E-LAND

*Integrated multi-vector management system for **E**nergy is**LAND**s*

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Abbreviations and Acronyms

Acronym	Description
BRP	Balance Responsible Party
DoA	Description of Action (annex I of the Grant Agreement)
DER	Distributed Energy Resources
DH	District Heating
EC	European Commission
EMS	Energy Management System
ESB	Enterprise Service Bus
ESCO	Energy Service Company
EV	Electric Vehicle
GA	Grant Agreement
GP	Gas Provider
MVS	Multi-Vector-Simulator
PC	Project Coordinator
PMC	Project Management Committee
SIG	Stakeholder Innovation Group
ToC	Table of Contents
WP	Work Package

Executive summary

This deliverable provides foundation for the exploitation of the E-LAND project and prepares the business-related tools for the E-LAND toolbox. A thorough stakeholder analysis is performed to understand identify potential supporters of the outcomes and sources of friction that might arise in the market. The market review points to important trends to consider before we discuss ELAND specific business model innovation in more details. Based on interviews for each E-LAND pilot site a first draft of a potential business model is presented. The draft business model will evolve as the E-LAND project proceeds. The review of the market trends and the business model innovation principles will provide the ground for the development of the E-LAND business model patterns later in the project. The deliverable points to important stakeholders to consider when further developing the E-LAND business models and setting up the exploitation plan. Figure 1 provides approach followed to achieve goals to be achieved in 1st year of workpackge 7. We conclude with a description on the way forward.

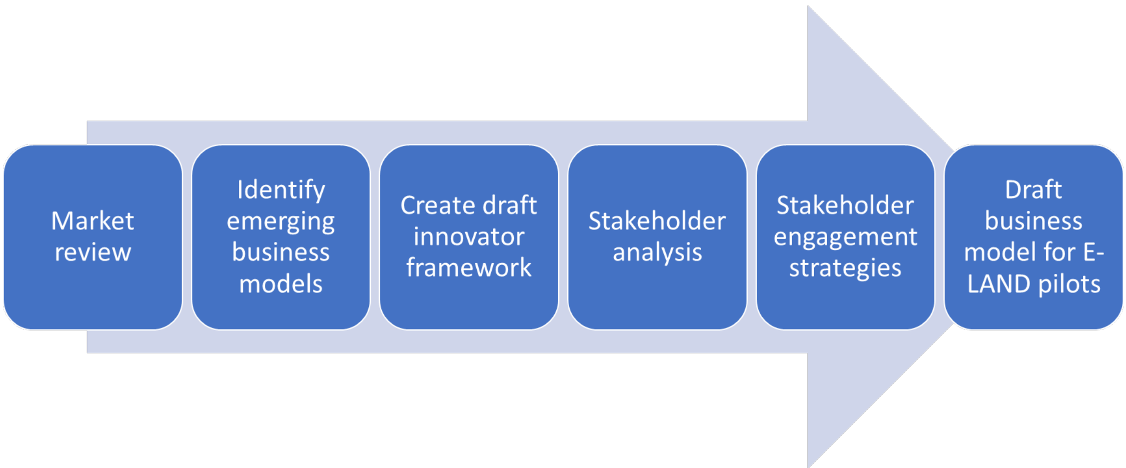

Figure 1: Five-Step approach to stakeholder analysis.

1 Background

1.1 Objectives of the deliverable

This deliverable is majorly connected to task 7.1 (Stakeholder and Market analysis) of Work package 7. The main objective of the deliverable it so to provide market and stakeholder review concerning E-LAND tools. As such it documents outcome of work done in Task 7.1 during project period M1-M12. It also provides initial ground work laid down for developing business model innovation tools (task 7.3). This document will further provide inputs to work to be done in task 7.2, 7.3 & 7.4 in WP7. Furthermore, work presented here would feed into WP8 activities and has strong linkages to WP2. Relevance of different stakeholder assessed in this work shall provide inputs to WP8 to effectively strategize communication and dissemination efforts. Community building work by WP2 shall support WP7 in engaging energy communities and gather insights for business model development.

1.2 Approach

Following general approach has been formulated to meet the objectives:

- Perform market review to provide an overview of business models concerning renewable energy, energy vectors, new societal demands and commercially available storage technologies. The review will also investigate societal trends which have gained momentum.
- Assess all the stakeholders affected by E-LAND tools and perform deep analysis on them to reveal sources of support and friction in the market. This stakeholder analysis shall also include pilot sites stakeholders.
- Based upon stakeholder analysis provide stakeholder engagement strategies and recommendations for recruiting stakeholders in stakeholder innovation group (SIG) of the project.
- Identify different business models emerging in energy sector and analyse common themes underlying these different business models. This lays foundation for business model innovator tool.
- Interview E-LAND pilot owners to identify their pain points and business ambition. Based upon this draft initial business model for each pilot site based upon E-LAND concept.

Next section provides an overview of E-LAND exploitable outcomes which forms basis of further work presented in this document.

1.3 ELAND outcomes

This section of the report addresses technical advancement and consequent potential market for solutions developed in the E-LAND project. The energy sector is changing in unpredictable ways. Distributed energy resources (DER) are opening up opportunities for communities in remote areas to gain access to electricity that is reliable, secure and low-carbon. However, providing a low-carbon, climate resilient energy supply continues to be a global challenge. The E-LAND project provides an innovative approach at the nexus of technical, societal and business challenges to develop synergistic solutions. The following table outlines the expected outcomes from the E-LAND project and the respective unique selling proposition.

Table 1: Expected outcomes and USP from the project.

Result	Component type	Unique Selling Proposition (USP)
Demand and generation forecasting algorithm	Software	• In addition to forecasting energy demand from electrical and thermal loads as a function of the type of day (workday or weekend) and time, DER are considered based on weather forecast and generation characteristics. • Through embedded forecasting modules, the reserve and risk strategies for system operation can be determined in advance. • A sliding correction algorithm can be parameterised to minimise the difference between the external weather forecast and current measured weather data.
Scheduling and planning algorithm	Software	• E-LAND will develop a scheduling and planning algorithm that provides decision support to optimise multi-vector operation in a trade-off situation between robustness and optimality.

		• It will also consider seasonal differences in energy generation and demand to determine short-term operation scheduling based on long term needs.
Battery storage and battery storage management	Software	• The state of health of the battery will be considered during planning and scheduling, therefore extending battery lifetime.
Multi-Vector-Simulator (MVS)	Software based planning tool	• The MVS will integrate not only electricity but also heating, cooling, transportation and sector coupling components (power to heat, power to gas). • It will also provide a technoeconomic investment optimisation for components of the Energy Islands (e.g. technical specifications, capacities, distribution in the grid). • The MVS will comprise a generic and versatile simulating tool that can capture several Energy Island cases and provide technoeconomic evaluation, putting special emphasis on the microgrid aspect and on its interaction with the local electricity markets.
Enterprise Service Bus (ESB)	ICT Technology	• The ESB will be used for interfacing and interaction between all other tools developed in the project. • It will coordinate data exchange between different systems including legacy systems and third-party IT applications
Energy Management system (EMS)	ICT Technology	• State of the art data mining tools will be adapted to deal with the complexity of multiple energy

		vectors and form a self-correcting forecasting mechanism. • Economic and ecological factors will also be taken into consideration along with all technical constraints.
KPIs visualisation system	Software	• Integrated KPI visualisation tools will allow for easy assessment of the requirements and technological impact for each project. • For example, each pilot site in the project will track CO_2 emissions, share of renewables in the energy mix and improvement in self-sufficiency.
Common Impact Model (CIM)	Community development	• The common impact model goes beyond current community engagement tools by combining state of the art community frameworks and community input • A generic model is customized through field site data, focus groups and on-site inspections to ensure that new technology is met with acceptance and a sense of ownership within the community
Business Model Innovator	Toolkit for business model development	• New business models will be developed and tested during the project pilots with a focus on involving local energy consumers and producers. • A business model innovator tool can be readily used by broader market players to design new business models or to improvise on existing ones under changing energy paradigm
Modular toolbox	Concept	• The modular toolbox will allow for new tools to be constantly developed to address new challenges in energy systems.

		• Market actors can either take the whole toolbox to develop and provide full-scale solutions or select specific tools to further advance their expertise • The toolbox approach makes the tools and method applicable and financially viable to different kinds of energy islands

1.4 Report structure

The report consists of seven chapters:

- Chapter 1 provides introduction to the work documented.
- Chapter 2 investigates the current status and market trends in relation to E-LAND concept and tools.
- Chapter 3 creates foundation for business model innovation tool based upon market review.
- Chapter 4 gives insights to needs and ambition of E-LAND pilot sites.
- Chapter 5 documents draft business model created for pilot sites based upon interviews, face-to-face consultations and workshops with pilot owners.
- Chapter 6 focusses on stakeholder analysis based upon which recommendation on engagement strategies and target stakeholder for stakeholder innovation group (SIG) is provided.
- Chapter 7 sums up work presented in this deliverable and provides way forward for future WP7 activities.

2 Market Review

2.1 Trends in Society

2.1.1 Increasing influence of sustainability

Social awareness for sustainability issues has made headlines internationally and has forced policy makers to address climate issues threatening our future. The Fridays for Future initiated in August 2018 by Swedish student Greta Thunberg has mobilized over 11 million people in 221 countries in a push to demand politicians to take action to maintain the global temperature rise to within 2°C.[1]

This social consciousness was rightfully translated to strong gains for green parties in May 2019's European Parliamentary elections (FT, 2019). Green parties who have traditionally been sidelined in influential government coalitions are now well positioned to take decisive roles in EU policy.

One such policy items released in the Spring of 2019 is the Clean energy for all Europeans package (CEP, 2019). This policy framework that aims to facilitate the transition away from fossil fuels towards cleaner energy sources will take center stage as it is interpreted into national laws and regulations during the following two years.

A strong driver for industrial shift away from fossil fuels in Europe remains the price of CO2 allowances which is expected to approach 50 EUR/ton if the EC proposal is respected (Schjolset 2014).

2.1.2 Ongoing emergence of the sharing economy

As it has been seen with various assets, like houses through AirBnB, various city bikes, or scooters, sharing them is becoming more and more popular. One driver for this is the fact that the Millennials[2] is currently the major generation at the age of acquiring various everyday assets, and as we know, they have suffered from poor job opportunities resulting from the financial crisis, global recession and slow recovery as well as from the high real estate prices and higher tuition fees compared to the previous generation. Thus, they are more likely to find sharing economy more attractive than investing in owning assets. In parallel with these

[1] More information on: https://www.fridaysforfuture.org/statistics/graph

[2] More information on: https://en.wikipedia.org/wiki/Millennials

economic developments, awareness and sense of responsibility of the global climate crisis are increasing.

Sharing economy is currently making its' entrance to energy sector as well. Due to one hand the rising taxation of electricity and on the other hand the technological improvements and price decrease of decentralized energy system components, energy generation and storage devices are becoming an attractive alternative for small actors and non-professional groups like neighbourhoods.

Examples relevant to E-LAND regarding sharing energy assets can be found in the ongoing initiatives in Europe, like the LEMENE project[3], which aims to increase the use of multi-vector renewables in an industry area in Finland through creating an energy community, where participants can actively participate in the local energy market. The energy self-sufficient and intelligent system enables also autonomous island operation, if needed. Another example, already commercial, can be found in Germany, Austria, Switzerland and Italy, where one can join the SonnenCommunity by purchasing the SonnenBatterie and households with own PV production can share their self-produced energy with other members of the community[4].

2.1.3 Locality

Locally-sourced production of goods is another strong social trend that has strong implications for the energy domain. The farm-to-table awareness is a good example of where public consciousness of food sourcing has led to policy changes on the European level (EU, 2011). Consumers are increasingly making decisions on their food consumption due to sustainability considerations, avoiding food sources with a large carbon footprint.

While the relationship between consumers and electricity is less understood by end-users, analysis into the technology domestication of users shows that the interest by end-users to produce their own electricity is one of the main decision factors for investment in renewable DER assets (INVADE D9.2, 2018).

The definition of energy communities in European policy (Directive (EU) 2018/2001); and their importance in the Clean energy package is a strong signal from the Commission that the guiding framework is supporting the current trend of community-based sourcing of resources and energy trade between local stakeholders.

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[3] More information here: https://www.esitteemme.fi/lemene/WebView

[4] More information here: https://sonnengroup.com/

2.2 Trends in business

2.2.1 Emergence of service-based industries

Starting from the well-known "Software as a Service" (SaaS) from ICT sector, service-based business models have been established to various industries. For example, Leadership as a Service (LaaS)[5] provides a ready-made platform for several leaders of the companies to tackle management, HR, and employees. Another example is a fast-growing business, Mobility as a Service (MaaS), from which functional services can be found widely throughout Europe and USA[6].

Regarding the energy sector, service-based business models have huge potential especially enabling fast deployment of decentralised renewables without requiring big end-user investments. This has been acknowledged by the important energy sector actors, like the Big Six energy suppliers in UK, which are developing or acquiring companies offering new services and novel technology. Centrica, for example, in 2015 bought AlertMe, a smart tech company that provides energy and home-monitoring hardware and services, and Panoramic Power, which helps companies improve their operational efficiency. In addition, new actors, like Google with its Nest home automation products and various start-ups are joining the competition.

Piloting initiatives from Energy as a Service (EaaS) concept are emerging around the world, like the case of Montgomery County in Maryland USA, which has entered into an innovative public-private partnership that allows the microgrids to be installed without any upfront costs to the County[7]. Another example is Nurmon Aurinko from Finland, which is running a PV project with a major food industry operator Atria Suomi Oy. The project uniqueness comes from the intelligent use of electricity service concept, in which the end customer does not require an own investment or resources[8].

2.2.2 Lower barriers for industry entrance and cross-industry collaboration

The European Union's forefathers believed in the idea to strengthen relationships between European states to make war impossible[9]. This idea led to economic integration where,

[5] More information here: https://laas.fi/en/
[6] More information here: https://maas-alliance.eu/maas-in-action/
[7] More information here: https://www.montgomerycountymd.gov/dgs-oes/Microgrids.html
[8] More information here: https://www.nurmonaurinko.fi/english

[9] https://europa.eu/european-union/about-eu/history/1945-1959_en

gradually, every industry was integrated into the common market. Therefore, by the 1990s European electricity and gas markets became liberalized and integrated (Léautier / Crampes 2016). Policy makers and regulators implemented competition in the utility market by removing legal and technical barriers to entry, monitoring anticompetitive conduct, restructuring the sector, and providing access to essential facilities (Meeus et al. 2005).

The politically motivated removal of entry barriers lead initially on the one hand to an enhancement of the "traditional" electricity and gas value chains by a trading function (Figure 2).[10]

Figure 2: The Electricity Value Chain. Source: own graph.

Regional supply monopolies were no longer existing, and trading of surplus generation became economically relevant as the access to transmission and distribution networks was open to competition. Therefore, it became possible to buy electricity anywhere in Europe and to utilize the transmission infrastructure to locally consume the purchased electricity. Furthermore, the initial liberalization process allowed electricity consumers to individually choose their supplier from competing companies as well as to "prosume" their self-generated electricity.

Currently, we observe a second phase of the electricity and gas industry transformation that is closely related to the digitization of the business. The value chain received a further enhancement and even academic textbooks nowadays introduce the "meter operation" as an additional part.

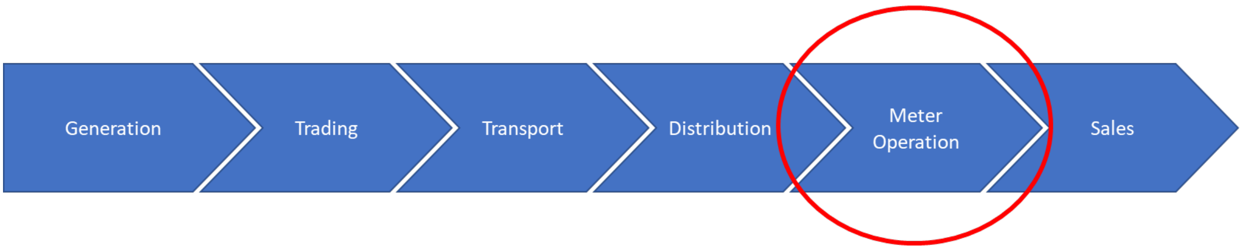

Figure 3: The New Electricity Value Chain. Source: own graph.

