

MAS²TERING

**Multi-Agent Systems and Secured coupling of Telecom and Energy gRIDs
for Next Generation smartgrid services**

FP7 – 619682

D1.5 <Business Strategies and Collaboration Opportunities >

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Abstract

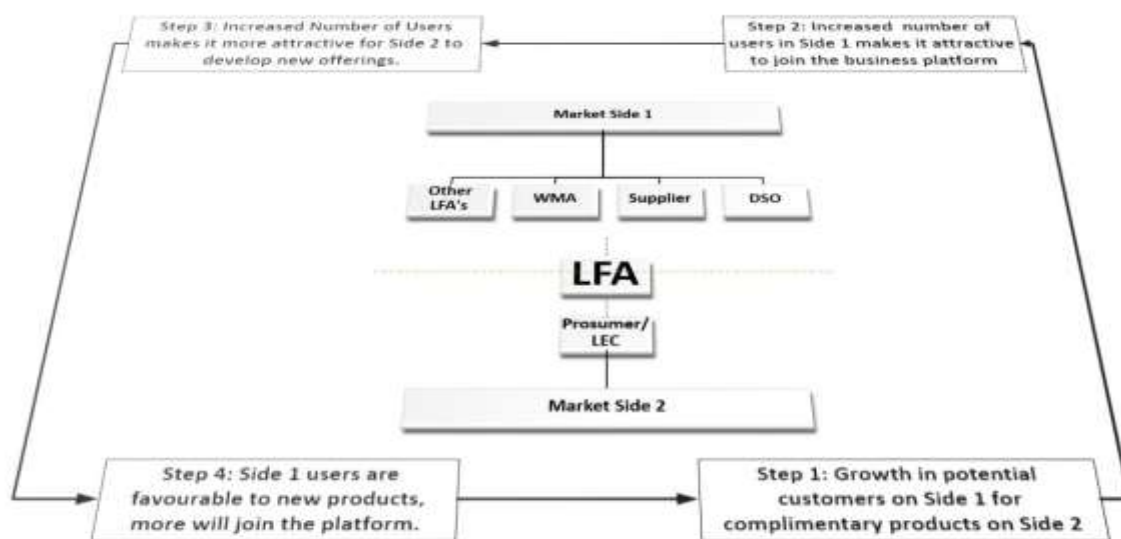
The Local Flexibility Market is presented as a multi-sided platform where the Local Flexibility Aggregator is positioned as the *'match-maker'* between energy actors who need flexibility for efficiencies and Prosumers who have engaged in demand response initiatives. The multi-sided business model provides opportunities for numerous stakeholders to exploit through potential business strategies and collaboration opportunities that evolve with transitional phases of the market's maturity. How the Mas²tering products can facilitate and penetrate this new market is presented and a business rationale and linkage is made for the project use cases.

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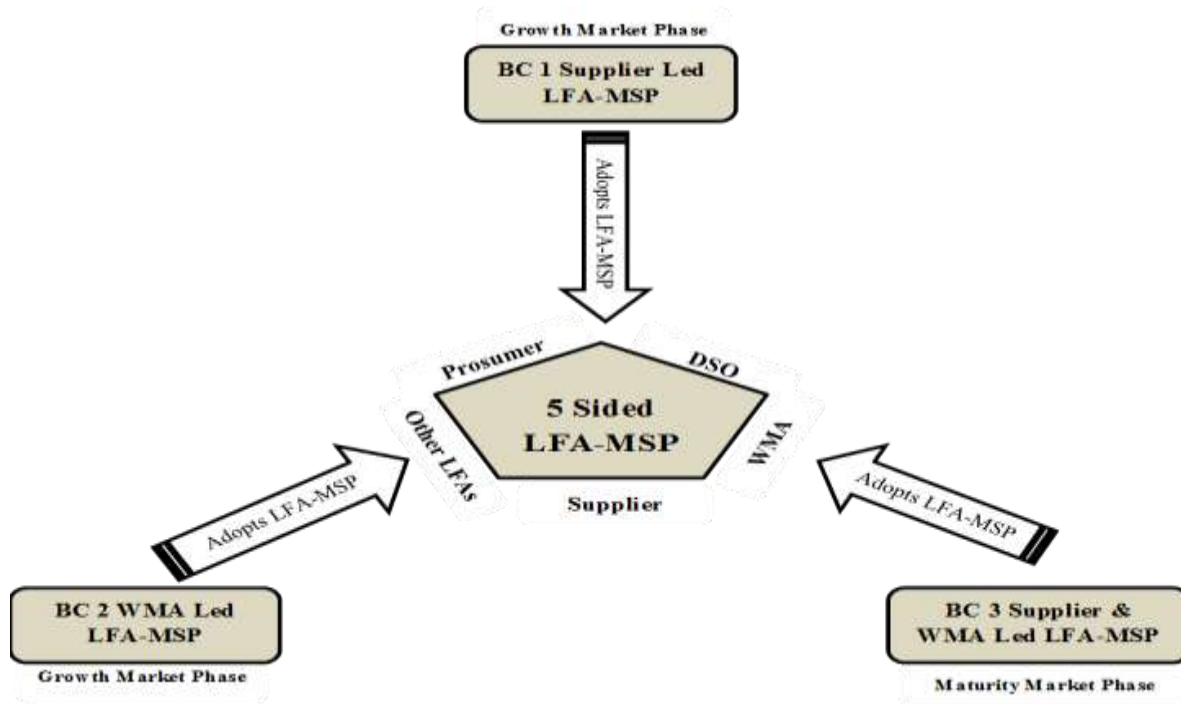
Executive summary

Based upon primary research conducted with industry representatives across the value chain, this report presents the results from T1.2 and provides a roadmap of potential business strategies and collaboration opportunities between actors for LV Grid Flexibility Management in the context of a market place in transition from a non-functioning flexibility market of today to a functioning flexibility market of tomorrow.

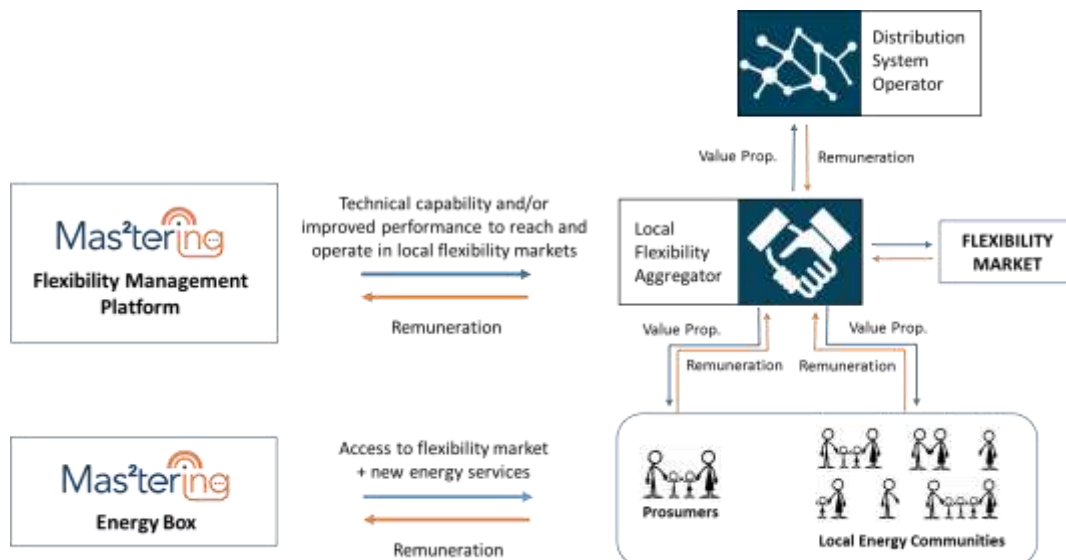
The report starts with conceptualising the Local Flexibility Market Model from a multi-sided platform perspective as illustrated in the Figure below. The report gives a detailed description of the entities, roles, structure and functioning of the new flexibility market design. Central to the market model are: Prosumers, Local Energy Community (LEC), Local Flexibility Aggregator (LFA), Supplier, Wholesale Market Aggregator (WMA) and Distribution Service Operator (DSO).



Next, utilizing the business modelling methodology of value network analysis, the report details the value flows within the context of a multi-sided platform to understand how value is created, delivered and captured in a network of interdependent relationships. This facilitated the development of a five-sided business model for the LFA as illustrated below. The report also provides detail around mini-business models for each customer side (Prosumer; DSO; WMA, Suppliers & Other LFAs) in order to signify their own distinct product offerings which require unique value propositions and the individual revenue streams that they create for the LFA. Regarding the LFA multi-sided business model (LFA-MSP) as the business opportunity, this report then identifies the business strategy and rationale for an actor or actor collaborations to adopt the LFA business model. This forms the basis for three potential business cases to be identified that correlate to the project use cases. These are a supplier-led assumption of the LFA-MSP business model opportunity (Growth Phase), a WMS-led assumption of the LFA-MSP (Growth Phase), and a combined or paired assumption of the LFA-MSP (Maturity Phase). Business strategies and collaboration opportunities also account for the evolution of the local flexibility marketplace where it is today, to pass through a growth phase and eventually to a fully functioning flexibility market in the maturity phase.



Finally, this document provides a description of the Mas²tering product and business model and how it relates to a multi-sided market place, the Local Flexibility Aggregator, Wholesale Market Aggregator, Local Energy Communities and Prosumers.



The findings from this report provide direct input to the business model validation activities in the next WP1 deliverable (D1.7 Mas²tering Business Models) where a cost benefit analysis will be conducted on the business cases identified.

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Abstract (for dissemination)	The Local Flexibility Market is presented as a multi-sided platform where the Local Flexibility Aggregator is positioned as the <i>'match-maker'</i> between energy actors who need flexibility for efficiencies and Prosumers who have engaged in demand response initiatives. The multi-sided business model provides opportunities for numerous stakeholders to exploit through potential business strategies and collaboration opportunities that evolve with transitional phases of the market's maturity. How the Mas ² tering products can facilitate and penetrate this new market is presented and a business rationale and linkage is made for the project use cases.
Keywords	Smart Grid, Low Voltage Grid, Local Flexibility Market, Business Models, Flexibility Management, Business Models, Multi-Sided Platform, LV Flexibility Grid Management, Business Strategies, Collaboration Opportunities, Local Flexibility Aggregator, Wholesale Market Aggregator, Supplier, Local Energy Communities, Prosumer.

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Abbreviations

BC	Business Case
BEMS	Building Energy Management System
BRP	Balance Responsible Party
DER	Distributed Energy Resources
DG	Distributed Generation
DM	District Management
DNO	Distribution Network Operator
DoW	Description of Work
DR	Demand Response
DSO	Distribution System Operator
ESCO	Energy Service Company
EV	Electric Vehicle
ICT	Information Communication Technologies
IT	Information Technologies
KPI	Key Performance Indicator
LEC	Local Energy Community
LFA	Local Flexibility Aggregator
LFM	Local Flexibility Market
LV	Low Voltage
MAS	Multi-Agent Systems
mDEM	Mas²tering District Energy Management Platform (and Market Model)
MSP	Multi-Sided Platform
MV	Medium Voltage
PV	Photovoltaic
RES	Renewable Energy Systems
SGAM	Smart Grid Architectural Model
TSO	Transmission System Operator
UC	Use Case
USEF	Universal Smart Energy Framework
VNA	Value Network Analysis
WMA	Wholesale Market Aggregator
WP	Work Package

Definitions

- **Business Case:** The business rationale for the consideration or implementation of a business model by specific actors at a specific point in time.
- **Balancing services:** services required to ensure that electricity demand and generation are always balanced in operative condition. Any unbalance induces frequency deviations. Energy balancing is managed at BRP level through financial incentives, national level by TSO and European level by ENTSO-e.
- **District/LV sub-grid:** portion of the LV grid supplied by a single MV/LV transformer.
- **Energy Box:** commercial device to be installed in residential and small commercial premises, able to communicate with smart appliances and technologies and with the smart meter. The device can provide the resulting actual consumption/generation data to third-party components and can optimize home load scheduling according to external signals.
- **Local Energy Community (LEC):** collection of consumption and/or production nodes that are managed by a single energy management entity. The nodes of a local community belong to a portion of the grid supplied by an individual MV/LV transformer but several local communities, each related to an energy management entity, can coexist in the same geographical area.
- **Local Flexibility Aggregator (LFA):** the LFA represents a local community of Prosumers within the Mas²tering framework.
- **Local Flexibility Market (LFM):** a marketplace that allows the trade of local flexibility between parties.
- **Mas²tering Flexibility Management Platform:** An ICT platform developed for use by the Local Flexibility Aggregator that coordinates and optimizes signals in the LV portion of the grid using multi-agent systems.
- **Multi-sided platform:** A platform that creates value by matchmaking between two, or more, sets of customers who can both buy and sell from each other.
- **Neighbourhood:** collection of consumption and/or production nodes belonging to the same geographical area (e.g. all consumption/production nodes of a street); oppositely to a local community, that relates to the energy management entity, a neighbourhood includes all nodes located in the concerned area, regardless of their energy management entities.
- **Prosumer:** this indicates an active consumer that is able to provide flexibility.
- **Scenario Planning:** is a strategy planning process of forecasting what future market conditions and events are probable in order to understand consequential effects and the actions required to respond to those conditions from a strategic perspective.
- **Value Network Analysis:** a methodology for understanding, visualizing, and optimizing internal and external value networks, relationships, and complex ecosystems.
- **Wholesale Market Aggregator (WMA):** is a demand service provider that combines multiple short-duration consumer loads for sale or auction in organised energy markets.

1 Introduction

1.1 Purpose, Scope and Objectives of Deliverable

Central in Mas²tering are the ideas that Low Voltage (LV) grid flexibility management is needed to meet EU grid targets and that Multi-Agent Systems (MAS) are an appropriate tool for the decentralized optimization and implementation of signals in the LV grid. To harness the flexibility potential of individual Prosumers into useful quantities, aggregation is needed. In the LV grid, Mas²tering designates a Local Flexibility Aggregator (LFA) which operates below the substation level as the mediator between the Prosumer and the flexibility market. Prosumers may also bind together into Local Energy Communities (LEC) which also have the purpose to act in a collective way and these LECs may naturally pair with an LFA. The LFA is envisioned to work bi-laterally with its local Distribution System Operator (DSO) and also to become part of a Wholesale Market Aggregators (WMA) portfolio. In this view of the Local Flexibility Market (LFM), Prosumers and local energy communities will become active and important grid participants, ensuring that flexibility is first used for in-home optimization, next traded at local level to bring added value to Prosumers and support DSOs in congestion management and then aggregated for wholesale markets (e.g. WMA).

The LFM that is emerging contains elements of a platform market, where there is a real need and high added-value for one or more *'match-making'* intermediaries between energy actors who need flexibility for efficiencies and consumers who have engaged in demand response initiatives. In Mas²tering, this *'match-maker'* is the LFA. Matchmakers are different from classical *'one-sided'* utility models involving the reliable and universal sale of energy at reasonable prices by Suppliers to consumers. Instead, the value of the *'matching service'* provided by the LFA at the LV level is that they bring together different groups of actors and facilitate the interactions between those customers. For this reason, these type of business models are often referred to as *'two-sided'* or *'multi-sided platforms'* (MSP) [1]. In essence, they are the point of contact or broker where different actors can interact and do business.

Given the importance of the LFA to the implementation of the Mas²tering project and its technologies, the aim of this report is to develop the business rationale for an actor or actor collaborations to adopt the LFA business model (LFA-MSP) and to set the bases for the formation of business cases that can be validated through a cost benefit analysis in the next stage of this work package. In particular, this document:

- Presents a conceptualisation of the LFM as a multi-sided platform. In **Section 2**, the characteristics of the LFM are described. The discussion centres on the roles of the key actors, the functions and activities of the LFA and who will occupy the central position of the LFA.
- Develops a concrete proposal of the LFA multi-sided business platform (LFA-MSP). **Section 3** provides an understanding of how the LFA-MSP will function, from whom it can create revenue, and what the challenges exist to its creation in the marketplace. The LFA-MSP has five customer sides - Prosumers, WMA, Supplier, DSO, other LFAs. For this business model to be successful, the LFA must have on board a critical mass of

Prosumers on one side in order to be attractive for actors on the other side and it must do so within a timeframe in order to prevent actors leaving the platform before others join. In this fashion, the value to customers on one side of the platform typically increases with the number of customers on another side.

- Identifies plausible examples of actor-led LFA business model scenarios. Utilising strategic forecasting analysis and scenario planning in **Section 4**, the evolution of the local flexibility marketplace is mapped in order to understand the potential business strategies and collaboration opportunities of the key actors within the LFM. In this regard, we viewed the LFA-MSP as the business opportunity and actor business strategies and collaborations as the means to ignite the LFA-MSP. Three actor-led-LFA-MSPs emerged, explicitly a Supplier-Led LFA, a WMA- Led LFA and a Participatory Supplier & WMA-Led LFA.
- Formulates the basis for several business cases. In **Section 5**, based on the business model scenarios presented, three business cases are identified that are correlated to the project use cases and which can be developed and validated in the next stage of this work package. The Mas²tering product and business model and how it facilitates the implementation of an LFA-MSP is also discussed.
- Finally, in **Section 6**, the main conclusions from the deliverable are summarised.

In order to keep the core document compact, only the principal findings from our primary research are presented in the document's main body. However, although separate from the core document, the Annexes contain findings and insights that are important to a full comprehension of the LFA-MSP scenarios presented. In particular, the description of the business modelling methodology of Value Network Analysis is presented in Annex A. Detailed description of the value flows (i.e. energy, settlement, data, relationship type and marketing) that were utilised to build the LFA-MSP are presented in Annex B.

1.2 Relationship with other Project Tasks and Deliverables

This deliverable is the output of Task 1.2 (Business Strategies and Collaboration Opportunities) In parallel, Task 1.1 (Project Workshop Series) and Task 1.3 (Business Model Development and High-Level Requirements Elicitation) are ongoing which provide input to this report and also receive output from this report. Overall, WP1 is placed at the front of the project and continues along its length so that the project places focus on the business relevance of the technical results.

In this regard, WP1 and D1.5 provide input to the technical development work packages WP2-WP5 (see Figure 1). In the previous WP1 deliverable D1.6 (Use Cases and Business Models Vision I) a “project storyline” was developed. This storyline was that of the individual Prosumer, the individual Prosumer acting within a local energy community, and finally the local energy community interacting with the LV grid where the DSO is participative. This storyline helped shape the project use cases. In this D1.5, a “business storyline” is developed which traces how the markets are likely to evolve from stakeholders acting independently to stakeholders acting collaboratively within a multi-sided business model. This storyline is described in Section 5 and reflects a Supplier-Led LFA, a WMA-Led LFA and a Participatory Supplier & WMA-Led LFA which can be correlated to Use Case 1, 2, & 3 respectively.

The business storyline is relevant for three reasons. First, it helps sharpen the iterative loop of development to include planning for post project TRL increase of the exploitable results. Second, and linking to WP7 where exploitation is treated, it helps make more clear the exploitation paths, what business models are viable as the market transitions and which actors are likely to engage at which phases of the market transition. Third, it provides input to WP6 and helps shape the validation planning activities to ensure both business models and technical functionalities are part of the validation plan. Lastly, business model development work in Task 1.3 and D1.5 provides direct input to the next WP1 business model release D1.7 (Mas²tering Business Models) to be released at the conclusion of the project.

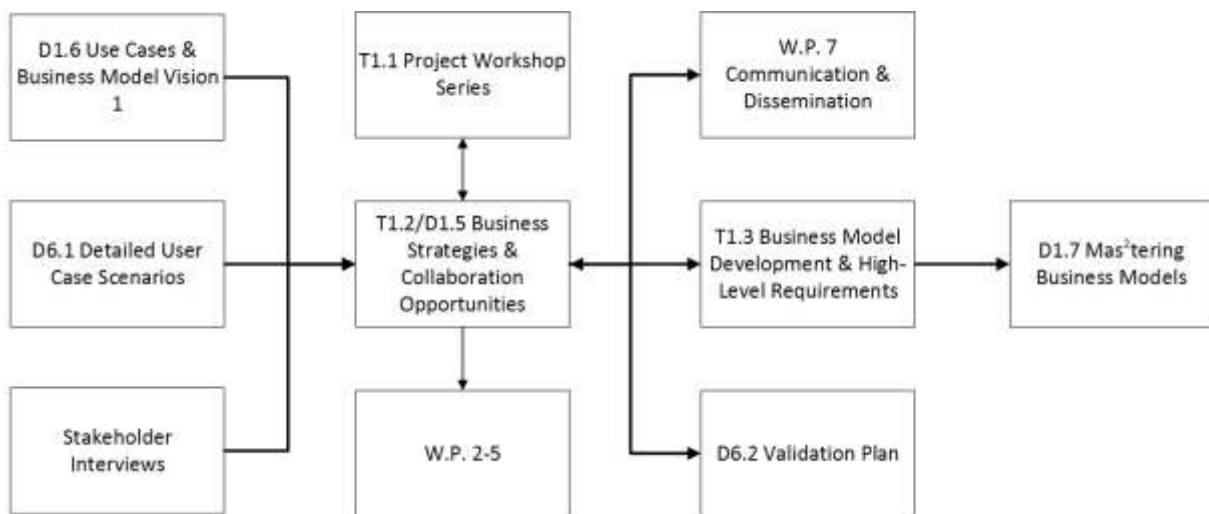


Figure 1. Relationship to Other Project Tasks and Deliverables

2 Local Flexibility Market Model: A Multi-Sided Business Platform

2.1 Conceptualising the Local Flexibility Market Model

Utilising the reference framework of USEF [2] as detailed in D1.6, Figure 2 provides a contextual and geographical representation of the LFM.

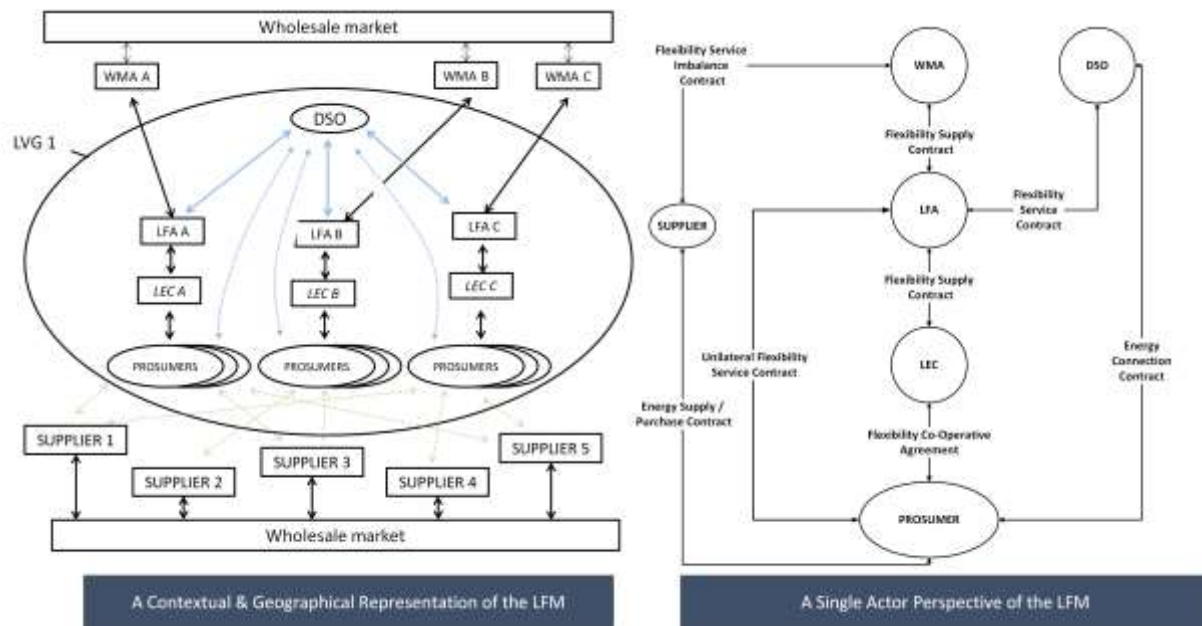


Figure 2. Market Design for the Local Flexibility Market (LFM)

The Consumer becomes a Prosumer and moves from a passive recipient of energy to an empowered and integral value chain participant offering flexibility. The scope of the Prosumer in the smart grid context is to have access to the market and use the active demand to both reduce its own consumption and get revenue from the provided flexibility. A new role of a LFA is foreseen in the energy value chain to act as an intermediary and facilitating agent between Prosumers and traditional market players. As can be seen from Figure 2, more than one LFA can operate within the geographical area. It is envisaged that the Prosumer is part of an LEC. Also illustrated above, the LEC can be considered from two perspectives. First, the Prosumers are part of an LEC because they are associated to the same LFA by an individual contract. Prosumers have no knowledge of one another and are free to choose the LFA that they prefer. However, participation to the LEC enables trading of flexibility between Prosumers managed by the LFA to guarantee privacy. In the second perspective, the LEC can be viewed as a more self-organised entity or cooperative (such as a building block) where Prosumers are a member and collaborate together for more efficient energy supply and services.

