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Report on Topic 1:

Investigation of relationship of Use Cases and cross-domain Business Models

Business Models Working Group

September - 2022

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Executive Summary

The BRIDGE Business Models Working Group (BM WG) was relaunched following the 2021 BRIDGE General Assembly and started the wok on 27.09.2021. The projects participating were grouped into three tasks.

- Task 1 aimed to zoom into concrete business models, related barriers to realize them and trend that may impact them.
- Task 2 investigated best practice for use cases monitoring and impact analysis and the role of Key Performance Indicators.
- Task 3 complemented and validated Task 1 and Task 2 activities with the help of a questionnaire to all participating projects.

The work in the Tasks resulted in the present report that was discussed in a dedicated session at the BRIDGE general assembly on the 23.03.2022. The report consists of three main chapters, as prepared by the corresponding Task teams.

Chapter 1, reporting on Task 1, entitled Business models, services, actors, and value chain segments of the involved projects, presents an **overview of the types of BRIDGE projects from the business model point of view**. We attempt to cluster and analyse them to determine which are the key revenue streams and the main barriers for their realization. The chapter also shows the barriers that prevent revenue streams. The business models of 18 H2020 projects that were involved in the analysis are analysed per 3 main clusters, namely Flexibility provision for grid services/flexibility market, Energy communities, and Bulk RES selling. In each cluster, the main BRIDGE projects are listed, with key partner roles identified, key activities, the main value propositions, customer segments, customer relationships, channels, key resources, cost structure and revenue streams. In this chapter, also the current situation, trends and barriers are assessed, per each of the three main clusters.

In the Flexibility provision cluster, projects exhibit a wide variety of value propositions for different market actors and applied technologies. Business Models (BM) were proposed for aggregators, retailers, or Energy Serving Entities (ESCOs). The core value proposition is to lower energy costs of consumers, partly by co-creation with consumers, partly by empowering them with new tools. Key customers are quite homogenous across the projects, one project focuses on building owners and managers as well as SMEs and prosumers. Central revenues for all projects are payments from BRPs, TSO and DSOs for flexibilities.

In the BMs of the projects in the Energy communities cluster the key consumers of the benefits are citizens, and not mainly market actors as in classical BM. This affects the customer relationship, key activities and the value proposition. In addition to well-known key activities of energy communities such as generation and supply, one project also mentions services to the DSO and improvement of security of supply, however, their implementation is not yet possible due to missing regulation in most countries. Importantly, the value proposition focuses on the economic value, social- and environmental benefits. Regarding costs energy communities often have high upfront costs but encounter difficulties getting loans from banks.

In Cluster bulk RES selling, key activities involve the optimization of power purchase agreements (PPA) for large RES producers. While this is currently the dominant way of financing for large RES producers, in the future RES producers could penetrate more into day ahead/intraday market participation. Key activities include the establishment of close contact with customers, compliance with different national regulations and market conditions of the different customers as well as understanding the variables that influence the pricing of the PPAs in various markets.

Trends influencing the feasibility of the above-mentioned business models include an increase in the electricity price and a growth in the gap between the peak load and the base load electricity prices. Both trends could make flexibility trading more interesting in the future. However, there are also regulatory barriers to be considered that currently reduce the leverage of the BMs' full potential. Furthermore, the added value for consumers and a higher customer loyalty might be created by combined offerings in the energy- and other sectors.

Best practice for monitoring and impact analysis of Use Case demonstrations using standardized Key Performance Indicators as a part of **Task 2 work is presented in Chapter 2**. The review of BRIDGE projects and literature yields the insights from the perspective of the value chains as the basis for definition of the key performance indicators (KPIs) as the function of actors or stakeholders, key concepts of business models evaluation, ways to define the hierarchical structure of the KPIs, and finally the DSO and TSO perspectives. A NobelGrid Business Model Evaluation Tool is presented, with its methodology and functionalities, as well as its use of the well-defined value network analysis chain (Generic → per High Level Use Case (HLUC) → per HLUC + Actor → per HLUC, Actor and Pilot site).

Next, the examples of key exploitable results (KERs) and the KPIs are shown, comparing to their function and the differences. The concept is based on domains for the KPIs - technical, economic, environmental, social, legal. Four categories of stakeholders are defined - TSOs/DSOs, Market Operators, Consumers, Institutions - and the interests of each stakeholder can be defined for each domain. Then the KPIs to measure these interests can be defined for each domain along with the stakeholders involved.

Finally, the examples of three project examples (EUniversal, FLEXGRID and eNeuron projects) used to illustrate the findings. The value propositions that derive from the business case analysis can be grouped according to the target stakeholders that they address. EUniversal defines both common- and demo-specific KPIs being used for the demonstrations. The general approach used defines use cases, connecting the use cases to project objectives, thematic pillars, groups of stakeholders and KPI domains to identify the matrix of KPIs. As the KPIs depend on the stakeholder perspective, these are assessed as well. In FLEXGRID, the value propositions and intermediate business models are analysed using the business model canvas for each of the stakeholders' perspective. The methodology for impact analysis proposed by the Joint Research Council (JRC) is used, where the research KPIs are mapped to project-level KPIs before being linked to the expected project impacts. The eNeuron project focuses on advanced approaches and tools for design, planning and operation of LECs. Since business models, infrastructure and wide ranges of objectives among community members all need to be addressed, balanced and managed, 19 KPIs have been defined (both global and project-specific), characterized by application domain, and they are correlated with the Key Exploitable Results (KERs) and the project objectives.