[10] The following descriptions focus mainly on liberalized electricity markets. However, analogous developments can be observed in the natural gas markets too.

The implementation of smart meters and digitized meter operation activities take on the one hand the customer autonomy to the next level. Further control is taken away from traditional monopolies/utilities and given to individual consumers and prosumers. On the other hand, the sub-activities that are related to the meter operation open the entry door into the electricity industry for new players that were previously unknown as competitors (see Figure 4).

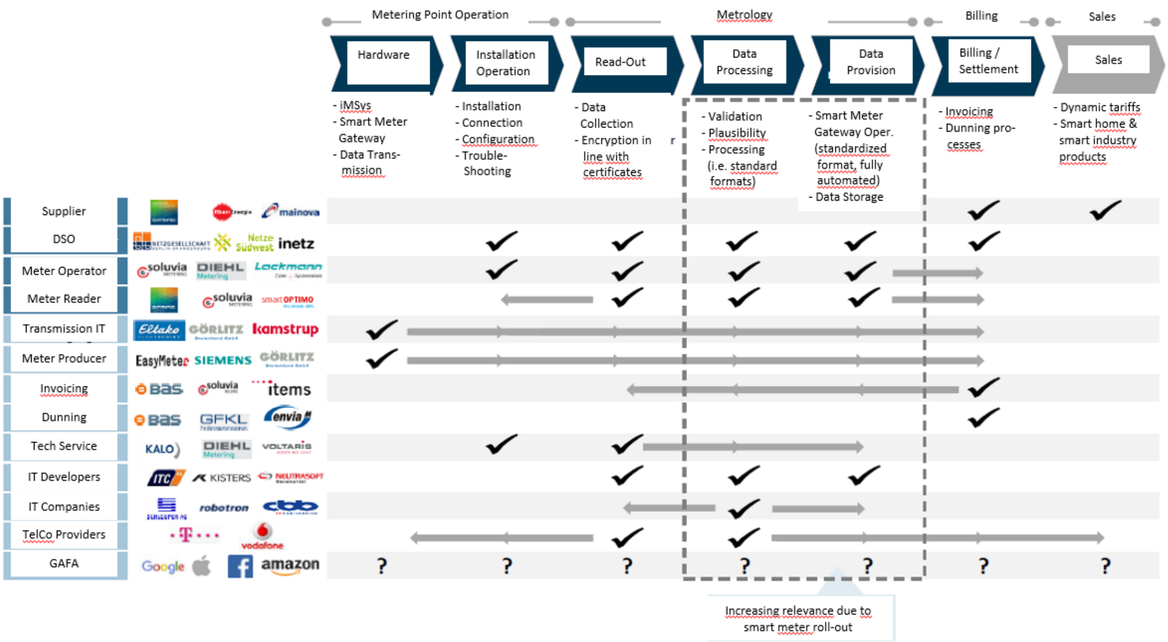

Figure 4: Meter Operation – Core Processes and Players. Source: own graph.

The boxes on the left-hand side of the figure above represent “traditional” (e.g. supplier, DSO) and new players (e.g. telecommunication providers, Google, Amazon, Facebook) with general competencies in the metering environment that are illustrated by the “check” icons. The grey arrows in the main field of the figure represent potential areas for forward- and backward-integration activities of the individual groups of players. E.g. telecommunication service providers are currently mostly active in the read-out and electronic processing of meter data. However, based on their “home industry” know-how they do also have the ability to forward- or backward-integrate their activities to expand the part of the metering value chain they do cover. Furthermore, the supply of electricity to smart meter equipped consumers becomes a completely digital process which reduces also the market entry barriers in the sales sector of the electricity value chain.

As a result of these developments, established utilities and potential new entrants need to decide whether to cover parts of the value chain completely on their own. Cross-industry collaborations, e.g. between established DSOs and telecommunication companies, might be a useful approach to manage parts of the electricity value chain in a more cost-effective way than before or to create synergies by partnering-up with another company to cover a wider part of the value chain.

2.2.3 Increasing relevance of eco-systems and co-innovation

The insights of the previous paragraph do also implicitly outline that the relevance of eco-systems and co-innovation increases in the energy industry.

Actors that participate in a business ecosystem depend on each other for success and survival. Moore defines business ecosystems as "an economic community supported by a foundation of interacting organizations and individuals" (Moore, J. 2005). A digital ecosystem can be described as a self-organizing digital infrastructure for creating a digital environment for organizations that 'supports the cooperation, the knowledge sharing, the development of open and adaptive technologies and evolutionary business models' (EU Commission 2018). Consequently, a digital business ecosystem integrates both the economic business ecosystem and the digital representation of the economy by a digital ecosystem. It is based on industry convergence (ICT technology) and openness (open innovation, open standards, open source software, open APIs) enabling innovation and value creation among the ecosystem actors (Kotilainen, Kirsi et al. 2016; Kotilainen, Kirsi et al. 2017).

This general description of a digital business ecosystem reflects that the digitization of industries and the change of value chains and interaction patterns between established and new market participants is not energy industry specific. However, the digital business ecosystem perspective provides a framework to integrate the various actors of the electricity value chain into an encompassing concept.

Kotilainen et al. (Kotilainen, Kirsi et al. 2016; Kotilainen, Kirsi et al. 2017) conducted comprehensive research work on prosumer-centric digital energy ecosystems. Within the E-LAND project we initially follow their insight that to comprehend the role of the heterogeneous group of prosumers it is necessary to develop an adequate idea of the different types of prosumers and of the drivers of their decision-making and behavior. For this end, they approach the roles of prosumers in a Smart Grid innovation ecosystem from a co-creation and -innovation perspective.

According to Chesbrough and Bogers (2014), co-innovation is a sub-component of *open innovation*: "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model. These flows of knowledge may involve knowledge inflows to the focal organization (leveraging external knowledge sources through internal processes), knowledge outflows from a focal organization (leveraging internal knowledge through external commercialization processes) or both (coupling external knowledge sources and commercialization activities).”

Based on this open innovation definition, the same authors derive the term “*co-innovation”* or *“coupled open innovation”* as an activity that “involves two (or more) partners that purposively manage mutual knowledge flows across their organizational boundaries through joint invention and commercialization activities” (Chesbrough / Bogers 2014).

Within the E-LAND project we will discuss co-innovation in digital energy ecosystems in the context of a Quintuple Helix model to develop business model which are accepted by stakeholders. It integrates the cooperation between universities, industry, governments, civil society and the “natural environments of society.” The latter reflects a sustainability perspective that recognizes nature as an essential part of the innovation and knowledge system (Mazhelis / Tyrvainen 2014).

2.2.4 Prices

2.2.4.1 Electricity price trends

The development of electricity prices for household consumers in the EU-28 and euro area since the first half of 2008 is presented in Figure 5. The price of the energy, the supply and the network (prices without taxes) remained stable during the last decade. It went from EUR 0.1149 per kWh in the first half of 2008 to EUR 0.1411 per kWh in the second half of 2014 and now stands at EUR 0.1329 per kWh. However, the weight of the taxes has increased constantly from 27% in 2008 to 37% in 2018 (Eurostat 2019).

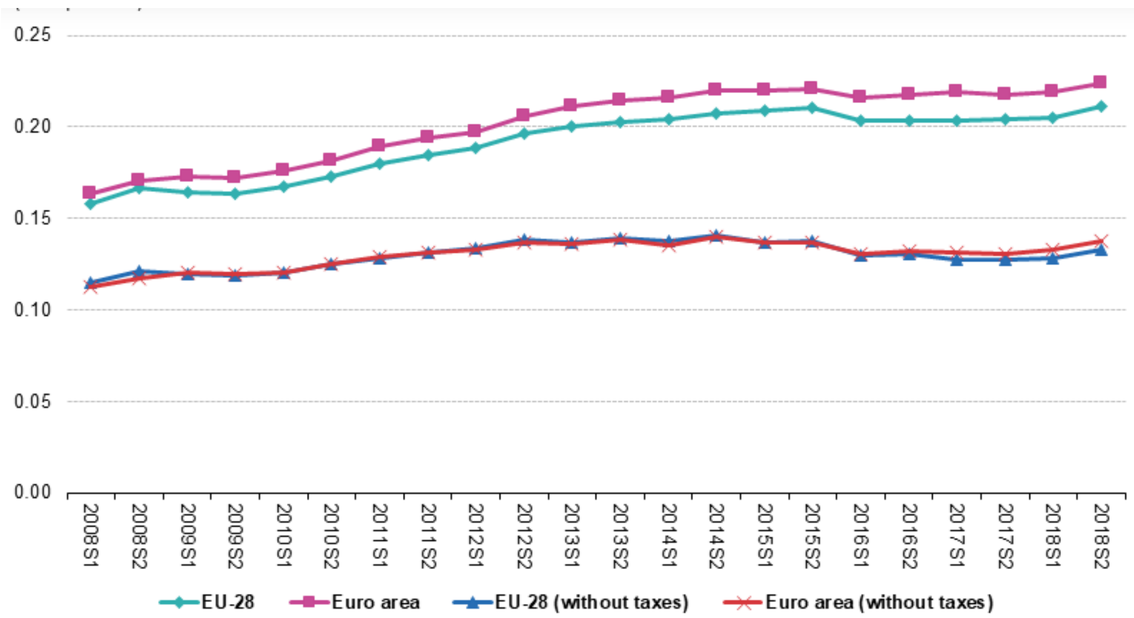

Figure 5: Development of electricity prices for household consumers EU-28 and EA, 2008-2018 (EUR per kWh). Source: Eurostat, 2019 (online data codes : nrg_pc_204).

Current household electricity prices in individual European countries are very different. For household consumers (defined as medium-size consumers with an annual consumption within the range of 2 500 kWh < consumption < 5 000 kWh), electricity prices during the second half of 2018 were highest among the EU Member States in Denmark (EUR 0.3123 per kWh), Germany (EUR 0.3000 per kWh) and Belgium (EUR 0.2937 per kWh) (see Figure 6). The lowest electricity prices were in Bulgaria (EUR 0.1005 per kWh), Lithuania (EUR 0.1097 per kWh) and Hungary (EUR 0.1118 per kWh). The price of electricity for household consumers in Denmark was more than three times as high as the price in Bulgaria (Eurostat 2019).

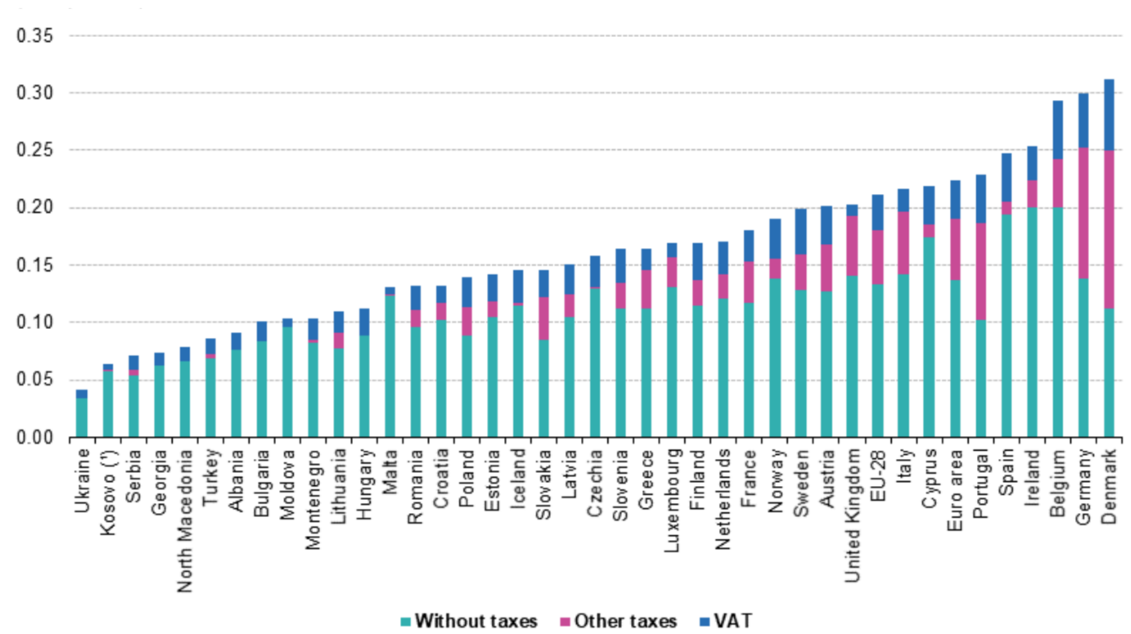

Figure 6: Electricity prices for household consumers, second half 2018 (EUR per kWh). Source: Eurostat, 2019.

From the previous figure it is obvious that the weight of electricity taxes and levies differs greatly between EU member states. The relative amount of tax contribution in the second half of 2018 in the EU was smallest in Malta (5.9 %) where a low VAT rate is applied to the basic price and no other taxes are charged to household consumers. The highest taxes were charged in Denmark where 64.3% of the final price was made up of taxes and levies.

The proportion of taxes and levies in the overall electricity retail price for household consumers is shown in Figure 7.

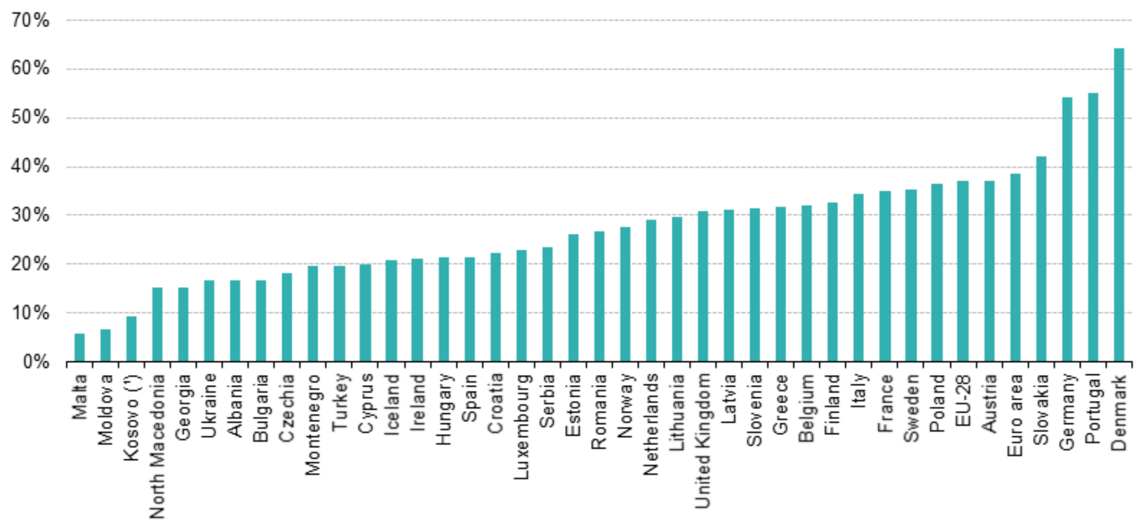

Figure 7: Share of taxes and levies paid by household consumers for electricity, second half 2018. Source: Eurostat, 2019 (online data codes : nrg_pc_204).

In general, we expect that the trend of diversified electricity prices between EU member states will continue. We don't see an alignment of RES subsidy / support schemes on a European level. Therefore, the high difference in electricity taxes and levies between European countries will continue. Within the E-LAND project consumers and prosumers might be able to take advantage and realize economic benefits by reduced taxes and levies on self-generated and -consumed electricity.

In the mid-term (i.e. 3 to 5 years from now) we don't exclude average electricity cost increases due to a higher taxation for fossil-fueled electricity generation. The societal demand for sustainability and climate protection makes political leaders in several European countries currently debate an increase of CO2-emission related taxes which might, as an add-on component on power deliveries, increase electricity prices.

In the long-term, the commercialization on competitive energy storage will be a core cost-cutting factor. Beyond 2030 a large-scale deployment of energy storage will allow electricity prices all over Europe to converge against the long run marginal cost (LRMC) of wind and solar power. Especially the currently under-utilized Nordic on-shore wind power generation potential is vast, with a substantial part available at a low cost. Furthermore, off-shore wind power is gaining political attention and it seems likely that support systems will lead to increased investment in off-shore wind over the next decade, with downward pressure on electricity prices as a result.