In essence, the LFA services an LEC who through their own smart technologies will also become an integral part of the value chain as providers of flexibility. Each Prosumer will use flexibility provided by his/her own smart technologies to reduce the costs associated with the energy bill of his/her house.

According to the specific set of smart technologies, renewables or storage systems present, Prosumers will likely use flexibility to self-consume renewable energy or to move loads to times when the cost of electricity is lower or potentially for more complex management strategies. In most cases, the reduction of the energy bill will be the first driver for Prosumers to change their load profile. However, besides using it in the house, Prosumers can decide to offer their flexibility as a product to other actors. Members within the LEC will be able to trade flexibility with each other in order to minimize the individual costs associated to their energy bill. One Prosumer will not only benefit from the flexibility provided by its own smart technologies, but will also benefit from lower rates offered to the LEC at large or be able to buy the flexibility provided by the other Prosumers of the same community when needed.

The LFA is responsible for acquiring flexibility from Prosumers, aggregating it into a portfolio, creating services that draw on the accumulated flexibility, and offering these flexibility services to the other market participants such as the WMA, DSO and other LFAs. Local flexibility is at the cornerstone of this new energy market design and is the focus and added value of Mas²tering. The argument being proposed is that at a local level a decentralised approach offers advantages over a centralised approach and that local optimization of flexibility provided by the LFA ensures that flexibility is first used for in-home optimization; second traded at local level and; third aggregated to be sold locally to DSO for congestion management and LV grid optimization or externally to wholesale market actors (e.g. WMA). For the DSO that provides services to a LEC, it is possible to use flexibility in an aggregated - but still local - form to cope with local congestion problems and capacity requirements. The DSO benefits from the local flexibility market in two ways. First, a more efficient and reliable distribution of electricity is possible because better balancing and predictability is attained at the local level. Second, investments to increase the capacity of the network can either be delayed or potentially avoided.

2.2 Reconceptualising the Market Model as a Multi-Sided Platform

Within the LFM model presented, the LFA clearly holds the central position and provides the link between the supply of Prosumers flexibility on one side and demand for flexibility by the market players on the other side. From a business and market modelling perspective this type of market design is referred to as a two-sided or multi-sided business market. In essence, Multi-Sided Platforms (MSPs) bring together different sets of actors who might otherwise not get the chance to engage with each other [3]. Flows of interactions can travel from one side of the market model to the other and in a multi-directional fashion. MSPs facilitate these interactions by providing the infrastructure to enable engagement and setting the regulations required to govern transactions between the multiple sides. MSPs have existed throughout history: think of the cattle mart in an old town square, facilitating and profiting from interactions between cattle buyers and sellers. A more modern example is Airbnb, which connects dwelling owners with renters [4]. Their prominence has soared significantly in recent times due to advances in information technology which has facilitated gaining access to both sides of the market and new opportunities to build successful platforms are arising in technology intensive industries [5].

2.2.1 Chicken/Egg Complexity of LFA business model

Figure 3 presents a re-conceptualisation of the LFM from a MSP perspective. A unique feature of MSPs is that the value to customers on one side of the model will increase in correspondence to the number of customers on the other side. This is known as the ‘cross-side network effect’ [3]. In most MSPs there are key drivers of the network effect – that is the customer who is the most important in increasing the value of the model to the other participants. In the LFA model that customer is identified as the Prosumer [6]. The number of Prosumers in the LFA-MSP will create the value to the other customers in the model: the DSO; and the local and wholesale aggregators. With a vast amount of Prosumers on-board the LFA model would also become very attractive to other players in the eco-system, such as appliance and device manufacturers and mobile app developers. Figure 3 also shows how a multistep process stimulates these cross-side network externalities in the LFA-MSP. The challenge in the LFA business model – and for all MSPs – is that it must get both sides of the model on board to succeed, and it must do this within a sufficient timeframe so that early adopters won’t leave the platform if others fail to join [7].

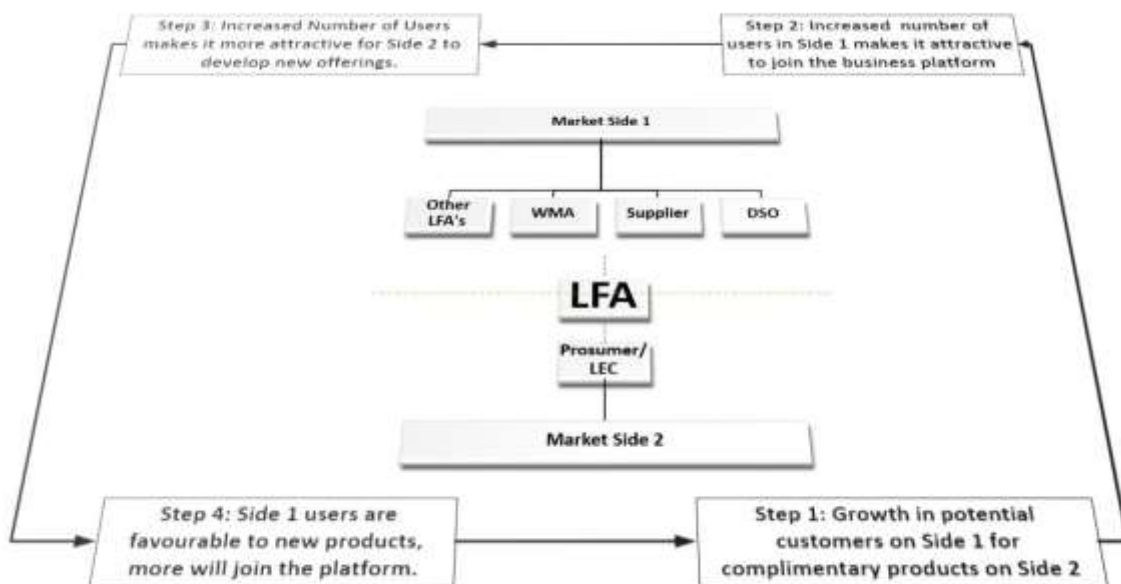


Figure 3. Local Flexibility Market as Multi-Sided Platform (LFM)

It is vital for the success of the model that a minimal number of customers be acquired in each customer group that provide enough liquidity in the market to create early and sustainable growth [8]. Once critical mass is achieved the rewards in a MSP are great: it creates a high barrier to entry; and business growth can often be exponential. But creating that critical mass can be a challenge, particularly when you consider that there is no value in the model until multiple customers are acquired, and no side will join until the other side is in place. The dot.com industry is littered with multi-sided business model failures where a critical mass of customers could not be achieved to ignite the model. Therefore, achieving critical mass is a necessary condition for model ignition. In the LFA context it is the Prosumer who is the key customer needed in order to create this critical mass. We discuss strategies to achieve this ignition in Section 4.

2.3 The Role of the Actors in the LFM

There is a significant gap between the markets of today and the LFM presented where local flexibility is used to address congestion, capacity, reliability and efficiency. The problem with the evolution to a functioning flexibility market is that they are the grids of the future and the structure of the market place is uncertain. It will see the integration of the current market-based energy system and its players with new services and roles as described in Table 1.

Table 1. Role of Actors in the LFM-MSP

Grid Actor	Roles in Classical Energy Market	Role in LFM-MSP	Objectives
Prosumer	The Prosumer is seen as a passive receipt and consumer of energy.	End users that provide flexibility. They may act through smart technologies or by changes in behavior. With renewables, they may generate to sell, self-consume or store electricity.	Save money and lower their electricity bills. Respect of comfort preferences and desired electricity use. Be more eco-friendly.
Local Energy Community	Aggregate the buying power of individual customers for energy savings. Focus on the integration of renewables.	Consumers and Prosumers that join together under a LEC to act in a coordinated way with respect to consumption, generation and storage. Financial and non financial benefits are possible. Potential to be a cooperative entity.	Save money and lower their electricity bills leveraging a community approach. Respect of comfort preferences and desired electricity use. Access to the Flexibility Market. Be part of an eco-friendly community.
Local Flexibility Aggregator	Does not exist	Central role in the MSP. Acts as an intermediary between the Prosumer/LEC and the flexibility market. Aggregates flexibility provided by Prosumer and LEC and sells it to the market players that require it.	Maximize the value of local flexibility for its portfolio, taking into account customer needs, economic optimization and grid capacity. Maximize profit. Build a client portfolio and position for cross selling opportunities between actors.
Wholesale Market Aggregator	Manage large amounts of load in a highly dispersed area in order to meet the requirements of producers, suppliers, BRPs and in line with the balancing requirements established by the TSO and the DSOs .	Will engage local agents such as LFAs to perform the customer acquisition role and local optimisation of flexibility to sell (Internal) as a product offering to the WMA who performs the wholesale market role.	Maximize the value of wholesale market flexibility for its portfolio, taking into account customer needs, economic optimization and grid capacity.
Supplier	The role of the Supplier is to source, supply, and invoice energy to its customers. The Supplier acts as the single contract point for access to the electricity market.		Maximize its benefit when sourcing, supplying and invoicing energy to its customers.
DSO	Distributes electricity at MV and LV levels and ensures quality of supply while maintaining grid stability.	Acts as a purchaser of flexibility from LFA for congestion management and voltage control.	Use LV flexibility as a tool to reduce grid congestion, further ensure the security of supply and improve network capacity planning.

The functions and activities that the LFA will perform in LFM are:

- 1 **Marketing:** Because the flexibility market is embryonic, the LFA will have to market and advertise its flexibility services to potential customers and educate the marketplace as to the benefit of engaging in flexibility.
- 2 **Creating Customer Empowerment:** Creating flexibility on the customer side will be the key to success of the transition to a new energy paradigm. This will require active participation and empowerment of customers in the energy system. The LFA will have to engage in change behaviour marketing programmes.
- 3 **Access to Local Flexibility Marketplace:** The LFA provides the Prosumer with access to the local flexibility marketplace.
- 4 **Provision of Technology Infrastructure:** Installs control and communication devices at customers dwelling to facilitate in-home optimisation and access to the flexibility market place.
- 5 **Prosumer Profiling & Segmentation:** The LFA will perform an initial study of whether the Prosumers demand response can be profitable by evaluating the appliances/equipment that can participate in demand response. The LFA must be capable of clustering customers in to segments based upon their characteristics and technology and behaviour usage constraints.
- 6 **Incentives Provision:** Provides incentives to customers to engage in flexibility. While incentives can be financial, they can also be a contribution to environmental sustainability, an informational incentive around the consumer's consumption patterns of energy, the desire for greater autonomy and control or a value proposition centred around having the latest cutting edge technologies.
- 7 **Prosumer Interface:** The LFA must interface with the Prosumer in terms of consumption data so that the Prosumer has access if they desire it.
- 8 **Load Forecasting:** The LFA must be capable of performing a consumption forecast to determine the consumption needs of the LEC.
- 9 **Price Forecasting:** The LFA needs to be able to forecast prices for future periods to facilitate planning.
- 10 **Flexibility Forecasting:** The LFA must be capable of flexibility forecasting Prosumers response to control signals.
- 11 **Scheduling and Optimization:** The LFA decides how to operate its portfolio of Prosumers to maximise profits and generate saving for the Prosumer.
- 12 **Settlement and Billing:** Calculates financial benefit to Prosumer and pays a premium for the provision of demand response.
- 13 **Market/Stakeholder Relationship Development & Management:** bilateral agreements/ aware of requests for demand response The LFA needs to maintain a close relationship with other actors – DSO and WMA.
- 14 **Cyber Security Enforcement:** The LFA must ensure that signals are adequately protected against cyber-attack.
- 15 **Data Privacy Assurance and Management:** The LFA must ensure that data privacy regulations are met and that data is anonymized as required.

2.4 Who will be the Platform Owner and Occupy the Central LFA Role in the LFM-MSP?

At this stage of the new market design, it is still open to which legal entity or a combination of entities will practically execute the role of the LFA. Based on the analysis of the Mas²tering research participants, the DSO as LFA was not considered a possibility because there was a general consensus amongst our interviewees that although the role and the responsibilities of the DSO will need to evolve into an active system operator as the grid matures, they nevertheless felt that as they are a regulated body they should not participate in retail markets and that it should remain as a neutral market facilitator while maintaining security of energy supply and a stable distribution network. Six possible options emerged from our interviews; Independent Commercial Entity, a LEC, Telco, a hybrid entity, an existing WMA, and an Electricity Supplier as illustrated in Figure 4.

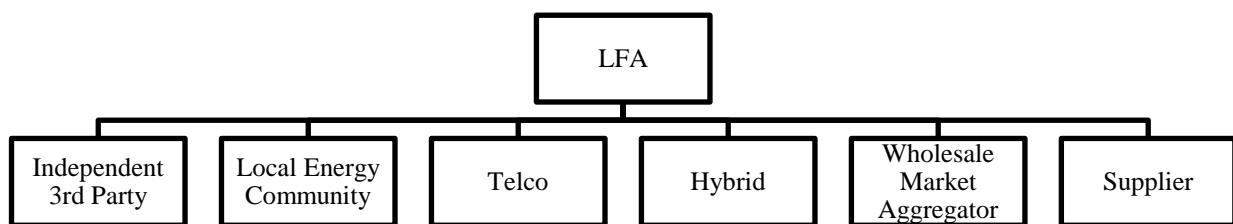


Figure 4. Potential Actors for the LFA Role

The LFA role could be adopted by an independent third party who does not have an existing relationship with electricity customers and in most EU states their legal relationship to other market players is currently undefined. Operationally, for the independent LFA to offer DR services at the LV level, it means that multiple contracts may have to be arranged with the Prosumer, Supplier, DSO and WMA. All of which may have contradictory flexibility requirements. A case study illustrating this LFA-Actor possibility is the French residential aggregator Voltalis who works with the retailer to help them implement demand response programs and installs a free smart box in the customer’s home that provides information to customers about energy consumption and automatically reduces their electric heating device in short time intervals which has a negligible comfort impact on the resident, and a rather huge impact on grid flexibility. Customers do not receive a premium from reducing their load but get a reduction in their electricity bill.

The LFA could also be a LEC. There has been an increased proliferation of local energy communities (see Table 17 in Annex B for examples of LECs) across Europe such as the BürgerEnergie movement in Berlin who are operating as a utility and re-investing in the integration of renewable energies. Similarly, located in Glasgow and Edinburgh and funded by Local Energy Scotland, residents in multi-tower blocks have formed an LEC called TowerPower to empower communities to negotiate the cost of their imported electricity with national energy Suppliers, using more accurate electricity demand data, incentivising energy efficiency and demand side management for TowerPower’s customers through ‘benefit sharing’ business models. While currently LEC are not performing a flexibility aggregation role and are more focused on the energy distribution side of the market, nevertheless, our

interviewees expressed a view that with the emergence of the more advanced LECs, one can foresee a future where the LEC can and will adopt the role of the LFA.

The third possibility is that the LFA could be a Telco. Indeed, nonutility companies such as Telcos are digitally more mature than traditional energy players and can leverage their existing network infrastructure and enabling capabilities to extract value from data. Moreover, they have existing relationships with customers and their brands have a strong consumer appeal and trustworthiness. However, it was envisaged by our research participants that Telco's would probably adopt some form of hybrid entity through collaborations, partnerships and mergers. A case in point is residential flexibility aggregator TIKO in Switzerland which is a partnership between Repower AG, an internationally active power company with activities along the entire value chain and the Telecommunications Service Provider Swisscom who were well positioned to combine its energy expertise in ICT with energy.

Based upon our analysis, the WMA and the Supplier are the most likely candidates to adopt the LFA role.

Table 2. Landscape Snapshot of Aggregators

Company	Customer Type	Main Activity in Aggregation	Country
EnerNOC	Industrial & Commercial	Demand Response	USA
Evonik	Power plants	Generation aggregation for balancing market	Germany
NRG Curtailment Specialists	Industrial, Commercial & Public	Demand Response	USA
Energy Pool	Industrial, Commercial & Public	Demand Response	France
NAPP (North America Power Partners)	Industrial & Commercial	Demand Response	USA
Innoventive Power	Industrial & Commercial	Demand Response	USA
Energy Spectrum	Industrial, Commercial & Public	Demand Response	USA
Flextricity	Industrial & Commercial	Demand and generation aggregation	UK
KiWiPower	Industrial & Commercial	Demand Response	UK
Powerhouse Generation	Industrial & Commercial	Demand Response	Belgium & UK
CPower	Industrial, Commercial & Residential	Demand Response	USA
Converge	Industrial, Commercial & Residential	Demand Response	USA
Enedis-Linky	Commercial & Residential	Demand Response	France
Energy Pool	Commercial & Residential	Demand Response	France, UK and Belgium
Tempus Energy	Commercial & Residential	Demand Response	UK
Upside Energy	Commercial & Residential	Demand Response	UK
Direct Energy	Residential	Demand Response	France
Voltalis	Residential	Sale of power reductions to BRP or TSO	France
TIKO	Residential	Demand Response	Switzerland

As illustrated in Table 2, the vast majority of large scale Demand Response (DR) of electricity today is in the industrial and commercial sector. These existing large scale industrial and commercial aggregators (WMA) operate in the wholesale market in regards to balancing demand on the electric grid in times of stress. Some aggregators such as CPower in the USA have demand response services for the multi-family residential sector but even these are large co-operative residential apartment complexes and are more representative of business to business arrangements. While the concept of residential demand response has been gaining momentum made viable by the introduction of smart meters and IoT technology, the view of our interviewees is that likely in the future that these WMAs will adopt more of passive (wholesale) aggregation strategy as opposed to active (retail) aggregation strategy. Active aggregation involves direct market contact to engage in individual customer acquisition while passive aggregation does not involve direct contact, instead another organisation acting as an agent performs the customer acquisition role and local optimisation of flexibility to sell as a product offering to the WMA who performs the wholesale market role. Moreover, WMAs are in essence B2B organisations, who deal with a small number of organisations to curtail a large amount of load and who are financially incentivised and motivated to actively engage in DR, as opposed to the residential DR, where it is a B2C and B2B approach where there are many more customers to educate, convince and contract to a flexibility programme and that takes time and money.

The other actor that is probably best placed to take on the role of the LFA is the Supplier who has a direct relationship with the Prosumer. The complexity of the relationship is significantly reduced because supply and flexibility are with the one actor. A case study illustrating this LFA-Actor possibility is the French electricity Supplier Direct Energy who service approximately 1.6 million customers. Alongside their retailer service, Direct Energy commenced a two-year pilot programme with their customers (n=500) as an aggregator of electricity demand response from their electricity customers. The Supplier can now aggregate and enhance the consumption of residential and small business on the wholesale market. Table 3 compares the above LFA-actor positions in terms of strengthen and weakness for role adoption.

Table 3. Comparative Strengths and Weakness of LFA-Actor Positions

Evaluation Dimensions	WMA	Independent 3rd Party	LEC	Telco	Supplier
Existing Prosumer Relationship	No Relationship	No Relationship	Relationship	Relationship	Relationship
Willingness at present	No	Yes	Yes	No	Yes/No
Possible at present	Yes	Yes	No	Yes	Yes
Relationship with DSO	Relationship	No Relationship	No Relationship	No Relationship	Relationship
Trading	Yes	No	No	Yes	Yes
Balance calculation	Yes	No	No	No	Yes
Partners required	Yes	Yes	Yes	Yes	No

3 Building and Designing the Multi-Sided Business Platform

In the LFM market model, the LFA will need to know

- (i) when to buy flexibility, how much and from whom and,
- (ii) when to sell flexibility, how much and to whom.

However, MSPs bring additional complexity because the LFA is required to create, deliver, and capture value for more than one stakeholder and unless it satisfies both sides of the platform, the viability of the business model will collapse. The LFA needs to also know

- (iii) how to manage both sides of the platform in order to facilitate the interactions between different participant groups and allow for an attempt to monetize the value created for one or more side of the platform.

In addition, to maximising its profitability, the LFA will need to exploit its relationship with the Prosumer in order to become attractive to other energy stakeholders as an access channel to the Prosumer. The LFA will need to know

- (iv) how to leverage its customer's relationship for indirect (non-flexibility) revenue generating models such as educating their customers about new technologies and even selling technologies.

The rest of the Section presents the findings from our primary research and is structured as follows. Next we will detail the interaction dynamics within the LFM in order to understand how value is created, delivered and captured (See Annex B for detailed analysis). Based on this analysis, the LFA-MSP was developed and is presented along with the challenges to igniting the business model.

3.1 Interaction Dynamics of Value Chain Functions in the LFM

The real challenge of understanding such an emerging and complex MSP is to map out the flexibility business model opportunities [9]. Utilising the business modelling methodology of value network analysis (VNA) (see Annex A), we compiled and analysed the value flows along the multi-commodity flow chain perspective within an Interaction Flow Matrix (see Table 21 Annex B), including interactions and potential conflicting objectives which provided us with an understanding of how a networked economy or multi-sided business model platform could potentially materialise [10]. Figure 5 depicts the value network flows within the LFM and the LFA relationships to other energy stakeholders. The Figure clearly shows that the LFM involves a complex networked web of stakeholder interactions to create value. Table 4 presents a synthesised explanation of the interactions dynamics between the various stakeholders that is presented in detail in Annex B.

