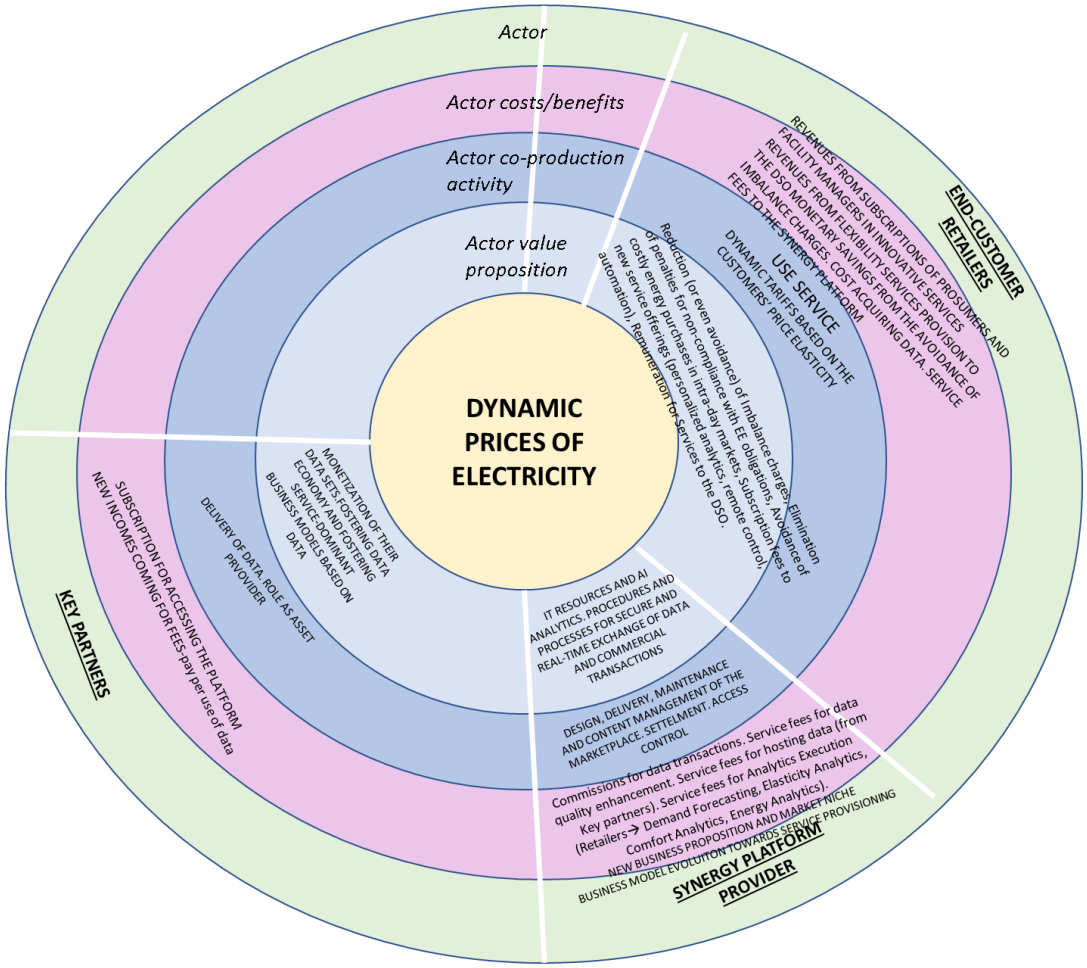


Figure 51. BM11- Objective Dynamic Pricing of Electricity

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