2.2.4.2 Natural gas price status and trends

In 2018, the global natural gas demand surged at its fasted pace since 2010 by 4.7% to 3850 bcm. The demand growth was mainly driven by the China and the US that accounted for 45% of the global increase in both, the consumption and supply of natural gas (see Figure 8) (CEDIGAZ 2019 a).

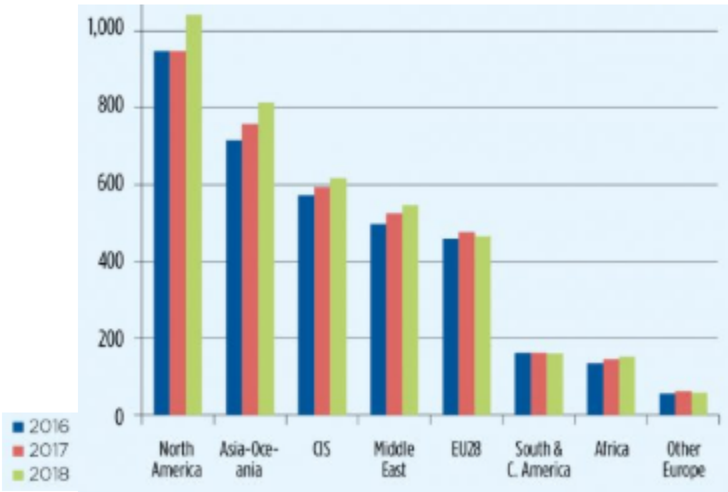

Figure 8: Natural Gas Consumption by Region (bcm; 2016 – 2018).Source: CEDIGAZ 2019 a.

Core reasons for the recent increase of natural gas demand are according to the International Centre on Natural Gas (CEDIGAZ) the:

- substantial global growth in energy demand based on a strong world economy and the abundance of competitive gas supply, especially in the US and in Russia;
- implementation of supportive energy and environmental policies, especially coal-to-gas switching policies, particularly in China;
- investment into transport infrastructure that also contributed to bolster gas penetration in key markets as well as by
- extreme weather conditions that lifted electricity demand and residential gas consumption, especially in the US (CEDIGAZ 2019 a).

Due to the increasing demand, natural gas prices rebounded in key markets in 2018 (see Figure 9).

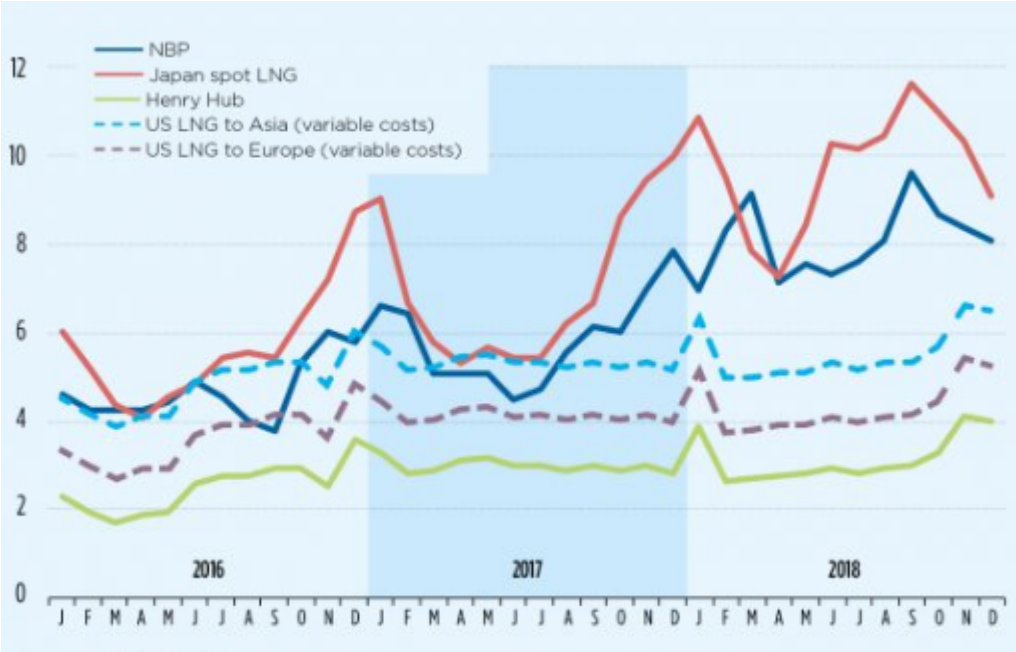

Figure 9: International Gas Prices and US LNG Competitiveness ($/MBtu). Source: CEDIGAZ 2019 a.

The increase in gas prices occurred in a general context of rising prices for all fossil fuels amid fast-growing energy demand. Higher coal, oil and – in Europe – CO2 prices, as well as a relatively tight LNG market led to a general increase in gas prices. The average National Balancing Point (NBP) price settled at $8.1/MBtu, 39% higher than in 2017, while Asian spot prices rose in the same proportion to $9.7/MBtu. In Q4, ample LNG supplies combined with warm weather caused gas prices to plummet. US spot prices increased from $3/MBtu in 2017 to $3.2/MBtu. After being flat for most of the year, they rebounded during the last quarter due to low storage levels (CEDIGAZ 2019 a). We expect this scenario to continue in the short-term which will keep gas prices stable or lead to a slight increase in the short-term.

OPECs annual World Oil Outlook for 2019 forecasts oil to remain the largest contributor to the energy mix for the next 20 years. However, natural gas is expected to become the second-largest energy source, reaching a share of 25% (2019 = 23%) in the total primary energy mix by 2040. “Demand increases for gas will come primarily from Asia, led by China and India, as well as OPEC Member Countries,” the group said (CNBC 2019). CEDIGAZ is even more offensive in its statements regarding the future natural gas demand growth. It expects the resource to be the fastest-growing fossil fuel over 2017-2040 (+ 1.4%/year). However, as the energy transition to a sustainable energy system accelerates, natural gas demand growth is expected to slow strongly after 2025 to 1.1% /year over the 15-year period, compared to 2%/year over 2017-2025 (CEDIGAZ 2019 b).

In the mid- to long-term interregional (long distance) trade is forecast to grow by around 3%/year until 2040. While the share of long-distance trade in global gas supply is expected to rise from 13% in 2017 to 18% in 2040, the Asian market becomes the largest importing region post-2025. Europe's weight in global trade diminishes strongly, underpinning a shift of trade flows from the Atlantic Basin to the Pacific Basin. At the same time, LNG expands more rapidly than pipeline gas to secure gas supply where local production falls short of demand. This will require the development of additional LNG supply capacities to cover the demand (see Figure 10) (CEDIGAZ 2019 b).

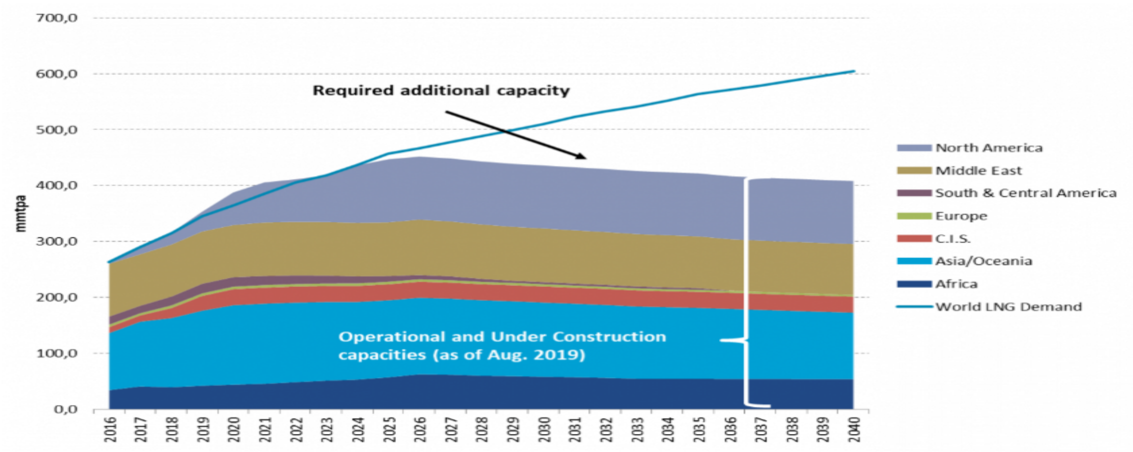

Figure 10: LNG Demand vs. Effective Existing and Under Construction LNG Supply Capacities. Source: CEDIGAZ 2019 b.

In case of existing LNG supply projects' delays, some tensions could already occur over the 2023-2024 period. However, as of August 2019, it is estimated that there will be a rapidly growing supply gap which will reach 75 Mt in 2030, 140 Mt in 2035 and almost 200 Mt in 2040 (CEDIGAZ 2019 b).

Therefore, we foresee a trend of increasing natural gas prices for the mid- and long-term period.

2.2.4.3 Diesel price status and trends

The diesel price is closely related to the developments on the global oil markets. After several years of oversupply, the price of oil has rebounded. After appearing limited to a range between the mid-$40s and $50 per barrel (bbl), Brent crude futures climbed to a peak of just over $86 in October 2018. Since that point of time the international benchmark has fallen nearly 30% and U.S. West Texas Intermediate (WTI) has fallen almost 20% over the same period (CNBC 2019). Brent crude is now trading around $ 65 - 70. The industry is thus recovering and stabilizing from the brutal last few years of weak prices, enforced capital discipline, portfolio realignments, and productivity efficiencies (Strategy & PWC 2018).

It is not surprising that the recovery is expected to lead to increased global oil and gas capital expenditures in the short- to mid-term (see Figure 11).

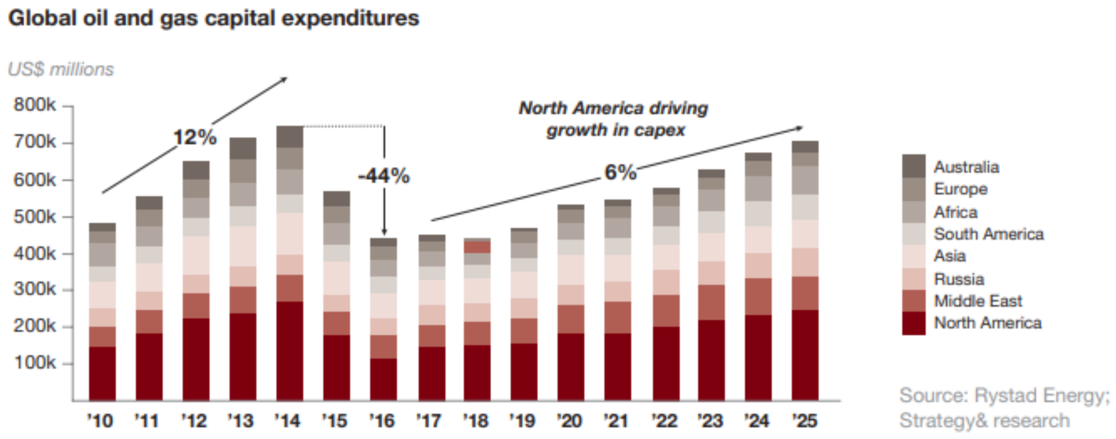

Figure 11: Expanding investments in Oil and Gas Exploration. Source: Strategy & PWC 2018.

Given that it takes about three to six years from project sanctioning to coming onstream, the decline in investment approvals during the price slump will most likely keep oil and, therefore, diesel prices on a stable level in the short- to mid-term.

Furthermore, the expected increase in exploration assets with a 6 percent compound annual growth rate comes along with supply-related challenges. On the one hand, there is an ongoing decline in new discoveries. By the end of 2017, the volume of new oil and gas discoveries, was at its lowest since the early 1950s. It's getting harder to find the large discoveries known as "elephants," and most prospective, cost-efficient areas have already been explored (Strategy & PWC 2018). And, although U.S. tight oil, or shale oil, is a dynamic new source of supply, the cost of its exploitation is still above current market price levels for oil and is also facing a tremendous amount of headwinds for environmental reasons.

For the demand-side, the Middle East-dominated oil producer group OPEC stated in its closely-watched annual World Oil Outlook (WOO) of November 2019, that the last 12 months had been "challenging" for energy markets once again. OPEC lowered its outlook number for global oil demand growth, to 104.8 million barrels per day (b/d) by 2024, and 110.6 million b/d by 2040. "At the global level, growth is forecast to slow from a level of 1.4 million b/d in 2018 to around 0.5 million b/d towards the end of the next decade," OPEC said in the report. The organization cites a short-term deceleration of growth in the United States and the mid- to long-term "gaining of momentum" of electric cars as relevant demand influence factors.

Some market participants fear a repeat of rising supply and faltering demand — the same situation that precipitated a dramatic fall in crude futures from mid-2014 to 2016. However, different to 2014, it seems that OPEC developed mechanisms to face the onslaught of supply-demand cycles that have started (CNBC 2019). Therefore, we expect based on the described mid- and long-term supply and demand factors also at least a stable diesel price in the related time periods.

2.2.4.4 Reserve and balancing electricity price

We use the case study of the German electricity market for an analysis of the development of reserve and balancing prices over time. This is because that market is rapidly transforming from a formerly centralized coal and nuclear power supplied market towards an increasingly intermittent and distributed renewable electricity market. The combined annual wind power and PV production reached 157 TWh in 2018. This value is equivalent to more than 30% of the annual electricity consumption of 508.5 TWh (Fraunhofer 2019) - a degree of penetration unmatched in any other major international power grid.

Especially in electricity grids with a high degree of intermittent generation, significant imbalances between generation forecasts and real-time generation occur quite often. To guarantee security of supply at all times, the transmission system operators (TSOs) contract reserve capacity from market participants to be able to balance the system at any time. For this purpose, two market segments are set-up: the reserve capacity market, and the reserve energy market.

The first is meant to secure a given amount of power in advance to have it at the grid operator's disposal in time of need. The selected providers receive a capacity remuneration and in return they are obliged to keep the awarded MW available. These costs are paid back via the grid tariffs and hence they are equally borne by all end consumers.

On the reserve energy market, selected reserve power providers submit a price per MWh for which their generation source would potentially be activated. In case of need, the grid operator will activate these bids starting at the cheapest. Only activated market parties receive the energy remuneration. On top, these costs are not borne by all end consumers, but charged through to the parties that caused the imbalance in the first place (this is known as the imbalance price). It gives a direct incentive to all balancing responsible parties to do their job as good as possible to avoid balancing costs.

This approach led to one of the most competitive reserve power markets in Europe and, consequently, to very liquid power exchanges. The reservation costs for secondary and tertiary reserves were dropping year after year. At the same time, the absence of a price cap on energy bids meant that imbalance fees could be high for parties that managed their portfolio uncarefully. Traders therefore made sure to trade away foreseen excesses or shortages in the intraday market, to avoid an imbalance penalty altogether. As a result, the number of reserve power activations dropped significantly, while the volume traded intraday was never that high before (see Figure 12) (De Decker et al. 2019).

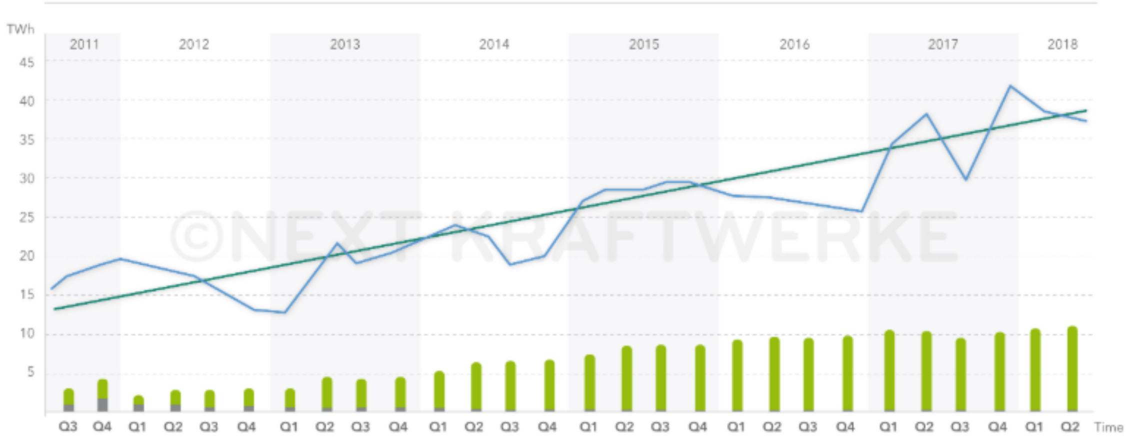

Figure 12: Development of Wind and PV Feed-In and Control Reserve Volumes in Germany (in TWh; 2011 – 2018). Source: De Decker et al. (2019).