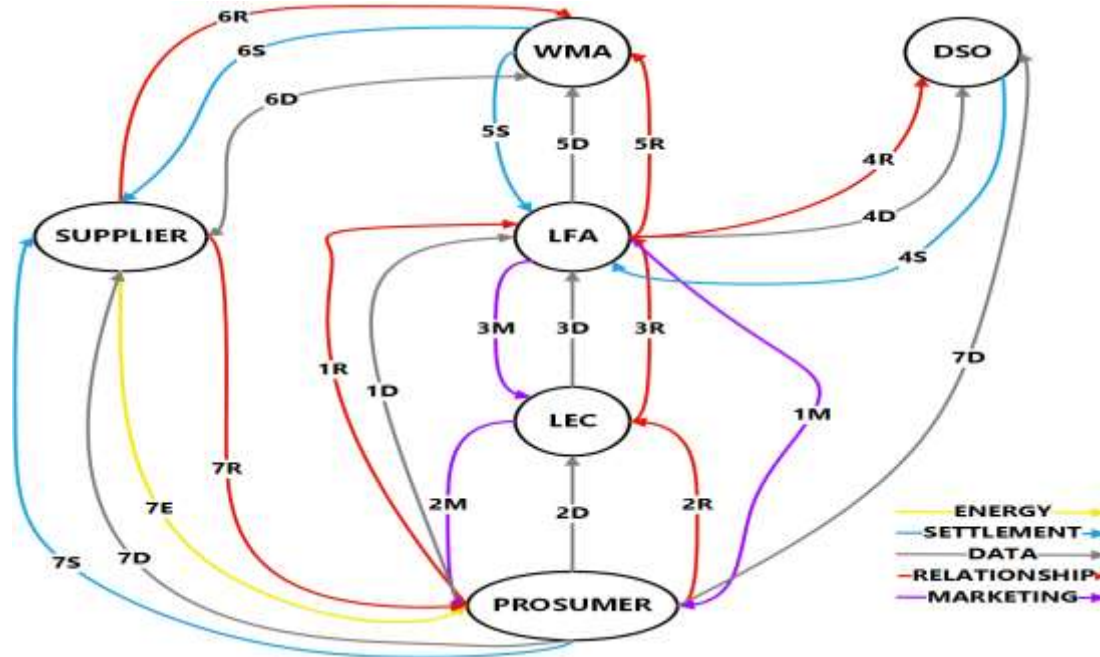


Figure 5. LFM and the LFA Relationships to other Energy Stakeholders

Table 4. Description of Actor Interaction Dynamics within the LFM

Interacting Functions	Flow Type	Code	Flexibility Market Design
Prosumer – LFA	Relationship	1R	Prosumers are part of an LEC because they are associated to the same LFA by an individual contract. Prosumers have no knowledge of one another and are free to choose the LFA that they prefer
Prosumer - LFA	Data	1D	Prosumer provides flexibility to the LFA
LFA – Prosumer	Marketing	1M	Advertising flexibility services and education of market
Prosumer - LEC	Relationship	2R	Individuals sign up to a collective of local householders in order to manage the flexibility commodity (sale & settlement thereof). The LEC can be viewed as an entity or cooperative (such as a building block).
Prosumer - LEC	Data	2D	Individual Prosumers pool their combined flexibility into a marketable commodity unit
LEC - Prosumer	Marketing	2M	Advertising flexibility services and education of market
LEC-LFA	Data	3D	The LFA buys the flexibility unit
LEC-LFA	Relationship	3R	The agreement governs the use of flexibility and settlement
LFA- LEC	Marketing	3m	Advertising flexibility services and education of market
LFA - DSO	Data	4D	The LFA provides the flexibility unit to the DSO. There are three flexibility services the LFA can provide to the DSO – Congestion Management, Voltage Control and Grid Losses Reduction
LFA - DSO	Relationship	4R	Flexibility Service Contract. The agreement governs the use of flexibility and settlement. In the delivery of flexibility services, two types of Flexibility Service Contracts are envisaged explicitly Fixed Price Contract and Indefinite Delivery Contract.
DSO - LFA	Settlement	4S	Buying Flexibility for congestion management, voltage control and grid losses reduction. A fixed price contract will be a higher premium product. Indefinite delivery contract will involve a fixed fee & variable fee.

LFA - WMA	Data	5D	The LFA provides an internal portfolio optimization for the WMA and occurs when the LFA receives a request from the WMA for the provision of flexibility in aggregated form (as per classical centralised management of flexibility) and provides flexibility offers; once flexibility offers are accepted, the LFA manages loads in its own portfolio in the most optimal way to respect the flexibility programme
LFA - WMA	Relationship	5R	A Bi-directional Indefinite Delivery Contract will be in place which governs the use of flexibility and settlement. This type of contract provides for the LFA to deliver services upon issuance of a request as the needs arise. This is a short activation time period such as hour-ahead.
WMA - LFA	Settlement	5S	Buying Flexibility to optimise its function (portfolio optimisation). The WMA will pay the LFA twice (i) a fixed fee that is based upon the amount of flexibility required (i.e. the possibility of accessing flexibility) and (ii) a variable fee proportional to the market cost of the imbalance
WMA- Supplier	Data	6D	Information exchange. In order to forecast future portfolio consumption, the Supplier needs to receive information from the WMA on the activation of the LFAs customers. This ensures that the Supplier can distinguish between LFA initiated DR that requires balancing actions or usual consumption changes that requires no balancing.
Supplier - WMA	Relationship	6R	Energy imbalance service contract. To ensure that the introduction of the LFA to the marketplace does not create a financial-loss situation for the Supplier, there will have to be an Energy Imbalance Settlement contract between the WMA and the Supplier based on a market-based pricing of energy and flexibility
WMA- Supplier	Settlement	6S	WMA pays compensation to the Supplier based on market-based pricing of flexibility.
Supplier-Prosumer	Energy	7E	Supplier sells energy to Prosumer
Prosumer – Supplier	Settlement	7S	The Supplier agrees commercial conditions with its customers for the supply and procurement of energy. Prosumer receives a reduction in their energy bill for changing their load profile.
Supplier – Prosumer	Relationship	7R	Contractual relationship
Prosumer – Supplier	Data	7D	Consumption Data. When flexibility contract is activated with the LFA, the Prosumer should inform the Supplier.
Prosumer-DSO	Data	8D	There is a data flow from the Prosumer to the DSO. Data is used to calculate distribution charges, but does not have a particular use as part of the Mas2tering solution.

3.2 LFA Multi-Sided Business Model

There are five sides to the LFA-MSP - Prosumer; DSO; WMA, Supplier & Other LFAs and each side has distinct product offerings. As they are designed for different customer segments, these products therefore require unique value propositions and create individual revenue streams. Figure 6 presents the multi-sided business model for the LFA, depicted with its nine building blocks [11]. To illustrate linkages related to the five customer segments, we have colour co-ordinated data under the *Value Proposition*; *Product Offering*; *Customer*; and *Revenue* blocks in the canvas.

KP key partners	KA key activities	VP value proposition	PO product offering	CR customer relationships	CS customer segments	
<p>Key partners to include:</p> <ul style="list-style-type: none"> a) Telco b) Cyber Security c) DSO d) BRP e) WMA f) Other LFAs g) ICT Developers h) ADR Developers 	<ol style="list-style-type: none"> 1. Marketing: Promotion of concept of flexibility to Prosumers 2. Creating Customer Empowerment 3. Access to Flexibility Marketplace 4. Provision of Technology Infrastructure 5. Prosumer Profiling & Segmentation 6. Incentives Provision 7. Prosumer Interface 8. Load Forecasting 9. Price Forecasting 10. Flexibility Forecasting 11. Scheduling and Optimization 12. Settlement and Billing 13. Market/Stakeholder Relationship Development & Management 14. Cyber Security Enforcement 15. Data Privacy Insurance and Management 	<ul style="list-style-type: none"> • Access to the flexibility market for the prosumer • Rewards for participation in the market include: <ul style="list-style-type: none"> a) Reduced energy bills b) Reduced energy usage c) Reduced environmental impact/footprint • Delay/avoid grid reinforcement • Optimise asset use • Reduce grid losses • Reduce frequency and duration of outages • Negate financial risk of incorrect forecasting • Assist balancing task • Negate financial risks • Aids co-opetition strategy • Assist balancing task • High end flexibility management and analytics 	<ul style="list-style-type: none"> • Bundled Flexibility Management services including: <ul style="list-style-type: none"> • Time of use optimisation • Self-balancing • Control of Maximum Load • Advice and recommendations on optimising the prosumer's participation in the flexibility market • Energy Management Services • Congestion management • Voltage control • Grid losses reduction • Internal Portfolio Balancing • Surplus flexibility • Threshold management – local shortages • Flexibility management services 	<ul style="list-style-type: none"> • Ongoing close relationship where prosumer will be required to trust aggregator • Aggregator could be rewarded for good service with longer contract periods and loyalty • Basic; Contractual; or Collaboration • Direct B2B relationship – service provision • Fixed price Contracts • Indefinite Delivery Contracts • B2B relationship - service provision • Bi-Directional Indefinite Delivery Contract • B2B relationship - service provision • Bilateral contracts • B2B relationship - service provision • Indefinite delivery contract 	<p>Residential prosumer</p> <p>Local Energy Communities</p> <p>DSO</p> <p>WMA</p> <p>Other LFAs</p> <p>Supplier</p>	
	<p>KR key resources</p> <ol style="list-style-type: none"> 1. Mas²tering Energy Box (Prosumer gets access to the flexibility services) 2. Mas²tering Flexibility Management Platform (capability to operate local flexibility management) 3. Staff skilled in forecasting and predicting energy demands 			<p>CH channels</p> <ol style="list-style-type: none"> 1. Local governments, Smart Cities, and neighbourhoods 2. Marketing channels will include: <ul style="list-style-type: none"> a) App to display energy consumption data, advice, requests and electricity trading data b) Website c) Existing customer relationship channels 3. Electricity distribution networks 		
<p>CS cost structures</p> <ol style="list-style-type: none"> 1. Marketing costs to encourage engagement in the flexibility market 2. Technology development costs 3. Settlement costs as part of bilateral contracts to various parties including Supplier/BRP; DSO; WMA; other LFAs; and the Prosumer 4. Staff and overheads 			<p>RS revenue streams</p> <ul style="list-style-type: none"> • Sale of Prosumer flexibility to DSO; WMA; other LFA • Increased ROI from the customer due to increased loyalty, and sale of added value services i.e. extra security; additional advice 	<ul style="list-style-type: none"> • Share of margin service tariff for the trade of flexibility • Cutting overall generation costs • Reduction of grid servicing costs • Reduced penalties 	<ul style="list-style-type: none"> • WMA pays fixed fee to the Aggregator • Compensation proportional to the market cost of imbalance 	<ul style="list-style-type: none"> • Compensation proportion al to the market cost of flexibility • Supplier pays fixed and variable fee to LFA

Figure 6. LFA Multi-Sided Business Model

Outside of these blocks, the LFA will have *Activities* that it needs to be able to carry out in order for the business model to function and contemporaneously it will require certain *Resources* in order to be able to carry out those *Activities*. These *Activities* and *Resources* will lead to certain *Costs* and these are documented in the Canvas along with the *Partners* required and the *Channels* that will be used to communicate with all external stakeholders including customers. To explain the LFA-MSP, we will explain each side of the MSP individually. In this fashion each side can be looked upon as a mini-business model within the overall LFA-MSP. The mini-business models presented will focus on four building blocks: Value Proposition; Product; Relationship Type; and Revenue Model. Following this, we will address the other building blocks within the LFA-MSP.

3.2.1 LFA – Prosumer Mini-Business Model

Table 5 presents the mini business model for the LFA-Prosumer. The two value propositions most established as having an impact in this business model and that can readily be deployed here are: reduced costs and reduced environmental footprint. A third value proposition is also identifiable and that is: access to the flexibility market. For early adopter Prosumers this value proposition will be a cause of enthusiasm as they will have a desire to access the flexibility market while the majority of Prosumers will have to be convinced of the worth of engaging in the market.

Table 5. LFA - Prosumer Business Model Characteristics

Value Proposition	Product Offering
Access to the flexibility market for the Prosumer Rewards for participation in the market include: <ul style="list-style-type: none"> • <i>Reduce energy bills</i> • <i>Reduced energy usage</i> • <i>Reduced environmental impact/footprint</i> • <i>Status/image</i> 	Bundled Flexibility Management services including: <ul style="list-style-type: none"> • <i>Time of use optimisation</i> • <i>Self-balancing</i> • <i>Control of maximum load</i> • <i>Advice and recommendation on optimising the Prosumer’s participation in the flexibility market</i> Bundled Value Added Services – e.g. discounts on white goods, promoting/selling technologies
Revenue Model	Relationship Type
Sale of Prosumers flexibility to DSO, WMA, LFAs Increased ROI from the customer due to increased loyalty, and sale of added value services i.e. extra security; additional advice, promoting technologies etc.	B2C- Ongoing close relationship where Prosumer will be required to trust aggregator Aggregator could be rewarded for good service with longer contract periods and loyalty Settlement - Basic; Contractual; or Collaboration

The LFA-Prosumer relationship will probably play out in one of two possible scenarios. The first is where the Prosumer will want to be actively involved in the decision making process for their home in real-time. And the second is where the Prosumer will be willing to relinquish a certain amount of control

to the LFA and within a range of pre-set criteria and list of requirements allow the LFA to manage their engagement with flexibility and in-home optimisation. In the first scenario the LFA will need to take on an advisory relationship with the Prosumer who will be keenly seeking and requiring information that allows them to engage in the flexibility market and reduce the costs and carbon footprint in their own home. In order for the Prosumer's engagement with the flexibility market to be successful the relationship will require a far greater frequency of contact than what currently exists between the Supplier and the Prosumer. Among other pieces of content, the Prosumer will have to be kept informed of the following:

- a) Comparisons of heat and electricity usage to their previous consumption and to average households in their neighbourhood.
- b) Alerts to notify the Prosumer to reduce certain usage within the home at certain times of peak consumption or if control has been handed over to the LFA, alerts to notify what adjustments have been made on the Prosumer's behalf.
- c) Information regarding dynamic pricing and advice on how to shift loads within the homes to times with cheaper available electricity.

Alternatively, the Prosumer may choose to relinquish a lot of decision making control to the LFA and by providing a set of requirements in advance the Prosumer can indicate what rules and criteria they wish to apply to the relationship and then allow the LFA to act on their behalf. In this instance it will be important that the Prosumer doesn't experience any discomfort due to LFA decision making (e.g. heating system turning off at inappropriate time; or hot water not being available) and that if they do they can report it and get the comfort level adjusted quickly. The Prosumer will also require easy-to-understand summaries of what actions have been taken during the previous month and what benefits have been accrued so they can track and measure what the LFA have done on their behalf.

Both scenarios require a significant change in the nature and the frequency of the relationship the Prosumer is used to having with his traditional Supplier. An information gathering exercise will have to be undertaken at the start of the relationship to establish what rules and criteria should apply in each relationship to ensure the comfort level of the Prosumer is not interrupted. It will probably be possible to design the service so that different levels of control can be relinquished to the LFA from total to none, and with intermediate levels in between.

When the Prosumer is at a low level of activity – i.e. they are not involved in generation or storage – then the LFA is unlikely to garner anymore revenue from the Prosumer than that which is currently gained by a Supplier of electricity. In fact, one of the key value propositions for the Prosumer is reduced energy costs, so we can anticipate that the LFA may stand to make less money from this side of the model than a Supplier currently receives. This could create two impacts on the LFA business model: a) the LFA's revenue model will need to come from its low margin flexibility trades to the other actors in the eco-system namely the DSO; WMA; Supplier and other LFAs; and also in facilitating the marketplace of trading between Prosumers and b) the revenue from the Prosumer side will perhaps have to be supported by collaboration opportunities with those seeking to get access to the Prosumer market, namely the appliance, device manufacturers and app developers. However, as the Prosumer increases their activity in the home and become engaged in storage and generation, the opportunity for the LFA

to create revenue increases as there is more potential for flexibility trading and increased interaction with the Prosumer.

3.2.2 LFA – DSO Mini-Business Model

Table 6 presents the mini business model for the LFA- DSO.

Table 6. LFA -DSO Business Model Characteristics

Value Proposition	Product Offering
Delay/avoid grid reinforcement	Congestion management
Optimise asset use	Grid Losses Reduction
Reduce grid losses	Voltage control
Reduce frequency and duration of outages	
Revenue Model	Relationship Type
Revenue from DSO not readily apparent	B2B relationship - service provision
DSO may not see value in paying for flexibility	Fixed price Contracts
DSO may even seek to be compensated for any loss in income from the Prosumer side due to introduction of flexibility	Indefinite Delivery Contracts

The value propositions underpinning the offering towards the DSO are aimed towards satisfying the need of the DSO to reduce its infrastructural costs and to avoid outages caused by imbalances. Delivering the value propositions as detailed in Table 6 to the DSO customer segment will require the development of B2B relationships characterised by a high level of mutual trust, sharing of information, and contractual agreements with key performance indicators.

However, where this mini-business model encounters a real threat to its viability is in its attempt to garner revenue from the DSO. If the Prosumer starts to self-consume and its use of the DSO is lessened, then it may expect to pay less to the DSO. The majority of the DSO’s costs are fixed, so even though the Prosumer is using it less, its costs will remain relatively high. Therefore, if the Prosumer pays it less it stands to earn less revenue overall. Another challenge to this mini-business model is that the significance of the value proposition for the DSO of reducing congestion is debatable as many experts argue that congestion will not be a significant issue for the DSOs, now or in the future. In fact, almost all interviewees expressed doubt or pessimism about the DSOs desire or interest in having access to Prosumer flexibility. This creates the double impact on the overall MSP that a) if DSOs are to be convinced to participate it may require a regulatory push as there is not an outstanding rationale for them to currently engage and b) revenue for the LFA business model will have to be garnered from customers other than the DSO. This push may involve incentives for lowering grid losses and improve electricity distribution effectiveness.

3.2.3 LFA – WMA Mini-Business Model

Table 7 presents the mini business model for the LFA-WMA. For the WMA, the LFAs business model is built around providing a solution to the financial risk inherent in their own business model where they can suffer losses due to inaccurate forecasting of energy usage. The LFA will assist them in their

balancing task and facilitate them to hedge against the type of risks they incur. In practice, their relationship and partnership would need to be quite close, utilising bilateral contracts and sharing information. The type of relationship required lent our interviewees to suggest that the LFA may well be a subsidiary or agent of the WMA. By introducing the new role of the LFA which combines the main aspects of flexibility management and aggregation for local optimisation, WMAs would reduce costs related to risk management, operate a more effective portfolio optimization costs and be able to mitigate the payback effect.

Table 7. LFA-WMA Business Model Characteristics

Value Proposition	Product Offering
Reduce financial risk of incorrect forecasting Assist balancing task	Internal Portfolio Balancing
Revenue Model	Relationship Type
WMA pays fixed fee to LFA Compensation proportional to the market cost of imbalance	B2B relationship - service provision Bi-Directional Indefinite Delivery Contract

3.2.4 LFA – Supplier Mini-Business Model

Table 8 presents the mini business model for the LFA-Supplier.

Table 8. LFA-Supplier Business Model Characteristics

Value Proposition	Product Offering
Assist balancing task High end flexibility management and analytics	Flexibility management services
Revenue Model	Relationship Type
Supplier pays fixed and variable fee to LFA	B2B relationship - service provision Indefinite delivery contract

For the Supplier, the LFA acts in an outsourced flexibility supply capacity and will charge based upon contract specifications. The LFA provides the Supplier with advanced ICT and aggregation capabilities such as forecasting, scheduling optimisation and load control to deliver flexibility services to their customers. The value proposition to the Supplier is that no other actor is involved in their relationship with their customers and based upon the LFA analysis, the Supplier would then sell the flexibility for the maximum benefit. The relationship would be characterised by bilateral contracts.

3.2.5 LFA - LFA Mini-Business Model

Table 9 presents the mini business model for the LFA-LFA. The business model for LFA-LFA trade is based on being able to supply flexibility to them at times when they require it. The relationship would be characterised by bilateral contracts where both actors in the relationship are both buyers and sellers

at different times depending on their requirements. This relationship would help to avoid any local shortages, ease the pressure on the grid and also assist in the ignition of the LFM.

Table 9. LFA - LFA Business Model Characteristics

Value Proposition	Product Offering
Negate financial risks <i>Co-opetition</i> strategy	Surplus flexibility Threshold management – local shortages
Revenue Model	Relationship Type
Compensation proportional to the market cost of flexibility	B2B relationship - service provision Bilateral contract

3.2.6 Addressing the Remaining Blocks in the Multi-Sided Business Model for the LFA

Based upon the forgoing, Figure 7 presents a useful synthesis of the LFAs suppliers, customers and product offerings. We will now focus on the remaining building blocks of the MSP in terms of the Channels, Activities, Resources, Key Partners and Cost Structure.

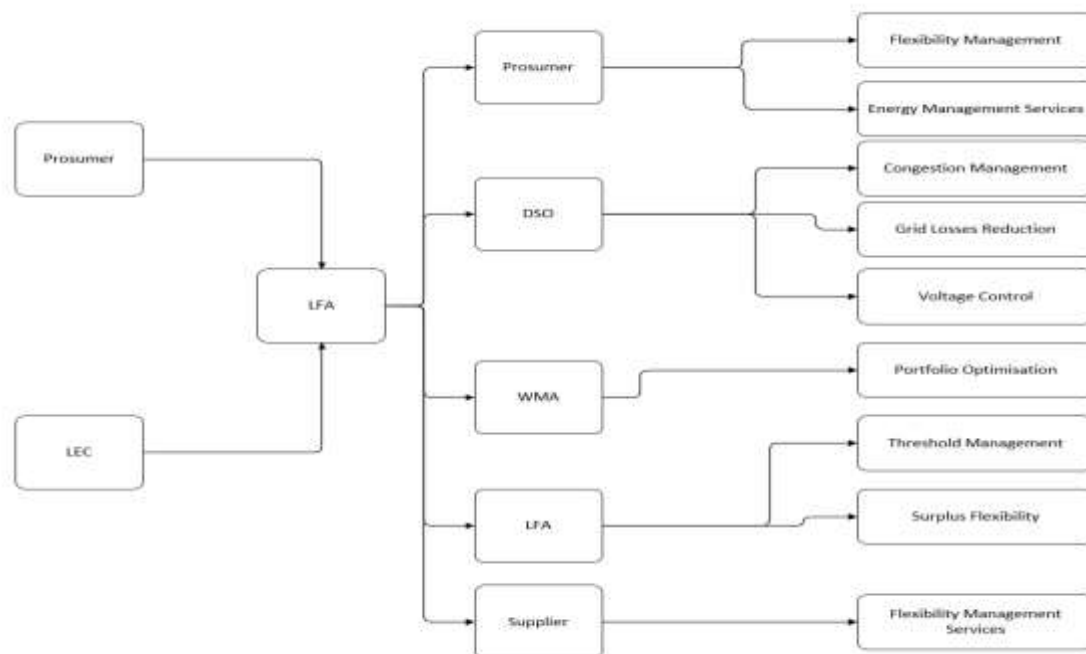


Figure 7. Synthesis of the LFA's Customers and Product Offerings

Channels:

Igniting the Prosumer will require clear communications of value propositions to convince them of the value of actively participating in the new market model. It will require a shift in consciousness to move from an existing Consumer mind-set to a Prosumer mind-set. The means of communication required will be very similar to those currently used by an energy Supplier or a Telco to communicate their product offerings: website; newsletters; advertising (TV, radio, digital); and social media campaigns.

Potential channels to reach Prosumers and engage communities would be Local Governments, Smart Cities and neighbourhoods that are actively engaging in the smart grid as they will give legitimacy to the LFA in the minds of the Prosumer. To communicate with the DSO; WMA and other LFAs, the LFA will require a B2B communications approach. In that context the LFA will need to demonstrate the value to these stakeholders of engaging in the new market model.

Key Resources:

Key resources that will be required to create, deliver and capture value in the business model, reach target markets, maintain relationships with the customer's segments and generate revenues will be as follows:

- **Physical resources:** There are two key technology resources for the LFA explicitly the Mas²tering Energy Box and Mas²tering Flexibility Management Platform. For the LFA the Mas²tering Energy Box represents the piece of equipment that gives the Prosumer access to the flexibility services and Mas²tering Flexibility Management Platform gives the LFA the capability to operate local flexibility management.
- **Human capital:** The LFA will require many high-level professional staff with skills similar to those required by a Supplier, the key difference being that they will also require staff with the skills and ability to forecast correctly and trade flexibility in the market.

Activities:

The key activities that the LFA will be required to perform are discussed in detail in Section 2.3. In general, the LFA activities can be categorised in to four broad functions: (i) Acquiring flexibility from Prosumers and LEC; (ii) Aggregating it into a portfolio; (iii) Creating services that draw on the accumulated flexibility, and (iv) Offering these flexibility services to the other market participants.

Key Partners:

Depending on who is to occupy the role of the LFA, there is potential for different make-ups of partnerships being required to own all the resources and perform all the activities required to offer these value propositions to customers:

- a. Gaining access to Prosumers may require an LFA partnering with a Supplier.
- b. LFA may require a partnership with a BRP if it is to trade on the balancing market.
- c. Key partnerships to deliver the customer interface element of the business model e.g. Telco providing the broadband services into the home.
- d. Cyber security partners will be required to keep customer data protected.
- e. ICT developers and ADR developers may want to provide new services and technologies to the LFAs customer portfolio.
- f. The LFA could become very attractive has a potential partner to Suppliers and Telco's in terms of customer retention and customer acquisition.

