*Smart system of renewable energy storage based on **IN**tegrated E**V**s and b**A**tteries to empower mobile, **D**istributed and centralised **E**nergy storage in the distribution grid*

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Abbreviations and Acronyms

Acronym	Description
API	Application Programming Interfaces
DoA	Description of Action (annex I of the Grant Agreement)
GFO	Global Flexibility Operator
SOTA	State Of The Art
TSO	Transmission System Operator
DSO	Distribution System Operator
EV	Electric Vehicle
QM	Quality Management
ESB	Energy Service Broker
TL	Task Leader
ToC	Table of Contents
WP	Work Package
ESP	Energy Service Provider
HAS	Home Automation Service
ESCO	Energy Service Company
BRP	Balancing Responsible Party
ESB	Energy Service Broker
OTT	Over The Top (Internet distribution)
FO	Flexibility Operator
DER	Distributed Energy Resources
CPU	Central Processing Unit
ToU	Time of Use

1 Executive summary

No matter what kind of business model you want to use, it will always start with the customer and your value proposition to the customer. However, the customers in the energy market are changing. Consumers are becoming prosumers, and active customers can choose to delegate necessary actions to software algorithms and energy centric Internet of Things.

But the energy customer is not the only one undergoing change. Also, value creation, value distribution and value capture, the three basic ingredients in all business models, are changing. For instance, value creation is moving away from traditional value chains towards value networks, and value delivery is now heavily dependent on the Internet to support the service delivery. Also, we see new value capture mechanisms like freemium or pay-with-your-data/asset arise. Even the concept of value is changing, typically from traditional money and revenues, to data or assets in new business models. All these changes are emerging from digitalisation, and it is all happening simultaneously.

Finally, the rise of new digital technologies like cloud computing, Internet of Things, and Artificial Intelligence, are all feeding on exponential growth mechanisms like CPU, memory, bandwidth and digital content. This is also a part of the new paradigm.

Our work has led to the conclusion that platform and ecosystem-based business models are disrupting all the industries they enter. We believe that the energy market will not be an exception, and that digitalisation inevitably will open the energy market for these business models. Our work has also revealed that Europe is lagging behind the US and Asia in numbers of companies exploiting platform-based business models.

For this reason, we have chosen to focus our work in D9.4 on studying these new business models, trying to migrate them into the energy industry by developing a generic business model framework that can absorb the changes described above. Our findings are documented in this report, but the main conclusions are as follows:

- Platform and ecosystem-based business models are applicable in the future energy market.
- We do find a few examples of local and national companies deploying this business model, and even some of our industrial partners in the INVADE-project have proven that they are capable of using a platform-based business model.

- The report also confirms that not all the pilots are capable of using a platform-based business model, mainly because of a company internal and grid only focus on storage, flexibility and services.
- So far, our experience tells us that having a very narrow mindset with respect to a particular flexibility service is not feasible. A customer will typically need different flexibility services at different times. Also, flexibility services are a difficult "sell" amongst end-customers and will benefit from being bundled with other more tangible energy services.
- Usually, platform-based business models have a global and consolidating role. However, this role seems to be unoccupied and can represent an important factor in the future energy market, if we as Europeans chose to do so. We are leading this race with respect to liberated energy markets and renewable solutions, and thus have a competitive edge.
- The flexibility market is divided into two main categories; the end-user flexibility market, and the market for flexibility trading. Both markets are explored in the INVADE pilots, and we believe that a platform-based business model fits very well in combining these two markets.

As both the work and pilots are under development, our goal is to go deeper into this material in the next report, D9.6, focusing on unsolved issues and pilot validation and what makes these platform-based business model succeed or not.

2 Head

According to the objectives in the DOA, the INVADE project should:

- *(3) "deliver an integrated INVADE platform based on flexibility cloud enabling flexible management algorithms, functions and control dashboards using Internet of Energy Things, Big Data analytics and visualization techniques to provide real-time information and control tools to stakeholders …"*
- (4) "integrate *with existing infrastructure and systems in selected pilot sites to validate the platform"*.
- *(5) "design innovative and competitive business models and verify them through planned activities such as analysis of users and behavior, deferral of grid investments, exploitation user group, and dedicated workshops to enable monetary and social benefits for a full chain of stakeholders."*

So, why does the INVADE project emphasize the importance of working with new innovative business models and technologies in parallel? We believe the answer comes from the following observations:

- The European energy market evolves into an end-user and prosumer centric context due to new regulation and a strong increase in renewable and distributed energy production and storage.
- As mentioned in the objectives, energy components are now becoming Internet of Things components, and the digitalization of the energy market introduces bi-directional flow of data in all the corners of the market, including the homes and its energy centric devices.
- Other industries have experienced massive disruption of existing businesses due to new business models that feed on digital exponential growth mechanisms, commonly known as platform-based business models.
- Value creation is moving from traditional value chains towards value networks. So, the value creation is now happening much faster between companies in what is often called ecosystems, due to the mutual benefits for the participants, fueled by cloud-based solutions and extensive use of Application Programming Interfaces (APIs).
- A strong move away from infrastructure and products towards a service driven energy sector.

The ambition and goal of the Deliverable 9.4 report is three-fold:

1. To study, understand and examine how new business models can impact the energy industry.
2. To propose a new business model framework that can be applied to the concrete large-scale pilots in the INVADE project, and to support the pilot partners in developing their existing business models further.
3. To develop new business models for the European energy industry capable of exploiting the huge business potential that lies in the borderline between digitalization and the energy market.

This work does not appear from a vacuum but stands on the shoulders of important work done in other work packages as illustrated in Figure 1. Experience from earlier EU-projects like EMPOWER and Triangulum is also contributing to this work.

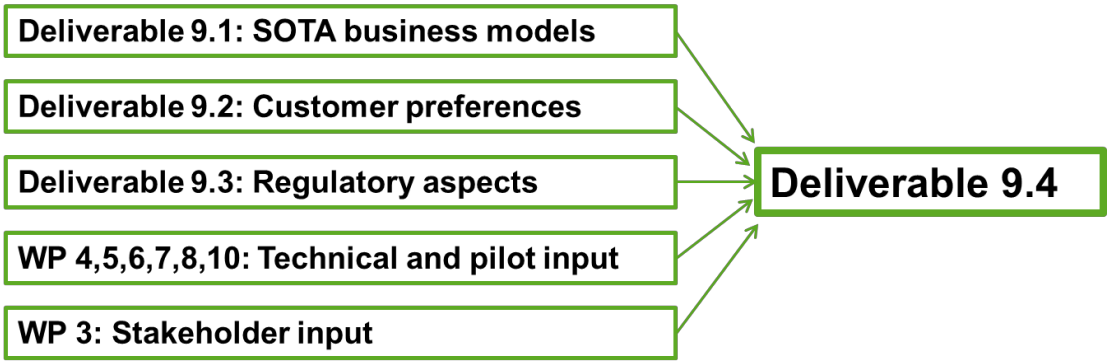

Figure 1: The relationship between relevant deliverables/WPs and Deliverable 9.4

This work is a continuous process, and we are still learning and discovering new areas. Some of these are described in the tail-chapter at the end of this report and will be included in the final business model work package report D9.6.

3 The Paradigm Shift

The global markets are experiencing a paradigm-shift due to new business models. One of the strongest indicators of this shift can be found in the Forbeslist in 2006 and 2017. The world's ten most valuable companies remained for the most part unchanged in the decades before 2006, and they all used traditional business models. However, in the following decade, this changed dramatically, and in 2017 six new companies had entered

the list, all using platform-based business models. Not only did they enter, but they also occupied the top 5 positions. Surveys presented by [1] show that European industry compared to US and Asia is lagging behind due to lack of business model innovation versus technology innovation.

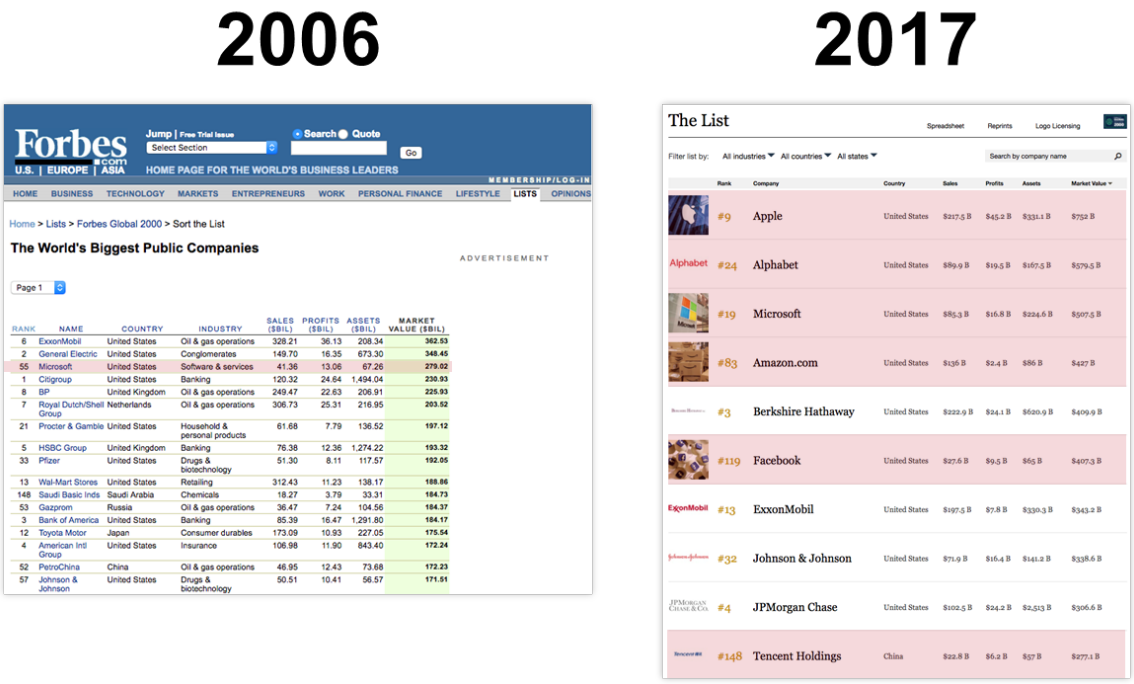

Figure 2: The dramatic change in the last decade on Forbes list of the world's most valuable companies due to new platform-based business models

3.1 The music industry – where it all started

The first company to deploy a digital platform-based business model was Apple, with the introduction of their App store in 2007.

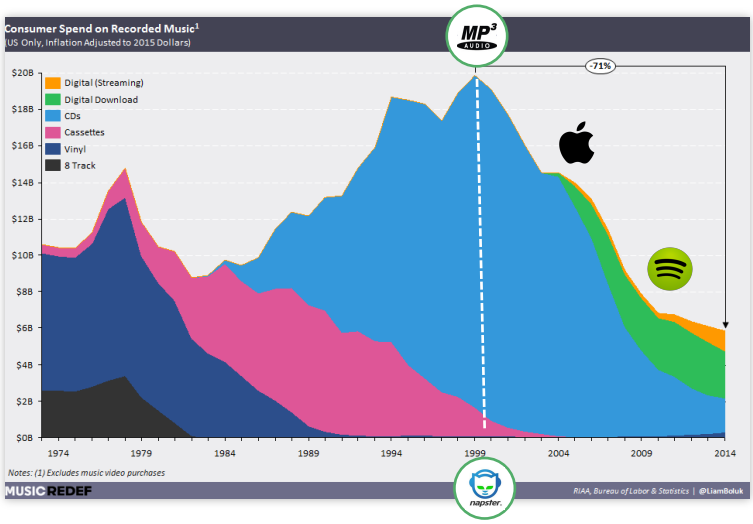

Figure 3: The impact of bidirectional flow of data towards the end customer in the music industry [2]

As Figure 2 and 3 both illustrate the fact that disruption takes place when a bidirectional flow of data is made available at the end customer's domain, enabling a two-way flow of data.

This new business model also represents a shift in power. Having control of end user devices, operative system and interfaces provide new actors like Apple, Google and Samsung with a major advantage compared to the traditional actors like mobile and telecom operators. The business model also removes middlemen, which results in a shift in revenues. [2] refers to these new business models as *disruptive ecosystems*, describing how an ecosystem of partners create value. Typically, the upstream part of the business model is the ecosystem of partners, and the downstream side represents different customers.

4 Method of approach

The methodology we have used in this works has consisted for the following main steps:

- Paper and book reviews
- Interviews with stakeholders
- One-day workshops with our “sister work package” WP3, as business models and exploitation are closely related subjects.
- Workshops very early in the project with other important work packages. Examples are:
    - The “Business models meet Technology” workshop in Q3-2017 (WP9 and 3 met WP 4, 5 and 6 in Granollers)
    - The “Business model meets Pilot owners” workshop in Q4-2017 (WP9 and WP3 met all the pilot owners in WP10 in Copenhagen)
- Business case developments for consortium members in conjunction with WP3
- Follow up meetings for clarification purposes when needed.
- Strong interactions with pilot owners in conjunction with WP3 and WP10 leaders
- Tentative business model development and validation of this against pilots and pilot owners
- Publication of papers on conferences to receive feed-back from the industry.

5 Business models – the basics

No matter what kind of business model you use, it will always start with asking who the customers are and what is your value proposition to the customer. And if you have complicated technology and solutions, this fact becomes even more important.

Therefore, it is crucial that the INVADE pilot owners ask themselves this question, and that the answer is understandable for the end customers.

Let us use Airbnb as an example. Their value proposition is two-folded as they deploy a two-sided business model.

1. They provide end-users (consumers) with a cheaper alternative to hotels, it is user friendly (use any device) and trustworthy because of two-way reviews - thus reducing risk.
2. For the other group of end-users (the producers), they enable them to capitalize on their existing assets (spare rooms). In addition, it simplifies their role of being a “hotel” as they remove the hassle associated with billing, marketing and insurance (called Host-protection insurance). The two-way review (also reviewing the consumers) will reduce risk for the producers too.

This example also emphasizes that value capture can happen in several areas of the business model, as well as by different actors. Airbnb also creates and captures value, but this is not described in this customer value proposition example.

5.1 Definition

You can find many definitions of a business model. However, we prefer the short and concise definition by Alex Osterwalder;

“A business model describes how you create, distribute and capture value”

So, if someone says that they have a subscription-based business model, this only describes a part of the business model, in this case the value capture part. Therefore, an INVADE business model must be able to describe how value is created, distributed and captured.

5.2 Digitalisation changes the business model game

As mentioned earlier, new digital business models have a massive impact on many industries. We believe that the energy industry is no exception, and we expect that new competitors will enter the energy market, which will change the competitive landscape.

From other industries being disrupted by the newcomers, we see that these new platforms and ecosystem-based companies rely heavily on customer value propositions, and they emphasize the importance of simplifying customers' everyday life as well as creating services people understand and need.

5.2.1 Value creation change

The most distinct change that digitalisation introduces is that value creation no longer takes place in a strict value chain, but now is created in a value network. Thus, value creation takes place in an ecosystem where mutually interdependencies exists. This also requires that without open innovation, you cannot build platform and ecosystem-based business models.

5.2.2 Value distribution change

The greatest change here is the Internet. All of the new Internet giants use Internet for distribution of their services. They also create a digital market place where they can sell their own services, but also sell 3rd party services directly to end customers.

Combined, the Internet distribution and the digital market place enable a global market place within a specific market/domain. Examples of such market places are Apple's Appstore, Google's Play andAmozon.com. But you also find pure "exchange" platform companies like Uber and Airbnb that do software solutions only. We also find platforms from companies like Siemens and GE, but they are not open market places for third party vendors.

Services exploiting the Internet for service delivery falls into two main categories:

- Services delivered over the Internet. Examples are Spotify, Netflix and YouTube.
- Services supported by the Internet to deliver more tangible services. Examples are Smart Home services, Airbnb and Uber.

So energy services will fall into the latter category, where the Internet is an essential and supporting part of the energy service delivery.

5.2.3 Value capture change - including the value concept itself

Traditionally, energy companies have sent invoices to their customers, and got paid. In digital business models we find different value capture concepts like freemium as-a-service. We also see that value can be more than money. In many cases, customer data, device data, floor space and other "currencies" replace the traditional and typical money=value concept. In the market today, there are companies that provides energy for free in exchange of other types of value from the customer, such as the Sonnen case.

5.2.4 Business canvas – a useful tool with limitations

Business canvas is a good and useful tool when describing the three parts of our business model. Canvas based business modelling approaches [4], [11] have largely been embraced by the international business community. However, it is important to emphasize that the various canvas methods are associated with certain limitations. The argument against the Osterwalder method is typically its heavy inclination towards established businesses. The Lean Canvas Model by Maurya has been tailored for start-ups [11] and has been applied in several R&D projects before by some of the authors here. A critic that can be brought forward for all of the canvas models in use is the inherent preoccupation with classic value chains. Multi-sided business models that are more related to the value network can be found in the concept by Stabell and Fjelstad [12].

But despite of these limitations, we will use a business canvas methodology in the analysis of the pilots in chapter 10. We have chosen the Lean canvas methodology and have modified this to better include the ecosystem value creation perspective.

6 Input from other INVADE deliverables

To create a new and robust business model, you will need to know state of the art within this field as well as what customers want and value. Finally, you will need to know the regulatory restrictions. Since INVADE has pilots in five different countries in Europe, regulatory constraints will vary from country to country.

This chapter gives a short summary of the D9.1, D9.2 and D9.3 deliverables covering these three aspects, as they provide important input to business modelling for our pilots and services.

6.1 Recommendations from D 9.1 Review of existing business models

6.1.1 The recommendations

INVADE is not merely concerned with the development of a new technical platform to support flexibility markets and management. It also seeks to establish new business models to support future commerce based on such a platform. The concept should also be able to connect with existing platforms for local energy trade or flexibility management. Connectivity is a prerequisite for rapid growth and significant scalability. The concept will be tested in five pilots across Europe. At the end of the project the ambition is to insource other embryonic platforms developed by independent initiatives. The inclusion of such is based entirely on commercial principles. The project has therefore emphasized the importance of parallel development of technical solutions and new business models. So far this has resulted in a functional specification that is currently fused with the technical needs. This implies the following platform and ecosystem-based business model to meet the future energy market. The main requirements have been identified in Deliverable 9.1 “Review of existing business models”:

The INVADE business model should according to this report support:

- multi-sided
- enable network effects with the purpose of fast growth
- absorb exponential digital growth mechanisms
- foster open ecosystems with focus on APIs
- customer centric and applicable for all participants in the energy market, and particularly with respect to the pilot sites

- generic – it should be able to support each pilot, but also be able of supporting (and explaining) other use cases, even the ones coming from new types of competitors.
- include the customer and her domain (devices, IoT, interfaces, agents) and be able to fit in a sharing economy structure.
- support digitalization in energy markets (analytics, machine learning, apps, big data, cloud, IoT, devices, Internet, ecosystems)
- flexible regarding activation (remove/turn off the parts in the generic model that are not relevant) but also to enable extensions
- support flexibility in roles (different components can have the same role (even simultaneously), or the roles can alternate (prosumer).

6.1.2 Platform- and ecosystem-based business models explained

The conclusion of D 9.1 is that INVADE should focus on the newest and most disruptive of the business models, known as platform- and/or ecosystem-based business models. Some of the arguments for choosing this model is described in the Head chapter, but it also makes sense to be part of such a technical and organizational infrastructure because outreach is better, services can be shared, and time-to-market can be decisively reduced. This business model is not a new phenomenon and has been one of the best examples of how network affects work. To explain this, let us look at an example. A market square is a typical example of such a business model and describes one of the most distinct features of a platform and ecosystem-based business model; a platform where you *exchange* goods or services. But to start the network effect we need two more ingredients; the customers and the market vendors. So, starting out with a farmer selling potatoes, this will attract some customers. And since there is a growing number of customers, other market vendors selling carrots and fruits are setting up their booths, which in turn attracts more customers because of the wide selection, thus achieving network effects.

In a digital version of this, physical limitations like space and distance are no longer limiting the growth from network effects, and we see hypergrowth and winner-takes-all effects when platform-based business models enter new markets. According to [2], they are fuelled by digital exponential growth mechanisms such as Moore's and Nielsen's law and the growth in IoT-units. Evans and Gawer [1] is referring to this digital network effect as "the self-sustaining momentum of growth".

Another important observation is that the market square is an excellent description of a two-sided business model, where the end-customers represent the downstream part of

the business model, whereas the market vendors represent the upstream part. The market vendors usually have to pay a fee to the market place owner, but in return they can have a direct customer relationship. The third observation is that market vendors are depending on the other vendors to attract customers, a phenomenon often referred to as an ecosystem. Atluri et al [3] list the development of an ecosystem mindset as the first of four prerequisites if you want to implement platform-based business models.

The closest that we have come to this type of model within the electricity domain is recent work related to local energy markets. A good overview of this can be found in [13] and [14]. [5] proposed a concept for smart grids that embraced a set of local hubs in the grid where both local suppliers and consumers could trade electric energy across the grid. Use of lines in the grid and congestion issues were priced in. This favoured local energy exchanges in peak periods. [6] created a peer-to-peer (P2P) trading concept directly inspired by the bazaar model described above. The P2P trading concepts, proposed by [7] and [8] present even more acute examples of this. [9] specifically addressed platform-based concepts for the EMPOWER concept on local markets but assumed a cloud-based service with “man in the middle”. INVADE builds on and combines ideas from this research. But its main ambition is to show how local markets and energy communities e.g. neighbourhoods and microgrids can be consolidated to facilitate aggregation and trade in energy, flexibility and associated services. The concept that we propose can form a widespread ecosystem. It can be hosted as a cloud service but can also be facilitated by blockchain technologies in a truly distributed way [10]. In our practical work, however, we proceed with a cloud-based approach. The reason for this will be shown as we seek to centralize some resources and consolidate and share an array of different data. Consequently, data constitute an important value booster.

Internet distribution of content and services (often called Over-The-Top) has dramatically changed the “middle man” of Osterwalder’s excellent short definition of a business model in [4]; “A business model describes how you create, *distribute* and capture value”. The marginal cost of distribution, and the elimination of physical distance and in some cases physical products (like CDs and DVDs) have made the whole business model disruptive. Whereas a disruptive product typically disrupts a competitor, a platform/ecosystem-based business model has the capability to disrupt whole industries. This is exactly what has happened in industries like music (Apple and Spotify) ref. chapter 1, transport of people (Uber), accommodation (Airbnb), marketing (Google) and more during the last 11 years since Apple launched the first instance of a platform/ecosystem-based business model. We believe that the INVADE concept has a disruptive potential if it is harboured

in a business concept that can unleash this potential. The proposed model has been designed to cater for this and the pilots will constitute the primary level of tests needed to verify the proposed business model.

If we take a closer look at these companies, we will find that they all emerged from the IT and software industry, accompanied by a highly disruptive platform/ecosystem-based business model. So, what makes this business model so disruptive? One explanation has been suggested by [2]:

"*The higher number of digital exponential growth mechanisms a business model can absorb, the more disruptive it will become*".

Another distinct feature of this digital business model is the inherent ability of doing industrial shifts. Examples of this are Google moving from the advertisement industry to smart homes and AI, and Uber moving from transport of persons to transportation of goods (food), and eventually transport as a service. And the energy industry will not be an exception.

6.2 Customer preferences

6.2.1 Recommendations from D 9.2 User practices and behavioural analysis

This report gives clear recommendations on what a business model should take into consideration with respect to user practices and behaviour. It states that "a business model that relies too heavily on having all its customers involved and engaged at all times could become extremely resource intensive, as well as possibly meeting tough challenges in realising goals and potential". The three main considerations are outlined as follows:

- A high degree of automation may be preferable to a high degree of involvement simply because many users are slow to adopt cutting edge technology. The success of the business model should not rely on having every customer completely engaged.
- A degree of involvement and customer side customisation and programming capability should be made possible in order to cater early adopters.
- While automation may solve many problems for customers and make their life easier, such automation is almost never implemented automatically. Users will still have to allocate some effort for implementing and running in new systems.