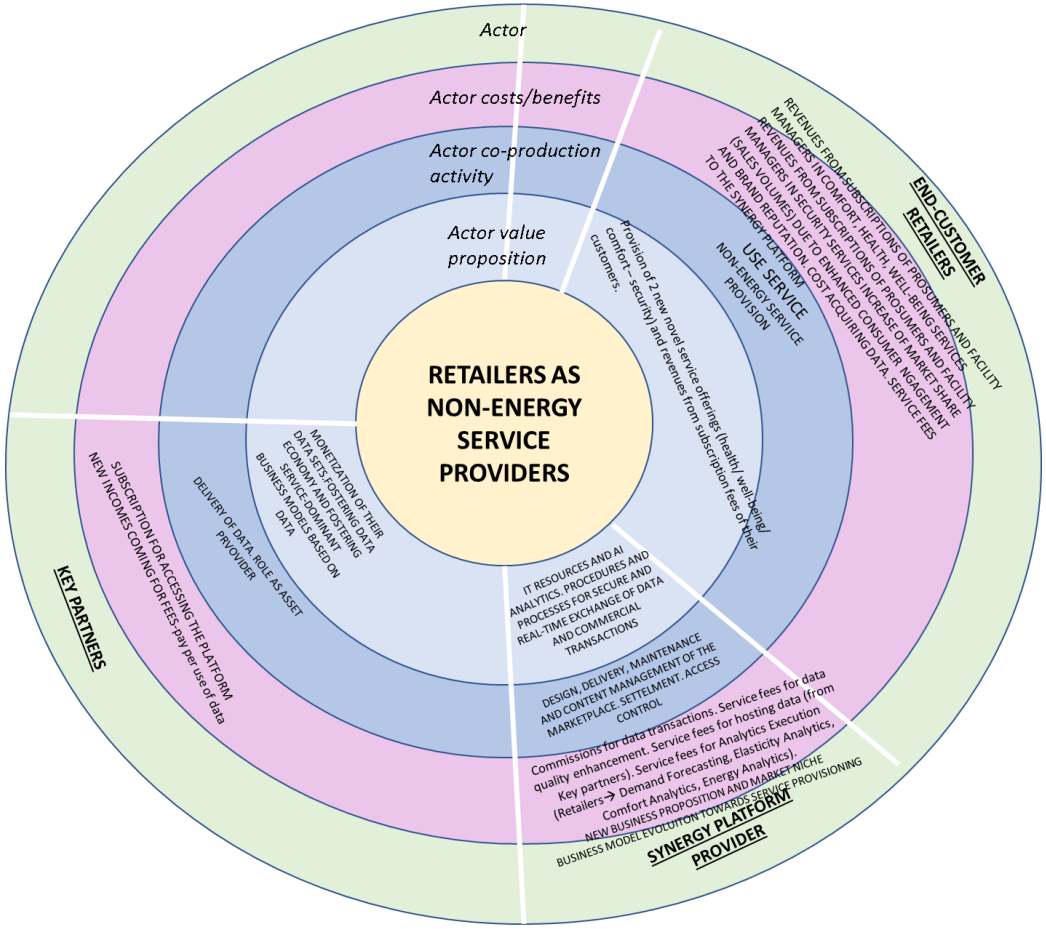


Figure 52. BM12- Retailers as Non-Energy Service Providers

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