Cost Structure:

1. Marketing costs to encourage engagement in the flexibility market.
2. Technology costs in terms of Mas²tering Energy Box and Mas²tering Flexibility Management Platform.
3. Settlement costs as detailed above within each mini case.

3.3 Challenges to LFA-MSP

There is still a large gap between the markets of today and a fully functioning flexibility market where flexibility is used to address congestion, capacity, reliability and efficiency. One of the main challenges is how to make the LFA-MSP work because it involves many interconnected actors sharing both risk and benefit and potentially unevenly. Table 10 presents the challenges and opportunities for igniting the LFA-MSP.

Table 10. Challenges and Opportunities to the LFA-MSP

Barrier/Challenge	Opportunity
Lack of Stakeholder Collaboration	It is the network of collaborative relationships that provides the key to understanding and realising the business model opportunities.
Lack of Supporting Regulations	There is an opportunity at an EU level to support the ignition of the flexibility market place. Communications from the commission related to new energy market design enhances the likelihood that flexibility concepts will be imminent.
Uncertain Regulatory Market	Currently the DSO has no economic mechanism to engage flexibility services. There is an opportunity to employ some form of market mechanism to create a new balancing market at the distribution level where the role of the DSO will evolve into an active system operator.
Insufficient Customer Engagement & Awareness	This means that industry stakeholders will have to become far more attuned to Prosumer needs. Prosumer benefits need to be clearly defined and advocated. Incentives need to be communicated in an easy to understand manner.
Not Enough Flexibility	The advancement of a functioning flexibility market has been slowed by the lack of publically supported incentives. There is an opportunity to provide Prosumers with incentives to buy smart appliances and technologies and also to provide an incentive to the DSO to participate in the market.
Low Impact of Smart Grid Business	Although there has been significant technology investment to date, the visibility of that investment is poor as so the impact on society and behavioural change has been poor. Recent developments such as widespread promotion of the roll-out of smart meters should advance greater awareness of the smart grid technologies.
Cost	The cost associated with moving to the smart grid is significant and the return on investment may not occur for several years. It is likely new market entrants will emerge and take advantage of the investment made by incumbents. A real opportunity for incumbents lies in developing future oriented business models that take advantage of the new network-enabled capabilities for competitiveness and profitability.
Fear of New Market Entrants	There is a certain degree of fear being promoted that incumbents will lose out to new market entrants. Incumbent energy providers have an advantage in this market staging, as they already have existing relationships with a critical mass of customers. Moreover, there are opportunities around collaborating with entrants and skills sets.
Utility Business Model	The classical one-sided market utility model as largely remained unchanged over the last century. The emergence of the smart grid will introduce MSPs which brings additional constraints and challenges in that a critical mass of Prosumers will be required to create the network effect desired to make these business models valuable. If MSPs can be ignited there is real opportunity for profitability.
Intersection between ICT and energy infrastructures	Overcoming strategic challenges at the intersection between ICT and energy infrastructures requires: Interoperability for ensuring convergence of network and transmission protocols, reliability and security for trusted provision of services and resilience; decentralized and self-organizing architecture for enhanced flexibility in grid control and management.

4 Business Strategies and Collaboration Opportunities

Viewing the LFA-MSP as the business opportunity, the aim of this section is to present plausible actor business strategies and collaborations for adopting and igniting the LFA-MSP. However, MSPs are usually situated within broader ecosystems of firms, government, regulation and other institutions and are rarely self-sufficient. Consequently, actor business strategies and collaborations must be placed in the context of the local flexibility marketplace and how it may evolve over time. In the next sections we provide the findings from our strategic forecasting analysis and scenario planning to identify actor - led LFA-MSP scenarios.

4.1 The Transition to a Local Flexibility Market

Applying a market lifecycle evolutionary approach, Figure 8 shows that the local flexibility marketplace is at an embryonic stage in its development lifecycle. From where it is today, a non functioning local flexibility market, it must transform to a fully functioning flexibility market. Analyzing two market risks (level of customer engagement and openness/collaborativeness of the business ecosystem), we depict how this market transition will evolve through a number of transition phases, explicitly Embryonic, Growth and Maturity.

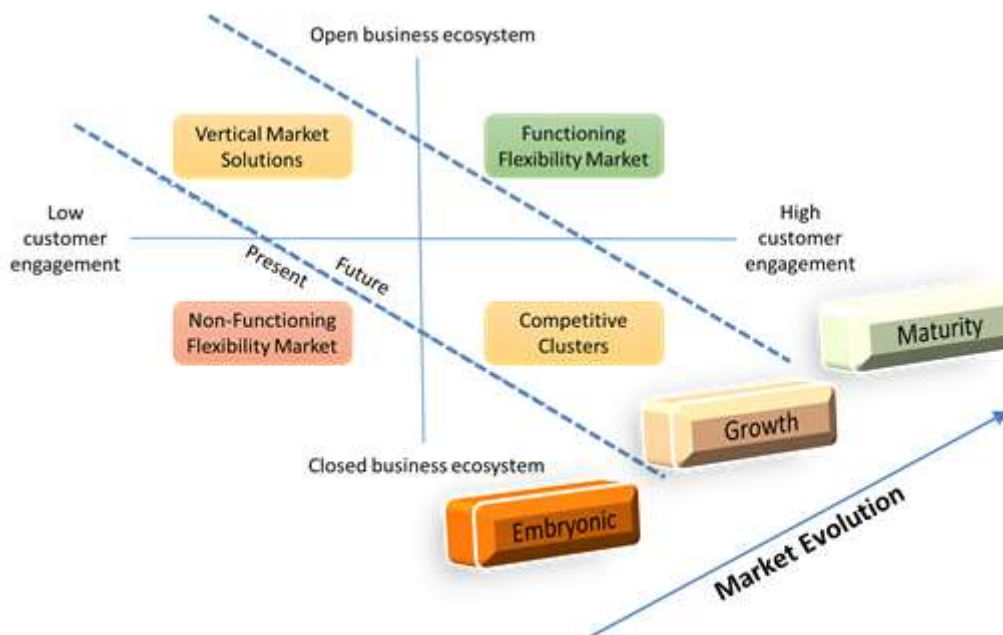


Figure 8. Phased Market Transition of the Local Flexibility Grid

Phase 1 Embryonic: Depending on where one looks in Europe, one can argue that the evolution of the flexibility marketplace is in the late phases of “Embryonic” or early phases of “Growth”. Policy guidance from the European Commission [12] [13] has called for the use of flexibility as a mechanism to improve market functioning but the flexibility market does not yet exist at large. In general, policy, market mechanisms and technologies are not mature. Characterised by a closed business system,

customer engagement is low and collaboration in the business ecosystem is low. Flexibility management is limited to a few select instances and/or research efforts; Suppliers, Telcos and other actors are working on energy boxes and flexibility management ICT platforms. An increased number of energy Suppliers are emerging on the markets with new services or types of contracts. Examples of local energy communities are becoming available and there are a growing number of aggregators establishing market position.

Phase 2 Growth: This phase of market evolution is characterised by two scenarios, explicitly competitive clusters and the vertical market solutions. Competitive Clusters is characterized by a closed business system mentality where there is high customer engagement but low collaboration between actors in the business ecosystem. This scenario would likely be realized by Supplier or Telcos fielding energy boxes to preserve their market position (e.g. prevent clients from switching to other providers) or to grow it (e.g. to get new clients). The focus of flexibility management services is not as much on climate change nor transformation of the electricity market, but on the battle for the Prosumer/individual energy contracts and the bundled services that can be linked to them. In this sense, Supplier will start offering energy services and encroaching on market space currently owned by energy management consultants or ESCOs. Conversely, the Vertical Market Solution is characterized by low customer engagement and high collaboration in the business ecosystem. It is likely realized by the continued penetration of aggregator companies (e.g. companies organized for and specialized to assume this role). The focus is on low-margin flexibility trading used to attain market position for the future flexibility market. Penetration will likely be attained via the development of vertical market solutions (high energy consuming industrials, micro-grids, islands, hotel chains, blocks of buildings, local energy communities, clear congestions points etc). The key technologies entering the marketplace in this scenario is the ICT platforms used to manage flexibility trading.

Phase 3 Maturity: This phase can be thought of as the merger of the vertical market solutions and competitive clusters scenarios. The potential of Prosumers at large using energy boxes is combined with the ICT management platforms that make possible wide-scale flexibility management trading for grid benefit. Flexibility trading and a flexibility market become a new normal. What is particularly evident from this phase is emergence of fully operational open business ecosystem characterised by multi-sided business platforms that adopt a value and participatory network concept that encourages and supports the interactions among all ecosystem participants to co-create value. There is high business ecosystem collaboration and high customer engagement consistent with MSP introduction.

4.2 Business Strategies and Collaboration Opportunities in a Market Transition Perspective

The purpose of this section is to identify potential business strategies and collaboration opportunities to ignite and capitalise on the opportunity of the LFA-MSP. As detailed above we make the assumption that the market is transitioning to the Growth Phase and eventually to Maturity and so the focus of our Strategic Forecasting Analysis and Scenario Planning is on these two phases, with a greater emphasis on the Growth Phase due to its ignition proximity. In constructing this analysis, an effort was made to limit the actors in each phase to those that have key roles. In reading the scenarios presented, it is also important to note that the “Actors/Roles” can have an added layer if any particular actor assumes a different or multiple roles. In addition, we also highlight the focus of the business strategy and

collaboration opportunity that is of relevance to the Mas²tering story line and use cases. In particular, the focus on the Prosumer (UC1); the focus on the LEC and local optimisation (UC2) and; the focus on the LV grid and the DSO (UC3).

4.2.1 Strategic Forecasting Analysis and Scenario Planning for Phase 2 Growth

The birth of the growth phase will be heralded with the introduction of a Prosumer centric marketplace. Our research participants identified Prosumer empowerment and orientation as the major drivers of change in the strategies of incumbent energy companies. In addition, the emergence of new technologies will inevitably lead to a host of new market entrants. Figure 9 provides an interesting view of the what that flexibility battleground in the growth phase of development may look like in the future and the various market stakeholders vying for acquisition of the Prosumers flexibility. With this view of the emerging flexibility market, we have made the following observations and present scenarios that may arise in the evolution of the market and the actors during this phase of growth. The scenarios allow us to converge on potential and likely business strategies and collaboration opportunities of the actors in the ecosystem in relation to both competitive clusters and vertical markets which are presented in Table 11. Thereafter, based on this observations, we present two competing actor-led LFA-MSP scenarios and the resultant business strategies and collaboration opportunities for business model ignition.



Figure 9. The Local Flexibility Battleground

4.2.1.1 *Competitive Clusters Scenario Observations:*

- The first battle-site in this scenario will more than likely centre around the retail market with an ever increasing number of energy Suppliers emerging on the markets with new and specialised services or types of contracts. Examples of LECs are becoming more widely available and there are a growing number of specialists DR and wider Virtual Power Plant aggregators establishing market position. The battle for market share will evolve into a channel fight focused on reducing the energy bill of the Prosumer and constantly offering innovative bundled services to meet the demands of a more sophisticated consumer.
- The battle for in-home services will ignite. Supplier, Telecommunication Service Providers and other actors are all looking to provide energy boxes to Prosumers homes. Both the Telcos and the Supplier want to own the home with home automation and energy services. Internet Service Providers (ISP) such as Google and Microsoft are also extending their offering to include energy services. Telcos may position to compete with Supplier or LFA, but more likely will choose to maintain focus on data/content/bundled services. In this case, Supplier are the main collaboration opportunity actor for Telcos. This collaboration will strengthen the Telcos position against its own competitors in the tele-communications industry.
- Consumer facing applications and energy management technology will be a key aspect of smart grid initiatives as will interactions with home appliance manufacturers to reach a consensus on common communication standards to enable homeowners to monitor and control their home appliances for in-home energy optimisation.
- Data services and access to the data generated from the home will also become a future battleground. Google and other technology giants will start to acquire energy companies because it gives them access to Prosumer data through smart meters. Historically energy incumbents tend to see energy as the commodity, while device and appliance vendors focus on the functional characteristics of their technology and how they can assist grid operators to build situational awareness.
- Supplier see themselves as key to the wide-scale adoption of Prosumer flexibility engagement. However, they will likely not lead market transition in favour of the LFA business model. Instead will likely need to be pulled into it once competitiveness demands it (as detailed in the Maturity Phase). The business case and collaboration opportunities in Competitive Clusters surrounding flexibility will likely remain lower TRL and the commercial ambition will be toward entry into energy management and bundled services. Customer retention and acquisition are key drivers, if not the primary driver of Supplier in this scenario.
- Suppliers will need to decide whether to perform aggregation internally or outsource depending on in-house ICT and aggregation capability. At the core of this decision will be to control access to the Prosumer from outside organisations.
- Depending on the in-house technology development capability of Supplier and Telcos, ICT developers may have little access to the market as Supplier and Telcos who dominate this scenario will develop proprietary solutions. Instead the best customer segment for ICT developers will be the Prosumer and through apps that build on top of or are independent of Supplier or Telco solutions.
- New market entrants such as Internet Service Providers will enter the market with a focus on the in-home services market. Competitive rivalry will increase between Telcos and ISP and move from the internet of things to the internet of services in the home. Supplier may become attractive partners or acquisition points.

4.2.1.2 Vertical Markets Scenario Observations:

- LFAs are doing the heavy lifting to pull forward the energy markets of tomorrow. They are doing it largely alone and with a low margin business model as the benefits of scalability and the LFM-MSP have not yet arrived. Focus is on survival and market positioning. They are adopting on-boarding strategies for Prosumers.
- WMA will begin to realise that untapped market of residential flexibility and start to establish LFA relationships and collaboration opportunities with Suppliers. Significant focus on establishing Business to Business contracts. On-boarding of Prosumers by LFA makes the Supplier relationship more likely. For the WMA access to the Supplier enhances the likelihood of profitability in the business model.
- WMA realise the need for technological solutions to engage in local flexibility market and will establish relationships with ICT developers for solutions.
- More LEC will emerge into the marketplace. Partly being pushed by Government and independent LFA's. LECs will engage in flexibility but will predominantly be focused on the energy supply side of the market. Advanced flexibility LEC will look for different market arrangements with a financial incentive and begin to form structures. LECs will become more interested in their data and ownership.
- ICT developers have access to the developing market as LFAs and WMAs will actively seek better technological solutions for the flexibility management of vertical market segments.
- DSOs will be actively lobbying for an economic mechanism to engage services on local flexibility markets or to sign bilateral contracts with market parties such as an LFA.
- There are discussions about how DSOs can be progressive and how DSOs can help lead market transition. It may be the case that these discussions may be looking in the wrong direction and instead the key question is likely how can the ecosystem at large be “jump-started”
- Large-scale Government action has the potential to be the catalyst for market transition. Governmental bodies will play a significant role in this phase. In particular, through the establishment of agencies focused on establishment of LECs. Government regulations surrounding the market place, the role of actors and the unbundling of responsibilities will be expected. Multiple parties will be lobbying for their perspective.
- The wide-scale adoption of a disruptive technologies such as smart appliances, domestic PV and storage have the potential to act as a catalyst for market transition. “Flexibility ready” electric vehicles are another potential technology and collaboration with EV manufacturers will likely present various actors with collaboration opportunities and resultant business strategies.
- Data Ownership will become a critical focus of concern for the government. DSO will be lobbying for control but so will other actors such as Metering companies.

Table 11 provides an overview of forecasted business strategies and collaborations opportunities amongst actors in the Growth Phase. Use Cases are briefly described in Section 5 and in detail in project deliverable D6.1.

Table 11. Forecasted Business Strategies and Collaboration Opportunities within Growth Phase

Phase	Actors/ Roles	Potential Business Strategies	Relates to	Collaboration Opportunities
Phase 2 Growth Competitive Clusters	Supplier	<ul style="list-style-type: none"> Prevent client defection to competitors with better services. Gain new clients by offering better services. To enter the energy management market. To develop and sell energy boxes to new and existing clients. Engage in customer-oriented programmes to educate the customer about the possibilities of energy efficiency and flexibility activation Marginally trade flexibility. Flexibility business strategy will first focus on customer retention 	UC1	<ul style="list-style-type: none"> Supplier- Prosumers for implementation of new types of energy contracts and access to flexibility markets. Supplier-Telcos for Energy Boxes / access to in-home consumption data. Supplier-ADR Technology Developers <ul style="list-style-type: none"> Supplier-White Goods Industry for in home control of appliances. Supplier-EV makers for at home integration of EVs. Supplier-RET makers for at home integration of renewables and storage. Supplier-ESCOs for energy management services. Supplier- DSO collaboration and coordination for implementation of dynamic pricing tariffs. Supplier-LFA for contracted flexibility services
	Telcos	<ul style="list-style-type: none"> Sell energy boxes or services related to in-home data and in-home control functionalities. Cross-selling of bundled content and data services through the energy box. Valorize existing network of fixed and mobile customers by facilitating energy provider switching. 	UC1	<ul style="list-style-type: none"> Telco-Supplier to deliver and integrate energy boxes in the case the Supplier is not implementing its own energy box. Telco-Supplier to offer bundled services into the existing Supplier/BR customer base. Telco-Supplier to valorize the telco network by incentivizing client switching via customized offers. Telco-White Goods Industry for the development of energy boxes and controllable appliances.
	ICT Developers	<ul style="list-style-type: none"> Provide disruptive apps that facilitate in or at home energy management. Provide dynamic pricing systems (hardware, software) to Supplier. 	UC1	<ul style="list-style-type: none"> ICT Developers-Prosumers for the uptake of disruptive apps. ICT Developers-Supplier for the development, co-development, implementation and support of ICT solutions.
	ADR Technology Developers	<ul style="list-style-type: none"> Sell ADR technologies to Prosumers. To increase competitiveness relative to peer ADR technologies or to gain pricing power. To increase sustainable image (white goods). 	UC1	<ul style="list-style-type: none"> ADR Tech-Supplier for co-development and piloting of technologies. ADR Tech-Telco for co-development and piloting of technologies.

	Internet Service Provides	<ul style="list-style-type: none"> Sell services related to in-home data and in-home control functionalities. Cross-selling of bundled content and data services through the energy box. 	UC1	<ul style="list-style-type: none"> ISP-Supplier to offer competing bundled in-home services of the Telco. ISP-White Goods Industry for the development of energy boxes and controllable appliances and to lock customers into in-home services bundles.
Phase 2 Growth Vertical Markets	LFA	<ul style="list-style-type: none"> Grow client base. Develop vertical service solutions for vertical market segments (local energy communities, large industrials, blocks of buildings, micro-districts). Trade flexibility. Provide flexibility management services. Provide energy management services. Provide energy box and monitoring solutions. 	UC1 UC2	<ul style="list-style-type: none"> LFA-Vertical Market Segments for the development and implementation of flexibility management solutions.
	WMA	<ul style="list-style-type: none"> To enter the local flexibility market. Flexibility business strategy will first focus on establishing local agents 		<ul style="list-style-type: none"> WMA – LFA for the development and implementation of WMA flexibility strategy
	ICT Developers	<ul style="list-style-type: none"> Sell flexibility management functionalities (hardware, software) to LFA, WMA. 	UC1 UC2	<ul style="list-style-type: none"> ICT Developers-LFA for the development, co-development, implementation and support of ICT solutions. ICT Developers-WMA for the development, co-development, implementation and support of ICT solutions.
	ADR Technology Developers	<ul style="list-style-type: none"> Use LFA Portfolios to achieve technology scalability 	UC2	<ul style="list-style-type: none"> ADR Technology Provider-LFA for the coordinated delivery of ADR technology.
	Governing Bodies	<ul style="list-style-type: none"> To establish functioning LEC through significant finances of local energy projects. Stimulate economic activity, tax revenue and job growth. To realize new sources of revenue by participating in the market. To implement efficient subsidies or incentives. 	UC1 UC2	<ul style="list-style-type: none"> Governing Bodies-Citizens for the development and adoption of policies and programs that support flexibility uptake. Governing Bodies-Business for the fielding and implementation of flexibility solutions.
	DSO	<ul style="list-style-type: none"> Lobbying for market mechanisms such a balancing market at the Distribution level. Engaging ecosystems actors for support. 	UC3	<ul style="list-style-type: none"> DSO- Governing Bodies to change regulations in terms of activity. DSO – Ecosystem Business for the fielding and implementation of flexibility solutions.

4.2.1.3 *Competing Business Model Scenarios in the Growth Phase*

The LFAs multi-sided business model is as presented in Section 3. The business model is the business opportunity and who ever adopts the role of the LFA will need a business strategy to ignite the business model. While the role of the LFA can be adopted by a number of actors, emerging from the ecosystem analysis in the previous section we made the observation of two plausible and directly competing LFA business platform strategies in the Growth Phase, explicitly a Supplier-Led LFA and a WMA- Led LFA.

Supplier-Led LFA-MSP Scenario:

In this scenario, the Supplier takes on the platform owner role within the LFA-MSP. For the Supplier, the chicken and egg problem is not as pronounced as it would be in new or pioneering LFA-MSP, because he already has existing contracts with customers, has relationships with energy stakeholders and trades in the wholesale market. The flexibility business strategy of the Supplier will first focus on customer retention in order to protect themselves from competitor's market share grabbing endeavours. In an active and hyper competitive environment, the Supplier depends on customer loyalty for growth as customer acquisition is a far more expensive strategy. In this fashion they will be constantly seeking new ways to deliver attractive value propositions to their customer base. The emergence of the smart grid and advancement of customer oriented technologies provides a real competitive advantage for the Supplier through their integration into their value propositions. Introducing and bundling flexibility services as part of that product offering is aligned to that market strategy.

The Supplier has a distinct advantage over other flexibility aggregators – it already has the relationship and contract with the supplier of flexibility – the Prosumer. The Supplier will see themselves as the holding the central position in the value chain between the Prosumer and the flexibility market. Because of their closeness to the Prosumer they will see themselves as critical to the successful ignition of the flexibility market. This relationship will see them position themselves as both the energy service provider but also as a customer-oriented flexibility manager. The Supplier will want to own the customer relationship. In this fashion, they will want to manage and control the following functions:

- Customer Service Manager Function: Responsible for managing the customer relationship and transitioning them to a Prosumer.
- Service Supply Manager Function: Responsible for managing the provision of services to the customer including energy, flexibility and technologies.
- Customer Account Manager Function: Responsible for invoicing the customer.
- Flexibility Manager Function: Responsible for collecting the flexibilities provided by its customer portfolio and sells aggregated flexibility to the market.
- Balance Responsibility Manager Function: Responsible for balancing operations by matching supply and demand for its portfolio of customers.

Figure 10 presents two possible business model scenarios for the Supplier as platform owner. The first business model scenario is an integrated flexibility supply where the Supplier is the LFA himself. The simplicity in this business model comes from the fact that it is a bilateral agreement between Customer and Supplier and most importantly for the Supplier's competitive position in the value chain - no other market participant is involved in their existing relationship. The Customer will receive a reduce energy

bill for their flexibility activation and the Supplier will trade the flexibility with other actors or on the wholesale markets through the WMA.