An interesting observation according to the figure above is the fact that market participants became incentivised to reduce their potential imbalances by intraday trading. Calls for reserve power decreased, although the installed generation of intermittent generation sources increased. Furthermore, the reservation costs plunged, and with them the costs for system balancing. Balancing parties managed assets to their best extent so that the grid operator needed to activate the reserve power less and less often. Society was better off with a cheaper and safer electricity system. The decrease of reservation costs of the three balancing products is illustrated in the graph below (see Figure 13).

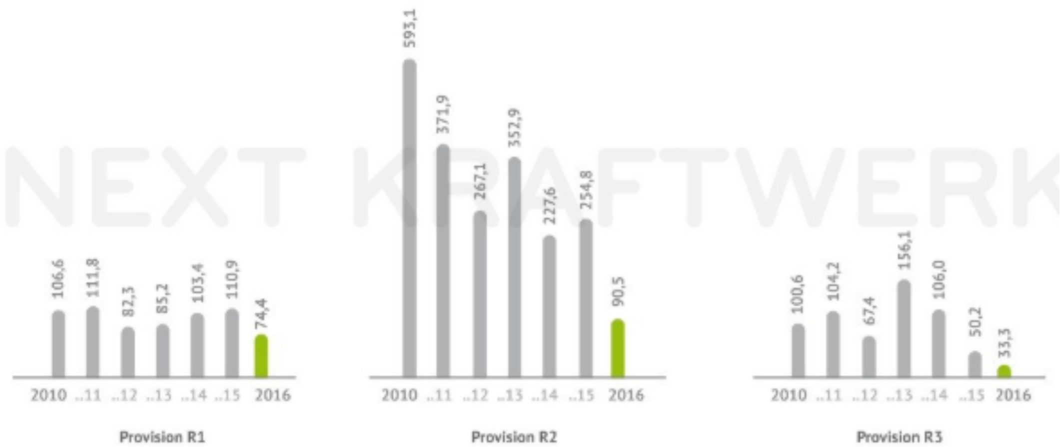

Figure 13: Cost of Balancing Power Provision in the German Market (Mln. Euro; 2011 – 2016). Source: De Decker et al. 2019 based on data of the German Federal Grid Agency, Monitoring Reports 2013 – 2017.

In 2017 the German regulator decided to implement a different market design with a so called “mixed price system” for the balancing markets which is heavily criticized by many market participants (De Decker et al. 2019).

Regardless of the mentioned market design reform, the previous analysis outlines at least two important insights for the E-Land project. On the one hand, there is no automatism that leads to higher reserve capacity call volumes in case of increasing intermittent generation implementation. A steep learning curve by market operators and participants leads to very good forecasts in intermittent generation systems. On the other hand, project calculations should conservatively include prosumer revenues from flexibility provision. The German experience shows that these revenues might drop heavily over time as market participants capitalize on their demand response and flexibility assets.

2.3 Trends in technology (technology as enabler)

2.3.1 Power-2-everything (P2E)

Studies have shown that integrated use of various energy infrastructure and carriers (also known as sector coupling) can lower the cost of energy transition. This is also the premise for E-LAND project. The EU commission has recognized this and has released its paper providing information on techno-economic and regulatory barrier on this issue (van Niddel et al., 2018). This paper also provide way forward on shaping policies that support efficient sector coupling. European Technology and Innovation Platform of Smart Networks for Energy Transition (ETIP SNET) is an influential body in influencing business and policies related energy market. In its Vision 2050 document it has clearly identified importance of sector coupling (Rainer et al., 2019). The Visions 2050 also provides roadmap towards sector coupling in EU. Power-to-everything (P2E) technologies thus would be central to couple various energy infrastructure and carriers. This section looks into four sub-categories of P2E technologies: 1) Power to gas, 2) Power-to-heat, 3) Vehicle to grid (V2G) & 4) Storage.

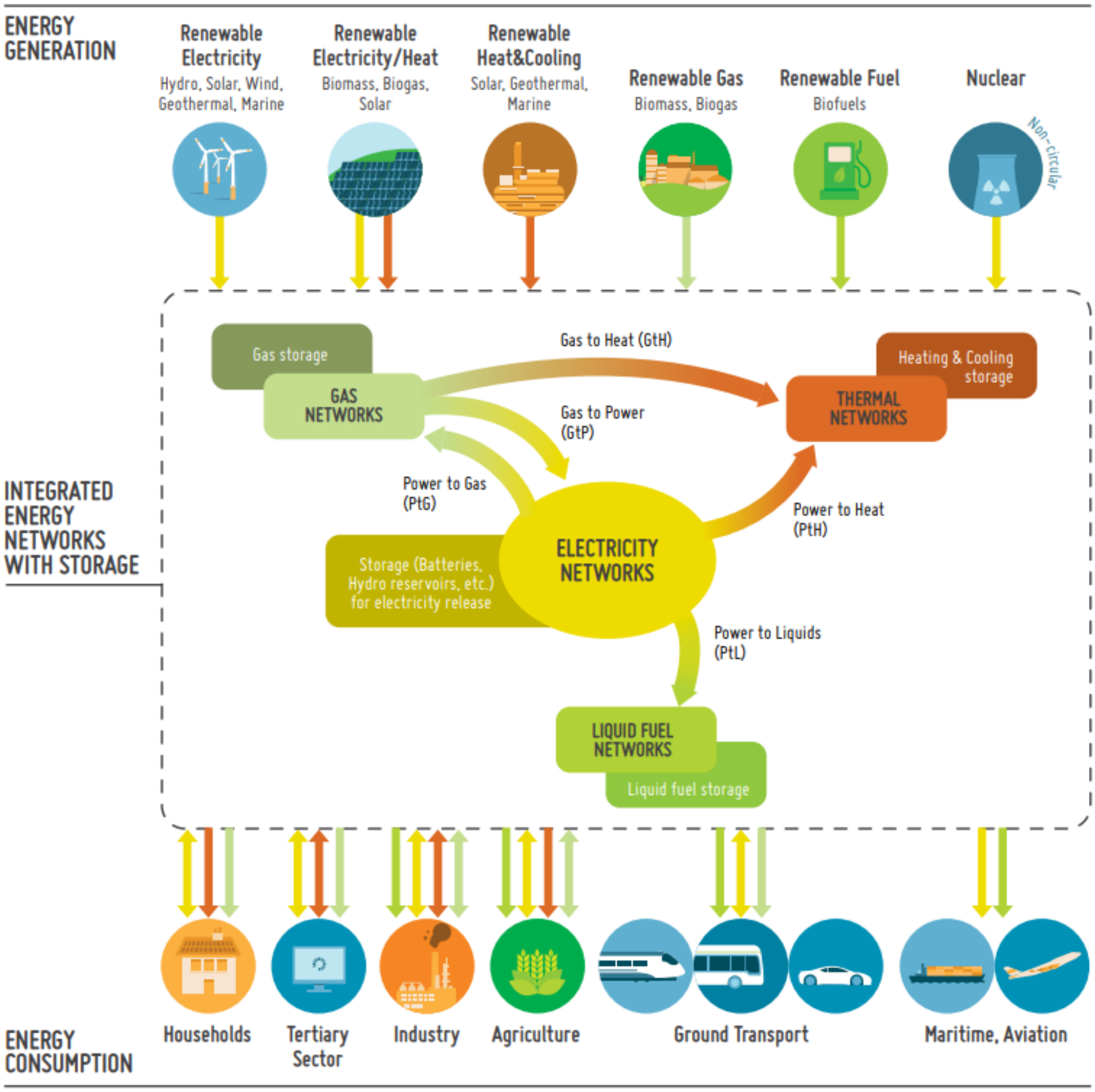

Figure 14: ETIP SNET Vision 2050 showing different P2E technologies.

<u>Power-to-gas (P2G)</u>

Existing businesses and projects currently use P2G technology to convert excess electricity to hydrogen which can then be used in other industrial processes or injected into gas grid (directly as hydrogen or after converting to methane) or can be stored for later use. Current functional business models for P2G are around selling P2G technology to industries which need hydrogen in their core process. Industries also see value in converting hydrogen into heat, or electricity or for mobility purpose locally. By using hydrogen for various energy demands in an industry premise the business can reduce their carbon emissions. In addition to this where possible (from regulation perspective) such industries are allowed to inject excess hydrogen produced in the gas grids. All the cases where P2G is used to provide energy related services to different energy sectors (like electricity and district heating) exist as demonstration projects. Key value proposition being tested in such demonstration projects are:

- Relieving grid during excess generation by conversion to hydrogen (which can either be stored, injected into gas grid, or converted to heat to be injected into heating network).
- Reduce carbon footprint of gas sector ("greening of gas")
- Green fuel for mobility
- Provide balancing services to the grid

European Network of Transmission System Operators for Gas (ENTSO-G) and European Network of Transmission System Operators for Electricity (ENTSO-E) see the potential for integrating gas and electricity sector especially for integrating wind and solar energy. And have therefore released a joint position paper on this topic which recommends further investments in upscaling of P2G plants by a factor of 10. Thus, it is expected that more cases of P2G providing energy services will appear in near future.

Some examples of businesses for P2G for industries:

Company	Short description	Web address
MAN Energy Solutions	German manufacturer of diesel engines and turbomachinery which has also recently ventured into manufacturing hydrogen electrolyzer. It is part of Volkswagen group.	https://www.man-es.com/
Nel Hydrogen	Norwegian based hydrogen electrolyzer solution provider which was established in 1927. Through years of its presence it has developed unique expertise in electrolyzer technology.	https://nelhydrogen.com/
ITM Power	UK based hydrogen energy solution provider. One of the members of UKH2 mobility programe	http://www.itm-power.com/

Examples of demonstration projects in EU can be found on ENTSO-G website and a review pf P2G projects is provided by Wulf et al. (2018).

Power-to-heat (P2H)

P2H is not a novel concept and already exist in places where heating with electricity is cheaper than other sources. Heat Pumps and electric boilers are classic example of P2H technology. However, to utilize P2H from ELAND perspective requires presence of heating networks (see

Figure 15). Such networks are only present in commercial complexes, industries and countries where district heating is primary source of heating. P2H cases from ELAND perspective mostly exist as demonstration projects. Current value proposition from P2H technology is in reducing dependence on fossil fuel for heating demand and reducing curtailment of excess renewable generation. Again, successful business exploiting P2H to actively provide services to in heating and electricity market is yet to be seen.

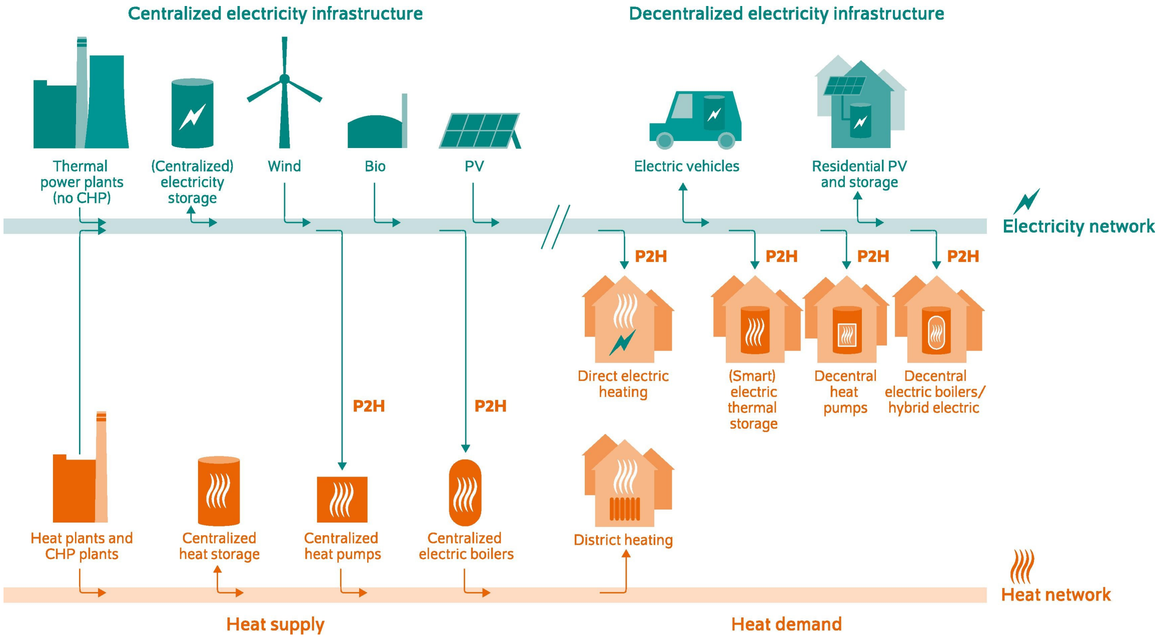

Figure 15: Picture showing interconnection between electricity and heat networks using P2H technologies. Source: Bloess et al. 2018.

<u>Vehicle-to-grid (V2G)</u>

Electric vehicle penetration in the market is very low and among them very few vehicles exit which have capability to supply power back to the grid (or to home or building). Nissan, Mitsubishi and PSA Groupe vehicles are the only ones which are V2G enabled in the market currently. As such all the cases of V2G currently are demonstration ones. Report on 50 V2G projects in world shows that V2G has potential to be an effective flexibility source which could benefit various market players like DSOs, TSOs, BRPs and building owners (V2H) (Everoze, 2018). However functional business case around V2G requires regulations, higher EV penetration and clearly defined incentives to provide flexibility to the grid.

<u>Power-to-Storage (P2S)</u>

Storage technologies which exist today are categorized as either chemical (e.g. hydrogen), electrical (e.g. capacitors), electrochemical (e.g. batteries), thermal (e.g. molten salt) or mechanical (e.g. pumped hydro). Each of storage type has its own application range and uses within energy system. The most advanced and popular storage so far is Li-ion batteries. Key value proposition for such batteries are: reduction in peak, increased self-consumption, additional revenues for providing services to the grid. Major market players are Tesla, LG, Panasonic and Samsung. In many cases, like for home owners, the battery storage is still not economically attractive case. Utility scale battery storage have shown to have more attractive business case.

Other storage technologies like hydrogen, underground storage, and flow batteries are gaining momentum. Hydrogen is emerging technologies as it has potential to be used in many other energy sectors like transport, heating and gas. Additionally, it has proven to be an effective seasonal storage form which when coupled with battery storage can drastically reduce cost of electricity while integrating renewables at the same time (Kharel & Shabani, 2018). However, such storage technologies needs to mature further to get market attention.

Flow batteries are spacious but have an advantage over lithium batteries in terms of having unlimited charging-discharging cycles. H2020 project INVADE[11] shows that flow batteries can have business case with utilities where it can be used at distribution level to manage the grid. Overall storages in order to be attractive business cases need to stack multiple values together. Sector coupling opens new markets for storage to provide additional values thereby becoming commercially more attractive.

2.3.2 Low-cost/high functional energy management systems

Today's energy management systems (EMS) can be broadly divided into two categories: 1) grid side EMS looking into operations of energy network (electricity, heat, gas, etc) and 2) End user side EMS looking into consumer energy asset management. Building EMS and microgrid EMS come under end-user EMS. Currently all the EMS work with single energy vector at a time thereby having different EMS for each vector. The scope of E-LAND is on end-user side EMS and thus this sub-section looks deeper into it. Key functions of end user EMS are:

- Basic energy information portal
- Maintenance programs
- Energy consumption benchmarking
- Advanced building analytics
- Advanced metering infrastructure (AMI) analysis
- Automated building control

[11] More information here: https://h2020invade.eu/

- Building optimization
- Ongoing performance analysis
- Demand response
- Energy dashboard
- Measurement and verification
- Notifications and alerts

Previously end-user EMS was limited to commercial buildings and large multi-tenant buildings as business case was more favorable. Siemens, ABB, Schneider Electric, GE and Eaton are the major market players providing such solutions. But with increased DER, emergence of IoT and EVs there has been increasing trends of home energy management systems and EV charging management systems are emerging. With this new plethora of players are emerging in this market including platform giants like Google and Amazon. Sensors, controllers and ICT are key building blocks of any EMS and with these in place multiple cloud platforms are being build on top to create new values. E-LAND EMS is a similar platform which connects individual EMS (focusing on single vector) together and sits on top of them.