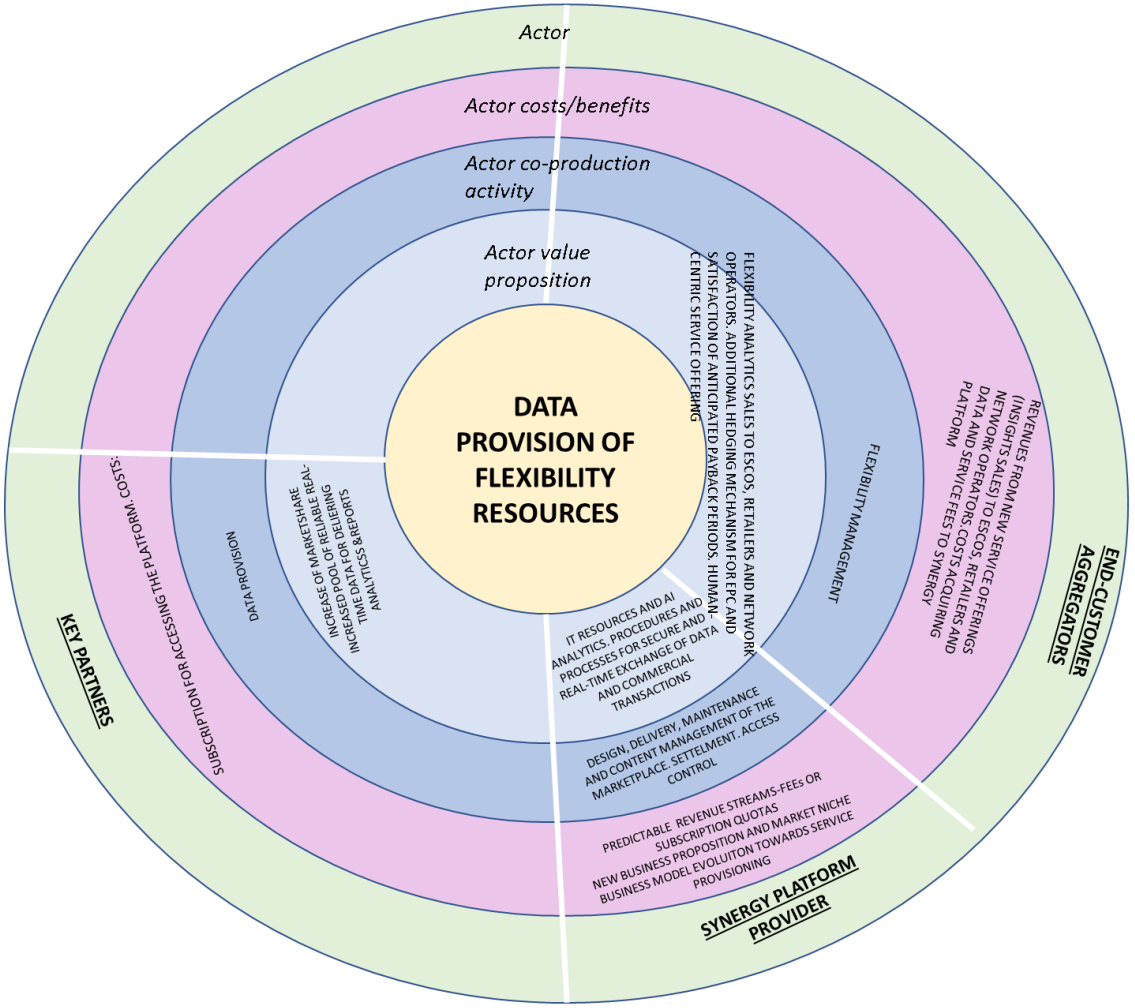


Figure 53. BM13- Flexibility and portfolio analytics (sales of insights)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