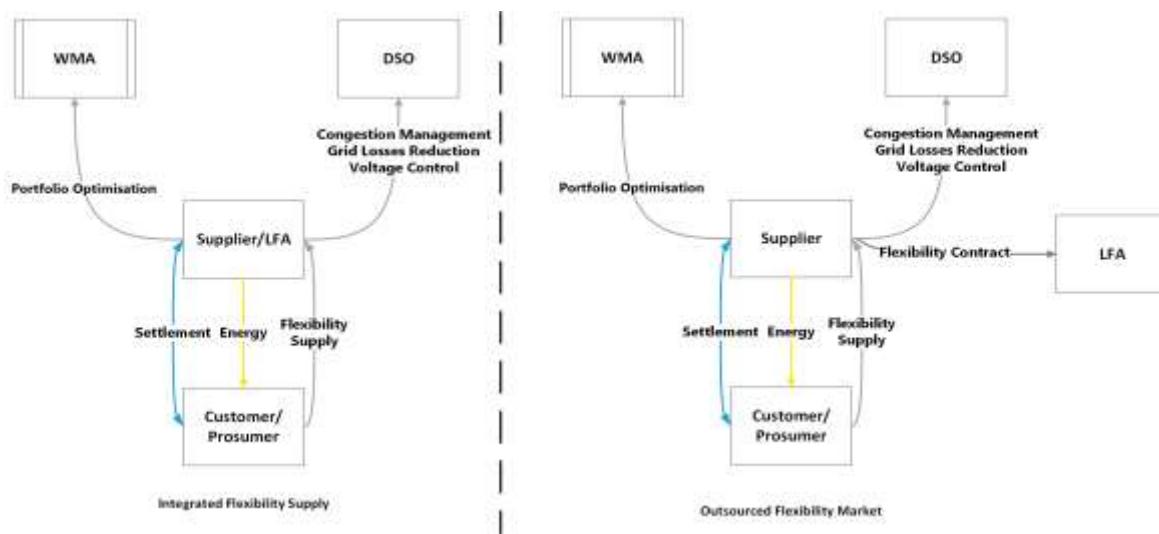


Figure 10. Supplier-Led LFA Business Model Scenarios

However, the role of the LFA may require skills and competencies not readily available within the structure of the Supplier such as advanced ICT and aggregation capabilities that would be needed to deliver flexibility services. The second business model focuses on this scenario and is an outsourced flexibility supply where the LFA acts as a service provider or sub-contractor to the Supplier and does not assume an independent role in the value chain. Outsourced activities would include forecasting, scheduling optimisation and load control. Based upon the LFA analysis, the Supplier would then sell the flexibility for the maximum benefit. From the Customer’s perspective, he does not see any involvement from the LFA in their relationship with the Supplier and nor does the LFA directly benefit from their relationship. Settlement to the LFA is paid by the Supplier based on contract specifications. Regardless of which business model scenario is operationalised, the Supplier is adopting the LFA role to protect and control his relationship with the customer.

Positioning itself as a customer-oriented firm, the Supplier will engage in customer-oriented programmes to collaborate and educate the customer about the possibilities of energy efficiency and flexibility activation. Because the Supplier is offering bundled services already to the customer, the flexibility offering extends their product portfolio and in some instances can be subsidised by other services in the portfolio. The Supplier will collaborate with Prosumers to implement new types of energy contracts and access to flexibility markets. For the Supplier it is strategically important that he is seen by the marketplace as the Prosumers partner and the main access channel. The Supplier has a unique selling proposition in that he has the access to all levels of optimization for energy efficiency programmes tailored for the customer and so has the capability to bundle energy sources, technology, price programmes and service offerings. Utilising the Suppliers already established relationship with the customer will be what other actors in the ecosystem will try to leverage, particularly the Telco and ISP. Indeed, collaborative relationships will emerge between the Supplier and Telcos to deliver and integrate

energy boxes in to the home, particularly if the Supplier does not have its own energy box. Similarly, White Goods Manufacturers will collaborate with Suppliers around in home control of appliances as it adds to their differentiation from competitors and in the future, potential access to additional revenues in flexibility, data etc. The Supplier will be actively engaging ADR Technology Developers as it is aligned with their strategy of continuously seeking to find new attractive value propositions to add to their bundled services.

Strengthening its position in the value chain, the Supplier will be actively engaging and collaborating with the DSO over the introduction of dynamic pricing. Because of their existing customer base, the Supplier will see dynamic pricing has providing them with a competitive advantage over new market entrants, indirect and direct competitors. By pricing their services on market demand, the Supplier will be able to generate greater profitability on each service. The growth in real time information will enable them to understand the effect of customer oriented programmes and sales efforts and make changes to initiatives where needed. It will also place the Supplier as the Customer's gatekeeper to the rest of the market and provide them with greater negotiating power because the Supplier will have knowledge over how much a product will sell for, when and whether the Customer will be motivated to purchase.

WMA- Led LFA-MSP Scenario:

In this scenario, the LFA is an agent of the WMA who will adopt a passive aggregation strategy where the LFA will perform the customer acquisition and local flexibility optimisation. In contrast to the Supplier-Led LFA, the LFA here has to confront the chicken-and-egg puzzle right up front. The main business strategies at the LFA disposal for igniting the MSP and securing critical mass are:

1. *Zigzag* strategy is where you push all sides of the business model simultaneously on route to critical mass.
2. *Two-step* strategy where you focus on getting one side to join first and once there is enough on-board, you persuade the other side to join the MSP.

Most ignition strategies combine the two. Normally beginning with a zigzag, followed by a two-step approach. Figure 11 presents the business model scenario for the WMA-Led LFA. The LFAs relationship with its Prosumer and in particular with the LEC is critical to success for the LFA in this scenario. Indeed, it's relationship with the LEC is probably the most important relationship in the MSP. The LFA needs to look at this relationship as a collaboration and not as your typically seller-client relationship. The 'cross-side network effect' of the LFA's business model means that in order for the LFA to have a business model that is of value to other energy market players in the ecosystem (i.e. WMA, Supplier, DSO and other LFAs), it needs to on-board as many Prosumer contracts as possible. However, signing a formal contract with an LFA to join a DR programme will at the outset be perceived by most Prosumers as bringing relatively small benefits to them. Moreover because of the embryonic nature of the flexibility market, there may be a lack of awareness amongst residential householders as to the services that can be provided by the LFA, let alone an understanding that they can be an active participant in the energy value chain. In addition, the Supplier will be marketing and offering competing flexibility services to Prosumers.

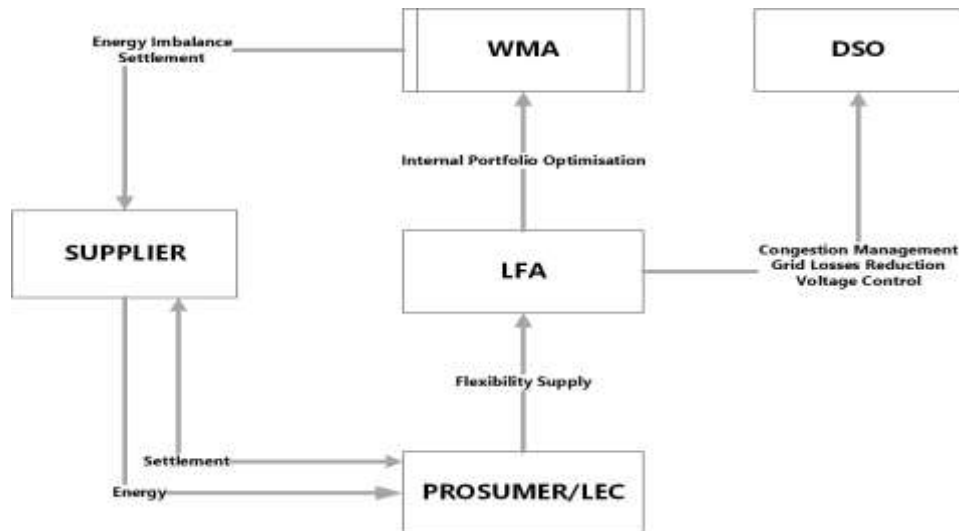


Figure 11. WMA-Led LFA Business Model Scenario

While the Supplier is primarily interested in the Prosumer, the ‘bottom up’ market entrants of LECs such as BürgerEnergie movement in Berlin to the smart grid value chain constitute a basis for new Prosumer-oriented business models. As detailed in Annex B.1, across Europe there is an increasing proliferation of cooperative LECs mainly driven by the view that the incumbent energy providers are not delivering the appropriate energy products and services that the end user desires. In addition, Prosumers and LECs that we interviewed felt that while consumers have evolved to understand the importance of the smart grid and are eager to adopt new technologies to engage it, there is however a lack of legitimacy and desire amongst energy provider’s to actually understand their customer’s behaviour in order to tailor energy programmes that meets the needs of end-users and encourages customer engagement and participation. In essence, there is a lack of belief amongst the LEC that the incumbent energy providers want to actually see the citizen at the core of the energy system, taking ownership and fully participating in the marketplace. Hence the rise of the LEC movement to take back control.

This is advantageous for the LFA (both independent and WMA). In comparison to the other energy actors in the ecosystem, this form of LFA is more locally focused and because his business model is based on local flexibility, the LFA can establish legitimacy and trust more readily than traditional energy companies. The LFA will need to capitalise on the perceived lack of trust between the LECs and incumbent energy providers. Simply by association to the industry, the LFA will have to overcome some of the legitimacy and trust issues highlighted above and should positioning himself as the *‘local actor with local interest’*. The LFA will have to engage in an active marketing change behaviour programme to ensure significant customer acquisition and it will involve transitioning LECs through a number of stages from unawareness to advocates:

- **Unaware:** The LEC is unaware of flexibility and the role of the LFA;
- **Awareness:** Becoming aware of the benefits of engaging in local flexibility and how they can generate and consume energy;
- **Knowledge:** Finding out how to change and engage by providing the right knowledge and skills to perform the required change behaviour;

- **Liking:** The LEC is now favourable towards implementation and wants to engage;
- **Conviction:** The LEC signs to a DR programme;
- **Advocate:** The LEC acts as a promoter and influence agent amongst peers.

Marketing interventions to stimulate behavioural change should include strategies based on education and information, incentives and support provision for the establishment and engagement with the LEC approach. The provision of education and information interventions will increase awareness and acceptance that change is needed within the residential landscape. It will also facilitate greater knowledge about flexibility services and how the LEC can take proactive action to engage in such programmes with a LFA. Given the importance of the LEC to the LFA business strategy, a marketing programme that assists and provides guidance and advice services to the establishment and enhancement of LECs could prove a very good customer acquisition strategy for the LFA. Indeed, engaging with local community groups takes advantage of their influence over their members and if successful should increase the rate of product diffusion and adoption by the LFA. The marketing efforts should be designed to enhance and promote a brand image of trustworthiness and reliability in the minds of prospective customers while highlighting the deficiencies of incumbent energy providers to satisfy customer needs. This will build legitimacy for the LFA and should result in LECs actively promoting and advocating the LFA services to its members.

Incentives provided by the LFA could also enhance the likelihood of adoption. For instance, the introduction of new technologies could be very attractive proposition to early adopters who will have the desire to be using whatever is at the forefront of technology in the home and their needs would be answered by the LFA. Government agencies specifically established to ignite LECs such as apartment blocks will become a strategic partner of the LFA. There will be a significant increase in government funded community energy projects which will require LFAs to manage these advanced energy communities' interactions amongst each other but also with the marketplace. From a strategic collaboration perspective, the LFA could adopt a *co-opetition* strategy with other LFAs in their LV area because it capitalises on pooling on-boarded customers in order to ignite the other side of the MSP. In reality, this collaboration strategy will probably be pushed by the WMA connected to LFAs because it potentially increases the likelihood of the WMA establishing a bilateral contract with the Supplier to control his portfolio in that local area.

4.2.2 Strategic Forecasting Analysis and Scenario Planning for Phase 3 Maturity

The Maturity Phase is characterised by a Fully Functioning Local Flexibility Market and Figure 12 presents how this market scenario may function. Table 12 presents a convergence on potential and likely business strategies and collaboration opportunities of the actors. In this phase we have made the following observations:

- Collaboration opportunities are notably higher in this phase as the market is now maturing to a Functioning Local Flexibility Marketplace. All actors benefit although Suppliers that do not transition their business models will not benefit.
- Entry and growth of new actors will be in part thanks to the decline of traditional actors
- Supplier shift focus from customer protection mode to customer relationship.

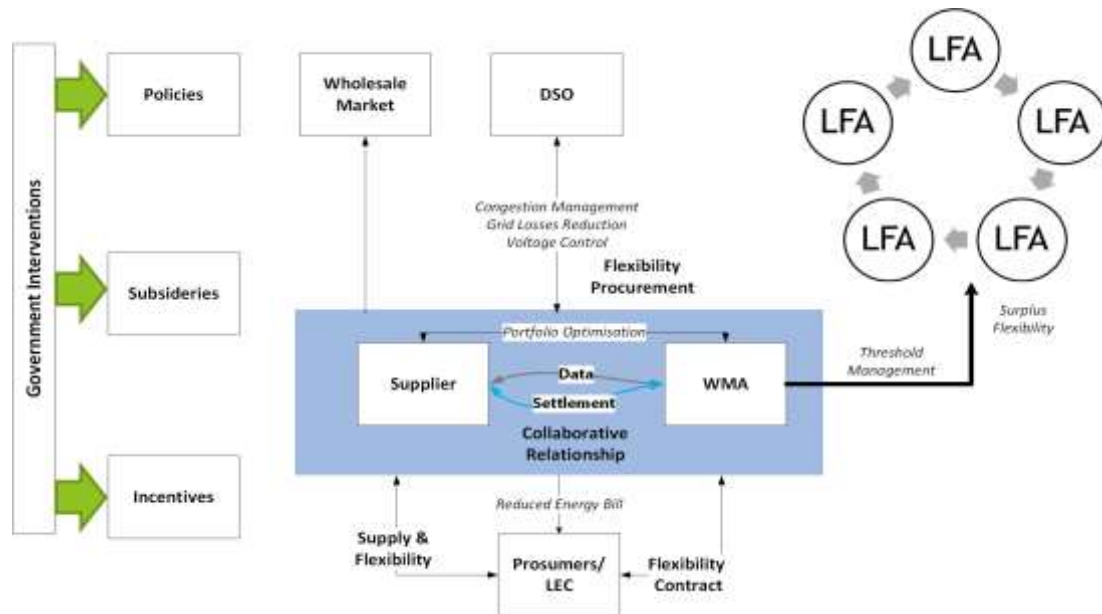


Figure 12. Participatory Supplier & WMA – Led LFA Business Model Scenario

- Partnerships, strategic alliances and mergers are likely a dominant theme of this Phase. Supplier will find mergers a fast way to catch up and scale the work done by surviving LFAs from Phase 2. Partnering to accelerate the cross selling of ADR Technologies can also be expected.
- LFA are in a strong market position due to the continuous on-boarding of Prosumers and LEC. Potential for multiple forms of partnerships and collaborations for expansion. In our conceptualisation we present a strong collaborative partnership between the Supplier and the WMA. Their position in the marketplace is strengthened a by a functioning local flexibility market where LFA-LFA relationships and partnerships are present.
- LEC are now actively engaging in flexibility and understand their value to the marketplace. Some LEC will want different market arrangements such as becoming a LFA and benefit sharing. Indeed, advanced LECs will want special or priority treatment.
- DSOs are now engaged in the flexibility marketplace. Likely to have a balancing market mechanism in place. likely to engage until the market matures and the regulation facilitates them engaging in the local flexibility market
- Market consultants will now enter the market as technologies, options between service providers and the need to facilitate public programmes matures. Market consultants are largely waiting for the market of tomorrow.
- Data services and access to the data generated from the home will become significantly competitive. Data aggregation services will also be offered to other stakeholders such as energy providers, marketers, appliance companies, software platforms and will drive unimaginable opportunities to entrants and services that cannot be foreseen today.
- Governmental bodies are now actively engaged in regulation and market structures and have the ability to play a key role in market expansion via subsidies, incentives, policies and interestingly in active market participation for new revenue opportunities.

Table 12. Business Strategies and Collaboration Opportunities within Maturity Phase

Phase	Actors/ Roles	Potential Business Strategies.	Relates to	Collaboration Opportunities
Phase 3 Maturity – A Function Flexibility Market	Governing Bodies	<ul style="list-style-type: none"> Stimulate economic activity, tax revenue and job growth. To realize new sources of revenue by participating in the market. To implement efficient subsidies or incentives. 	UC1 UC2 UC3	<ul style="list-style-type: none"> Governing Bodies-Citizens for the development and adoption of policies and programs that support flexibility uptake. Governing Bodies-Business for the fielding and implementation of flexibility solutions.
	DSOs	<ul style="list-style-type: none"> Purchase flexibility to manage congestion. Purchase flexibility to defer investments. Purchase flexibility to increase LV efficiency and performance. 	UC3	<ul style="list-style-type: none"> DSO-Aggregator for bilateral contracts and ICT solutions that facilitate management of the LV Grid via DSO flexibility purchase. DSO-ICT Developers for ICT solutions that facilitate LV Grid flexibility management where this is not outsourced to an aggregator. DSO-Supplier for ICT solutions that facilitate LV Grid flexibility management where not outsourced to an aggregator or ICT developer.
	Supplier	<ul style="list-style-type: none"> As in Growth Phase. Partnering with aggregators to manage and trade flexibility as a revenue source. Partnering with Governing Bodies and DSOs to bring service offerings to these actors. 	UC3	<ul style="list-style-type: none"> Supplier-Aggregators for scenarios where the utility outsources the aggregator role (Aggregator provides a service). Supplier-Aggregators where client portfolios are merged. Supplier-Governing Bodies for the development of customized contracts / service offering to support local programs. Supplier-DSOs in the case the utility acts as an aggregator or ICT developer (selling ICT or managing flexibility).
	LFA/WMA	<ul style="list-style-type: none"> As in Growth Phase. Partner with Supplier to deliver flexibility management solutions. Partner with Governing Bodies and DSOs to bring service offerings to these actors. 	UC1 UC2 UC3	<ul style="list-style-type: none"> LFA/WMA-Supplier to either provide flexibility management services or to attain scale by merging client portfolios. LFA/WMA-Governing Bodies for the development and implementation of local flexibility management solutions. LFA/WMA-DSO for bilateral contracts to deliver flexibility to DSOs.

	LEC	<ul style="list-style-type: none"> LEC are engaging in flexibility. Advanced LECs will want special or priority treatment. 		<ul style="list-style-type: none"> LEC- LFA for the development of collaborative relationships. LEC- Supplier for the negotiation of industrial style tariffs for LECs.
	ADR Technology Developers	<ul style="list-style-type: none"> Partner with Governing Bodies, Supplier, or Aggregators to attain technology scalability. Direct sales to Prosumers participating in the flexibility markets. Lobby for subsidies or incentives. 	UC2 UC3	<ul style="list-style-type: none"> ADR Tech-Governing Body for development and implementation of subsidies, incentives and programs to facilitate technology uptake. ADR Tech-Utility for sales via strategic alliance or cross selling. ADR Tech-Aggregator for sales via strategic alliance or cross selling.
	ICT Developers	<ul style="list-style-type: none"> Sale of advanced ICT solutions and analytics targeting Supplier, Aggregators, DSOs and Governing Bodies. 	UC3	<ul style="list-style-type: none"> ICT Developers-Aggregators/Supplier for the co-development of advance solutions/analytics. ICT Developers-Governing Bodies for the co-development of solutions targeting public programs.
	Market Consultants	<ul style="list-style-type: none"> Provide consultancy to market participants and most likely to vertical markets and governmental bodies. 	UC3	<ul style="list-style-type: none"> Market Consultants-Governing Bodies for the co-development of public programs. Market Consultants-Market Entrants for services related to selecting from the various technologies and providers.

5 Business Case Formulation

Now that the characteristics of the LFA-MSP, its ecosystem, stakeholder business strategies and the main actor-led LFA business model scenarios have been defined, it is possible to formulate several business cases that are correlated to the project use cases and which can be developed and validated in the next stage of this work package. To put the business cases in context, we will first briefly present the Mas²tering use cases, technologies and business model.

5.1 Mas²tering Use Cases

As detailed in D6.1, Mas²tering relies on three use cases to assess the effectiveness of the Mas²tering product against the scientific and technical objectives of the project.

The first use case (UC1) focuses on the Home Area Network (HAN) and the services that involve the prosumer. The purpose is to demonstrate the interoperability between the HAN management system, the smart meter and the Energy Box, which allows the bi-directional communication between the prosumer and the rest of the LV grid.

The second use case (UC2) focuses on the local community of prosumers represented by a Local Flexibility Aggregator in a local area of the LV grid; the scope is to demonstrate that MAS optimization performed at this local level is effective for energy management and local balancing, as an alternative to traditional centralised optimization. The objective is to maximise revenue for prosumers belonging to the local community when coping with variable external conditions but not considering grid-related constraints.

The third use case (UC3) can be considered as an extension of UC2 and tackles the LV grid, intended as the union of local communities of prosumers in a given area (represented by a MV/LV substation). The UC targets in particular DSOs and aims at demonstrating that the local optimization enabled in UC2, coupled with appropriate grid monitoring can be a cost-effective way to deal with local congestions and globally increase grid performances, reliability and resilience.

5.2 The Mas²tering Product: Key Exploitable Results

The set of project exploitable results currently under development in WP7 activities can be clustered into two Key Exploitable Results (KER). They become the Mas²tering products and they are the Mas²tering Flexibility Management Platform and the Mas²tering Energy Box.

5.2.1 Mas²tering Flexibility Management Platform (KER1)

This platform is developed to either (a) give the LFA the technical capability to conduct flexibility management in the low voltage portion of the grid or (b) to do it more effectively and efficiently through the use of the functionalities developed in Mas²tering (multi-agent systems, cyber security, forecasting

where each is proprietary). The platform enables the three steps of the Mas²tering market-based mechanism, as described in D6.1. The use of agents allows for market negotiations between actors finalised at increasing Prosumers' revenue and enhance grid performance and resilience. Main components are the MAS optimization system, required to drive the negotiations; the forecasting web service, required to forecast Prosumers' consumption and generation; the historical data server, required to store historical data of both consumption and generation and improve the accuracy of forecasting algorithm; the cyber security components, required to ensure privacy, data integrity and protection against cyber-attacks. Without the platform the LFA would not be able to operate a proper local flexibility management, with the risk of losing clients and incur in penalties.

Market Readiness: During the project, the platform will attain a TRL between TRL5 and TRL6 which is to state that it will reach the late stages of development and early stages of demonstration. It combines IP from partner CEA for multi-agent systems, AIRBUS for cyber security and CU for forecasting services. It is clear that each of these partners will continue to exploit their individual foreground via their professional activities. It is not clear yet how these partners may work together or in combination with other consortium partners to attain the next TRL levels of the Mas²tering Platform en route to commercial exploitation.

5.2.2 Mas²tering Energy Box (KER2)

The Energy Box is developed to be the device that enables the communication between the HAN and the rest of the energy network and flexibility management at the home level. Because of its connection to the smart meter, end user and smart devices, it becomes a natural portal with which to deliver energy management services and bundled content. The Energy Box is the linking point for the implementation of the Mas²tering platform services. It collects useful information from the Prosumer regarding consumption, generation and planned use of appliances; it receives commands from the MAS platform following optimization and translates them into actions for the appliance or for the Prosumer. For the LFA the energy box represents the piece of equipment that gives the Prosumer access to the flexibility services. The Energy Box is developed to be the device that enables flexibility management at the home level. Because of its connection to the smart meter, end user and smart devices, it becomes a natural portal with which to deliver energy management services and bundled content.

Market Readiness: During the project, the Energy Box will attain a TRL level between TRL6 and TRL8 which is to state it reach demonstration in relevant environments. The Energy Box combines IP from partner TI (hardware + software) and Airbus (cybersecurity). Although TI has the role of energy box development in Mas²tering, partner ENGIE is also developing a proprietary Energy Box as part of their commercial operations separate from the project indicated the commercial interest of both Telcos and Supplier in this product. Both companies expect to field such devices (e.g. attain TRL9) in the near to mid-term future.