2.4 Implications for E-LAND

In combinations the trends affect the E-LAND project and the respective E-LAND business models in important ways. First, the trends have an impact of current and future customers. This impact can be for instance seen when considering the increasing relevance of integrated energy networks. The coupling of electricity with various kinds of energy networks and consumption, leads to novel actors on energy market. Second, the impact refers to the value propositions (hence the products and services) that customers require. Supported by sustainable requirements of the society and respective policy (e.g. climate policy), novel kinds of value propositions are expected. Examples are more sustainable energy services with lower CO_2 emission or services for prosumers how combine production and consumption of energy in one or across multiple energy vectors. Third, the impact refers to the value delivery. For instance, the increasing relevance of eco-system makes collaboration and interdependent business model co-innovation much more important. Products and services are increasingly delivered through different partners, which might even come from diverse industries. Finally, the market trends, such as for instance the prices have a profound impact on the financing and profitability of business models. While traditional supply of energy might be associated with increasing costs (e.g. due to increasing CO_2 prices), markets provide novel opportunity for monetization such as through reserve markets.

3 Business model innovation in E-LAND

3.1 Foundations

The foundations of business model innovation in E-LAND have been developed and compiled in two main paper projects (see abstract and current status of both papers at the Appendix I). The first paper (Loock, Vernay, Cousse and Latilla, 2019) outlines that business model innovation for digital energy happens in eco-systems in which eco-system partners learn interdependently how to create and capture value in the energy sector by using digital technology. The second paper (Tuiskula, Puranik, Pellerin, Loock & Kunze, 2019), outlines different business model innovation topics that are important for E-LAND to be considered.

Business models are defined as mediating devices to create and capture value from digital technology in the energy industry (see both papers for academic references and foundations of this definition). Business models specify (i) who the customers are, (ii) what the value proposition is, (iii) how the value delivery is organized and (iv) how the monetization takes place (Baden-Fuller & Heafliger, 2013). We refer to important reviews for research on business models for further information (such as Massa, Tucci and Afuah, 2016). Business model innovation is defined as “designed, novel, and nontrivial changes to the key elements of a firm´s business model and/ or the architecture linking these elements” (Foss & Saebi, 2017, p. 216).

Business model innovation in E-LAND builds on existing research on business model innovation in the energy sector. Novel business models are increasingly built on “couple-services” to avoid (if possible) the dependence of costly assets (see for instance for specific flexibility-based business models in Helms, Loock & Bohnsack, 2016). It is important for novel business models in the energy sector that they meet customer demand. Often, such as in the willingness-to-provide flexibility, customer demand is dependent on specific contingency factors to the business model. For instance, it has been proven to be relevant what technology is applied exactly and what kind of payments and incentives are offered to customers and prosumers (e.g. Kubli, Loock & Wüstenhagen, 2018). Based on the different customer and prosumer preferences it is important to map business models with market segments that might be attracted by those business models. Not all energy related business models fit to each market segment (see Curtius, H, Künzel, K, Loock, M, 2012).

In addition, the process of business model innovation from the E-LAND perspectives considers three important pillars: (i) business model innovation is a co-learning process among different partners in an eco-system (for more details see Loock, Vernay, Cousse and Latilla, 2019). (ii)

Business model innovation sometimes is supported by patterns (see Gassmann et al., 2014 and Lüdeke-Freund et al., 2018). The pattern approach to guide business model innovation will become important in the further development of the E-LAND project as for the E-LAND toolbox specific E-LAND business model patterns will be developed. (iii) Business model innovation also relates to the configuration of simple rules and it is of interest how single parts of the business model (and its respective simple rules), really fit to each other so that they form a consistent business model (Loock & Hacklin, 2015).

3.2 Business model innovation topics

Business model innovation with a narrow focus on E-LAND relates to four different innovation topics. The topics have been developed in an interactive manner among ELAND collaborators. The results are developed towards a paper on E-LAND specific business model innovation topic, which also will serve as a starting point for the development of the E-LAND business model patterns later in the project (in task 7.3).

Four business model innovation topics are of relevance to the E-LAND project. They can be identified along a two-by-two matrix. On one dimension differentiates between single vectors vs. multiple vectors. The differentiation works based on the comparisons of input and output vectors and relies on specific set of criterias as described by Mancerella (2014). If the input is electricity vs. the output thermal storage, then it is a multi-vector approach, if the input and output relate to the same vector, then it is considered single vector. Further, if there is multiple input and single output and/or single input and multiple output then it is multiple vectors if not it is considered single vectors. An additional condition relates to measures: if more than one vector is measured and subject to optimization then the model is considered multi-vectors, if not then single vector. The other dimension of the matrix is organized based on a differentiation between "device only" vs. local community. An important aspect within this differentiation is the device ownership. If the device is owned by the prosumer then "device only" if the ownership is different "then beyond device / local community". Table 2 provides an overview.

Table 2: Business model innovation topics matrix.

	Novel approaches to single energy vectors *(e.g. electricity only)*	**Novel approaches to multiple energy vectors** *(e.g. different forms of electricity, heating, mobility, etc.)*
Device only *("easy to do")*	Business model innovation topic 1	Business model innovation topic 2
Local community *("more challenging, more potential")*	Business model innovation topic 3	Business model innovation topic 4

There are further arguments for structure within the cells. In comparison of innovation topic three and four there appear to be differences in regard to devices is not owned by prosumer towards novel approach of sharing and novel local market structure. A comparison between innovation topic two and four points to different types of energy vectors: mobility (vehicle-2-grid), heat (power-2-heat), hydrogen (power-2-gas) that are to be considered, with some of them being more "easy to do" and some of them requiring a local community and being "more challenging but with more potential". Within in the cell of innovation topic 1 business models are also different regarding if they relate to a (physical) device or if they relate to a more intangible software-driven service which may or may not be coupled to a device (see Helms, Loock & Bohnsack, 2016). This work will be further developed in task 7.3 together with pilots and external stakeholders. The final business model innovator framework will be documented in D7.2. This innovator framework shall support new business model development for variety of stakeholders.

3.3 Benchmarks for business model innovation in E-LAND for each topic

After developing the first draft of framework we have then identified important business model innovation across Europe that are relevant for the E-LAND project. Each of the E-LAND collaborators involved in the task has identified important business model innovations. We have then collectively evaluated each of the business model innovations in regard to fit with the E-LAND project and in regard to the business model innovation topics. Through this process we have been able to refine the business model innovation topic. Further, we have been able to classify the different business model innovations based on the topic framework. Table 3 provides an overview of the relevant business model innovation projects in relation to the different topics. We also provide links for further information. This list and classification serve as a collection of benchmark cases for the further development of business model innovation in E-LAND. The aspiration of E-LAND is to build on these cases as state-of-the-art in the energy industry, but also to go beyond these cases in the further development of E-LAND specific business models. One way of going beyond existing cases would be to add new business model patterns to them which bring in complementary benefits.

Table 3: Business model innovation topics and corresponding identified benchmark cases.

Business model innovation topic (BMIT)	**Benchmark cases (selection)**
BMIT 1	• E.ON Solar Cloud • ThermoVault: http://www.thermovault.com • Kiwi Power: https://www.kiwipowered.com • https://www.alpiq.com/energy-solutions/energy-management/green-battery/ • Eneco crowed net: https://www.eneco.nl/energieproducten/crowdnett/ • Piclo (UK), previously open utility: https://piclo.energy/ • Shopping center Sello (Vibeco) • Nurmon, Finnland • Entelios managing flexibility: https://www.entelios.com/ • Smartly: https://www.smartly.no • Open Energi: https://www.openenergi.com • https://www.alpiq.com/energy-solutions/digital-energy-solutions/reference-werdhoelzli/ • E-Smart Systems / Connected Prosumer / Connected Grid: https://www.esmartsystems.com/
BMIT 2	• Hafenstrom: https://hafenstrom.com • Tiko: https://tiko.energy • Cut Energy in Germany (big industrial storage): http://www.cut-energy.de (also active in water management/ optimize pumping;) • Plug n Roll: https://plugnroll.com (connecting to the electricity network and provides service to transportation) • Power-2-gas (see section 2.3.2)

	• Alstom: https://www.alstom.com/de/our-solutions/rolling-stock/coradia-ilint-der-weltweit-erste-wasserstoffzug • Primeo Energie: https://www.primeo-energie.ch/de/gridsense (because can be applied to multiple vectors)
BMIT 3	• Nodes market place: https://nodesmarket.com • https://www.wemag.com/produkte-gewerbe/batteriespeicher • Vandebron, NL: https://vandebron.nl • Node Energy: https://www.node.energy • Blockwerke; https://www.presseportal.de/pm/128710/4184918 (Swiss alternative: https://quartier-strom.ch • Sonnen Community; https://sonnen.de/sonnencommunity/ • Next Kraftwerke: https://www.next-kraftwerke.de (optimize spot markets vs. Balancing markets) • Crowdfunding platform: https://joukonvoima.fi/en/?_ga=2.94832348.1740204251.1571225546-1322447963.1570174980 specific for sustainable projects -> adding the crowdfunding aspect in relation with the sustainable is the core argument (most of the projects are funded on the platform are in relation to energy, but not all) • Bitlumens: https://bitlumens.com • Rural spark: https://www.ruralspark.com/
BMIT 4	• https://euref.de Green university campus/ EUREF campus (mostly based on Schneider technology) • Energy village: https://nef-feldheim.info/energieautarkes-dorf/ • Ascha, Bayern: http://www.kommunal-erneuerbar.de/energie-kommunen/energie-kommunen/ascha.html (community driven, local citizen invest into a cooperative) • Lemene, Finland: https://www.esitteemme.fi/lemene/WebView (special focus on social energy, share resources: gas, electricity heat) • Smart Energy Aland, Finland (flexens) (focus on whole island: this is different to E-Land) https://flexens.com/the-demo/. • Green Energy Showroom, Eastern Finland https://www.greenreality.fi/en/network/what-greenreality-network

4 E-LAND pilot interviews

In collaboration with WP2 interviews have been conducted with the pilot representatives and also with WP2 representatives shortly after the pilot-site workshops conducted for WP2. Full transcripts of the interviews are internally available to project partners on request. To process the interview data in WP2 a scientific paper has been developed, which is currently under review in a scientific journal (Loock, 2019: "When heuristics fix one problem but not the other: Progressing The E-LAND project from Formation to Implementation"). The paper lays out a distinct methodology of how to adopt E-LAND specific rules in a stepwise approach. In order to fully display this approach we refer directly to the paper.

The interviews have important implications also for the business model innovation development in WP7, as some of the initial approaches in the DOA are required to be changed slightly. For WP7 it provides inputs to identify relevant stakeholder to engage from pilot sites through task 7.2 and formulate engagement strategy. Additionally, it is clear that personals from higher management have to be involved which have decision making power to support innovation in business models. As such findings from pilot interviews will help in strategizing gathering of inputs related to business model innovation in next phase of the project. A strategy to involve stakeholders for business model innovation will be provided in deliverable D7.2.

The table below summarizes important findings from the interviews.

Table 4: Example of E-Land guidelines (heuristics) and how and why they change from the project formation to the project implementation phase.

Initial heuristic (which works well for the project formation phase)	***How it works for the project formation***	***How it does not work for the project implementation***	***Revised heuristics (which changes the initial heuristics so that it works for implementation)***
For each pilot site "project owners" control the pilot site in favour of Eland.	Is compelling in the formation phase as it clearly delegates the pilot site	Neglects the complex reality: Does not work in implementation as the real structure at the pilot-site is different; pilot site owners are lacking power and direct	*For each pilot site an Eland partner manages the linkages and negotiations between the pilot site, the local stakeholders required in the pilot*

	controlling to one responsible partner.	control to implement things at the pilot site (e.g. Spanish project partner has no direct control over technology park management; Romanian project partner requires approval from supervisors; Hierarchy and strategy is not well defined for the Nordic project partner etc.)	*implementation and the Eland project.* *However, the actual pilot partner in the consortium will still be responsible of fullfilling the DoA requirements related to the specific pilot.*
Use-cases are developed in a sub-task.	Is compelling in the formation phase as it clearly delegates the use-case development to a responsible group of partners.	Sub-task developments in the implementation can move away too far from the proposal.	*Use cases are developed in a sub-task and mapped to the list of KPIs and ambitions as developed in the proposal (minor, through adding).*
The initiator manages and controls Eland.	Is compelling in the formation phase to efficiently manage the process under the given constraints in that relate to the formation phase.	The project is collaborative, involving diverse partners.	*Being a collaborative project, Eland specific hierarchy with the involvement of all partners (with a project coordinator role and a scientific coordinator role, the TMT and project secretary) controls Eland.*
Writing a joined document shall be the central output.	Works in the formation phase, as a joined proposal is required.	The work to be done is too diverse and benefits some degree of division of labour; the project ambition goes beyond “only” writing documents	*Diverse outputs shall be generated as central output (e.g. documents, workshops, business models etc.) and they shall be generated by different parties based on the individual*

			expertise of the partners and assigned roles in the different work packages (e.g. complementary deliverables with different authors).
Single partners contribute and manage their parts.	Works in the formation phase, as it helps to display how partner profile and competence matches with the proposed work; this signals consistency and thus quality of the proposal	Technical and business partners are forming coalitions among each other and do not mingle (as intended in the project)	*Single partners contribute and manage their parts, but the other partners are controlling the distributed work (e.g. through applying a peer-review quality control system). At the end, all deliverables and projects' outcomes are to be accepted by the TMT in a collaborative way.* *In addition, collaboration is encouraged and initiated throughout the project execution between the different experts.*

5 Draft business models for E-LAND pilots

5.1 Background

To draft the business models for E-LAND pilots, we build on business model innovator framework from section 3.2. Especially the description of the draft business models follows the definition of business models and business model innovation as presented in chapter 3.1. (especially i.-iv) Moreover, we outline for each of the draft pilot business models to which benchmark from the case collection in chapter 3.3) they relate to and how the draft E-LAND business models may go beyond the state-of-the-art of the particular benchmark. For developing draft business model extensive face-to-face discussions and meetings were organized with pilot owners to understand their business ambitions. The drafts have been developed together with Erik Gjesdal (SE), Sanket Puranik (SIN) and Moritz Loock (UNISG). Conceptual views of all the pilots can be found in deliverable D3.1 – Use case definitions.

5.2 Romanian E-Land pilot site

The suggested business model for the Romanian E-LAND pilot site can be described as a "Romanian EUREF-Campus". This related to BMIT4 such the business model relates to the EUREF campus in Berlin[12]. But it is also different in important regards compared to the EUREF campus and is therefore complementary to it. The difference is: (1) The business model of the Romanian E-LAND pilot site is closely linked to Romanian and Eastern European prosumer and grid requirements and regulations. (2) The business model is a laboratory that encourages and supports local entrepreneurship (3) The business model has a particular focus on flexibility business models (e.g. ancillary services) and CO2 certification. Business model for this pilot relates to use cases: PUC2, PUC4, PUC6, and PUC8 (see deliverable D3.1 for use case description).

Business model building blocks:

- *Customers:* Local managers, entrepreneurs, students, teachers, researchers and optionally: governmental agencies, NGO's, energy clusters, etc. who are interested in learning the potential of E-LAND related technological potential and business potential.

[12] More information here: https://euref.de

- *Value proposition*: Showcases state-of-the art E-LAND technology and business model patterns, to support local entrepreneurship.
- *Delivery configuration*: EUREF-campus like infrastructure and specific interface to the Romanian and Eastern European requirements.
- *Monetization:* to be developed (maybe like an incubator in which participants pay an access fee).