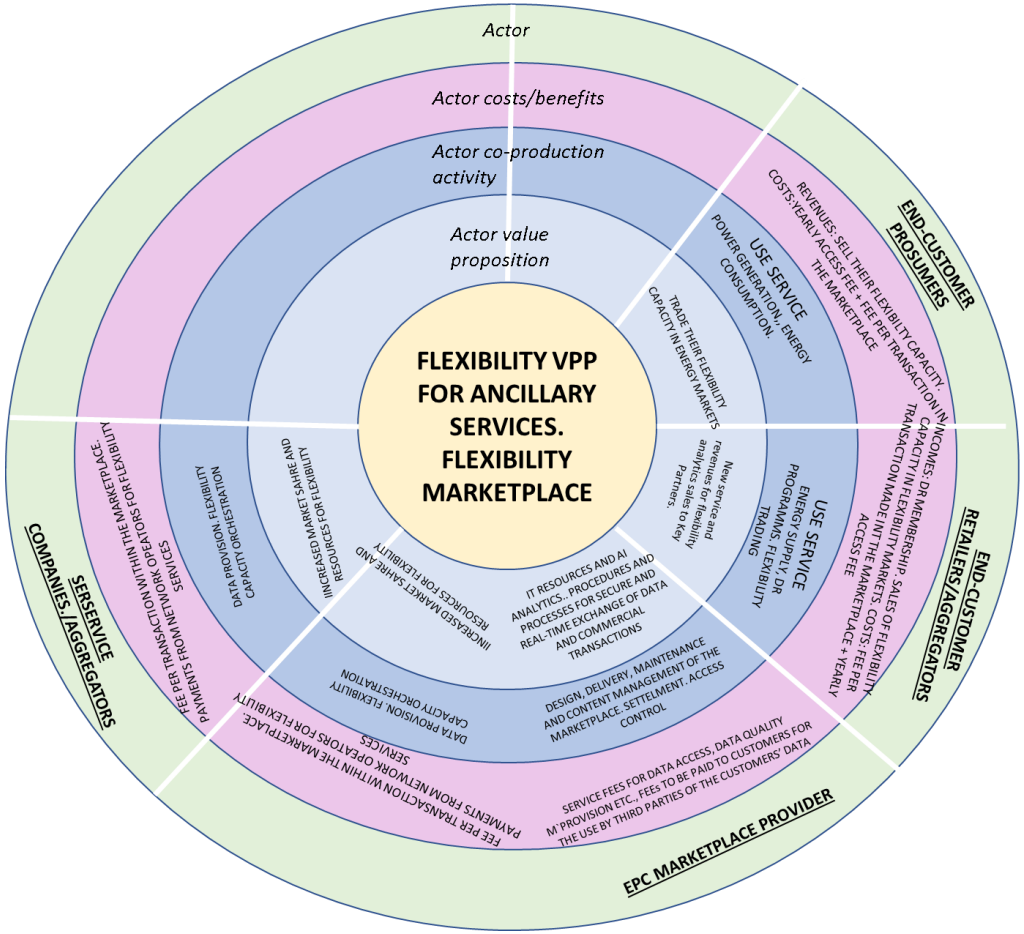


Figure 54. BM14- Flexibility VPP configuration for ancillary services

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

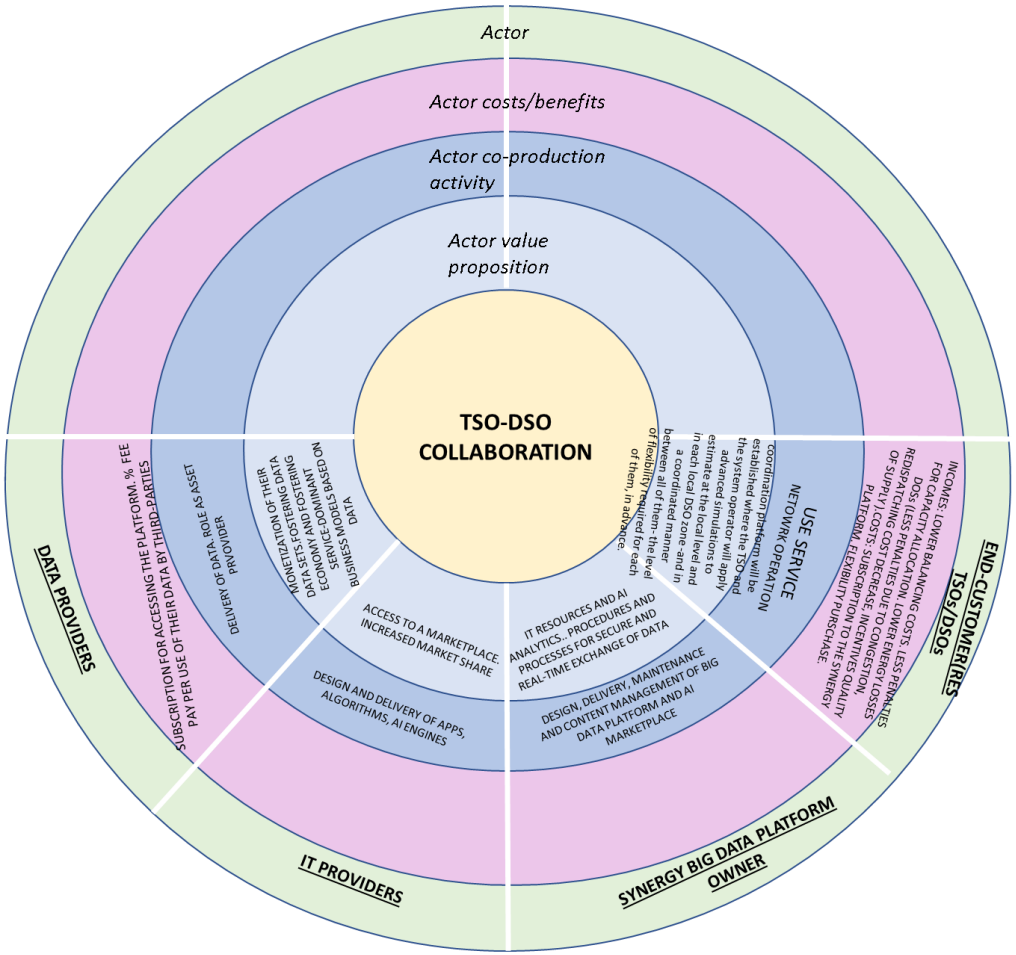