5.3 Business Model for Mas²tering

Figure 13 depicts a project-level consolidated business model which couples together KER1 and KER2. In this sense, the Mas²tering business model is the delivery of the Mas²tering Flexibility Management Platform

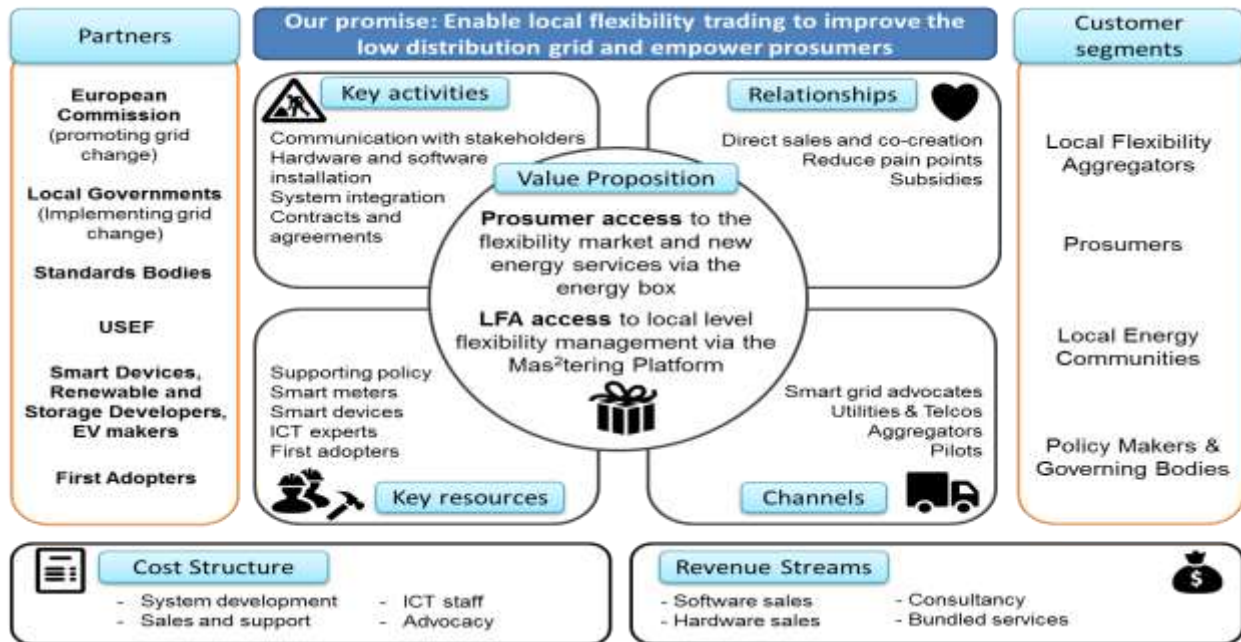


Figure 13. Mas²tering Business Model (as a project)

and the Mas²tering Energy Box in order to enable or make more efficient the local flexibility market for LFAs, Prosumers, local energy communities and governing bodies. The elements of the business model canvas developed in the context of the Mas²tering project are briefly described

5.3.1 Customer Segments and Market Points of Entry

Within the context of these two KERs, the Mas2tering project will have two entry points into the market. They are aggregators (with specific focus on the distinction to Local Flexibility Aggregators) for KER1 and Prosumers or Local Energy Communities for KER2 as depicted in Figure 14. It is also possible that the Energy Box could be delivered by Supplier or Telcos to LFAs to extend their client base into the LV Grid if they do not have proprietary solutions themselves and choose to provide it as part of their service contract. Once delivered, these KERs make possible or facilitate the business models of the actors they are delivered to. In specific, the business model of the LFA and the business model surrounding the Energy Box provider and services delivered by the Energy Box. Governing bodies are a deliberate customer segment identified through the interview processes and workshops in that we see the opportunity for them to become direct market participants by becoming service providers between aggregators and Prosumers, to potentially take part in the formation of aggregator companies or to put policies or subsidies in place that facilitate the development of the local flexibility market. Notwithstanding possible competitive aspects in the implementation of the project-level business model, there is considerable non-competitive work to be done with respect to standards, supporting policies, and the interoperable technologies required to make the flexibility markets work.

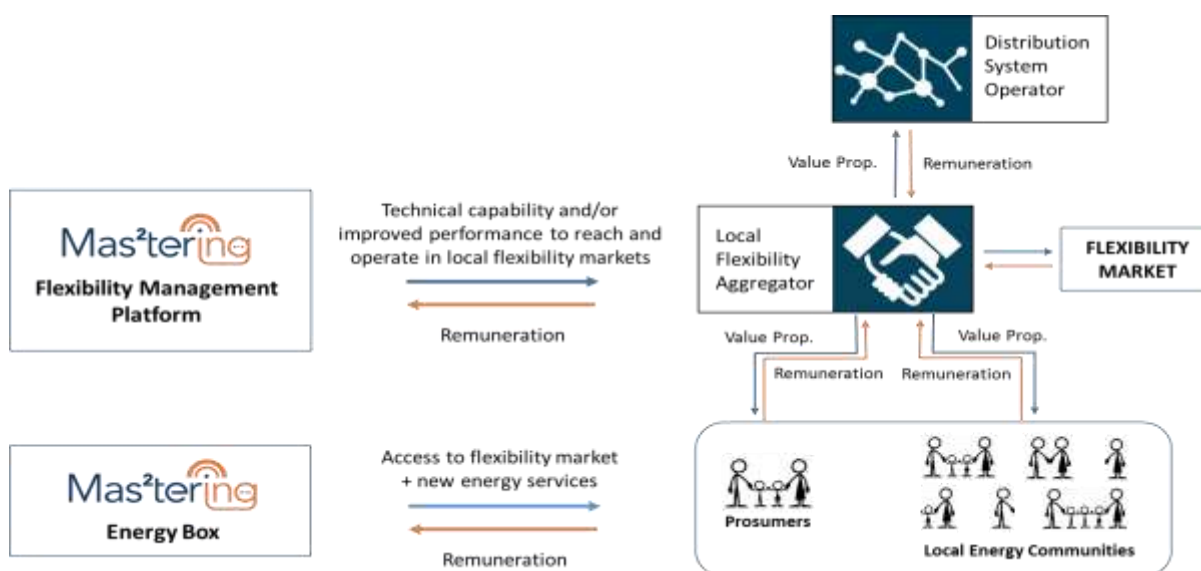


Figure 14. Market Entry Points

5.3.2 Value Proposition

There are a number of value propositions underpinning the Mas²tering business model for both the Prosumer/LEC and the LFA. However, for the LFA, the most influential proposition that Mas²tering provides is the technical and functional capabilities of the platform that enable him to optimise his multi-sided business model. In essence, it enables the LFA to effectively exploit the active participation of the LEC on one side of the LFM-MSP, in order to aggregate flexibility for the provision of commercial services to energy market stakeholders on the other side of the LFM-MSP, while ensuring maximum value of the Prosumers flexibility. The following are the Mas²tering value propositions:

- Provides LFA with the technical capability to conduct flexibility management in the low voltage portion of the grid.
- Allows the LFA to do it more effectively and efficiently through the use of the functionalities developed in Mas²tering (multi-agent systems optimization, cyber security, forecasting where each is proprietary).
- Enables the LFA to exploit the participation of the Prosumer. The Energy Box is developed to be the device that enables flexibility management at the home level. Because of its connection to the smart meter, end user and smart devices, it becomes a natural portal with which to deliver energy management services and bundled content.
- Empowers the Prosumer to optimise energy flows within his/her home via self-consumption of energy.

- Enables Prosumers to offer their flexibility as a product to other actors within the LEC in order to reduce his/her their energy bill.

5.3.3 Channels

Within this business model, it is possible that both the Energy Box and Management Platform are delivered by the same actor. This would reduce several complexities. It may be more likely however, that the KERs are delivered by different actors, for different purposes, using unique business models. In specific, the first aggregators on the market to adopt such technologies and assume the role of a local flexibility aggregator may not be Supplier but companies or organizations that specialize themselves for this purpose targeting vertical market segments. In this case, there may be competition for clients and the services that can be offered to them.

5.3.4 Cost and Revenue

Mas²tering Flexibility Management Platform (KER1): With respect to pricing, the Mas²tering Platform is a business enabler and as such a premium platform. Its cost will likely consist of a flat fee plus added cost based on the number of Prosumers managed. This makes it possible to offer pricing where an aggregator with 1000s of clients would not pay the same price as the manager of a block of buildings assuming the aggregator role. The flat fee can be thought of in terms of tens of thousands of euros. The user fee can be thought of in terms of tens of euros. The maintenance and continued support of such a platform is expected to be significant source of recurring revenue *Mas²tering Energy Box (KER2):* With respect to pricing, the box can be thought of in terms of tens to hundreds of euro. It can be expected that in the early phases of the market Prosumers would not face upfront box costs, but either be subsidized or have payments bundled and spread across time into a flexibility management service contract.

5.4 Business Case Formulation: Alignment of Project Use Cases and Subsequent UC Business Models.

One output of the work presented in this report is to give a business storyline and business rationale that links to and helps shape the project use cases, the validation plan for the use cases, and subsequent business model work from those use cases that will be reported in the next work package 1 deliverable (D1.7 Mas²tering Business Models). From the work, interviews and workshops conducted to date, it is clear that LFA- MSP business models between the actors connected bi-laterally within the platform will be dependent upon the specific organizations involved, the services and products offered, and the location in which they operate. That said, it is possible to identify business cases that are indicative of the business model scenarios identified in previous chapter and strongly correlate those to the project use cases by providing the business rationale. In this sense, we apply the definition that a business case presents the business rationale for an organization to implement a business model. In this fashion, we investigate the business rationale of different actors or pairs of actors to assume the LFA-MSP business model opportunity described in Sections 3-5. These business cases are also likely to occur at different points in time in the marketplace as they are intended to align with the various phases of market maturity presented in Section 4.

Business Case 1 (UC1): *Use of the LFA-MSP business model opportunity by a Supplier to increase competitiveness, expand its value added services, retain or grow its client base and answer the call to empower consumers from either Prosumers themselves, regulation or market pressures.*

It is rare that market incumbents initiate / lead market transition. Hence, it is interesting to have a business case that can be used to approach Suppliers with the following perspectives / arguments:

- Flexibility management can prevent you from losing existing customers who may migrate to competitors offering these types of services.
- Flexibility management can give you access to new customers by attracting customers from competitors who do not offer these types of services.
- Flexibility management can give you an additional service and revenue stream from your existing customers and enable penetration into energy management product sales and efficiency services.

On the other side of the Supplier in this business case is the Prosumer, with which the following perspectives / arguments are present:

- Signing up for flexibility management services gives you greater choice and impact on the electricity market.
- Flexibility management reduces your energy bill.
- Flexibility management is a sustainable choice.

Investigating and making concrete various aspects of these perspectives / arguments is the purpose of Business Case 1 (BC1) which pairs with Project Use Case 1 (UC1). In BC1 we assume that the Supplier directly subsidizes flexibility by offering preferential electricity rates to its customers and enabling in-home flexibility optimization through the energy box. This choice is made to investigate if such a strategy is financially viable. If so, it could be implemented today by Suppliers (in the absence of regulations, policy and a fully functioning flexibility market) and it would clearly demonstrate that the anticipated low value of flexibility trading itself is not a barrier. The enabling technology for BC1 is the Mas²tering Energy Box coupled to the PV forecasting module and historical data server of the Mas²tering Flexibility Management Platform. The Mas²tering Flexibility Management Platform is not needed in its entirety unless the Supplier develops the business processes to engage in the flexibility market. Instead, this BC assumes a “soft launch” of flexibility management by Suppliers where flexibility may be used only internally or directly subsidized. As such, BC1 aligns with the “competitive clusters” scenario presented in Section 4.

In shaping UC1 and determining what can be demonstrated in the Mas²tering project, there are concrete and soft aspects of UC1 and the subsequent realization of figures related to the business model. It can be concrete, the value proposition offered to a household with flexible loads and combination of renewables/storage. It will likely be less concrete numbers associated with client retention, client acquisition or increased competitiveness. However, given concreteness related to the value of various services proposed at the home level, Suppliers will be better informed to evaluate if BC1 is attractive to them.

Business Case 2 (UC2): *Use of the LFA-MSP business model opportunity by an existing WMA to provide flexibility management services to Prosumers within a Local Energy Community to increase their flexibility portfolio and to facilitate the formation and goals of Local Energy Communities.*

We are encouraged by the increased number of LEC type entities in Europe and also by existing aggregators at the industrial level expressing interest in local area flexibility but lacking the technological solutions to do it. In this case, Mas²tering is not trying to convince the market actors, but is instead providing a solution they are already looking for or are open to receiving. Hence, BC2 and the corresponding UC2 is the engagement of an LEC by an WMA (who is not a Supplier) which assumes the LFA role to provide Mas²tering enabled flexibility management solutions. Business rationale for the WMA includes:

- The expansion of its flexibility portfolio and hence turnover on flexibility trades.
- The potential to shift unallocated pockets of flexibility between its existing client portfolio (typically large industrials) and the LFA.
- An additional source of revenue from membership fees associated with the LEC.
- The potential for an additional source of revenue in the form of Prosumer energy management services.

On the other side of the WMA in this business case is the Local Energy Community. For the LEC, benefits include:

- The ability to trade flexibility within the community.
- Access to unbiased flexibility management using potentially more expert analytics and at preferential rates than would be possible acting as an individual.
- Social benefits in the form of being part of a community, feeling more in control, acting in a sustainable way collectively.

BC2 aligns with the “vertical solutions” scenario within the growth phase of the flexibility market. The enabling technology in UC2 is the energy box coupled with the Mas²tering platform (in its entirety). The argument is that in this case, the LFA will as its core business deliver flexibility optimization and thus provide a more value-added solution than present in UC1 where flexibility management is more the means to other customer services and less the means to generate profit.

To make BC2 concrete through demonstration activities in UC2, it will be necessary to make reasonable assumptions related to the membership fees / pricing / contract type between the LFA and LEC. It will also be necessary to make assumptions related to the pricing of flexibility both on the supply side (from the LEC) and on the sell side (to the WMA). The settlement process between the LFA and WMA will need to be made clear. Given this, BC2 and its investigation via UC2 should make more clear the value proposition of engaging an LEC for existing WMAs (in the capacity of an LFA), for LECs to engage an LFA, and for Prosumers to join an LEC.

Business Case 3 (UC3): *Partnering between a Supplier and WMA to exploit the LFA-MSP business model opportunity in a fully functioning flexibility marketplace where the DSO is a flexibility buyer*

This business case explores what a Fully Functioning Local Flexibility market may look like. Following the rationale presented in Section 5, one could imagine a Supplier partnering with a WMA. In such a pairing:

- The Supplier would gain the flexibility management capacity and business processes of the aggregator without having to develop those capabilities in house.
- Instead of subsidizing flexibility or using flexibility only internally, the Supplier would have access to revenue from flexibility sales.
- The WMA would gain access to the client base of the Supplier significantly expanding its portfolio.
- The WMA would gain access to potentially better margins via better rates provided by the supplier.

With respect to revenue streams, new possibilities considered in this business case not considered in BC1 or BC2 include:

- The sale of flexibility to the DSO, and to other LECs.
- Additional revenue streams from the MSP (cross selling) via partnering with Telcos, ADR technology manufacturers, application developers and software developers.

BC3 aligns with a “Fully Functioning Flexibility Market” scenario presented in Section 4. The key enabling technologies in this use case are both the Mas²tering Energy Box and the Mas²tering Flexibility Management Platform. BC3 and the corresponding work in UC3 will make a deliberate attempt to make more concrete the value proposition of flexibility to the DSO which will require assumptions related to congestion, capacity management and grid losses reduction (see Annex B.2). Soft aspects will remain with respect to the aspects listed in UC1 and assumptions about what cross-selling potential is attainable in the fully ignited MSP.

Table 13 provides a summary of the three business cases and their linkages across various project activities. The business cases presented are not intended to represent the market at large, but three possible instances of the market in the context of its transition from today to the market of tomorrow where flexibility management is a new normal. Business case validation in D1.7 will involve conducting a Cost-benefit analysis (CBA) which is described in Annex C. The CBA will contain aspects validated by the project UCs and other aspects that will require projections and logical arguments.

Table 13. Business Cases Linkages Across Project Activities

Business Case	Linkage to D1.5	Linkage to UCs (D6.1) and Business Model Opportunities (D1.6)	Research Questions / Aspects to make clear in D1.7
Supplier assumes the role of the LFA and offers Flexibility Management as a value added service.	Competitive clusters scenario where the utility is more focused on customer acquisition/retention and entry into energy management services.	UC1 <ul style="list-style-type: none"> Flexibility as a product from Prosumers to LFA. Energy management services from the LFA to the Prosumers. Bundled services with Telcos. 	<ul style="list-style-type: none"> Will Suppliers subsidize flexibility spreads or will they set up the business processes to engage the flexibility market? What is the value of client acquisition and client retention? What is the expected value of energy management services to the Prosumers?
A WMA assumes the role of the LFA creating LECs or engaging existing LECs to offer Flexibility Management services.	Vertical markets scenario where an existing aggregator wants to grow its existing Flexibility Portfolio by adding residential flexibility.	UC2 <ul style="list-style-type: none"> Flexibility as a product from LEC/Prosumers to LFA. Flexibility management services from LFA to LEC/Prosumers where flexibility is traded between Prosumers of the LEC. 	<ul style="list-style-type: none"> What is the additional expected value of LECs vs. individual Prosumers? What LEC characteristics make the business model viable?
Suppliers and WMA collaborate to deliver LV grid Flexibility Management services with DSO engagement.	Fully functional flexibility market scenario where the MSP business model has been ignited.	UC3 <ul style="list-style-type: none"> Flexibility as a product from LEC/Prosumers to LFA. Flexibility management services from LFA to LEC/Prosumers where flexibility is also sold to the DSO, WMAs or other LECs. Facilitation of ADR technologies, apps, services or content by Suppliers into the client base. 	<ul style="list-style-type: none"> What is the expected value of DSO engagement? What is the expected value of system efficiencies? What is the expected value of cross-selling opportunities?

6 Conclusion & Next Steps

Considering LV flexibility management and the future smart grid, this report has:

- Conceptualized and developed the LFA business model opportunity as a multi-sided platform. This type of business model is relatively new and how to structure it, ignite it, and fully deploy is not yet commonplace. Applied to flexibility management, the impact is that it allows us to move beyond the question of “is load shifting a viable business?” to a broader view of the value brought to multiple actors in an electricity market redesign and how that can be made into a viable business at the LV grid level.
- Conducted a VNA to fully define the flows and interactions that make up the LFA business model. It has up to five sides in which the LFA can make business with Prosumers, LECs, WMA, DSOs and Suppliers. Mini-business models between the LFA and each side of the platform are presented consisting of the value proposition, product offering, revenue model and relationship type. Functions and activities are detailed. Barriers and challenges are examined. The impact is that this analysis makes it more clear for any organization how to think about assuming the role of the LFA and making use of the LFA business model opportunity.
- Presented a view on how the market will transition from where it is today, to pass through a growth phase and eventually to a fully functioning flexibility market. In this view, Suppliers and aggregators work in very different ways. Suppliers focus more on client retention/acquisition and penetration into energy management services (Competitive Clusters) whereas aggregators focus more on flexibility trading and client portfolio creation (Vertical Markets). Eventually, these parallel efforts merge and this is a sign of the transition to market maturity. The view on how the market will evolve is important because it helps more clearly identify the business strategies and collaboration opportunities between actors at different points of time and these are presented. It also provides the rationale for why particular actors may assume the role of the LFA and this is also presented. It also provides insights to market points of entry for various products, services or technologies. This is discussed and its application to Mas²tering becomes a Section of the document (see Section 5).
- Formulated three business cases. These are a Supplier-led assumption of the LFA-MSP business model opportunity (Growth Phase), a WMS-led assumption of the LFA-MSP (Growth Phase), and a combined or paired assumption of the LFA-MSP (Maturity Phase). These business cases are linked to the project use cases. In parallel, these business cases are linked to the Mas²tering key exploitable results (Mas²tering Energy Box and Mas²tering Flexibility Management Platform), likely market points of entry and business model for their sale. The impact of UC linkage is that it helps guide project demonstration activities and the validation plan. The impact of the KER linkage is that it helps shape project exploitation planning by providing visibility on who may be purchasing Mas²tering products and services, at what point in time and for what purpose. Overall, the business cases also provide a direct lead into the next WP1 deliverable D1.7 “Mas²tering Business Models.”

Along the developmental one-year process of this report which has included watch activities, literature reviews, the study of similar research projects, workshops and numerous stakeholder interviews, the authors have developed the following insights:

- The VNA and flow maps clearly show a more sophisticated customer and a significant recharacterization of the energy market design. As energy, information and revenue flows can happen in various combinations, the nature of value has changed as there are far more types of reciprocal value and combinations of actor exchanges to deliver value. Moreover, as new types of reciprocal value will be generated, new value added businesses and services and new participants to the ecosystem that traditionally would not have been directly involved in the industry will emerge. In comparison to the traditional utility model, the complexity of this recharacterization of the industry ecosystem is significant. To date, energy market actors have primarily focused on technology advancement which is within their comfort circle, however, this recharacterization will also require a call to action to engage in business model transformation which is new to most.
- Empowered by ICT, analytics and smart technologies, the emergence of the Prosumers and LECs as active participants in the energy value chain is disruptive to the current ecosystem and may herald the era of multi-sided platforms. There is growing evidence that Prosumers will demand more from their relationship with the energy value chain than just payment for energy consumed and there exists an element of prosumers / LECs wanting to have more control / recognition for their role in the value chain. This presents an opportunity for new market participants to enter the marketplace and also provides a call to action for market incumbents to innovate their products/services to meet this new type of market demand.
- The role of the LFA can be seen as a *'match-maker'* in the recharacterisation of the existing market model, through the introduction of an MSP. Herein lies the real business opportunity in the LFM. The LFA-MSP developed in this research can be adaptable to different types of stakeholder ownership. In this fashion, the MSP can be seen as an opportunity for exploitation.
- The Growth Phase (Competitive Clusters and Vertical Markets) of the market transition will persist until there is a trigger and/or tipping point toward market maturity. Although this may happen via normal market processes, it can be accelerated either via government subsidies, a disruptive technology or a combination of both. A potential disruptive technology is the flexible-friendly electric vehicle. As the market transition and future electricity market will unlock value, new jobs and new innovations will be created. Governments at all levels can benefit from a proactive posture as opposed to a passive posture.
- Once ignited in a fully functioning flexibility market, the LFA-MSP has immense potential to unlock value and facilitate collaboration opportunities between stakeholders. Until that time however, access to market participation and the resultant innovation potential is limited.

Next Steps:

This report has provided direct input for D1.7 (Mas²tering Business Models) by presenting three business cases and aligning them to project UC and validation activities. Once again, these business cases are:

- Supplier-led LFA in the Growth Phase
- WMA-led LFA in the Growth Phase
- Supplier-WMA pairing in the Maturity Phase

For WP1, Year 3 of the project will kick-off with a consortium workshop to conduct Step 2 (Business Case Design) of the CBA process detailed in Annex C. A CBA will be conducted for each of the three business cases to answer the question “Can assumption of the LFA role by the specified actor at the specified point in time be a viable business opportunity?” In addition, two mini-CBAs will be conducted on two stakeholder perspectives within the business cases which will provide input to the CBAs overall. These perspectives are:

- The Prosumer perspective
- The DSO perspective

The results of the Business Case Evaluations and ensuing Business Case Recommendation will be presented in D1.7.

In addition, this report provides strong input to WP7 exploitation activities. In particular, we now know that the most promising exploitation path for the Mas²tering platform (potentially coupled with the energy box) is the WMA operating in a country with high flexibility potential and looking to add residential flexibility to their flexibility portfolio. This enables a sharpening of the market analysis and development of exploitation planning.