5.3 Norwegian E-LAND pilot site

The business model may relate to two different features (sub-business models): (1) Land power connection for ships. This requires additional investment into infrastructure. This business model may relate to Hafenstrom[13] (BMIT 2); the ships docking at the harbour will be provided with grid connection to run their auxiliary demand. Ships will be charged for the electricity they consume. Meeting demand of the ships would result in additional peaks in the demand profile of the harbour resulting in increased connection cost. The connection cost would be reduced using demand side management of other loads present at the harbour. This also links to a major support mechanism of the German government which just announced to support “Landstrom”-projects with additional regulation and investments. (2) Increasing self-sufficiency of the harbour island. Harbour is planning to invest in rooftop PV of capacity around half a megwatt. The electricity from rooftop PV, solar thermal (which is already present), energy stored in ground battery storage (currently being installed), smart charging (EVs present at pilot site) and demand side management will be used to increase self-consumption (by using both electricity and heat energy vectors) and reduce electricity connection costs. Overall, the business models relate with a sustainability strategy of the harbour and relate to use cases PUC2, PUC3, PUC4, PUC7, PUC8 (see deliverable D3.1 for use case details). It should be highlighted that there are several businesses that are present at harbour which are not part of E-LAND pilot owner (BIKS). There lies opportunity to further increase self-consumption if other businesses agree to cooperate with BIKS.

Business model building blocks:

- *Customers*: 1) Ships that shall be attracted to use the harbour. 2) Themselves, to reduce energy costs

[13] More information here https://hafenstrom.com

- *Value proposition*: 1) Access to sustainable energy at harbour. 2) increased self-consumption and reduction in energy related costs.
- *Delivery configuration*: 1) The land power connection which will allow ships to turn off their engine. Potential gains from demand side management operation are shared with the ships. 2) Providing optimal operating schedules to all the previously mentioned distributed resources which are part of BIKS.
- *Monetization*: 1) Improved energy management, increased value offered to ships which attracts novel ships, 2) savings from increased self-consumptionand additional gains from demand side management and Flexibility (Ancillary) Service provision.

5.4 Spanish E-Land pilot site

For the Spanish pilot site, it will be especially important to develop a business model that is replicable. The business model has yet to be developed. Some initial considerations are listed below. In addition, potential business models can eventually be inspired by the business models described in Kubli, Loock & Wüstenhagen, 2018.

Some finding related to business side of Spanish pilot based upon visit and face-to-face interactions are:

- ✓ The hydrogen production technology is owned by foundation and thus cannot be used for profit making.
- ✓ Inycom (Spanish pilot owner) is not inclined to have business with flexibility as regulation does not allow it.
- ✓ Demand side management (DSM) is possible with an aim to save on energy costs and reduce peaks. Hydrogen electrolyzer has biggest consumption at whole park and DSM is attractive case to optimally operate electrolyzer. There are feed-in tariffs so there is good business case for DSM.
- ✓ Euref style campus is interesting option for Inycom. They have a school at their site.
- ✓ They do not have clear option for revenue stream.
- ✓ Inycom has complete control over their building. They do have dialogue with administration who are now planning future of the tech park. Close collaboration with electrolyser (Hydrogen foundation of Aragon) exist.
- ✓ Electrolyser company has local microgrid. There are talks about their involvement, but it will be clear by January 2020.

- ✓ Inycom already has lot of PV and many different manageable loads. They do not have any battery storage.
- ✓ Electric cooling and diesel heating (boiler) are part of HVAC system. Interesting case would be to reduce dependency on diesel boilers.
- ✓ Local DSO has power quality issues. Inycom has applied for netting meter to know their consumption so that they can implement DSM to support the grid..

Business model building blocks:

- *Customers*: to be developed
- *Value proposition*: to be developed.
- *Delivery configuration*: to be developed.
- *Monetization*: to be developed.

6 Stakeholder Analysis

6.1 Stakeholder analysis methodology

A five-step approach is used to effectively identify stakeholders and create an engagement strategy moving forward in the project, as described in Figure 16.

Figure 16: Five-Step approach to stakeholder analysis.

Step 1 Identification of stakeholders related to the project, both present in pilots and beyond. These are classified into stakeholders that are *actors in the energy systems* under design, those providing *technology solutions*, *regulatory/advisory* stakeholders and *others*.

Step 2 The core business motivations of each stakeholder are analysed, and narratives are built according to the toolbox components that can they can utilize.

Step 3 Stakeholders are mapped into mapping dimensions described in Section 6.3.

Step 4 Based on stakeholder mapping, key stakeholders are identified for the creation of the SIG.

Step 5 An engagement strategy is formulated for each stakeholder type according to the stakeholder maps and how they can interact with the project.

6.2 Stakeholder classes and narratives

The first step towards analysing the stakeholders is a first classification by the way stakeholders interact with the project. As described in previous deliverables, the E-LAND project proposes a toolbox of components to address technical, business and societal challenges associated with low carbon energy supply in energy islands. Stakeholders are therefore classified as the following:

1. ***Direct beneficiaries:*** those who directly with aspects of the energy systems benefiting from the toolbox
2. ***Technology providers:*** those who provide the equipment used by energy system actors
3. ***Regulatory/advisory:*** stakeholders who shape and influence energy regulations, policies, etc.
4. ***Indirect beneficiaries:*** Other stakeholders who benefit from the outcomes of E-LAND.

Table 5: ELAND stakeholder classes.

Direct beneficiaries	Technology providers	Regulatory/advisory	Indirect beneficiaries
• DSOs • DH provider / network operator • Energy communities • ESCOs • Facility managers / operators • Flexibility market operators • Gas providers • Microgrid operators • TSOs	• Hardware suppliers • ICT industry • Software developers • Storage technology providers	• Associations in energy sector • Energy market regulators • European commission • Governments • Municipalities	• Aggregators • DER owners • Electricity retailers • Energy consumers • Environmental organisations • EV charging infrastructure operators • EV charging infrastructure owners • EV owners • Microgrid asset owners • Research institutes

Each stakeholder listed in Table 5 is analysed to evaluate what E-LAND can bring to their operations. For this, the core business motivations are identified: what is the prime focus of these organizations?

The components of the E-LAND toolbox that are most relevant for each stakeholder are then highlighted. These components are the ICT technology, community and business model outcomes of the project which are described in Table 1.

Finally, a narrative is built that explains how the stakeholders can make use of the relevant components to help in achieving their core motivations: how can each stakeholder make use of the components / outcomes of the E-LAND project in their operations? This analysis is presented in Table 6.

Table 6: Stakeholder motivations and narratives (based upon DoA).

Motivation	Relevant components	Narratives
Aggregator (incl. Virtual Power Plant)		

▪ Increase portfolio size ▪ Increase number of services to DSO ▪ Reducing portfolio deviations	▪ Software algorithms ▪ KPIs visualisation system ▪ Business model exploitation plan	An aggregator can leverage the optimal management of the local resources enabled by the E-LAND system to maximise profits by providing energy services to the grid, as well as participating in wholesale market. With an increased use of local renewable generation, aggregators can reduce deviation from generation and load profiles.
Associations in the energy sector		
▪ Increased market opportunities for technology ▪ Improve investment decisions / planning ▪ Insights into new technologies for management of local energy systems	▪ Software algorithms ▪ KPIs visualisation system ▪ Business model exploitation plan	These associations want to stay up to date with market developments in energy management. Successful innovations as a result of the E-LAND project can be disseminated to association members who could benefit from the solutions. They can also help in standardising technologies.
Consumers		
▪ Improved reliable access to energy ▪ Lower cost of energy ▪ Higher integration of self-generated energy ▪ Economic benefits from providing energy services ▪ Increased involvement in co-creation of sustainable solutions ▪ Capacity to set own sustainability goals	▪ EMS ▪ Battery storage scheduling ▪ CIM	Consumers will have better access to reliable energy. Furthermore, they will benefit from lower-cost energy provided through the E-LAND system. Battery storage and management technologies will increase the usage of self-generated energy. Consumers will be able to participate in providing energy services to gain an additional revenue. Finally, the common impact model (CIM) will involve end-users in co-creation of sustainable solutions to address local needs. Users will have the opportunity to set their own sustainability goals.
Distributed Energy Resource (DER) owners		
▪ Increased integration of distributed energy ▪ Reduction of curtailment ▪ Increase storage efficiency ▪ Extend battery storage lifetime	▪ Software algorithms ▪ EMS ▪ ESB	Asset owners of generation and storage facilities will be able to provide energy services to the grid across multiple energy vectors. Furthermore, the demand and generation forecasting components of the E-LAND system uses machine-learning techniques to improve the accuracy of production planning of renewables. This will increase the market share for distributed energy generators.
DSOs		

▪ High resolution grid monitoring ▪ Improved grid management / reliability ▪ Delaying infrastructure investment	▪ All	From a technical standpoint, the E-LAND system will enable for better grid monitoring and grid management through its software algorithms, MVS, KPIs, etc. Further optimisations of the energy vectors will allow delaying investment in infrastructure. The business model component of E-LAND will also provide critical tools for DSOs to survive in the changing energy landscape. It will explore potential shifts from asset-based business models to service-based businesses and other possibilities which are widely discussed in the DSO community. Finally, CIM and community components of E-LAND will help DSOs properly address needs of local energy communities and engage consumers to implement lasting solutions in their networks.
District Heat (DH) provider / network operator		
▪ Increase services provided by DH network	▪ MVS ▪ EMS	DH providers and network operators will be able to participate in providing energy services in different energy vectors through the E-LAND system. This increase the market opportunity for technologies using thermal storage, for example.
Electricity retailer		
▪ Provide the best price of electricity to their customers	▪ Software algorithms ▪ KPIs visualisation system	Electricity retailers can benefit from improved forecast of generation and demand using E-LAND's software algorithms. This enables them to trade more efficiently and provide best prices to their customers.
Energy communities		
▪ Improved reliable access to energy ▪ Lower cost of energy ▪ Increased consumption from local energy ▪ Economic benefits from providing energy services ▪ Successful and lasting adoption of new technology ▪ Capacity to set own sustainability goals	▪ EMS ▪ Battery storage scheduling ▪ ESB ▪ CIM	Improving reliability and affordability of access to energy improves of the quality of life of members of energy communities. E-LAND will likely reduce the cost of energy in rural areas by providing lower-cost energy through the E-LAND system. Energy communities will be capable of meeting their energy needs using local energy resources in a sustainable way. They will also benefit from revenue streams by providing energy services to nearby communities, DSOs, or even TSOs. Finally, the CIM is customized for communities to deliver strategies for more successful and lasting adoption of new technologies. Community members will have the opportunity to set their own sustainability goals.

Energy market regulators		
▪ Insights into new technologies for managing local ecosystems	▪ N/A	Regulators can gain insights into new technologies and strategies developed by the E-LAND project.
Environmental organisations		
▪ Gain insights into environmental impact of energy activities	▪ N/A	Environmental organisations will be kept up to date with technical solutions that can contribute to reducing environmental impacts of energy activities and help fight climate change.
ESCOs		
▪ Increased customer interest for investment in local storage / local generation ▪ Explore new service-based business models ▪ Better optimization tools	▪ All technology components ▪ Business model component	ESCOs will benefit from new opportunities of providing services by integrating different energy vectors. This is highly relevant to those dealing with ICT projects. They are likely to pick up outcomes of E-LAND's new service-based business models and optimization tools.
European Commission (EC)		
▪ Achieving climate objectives ▪ Reducing dependency on fossil fuels	▪ N/A	The increased integration of local DES will contribute to achieving the EC climate goals as well as reducing dependency on fossil fuels.
EV charging infrastructure operators		
▪ Reduce cost of charging for end users ▪ Promote sale of renewable energy to end users	▪ Software algorithms	EV charging infrastructure operators can market the sale of local renewable energy to their clients. Furthermore, they can improve their charging optimization by providing grid services across multiple vectors in the E-LAND system.
EV charging infrastructure owners		
▪ Avoid / delay investment in grid upgrades	▪ MVS	EV charging infrastructure owners will be able to avoid or delay investment in grid capacity increase necessary by using grid services across multiple vectors in the E-LAND system.
EV manufacturers		
▪ Increased market opportunities for technology	▪ N/A	E-LAND will provide new opportunities for grid support from EVs and manufacturers are likely to be interested in gaining insights to provide

<table>
<tr><td></td><td></td><td>technology necessary to adequately support this development.</td></tr>
<tr><td colspan="3">EV owners</td></tr>
<tr><td>▪ Charge vehicles at lower cost</td><td>▪ Battery storage scheduling</td><td>EV owners will be able to profit from providing grid services as variable loads. This will lead to possible decreased cost of charging energy, parking, etc.</td></tr>
<tr><td colspan="3">Facility manager / operator</td></tr>
<tr><td>▪ Ensure reliable energy supply to tenants
▪ Promote the use of renewable energy in facility
▪ Avoid / delay investment in grid upgrades</td><td>▪ ESB
▪ EMS
▪ KPIs visualisation system
▪ CIM</td><td>Facility managers / operators will have better access to reliable energy with the E-LAND. Furthermore, the system will increase local consumption of energy within the LES to reduce grid dependency and achieve environmental goals. These stakeholders will be able to maximise their profits by providing energy services to the grid and some can eventually invest towards operating as an aggregator to participate in energy markets.</td></tr>
<tr><td colspan="3">Flexibility Market Operator</td></tr>
<tr><td>▪ Increased presence of DERs
▪ Increased local market interactions</td><td>▪ Software algorithms
▪ MVS
▪ KPIs visualisation system</td><td>The flexibility market operator will benefit from the better integration of the energy management system across multiple vectors. This will facilitate the interaction between the flexibility suppliers in the LES.</td></tr>
<tr><td colspan="3">Gas Provider (GP)</td></tr>
<tr><td>▪ Increase market opportunity for gas</td><td>▪ Business Model Exploitation Plan</td><td>The multi-vector energy management system of E-LAND will increase opportunities across energy vectors, such as gas-boilers capable of providing energy services towards thermal and electric networks.</td></tr>
<tr><td colspan="3">Governments</td></tr>
<tr><td>▪ Achieving climate objectives
▪ Reducing dependency on fossil fuels</td><td>▪ N/A</td><td>The E-LAND project will contribute towards governments achieving EC climate goals.</td></tr>
<tr><td colspan="3">Hardware suppliers</td></tr>
<tr><td>▪ Increase market opportunity for technology</td><td>▪ EMS</td><td>Hardware suppliers will benefit from integrating new energy management technologies into their portfolio.</td></tr>
<tr><td colspan="3">ICT Industry</td></tr>
</table>

▪ Increase market opportunity for technology	▪ Software algorithms ▪ MVS ▪ ESB ▪ EMS	The ICT industry is a key stakeholder in making E-LAND a success story's actors who are already involved in smart grid activities will likely lead the development of ICT infrastructure for multi-vector energy management systems.
Microgrid operator		
▪ Increase share of demand covered by local renewable generation ▪ Ensure reliable energy supply to end users ▪ Decrease reliance on external electric grid ▪ Reduce cost of electricity to end users	▪ All	The operator of the LES operating as a microgrid will be able to utilise flexibility provided across multiple vectors to reduce grid dependency and achieve environmental goals. The microgrid operator can benefit from the CIM to better implement lasting solutions on a local level, as well as identify new revenue streams and future opportunities with the novel business model exploitation plan.
Microgrid asset owners (cables, actuators…)		
▪ Increase market opportunity for technology	▪ N/A	Owners of microgrid assets will benefit from increased opportunities to provide services with their equipment across multiple vectors.
Municipalities		
▪ Ensure access to reliable energy services to residents ▪ Promote local development ▪ Promote the use of renewable energy ▪ Reducing dependency on fossil fuels	▪ CIM	Improving reliability and affordability of access to energy improves of the quality of life of residents. E-LAND will likely reduce the cost of energy in rural areas by providing lower-cost energy through the E-LAND system. Energy communities will be capable of meeting their energy needs using local energy resources in a sustainable way. Finally, the CIM is customized for communities to deliver strategies for more successful and lasting adoption of new technologies. Residents will have the opportunity to set their own sustainability goals.
Research institutes		
▪ Know state-of-the-art of energy management systems ▪ Further the research in the respective field	▪ All	Understanding state-of-the art and further advancing the E-LAND tools. Potential spin-outs from partner universities.
Software developers		

▪ Increase market opportunity for technology	▪ Software algorithms	Hardware suppliers will benefit from integrating new software algorithms from E-LAND into their offerings.
Storage technology providers		
▪ Increase market opportunities for energy storage	▪ Battery storage and battery storage management ▪ EMS ▪ Business model component	E-LAND will increase advantage of having storage vectors in the energy system, which will open market opportunities for storage technology providers. The business model component of the project will enable these players to evaluate such potential models.
TSOs		
▪ Improved grid management / reliability ▪ Receive balancing services at lower cost	▪ Battery storage and battery storage management ▪ EMS	The E-LAND system's tools will provide TSOs with flexibility services when needed, lowering their balancing reserve costs.