Figure 55. BM15- TSO-DSO Collaborative Network Management

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

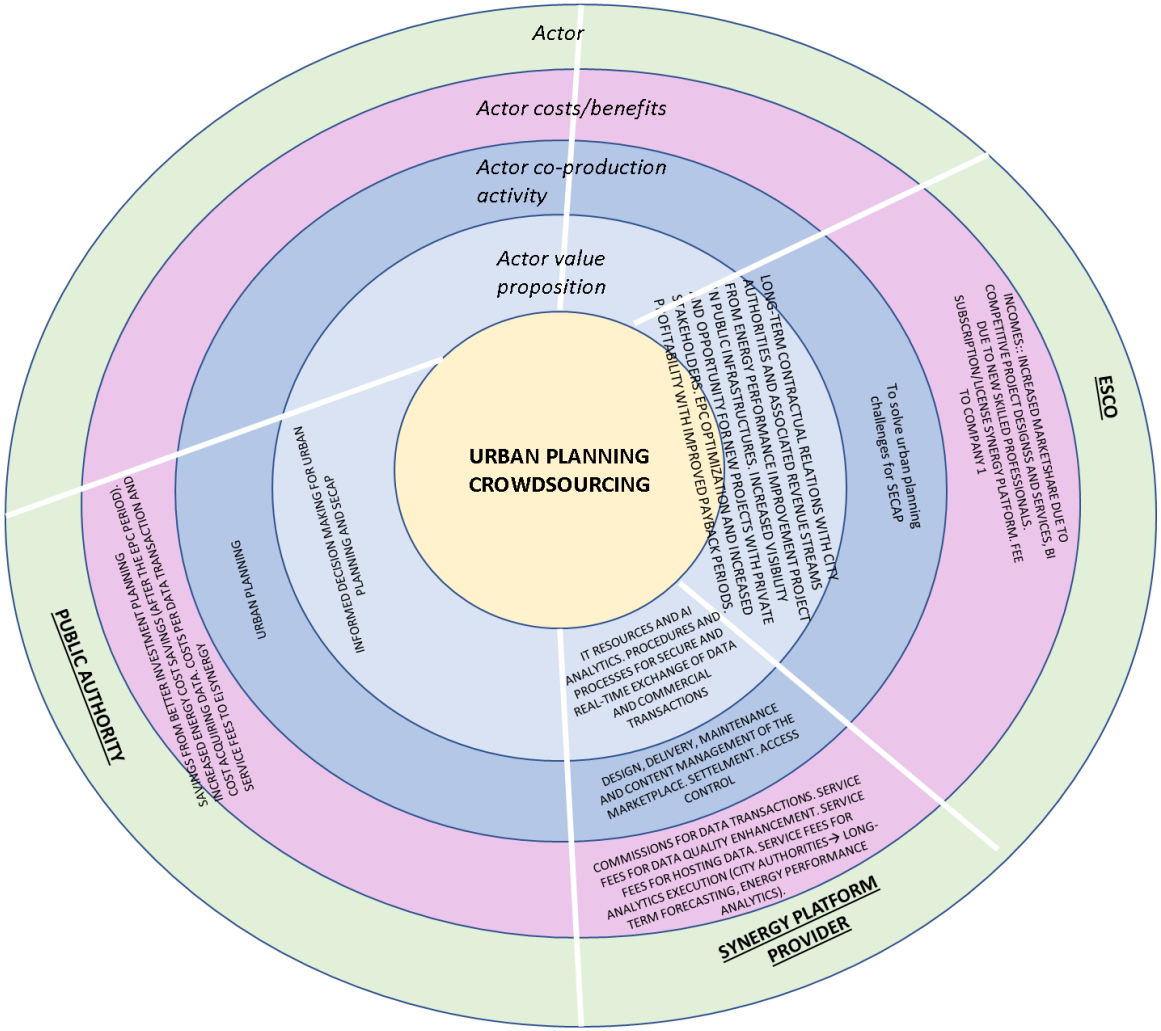


Figure 56. BM16- Urban Planning Crowdsourcing marketplace