In conclusion, an approach that says: “this will be taken care of for you” may be a better approach than “you will have full control”. Many customers will not know what having full control entails and are not ready for or interested in it. In a worst-case scenario, when giving customers more control they may experience it as more work.

6.2.2 Recommendations from a sales manager and industry representative

In an interview with the Sales Director in Smartly[1] we asked the following question: “Can you name the three most important customer preferences (values) based on your meetings and conservations with customers?”. The answer came immediately and was as follows:

“I will give you only two: simplicity and lower price”. He emphasized that with simplicity he meant that you as service provider should seek to help and simplify the customer’s life.

The answer is not a full overlap between the D9.2 deliverable recommendation and acts as important corrective to the more academic research approach found in D9.2.

6.3 Recommendations from D9.3 Report on legal policy implications

The biggest overall barrier to energy storage in the current EU legislative landscape is the lack of attention paid to storage itself. When the Electricity Directive (Directive 2009/72/EC) was approved in 2009, energy storage was simply not included in the picture, resulting in unintended barriers and bottlenecks in the legislation. Currently Europe does not have a common regulatory approach to energy storage - potentially creating important differences between member states.

This lack of a definition of energy storage in the current EU legislation leads to a series of barriers, thereby creating an uncertain investment environment. These barriers are listed in D 9.3 as the following:

- Unclear regulation and rules governing the ownership of storage
- Double grid fees and taxation (the battery is a bi-directional unit that charge/discharge). EUROBAT supports the removal of double grid fees. This also affects smart charging in electric vehicles.

[1] Smartly is the commercial part of Lyse in the INVADE project

- The renewable Energy Directive states that operators of renewable energy plants do not have any responsibility to contribute to the flexibility system. This measure, combined with unclear ownership landscape for TSO/DSOs clearly prevents the deployment of storage systems.
- VAT duty on e-drivers as well absence of other incentives slows down the uptake of EVs. Norway has the highest EV density in the world due to removal of VAT, road tax, parking and ferry fees and the ability to use the public transport lane.
- The netting rule enables PV households to “virtually” store electricity for free on the grid. This is an effective barrier for the uptake of battery storage at the prosumer level. Spain is on example of countries enforcing this rule.
- In the e-mobility market, the high taxation on green energy versus low taxation on grey energy is also a barrier that needs to be addressed.

On the other hand, effect-based tariffs and incentives for promoting E-mobility will increase the uptake of EVs, also known as “battery-on-wheels”.

We will return to the country-specific regulatory issues influence on business models in Part 2.

7 The generic business model framework

According to the INVADE DOA, "future business models will focus on the multi-dimensional *value* of storage rather than on cost of storage… Business models providing storage and related services and encourage active consumer participation in flexibility management while respecting their consumption preferences and behaviour will be highly appreciated in the future energy market".

The work in the first three deliverables in WP9, confirms this assumption and we see four clear trends that act as prerequisites in designing new innovative business models in the INVADE project:

- Digitalisation will have a deep impact on the energy market, including the emergence of new digital competitors.
- Customer (prosumer) centric and customer friendly services make their way into the energy market.
- Regulation is still immature, paving the way for multi-sided markets but also a considerable amount of uncertainty. But regulation is also becoming more customer centric and encourages customers to become active in the future energy market.
- Platform- and ecosystem-based business models are proving very strong in other industries and markets, and we believe it is a question of time when they make their mark in the energy market as well, representing the "new" in the term new business model.

7.1 The INVADE ecosystem approach

One of the ambitions in the INVADE project is to have an industrial and realistic approach towards solutions and business models. For this reason, we will also demonstrate that the INVADE platform is able to connect to existing platforms, typically present in a region or nationally.

For this reason, we have decided to include a hierarchy of ecosystems, where the local/regional solutions/platforms are called local ecosystems, whereas the overarching platform (can be the INVADE platform) are referred to as a global or central ecosystem.

If we are narrowing the services down to flexibility, we will typically refer to local ecosystems as Local FO (flexibility operator) and Global FO.

We will argue that two or more ecosystems can coexist in a mash-up or shared infrastructure because they use the same resources, but in a non-competitive way/ complementary way. Examples of shared resources can be;

a. Energy
b. Power/flexibility
c. Data & computational resources
d. Invoicing

We will describe this further in chapter 7.1.1.The reason for using the term ecosystem is two-fold; first it describes the dependency of ecosystem partners for producing services, but it is also a more generic term than flexibility, thus indicating that other services can be included.

7.1.1 The role of the global/central ecosystem

What characterizes a central ecosystem, and what role and services can this give to local ecosystems and other actors?

The term " Flexibility Operator" (FO) may be too narrow compared to the role of central ecosystem player. A regional and national FO can handle this role itself, usually linked to a regional DSO, housing cooperative and more. And then the question arises as to what value a central/global player should provide. Having a too narrow scope with respect to services may represent a risk.

Therefore, a central ecosystem operator should be able to offer services to local ecosystems. This can of course be an FO service in areas where this does not exist. Replacing the term " Flexibility operator" with "Energy service broker" (ESB) can be relevant in a situation where some services are provided by the global ecosystem and other services are delivered from other local ecosystems through the global ecosystem. Thus, the central ecosystem operator has a "service repository " (or "app store" as it would be called in a typical Internet scenario).
Below we list examples of services that can be provided by a global ecosystem:

- <u>Forecasting.</u> This is typically a service that requires significant and heavy expertise in machine learning and AI. The service is typically generic by nature and aimed at ecosystem partners.

- Advanced forecasting. This is the same service as before, but with the distinct difference that you value- add the generic forecast service with subject-specific expertise. This will in the INVADE project typically be a specialist in smart grid, flexibility operator or other. Such services can be priced higher and be more robust in terms of disruption from pure AI providers.
- Energy service broker service. Such a community service may resell and market a single service from one of the ecosystem partners. In the INVADE project there may be a service from GreenFlux, Smartly, Albena or Estabanell.
- Operation of ecosystem partner services as mentioned above. A regional ecosystem partner / actor often has enough to sell, deliver and operate in his own service in his own region. A central ecosystem actor can therefore make it easy for your partner to get earnings on their service that has been developed through pure revenue-share. This increases the likelihood that a local partner stays in the ecosystem, and further capitalizes its development. We also see this among such actors in the Internet world, where the central partner typically takes 30% to sell on the square, but if you also run such a service, this cut can be increased.
- Open data integrations. A key player can create the API for open data that is of interest to multiple parties. An example of this is value data. The open data sources should have the largest possible coverage area. This ensures high level of reuse and will be attractive for ecosystem partners to use.
- Self-developed services. A key player can develop her own services, but it is important to develop services that do not undermine local ecosystems' own services. Here you should create value-added services where you have strong and specific competence.
- Combinatorial innovation. Having a central position in a ecosystem can create new opportunities for creating new services combining different data sources or/and existing services.

7.1.2 The role of Local ecosystems

In order to do service creation, open innovation and combinatorial innovation, you will need an ecosystem of partners that are integrated using APIs and cloud-based solutions. Ecosystems are also prerequisites for fast adding of complementary services.

In theory, local ecosystems can offer the same services as found in a central ecosystem, as described above. However, from an economic point of view, there will be clear synergies adding parts of common functions to a central ecosystem. Some

examples of typical local ecosystem services are listed below:

- Sales of own services. For a local FO operator, this is what will be the basic service and from where you start.
- Sales of additional/complementary services. Here being part of a central ecosystem will be an advantage in a local market. This will give a local ecosystem easy and quick access to new exciting end-customer services that other ecosystem partners have developed and launched. We will typically get a triple revenue share; local ecosystem that sells to the final customer, central ecosystem that delivers (and potentially also operates) the service, and the other local ecosystem connected to the central ecosystem which has developed the imported service. This will give local competitive advantage.
- Integrating local data and services.
- Customer support.
- New and combinatorial service development, but also combinatorial innovation based on data.

We can also look for more peer-to-peer delivery between local ecosystem partners. This situation is relevant if the global ecosystem manager decides to focus on global service delivery, and not taking the role as Energy Service Broker for the local ecosystems. Having an Energy Service Broker role does not require that the services are delivered via the central ecosystem. One example of this can be a call on a VoIP network, where the signalling and setup will be handled by the central operator (using the SIP protocol), while the conversation (value) is handled by a communication protocol (RTP) not involving the central operator in the service itself.

7.2 The generic business model framework including energy market structures – the initial draft

Our first version of a generic platform-based business model applicable in the future energy market has been developed (Figure 4). It underpins the current development, technical as well as exploitation wise. A platform and ecosystem-based business model depends heavily on Internet distribution, IoT and APIs (Application Programming Interfaces) in addition to the flow of energy in in the energy system. This fact will be reflected in the model. The generic model consists of multiple layers which communication needs to support. At the leaf nodes of the hierarchy we find loads and

generators. These include PV panels, batteries, controllable and dispatchable appliances, charging spots and electric vehicles. These are aggregated locally and can be used to improve self-consumption through local trade or alleviate grid operations [8], [9]. At a higher level, local energy communities are organized under one umbrella, which is offered by a local Flexibility Operator (FO). It can aggregate flexibility with the purpose of offering flexibility to the central market represented by the Balancing Responsible Party (BRP). Peer-to-peer trade operations proposed by [5] can also be facilitated.

At the right-hand side in Figure 4 we have depicted other ecosystems not developed by INVADE. We anticipate other ecosystems that can benefit from the latent benefits of a shared set of resources. Open initiatives, similar to the one represented by the more proprietary Tesla system is a case in point. The bold dotted arrows show how the different ecosystems can bypass each other. Another thing to note is the third main component of the platform depicted at the centre of Figure 4. Here a set of computational services can be found. This is the main asset of the global FO. This hub can for example offer computational resources for forecasting and remote diagnosis of hardware. In a system like this, centralized data storage, curation and analysis have the potential to provide significant value for all connected.

Other computational services include billing, financing, remote sensing and more.

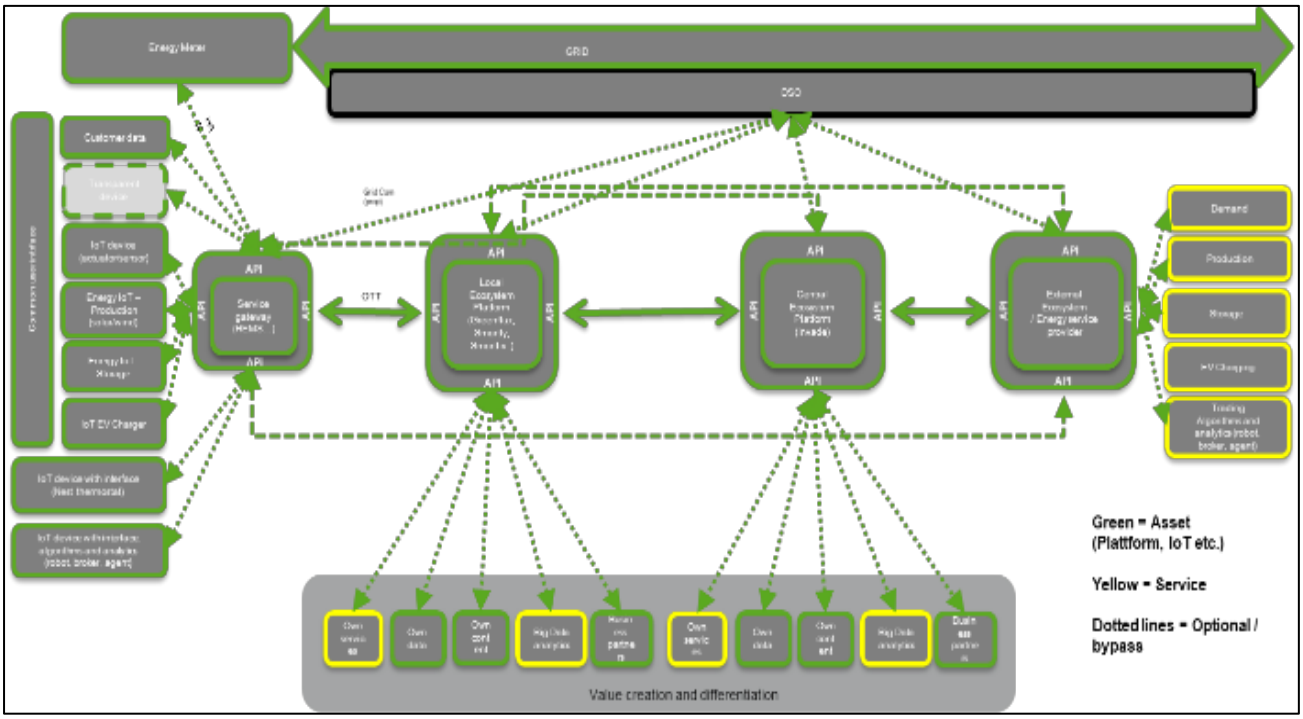

Figure 4 The first draft of a generic business model framework and energy market structure

7.3 The simplified (abstracted) generic INVADE business model framework

A business model cannot capture all technical and market specific details. In addition, if you want to create a classification of business models, you need to abstract the business model. This is what we do in this chapter. In fact, our aim will be to make the INVADE business model so generic that it can even be applied to other industries and markets. So, the wider the applicability, the better generic model you will have.

This is how the generic (and abstracted/simplified) business model structure looks like in the INVADE project:

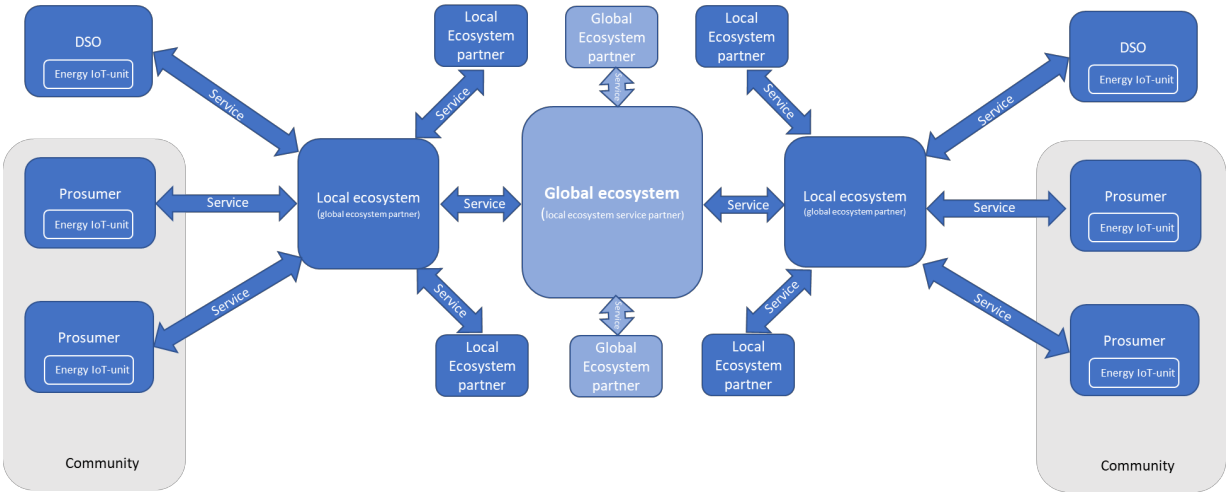

Figure 5 The INVADE generic business model framework

This model is a more abstract model than the initial draft, where the intention here is to describe the ecosystem and market place architecture as well as a hierarchy of ecosystems. The generic model also emphasizes the services and removes details both at the technical level (APIs, business logic and more), as well as the contractual details (service contracts, legal contracts and more). However, we have used some domain specific terms in the energy market like DSO or prosumer to make the generic business model a bit more familiar with respect to the flexibility market, which after all is the target market in the INVADE-project.

The term prosumer means that the customer can be a producer, a consumer or both. Community can be a hotel, a multi-tenant building, a parking lot facility or a cooperative.

Finally, the model emphasizes that a company can change roles or extend its role and ecosystem. This is important in the discussions of how the business model is changed and can evolve.

To demonstrate the generic capabilities, we have applied the business model on AirBnB and EasyPark in the next chapter, where AirBnB is an example of a distant market, and EasyPark is an example of an adjacent market.
Another exciting company is enel x, that openly talks about the importance of platform-based business models (see figure 6). It also applies this by combining many different service domains in its offerings. We will study enel x more thoroughly in D9.6.
They are describing “global product lines” and that they want to collaborate with national and local energy companies. This approach is similar to what we described in the global ecosystem chapter.

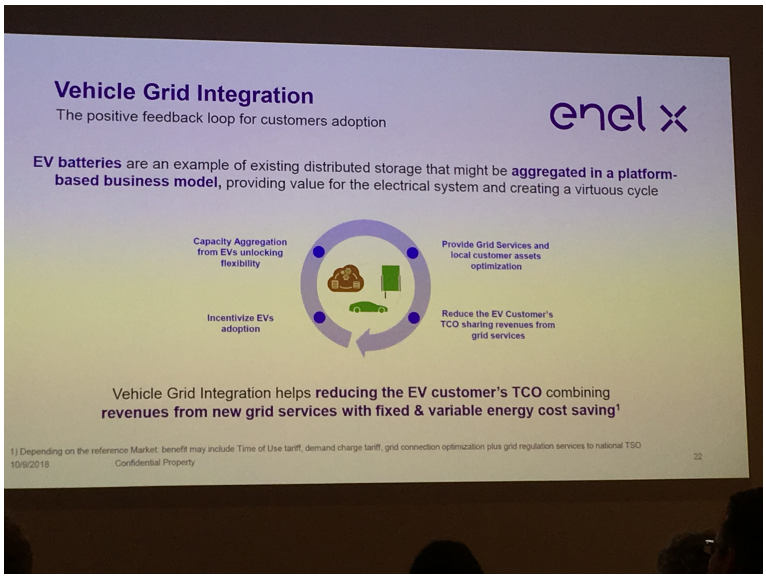

Figure 6 From the enel x presenetation at the INVADE-conference in Oslo 10th of October 2018

8 The generic INVADE business model framework exemplified

In the earlier chapters we have described how platform- and ecosystem-based business models work, and how they affect industries. We have also described a hierarchy of ecosystems (local/global) that are applied in the generic INVADE business model.

So, can we find examples of this ecosystem hierarchy and global ecosystem in the real world? We believe we can. Two concrete examples are described in this chapter, and one potential example in the energy sector. This will be a case for further studies in D9.6.

It is worth noting how easily a global ecosystem company can conduct industrial shifts, a phenomenon well described in this chapter. This is also a reminder of how a new breed of competitors will enter the energy market.

8.1 The INVADE generic business model applied on AirBnB

“AirBnB has gradually become more than just a company. It’s become an ecosystem,” said Nathan Tobin, head of growth and sales for the AirBnB property management company Guesty. But the AirBnB ecosystem is a close-knit community, and many of the companies work together. Guesty works with Keycafe to coordinate key drop-offs, and property management platform Pillow Homes gets pricing data from Everbooked and Airdna.

Another company is Properly, based in San Francisco. It coordinates cleaning services, so hosts don’t have to stress about straightening up between guests. Hosts use the app to create a visual checklist for their cleaners to follow — they can take a picture of a dining room table and add an icon that indicates the table needs to be waxed, for example.

These are just a few examples of how the global ecosystem manager AirBnB have added global ecosystem partners. It should be noted (not showed in figure 7) that some of these global ecosystem partners rely on local partners as well.

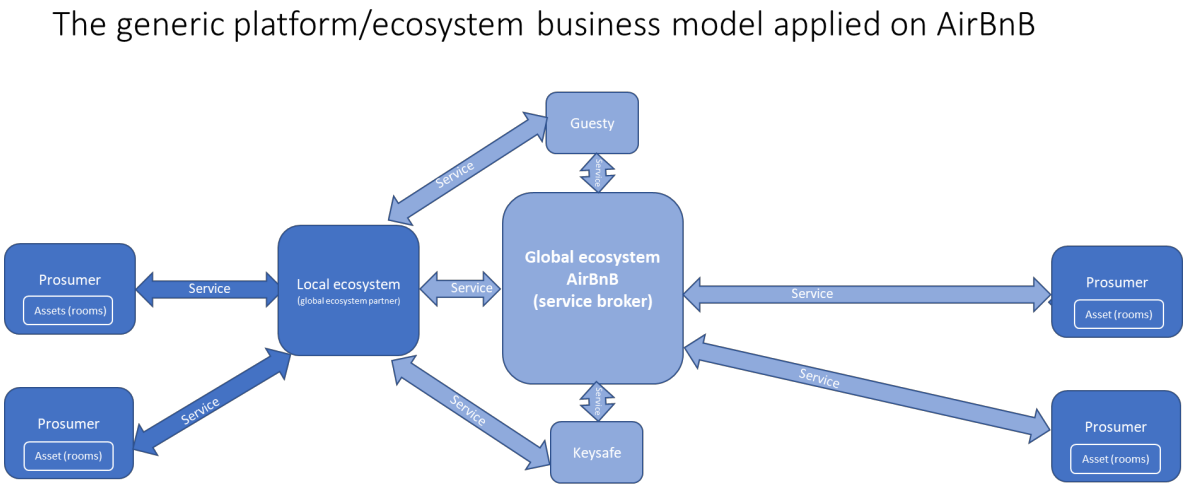

Figure 7 The generic INVADE business model applied to AirBnB

8.2 The generic business model applied on EasyPark

EasyPark (https://EasyParkgroup.com/) is an international company that integrates its services with national and local parking companies like Q-Park. It offers an app and smart support technology that allows the user the following:

- To find a free parking spot
- To set the time, pay and, if needed, shorten or extend the parking time from a distance (no running to the meter to avoid a ticket)
- Be invoiced over the telephone bill
- Support parking officers with an AI based license plate registration system (see figure 10)

For this convenience the driver pays a little more.

The fact that EasyPark also delivers services directly to the end-customer, in parallel with services from the local ecosystem, is illustrated in the generic model by the two curved arrows illustrating their two main services “help finding a vacant parking lot”, and “pay as you use” service that gives economic benefits for the end-customer.

Figure 8 also shows the global providers (called Technology partners by EasyPark) that EasyPark claim to have, and according to the list we believe these partners can be both global service providers and sub-contractors/vendors.

The generic Invade platform/ecosystem applied on EasyPark

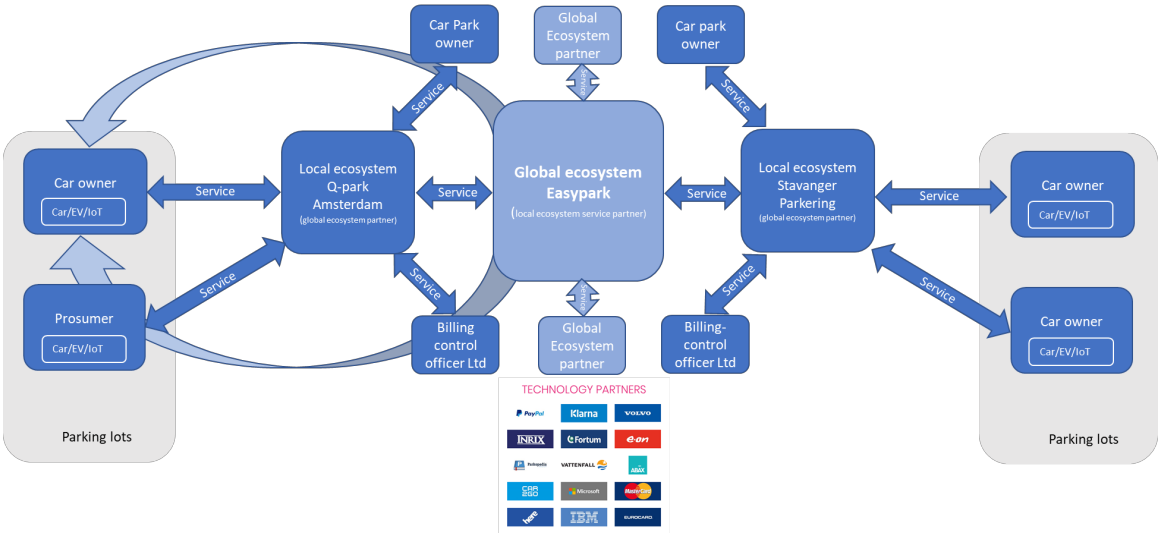

Figure 8 The generic INVADE business model applied to EasyPark

Figure 9 The EasyPark (end-user service) app: Find a parking spot. Turn the wheel and thus specify how long you wish to park the car.