Annex A Methodology

This Annex aims at describing the business modelling methodology of Value Network Analysis (VNA) was employed. As a network analysis approach [14], VNA focuses not on the actor or the industry but the value-creating system itself, within which different economic actors perform roles – DSO, Supplier, WMA, LFA, LEC, Prosumer– who in essence work together to co-create the value of local flexibility. This is important because different actors can assume numerous roles in the value chain, and so developing the MSP from a function perspective means that the MSP is not limited to a specific actor. Analysing the value flows along the multi-commodity flow chain perspective, including interactions and potential conflicting objectives provide us with a contextual understanding of how a networked economy or multi-sided business model platform could potentially materialize [15].

The central tenet of VNA is to understand:

1. *How value is created in a network of interdependent relationship?*
2. *Where value is located in the network?* and
3. *What network interactions are required for value delivery?*

A.1 Meta Model for Value Network Analysis

A meta-model provides a framework for expressing specific models, concepts, relationships for exchange between different modelling tools. Figure 15 presents the meta model for VNA utilised in this project.

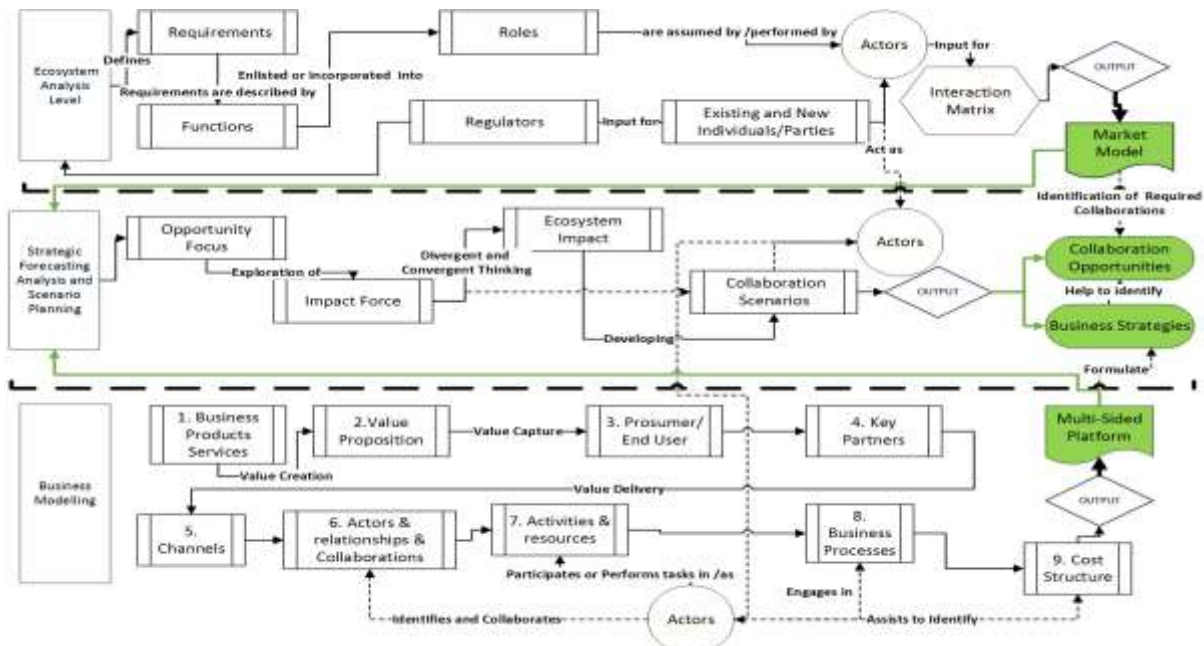


Figure 15. Meta Model for Value Network Analysis

Three interconnected levels of analysis are depicted as Ecosystem, Business Model and Strategic Forecasting Analysis and Scenario Planning. The Ecosystem Analysis Level allowed us to understand the LFM and the interaction dynamics between the different actors. The Business Modelling Analysis Level facilitated the development of the MSP. Both of these analysis led to an understanding of the opportunity focus and the collaboration and business strategies required to ignite that opportunity. The detail of the methodological process followed at each level of analysis is presented below:

A.1.1 Ecosystem Level Analysis

Ecosystem mapping methodologies were utilised to identify the actors, roles and interaction dynamics.

- a) **Develop Ecosystem Flow Map:** Value flow analysis involved mapping the interconnections with a comprehensive visual approach for identifying and understanding the flow interactions between the network actors. As illustrated in Figure 16, five value flows which represent the relevant value exchanges of Energy (E), Settlement (S), Data (D), Relationship (R) and Marketing (M) were utilised to model these interactions between the actors. In order to accurately depict the five flows in our network and in flow diagrams, we have consistently colour-coded each flow in the same way for all diagrams in the ecosystem. Our flow diagrams represent a sequence of movements and actions of people or things involved in the LFM.

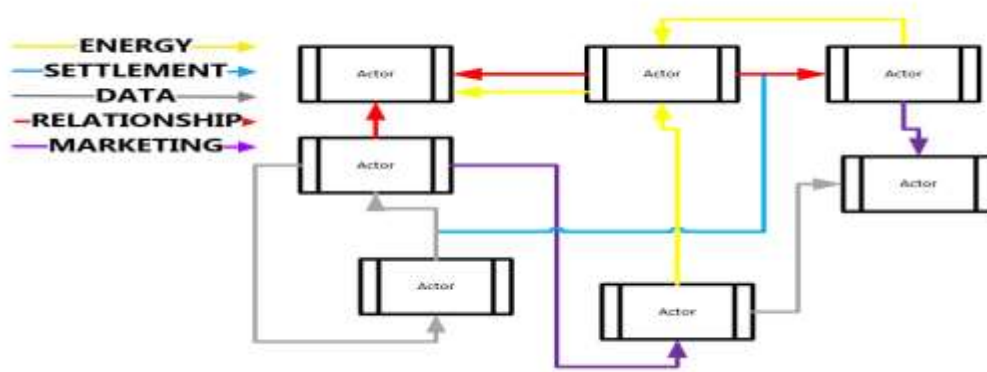


Figure 16. Diagrammatical Illustration for Mapping Flows between actors

- b) **Develop Interaction Flow Matrix:** The interaction flow matrix (see Table 21) identifies and quantifies the type of interaction between the actors involved in the ecosystem map as well as their interaction with the system as a whole across the five identified flows. In essence, using the exchanges identified in the value flow mappings, detailed extraction of these interaction flows were then mapped using an interaction flow matrix (see Table 20 Annex B) enabling a deeper understanding of how value is created, delivered and captured between the actors utilising a number of diagnostic criteria: Value Creation; Value Delivery; Value Capture; Constraints; Business Opportunities and Business Strategies.

Value Flo		Customer Value Proposition	Value Capture	Value Delivery	Value Capture	Constraints
Prosumer	Energy Flow [E]	DSO				
	Data Flow [D]	Prosumer				
	Data Flow [D]	LEC				
	Data Flow [D]	LFA				
	Marketing [M]	LFA				
Settlement Flow [S]	Supplier					
LFA	Energy Flow [E]					
	Data Flow [D]	Prosumer				
	Data Flow [D]	LEC				
	Data Flow [D]	LFA				
	Data Flow [D]	WMA				
	Data Flow [D]	DSO				
Settlement Flow [S]	DSO					
DSO	Energy Flow [E]					
	Data Flow [D]	LFA				
	Settlement Flow [S]	Supplier				
Supplier	Energy Flow [E]					
	Data Flow [D]	LFA				
	Settlement Flow [S]	Prosumer				

Figure 17. Interaction Matrix Framework

A.1.2 Business Model Level Analysis

The business model is the opportunity for creating, delivering and capturing value profitably. Our approach [11] to generating business models is depicted in Figure 18 which details the building blocks and the canvas utilised in this project: A Value Proposition (VP) represents value for one or several target customer(s) and is based on one or several capability(ies). It is a part of the product it is related to value for the target customer. It allows for innovation and differentiation to achieve a competitive position.

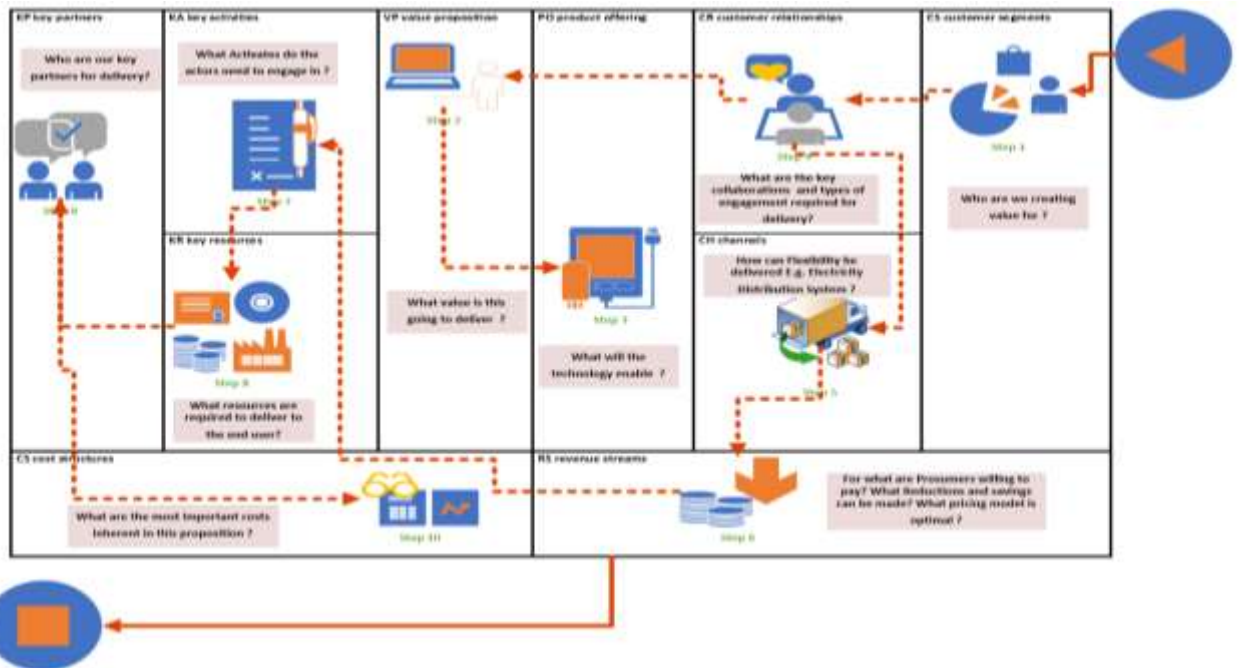


Figure 18. Business Model Canvas

A target Customer Segment (CS) defines the type of customers a company wants to address. A distribution Channel (CH) describes how a company delivers a value proposition to a target customer segment. The Relationship (CR) element describes the relationship a company establishes with a target customer segment. The resources (KR) are inputs into the value-creation process and the Activity (KA) is an action a company performs to do business and achieve its goals. A Partnership (KP) is a cooperative agreement formed between two or more independent companies in order to carry out an activity. The Revenue stream (RS) and pricing element describes an incoming money stream from the value offered by the company. Finally, the Cost Structure (CS) element measures all monetary costs incurred by the company.

A.1.3 Strategic Forecasting Analysis and Scenario Planning

The focus of this analysis stage is on potential future scenarios for collaborative opportunities and designing business strategies to deliver the opportunity. The ecosystem and business model analysis have to be thought of providing the opportunity to design a scenario where stakeholder collaboration and business strategy are required to ignite the business model. The value in this analysis is the creation of different forecasted or future oriented scenarios in which today's decisions may play out. In essence, they are accounts or stories that have a beginning, middle and end and show how the ecosystem may transition and evolve over time. Strategic Forecasting Analysis and Scenario Planning will follow the following steps [16]:

- a) Opportunity Focus: The business model analysis should determine the focus of opportunity to explore.
- b) Impact Force: Explore the forces that may impact and challenge the focus.
- c) Ecosystem Impact: The ecosystem analysis will have determined key external factors and risks that impact focus.
- d) Divergent Thinking: This is a creative process to create, innovate, brainstorm about the future. The focus here is to push imaginative and divergent thinking to the fore.
- e) Convergent Thinking: Ideas are eliminated due to impracticality or lack of prioritisation. In the last step we consider all possible focuses, whereas in this stage, we converge to the correct focus.
- f) Developing Collaboration Scenarios: Collaboration opportunities are documented and the story around the scenario are elaborated upon.
- g) Developing Business Strategies: A scenario does not determine business strategy. In this stage, strategies are devised around a very specific scenario.

It should be noted that that last four stages while presented in linear fashion are in practice a very iterative process.

A.2 Research Method

Table 14 details the data collection conducted in the course of this task which consisted of interviews, workshops and presentation.

Table 14. Data Collection

Research Method	Quantity/Participants	Actor Representation
Interview	14	LEC/Prosumer; Aggregator; Supplier; DSO; TSO; Telco; Energy Equipment Manufacturer; Flexibility Platform Provider; ICT Developer; EU Energy Policy.
Workshop - Internal	4	Supplier, ICT Developers, Metering, ESCo
Workshop External	1 (22 participants)	Aggregator; Supplier; DSO; Energy Equipment Manufacturer; EU Energy Policy; EU-Energy Research Projects

Table 15 below indicates the key methods and tools utilised in our investigation across the three levels of analysis.

Table 15. Methods Grid

Level	Step	Method employed	Tools used	Output
Ecosystem Level Analysis	Define the Network and Ecosystem its representative actors	Literature Review Use Case Analysis Secondary Data analysis	Literature review	Defined actor's roles (functions) and responsibilities for analysis and deeper investigation
	Develop Ecosystem Flow Map	Modelling Techniques Process Mapping	Telephone Interviews	Actor Exchanges represented in Flow Diagrams. Input for the Interaction Matrix.
	Develop Interaction Flow Matrix	Value Flow Analysis Modelling Interaction Matrix	Telephone Interviews Workshop	Value Flows. Constraints Business Opportunities Business Strategies
	Validation of Flows and Exchanges	Review with project partners	On-line Interviews Workshops Paper presentations	Validated Interaction Matrix
Business Model Level Analysis	Business Model Generation	Business Model Mapping	Interview and BMI Canvas	Multi-Sided Platform
	Validation of Suggested Business Models-	Primary Research Online Interviews Engagement Workshops Face to face Interviews	Shared Presentations of Models Semi-structured interview template Qualitative Data Analysis	Validation of suggested Business and Market Models. Refinement of Business services and Market Models based on analysis of interview transcripts
Strategic Forecasting Analysis & Scenario Planning	Identification of Collaboration Opportunities	Proposed Business model & Flows Diagrams	Interview Internal Workshop	Clarification and validation of key roles and their associated responsibilities in a LFM.
	Scenario Planning	Scenario Building & content analysis Documentation of collaboration opportunities	Interviews Internal Workshop	Identification of scenario focus
	Business Strategies	Strategic Review – VNA	Multi sided platform	Development of future strategies

Annex B Interaction Dynamics in the LFM

This annex presents the findings from the value network analysis (VNA) that details the interaction dynamics between the actors in the LFM. The findings from this analysis was used to build the LFA-MSP. As detailed in Annex A, the value flows along the multi-commodity flow chain perspective were identified and compiled within an Interaction Flow Matrix which is presented at the end of this annex (see Table 20). The Figure below from Section 3.1 is re-shown here for ease of reading.

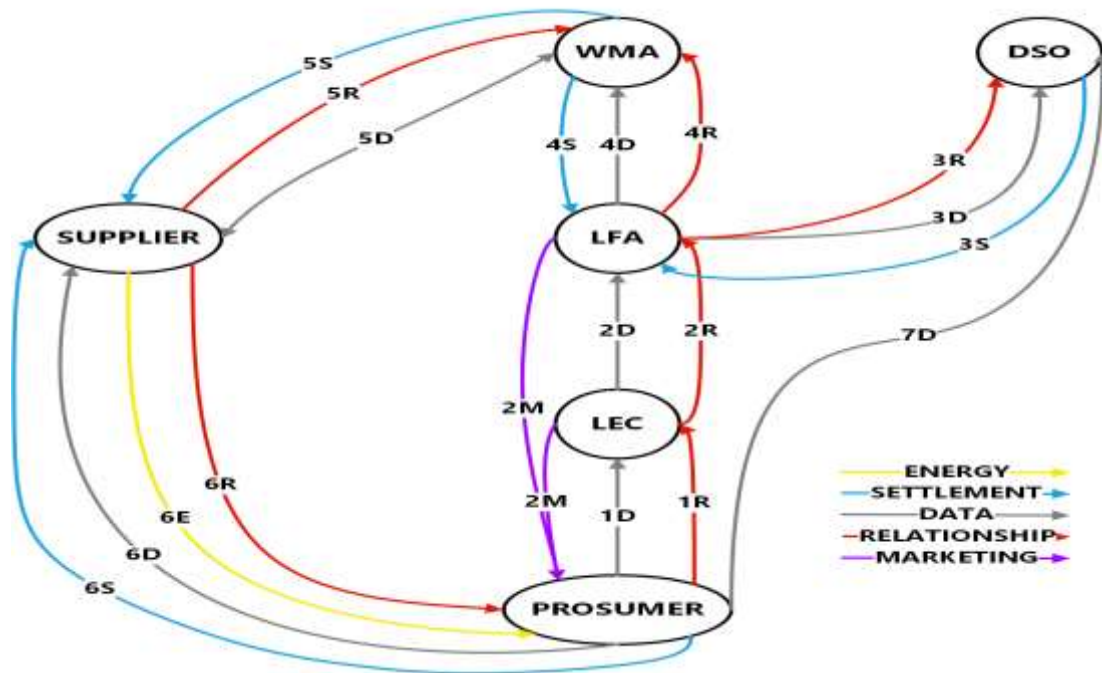


Figure 19. LFM-MSP and the LFA Relationships to other Energy Stakeholders

B.1 Prosumers - LEC - LFA Relationship (Flow Code: 1D, 1R, 1M, 2D, 2R, 2M, 3D, 3R, 3M)

In Figure 19, the Consumer becomes a Prosumer and agrees to change their planned consumption profile, this is demand response. Prosumers also imply change to the “supply profile” (“pro” in Prosumer comes from production) this is called flexibility and the consequent shifting of loads can provide one tool to increase Prosumer’s revenue and contemporary manage network capacity, congestion, and to achieve balance at local levels. If homes can individually and collectively level their demand load profile, then the generation, distribution and storage of electricity at the LV level (and indirectly at higher voltages) can be optimized. In such a scenario, we can define smart consumers and Prosumers as those that use demand response to shift their flexible loads. Prosumer needs have been identified as reducing their energy costs and participating in more environmentally friendly electricity usage.

The Prosumer has a dual role of consumer and supplier of flexibility. As a supplier of flexibility and in return for their interaction with the LFA, the Prosumers gains access to the energy markets, can minimize the costs associated with their energy bill with greater effectiveness and is rewarded with a premium to shift its load as a provider of flexibility. However, this logic means that as a supplier, like in any other industry, the Prosumer receives remuneration for their service. This implies a systematic revenue stream that honours the de facto supplier of flexibility - the Prosumer for their provision of product or service. This thinking diverges from most literature thinking and commentary where the incumbent market players traditional view of business model is favoured and where the Prosumer is seen as both the supplier of flexibility and a price payer for that service or at the very minimum a neutral or passive contributor that makes comfort, control or financial sacrifices to enable energy system participants to capitalise effectively on that discomfort. This implies that a systematic means of Prosumer remuneration to compensate them for their contributions is required.

In terms of settlement, there are a number of strategies or combinations that could be envisioned (Table 16). In the Basic Settlement strategy, the aggregator will cover the cost for installed technology and the Prosumer receives payment for DR availability. There is no penalty charge for Prosumers overriding planned actions. In this strategy, revenues will likely be small for both parties. The Contractual Settlement Strategy focuses on DR availability of the Prosumer who makes a contract with the LFA to enable load control. In this settlement strategy it is likely that the LFA does not pay the Prosumer directly for their flexibility but instead the customer receives a reduction in their bill. Penalties will likely be enforced for Prosumers overriding planned DR calls. Voltalis, the French aggregator applies this settlement strategy. It does not pay any financial benefit to their customers when their heating device reduces their load, but the customer receives a reduction of 5-10% in their electricity bill due to those interruptions in electricity consumption for heating. The Swiss aggregator TIKO applies a similar strategy. The customer signs up to a three-year contract, pays a much reduced price on TIKO technology and is rewarded with a reduced bill. If the customer breaks the contract, it must pay a penalty fee for the market value of the technology. Settlement could also be price based such as Time-of-Use or dynamic pricing. The Prosumer would receive a price information from his LFA and receive payment for the DR event. Finally, the collaborative settlement strategy is where the Prosumer could share in LFA's profits from the provision of flexibility services to market players. Table 16 presents the different settlement combinations.

Table 16. Different Settlement Strategies for LFA & Prosumer

	Basic	Contractual	Collaborative
Technology charge	Aggregator Pays	Aggregator Pays. Subsidised technology to Prosumer	50/50 Aggregator & Prosumer
Load Control	-	Yes	Yes
DR Availability	Yes	Yes	-
Penalty	-	Yes	-
Price Based	-	Yes	-
Profit Sharing	No	No	Yes

As discussed earlier, the LEC can be perceived from two viewpoints (i) where the Prosumers are part of an LEC because they are associated to the same LFA by an individual contract and (ii) the LEC can be viewed as an entity or cooperative (such as a building block). Across Europe there are numerous initiatives emerging where Prosumers are organising themselves into some form of legal entity like a cooperative, a foundation or a corporation to facilitate locally generated energy being consumed where it is produced. Examples of LECs are presented in Table 17. Our research found that there are heterogeneous motivations for Prosumers to sign up to a LEC ranging from the desire take control of their own energy; willingness to engage in an environmental-friendly behaviour to support sustainability; desire to be helpful to the local community; interested in installing state of the art energy technologies; the desire for greater choice; greater energy autonomy; greater self- sufficiency and creating the opportunity for financial gain. This LFA-LEC-Prosumer relationship is critical because it can be an MSP ignition mechanism. The LEC provides the LFAs with legitimacy amongst its members and speeds up the on-boarding of Prosumers. Marketing programmes will have to be designed to stimulate their engagement and acquisition. The business strategies to ignite the business model are discussed in Section 4.2.

The increased proliferation of LECs is been driven by the view that the incumbent energy providers are not delivering the appropriate energy products and services that the end user desires. In addition, Prosumers

Table 17. Examples of European Local Energy Communities

Country	Example	Description
Scotland	TowerPower	TowerPower is an LEC negotiating the cost of their imported electricity with national energy Suppliers, using more accurate electricity demand data, incentivising energy efficiency and demand side management for its customers through ‘benefit sharing’ business models.
England	Oldham Community Power	To enable its members to reduce their energy consumption and carbon emissions; to generate an income from electricity sales that can be invested back into community projects; and to educate people on how to reduce their own energy usage at home.
Germany	BurgerEnergie Berlin	Strive to democratize decision making in the energy system by empowering citizens by operating as a utility. Profits are re-invested for the integration of renewable energies.
Netherlands	Lochem Energie	Engaging citizens to participate in the generation of local energy; Supply locally generated solar power.
Portugal	Coopérnico	Involves citizens and businesses in the creation of renewable and decentralised energy.
Ireland	Templederry Community Wind Farm	Community owned wind farm that produces and markets 100% renewable energy resources.
Italy	Energia Positiva	The cooperative issues shares and so members become co-owners get access to clean energy from local sources and receives a reduction in their bill.
Spain	Som Energia	A consumer cooperative that markets and produces energy from renewable sources.

and LECs that we interviewed felt that while consumers have evolved to understand the importance of the smart grid and are eager to adopt new technologies to engage it, there is however a lack of legitimacy and desire amongst energy provider's to actually understand their customer's behaviour in order to tailor energy programmes that meets the needs of end-users and encourages customer engagement and participation. In essence, there is a lack of belief amongst the LEC that the incumbent energy providers want to actually see the citizen at the core of the energy system, taking ownership and fully participating in the marketplace. Hence the rise of the LEC movement to take back control.