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

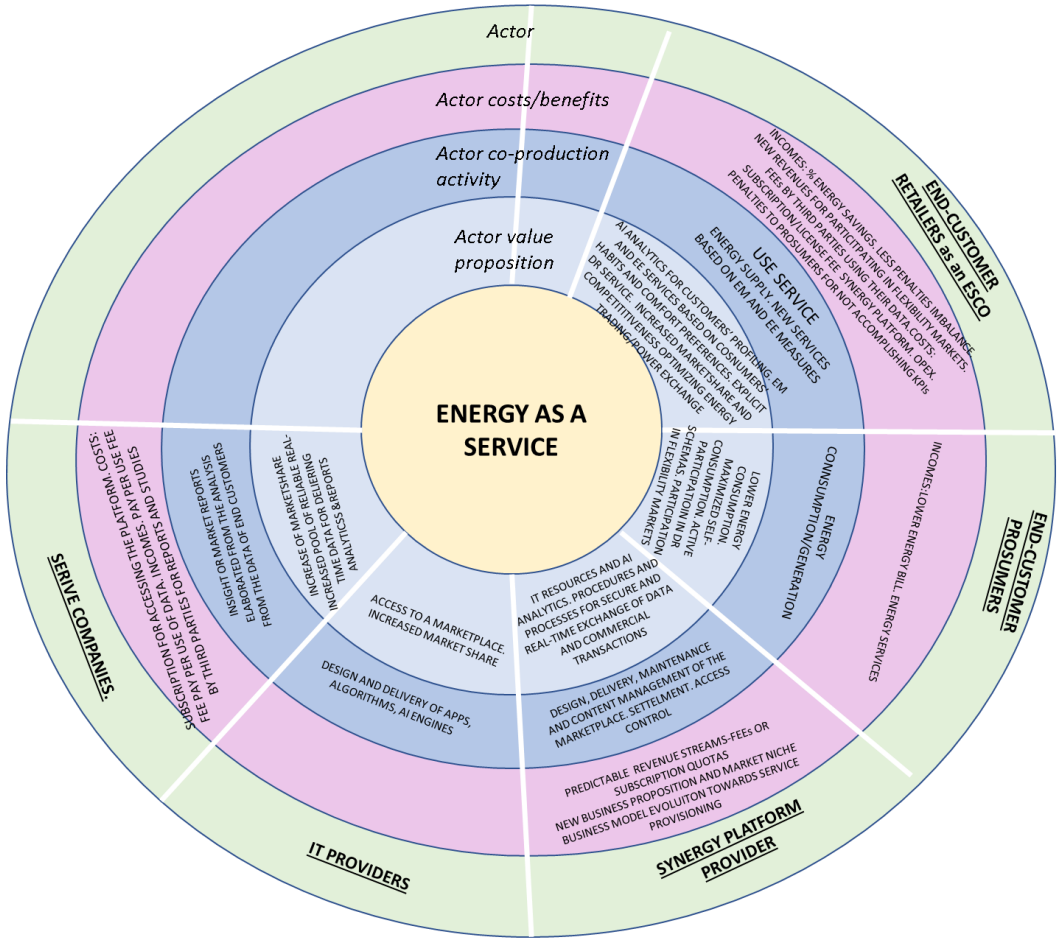


Figure 57. BM17- Synergetic Energy as a Service Model (Retailer-ESCO & Retailer-Aggregator)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.