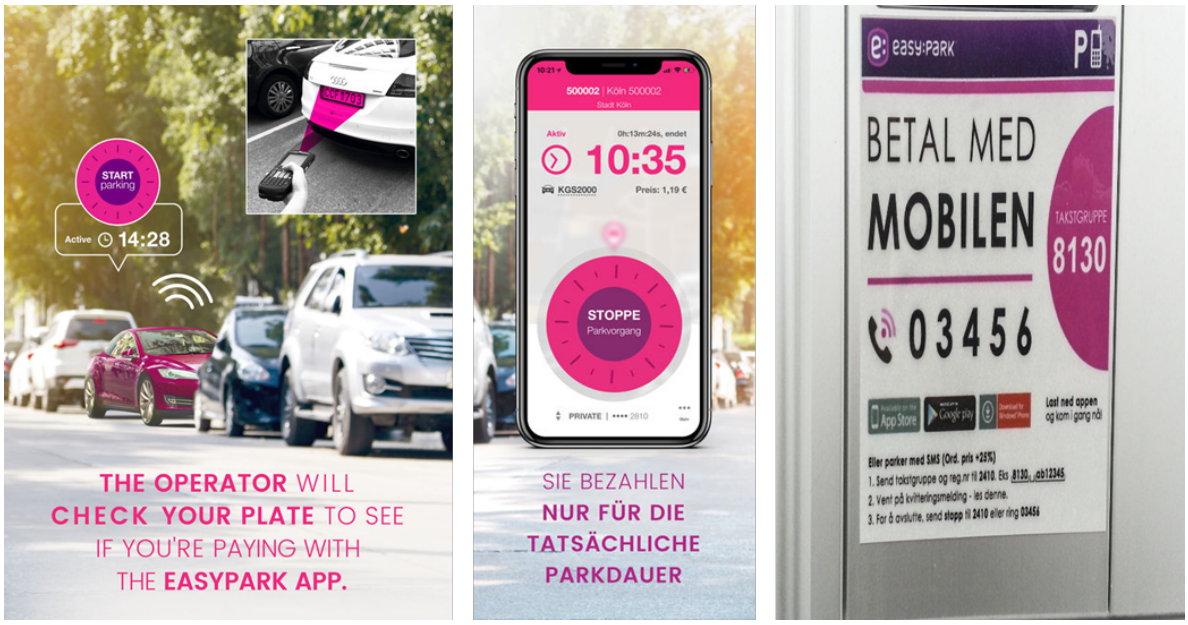

Figure 10 EasyPark uses advanced image recognition and GPS to support the parking service and the end-user.

8.2.1 The End User Experience

As a customer of EasyPark you download the app and preregister your car with the license number etc. By accepting the terms in the regular app-way a legal agreement has been established. It takes 5 minutes to set it up. To read and understand the legal terms could actually take a full day or even more. It is suspected that few bother to do that. However, when scrutinizing the agreement, it shows very clearly the technical implications and the division of responsibilities between multiple business partners and the end user.

The app provides a map where all the P-spots that are registered within the EasyPark domain can be shown. If you find a P-spot on your own, you park and set the time. In most cases the GPS on your phone has already identified the spot and the tariff that you have to pay. Alternatively, you have to find the parking meter and identify the tariff zone (Figure 10, right). Once done, you rush to your dentist or meeting or airplane. If your return is delayed, you may extend the parking time. If you are done quickly you may reduce it and pay less. No coins, no cards – really very convenient.

8.2.2 Organization

EasyPark enters an agreement with parking place owners or operators like Q-Park, OnePark or municipalities. The P-lots are registered in the EasyPark system and the local P-officers are equipped with a camera which is online with their system. The

revenue generated is split between EasyPark (15 – 25%) and the local parking company. Q-Park and EasyPark are both ecosystem managers. Q-park owns only a few parking spots. It is first and foremost and operator. It is all a franchise. Their main instruments so far have been the parking meter and the P-officer who checks the validity of the paper ticket in your window. EasyPark is overarching Q-Park and relates to multiple parking companies like Q-park all over the world. The parking lot owner is the asset owner. Q-Park is also an asset owner (parking meters) but is less bound to the local premises. It can also operate across a wide geographical spread since it is easy to install or move parking meters. But there is still an investment cost involved that is significant. In addition, there is a need to cover for the labour involved, namely the P-officers and the service people setting up and maintaining the meters, mark the p-spots with fresh paint, etc. EasyPark has none of this. It has abstracted away from it all. It just sits on top of the local and regional players and operates its platform business concept world-wide – just like Uber and AirBnB. What is interesting to note here is that EasyPark gets to know the parking customers better than anyone more closely located to them geographically. That is an irony. Together with the telephone company (or blockhain in the future?) it is also a clearing and billing central (see figure 11 below).

In a sense EasyPark compares to the global ecosystem acting as flexibility operator introduced in Chapter 4. Q-Park relates to a local ecosystem acting as flexibility operator. The parking house owner may be compared to the building owner housing the battery that offers flexibility.

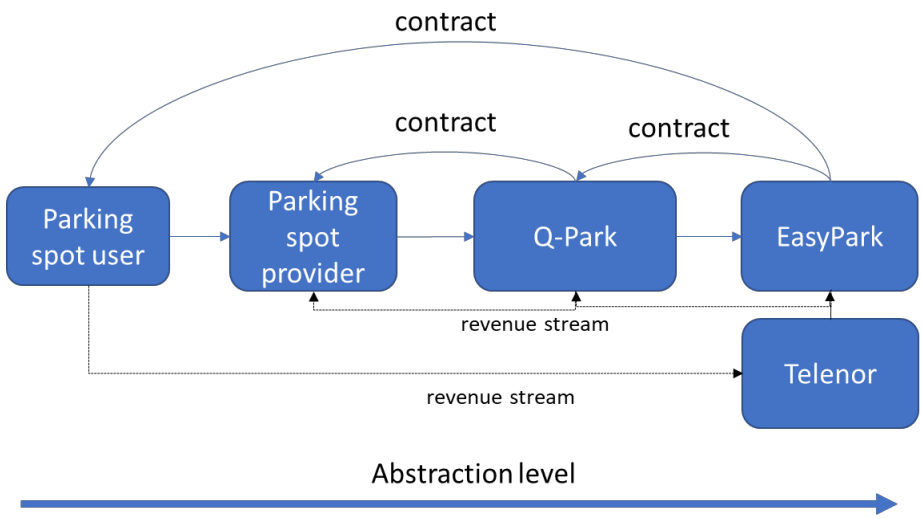

Figure 11: A conceptual diagram describing the relationships that EasyPark manages.

8.2.3 Will EasyPark support EV charging?

It seems pretty obvious that the EasyPark system could create the backbone for both charging and flexibility. The different services use essentially the same information from the end-user. From that perspective entering this information 3-4 times is most likely out of the question. As a consequence one app for a combined service should trump multiple apps that need the same information. What emerges is a stack of different services for the convenience of the end user (Figure 12). In terms of platform engineering such a stack is often referred to as a mash-up. U**¡Error! No se encuentra el origen de la referencia.**

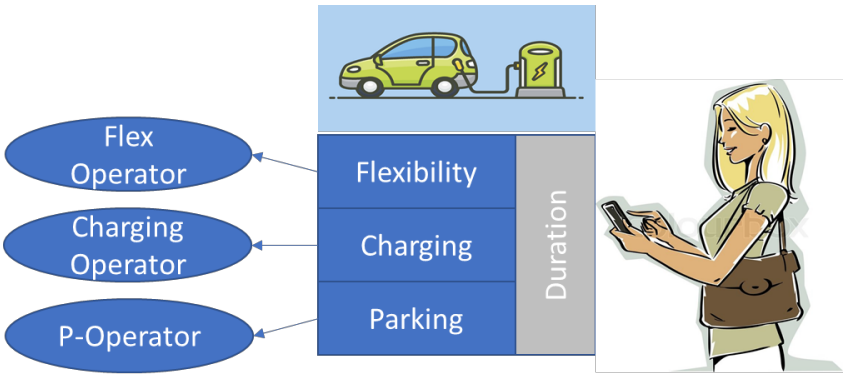

Figure 12 One user interface offered by the ICT platform distributes the same information to multiple services

When spots for parking are transformed into docks for EV charging, multiple business scenarios with mash-ups are possible. 1) The municipality or the P-house owner may require a charging operator to organize this or someone else. 2) The asset owner leaves that to the parking operator (i.e. Q-Park) who figures out how to do it. This could imply a quite complex set of contracts between stakeholders (Figure 13).

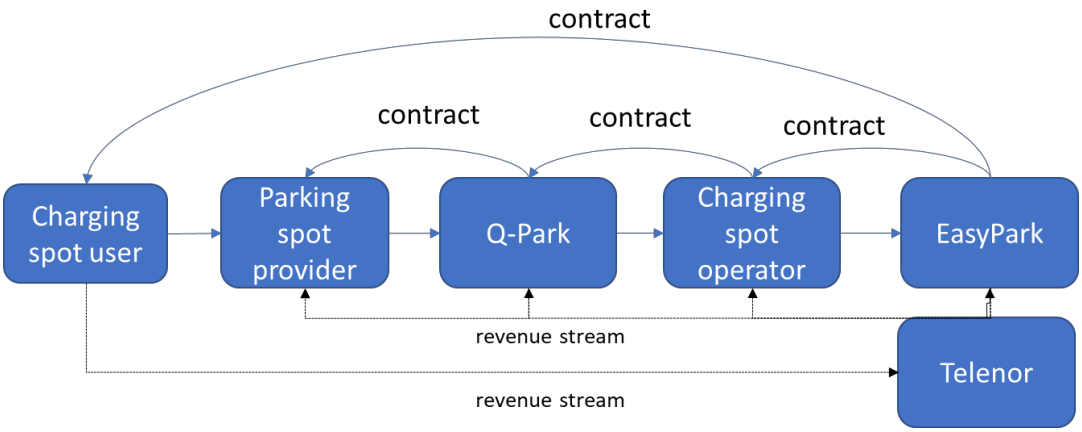

Figure 11: A conceptual diagram describing the relationships that a parking service like EasyPark typically must manage if it is going to manage a mash-up as explained.

The EasyPark app would already know if the car that is parking is registered as an EV. It knows whether the p-spot also comes with a charger or not. The app can be extended to communicate with the charger to know the SOC level of the battery. All the EV user must do is to dock his car, turn the wheel on the app (see figure 12) and do his/her business. The app will tell the user when the car is fully charged and suggest to him to move it in order to avoid a very high parking fee for the time that the car stays put without charging. Now with this the number of technical interfaces, contracts and even ecosystems increase, but with the EasyPark app this challenge can be largely reduced to an additional option in the app and one more branch for the revenue stream. The parallel between EasyPark and the role that has been called the Global Flexibility Operator in the business model should be obvious.

8.3 Summing up the case of AirBnB and EasyPark

The AirBnB case shows that this pratform and ecosystem-based business model fits well with our generic INVADE business model. Even though AirBnB operates in a completely different market, there are strong similarities in the business model framwork.

TheAirBnB case also illustrates how a global ecosystem can delvelop, and the fact that it can have a direct relationship towards the end customers on one hand, but also have a presence of local ecosystems providing local services to the producers who rent out their asset. It is also an excellent example of how actors in the ecosystem can change roles, as a customer can be both a producer (renting out rooms) and a consumer (that rents a room). It also shows that local ecosystems can consist of services delivered by global service providers like Guesty and Keysafe.

The EasyPark case shows how a platform based business model can be expanded and conduct industrial shifts with relatively low investment costs. There is no question about scalability and once a charging spot facilitator hooks into a system it can expand its operations to all the places where EasyPark is currently operating. Standardization with respect to chargers, protocols etc. greatly facilitates the expansion. For the user, the integration of charging into EasyPark would greatly simplify things. In addition, it is an instrument for reducing customer churn. If the user replaces his/her fossil fueled car with an EV, EasyPark does not have to see him migrate to another platform. Same with flexibility operator. Keep in mind that the EasyPark expansion is greatly facilitated by hooking into other ecosystems that have already invested in standardization measures to reduce its own burdens. The most important thing for INVADE members is that you are not alone on this planet and do not have to do everything yourself. In fact, like

EasyPark it is sometimes better to stay on top, leverage the market power and convenience of the end-user by organizing the assets that others have invested in and created in a way that standardizes, consolidates and simplifies operations. Consequently it may be better for INVADE to hook into an existing app, existing billing system, existing EMS etc. rather than go all the way down to the nitty gritty details. What cannot be done technically in a cheap way is handled by means of lengthy contracts.

The most important learning from the EasyPark example is two-fold; First, it shows that a platform/ecosystem based business model is applicable to the flexibility market, and second it shows how easily central ecosystems from other adjacent industries outside the energy industry can move into the role of also becoming a global ecosystem for flexibility services.

9 Products, services, APIs, contracts and business logic

The EasyPark example clearly shows the importance of contracts. Typically, legal contracts are not enough to make services work, and there will be a need to technically integrate services and systems together.

The figure below is an attempt to describe (the obvious) that a service delivery cannot stand on its own and will be accompanied by contracts specifying the economical and legal obligations on both parties as well as a description of the service. Technical integrations (Application Programming Interfaces (APIs)) is also necessary to deploy the services in real life as well as the Service Business Logic (SBL) that will control the service operation according to the specifications in the service contract.

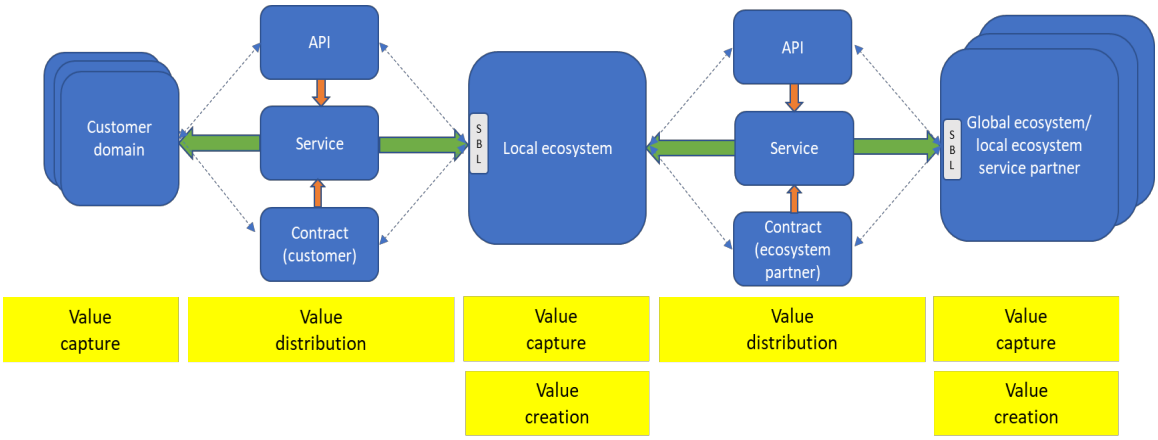

Figure 14: The relationship between business and technical domain in the generic model

Figure 14 emphasizes the fact that two-sided business models must have an ecosystem of partners which means that the number of contracts (and APIs) increases. Keeping the ecosystem partners happy now comes in addition to keeping your customers happy.

10 Pilot business models

Chapter 10 will concentrate on analyzing the pilot and country specific business models using the generic business model frameworks as a basis. For the specific analysis regarding the flexibility operator we will use the Lean canvas-methodology.

Each pilot will be analyzed using the same methodology that consists of six successive steps. The steps are as follows:

1. Regulatory conditions in the pilot country
2. Analysing the services and customer value propositions
3. Decide whether the platform/ecosystem-based business model is applicable in the pilot
4. Business model description deep-diving into the flexibility operator role (more energy details).
5. Describing the business model before the INVADE project (BEFORE) and the new business model used in the INVADE project (NOW)
6. Recommendations both with respect to the flexibility specific role, and potential overall development of the business model (NEXT).

10.1 The Norwegian pilot business model

The Norwegian pilot takes place in the Lyse Group, a company providing multi-utility services like renewable energy, district heating, smart home services, broadband and entertainment services in both the public, business and residential market.

The strategy is to combine the capabilities in both the energy and broadband market, and combining new technologies like batteries, Internet of Things, EV, AI and machine learning and more, were yet to be explored before the INVADE project. A possible scenario could be to combine the TV-service ecosystem (content market place) from Altibox (the broadband service company) with the Smartly energy service ecosystem to enable new combinatorial services.

At the same time, exploring and understanding new digital business models was high on the Lyse group's agenda.

The pilot consists of customers in both the business and residential market, including the "hybrid" multi-tenant market, and includes both consumers and prosumers. For more detailed information, we refer to D 10.1 and D10.2.

10.1.1 Regulatory issues - Norwegian market

Norway has since the 1990s had a highly liberalised energy market, and a market driven approach in energy trading. However, there are important changes in the regulatory landscape, and the most important ones influencing the business model are:

- The installation of automatic meter reading in all households within 2018. This makes energy data available, but not in real time. These new meters enable consumers to become prosumers using four-quadrant meters.
- Strong incentives[2] to promote the migration to electric vehicles (EV). The result is that Norway now has the highest EV penetration in the world - the charging infrastructure is extensive and growing.
- Effect (power) based tariffs are recommended to be introduced in 2019-2020 by NVE (the regulator) to reduce the strain on the grid. Lyse Elnett (the DSO) is planning a pilot to test these tariffs, and the INVADE pilot will include some of these households.
- Incentives in the form of financial support to customers investing in PV.

10.1.2 The services and customer value propositions analysed

The Norwegian pilot focuses on end-customers. This is also reflected in the proposed pilot services. The DSOs approach is not to be a market player, and they trust that price signals will take care of the stability of the grid. However, using batteries to improve the quality and to avoid/postpone investment in the grid infrastructure is relevant.

From D 4.2 describing the INVADE concept design, the services in the Norwegian pilot are shown in Table 1.

[2] Examples are no parking and toll fees, driving in the bus lane, removal of VAT and taxes.

Table 1 Flexibility services in the Norwegian pilot

Flexibility customer	Flexibility services INVADE	Office	Households	Cooperatives
DSO	Congestion management	N	N	N
	Voltage / Reactive power control	N	N	N
	Controlled islanding	N	N	N
BRP	Day–ahead portfolio optimization	N	N	N
	Intraday portfolio optimization	N	N	N
	Self-balancing portfolio optimization	N	N	N
Prosumer	ToU optimization	Y	Y	Y
	kWmax control	Y	Y	Y
	Self-balancing	Y	Y	Y
	Controlled islanding	N	N	N

The three services that are specified are; ToU-optimization, KWmax control and Self-balancing. From a technical perspective these terms mean something. In a customer and market perspective they do not. But we should still be able to derive the customer value proposition from them.

Another important observation is that it can be hard to isolate these services from each other in a real customer usage context. Let us look at an example:

A prosumer has installed a PV system, has an EV in the garage part of the time, and has installed a smart water heater (thermal storage). In the morning he wants to use his stored energy to avoid high effect tariffs, so he can activate the ToU-optimization (load shifting) service to delay the heating of the water heater by two hours. The ToU-service can also be activated to sell excess energy from PV-production when the prices are high. During the day, KWmax control service may kick in for instance when you come home from work and plug in your EV to avoid high fines from the effect-based tariffs. And if the weather and price predictions indicate that there will be no sun the next 4 days, and prices are high, the self-balancing service (and algorithm) decides to store all the PV production in the home battery.

In this example we clearly see that the different technical services are interleaved in a real use-case. We can choose to look at each of the three services separately and derive the customer value proposition from each of them. However, they will be combined in the three use cases in the pilot.

Thus, the overall customer value proposition will be:

We will reduce your energy/power costs and increase your revenues (for you), using the available assets (energy IoT-devices) in your household/building.

This fits well with Smartly's customer promise which is "Hvilepuls" (we help you to maintaining a low heart rate). How we do this (APIs, algorithms, ecosystem partners etc.) is not of interest regarding the value proposition. How we control the customers assets will be reflected in the customer contract.

The three use-cases implemented in the Norwegian pilot are:

1. Optimized energy consumption based on hourly energy prizes. In its simplest form, this will disconnect low-priority loads at price peak hours (using KW max control). Alternatively using the more advanced Time of Use optimization.
2. Optimized energy consumption based on effect (power) based tariffs. In its simplest form, this will disconnect low-priority loads at power peak hours (using KW max control). Alternatively using the more advanced Time of Use optimization.
3. Optimized utilization of self-generated PV production (prosumer). In its simplest form, the solar generated energy is stored, consumed or sold in different time-patterns, where the optimization is controlled by advanced algorithms taking into account price, weather, effect tariffs and other parameters.

Having the value proposition in mind, it is important to note that the optimization is done with respect to the customers' economy, and idealistic factors like reduction of CO2 footprint and "helping the grid" are not influencing the optimization.

The name of the service called "self-balancing" has some issues. First, it indicates that you as a customer have to do this yourself (self-service) which is wrong. The local ecosystem does this on behalf of the customer. Second, it implies that it is the balancing that is to be optimized. This is also wrong, because we optimize with respect to the customer's economy.

It is important to note that after the INVADE project was launched, the energy retailer (Lyse Energisalg) has introduced a feed-in offer where they will pay the prosumer the double of the spot price.

10.1.3 Is the platform/ecosystem-based business model applicable in the pilot?

The litmus test is the following:

1. Value creation: Can value be created by using an ecosystem of partners?
2. Value distribution: Can you use Internet to distribute value?
3. Value capture: Can value be captured using Internet based devices (IoT) and/or interfaces (SW-applications)?

If the answer to these three questions is yes, you can use a platform/ecosystem-based business model.

In this kind of business model, it is normal to find value capture mechanisms that scales fast (PWYD – pay with your data (free), freemium, no cure no pay, sharing benefits with customers, etc) but this is not a requirement. The reason why you so often find these mechanisms is that a platform driven market is a “winner takes it all” market where speed and size are crucial.

In the Norwegian pilot the answer to these business model questions is easy. This is because Smartly has already deployed a platform/ecosystem-based business model in the smart home market, and since the business model represents an extension into the energy and flexibility domain the answer to all three questions is yes.

10.1.4 Analyzing the business model emphasizing the flexibility operator role

Smartly represents the Norwegian flexibility operator (local FO) and has organized a set of households and businesses. The local FO entity can connect directly to dispatchable loads through agnostic gateways. They can also connect to local EMS/HAS systems and be part of a more extensive user-centric smart house system.

The service contracts that the FO offers participants are meant to reduce energy costs with TOU/kWmax pricing. Here, the FO plays the role of a regular ESCO service provider.