6.3 Stakeholder Maps

Two maps are used to describe stakeholders that are impacted by the E-LAND solutions. These maps are based on previous work done by Mitchell et al (1997), and the theory behind them are described in the INVADE H2020 project deliverable D3.2. These maps include the following:

1. Power-Legitimacy-Urgency map
2. Power-Interest-Attitude map

The attributes used to classify stakeholders within these maps are described in the following paragraphs.

1) **Power:** A stakeholder's ability to influence the project's outcomes. For this, it's important to consider:

   a) The ability to affect market pick-up and penetration of the innovation. Including the ability to influence regulations, current market share of stakeholders and geographic presence.

   b) The ability to influence design of the innovation.

   c) Available working capital and ability to mobilise it.

   d) Ability to research and innovate.

2) **Urgency:** This refers to how urgently ELAND outcomes are needed by stakeholders. Urgency provides opportunity for an innovation to be picked-up by the respective stakeholders. Such stakeholders are natural promoters of the ELAND innovations and at the same time could form competition by adopting competing innovations.

3) **Legitimacy:** According to Suchman (1995), legitimacy is "a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions". This explains how a stakeholder's brand image can be positively perceived by society, giving it legitimacy, while a negatively perceived stakeholder will not have legitimacy. For example, renewable energy suppliers having legitimacy while polluting energy suppliers are likely to have no legitimacy in their market actions. Support from stakeholders with legitimacy is likely to boost the uptake of an innovation in the market and create confidence in other stakeholders to invest in the innovation.

4) **Interest:** This evaluates the interest the stakeholder has towards the innovation. For example, the interest could be in adding the innovation to their existing business portfolio or becoming end-user of the innovation. Interest could also be developed if the stakeholder perceives innovation a threat to their business. In this case the stakeholder wants to keep close track on market developments of the innovation. At the early stage of innovation development, it is often difficult to assess the interest of a stakeholder. Therefore, the initial focus here is on understanding the motivation, needs and business strategies of the stakeholders.

5) **Attitude**: Attitude is dependent on the way an innovation affects the existing business models of stakeholders. Attitude is also related to the nature of a stakeholder. For example, if a stakeholder has a conservative approach to the electricity sector, their are likely to resist an innovation which disrupts the sector and would have a negative attitude. Conservative DSOs are typical examples of such stakeholders.

6.3.1 Power-Legitimacy-Urgency map

The Power-Legitimacy-Urgency (PLU) map detailed in this section describes the relationship different stakeholders have with the innovation. The combination of attributes in this map results in a classification of stakeholders according to different groups:

- *Dormant stakeholders:* These stakeholders possess only power. As other attributes are missing these stakeholders remain dormant. Exploitation efforts of the E-LAND project should consider exploiting power of such stakeholders to benefit market pick-up of the innovations.

- *Discretionary stakeholders:* Such stakeholders only possess legitimacy and their role for the success of innovation is often ignored. Gaining acceptance from discretionary stakeholders is an effective way to deal with resistance that innovations often face from incumbents. Support from discretionary stakeholders also attracts powerful stakeholders to adopt innovations.
- *Demanding stakeholders:* Stakeholders with only urgency attribute are demanding stakeholders. They are looking for solutions which can be provided by the innovation. It is important that such stakeholders are identified earlier and are informed about the innovation. Once they realise the potential of the innovation to solve their problem they are likely to adopt it and be its promoters.
- *Dominant stakeholders:* Stakeholders who have power and legitimacy are dominant stakeholders. They don't have urgency and are likely to play a passive role in innovation adoption. However, they should be monitored closely, and when the urgency arises, they can easily adopt and promote an innovation. It is important to remember that if such stakeholders have a negative opinion on the innovation, they are likely to resist its market penetration.
- *Dependent stakeholders:* These stakeholders have legitimacy and urgency but no power. Without power, they depend upon advocacy from powerful stakeholders. In cases where regulations are the biggest barrier for innovation, forming alliances between dependent stakeholders and dormant stakeholders can help in adapting regulations to support the innovation.
- *Vital stakeholders:* Equipped with both power and urgency, these stakeholders are vital to the success of the innovation. The adoption of E-LAND outcomes by vital stakeholders is necessary for exploitation. Vital stakeholders can also adopt innovative solutions from competing initiatives, which can negatively affect the project's impact. Therefore, it is important to follow these stakeholders closely and influence them before they move towards competitors.
- *Definitive stakeholders:* These stakeholders have all three attributes and are high-priority stakeholders. Exploitation activities should channel most efforts to get such stakeholders interested in the project outcomes.

The classification of the stakeholder listed in section 6.2 based on the Power-Legitimacy-Urgency attributes is shown in Figure 17.

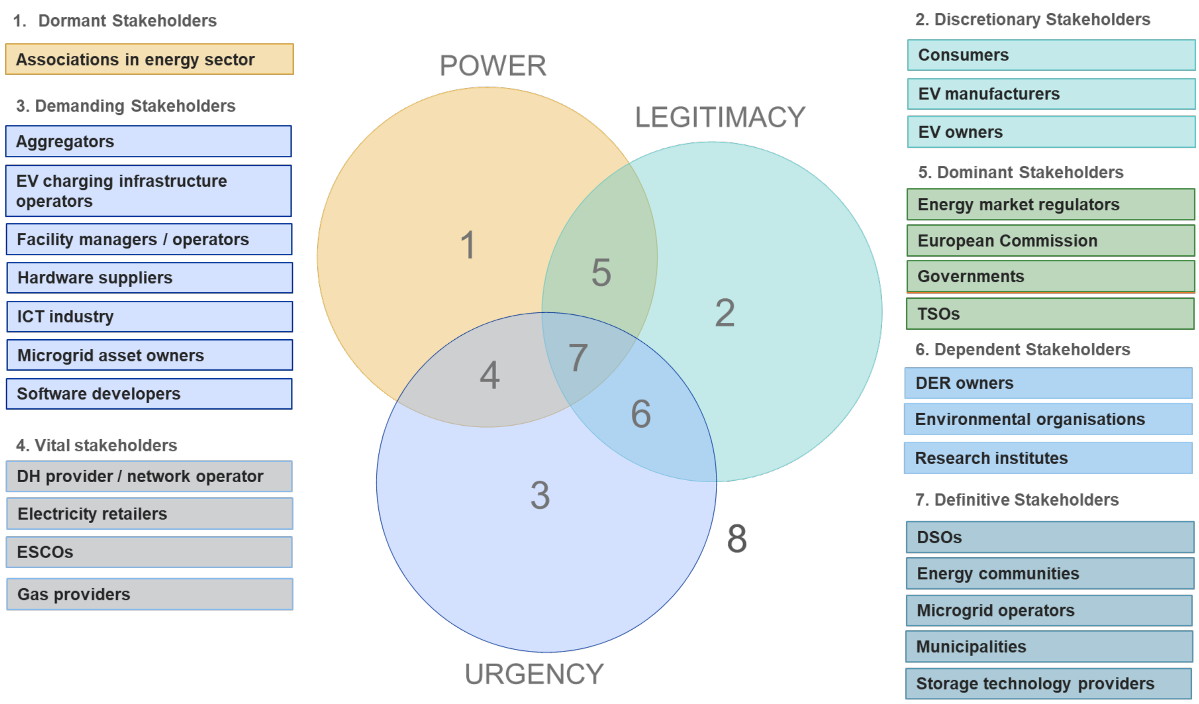

Figure 17: Power-Legitimacy-Urgency mapping of ELAND stakeholders.

6.3.2 Power-Interest-Attitude map

The second map used in the stakeholder analysis, the Power-Interest-Attitude (PIA) map, reflects the behaviour that stakeholders might have towards the project's innovations. This provides inputs towards which stakeholders should be involved in the creation of the Stakeholder Innovation Group (SIG) and has strong influence on exploitation strategies from the project. Mapping of the stakeholders based on these three attributes divides them in the following groups:

- Latent stakeholders: Stakeholders possessing only power are latent stakeholders. They have no interest in actively influencing market development of the innovation. For this, they should form alliances with stakeholders with an addition dimension such as interest or attitude. An example of this can be national and local governments who don't have policies to support innovation.
- Innovation brokers: These stakeholders have power and are interested in what the innovation has to offer. There are usually unsure of how the innovation will impact their business. They act as innovation brokers and test the innovation, for example through initial case studies and pilots, to evaluate its potential. This can be an forward-looking energy manager who is looking to test new innovations.
- Gate keepers: Stakeholders with both power and attitude will either block or allow the innovation to enter the market where they have power. If a gate keeper has positive

attitude towards the innovation, then it is likely to facilitate its market entry. Whereas a gate keeper with negative attitude can block market entry. Associations in the energy sector are an example of powerful stakeholders who can either allow or block innovation depending on their attitude towards an innovation – whether they perceive it as a benefit or a threat to their members.

- *Valiant stakeholders*: Stakeholders with both attitude and interest usually tend to explore new market opportunities, thereby affecting innovation adoption both positively and negatively. If they have negative attitude, they will try to slow down the market uptake of innovation and if they have positive attitude, they could be strategic allies in the market. As valiant stakeholders lack power they cannot block market penetration and growth of an innovation.
- *Agents of change*: Stakeholders with all three attributes are agents of change. Such stakeholders are prime targets for exploitation activities of the innovation. Targeting such stakeholder early in the E-LAND SIG is critical for successful exploitation of the project's outcomes.

The qualitative rating of these attributes leads to the PIA mapping shown in Figure 18.

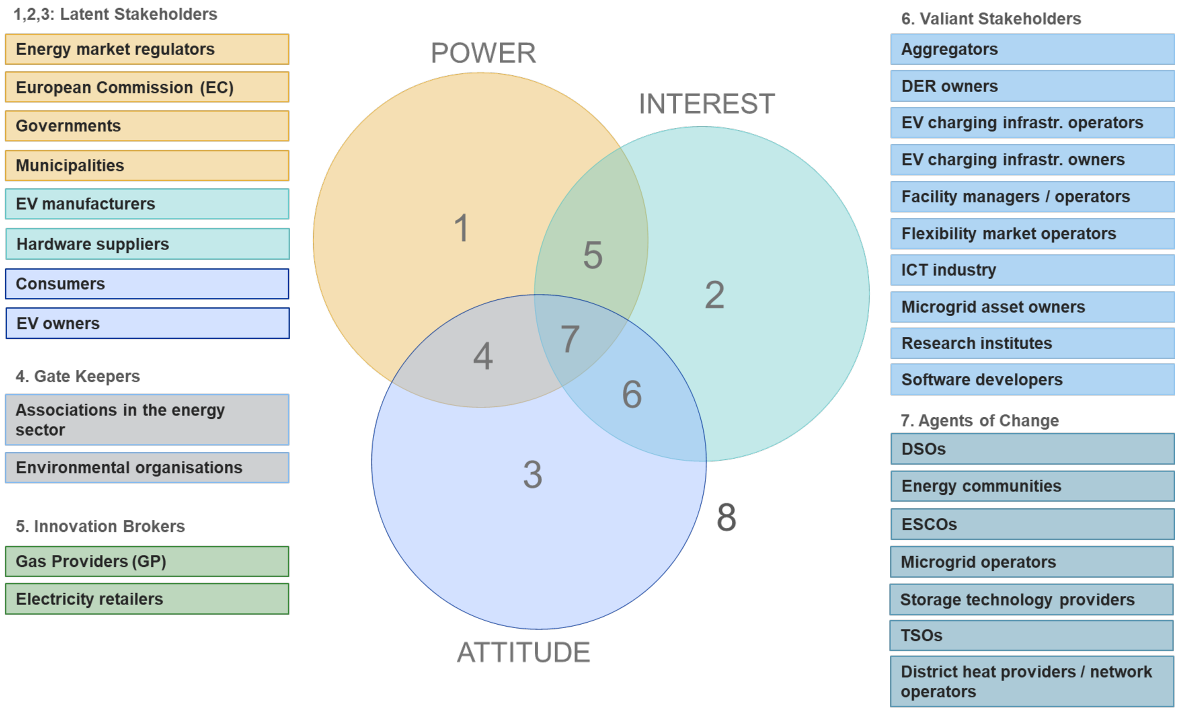

Figure 18: Power-Interest-Attitude mapping of ELAND stakeholders.

6.4 E-LAND pilot business model mapping to stakeholders

In previous section various stakeholder classes have been identified based upon different attribute stakeholder possess. All possible stakeholder which might affect project outcomes are considered and classified in section 6.3. This section looks into specific stakeholders affecting business models of the E-LAND pilots. For this, relevant stakeholders affecting pilot sites are categorized using the maps provided in section 6.3 of this report. In Table 7 stakeholders at pilot sites have been mapped based upon interviews conducted (see chapter 4 and deliverable D2.2). It was not possible to interview all the stakeholders and, in such cases, mapping was done based upon inputs from pilot owners and analysing stakeholder's business goals and activities through internet channels. It should be noted that business model being developed are in initial stages and stakeholder mapping would evolve overtime as the business model matures. The mapping shall later be updated and presented in future deliverable D7.4. Next section will provide information on how best to engage different stakeholders identified so far.

Table 7: Stakeholder mapping pertaining to business models at pilot site.

E-land pilot site	Stakeholders	Stakeholder type (PLU map)	Stakeholder type (PIA map)
Romanian business model	Valahia University of Targoviste: Students	Discretionary	Latent (interest)
	Valahia University of Targoviste: Professors	Discretionary	Latent (interest)
	Valahia University of Targoviste: Adminstration	Dominant	Latent (interest)
	Valahia University of Targoviste: Institute of Multidisciplinary Research for Science and Tehnology (ICSTM)	Owner	Owner
	Schneider Electric	Dormant	Innovation broker
	SDEE Electrica (local DSO)	Dominant	Latent (power)
	Romanian Energy Regulatory Authority (ANRE)	Dominant	Innovation broker

	European Bank for Reconstruction and Development (EBRD)	Dominant	Innovation broker
Spanish business model	Inycom	Ownwer	Ownwer
	Walqa Technology Park Management	Dormant	Latent (power)
	Workers in the Technology Park	Discretionary	Latent (interest)
	Aragon Regional Government	Dominant	Latent (power)
	Aragon Hydrogen Foundation	-	Latent (interest)
	Huesca City Council	Dormant	Latent (power)
	ENDESA (local DSO)	Dominant	Latent (power)
Norwegian business model	Borg Havn IKS (BIKS)	Owner	Owner
	Andersen & Mørck (port operator)	-	-
	Glacio (cooling/refrigeration company at the port)	Discretionary	Latent (interest)
	Nexans (subsea cables company at the port)	Dormant	Latent (power)
	Denofa (Soy bean processing company at the port)	-	Latent (interest)
	Batteriretur (Battery recycling company at the port)	Demanding	Valiant
	Borregaard (lumber company at port – warehouse 14)	-	Latent (interest)
	Fredrikstad municipality	Dominant	Latent (power)

	Sarpsborg municipality	NA	NA
	Fredrikstad Fjernvarme (local district heating provider)	Dormant	Latent (power)
	Norgesnett (local DSO)	Dormant	Latent (power)
	Hafslund (regional grid owner)	Dormant	Latent (power)

6.5 Stakeholder engagement forms and strategy

Various stakeholder engagement forms have been previously identified in H2020 project INVADE (Deliverable D3.1). Engagement forms from INVADE project have been adapted to E-LAND and connected to its various tasks. This adaptation is shown in Table 8. Different engagement forms require different level of efforts thus they must be chosen wisely within availability of resources in the project. The stakeholder engagement strategy in E-LAND identifies engagement forms which should be used for targeting different types of stakeholder classes as identified in previous section 6.3 and 6.4. This forms as a guideline while approaching a particular type of stakeholder. A simple example can be of DSO, when required a DSO (classified as dormant & latent) should be engaged using strategies recommended in tables 9 & 10. Stakeholders over the course of project and during further development of business model can gain more attributes or loose some, as such its classification will change and engagement strategies should be changed accordingly. Under WP7 the stakeholder will be monitored regularly (twice a year) and mapping will be updated accordingly if required.