B.2 LFA – DSO Relationship (Flow Code: 4D, 4R, 4S)

The creation of a LFA will provide the DSO with a new range of potential solutions to assist them in tackling grid problems, including those that arise out of emergency circumstances and those that concern the longer term planning and operation of the grid.

As detailed in Table 18, there are three flexibility services (4D) the LFA can provide to the DSO:

Voltage Control: This would occur when the share of intermittent and fluctuating distributed energy resources (DERs) represents a significant proportion of the local load. To maintain grid stability and avoid exceeding the voltage statutory limits, which may lead to asset damages (for both the grid and the Prosumers), the DSO will want to adapt the load profile to actual production in the given area. For this service offering to have any credibility with a DSO, the LFA would have to have a highly functioning relationship with the LECs in the given area. In this fashion, the LFA is offering a holistic service to the DSO that he can reliably curve consumption in a given area. In terms of settlement (4S), the DSO would remunerate the LFA based on an estimation of its own gains in terms of what proportion of the total adjustable power was actually adjusted by the LFA. In return the DSO would ensure grid quality of supply, avoid the payments of any associated penalty and also better plan reinforcement and maintenance activities.

Congestion Management: The word *congestion* is generally used at transmission level to indicate a shortage of transmission capacity to supply a given consumer area. In a smart grid environment and in Mas²tering, this refers to occurrences when the LV grid cannot be operated in safety and curtailments are required to avoid damages to grid assets (e.g. transformer and cables). A clear example is a grid operated at its top capacity that experiences an unexpected peak of demand that overcomes the limits of the transformer. The LFM can be used to provide flexibility to the DSO and cope with congestions. In this way the DSO would ensure the continuity of the supply and avoid the payment of penalties. In addition, through continuous participation to the LFM, the DSO would be able to better plan grid reinforcement, e.g. by deferring investments in areas of lower risks of congestion. Similar to above, this service requires the LFA to have a highly functioning relationship with his LECs to ensure effective delivery of service.

Grid losses reduction: Grid losses are proportional to the square of the current. Even in normal operating conditions (when no congestion is expected), the DSO may be interested to shave the global load profile of the LV grid to reduce grid losses and improve the efficiency of the distribution. This can be done by buying

flexibility from the LFAs in the LFM when required. In turn the DSO could get incentives for the effective operation of the distribution grid.

In the delivery of these services, two types of Flexibility Service Contracts (4R) are envisaged (see Table 18).

Table 18. LFA Services to DSO

Services	Classical Solution	Settlement	Strength	Risk
Voltage Control	Grid Investment Grid Losses Outage	Fixed Price Contract.	Higher Premium Product. Predictable budget scenario for both LFA & DSO.	Ensuring Predictably of Supply. Penalty Fee. Market Changes may positively or negatively affect margin.
		Indefinite Delivery Contract.	Fixed Fee & Variable Fee. Can justify price variations. Ensures against unexpected costs.	Ensuring Predictably of Supply. Penalty Fee.
Grid Losses Reduction	Does not exist.	Indefinite Delivery Contract.	Fixed Fee & Variable Fee. Can justify price variations. Ensures against unexpected costs.	Ensuring Predictably of Supply. Penalty Fee.
Congestion Management	Does not exist.	Fixed Price Contract.	Higher Premium Product. Predictable scenario for both LFA & DSO.	Ensuring Predictably of Supply. Penalty Fee. Market Changes may positively or negatively affect margin.
		Indefinite Delivery Contract.	Fixed Fee & Variable Fee.	Ensuring Predictably of Supply. Penalty Fee.

Fixed Price Contract (FPC): This type of binding bilateral contract will require the LFA to successfully perform the contract and deliver services for a price agreed to up front. For instance, in the delivery of congestion management services to the DSO, the LFA will be contract bound to reduce the load by a certain amount of power during specific time slots known in advance. The envisaged time period in this contract would be day-ahead. If the LFA does not deliver as promised, a penalty fee will be enforced to compensate the DSO for losses incurred. This implies that the LFA must be capable of delivering predictable flexible load through its relationship and contract with its LEC.

Indefinite Delivery Contract (IDC): This type of contract provides for the LFA to deliver services upon issuance of a request as the needs arise. In contrast to a FPC, this is a short activation time period such as hour-ahead. For instance, congestion management services may be activated by the DSO when actual consumption exceeds predictions and needs near immediate correction. In this relationship, the DSO will pay the LFA twice (i) a fixed fee that is based upon the option to access a specified amount of flexibility required (i.e. the possibility of accessing flexibility) and (ii) a variable fee based upon the actual use of the flexibility option. Similar to a FPC, if the LFA fails to deliver as promised, a penalty fee will be enforced by the DSO which further highlights the importance of the LFA – LEC relationship to ensure predictable supply.

B.3 LFA – WMA (Flow Code: 5D, 5R, 5S)

Table 19 describes that flexibility service (5D) the LFA can provide to the WMA:

Internal Portfolio Optimisation: This occurs when the LFA receives a request from the WMA for the provision of flexibility in aggregated form (as per classical centralised management of flexibility) and provides flexibility offers; once flexibility offers are accepted, the LFA manages loads in its own portfolio in the most optimal way to respect the flexibility programme. This is attractive to the WMA because he will be involved in the buying of electricity on the day-ahead market according to the anticipated consumption levels of their clients. This carries the risk that the real time consumption levels might not match the anticipated and already purchased energy from the day-ahead market. If the amount of predicted electricity does not match up with the real time usage, then the WMA will be in imbalance and will have to trade on the balancing market to make up for its errors in prediction. Often the WMA might suffer a financial loss when trading due to lower income or additional costs. So there is a need for the WMA to negate these financial risks and the product offering of the LFA that can adapt the actual consumption of consumers to the day-ahead prediction on an hourly basis will interest the WMA.

In the context of this relationship type and the delivery of portfolio optimisation, the type of Flexibility Service Contract (5R) envisaged would be a Bi-directional Indefinite Delivery Contract.

Bi-directional Indefinite Delivery Contract: This type of contract provides for the LFA to deliver services upon issuance of a request as the needs arise. This is a short activation time period such as hour-ahead. In this relationship, the WMA will pay the LFA twice (i) a fixed fee that is based upon the amount of flexibility required (i.e. the possibility of accessing flexibility) and (ii) a variable fee proportional to the market cost

of the imbalance. In order to be effective, the WMA would ideally need to be able to control the load of the LFAs portfolio. This type of bilateral contract would require the LFA to be devoted to balancing the WMAs portfolio and may not be able to participate in other services.

Table 19. LFA Service to WMA

Services	Classical Solution	Settlement	Strength	Risk
Internal Portfolio optimisation.	None.	Bi-directional Indefinite Delivery Contract.	Fixed Fee & Variable Fee. Can justify price variations. Ensures against unexpected costs.	Ensuring Predictably of Supply. Size of local load must be equivalent.

B.4 WMA – Supplier Relationship (Flow Code: 6D, 6R, 6S)

(5R) The role of the Supplier is to purchase electricity and supply it to its customer portfolio. As a Balance Supplier it markets the difference between actual consumption and energy bought. Any deviations from the consumption programmes declared at the closure of the wholesale market beyond commercial conditions with its customers for the supply, the Supplier is put in imbalance and may result in the payment of fines. However, the introduction of the LFA to the local flexibility market cause complications to the market mechanism, just described. The activities of the LFA will alter the consumption pattern of the Suppliers customers beyond the original commercial conditions agreed. In essence, when the LFA activates a Prosumer, part of the energy injected by the Supplier is not consumed by its own customers but consumed somewhere else in the system and the Supplier is put in imbalance. From the Supplier perspective, electricity that he has paid for, is been acquired by the LFA without remuneration and sold to other actors for profit.

(5S) To ensure that the introduction of the LFA to the marketplace does not create a financial-loss situation for the Supplier, there will have to be an Energy Imbalance Settlement contract between the WMA and the Supplier based on a market-based pricing of energy and flexibility. Table 20 provides a description of the Imbalance Settlement.

(5D) In order to forecast future portfolio consumption, the Supplier needs to receive information from the WMA on the activation of the LFAs customers. This ensures that the Supplier can distinguish between LFA initiated DR that requires balancing actions or usual consumption changes that requires no balancing.

Table 20. Description of Energy Imbalance Contract

Relationship	Description	Strength	Risk
Energy imbalance service contract.	WMA pays compensation to the Supplier.	Attractive to Prosumer (one bill).	Potential relationship power-conflict.
	Market-based pricing of Flexibility.	Facilitates a mass market roll-out.	WMA/LFA needs Supplier agreement.

B.5 Supplier – Prosumer Relationship (Flow Code: 7E, 7D, 7R, 7S)

The role of the Supplier is to purchase electricity and supply it to its customer portfolio. (6E). The Supplier agrees commercial conditions with its customers for the supply and procurement of energy (6R & 6S). When flexibility contract is activated with the LFA, the Prosumer should inform the Supplier (6D).

B.6 DSO – Prosumer Relationship (Flow Code: 8D)

There is a data flow from the Prosumer to the DSO. Data is used to calculate distribution charges, but does not have a particular use as part of the Mas2tering solution.

B.7 Other Service Actors

Other service providers that will be critical in the ignition of the business model will be other LFAs. It is important that relationships are formed so that the LFM-MSP can be scaled. There is the potential to establish arrangements between LFAs for the pooling of their customer base to ignite interest in combined services amongst energy stakeholders such as the Supplier, WMA and DSO. In addition, it is important that LFA-LFA trade occur as this will fuel the establishment of the LFM-MSP.

Table 21. Interaction Flow Matrix

Flow To (i.e., Who - Buyer)	Value Flow	Flow From (i.e. Seller)	Use Case	Product/Opportunities	Market Opportunity	Customer Needs/Pain	Type of Relationship [R]	Value Proposition to Customer (i.e. The Value)	Enabling Technology	Value Chain Partners	Business Strategy	Revenue Model	Constraints
Value Flow				Customer Value Proposition					Enabling Technology	Value Delivery		Value Capture	Constraints
Prosumer	Energy Flow [E]	DSO	All/1	Electrical Power Supply	Open opportunity to supply to households who are willing to participate in the flexibility market	Wants to reduce total energy usage Wants to reduce peak energy usage to allow for greener energy generation	Service Provision (Indirect)	Cheaper energy bills More environmentally friendly	MAS Smart Meters Gateway Technology Platform ADS	LFA Cybersecurity Telco Prosumer Supplier	Lobbying for market mechanisms such as a balancing market at the distribution level	Flexibility capture is provided by the Prosumer / LFA relationship. Service charge rebate is paid to the DSO by the LFA	Model Maturity Amount of energy bill reduction possible Critical mass of Prosumer take-up required for Network Effect
	Data Flow [D]	Prosumer	2&3	Flexibility Co-operation	Opportunity exists to allow Prosumers to sell/trade flexibility with one another / the community at large	Competition with neighbours Co-operation in reducing total energy costs Profit from own flexibility	Service Provision (Indirect)	Cheaper energy bills More environmentally friendly Novelty	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	LFA Cybersecurity Telco Prosumer Supplier	N/A	Allows Prosumers or groups of Prosumers the ability to save money by trading flexibility at a local level	Amount of savings possible might preclude participation Critical mass at a local level is required Neighbours need the same level of technology enabled devices installed
		LEC	2&3	Sale of combined flexibility	Individual Prosumers pool their combined flexibility into a marketable commodity unit	Wants access to flexibility market LEC makes access profitable by pooling resources	Direct relationship	Cheaper energy bills More environmentally friendly Novelty Group power	MAS Smart Meters Gateway Technology Platform ADS	LFA Cybersecurity Telco Prosumer Supplier Third party application providers	LEC must create groups of early adopter Prosumers through education and using the environmentally friendly VP	Allows groups of Prosumers the ability to save money by trading flexibility at a local level	Amount of savings possible might preclude participation Critical mass at a local level is required Neighbours need the same level of technology enabled devices installed

		LFA	All	ToU Optimisation Self balancing Control of Max Load Bundled Flexibility Management Services	Energy Optimisation Services Minimise Prosumer overall energy cost Minimise Community overall energy cost	Reduce energy costs Reduce overall electrical usage Make money from selling your energy usage flexibility Reduce environmental footprint Easy access to energy markets Profit from own flexibility	Service Provision (Direct)	Cheaper energy bills More environmentally friendly Trigger for flexibility of supply instance in situations of peak demand Trigger for flexibility of supply instance in situations of low overall demand	MAS Smart Meters Gateway Technology Platform ADS	LFA Cybersecurity Telco Prosumer Supplier Third party application providers	Collaboration with supplier best strategy to create the rapid on- boarding of Prosumers required to ignite business model	Service tariff for the trade of flexibility Margin on Wholesale vs Retail flexibility rates	Cost of Prosumer installations Critical mass of Prosumer uptake
	Marketing [M]	LFA	All	Advertising flexibility services and education of the market	Market must be ignited for LFA business model to be viable	Insights and support required into how to capitalise on new / emerging cost saving products Wants to be more environmentally active, but hasn't got the knowledge	Support Role	Reduction of energy expenditure by optimising use of smart appliances and technologies in the house Keeping up to date with latest market & tech movements to ensure max savings achieved More environmentally friendly consumption for customer Support the customer in their participation in SmartGrid	Website Social media Apps	Prosumer LFA Suppliers ADS manufacturers / Retailers	See above	Not required for this flow	Challenge of converting consumer to Prosumer and convincing them that worthwhile savings are possible

	Settlement Flow [S]	Supplier	All	Balanced Supply Contract Charges for Product Credits for Flexibility	As is currently the Supplier role - provide invoicing & collection of funds for the supply of services Expanded services to Prosumers Share in flexibility trade margin Provision of an 'All In' billing & credit service to Prosumers	High energy costs Provides one possible point of participation in MAS Needs familiar relationship with established named entity in the MAS Needs an 'All In' service for participation in Flexible Energy market - this allows for single nett bill of charges taking into account electrical usage and flexibility credits	Service Provision (Direct)	Cheaper energy bills More environmentally friendly Removes potential complexity arising from several Prosumer relationships - single bill	MAS Smart Meters Gateway Technology Platform	LFA Cybersecurity Telco Prosumer Metering Supplier	Prevents client defection to competitors with better and additional services Enter energy management market	Service contract charge; margin	Model Maturity Amount of energy bill reduction possible Critical mass of Prosumer take-up required for Network Effect Increase in market competition due to new actors in the Value Chain
LFA	Energy Flow [E]												
	Data Flow [D]	Prosumer	All	Sale of flexibility	Sale of flexibility	Needs access to Prosumer data Needs control of Prosumer's loads	Service Provision (Direct)	ToU Optimisation KWMax Control Self Balancing Controlled Islanding	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	Cybersecurity Telco Prosumer Supplier Third party application providers	N/A	Bill credit arising from sale of flexibility	Scheme being available to Prosumer Amount of bill credit available Cost of system participation (ADS etc.)
		LEC	2&3	Sale of flexibility	Opportunity exists to facilitate individual Prosumers to pool their combined flexibility into a marketable commodity unit	LFA needs large numbers of active Prosumers to fuel its business model	Service Provision (Direct)	Access to active and engaged Prosumers willing to trade flexibility	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	Cybersecurity Telco Prosumer Supplier Third party application providers	LEC must create groups of early adopter Prosumers through education and using the environmentally friendly VP	Sale of flexibility	Difficulty in on-boarding a critical mass of Prosumers to create value from the combined flexibility
		LFA	2	Sale/Cross-selling of flexibility Surplus Flexibility Threshold management - local shortages	Local balance of peak power outputs	Threshold management - local shortages Balance ability for unexpected deviation in peak power	Bi-lateral contracts	Ability to spread risk of exceeding declared max/peak usage	MAS Smart Meters Gateway Technology Platform	DSO Cybersecurity Telco	Co-opetition strategy	Reduced penalties - symbiosis Increased revenues from enhanced risk management	Critical mass at a Prosumer level is required Trust in system capabilities

		WMA	2&3	Portfolio balancing	Opportunity exists to support the WMA in its role	Carries the financial risk of incorrect forecasting Difficulty of the balancing task	Bi-directional Indefinite Delivery Contract	Negate the financial risk of incorrect forecasting Assist in the balancing task	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	Cybersecurity Telco Prosumer Supplier Third party application providers	Collaboration strategies with LFAs	Compensation proportional to the market cost of imbalance	Critical mass at a Prosumer level is required Trust in system capabilities Barrier to entry into market for new competitors
		DSO	2&3	Creation of integrated Smart Grid by providing demand for load flexibility	Trigger for flexibility of supply instance in situations of peak demand Trigger for flexibility of supply instance in situations of low overall demand	In order to offer inducements to Prosumers for participation in the flexibility market the LFA requires signalling as to the status of energy production costs / wholesale pricing for the product supplier	Service Provision (Direct)	Enables LFA to participate in SmartGrid	MAS Smart Meters Gateway Technology Platform	Cybersecurity Telco Prosumer	Lobbying for market mechanisms such as a balancing market at the distribution level	Cutting overall generation costs Reduced penalties	Critical mass at a Prosumer level is required Trust in system capabilities Barrier to entry into market for new competitors
	Settlement Flow [S]	DSO	2&3	Aggregated Flexibility Compensation	Reduce in overall cost of overall Energy production / peak Energy Production	DSO needs to reduce Peak demand as it is costly to generate & distribution system is near max capacity (avoid grid investment) Optimisation of asset usage	Service Provision (Indirect)	Enables DSO to participate in SmartGrid	MAS Gateway Technology Platform	Cybersecurity Telco Prosumer Supplier Third party application providers	Lobbying for market mechanisms such as a balancing market at the distribution level	Financial incentives for efficient grid & energy production management Savings with respect to grid reinforcement	Critical mass at a Prosumer level is required Trust in system capabilities Barrier to entry into market for new competitors
DSO	Energy Flow [E]												
	Data Flow [D]	LFA	2&3	Congestion Management Voltage Control	Opportunity to create savings in grid investment and prevent grid losses	Congestion management and grid capacity management	Fixed price contracts Indefinite delivery contract	Delay/Avoid grid reinforcement Optimise asset use Reduce grid losses Reduce frequency and duration of outage Reduce frequency and duration of outage Avoid grid investments	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	Cybersecurity Telco Prosumer Supplier Third party application providers	Collaboration with supplier best strategy to create the rapid on-boarding of Prosumers required to ignite business model	Cutting overall generation costs Reduced penalties	Regulated market Contractual relationship Grid capability to offset demand spikes DSO might need to invest in grid anyway so does that offset the main VP

	Settlement Flow [S]	Supplier	2&3	Aggregated Flexibility Compensation Connection Contract (Wholesale)	Compensation for Energy Supply in SmartGrid	Compensation mechanism for services supplied	Service Provision (Direct)	Compensation for Energy Supply in SmartGrid	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	LFA Cybersecurity Telco Prosumer Third party application providers	Prevents client defection to competitors with better and additional services Enter energy management market	Compensation for Energy Supply in SmartGrid	Compensation for Energy Supply in SmartGrid, as such there are no constraints once Supplier is already a Retail Electrical Supplier
Supplier	Energy Flow [E]												
	Data Flow [D]	LFA	2	Information exchange	Supplier will need to react to changing marketplace	Suppliers marketplace is going to change rapidly. Will need strong partners to show customers they can facilitate sale of flexibility	Energy imbalance service contract	Ability to show engagement with flexibility services	MAS Smart Meters Gateway Technology Platform	DSO Cybersecurity Telco Prosumer	Collaboration with supplier best strategy to create the rapid on-boarding of Prosumers required to ignite business model	Compensation to the Supplier Market-based price of Flexibility	Potential relationship power-conflict LFA needs supplier agreement Difficulties when Prosumers change Suppliers
	Settlement Flow [S]	Prosumer	1	Connection Contract (Retail)	The flexibility the LFA has sold the DSO is settled from the Funds coming to the Supplier on foot of invoice to the Prosumer	Compensation mechanism for services supplied	Service Provision (Direct)	Opens up new services and business models Closer involvement with clients Improves synergy in the energy value chain	MAS Smart Meters Gateway Technology Platform ADS Third Party / Apps	LFA Cybersecurity Telco Third party application providers	Prevents client defection to competitors with better and additional services Enter energy management market	Compensation for Energy Supply in SmartGrid	Competition from new/novel service providers in the value chain

Annex C Cost Benefit Analysis

A Cost Benefit Analysis (CBA) is an analytical tool for assessing the economic costs and benefits of an investment decision and it depends on case scenarios which in essence are the stories showing business rationale and potential outcomes. Cases normally include several scenarios representing different possible outcomes. The costs and benefits that are considered are those that are relevant to the case scenario and, in this respect, will include incremental items (such as additional materials or services) but exclude 'sunk' items that will be the same regardless of the outcome (e.g. a cost that has already happened or is committed). At its most basic level, a CBA involves comparing total costs to total benefits. Where benefits exceed costs, in a short-term decision (perhaps a year or less), the outcome is positive and then it is a judgement as to whether this excess is sufficient to proceed. Longer term decisions require greater consideration of the time value of money.

In this regard, there are a number of inter-related analytical principles underlining the CBA methodology:

Opportunity Cost: The opportunity cost refers to the value foregone from making one particular investment decision instead of another (e.g. undertaking Investment A means that the gains from Investment B are foregone; these lost gains are then a 'cost' of undertaking Investment A in an evaluation decision). The principle argues that if input, output (both tangible and intangible) and external effects of an investment are valued at their opportunity costs, the return of the investment that is calculated is a proper measure of the investments contribution.

Time Value of Money: The principle describes the greater benefit of money in the present rather than in the future (e.g. a € today is worth more than a € in a year's time). In order for investors to invest money in the present and to compensate for the time value of money effect, the expected returns must include a premium or discount yield (i.e. proportional share of the initial liability and the amount that has to be paid in the future to settle the liability). In essence it involves the net value of cash flows (i.e. costs and/or benefits) that occur in different points of time and allows for the valuation of a likely stream of income in the future, based on a discount yield from the investment decision.

Cost Model: CBA is based on a set of predetermined quantifiable costs and benefits which are measured by performance metrics namely:

- * Net Present Value (NPV): Because of its simplicity, NPV is a useful tool to determine whether an investment will result in a net profit or loss. NPV involves comparing the costs and benefits of the investment decision in terms of their present value.
- * Return on Investment (ROI): The metric is used to measure, in a time period, the expected rate of return on the money invested in an opportunity so as to decide whether or not to make an investment.
- * Payback Period: The period (normally expressed in years) that is required for the investment to become profitable. This can also be calculated using discounted cash flows.

Incremental approach: CBA compares a scenario with the investment against a baseline ‘Business as Usual’ scenario without the investment. In essence, it explores what would happen in the absence of the investment decision.

While there is no universally accepted CBA process, in general the following steps are followed:

Step 1: Define the Business Case. This involves understanding the business rationale for the case, who will use the case and for what purpose or objective. It also provides an understanding of why the business case is important and how it is aligned with the business strategy of the stakeholder(s) involved.

Stage 2: Business Case Design. This involves identifying the scope of the analysis, the assumptions for projecting costs and benefits and the time period. The cost model will be developed detailing all relevant cost categories, items and methods for estimating costs for the case. Rationale for how benefits are valued will be developed.

Step 3: Financial & Economic Analysis. Calculate case costs and benefits as cash flow events, allocated to appropriate time periods. Present economic performance indicators.

Step 4: Business Case Evaluation. In this step, the financial and non-financial metrics for each scenario is compared and evaluated. Sensitivity analysis shows how business case assumptions impact the results. Potential risk factors are identified to understand the likelihood of the outcome materialising.

Stage 5: Business Case Recommendation. This step presents the business case that will likely be recommended for action along with the critical success factors identified for successful implementation. Business cases can also be ranked. Strategies for lowering costs, accelerating gains and mitigating against risks are developed.

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