The flexibility market and FO role is divided into two categories, efficiently divided by the smart meter. The first category is end customer flexibility services residing behind the meter. This is what Smartly is doing in the Norwegian pilot. The second category is flexibility trading which involves actors like DSOs, BRPs and aggregators. The lean canvas analysis is covering the end customer flexibility services.

However, with a critical mass of households and businesses, the local FO can turn to the local DSO and offer similar services to alleviate the grid. Different market designs

have been proposed that show how a community of households can become a self-balancing energy cell through peer-to-peer trade between prosumers, regular suppliers and pure consumers.

These concepts illustrate on a local level what Uber and AirBnB achieve in transportation and the lodging business respectively. The concept can easily be extended to manage home charging of EVs through the OCPP v1.6 protocol. In the way pointed out by Bremdal (2017) local communities can be united under one management. This increases the attraction potential for third parties that see the united group of local communities as market for advertisement, products and services. The consolidation helps to aggregate flexibility services to a level where they can make a difference to balancing responsible parties (BRP) and the central market. This is shown in Figure . The only local ecosystem partner shown in the figure is the global ecosystem. The local ecosystem can potentially be extended with a parking house with extensive charging facilities for private cars, taxis and electric buses. The whole parking garage system is organized as a microgrid with more than 500kWp production based on PVs and 1MW of battery capacity. It is designed to offer flexibility services in addition to its parking and charging business. The current idea is to insource this microgrid under the supervision of a different local FO, but under the additional supervision of an overarching entity that is labelled “Global FO”. This will yield a whole set of new synergies.

The local FOs (or ecosystems) can share forecast services, data repositories, remote technical services, billing and more. It is like two different stores transformed into departments in a supermarket or shopping mall. Benefits in terms of marketing and

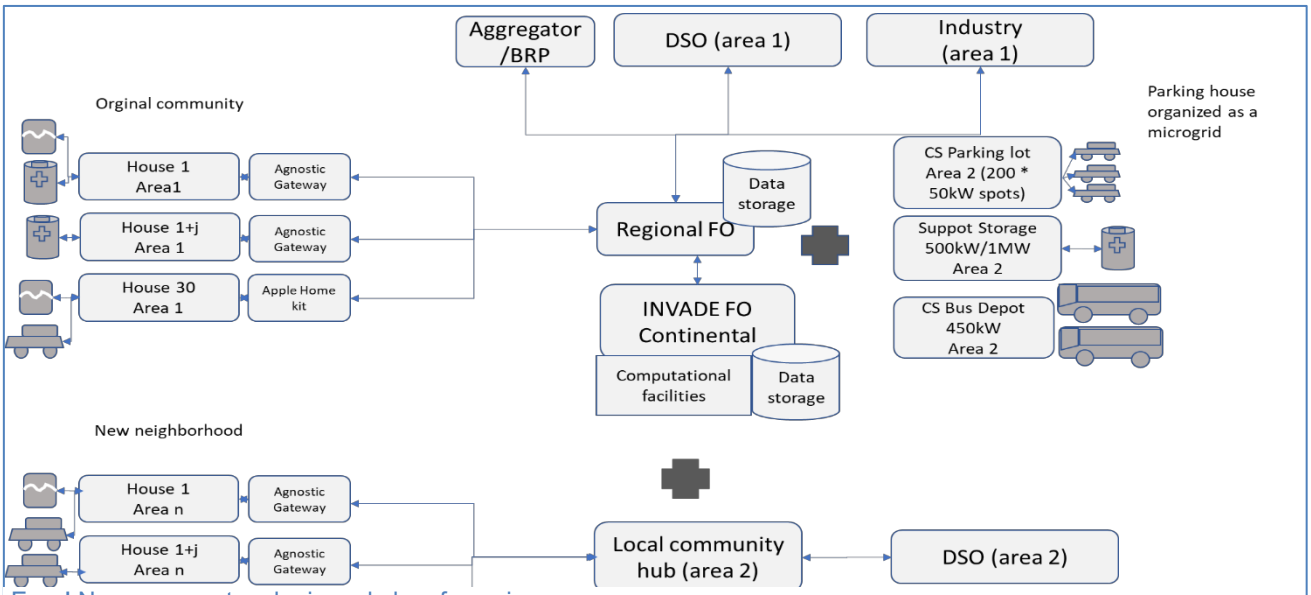

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Figure 15 A possible extension scenario for flexibility services in the Norwegian pilot

business attraction is expected to rise too. For the households and drivers, selling flexibility will also benefit from economy of scale.

A network effect is likely to occur at different levels. Another practical benefit for the residents in Area 1 who own an EV is seamless roaming. It makes no difference whether charging is done at home or in the other parking area. Other residential ecosystems like Area 2 may exist as shown and can be insourced accordingly. Apps and software for monitoring energy use, agent-based trade etc. developed for this area may be uploaded and shared by members of the others by means of the platform offered by the Global FO. This way the Global FO can offer complementary services to the local FOs. Such assets can also be non-energy specific, such as games and media resources. A fair degree of standardization and agnostic communication devices will allow the concept to scale up quickly.

Coming back to the real pilot implementation, the original plan having residential customers has been extended to also including multi-tenant homes and businesses. This is also reflected in the Lean Canvas shown in Figure . In fact, not only has the customer segments been extended, but the priority has changed considerably, a fact that is reflected in the canvas.

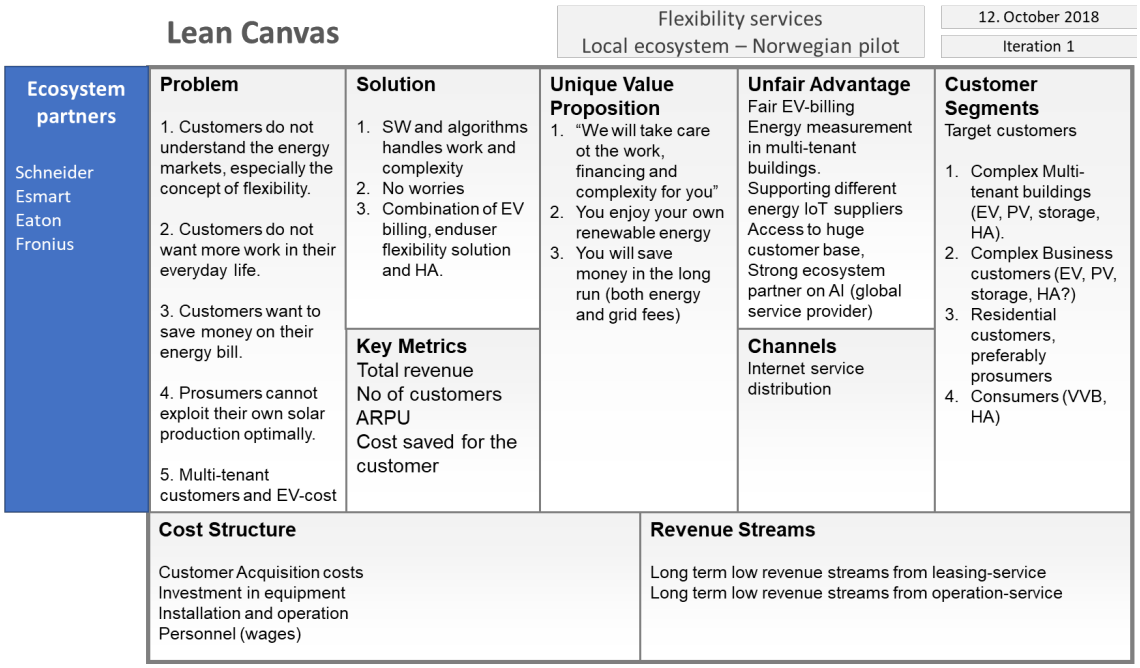

Figure 16 The Lean canvas exercise for the Norwegian pilot focusing on the flexibility service

10.1.5 The new business model in the Norwegian pilot (BEFORE and NOW)

This section describes how Smartly's existing business model has changed due to the INVADE project using a BEFORE and NOW description by using the INVADE generic business model framework from chapter 4.3 to describe the steps.

As we established in 7.1.3, Smartly had a platform and ecosystem-based business model before they joined the INVADE project, and they acted as a local ecosystem. They had a richer ecosystem than what is shown in Figure 17, but we have used two of their ecosystem partners as examples within the smart home service domain.

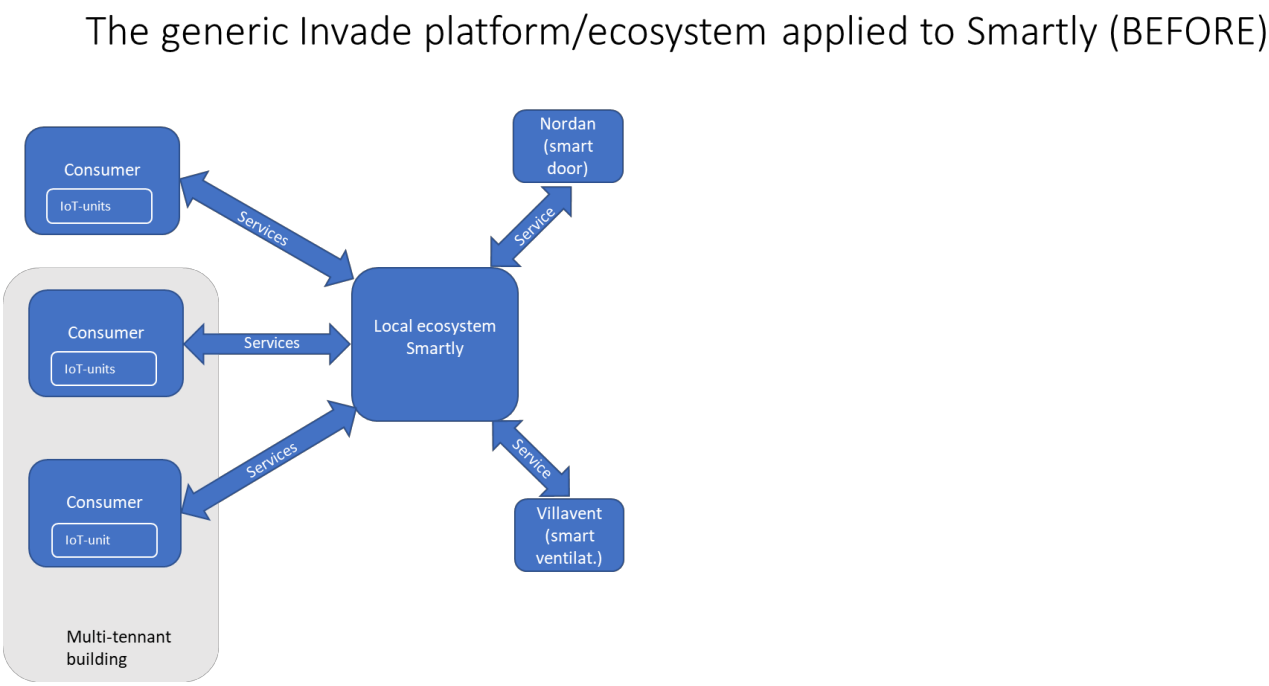

Figure 17 Smartly's business model before the implementation of the INVADE project

So, one of the important business model questions was concerning extensions. For Smartly there were two extensions that needed to be considered: Should they extend their product portfolio to include energy and flexibility services? And should they extend their local ecosystem with new (and necessary) partners?

The answer to both these questions is yes, so their product portfolio now includes flexibility services in the multi-tenant, business and residential market, and they have

new ecosystem partners on both energy IoT devices, as well as machine learning/AI. This is illustrated in Figure 18.

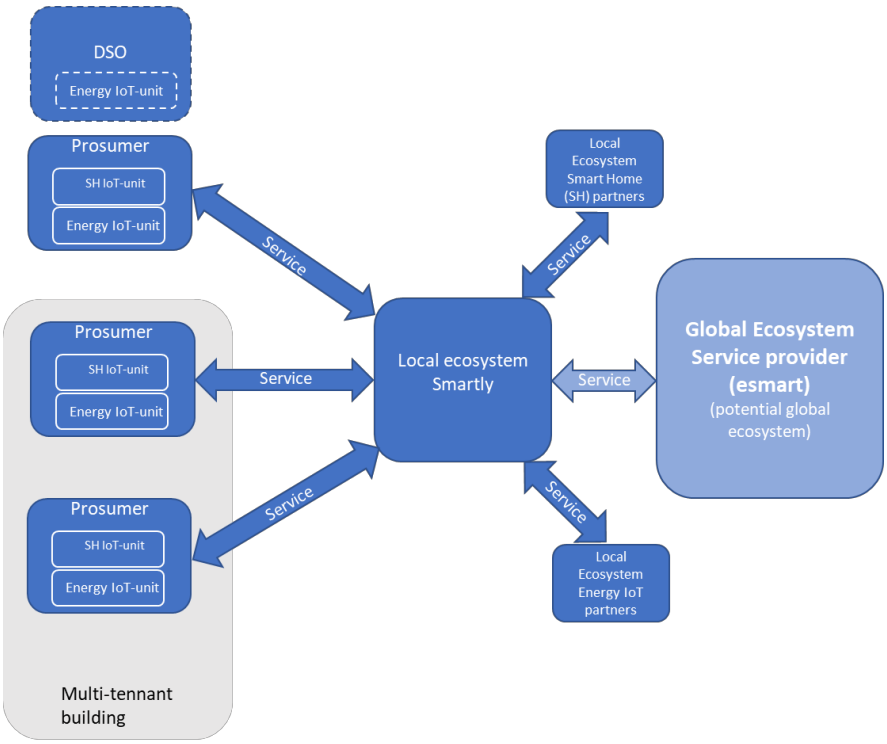

Figure 18 Smartly's business model in the INVADE project pilot (NOW)

10.1.6 Recommended business model Norwegian pilot (NEXT)

Smartly comes from the residential smart home market. But this focus has changed significantly during the INVADE project period. In the beginning of the project, they changed their market segment to the housing association/multi-tenant buildings. We believe this is a wise move. The main reason for this is that the residential smart home market is crowded, and the sales process in the housing association-segment is complex, making it more difficult for the global competitors to handle, and thus compete. These customers are also in favor of long term contracts.

Our recommendation is to stay with this market segment, and apply the same solutions in the business market, and to focus on combinatorial innovation and market offerings in the borderline between smart building and smart energy solutions, where flexibility services and use of new energy IoT-components are important.

These two market segments already have power-based tariffs, so there is no need to wait for this to happen as is the case in the residential market. Even other services from i.e. a smart city domain can be relevant.

This is also the reason why the pilot topology had changed during the INVADE- project, and now contains both multi-tenant buildings and business customers. We recommend Smartly to increase the flexibility operation in these two segments.

With respect to the business model, our recommendation is to continue to use the platform and ecosystem-based business model, and to extend its use in the business market, as well as to extend the service offering and footprint of each service. With footprint we mean that i.e. the smart charging service should not only include one brand, but several. We see that Smartly is doing the API-integration at the cloud level. We believe this is wise.

Finally, we recommend that Smartly's service offering is seen in combination with other service offerings from Lyse. This principle also applies to the flexibility services itself, where customers will need a combination of single flexibility services like kWmax (peak shaving) and ToU-optimization (load/energy shifting) and self-optimization. Now with both a platform-based business model and API-based platform in place, combining services and creating new ones will be easier to implement. In the long run it could even open up for a realization of a service market place, but this is a difficult position to both establish and keep over time.

So far, no company has fully taken the role as global ecosystem manager in the INVADE platform, but several of the project partners can grab this opportunity.

As described earlier, one of the functions of a central ecosystem manager is to facilitate service consolidation/exchange between different local ecosystems in order to enrich their service offerings.

This is a natural NEXT STEP in this kind of platform/ecosystem-based business model, and the rest of this chapter is used to examine how this could have been done.

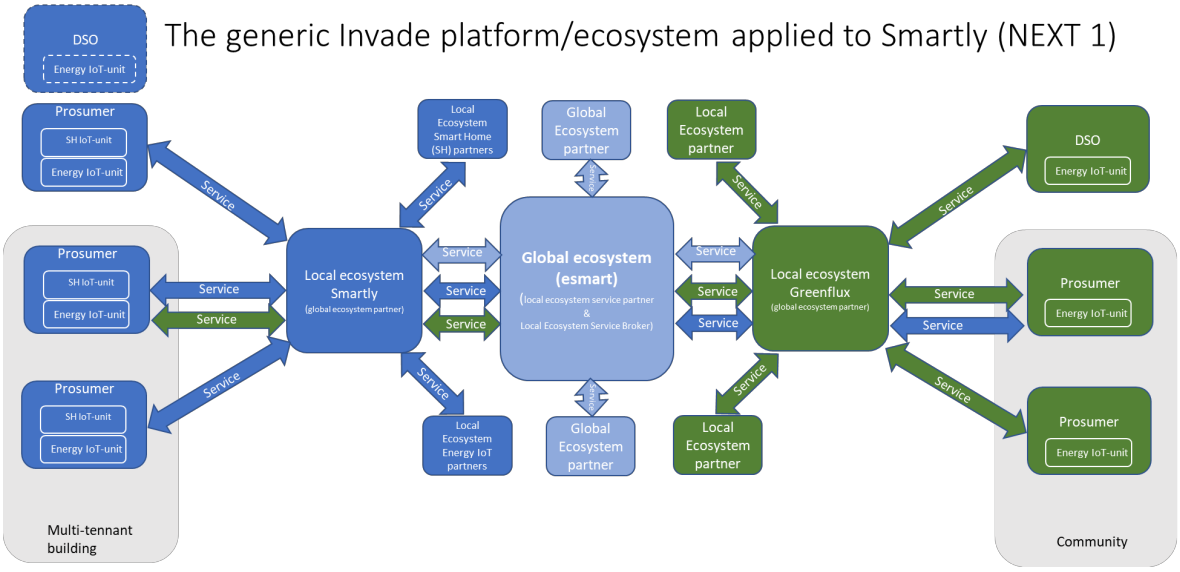

Figure 19 The generic INVADE business model describing the Energy Service Broker role of the global ecosystem and the import/export of local ecosystem services in the Norwegian pilot

Here, Smartly can exploit the central ecosystem for service export as well as import. There is a potential for Smartly to import services from other local ecosystems. GreenFlux can be used as an example of another local ecosystem, and is shown in Figure 19.

In this case, Smartly could import the services developed by GreenFlux to extend their service domain. This would require that Smartly and GreenFlux start a collaboration and that they establish a contract. This process could be facilitated by the central ecosystem. It would also require that for instance eSmart takes the role as a global ecosystem and enables local ecosystem service exchange.

The figure also shows the possibility for Smartly to export services to another local ecosystem, in this case GreenFlux. Such a NEXT step would alter both roles and the business model significantly.

However, the scenario above requires that the central ecosystem offers local ecosystem service exchange. If this is not the case, such local ecosystem service exchange could still be realized, but then by means of direct contracts. In this scenario, the central ecosystem is reduced to a global service provider. This is illustrated in Figure 20.

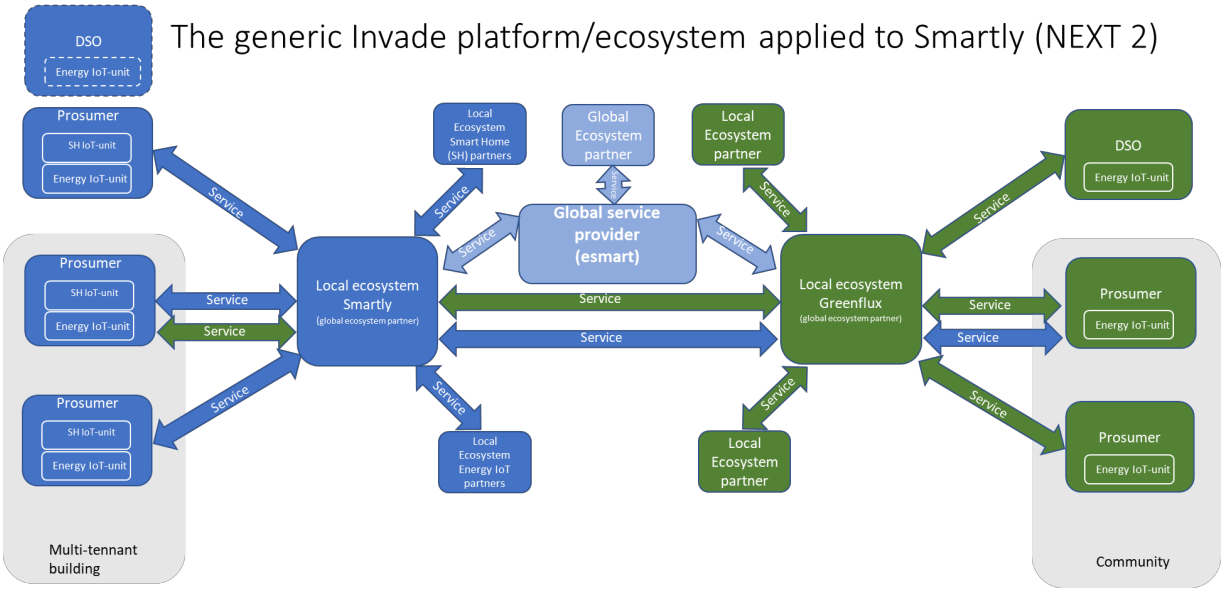

Figure 20 The generic INVADE business model describing the global service provider role of the global ecosystem and the direct import/export of local ecosystem services in the Norwegian and Dutch pilot

10.2 The Bulgarian pilot

10.2.1 Regulatory issues Bulgarian market

On the 1st of July 2018, major amendments and modernisation was in force through the Bulgarian Energy Act. One of the new components is CID, a transitional mechanism with contracts for differences (CID) recommended by the World bank on financial recovery and market liberalisation. Now all electricity producers that exceed the 4MW limit have to be traded on the independent energy exchange. Technical grid losses will also be compensated for via the “Security of Electrical power system” fund. 5% of the revenues of BRPs, DSOs and producers finance the fund. This act also controls the import and export of energy, in which Bulgaria has a major role due to its central location between eastern and western Europe. The energy sector is ruled by the Energy Sector Act (ESA).

The energy mix in Bulgaria is consisting of 5000 MW green energy consisting, of which 800 MW is wind, 2700 MW hydroelectrical, 1040 MW PV, and micro-plants (apx. 400 MW). The rest of the total energy production of 12670 MW is thermal and nuclear energy production.

In the North-Eastern part of Bulgaria, the regional grid operator is Energo-Pro.

Even though regulation has made a major jump towards liberalisation, the experienced reality for Albena is that they consider their DSO quite conservative and less customer-oriented. This is also the main reason why Albena is seeking a larger and active role in this market, and is seeking to lower the base load and fines, as well as reducing the dependency of external BRP and DSO.

10.2.2 Is the platform/ecosystem-based business model applicable in the pilot?

In the Bulgarian pilot, we need to analyse if they have had a local ecosystem role before the Invade-project. One could argue that there were no flexibility services in Albena before the Invade project started. This is correct if we limit ourselves to flexibility services. But taking a broader view, we see that Albena has an extensive role with respect to providing environmental friendly and renewable tourism. Two concrete examples are the use of PV-panels and up-cycling of food waste.

However, before the Invade project there were no services based on Internet or ecosystem of partners connected to their very physical and local ecosystem of renewable and environmental friendly tourism services. One important aspect to be aware of is that Albena extends the term “environmental friendly” and “sustainable” to also include societal challenges. They have a program for including local people that struggles in the labour market, a true example of responsible business development.

So, let us use our litmus test to see whether the Bulgarian pilot could be classified as a platform and ecosystem-based business model.