Table 8: Engagement forms adapted to E-LAND project.

Engagement form	Specification	Abbreviation
Monitoring	Implies following the development in the energy market and smart grid domain closely. It relates to T7.1, T7.2, T7.4 Contribution to standards and policy and regulatory agendas.	MON
General communication	This relates to tasks in WP8	GDA

& dissemination activities		
Surveys	Could be investigations of different sorts to harvest specific answers, e.g., user practices[14] and regulatory barriers. This exploitation form also relates to T7.2 SIG activities.	SUR
Information relay	Relates to effective networking on social media, communication through newsletters and networking in the physical space, e.g., at conferences. Also related to T7.1.	INR
Participation in events	This is an opportunity to single out important and influential individuals and to pick-up developments as well as news about changes in policies. This will also provide inputs to T7.4 Contribution to standards and policy and regulatory agendas. Examples are conventions, conferences and seminars.	PIE
Interviews	Involves interviews and consultation with key people from the industry and government. SIG member will be interviewed but this kind of engagement is not limited to the SIG. This will be part of task 7.5 Exploitation enhancement activities. Provides inputs to T7.6 Business and exploitation plan. This engagement form will also contribute to standards and policy and regulatory agendas.	INT
Demonstrations	Relates to engaging stakeholders to participate in key pilot demonstration events.	DEM
Workshops and project events	Workshops, seminars and conferences are planned in the project. These are crucial events to engage important stakeholders, like SIG members.	WPE

[14] As users are considered the actors which will use the E-LAND innovations.

	Workshop plan has been provided in the DoA and forms part of task T7.5	
Document reviews and feedback	Implies requesting feedback and voluntary peer reviewing of papers and deliverables produced to harvest early feedback. Could be related to T7.4 Policy recommendation and assessment.	DRF
Exploitation partnership building	This includes involvement of the project's SIG. The recruitment of members of this group is important. The effort is related to T7.5 Exploitation enhancement activities and provides input to T7.4 on policy and T7.6 Business and exploitation plan.	EPB

Table 9: Stakeholder engagement recommendation based upon PLU map.

Stakeholder classification	Engagement forms
Dormant	MON, WPE, DEM, GDA, INR, PIE
Discretionary	SUR, INR
Demanding	INR, GDA, DEM, SUR
Dominant	DEM, INT, MON, PIE, EPB
Vital	PIE, EPB, FFC, MON, WPE, INR, PPM, SUR
Dependent	EPB, WPE, INR, SUR
Definitive	INT, SUR, EPB, WPE, INR, DEM, MON, DRF

Table 10: Stakeholder engagement recommendation based upon PIA map.

Stakeholder classification	Engagement forms
Latent	MON, DEM, GDA, INR, WPE, SUR
Innovation broker	SUR, INR, DEM, EPB, PIE

Gate keepers	MON, INR, GDA, DEM
Valliant	DEM, INT, MON, PIE, EPB, WPE
Agents of change	SUR, EPB, WPE, INR, DEM, MON, DRF, PPM

6.6 Recommendations for SIG

Stakeholder Innovation Group (SIG) is a limited group of stakeholders external to the project who will be vital to maximizing impact beyond the project. The SIG will be convened to workshops to provide feedback on the project, share insights and help identify business havens that are ripe for business exploitation of the E-LAND concepts. SIG members will be recruited using business connection of consortium members. From stakeholder analysis WP7 has identified the stakeholder types that are most likely to be influential, these are:

- Energy communities
- Microgrid operators
- ESCOs
- Utilities providing: district heating, gas, electricity
- Storage technology providers
- Municipalities
- Regulators
- Associations in the energy sector

Consortium members are recommended to identify above mentioned type of stakeholders for SIG. Based upon the recommendations some of the project partners have nominated relevant stakeholders to WP7. Recruitment of SIG started from month 7 (M7). It is an ongoing process and salient members would be recruited throughout the project lifetime. Four workshops with SIG have been planned two in Europe (in M18 & M37) and two with Indian stakeholders (M22 & M34).

7 Way Forward

In this deliverable we have provided an in-depth market and stakeholder reviews which sets foundation for business model innovator tool creation and exploitation activities. Trends and benchmark business cases in energy sector are identified and mapped into 2 by 2 matrix prepared in the project. Additionally, initial draft for pilot business models are provided.

However, it is realized that more work is needed to be done in the project before a mature version of draft business models for pilots are ready to be tested. The steps forward are step 2 & 3 of following generic approach of WP7:

(1) The first step is building the foundations of business model innovation in the E-LAND context. This step has been achieved through this deliverable and the associated scientific papers to which we refer in the appendix.

(2) the second step is the development of the E-LAND business model patterns and further maturing the business model innovator framework drafted in this report. This step has been planned for the coming year. It builds on step (1) and has already been initiated. A crucial aspect will be to define business model patterns that are closely linked to the E-LAND specific ambitions, activities, technology and pilot-site testing. This step shall lead to creation of a catalogue comprising 25 business model patterns pertaining to E-LAND. Relevant stakeholders from pilot sites and external stakeholders from SIG will be consulted for the business model pattern catalogue.

(3) The concluding final steps refers to the actual strategy engaging stakeholder who are key beneficiaries of E-LAND tools (as identified in DoA) by using the E-LAND business model patterns for stakeholder specific design of business models. Based on the patterns it is planned to develop a teaching case study including a seminar concept that proposes of how to utilize the E-LAND business model patterns for different stakeholders. It is intended to develop the methodology of engaging stakeholders in E-LAND business model innovation through interdependent usage of the E-LAND business model patterns and by learning how to best design business models by combining E-LAND business model patterns. Step 3 is scheduled right after the development of the E-LAND business model patterns. A written case study description will capture how this process works. Here again feedback will be gathered from SIG members.

The work will be set-up to meet the distinct KPI`s as mentioned in the DOA on p. 40:

Table 11: Table from DoA about business related KPI's.

Number of potential services identified from the community to the DSO (5)	All pilots	All activities related to creating business development tool and of WP7	Business development tools
Number of business model patterns viable for E-LAND (25)	All pilots	Pilot activities and pilot actors support the development of viable business model patterns and provide the possibility to evaluate the viability.	Business development tools

8 References

Bacher, R., Peirano, E., and Nigris, M. ETIP SNET Vision 2050 (2018). [Online]. Available: www.etip-snet.eu/etip-snet-vision-2050/

Baden-Fuller, C., & Haefliger, S. (2013). Business Models and Technological Innovation. Long Range Planning, 46(6): 419-426.

Bloess, A., Schill, W.P. and Zerrahn, A., (2018). Power-to-heat for renewable energy integration: A review of technologies, modeling approaches, and flexibility potentials. Applied Energy, 212, pp.1611-1626.

CEDIGAZ (2019 a): The Global Gas Market in 2018, 14th of May 2019; Online: https://www.cedigaz.org/the-global-gas-market-in-2018/

CEDIGAZ (2019 b): Natural Gas Demand Grows Strongly by 40% from 2017 to 2040, August 5th, 2019; Online: https://www.cedigaz.org/natural-gas-demand-grows-strongly-by-40-from-2017-to-2040-supported-by-air-quality-policies-abundant-low-cost-supplies-and-the-expansion-of-lng-trade/

Chesbrough, Henry / Bogers, Marcel (2014): Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation, in: Chesbrough, Henry / Vanhaverbeke, Wim / West, Joel (eds.): New Frontiers in Open Innovation, Oxford: Oxford University Press, 2014, pp. 3 – 28.

CNBC (2019): OPEC lowers forecast for oil demand growth, says its own market share is dwindling, 5th of November, 2019.

CEP, (2019). Clean energy for all Europeans, Spring Package 2019. Available online: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans.

Curtius, H, Künzel, K, Loock, M (2012): Generic Customer Segments and Business Models for Smart Grids, derMarkt: International Journal of Marketing, 51:63–74.

De Decker, Jan De Keyser, Elias Kreutzkamp, Paul (2019): Lessons learnt from Germany´s mixed price system, Cologne, 23rd of July, 2019; Online: https://www.next-kraftwerke.com/energy-blog/lessons-reserve-power-market.

ENTSO-E – ENTSOG Joint Paper, October (2018). Power to Gas – A Sector Coupling Perspective. Available online: https://www.entsog.eu/sites/default/files/files-old-website/publications/Press%20Releases/2018/ENTSOs%20Position%20on%20Sector%20Coupling_Madrid%20Forum.pdf. North Sea Wind Power.

Everoze, 2018. V2G GLOBAL ROADTRIP: AROUND THE WORLD IN 50 PROJECTS.

European Union, Office for Official Publications of the European Communities, & Statistical Office of the European Communities. (2011). Food: From Farm to Fork Statistics. Office for official publications of the European Communities.

EU Commission (2018): “Digital Ecosystems,” Directorate General Information Society and Media, European Commission; Online: http://www.digital-ecosystems.org.

Eurostat (2019), Electricity Price Statistics (data extracted in May 2019); Online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics#Electricity_prices_for_household_consumers

Foss, N. J., & Saebi, T. 2017. Fifteen Years of Research on Business Model Innovation. Journal of Management, 43(1): 200-227.

Fraunhofer (2019): Öffentliche Nettostromerzeugung in Deutschland 2018: Erneuerbare Energiequellen erreichen über 40 Prozent, Freiburg/Breisgau, 02.01.2019; Online: https://www.ise.fraunhofer.de/de/presse-und-medien/news/2018/nettostromerzeugung-2018.html

FT, (2019). Green parties emerge as big winners in European Parliament elections. Financial Times. Available online: https://www.ft.com/content/56183ac6-807a-11e9-9935-ad75bb96c849.

Gassmann, O., Frankenberger, K., & Csik, M. (2014). The business model navigator: 55 models that will revolutionise your business: Pearson UK.

Helms, T, Loock, M, Bohnsack R (2016): Timing-based business models for flexibility creation in the electric power sector, Energy Policy (92): 348-358. (Impact Factor: 4.880)

INVADE D3.2, (2017). Stakeholder Analysis. Available online: https://h2020invade.eu/wp-content/uploads/2018/02/D3.2_Stakeholder-analysis.pdf

INVADE D9.2, (2018). Input on user behaviour and technology domestication amongst users to the business model development. Available online: https://h2020invade.eu/wp-content/uploads/2017/06/D9.2-Input-on-user-behaviour-and-technology-domestication-amongst-users-to-the-business-model-development.pdf.

Kotilainen, Kirsi / Sommarberg, Matti / Järventausta, Pertti / Aalto, Pami (2016): Prosumer centric digital energy ecosystem framework, MEDES'16, November 01-04, 2016, Biarritz, France.

Kotilainen, Kirsi / Järventausta, Pertti / Aalto, Pami (2017): Prosumer centric co-creation in Smart Grid innovation ecosystem, IEEE Innovative Smart Grid Technologies Conference Asia (ISGT-Asia), Melbourne, VIC, Australia, 28th of Nov – 1st of Dec 2017.

Kharel, S., & Shabani, B. (2018). Hydrogen as a long-term large-scale energy storage solution to support renewables. Energies, 11(10), 2825.

Kubli, M, Loock, M and Wuestenhagen, R (2018): Co-Creation innovation with flexible prosumers: Exploring willingness to provide flexibility in power markets, Energy Policy (114): 40-548 (Journal Impact Factor: 4.880)

Loock, M, and Hacklin, F (2015): Business modeling as configuring heuristics, Advances in Strategic Management (33): 187-205.

Loock, Verney, Cousse & Latilla (2019): Business model innovation in digital transformation: Proximity and the alignment paradox (currently under 2. round review).

Léautier, Thomas-Olivier / Crampes, Claude (2016): “Liberalisation of the European electricity markets: a glass half full”, Florence School of Regulation, published on 27th April 2016.

Lüdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., & Breuer, H. 2018. The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. Sustainable Production and Consumption, 15: 145-162.

Mancarella, Pierluigi. "MES (multi-energy systems): An overview of concepts and evaluation models." Energy 65 (2014): 1-17.

Massa, L., Tucci, C., & Afuah, A. (2016). A critical assessment of business model research. Academy of Management Annals.

Mazhelis, O. / Tyrvainen, P. (2014): "A framework for evaluating Internet-of-Things platforms: Application provider viewpoint," Internet Things (WF-IoT), 2014 IEEE World Forum, 2014, pp. 147–152.

Meeus, L. / Purchala, K. / Belmans, R. (2005): Development of the internal electricity market in Europe, Electricity Journal, 18(6), pp. 25-35.

Moore, J. (1996): The Death of Competition - Leadership and Strategy in the Age of Business Ecosystems. Wiley, 1996.

Schjolset, S. (2014). The MSR: Impact on market balance and prices. In Point Carbon. Thomson Reuters.

Strategy & PWC (2018): Oil and Gas Trends 2018-19 – Strategy Shaped by Volatility, 2018.

Tuiskula, Puranik, Pellerin, Loock & Kunze (2019): Business model co-innovation in the energy sector: Drivers, topics and perspectives (in preparation for submission to a scientific journal).

Van Nuffel, L., Gorenstein Dedecca, J., Smit, T. and Rademaekers, K. (2018). Sector coupling: How can it be enhanced in the EU to foster grid stability and decarbonise. Trinomics BV Retrieved from http://www. europarl. europa. eu.

Wulf, C., Linßen, J. and Zapp, P. (2018). Review of power-to-gas projects in Europe. Energy Procedia, 155, pp.367-378.

Appendix I

Author's note: The current versions of the papers are available to ELAND partners on request and these papers are under review for publication in academic journals.

Paper 1: Loock, Verney, Cousse & Latilla (2019, under review)

Citation, status (invited to be presented in Milano)

Citation/ status: *Loock, Verney, Cousse & Latilla (2019): Business model innovation in digital transformation: Proximity and the alignment paradox (currently under 2. Round review in an academic journal, invited to present at journal specific conference in Milano in December 2019).*

Importance to E-land: This paper builds the scientific bases for business model innovation in ELAND. It outlines how business model innovation is a process of interdependent learning of partners in an eco-system. It advices ELAND and beyond to facilitate the interdependent learning in specific ways.

Abstract: Business model innovation is central to digital transformation. But we do not know how different partners, undergoing digital transformation, learn together to develop novel business models. This paper draws on in-depth case study analysis, from which a novel theoretical model emerges: Business model innovation is a process with the twofold, paradoxical goals of achieving alignment among ecosystem actors and of creating ongoing innovation through digital technology. We show how business model innovation is a process of interdependent learning that contributes to solving the alignment paradox. We further show how proximity to digital technology, customers, and other actors in the ecosystem affects this process. Important implications and opportunity for future work are discussed.

Paper 2: Tuiskula, Puranik, Pellerin, Loock & Kunze (2019)

Citation/ status: *Tuiskula, Puranik, Pellerin, Loock & Kunze (2019): Business model co-innovation in the energy sector: Drivers, topics and perspectives (in preparation for submission to a scientific journal).*

Importance to E-land: This paper develops a frame of reference for the further business model innovation in ELAND. It points to important innovation topics and to benchmark in the European energy industry. The paper will help the ELAND project to build on existing business model innovations and to go beyond these benchmarks in developing and testing ELAND specific business models.

Abstract: What are important aspects of business model co-innovation in the energy domain? This paper lays the foundations of the work on business model innovation in the E-Land project. In particular, the paper prepares the work and publications on business model innovation patterns (paper and teaching case/ workshop concept). For that, this paper reviews the relevant literature on business model co-innovation. Further, the paper structures important recent developments in the energy sector which act as drivers for business model co-innovation. These drivers are linked to two important influencing factors of business model co-innovation (single and multi-energy vector perspective on the one hand and devices and local ecosystems on the other hand). Based on the drivers four business model co-innovation topics are identified and explained. Important case studies are presented for each topic. Based on this, the paper discusses perspectives on business model co-innovation for each of the topics and for integrating all topics towards ELAND specific business model innovation.