We will need to divide this analysis in two

1. Value creation: Can value be created by using an ecosystem of partners?

   The answer to this is yes. Albena has during the Invade-project included their large water boilers into energy-IoT units that has now become smart using new technology from Schneider. Even very old water boilers have been equipped with these IoT-adapters. Also, they are receiving optimized time-series from the advanced machine learning algorithms developed in the Invade-platform and are thus exploiting features from other ecosystem partners. The services could easily be extended with services from other Invade ecosystem partners if they choose to do so. Two examples are GreenFlux and Smartly.

2. Value distribution: Can you use Internet to distribute value?

   All the Schneider IoT adaptors are using Internet to send data and to receive the optimized time series. To receive price information and to offer flexibility for sale

also requires Internet distribution. So, the answer is yes with respect to the flexibility services.

3. Value capture: Can value be captured using Internet based devices (IoT) and/or interfaces (SW-applications)?

   This has already been answered in 2). The answer is yes.

What makes the Albena pilot so special is the fact that they combine a very physical and local ecosystem to a platform-based business model and solution (the Invade-project), that can unlock a completely new business potential within the tourism industry. More about this in the following chapter.

10.2.3 The services and customer value propositions analyzed

In this chapter, we could choose to limit ourselves to analyze the flexibility services only. However, we believe the "connection" between the flexibility-services and the local physical ecosystem and concept is too exciting to ignore. This will be covered in chapter 7.2.3.2.

Table 2 The flexibility service overview for the Bulgarian pilot (from D 4.2)

Flexibility customer	Flexibility services INVADE	Y/N
DSO	Congestion management	N
	Voltage / Reactive power control	N
	Controlled islanding	N
BRP	Day–ahead portfolio optimization	TBD
	Intraday portfolio optimization	TBD
	Self-balancing portfolio optimization	TBD
Prosumer	ToU optimization	Y
	kWmax control	Y
	Self-balancing	Y
	Controlled islanding	TBD

10.2.3.1 <u>The flexibility value proposition in a hotel context</u>

Albena is running more than 40 hotels in Albena located at the Black sea coastline, and because of this scale they also manage their own medium voltage grid. The hotels vary in size, age and standard, but they all share the same typical usage profile. They have high utilization during the spring, summer and autumn period, and low utilization in the

winter season. During a normal day in the active season, the hotels and hotel rooms share the same energy profile due to the guest's daily activities.

The hotel guests expect food on the table, enough hot water in the shower and air-conditioned rooms and facilities, as well as good service. So, in a pure flexibility context, this is our proposed customer value proposition:

Maximize the economic benefits from IoT-enabled energy devices, without compromising the service and comfort level of the hotel guests, as well as improving the environmental and renewable profile of the hotel company.

In this definition, the customer is the hotel owner, and maximizing the economic benefits can be both top line growth (new revenue streams) as well as reducing the bottom line (reducing costs). In the Invade-project, an installation of a battery is done at one of the 40 hotels, The Flamingo Grand, and combining this with already existing PV systems. In two other hotels water boilers have been re-constructed to be able to be controlled and function as thermal storage and thus flexibility resources. These installations can be replicated in the other hotels, and Albena has plans for such an extension.

Also, Albena does not want to take the role of a local flexibility operator (FO), but seeks to be part of a local ecosystem as a large prosumer.

10.2.3.2 The "green inclusive" concept

The green inclusive concept is a holistic approach that tries to combine the excessive work done on renewable energy and environment friendly tourism in Albena, with the new flexibility services and the platform-based business model, to make the whole vacation a green experience.

It also stands in clear contrast to the typical "all inclusive" concepts where environmental impact is usually not the main priority. That said, you could combine the two to achieve a more responsible tourism concept, where the "green" stands for the responsibility part, and where the "all" stands for the simplicity part for the hotel guest. But for the rest of the discussion we will treat the two concepts separately.

The concept stands well with Albena's focus on the use of short travelled local food, up-cycling of waste and resources, and protection of the nature. Extending this to include smart and energy efficient services and EVs made available at the airport charged with solar power from the hotels describes some of the possibilities.

To realize such a concept, adding unique services from other local ecosystem partners could be an interesting path to follow. Having a two-sided business model will also enable

Albena to reduce cost from the DSO, or even increase the top line growth from both DSO and end-customers.

Having combined a true environmental and renewable concept with a platform-based business model and technology platform, can result in a unique and hard-to-copy concept capable of replication. And as always, having implemented this concept in many of the Albena hotels gives the advantage of being your own documented "living proof" of the total concept. Because no one knows the hotel industry better than a hotel chain like Albena. And more importantly; no one can sell this concept better than a hotel chain themselves.

This time the customer is the hotel guest (and secondary other hotel chains), and the proposed customer value proposition can be:

We will provide you with the most complete environment and renewable friendly vacation experience (using new technologies like AI, IoT, PV, EV, and cloud computing). We call it "green inclusive".

For hotel guests "how" is not necessarily important, hence the parenthesis. But having said that, some of the hotel guests might find a "sustainable safari" both interesting and an attractive activity during their stay.

So, in the same way "all-inclusive" removes the worries from the hotel guest regarding extra expenses from food and beverages, "green-inclusive" removes the environmental and climate worries from the hotel guest. We believe that these worries will grow, both in scope and also in new markets.

This concept is not representing an industrial shift but could be categorized more as an industrial merger between tourism, IT, green and energy industries. An exciting and potent combination indeed.

10.2.4 Analyzing the business model emphasizing the flexibility operator role (including Lean Canvas)

This chapter seeks to analyse the "flexibility business model" using the Lean Canvas methodology. The original Lean Canvas model does not cover value creation using an ecosystem of partners, so we have added this perspective in the blue box called "Ecosystem partners" who are essential in creating the value proposition.

Lean Canvas

Flexibility services (only)
Local ecosystem – Bulgarian pilot

30. October 2018
Iteration 1

Ecosystem partners

Schneider
Esmart
SMA (battery)

Problem

1. DSO give high penalties for exceeding power/energy limits.

2. Imported energy is not renewable, and increases the Albena CO2 footprint..

3. PV produced energy is not used optimally..

4. High daily peak-hours must be reduced..

5. How can a green hotel become a competitive advantage

Solution

1. SW and algorithms handles work and complexity
2. API-integration is already done and proved. Saves money and time.
3. Ecosystem partners in place.

Key Metrics

Total revenue growth
Reduction of penalties
Customer satisfaction
Greener hotel brand
ARPU
Environmental "savings" per guest

Unique Value Proposition

1. "We both reduce your energy cost, CO2-footprint and power penalties"
2. We enable you to harvest revenues from your installed flexibility resources.
3. We also make your brand greener, by increasing your renewable share.
4. We improve the utilization of your PV-installation (daily, season-wise)

All combined !!

Unfair Advantage

Strong hotel competence
Building your own proof case.
Strong environmental competence & practice
Strong IoT/Scada partner
Access to huge customer base,
Strong ecosystem partner on AI (global service provider)
Potential ecosystempart.

Channels

Internet service distribution

Customer Segments

Target customers

1. Hotels (prosumer with thermal storage, battery storage, PV, EV)
2. Hotel (consumer with thermal storage)
3. Hotel guests, especially those with a green mindset)

Cost Structure

Investment in equipment (IoT adaptors, PV, EV, batteries, flexible water boilers)
Installation and operation

Revenue Streams

Reducing peak-penalties
Reducing total energy bill (long term investment)
Increasing renewables/reducing the CO2 footprint
Revenue from flexibility sale

Note: The customer here is another hotel (chain) and not the hotel guest. Albena replicates their solution is the «living proof» themselves. The combination of high hotel competence, very advanced technologies (like AI) and ecosystem partners and access makes this very hard to copy.

Figure 21 The Lean canvas exercise for the Bulgarian pilot focusing on the flexibility service

The Lean Canvas in Figure 21 mainly focuses on the flexibility services in the Bulgarian pilot.

10.2.5 The new business model in the Bulgarian pilot (BEFORE and NOW)

Albena has been developing their local and environmentally friendly hotel concept. So, the INVADE project can stand on these shoulders when introducing new and advanced flexibility services, and thus make a combination of these two domains.

The move from a local physical service provider towards a local ecosystem[3] is made possible because of the INVADE project, where the global service provider (eSmart) and industrial ecosystem partner Schneider provides the flexibility part of the services. This change is illustrated in Figures 22 and 23.

[3] https://www.bcg.com/de-de/publications/2017/business-model-innovation-technology-digital-getting-physical-rise-hybrid-ecosystems.aspx

We have used light blue colour to illustrate the flexibility part from the original environmentally and renewable services.

The generic Invade platform/ecosystem applied to Albena (Before)

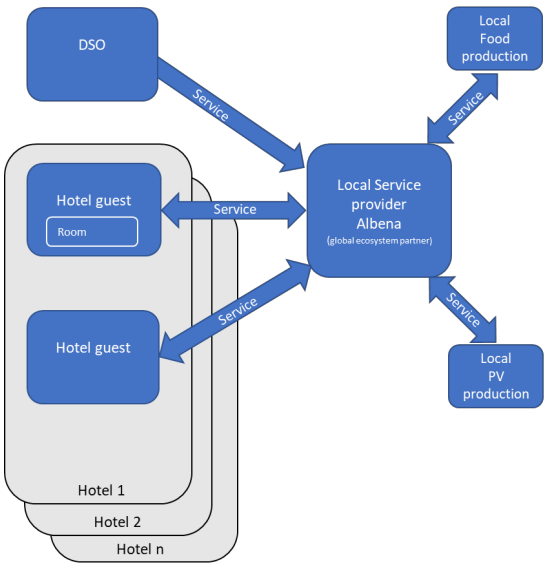

Figure 22 The original Albena local ecosystem mainly focusing on physical environmental friendly services

The generic Invade platform/ecosystem applied to Albena (NOW)

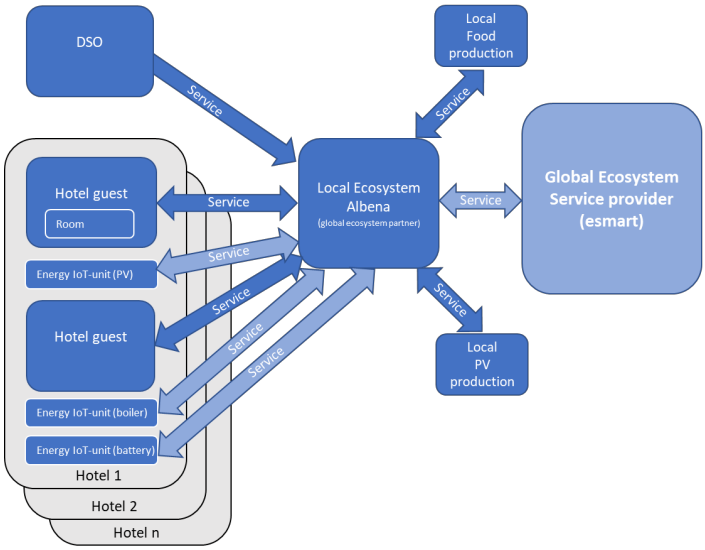

Figure 23 The Albena local ecosystem in the INVADE project Q4-2018

10.2.6 Recommended business model Bulgarian pilot (NEXT) (both flexibility specific and overall business model recommended)

If the customer flexibility services installed at Flamingo Grand Hotel (one of the newest hotels) in addition to one of the oldest hotels are producing considerable savings, this solution should be replicated at more hotels in Albena. This will strengthen Albena's business case as well as brand, and they will become their own living proof.

From here, Albena can choose to follow up to three different paths in the next phase of business and business model development. They will be described in this chapter, and are as follows:

1. Expand from the customer flexibility services to also include flexibility trading. This is the pure flexibility approach.
2. Expand the service portfolio exploiting services developed by other local ecosystems. This could be done using a service exchange function at the global ecosystem, or direct exchange of services between local ecosystems.
3. Establish a completely new "green" hotel concept that exploits the powerful and hard-to-copy combination of the Invade-platform and the environmentally friendly and renewable concept that Albena already has developed. This is a very bold move that would provide Albena with an additional revenue stream from exporting a new hotel service concept we have called "green inclusive".

From the flexibility service table in chapter 7.2.3, we see that Albena has not chosen to move into the flexibility trading services, and the services are still marked as "TBD" (To be Decided). Albena does not have any plans for acting as a flexibility operator themselves in the Bulgarian market, so if the role is not occupied in this market, this makes the move difficult. But this might happen in the project period.

Expanding the service portfolio with more software-dependent services is the second choice Albena can take. But if this should be facilitated by the global ecosystem manager, it would require that an INVADE partner takes this role. In Figure GreenFlux has been used as an illustration, but they have not taken a global ecosystem role yet. So, a bi-lateral agreement between Albena and another local ecosystem seems more likely. One example could be the provisioning of GreenFlux' smart charging, management and billing services when EVs are used as transport and flexibility resources.

Figure illustrates how the business model structure could look like if GreenFlux took a global ecosystem role using our generic platform-based business model framework.

In this example GreenFlux has now taken a role as global ecosystem where they provide their own services, and also act as a local ecosystem service exchange. ESmart has now become a global service provider.

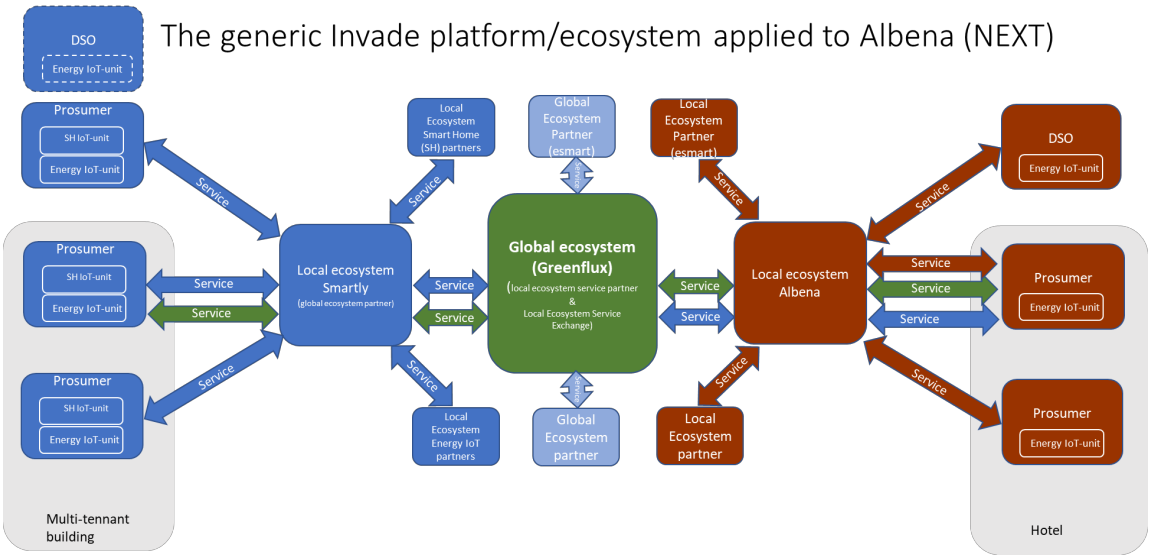

Figure 24 Using the generic INVADE business model framework to describe the bundling of own and imported local ecosystem services which could make the "green inclusive" concept even stronger.

This scenario would require that Smartly and Albena starts a collaboration and that they establish a contract facilitated by the global ecosystem partner which in this case is GreenFlux. It would also require that GreenFlux takes the role as global ecosystem and enables local ecosystem service broker role. The figure also shows the possibility for Smartly to export services to other another local ecosystem, in this case Albena.

Last but not least, the "green inclusive" concept itself can have the potential to be replicated in other countries or hotel chains. Such a next step would alter both roles and the business model significantly and is illustrated in Figure 25.

In the figure we have exemplified the replication of the "green inclusive" towards two other hotel chains namely IBIS and Thon hotels.

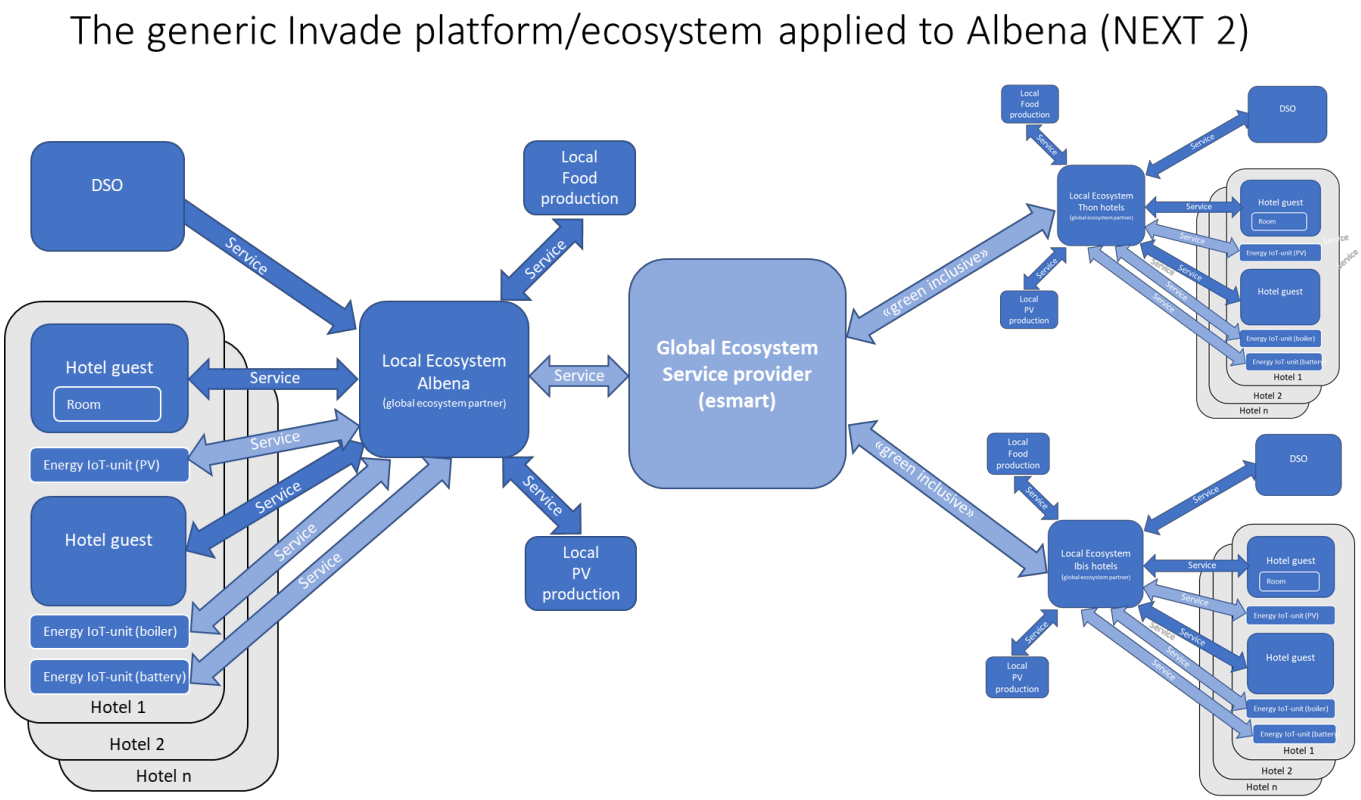

Figure 25 Replication of the green inclusive concept expressed in the Invade business model framework

10.3 The Dutch pilot

10.3.1 Introduction

According to the DOA, GreenFlux provides everything necessary for the driver of an electric vehicle to have a flawless electric charging experience. They provide charge points, charge cards, apps, billing and settlement solutions. They are heavily invested in the creation of open communication standards between the different actors in the EV-domain and they have researched and piloted a variety of smart charging solutions. They promote smart charging already by means of their own hardware and software and that allows them to offer flexible pricing. This in turn suggests grid capacity support and efficient revenue flow and control. It also suggests support for and exploitation of local distributed energy resources (DER). They further claim access to 52.000 stations in 10 countries in Europe via CIR and OCPI. This implies management of 220.000 payment transactions per month.

10.3.2 Regulatory issues Dutch market

According to Wikipedia, before 1998, utilities that owned an electricity network could also sell the electricity at the same time. This gave companies that owned the network unfair advantages over companies that were only active in the retail of electricity. Therefore, in 1998, the electricity sector in the Netherlands was restructured with the introduction of the Electricity Act [a1]. This Act demanded the decoupling between utilities and electricity supply. Generation and retail of electricity in the Netherlands were thus liberalized. This caters for the ideas proposed here. It should be noted, however, that the transmission and distribution were and are still centralized and operated by the system operator, TenneT, and the utilities. The system operator and utilities have a monopoly position in the energy market. Therefore, to guarantee the rights of consumers and businesses in the electricity sector, these parties have to be regulated. To accomplish this, in 2013 the Authority for Consumers and Markets was founded [2a]. TenneT, is the only stakeholder responsible for managing the high-voltage grid (between a voltage of 110 kV to 380 kV) in the Netherlands. There are seven utility companies that own the regional energy grids: Cogas Infra en Beheer B.V., Enduris B.V., Enexis B.V.,Liander N.V., Stedin B.V. and Westland Infra Netbeheer B.V.

In the context of INVADE it is important to note that the Dutch pilot is a cooperative effort between the partners ElaadNL and GreenFlux. ElaadNL's role with respect to policies and regulatory issues is important. It is an organization founded by Dutch DSOs to meet the challenges represented by the emerging Dutch fleet of EVs and their needs for charging. ElaadNIL will develop a view on future contracts and tariffs to be applied by DSOs and co-develop and test these contracts and tariffs and in cooperation with the DSOs strive for approval by the Dutch regulator. This should open up a market. That is an ambition. Current regulations inhibit or slows down the process. When the DSOs make the first move with these new instruments, end-users are likely to respond and seek support from players like GreenFlux.

10.3.3 The services and customer value propositions analysed

The pilot in The Netherlands will be focused on the impact of electric vehicle charging on the electricity network and the possibility to use as much as possible renewable energy, meanwhile keeping the energy grid in balance. EVs are seen as both a load issue and a flexibility measure together with stationary batteries to manage aggregated loads caused

by charging. The pilot is targeting the DSOs and prosumers of different types (

Flexibility customer	Flexibility services INVADE	Large scale office	Large scale public	Small scale home	Small scale public & office
DSO	Congestion management	Y	Y	Y	Y
	Voltage / Reactive power control	N	N	Y	N
	Controlled islanding	N	N	N	N
BRP	Day–ahead portfolio optimization	TBD	TBD	TBD	TBD
	Intraday portfolio optimization	TBD	TBD	TBD	TBD
	Self-balancing portfolio optimization	TBD	TBD	TBD	TBD
Prosumer	ToU optimization	Y	Y	Y	Y
	kWmax control	Y	Y	Y	Y
	Self-balancing	N	N	Y	N
	Controlled islanding	N	N	N	N

). In addition, there is a pending potential associated with the flexibility needs of BRPs that are most likely to be explored during the exploitation phase given a successful

verification of the basic concept tested.

Flexibility customer	Flexibility services INVADE	Large scale office	Large scale public	Small scale home	Small scale public & office
DSO	Congestion management	Y	Y	Y	Y
	Voltage / Reactive power control	N	N	Y	N
	Controlled islanding	N	N	N	N
BRP	Day–ahead portfolio optimization	TBD	TBD	TBD	TBD
	Intraday portfolio optimization	TBD	TBD	TBD	TBD
	Self-balancing portfolio optimization	TBD	TBD	TBD	TBD
Prosumer	ToU optimization	Y	Y	Y	Y
	kWmax control	Y	Y	Y	Y
	Self-balancing	N	N	Y	N
	Controlled islanding	N	N	N	N

Table 3 The GreenFlux/ElaadNL pilot services

The pilot is split in several categories or sub-pilots. Each pilot targets specific groups of charging point and parking owners (Figure 26). This is interesting in light of the ecosystem concept addressed in this discourse. The segments can be listed as follows

- 22 private homes with in total 25 charge points. 3 homes will have 2 charge points. Installed in different locations in The Netherlands connected to different grids
- Large scale offices and parking lots sub-pilot, for semi private/public situations and unknown users. The pilot will encompass 25 offices with approximately 300 charging points distributed across The Netherlands.
- Small scale public office sub-pilot with known users, with solutions that can finally also be used in other public situations, e.g. energy storage and Vehicle 2 Grid.
- ElaadNL offices in Arnhem (The Netherlands) with known users (employees) and visitors

- Large scale public sub-pilot with about thousand charge points and many unknown users. This pilot is focussed on smart charging on very large scale in the public domain. Location of chargers in public domain spread across The Netherlands. Stations are already installed and in use. Users are customers from many different Mobility Service Providers.

This diversified approach is driven forward to meet some inherent technical demands related

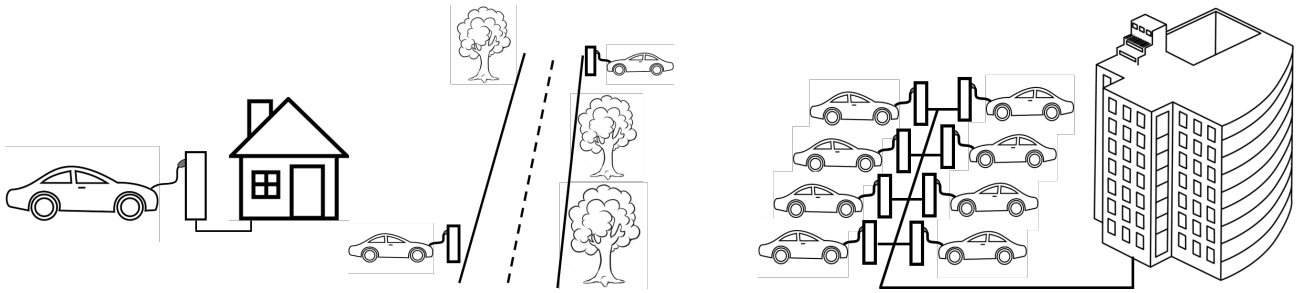

Figure 26 Principal stakeholders targeted by GreenFlux and ElaadNL: EV owners and his/her residence, public street parking typical owned by municipalities, office parking spots with chargers.

to charging. But mostly this reflects a market segmentation where differences in needs and requirements will be explored. The value proposition needs to be adjusted in accordance with these differences. An important aspect here is how complementary or conflicting the needs related to the different customer segments are. A charging profile that can be satisfied with overnight charging can be seen as complement to superfast charging in a public spot required by a passing, long-distance traveler. In turn, this spurs ideas related to charging and flexibility management. How can these flexibility resources be organized so as to make the GreenFlux and similar operations more profitable while customer and supplier concerns are persistently taken care of? Naturally, GreenFlux sees all of this in the context of its current operation (see Figure). The company's business objective today is to offer management and billing services to owners of local charging spots. GreenFlux has stated at an early stage that they hope to achieve a direct coupling between a customer's local energy production and the charge process of his/her electric vehicle(s) by means of the INVADE platform. They believe that 'using your own energy' for charging your electric vehicle is a very strong driver for investing in both local production and local charging infrastructure. By making this connection possible and attractive, they want to stimulate two important developments at the same time. This they believe could yield many business opportunities. By researching several smart charging

regimes in different customer domains, INVADE will provide the essential insights upon which to build further services.

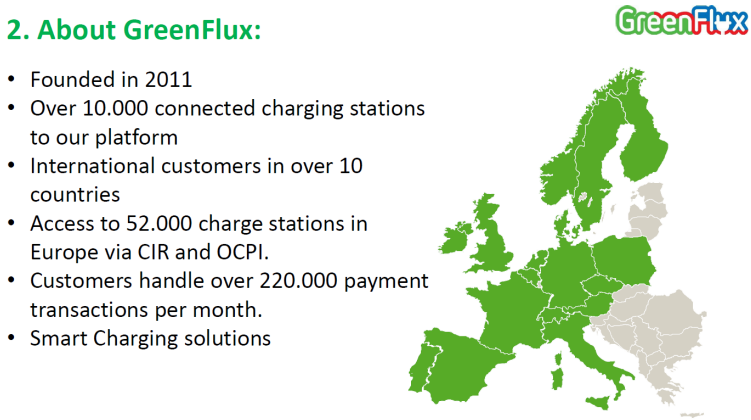

Figure 27 Key characteristics of the current GreenFlux operation.

It became clear from the start of the project that GreenFlux is well positioned for the type of business model that has been proposed. Through the project it has also become more pronounced that GreenFlux aspires to manage “crowdsourcing of flexibility”. GreenFlux has the technical capability and knowledge to take the position of a continental and possibly global Flexibility Operator (FO). They are already present in 10-15 countries and the INVADE concept can easily be rolled-out as an added element to their current operation. This calls for a mash-up like the one illustrated with the example of EasyPark explained before.

But they are also in a position to expand horizontally, increasing their local presence in different geographical areas while still managing its business by means of their management platform like they do today from Eindhoven. Presently their basic proposition is to provide a consolidated service for CPOs (Figure 28). This consists of remote service management for charging spots, metering, billing and payment. GreenFlux has stated at an early stage that they hope to achieve a direct coupling between a customer’s local energy production and the charge process of his/her electric vehicle(s) by means of the INVADE platform. They believe that ‘using your own energy’ for charging your electric vehicle is a very strong driver for investing in both local production and local charging infrastructure. Their interaction with other stakeholders is minimal and limited to exchange of information, typically related to capacity concerns and grid conditions. In order to execute their present service a customer and CPO registry, a ledger and a metering base are required. Two other assets must be highlighted too. One is the direct communication with the end-user (EV driver/owner).

The other is how they prepare chargers for their service through the manufacturers of the different chargers. As a result, he CPOs only have to activate this function to become part of the GreenFlux cloud-based service and leave the day-to-day operation to GreenFlux.

GreenFlux is all set to extend its operation in into the flexibility business (see Figure 29). This is happening along two axes. One is through ElaadNL and that target is DSOs.

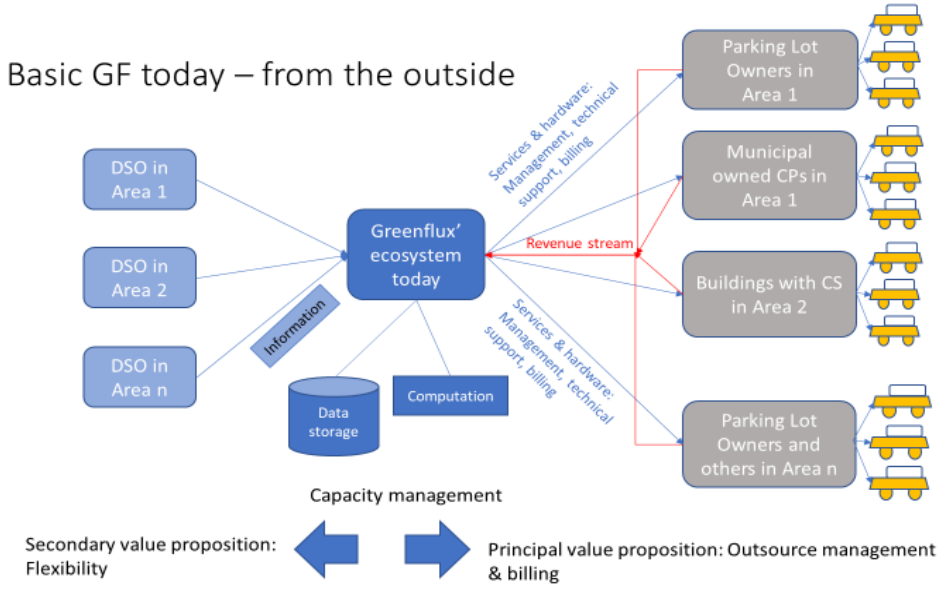

Figure 28 Simplified presentation of GreenFlux current business model

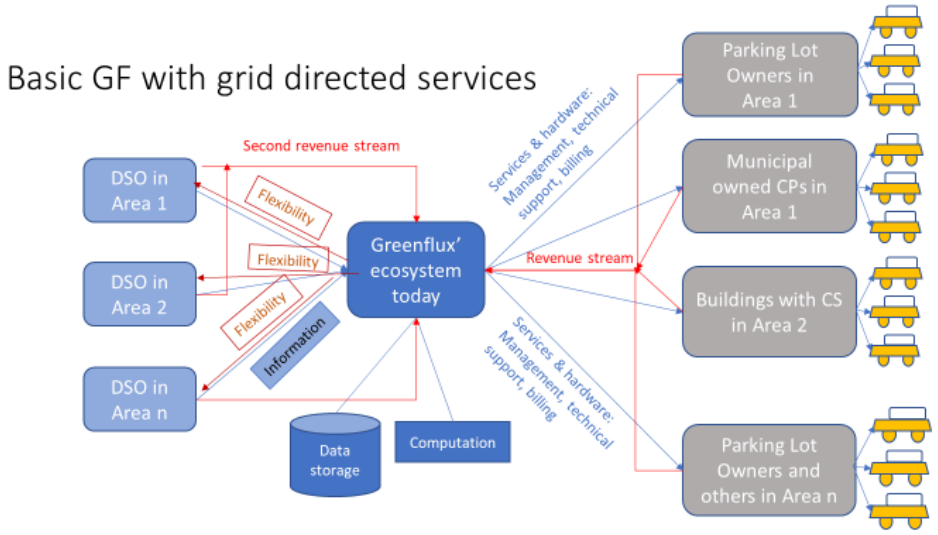

Figure 29 Simplified presentation of a business model that GreenFlux is likely to adopt after INVADE. As can be observed the added value services based on flexibility use the current structures.

The other is directed towards end-users, both EV owners and CPOs. In this way the company can reinforce their primary service towards the CPOs and EV owners using their existing technical infrastructure and customer relationship. The primary offer would be to keep electricity costs down by leveling out power peaks and take advantage of smart charging within a ToU tariff regime. Having consolidated this and with the help of ElaadNL in its unique position with the Dutch DSOs it can offer aggregated flexibility as illustrated in Figure 29. Note here that CPOs and end-users can be both customers of other's flexibility and customers of a service that help them manage their own energy and power loads. In addition, the same stakeholders can sell their flexibility to other CPOs as well as DSOs. Thus, an ecosystem is established.

As can be observed, on an overall level, the technical and commercial structures do not change much. The basic channels of operations need only to be strengthened. Simply put, this implies that GreenFlux harnesses its existing ICT platform with additional options and interface elements that enables it to support the added services. As Figure 29 suggests GreenFlux is positioned in the middle as a spider in a cobweb. Here operations need to be reinforced with mechanisms for managing a new type of contracts and mechanisms or aggregating the flexibility. In addition, instruments for anticipating traffic, charging patterns, grid conditions etc. need to be added. But once this is in place GreenFlux has reinforced customer, supplier and technical control. An expanding revenue stream is, however, essential to sustain such a control. Revenue boost is associated with level of activity and number of connected customers and suppliers of flexibility. Here resides a potential reinforcement effect typical for the type of business model that we are addressing in this discourse. The more need for power control and associated services the more demand for flexibility resources and the better payoffs for these. This can recruit more resources i.e. CPOs and EVs, which in turn can be consolidated to manage grid loads and voltage issues in more extensive areas and for more DSOs and CPOs. This drives revenues up. And as long as it does the ecosystem and the cash flow through the system will just increase. It is what is called auto-reinforcement in these kinds of systems.

However, a failure or problems with the service offered can backfire in a similar way. Again, this characterizes the type of business model that we have introduced. The structure and the proposed business model applied to GreenFlux can also expand horizontally to include other ecosystems of the same kind in different geographical areas offering similar services. With the company's presence in several countries already a rapid roll-out with the existing GreenFlux domain and beyond is a true possibility. But the

business model applied to the case of GreenFlux can also be extended to cater for other types of flexibility. The natural thing would be to offer ecosystem membership to companies that have a local presence and that are providers of batteries, working demand-response operations. This could accelerate the expansion of the GreenFlux ecosystem based on the principles explained here and help it reach critical mass in the regions where it wishes to be present. Increased consolidation of such resources would then enable them to position their resources effectively with larger utilities, BRPs and even the TSO. This is schematically illustrated in Figure .

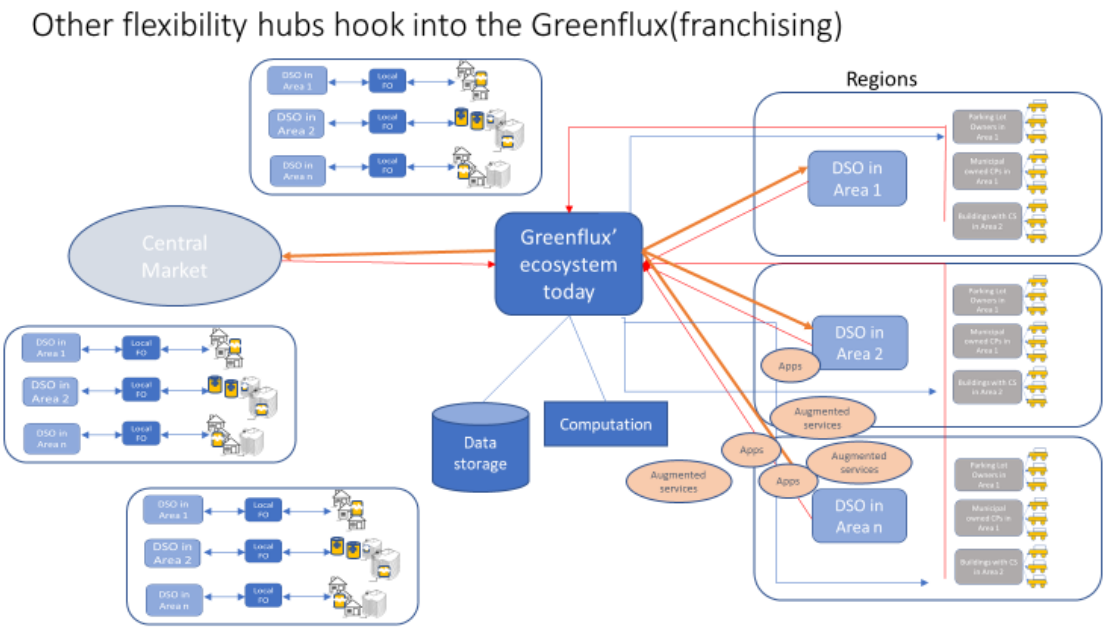

Figure 30 A possible business model expansion for GreenFlux in the future highlights how other, complementary ecosystems can be insourced and managed under the same management concept as today.

10.3.4 Recommended business model Dutch pilot (NEXT)

A canvas model has been created based on available information on GreenFlux present operation (see Figure 31). It can be compared to the possible extension as shown in Figure 32. This canvas-oriented specification resides on the description given in association to Figure .

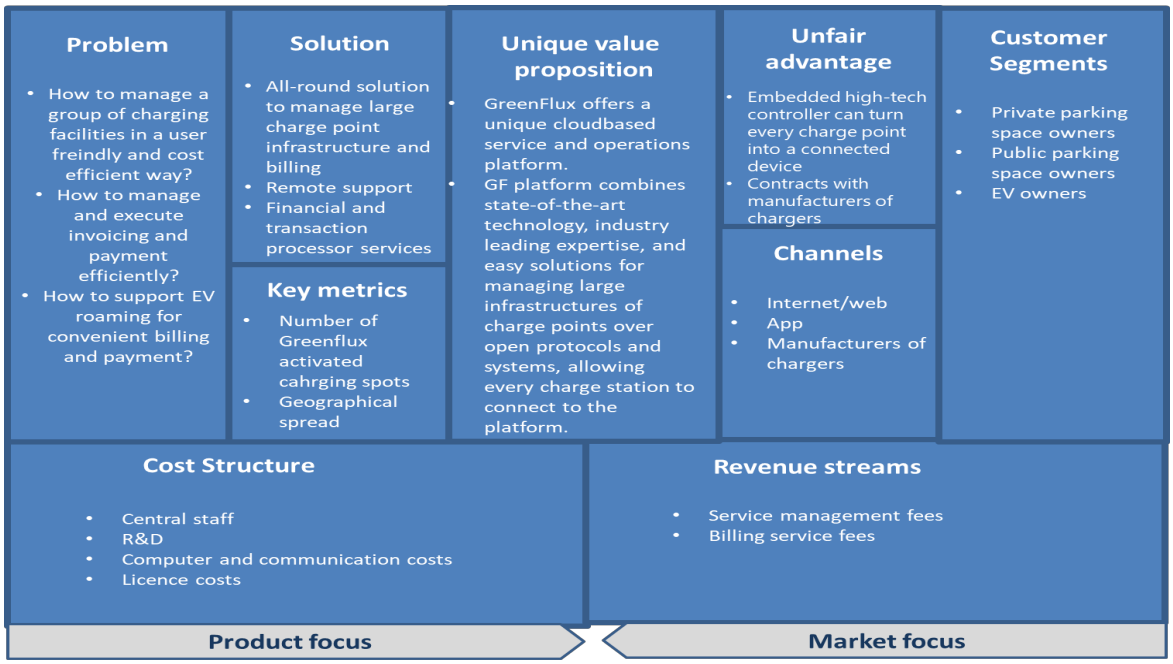

Figure 31 A canvas model of the present GreenFlux operation

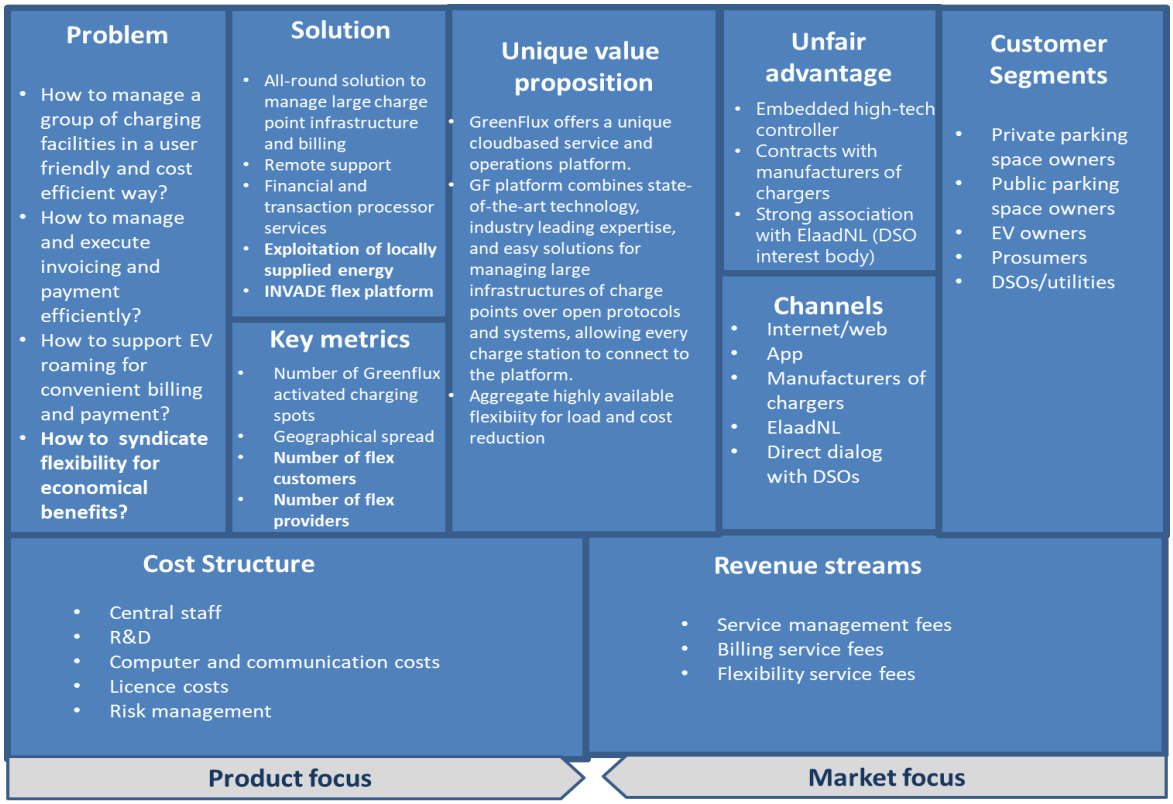

Figure 32 A canvas model of the GreenFlux model entering the flexibility business with INVADE

Even with potential accuracies it can easily be observed that it is an incremental extension taking care of GreenFlux' existing ICT platform and business model.

We have argued that the proposed business model that has been developed in WP9 should fit well with the ambitions in several pilots. This is very much true for GreenFlux as well. How far GreenFlux is willing to go is a question of strategy, capital and risk. The project has maintained a dialog around the hypothetical propositions made. They have not been rejected by the company itself. To what extent they are willing to pursue the ends described here will become clearer as the project and the pilot becomes more mature and results from the experiments carried out in the pilot can be analysed. That is partly a job that will be allocated to the exploitation part of the project and the strategic work of the company management.

The interactions maintained, and the analytic work carried out so far suggests that the application of the business model described here fits well with GreenFlux. The end result at the conclusion of the project is likely to be close to what has been described in Figure 31. From there, however, many different avenues can be pursued. Nevertheless, work in WP9 and WP3 should align closely with the business management of both GreenFlux and ElaadNL to test out stakeholders' willingness to take part in a regime that caters for something depicted in Figure 32.

10.4 The Spanish pilot

10.4.1 Regulatory issues Spanish market

The previous Spanish law (RD, 2015) concerning PV generation, often known as the 'Sun tax' has been recently abolished - in October 2018[4]. The previous restrictive policy had made investments in PV and storage uneconomical for residential and commercial building owners [15]. This almost thwarted building owners to install rooftop PV and storage. Amendments are under way regarding PV and storage in Spain and the amendments are likely to make investments in PV economical.

Spain's regulations are currently not favourable to aggregators and storage. Aggregated demand response and storage are not allowed to participate in balancing markets and to provide ancillary services. Only generation assets are allowed to be aggregated. Thus, aggregator business models aren't feasible under these strict regulations and possess

[4] Source: https://www.reuters.com/article/us-spain-politics-electricity/spain-scraps-sun-tax-in-measures-to-cool-electricity-prices-idUSKCN1MF1T0

challenge for global FO to operate and create value at regional and national level. At present the regulations also do not allow grid operators to own any kind of storage.

Royal Decree 1634/2006 [16] set a target to substitute traditional meters with smart meters by 2018 for all the consumers having connected load of less than 15kW. Massive roll-out happened between 2012-2016 covering 80% of the target consumers. So far 96% penetration of smart meters have been achieved and it is likely that the goal of 100% will be achieved by end of 2018.

10.4.2 Introduction - The current business model in the Spanish pilot (BEFORE)

The Spanish pilot is located in Granollers where EPESA is the DSO. Currently Spanish pilot site operates in traditional fashion where power consumers play a passive role and grid operators provide access to reliable power in a typical pipeline-based business model. In this model the flow of value and money are linear. The ambition with the pilot owner (i.e., EPESA) is to explore new business opportunity in form of flexibility operator. By assessing feasibility of FO, EPESA wants to support integration of renewable electricity (especially rooftops PV which are popular in Spain) in the system in an innovative, reliable and cost-effective way. Based upon this ambition the pilot will test flexibility services to local DSO and BRP through a centralized battery connected to one of EPESA substations. Complete details of the pilot site are provided in Deliverable D10.1, D10.2 and D4.2.

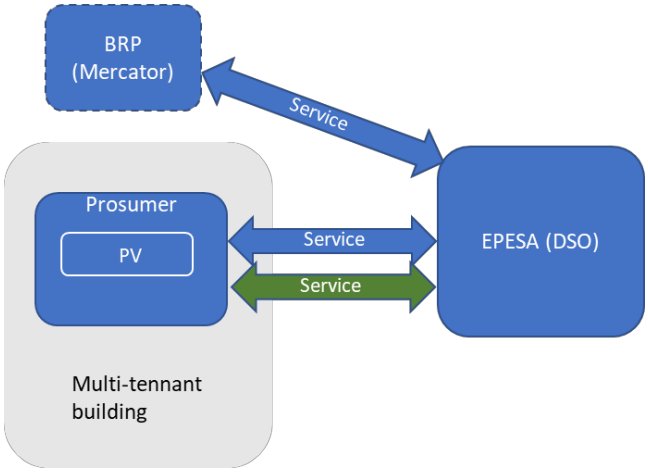

Figure 33 Existing business model of EPESA.

10.4.3 The services and customer value propositions analysed

The Spanish pilot consists of building from where the DSO operates and thus is critical infrastructure which needs to have complete security of supply. A medium sized battery

storage of 200 kWh is connected to the same substation as that of the DSO building. Half of the battery capacity will be reserved to provide backup for the DSO building. The other half of the battery will provide services to DSO and BRP. The pilot will also have PV installed at the premises of the DSO building. EPESA has a subsidiary 'Mercator' which is a BRP. In the future when regulation permits, EPESA expects to establish new business as FO and provide services to other DSOs and BRPs of the region.

The Spanish pilot will focus on providing flexibility services to DSO and BRP. The primary flexibility resource will be a medium sized centralized battery connected to secondary substation. The Spanish pilot implements use case 2 as described in Deliverable D10.1. The centralized battery will be complimented by EV control and generation curtailment as other flexibility resources. The flexibility services and sources in the Spanish pilots are summarized in table 4. The ambition is that the centralized battery would support higher integration of renewables at distribution level by supporting DSO and BRP through flexibility services. Actors involved in the Spanish pilot are DSO, BRP, FO, & building owner (prosumer).

Based upon the needs of the customers of the Spanish FO the following value proposition are drafted in the Spanish pilot:

1. <u>Value proposition for DSO:</u>
    a. Reduction in penalties for not meeting customer's energy demand due to congestions.
    b. Reduction in renewable power loss due to curtailment.
    c. Lower costs for maintaining required voltage level in the grid/reactive power support in case of high PV generation.
    d. Delay grid reinforcement.
    e. Reduction in usage of diesel generator during controlled islanding.
2. <u>Value proposition for BRP:</u>
    a. Increased revenue generation by optimizing day-ahead, intraday and self-balancing portfolio using battery.

To deliver these values five services will be provided, three to DSO and two to BRP. The flexibility services together with the sources of flexibility are listed in Table 4.

Table 4 Flexibility services to be implemented in Spanish pilot together with flexibility sources. Source: INVADE Deliverable D4.2.

Flexibility customer	Flexibility services INVADE	Centralized storage control	EV control	Generation curtailment
DSO	Congestion management	Y	Y	Y
	Voltage / Reactive power control	Y	Y	Y
	Controlled islanding	Y	Y	Y
BRP	Day–ahead portfolio optimization	TBD	N	TBD
	Intraday portfolio optimization	Y	N	Y
	Self-balancing portfolio optimization	Y	N	Y

The *day-ahead portfolio optimization* aims to shift demand to the time periods with lower electricity costs, thereby reducing procurement costs for BRP. *Intraday portfolio optimization* similarly equips BRP to prepare market bids for intraday market. Due to high price volatility in the intraday market, optimizing such bids is likely to yield higher gains for BRPs and thus is a priority for them. In *self-balancing portfolio optimization* BRP doesn't bid in the market but tries to avoid any deviation from accepted portfolio from day-ahead and intraday market.

For DSOs it is important that the peaks are avoided to reduce thermal overload and to integrate more intermittent renewable energy without additional investments in the grid reinforcement. Moving the peaks through congestion management is thus an important service for DSOs. Rooftop PVs already grow in numbers and with more supportive policies these are expected to grow further. This will result in high solar power influx in day time without the same demand. Mismatch between supply and demand and no reactive power generation from DG would require reactive power/voltage control which could be provided through batteries. In case faults happen, this can result in an islanding situation of certain parts of the grid and it is in the DSO's interest to assure power supply in the islanded part of the grid. Using a centralized battery to ensure power security thus has high value for the DSO. The DSO head office is supported by a backup diesel generator. Using flexibility of the battery the DSO wants to reduce, possibly eliminate,

diesel consumption for back-up power. The DSO considers back-up available of 2 hours to be sufficient in this case (see deliverable D 10.1 Pilot specifications).

10.4.4 Is the platform/ecosystem-based business model applicable in the pilot?

1. Value creation: The value is not created using an ecosystem.
2. Value distribution: Yes the value can be distributed via internet.
3. Value capture: The value from the centralized storage is planned to be captured through internet (FO).

As the value is not created using an ecosystem the platform-based model is not applicable to Spanish pilot.

10.4.5 Analysing the business model emphasizing the flexibility operator role (NOW)

To introduce a FO in the current scenario, EPESA either needs new a new role within their organization or a new partner acting as the FO. A decision was made that the existing BRP, Mercator, within the EPESA group will add a new role of FO to its business portfolio. Mercator as local FO will have control over the centralized battery via internet.

The service contracts by Mercator FO will be designed for improving the intraday and day-ahead electricity market portfolios for the BRP and will assure minimal deviation from committed schedule of electricity trade. To DSO Mercator will provide services to manage grid during a fault, voltage control as and when required (KPI are mentioned in Deliverable D10.2).

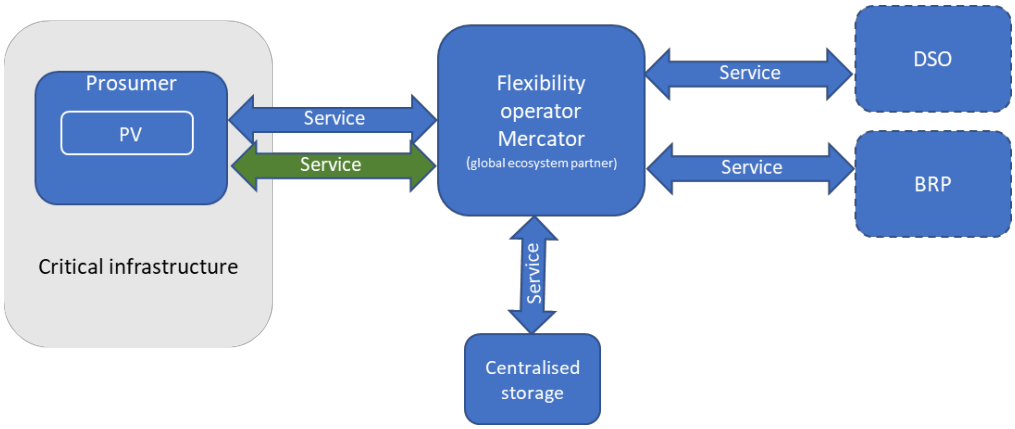

Figure 34 INVADE concept applied to Spanish pilot (NOW).

There are three key customers of Mercator FO: BRP, DSO and critical infrastructure owner (a prosumer, and in this case DSO). BRPs play in a highly competitive market and are likely to benefit in their business from the services of FOs. While DSOs are passive

players who are highly regulated by the government and by law are not allowed to own storage. At the same time, they are obliged to provide reliable and secure access to electricity. Thus, a FO can be a perfect middle player to provide services to the DSO through operating storage.

Parallelly Mercator FO can also provide services to the BRP to avoid penalties and bid optimally. The Idea in the Spanish pilot is to use half of the battery capacity to provide back-up to critical infrastructure and rest half to provide services to the DSO and BRP. Figure 35 is the lean canvas for the Spanish pilot. It includes additional possible values and customers which could benefit from the Spanish FO which are covered in the pilot (more description provided in the next section).

Lean Canvas | Spanish pilot | 12. November 2018 | Iteration 1

Ecosystem partners	Problem	Solution	Unique Value Proposition	Unfair Advantage	Customer Segments
Esmart Scneider CPO	1. DSO faces reactive power problems during high PV electricity influx. 2. Congestion in distribution network at peak hours. 3. DSO wants to delay grid investments. 4. BRP wants to reduce imbalances 5. BRP wants to improve their day-ahead, & intraday portfolio using storage	1. Centrally located storage in distribution grid provides multiple services to both DSO and BRP 2. Load management at building?? **Key Metrics** ??	1. Better renewable integration without additional investment in grid 2. Better power quality 3. Security of supply when fault occurs 4. Increased revenue generation for BRP using storage 5. We can facilitate service exchange and thus make the local DSO offer unique	Unique combination of AI, ML and DL competence and energy market competence. **Channels** Internet service distribution	1. DSO 2. BRP 3. Local Ecosystems in different market segments. 4. Critical infrastructures

Cost Structure	Revenue Streams
Customer Acquisition costs Competence cost Data platform cost (Installation and operation People, etc.	Long term low revenue streams from BRP portfolio optimization Long term low revenue streams from BRP's self balancing Long term low revenue streams from DSO for avoiding congestion, providing peak power

Figure 35 Lean canvas applied to Spanish FO.

10.4.6 Recommended business model Spanish (NEXT)

Evidently Mercator would depend upon bulk flexibility which could be sufficient for the needs of both BRP and DSO. With the platform from eSmart (partner) Mercator FO can control the centralized battery and also aggregate many such batteries to provide services to the BRP and DSO. Additionally, the Mercator FO can control many centralized or distributed batteries located in different regions under one cloud-based platform and provide services to multiple DSOs and BRPs at the same time. Thus, the operations can be conveniently scaled-up to be at national or even global level. The local Spanish FO can partner with other local platforms like that of GreenFlux or Smartly to

import services if required via a central ecosystem. Currently, penetration of distributed storage, EV and IOT is low in Spain which provides Spanish FOs an advantage by providing flexibility through centralized storage. However, in the future with growth of IOT devices in homes and EVs the local Spanish FO would have to diversify the assets it controls - otherwise it is likely be ousted from the market by other local FOs having diversified portfolio for flexibility sources. Thus, collaboration with other local platforms would be essential.

The Spanish pilot should be used by the local FO to fine tune services it will offer to the BRP and DSO. By understanding interplay between back-up battery capacity and battery capacity for DSO and BRP, there is a possibility to derive more benefits from an existing battery. It is recommended that to exploit complete benefit from the FO platform, the Mercator FO should expand its business area to provide services to multiple DSO, BRP and critical infrastructures.

Additionally, the local FO can manage multiple centralized storage. Through a global FO, the Mercator FO can derive more business from other ecosystems like that of Smartly or GreenFlux. Other local systems can enhance Spanish FO business by providing access to additional flexibility or by outsourcing their services which can then be implemented by Mercator FO. The possibilities of expanding in the market is depicted in the generic INVADE business model for FOs in 36.

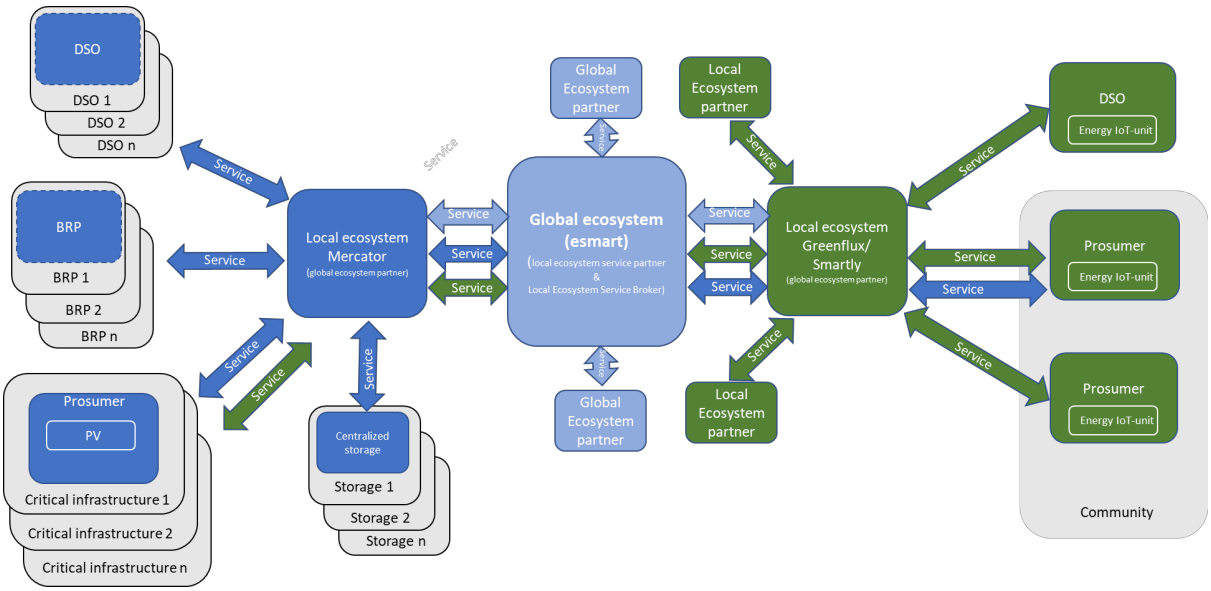

Figure 36 Generic INVADE business model describing interaction between Spanish FO and other local FOs for exchange of services.

10.5 The German pilot

10.5.1 Introduction

The German pilot is organized by Badenova. Its headquarters and the pilots are located in Freiburg in the southern part of Germany (Figure 37). Badenova was founded in 2001 as the result of a merger between six local utility companies. It is organized as an incorporated company with several subsidiaries targeting different aspects of energy and water. Shareholders are more than 90 municipalities and Thüga, the largest German network of local suppliers. Freiburg is one of the sunniest regions in Germany. The density of Distributed Energy Resources (DER) is among the highest and oldest in Germany. Residential areas and farms that have enjoyed heavily subsidized contracts for their investments in DER will expire in a few years. This calls for innovative solutions that can maintain and increase DER capacity even more while managing the negative side effects of this type of energy resources. This makes Freiburg and the Badenova pilots interesting as potential role models in Germany.

Figure 37 The electricity and gas grid realm of Badenova

However, further development and use of renewable energies is also susceptible to the lack of capacity in power lines leading to the outskirts of the city. Due to the relatively high sun radiation in the south-west compared to other regions in Germany, many PV plants are installed which are mainly connected to the low voltage network. Feed-in peaks during the day require new strategies to cope with congestion management and occurring voltage peaks.

10.5.2 Regulatory issues German market

As a front runner in Europe for the transition to renewable energy resources German legislation has applied government subsidies at large to stimulate investment in renewable resources. According to Global Legal Insights[5] this tends to continue. In July 2017 the Tenant Energy Act (*Gesetz zur Förderung von Mieterstrom und zur Änderung weiterer Vorschriften des Erneuerbare-Energien-Gesetzes-Mieterstrom Gesetz*) was introduced and approved by the EU Commission and the Federal Government in Germany. Tenant energy models are envisaged to stimulate additional investment in solar and enhance active participations in the energy transition. The most important part of the Tenant Energy Act is the tenant energy "surcharge" to units up to 100kW and received by the landlord, provided that the electricity is consumed by an end-user within the building or premises where the DER is installed. It constitutes an additional revenue component for electricity produced from renewable sources besides market premium and feed-in tariff.

But as before - the cost for this is pushed on to the consumers. As a consequence, these end users wind up with a unit cost where tariffs and taxes dominate making price elasticity in the market very low.

According to Smart Energy International [6] "*the country has fallen behind some of its Western European counterparts in the deployment of smart grid technologies, most notably smart meters. Up until now, Germany has been largely hesitant to install high volumes of smart meters, wary of the costs, technical challenges, and a host of data security concerns. After years of intense debate, the tides are now beginning to turn with the passage of the Digitisation of the Energy Turnaround Act in July 2016".* This legislation establishes guidelines for Germany's initial minimalistic smart meter rollout that started in 2017.

The German Ministry for Economics contracted EY (formerly Ernst & Young) in 2013 to perform a cost-benefit analysis of a nationwide smart meter rollout. This was based on the EU Directive 2009/72/EC. This directive states that member nations should achieve

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[5] https://www.globallegalinsights.com/practice-areas/energy-laws-and-regulations/germany#chaptercontent3

[6] https://www.smart-energy.com/magazine-article/germany-moving-ahead-smart-meter-rollout-plans/

80% smart meter penetration by 2020 provided a positive economic evaluation. The investigation that EY undertook concluded that a roll-out would result in a negative cost-benefit ratio and would be economically unreasonable for most German consumers. That conclusion put Germany next to a few other member states such as Belgium, Czech Republic, Latvia, Lithuania, Portugal, and Slovakia. As a consequence, the German authorities settled on a limited smart meter deployment strategy. This means that from 2017 large consumers with average annual consumption in excess of 10,000 kWh will be required to install smart meters. In 2020 the threshold will be lowered to 6000 kWh. According to Smart Energy International this amounts to 15% of the electricity consumers and approximately 7.5 million meters across Germany. As the average electricity consumption in Germany is considered to be around 3500 kWh most Germans will not be affected.

Battery sales has been on the rise for a long time in Germany. German suppliers can enjoy a vital and growing home market. According to Wood Mackenzie consultants the big driver financially was battery sales to utilities and commercial and industrial (C&I) customers. These were worth €1.12 billion in 2017 and are set to grow more than 22 percent to €1.37 billion this year. Germany's residential battery storage market was worth a very respectable €490 million in 2017. And it continues to outperform the large-scale battery segment in terms of volume. Wood Mackenzie estimates that Germany had around 280 megawatts of residential storage capacity spread across roughly 85,000 installations in 2017. The capacity was up more than 51 percent from a 2016 level of 185 megawatts and is expected to rise a further 37.5 percent this year, to 385 megawatts.

Energy storage systems benefit from the connection privilege for RES plants to the public grid. Electricity stored in a storage system qualifies for the feed-in premium (*Marktprämie*), which is granted to the plant operator under the Renewables Act that was passed in 2017 (EEG 2017) once the electricity is fed into the public grid. Norton Rose Fullbright[7] is a global law firm. They point out that the EEG 2017 ensures that the *EEG surcharge is not imposed twice on the electricity stored in a storage system, but only on the electricity fed from the storage into the public grid, provided that metering requirements are complied with and subject to certain limitations in the event of only partial feeding-in into the public grid*. Storage systems are thus considered consumers of electricity. That also means that the electricity stored into the storage system is

[7] http://www.nortonrosefulbright.com/about-us/

subject to the same levies and taxes which are imposed on the consumption of electricity. Norton Rose Fullbright observes that *the final recipient of the electricity, which has been fed from the storage system into the grid, is also a consumer, it has to pay the same levies and taxes again. As a result, the same electricity is subject to a double charging.* This represents a general challenge across Europe.

For those wanting to install a battery a legal permit is pending. The required type of permit depends on the nature of the storage system. A battery storage system requires a building certificate. In order to obtain such certification, the battery storage system must comply with the applicable planning and building law. Power to gas/liquid systems usually require a permit under the federal Emission Control Act (*Bundesimmissionsschutzgesetz*). For those market players wishing to participate in the reserve control market, storage systems have to successfully pass a prequalification procedure undertaken by the German TSOs.

10.5.3 The services and customer value propositions analysed (determined)

Flexibility customer	Flexibility services INVADE	Y/N
DSO	Congestion management	Y
	Voltage / Reactive power control	Y
	Controlled islanding	N
BRP	Day–ahead portfolio optimization	N
	Intraday portfolio optimization	N
	Self-balancing portfolio optimization	Y
Prosumer	ToU optimization	Y
	kWmax control	Y
	Self-balancing	Y
	Controlled islanding	N

Table 5 The service targets for the German pilot

The German pilot will target both the needs of DSOs and prosumers. For this purpose, Badenova has prepared two distinct pilots. One pilot case is associated with a farm at the outskirts of Freiburg. The farm owner is a prosumer who has experienced voltage problems that Badenova is obliged to solve. The farm is located at the end of a 840 meter radial. Today the issue is managed by a step-up/down transformer. However, Badenova wishes to investigate the possibilities that a battery can offer. For this purpose, a large redox battery has been chosen. In the strictest sense this is a mere technical test.

Neither the DSO nor the farm owner will gain an economic or commercial benefit. This is because the problem is already solved and because the consumer is already being compensated for disconnections that he experiences. However, in time, the battery may be a better solution if the owner decides to expand his PV panels. Enough space on the roofs is left for this. Besides the buffer created can be used for hedging surplus energy generated locally.

The driving idea behind this is that this demo site can cater for safe tests and create operational experience to be expanded to other areas. Currently suburban areas of Freiburg are growing rapidly. This growth applies to increased consumption but also a surge in the number of PV systems. Some of them are connected to weaker lines where batteries of the type that will be tested in the pilot can serve as an alternative to regular infrastructure reinforcement. What should be noted in this particular demo is that the DSO owns and operates the battery alone.

The second pilot is related to regular households equipped with a combined photovoltaic-battery system already optimizing their degree of self-consumption by a home management system supplied by SMA[8]. Then, on top of that, INVADE is meant to create additional value by alleviating the DSO by levelling peaks. The Sunny Home Manager provided by SMA controls all the energy-IOT units in the home, including the EV charger and acts as a lower control level. The INVADE platform is set as a superior control level using the distributed storages to decrease peak demand of the entire electrical gird. The concept is depicted in Figure 48.

[8] https://www.sma.de/en.html

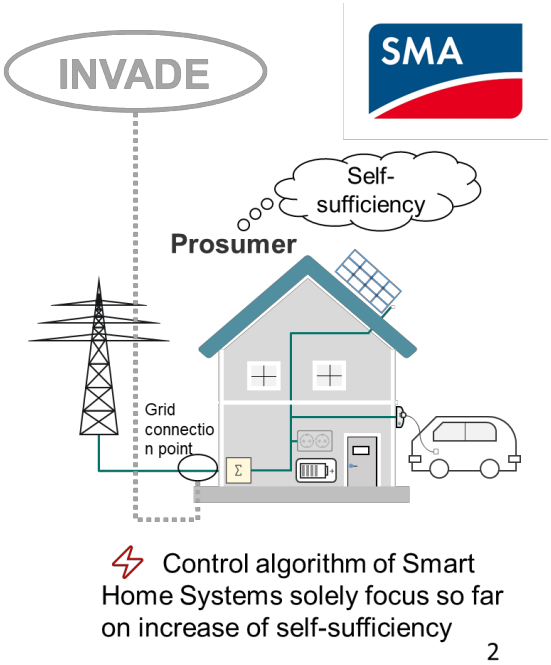

Figure 48 The SMA system optimizes self-consumption automatically for the prosumer. The INVADE systems is meant to enable flexibility yields for the benefit of Badenova.

SMA has already a platform to connect Sunny Home Manager devices. It can also connect to devices with other brands. In that sense it is open. The SMA system has until now been a stand- alone system focused at optimizing the benefits of the individual household. This implies that data generated and the signal pattern that develops in a residence is not accessible to SMA. However, this will change with the introduction of their gateway that will connect the house to a data centre under the provision of end-user approval and guarantees of privacy. The “ennex-OS” comes with a well-defined API for external data exchange. This solution will also allow to consider and visualize aggregated community data for the connected households. However, SMA maintains a strict policy regarding the spreading of its API specification. It must therefore be considered a proprietary system. A non-disclosure agreement is likely to be signed by all affected partners.

As old long-term feed in contracts for PV systems with guaranteed prices are about to expire, Badenova wants to position itself for a more innovative initiative. PV storages could become very attractive for prosumers as self-sufficiency is generally perceived as the best economic alternative. At the same time todays’ generation costs from residential PV systems are much lower than the historic ones and the cost for purchasing electricity from a utility has increased over the last years significantly due to many taxes. Consumption that is covered by a prosumers’ own generating facility carries more value than what the feed-in benefit can offer without subsidies. According to the feed-in, tariff

for residential owners has been reduced from 50 cent/kWh to the present 10 cent/kWh) while the tariffs have increased. For the commercial customers the ratio is 30 cent to 15 cent/kWh. The market has reached a sweet spot where it makes sense to encourage self-consumption rather than feed in into the grid.

Badenova is looking especially into three defined segments: The first segment can be labelled “first movers” strongly interested in new technology. Others are “green minded” customers willing to support the “Energiewende” towards a decentralized energy system based on renewable energies. The last group is interested in a financial benefit. To a large degree this pilot resembles the Lyse/Smartly case. But it is less extensive in terms of number of households and in scope. One handicap in this respect is that in general households in Germany are not equipped with smart meters but are invoiced based on a conform consumption profile. According to Badenova, SMA is a HAS market leader in Germany. But SMA sells boxes, not a subscription. Moreover, it sells their system as a kit across the counter of a major retail chain in Germany.

Finally, the model in Figure 48 with the use of SMA and its recent cloud extension is highly compliant with the ideas that have been developed in WP9. But this extension of the SMA HAS/EMS device also raised a few questions. SMA is inclined to create a link from its system to its own data cloud where feeds from different households can be consolidated and aggregated. The role of SMA raises a discussion on data flow control and the division of roles between Badenova and SMA. That places this pilot right at the heart of the work that both WP9 and WP3 are exploring from their separate vantage points.

10.5.4 Is the platform/ecosystem-based business model applicable in the pilot?

The platform and ecosystem developed in WP9 and presented above are applicable to the Badenova case along the lines described in the previous paragraphs. However, there is a question of role assignment and control. We have the present stand-alone system from SMA, the residents where this system is deployed, the battery owners and the beneficiaries from this. The principal question is who will seize the central control and offer the type of backbone functionality that we addressed in the paragraph of EasyPark? This will be discussed here.

The central control is not necessarily the Flexibility Operator (FO). It is more likely the communication and computational centre that offers the infrastructure for all the services that are exchanged. As pointed out, some of these services can be foreign at the outset, completely residing in ecosystem separated from the main stream. However, in lieu of

the German pilot an important feature of control becomes pronounced, namely the role that is in direct contact with the end-user, the number of end-users and what legal instruments create the primary binding towards the service providers.

In the case of today's mainstream energy storage projects in Germany and abroad the supply contract for the battery storage system and a construction contract for the planning and erection of the storage system matters. There are also projects in which supply and construction of the system are subject to an EPC contract which reduces the interfaces of the project. Depending on the technology, there are also one or more operation and maintenance agreements. Depending on the business model, further agreements deal with the marketing of the storage system on the reserve control market as well as the connection of the system to the grid. If the storage system is the asset of a separate company respective corporate documents complete the picture that we have previously sketched out. In international projects storage systems are part of stand-alone solutions or help to improve the stability of larger transport and distribution grids. The German market however is specific, as the German electricity grid is one of the most stable grids in the world and stand-alone solutions are rare. Therefore, the business model for a German energy storage system is slightly different to business models in other markets. The key business models in Germany comprise:

1. Provision of reserve control
2. Combination of storage and PV-rooftop systems in residential houses for optimization of private consumption, also in combination with cluster solution for reserve control
3. Stabilisation of regional and local distribution grids
4. Improvement of reliability of electricity supply for industrial production.

Badenova is targeting item number 2 and 3 in the list above. Currently Badenova is exploring the business opportunities associated with the opportunities that the pilot offers. One option is related to the households where a curtailment signal/plan issued on behalf of a DSO through the INVADE system overrides the SMA. The other was related to the idea of finding a less costly alternative to manage deviations between forecasted loads and actual. With lack of metering this is a challenge but can produce a very good upside. However, the method for this is not established and must be worked out.

Given the general context for Germany and the specific business ambitions of Badenova the following can be assumed. As long as Badenova takes the ownership of a battery there are only two roles involved (Figure 39), whereas Badenova as a grid owner also takes the position of a FO. Alternatively, the FO role is assigned to another Badenova

company. It is then the task of that company to extend its role and number of users in accordance with the grid company's needs and wishes. This seems to be compliant with the wishes that Badenova has defined for itself in the expanding urban areas of Freiburg. In that case it is possible to consider that operation as a future branch of the type of ecosystem that has been described above (Figures 40 and 44). Hence, the battery supplied flexibility operation can capitalize on the flexibility of residents equipped with SMA equipment in the same grid area. This is of course mutual. The great beneficiary would be the DSO and the centre piece would be the FO.

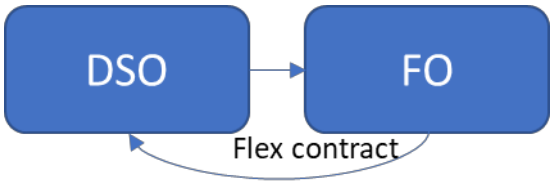

Figure 39 Batteries in front of the meter assumes a bilateral agreement between the DSO and the FO only

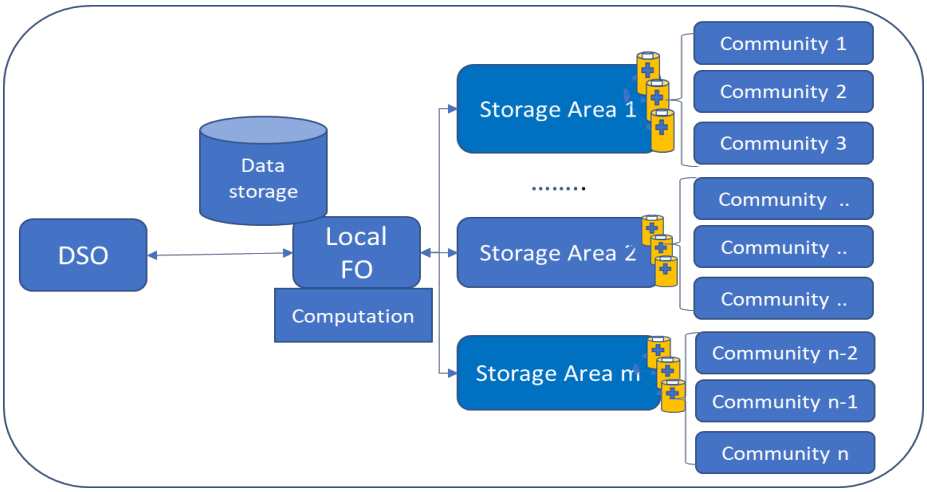

Figure 40 Batteries deployed in front of the meters in different urban areas can consolidate flexibility for local and more central purposes

Figure 41 The SMA kit: SMA existing business concept implies over-the-counter sale of the SMA controller

The current SMA kit installed in private houses is likely to constitute the nucleus in the other part of the ecosystem if they are connected to this centre piece. As explained, this is about to happen in the German pilot. The extended SMA concept as depicted in Figure 48 can be illustrated as shown in Figures 42 and 43. The flexibility can be consolidated and aggregated to facilitate the grid owner's needs. However, it is also possible to envision a local energy and flexibility market in the future in various ways as explained in [5],[8],[9] and [14]

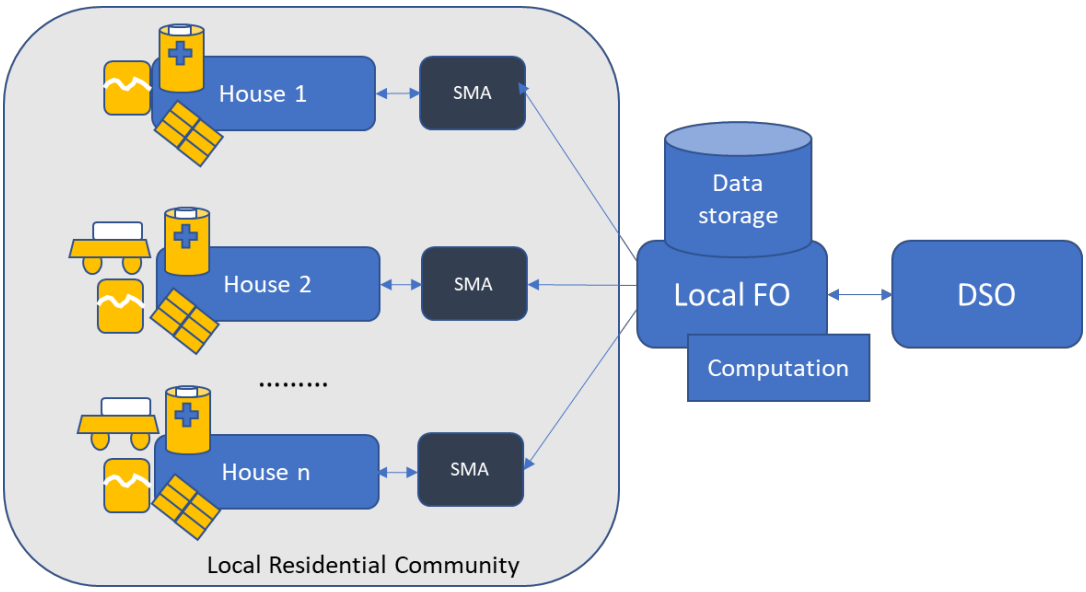

Figure 42 The principle of the second Badenova pilot constitutes a symbiotic relationship between the end-user and the DSO. This constitutes a nucleus in the proposed business model.

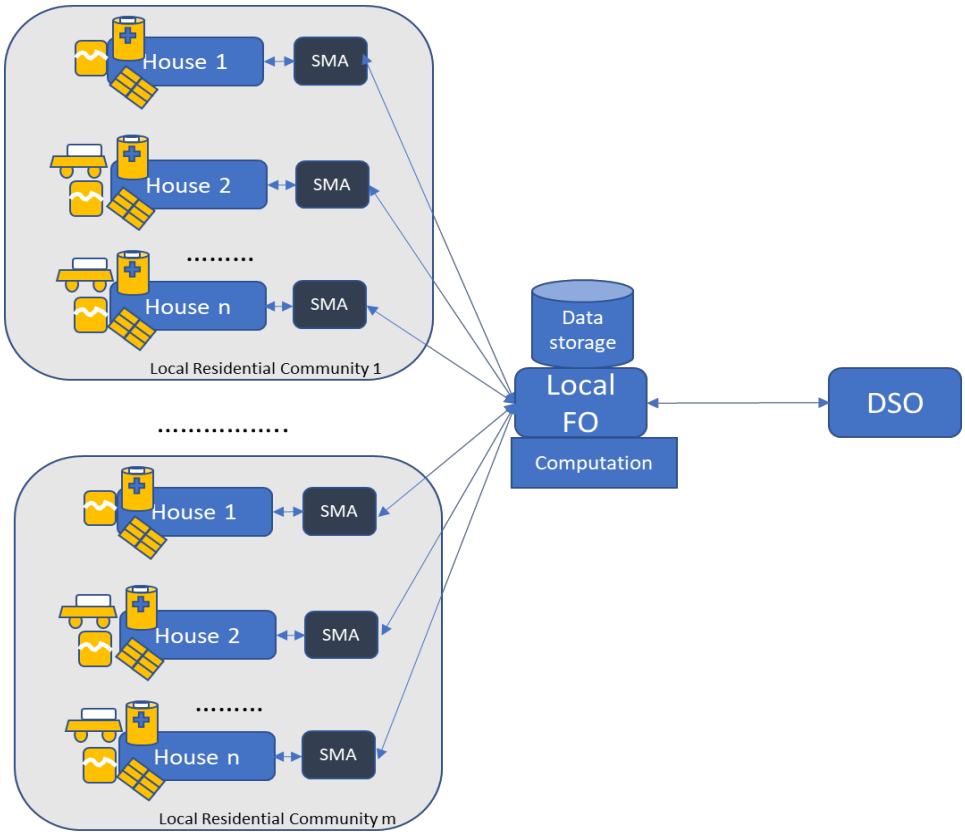

Figure 43 The basic pilot concept can be easily replicated for other communities within the Badenova grid system

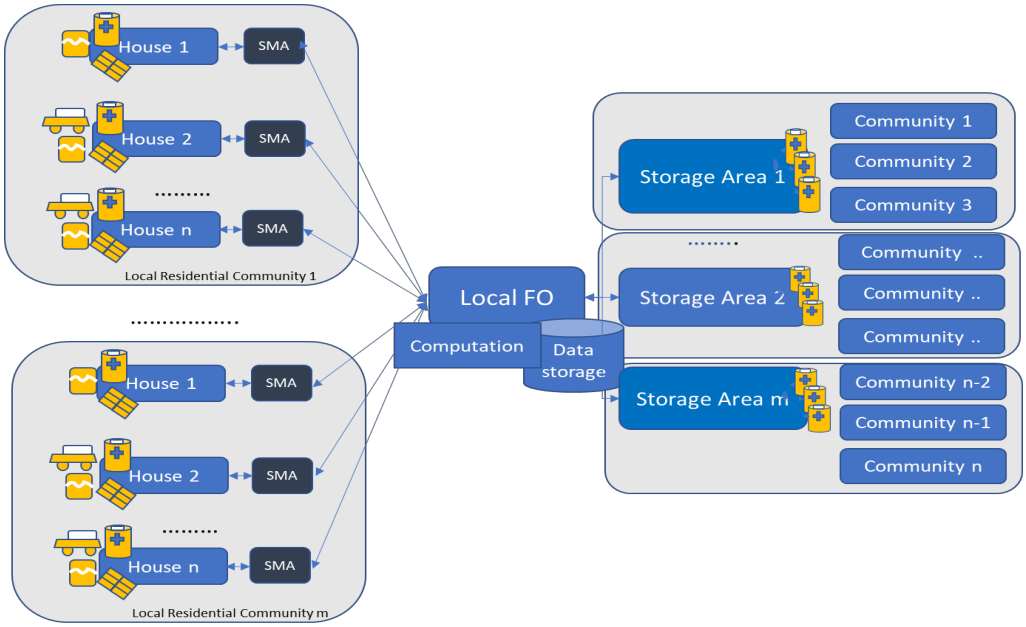

Figure 44 The concepts developed in the two demos for the German pilot can be combined and reinforce each other to form an ecosystem of considerable size within the Badenova grid region

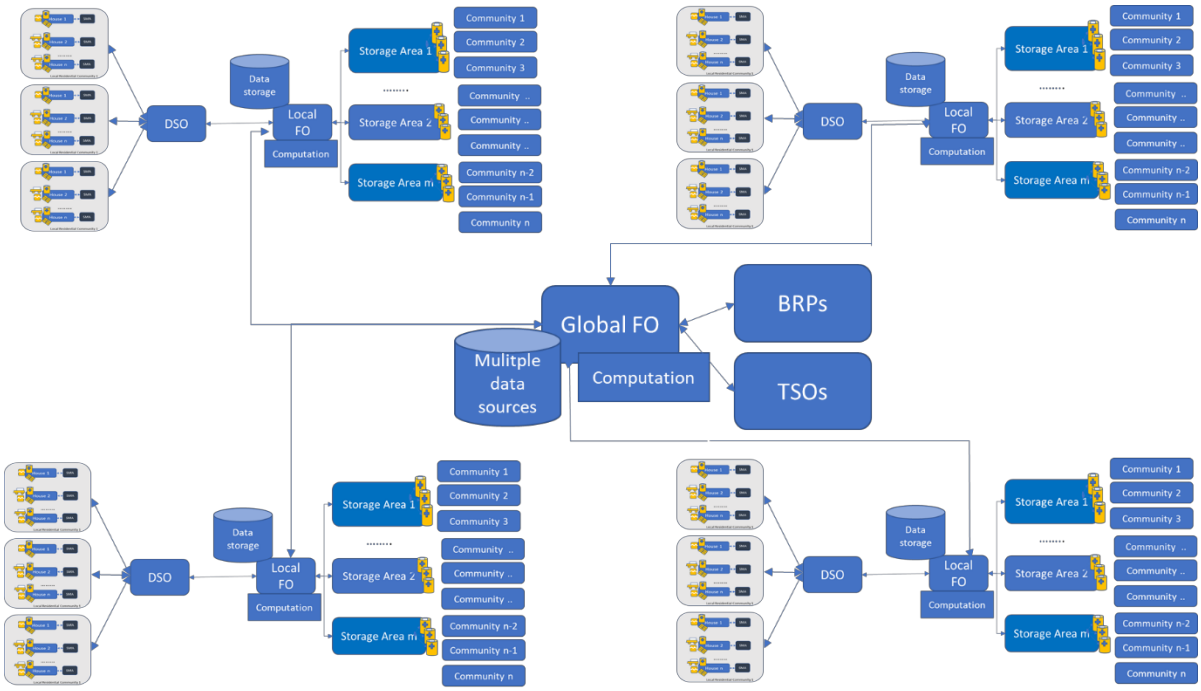

Figure 45 The concept can possibly grow into a state or federal ecosystem depending on the ambitions of the partners involved.

Figure 44 shows the two pilots extended and combined to form a more complete ecosystem where two-way exchanges of flexibility and energy are possible for mutual advantage. As long as focus is maintained on local residents, battery owners and the local grid there is a limit to expansion. However, like AirBnB and Uber these local networks can be considered native representations of an omnipresent franchise which is controlled by global operator that may not offer primarily large volumes of flexibility for the Transport System Operator or a regional balancing responsible, but services based on a massive amount of data from a rich number of sources. Given the modest extension of the SMA kit accelerated by the Badenova pilot it may seem quite far-fetched to think that SMA could ever aspire to become the Global FO hub. However, the new gateway that will allow data feeds into an SMA controlled data lake is a natural start.

The new gateway-based extension and data feed will bring the residential end-user closer to SMA. In fact, SMA could be in a position to create an EasyPark type of backbone system that can carry multiple services such as the type of aggregated flexibility that Badenova wants. The big question is how well SMA is able to tie in the end-user. What is more certain is that the regional focus that Badenova has is likely to disqualify it from a role as a national or global hub. Consequently, it is more likely to think of the Badenova concept as a poke in the wheel of someone like SMA.

10.5.5 Recommended business model German pilot (NEXT)

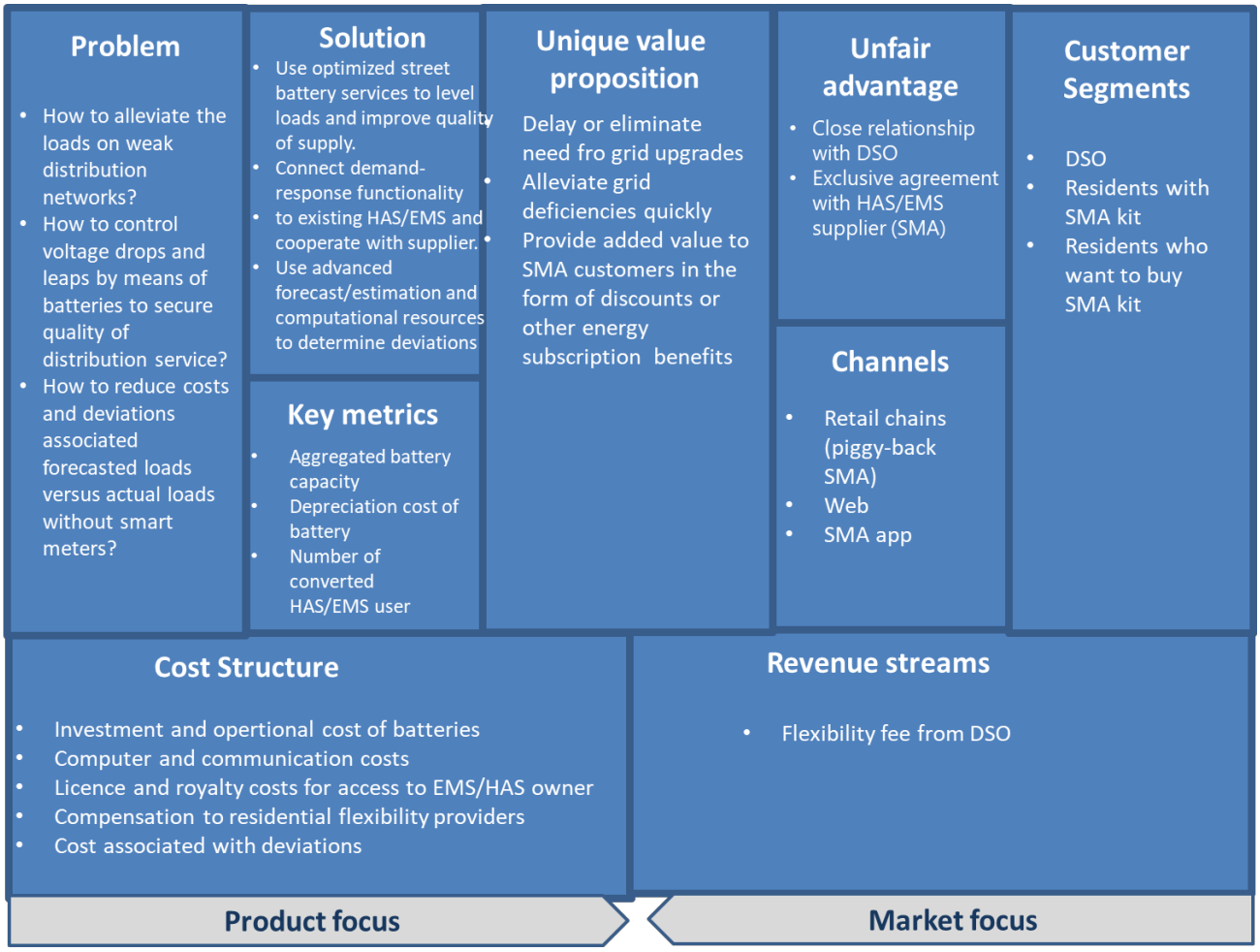

Figure 46 Tentative Canvas Model developed for Badenova based on the role as pilot owner

Based on the analysis described above the business model developed for INVADE would also fit the German pilot. Badenova as a grid owner can fill the DSO role. A Badenova subsidiary can also seize the position as a Local FO as described above. However, the corporation has an inherent local/regional focus limited to a small part of Germany. That makes it an unlikely candidate for a Global FO. However, that position could be open for a company like SMA. Based on the declared ambitions of Badenova as a pilot owner we have created a tentative business model within the Lean Canvas format in Figure 46. This should also constitute the foundation for a tangible business after INVADE and at the same time earn it a position in the type of ecosystem that we have defined, albeit not necessarily as the centrepiece of something that extends beyond the Freiburg area.

11 Tail

The work on Deliverable 9.4 has given us new insight into how new business models can enter and be exploited in a service driven energy market. However, the work has also resulted in areas that are still unexplored, and that need further work to be understood. Some of these issues are listed below and are examples of what we need to work with in the last year of the INVADE-project, and where once again business model work goes hand-in-hand with the important Exploitation work in WP3.

- In our work with business canvas methodology in the pilot description, we see that this methodology has some limitations when it comes to platform and ecosystem-based business models. So, we hope we can make some modifications to make it fit better.
- Not all platform-based business models are successful, and some struggle with growth and/or profits. So, what are the factors that you should be aware of to avoid the pains?
- Finding more and better examples. Are there companies we have missed in our work? Enel x is an example of a European company we want to study, Tendril in the US is another.
- Looking at some of the more challenging elements of platform-based business models like inequality and unsocial factors, and lack of total social responsibility.

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