Chapter 3 deals with the **benchmarking, indicating good practices and barriers** following the activities of **Task 3** involving the analysis of the widely circulated questionnaire. The results are structured into topics including lessons learned, good practices, identified barriers, and current trends. Lessons learned focus on value proposition and revenue models for energy communities, digitalisation impact, discussion of barriers and ways to overcome them in digitalisation activities, and the lessons learned about the impact of digitalisation in the project setting. Good practices covered business model tools, methodology employed, key exploitable results and the way the project treat intellectual property rights. Finally, the current and future industry trends were identified and their impact in Horizon projects. The data collected indicated three main trend categories identified by the experts: 1) Digitalisation (artificial intelligence, big data, smart technology deployment), 2) Customer engagement and energy communities (especially the revenue streams for all involved actors), and 3) Energy sector (intensified synergies related to energy supply and demand-side optimisation, distribution grid state estimation and fault detection and RES generation modelling and energy demand forecasting.)

Value proposition and revenue models for energy communities differ from those of the supply side (RES or services) and of those for the DSOs. We highlight the dilemma of which is the main value proposition of the energy communities to their members, as other value propositions than self-consumption often cannot be realized including providing flexibility to markets (See Chapter 3). Focusing only on self-consumption may lead to an overinvestment in technology which is from the societal point not the most cost-efficient way to decarbonise the economy.

From the perspective of digitalisation, the service-oriented projects favoured aggregator platforms, while product-oriented projects favoured data handling and energy control/demand response. It transpired that the tools and methodologies used to identify and describe KERs in projects are diverse: IP Templates, Value Chain Design, Excel tables / Characterisation Table (often including useful info for IPR), MIRO visual overviews, SWOT & PESTLE analysis, plain text and the methodology of the BRIDGE Taskforce on Replicability & Scalability.

Among the barriers, the following key regulatory barriers have been identified: Market access barriers for aggregators, ongoing balancing market reforms in some EU countries; Legislation affecting aggregators' possibilities; In some national contexts, flexibility has not yet become a tradeable commodity (especially for small prosumers), while data transactions are not yet regulated; Regulatory framework is under development; Access to national flexibility markets is missing; Qualification for different markets is lacking; Poor participation of DERs in balancing markets; In some countries regulation does not allow for value stacking; Regulatory issues related to allowing the delivery of electricity to the grid.

Among the good practices and barriers identified by the Task 3 are: In BM tools, the BM canvas is the most frequently used tool; The most useful BM development approach are targeted workshops; while some projects have several well defined KERs from the very beginning, in most projects they are typically defined in the last third of the project duration; Common tools or methodologies to characterize KERs should be developed. The identified barriers include Regulatory barriers (market access, legislative, participation in markets) and Digitalization barriers (integration and handling of data, followed by privacy).

The final **Chapter 4** presents the **synthesis of the results and the conclusions** of the report.

Introduction and Process

The Business Models Working Group (BM WG) has been successfully reactivated in summer 2021 following the 2021 BRIDGE General Assembly after a two-year hiatus following the completion of the main activities. While some of the associated topics were addressed during that period by the newly established Task Forces, concentrated activities on business model definition and investigation were identified and posed as a requirement in H2020 and HE calls.

The BM WG started work on 27.09.2021. The relaunch of the BM WG has seen 41 projects and 93 individuals expressing interest to cooperate in the BM WG, as many BRIDGE projects address the business-, economic- and general value-oriented aspects of the services and activities pursued. The reactivation of the BM WG aimed to leverage the work already done in these projects.

The topic at which the work in the year 2021 aimed was **Investigation of relationship of Use Cases (UC) and cross-domain Business Models**. The work was structured around the following three distinct Tasks:

- **Task 1**: Definition of the Value Analysis Methodology, covering the relationship of Use Cases, Business Models, Services, Actors, and value chain segments of the involved projects aimed to zoom into concrete business models, related barriers to realized them and trend that may impact them.
- **Task 2**: Identify the best practice for monitoring and impact analysis of Use Case demonstrations using standardized Key Performance Indicators.
- **Task 3**: Highlight concrete results from projects, and identify good practices and possible barriers to be used in benchmarking (e.g. examples of benefits). The task complemented and validated Task 1 and Task 2 activities with the help of a questionnaire to all participating projects.

All Tasks held regular meetings leading to a draft report that was discussed in a dedicated session at the BRIDGE general assembly on the 23.03.2022.

The three tasks jointly prepared a questionnaire that was launched online in December 2021 and sent to over 50 projects to canvass their experience with various aspects of Business Models. The questionnaire contained 56 questions and was prepared in the web form. From those, 32 responses were received and the insights complemented the results of the desktop research and the WG participants' contribution to prepare the first year report of the BM WG.

1. Business models, services, actors, and value chain segments of the involved projects

The aim of this chapter is to understand the types of BRIDGE projects from the business model point of view, how they can be clustered and analysed to determine which are the key revenue streams and the main barriers to realize them. Also barriers that prevent revenue stream to be realized were assessed.

In the first step, the participating projects were clustered with the aim to understand a more general view of the business models logic across a set of projects as well as to provide an overview of specific barriers per project cluster.

Table 1-1: BRIDGE projects and their clusters

Cluster name	Projects
Energy islands/communities	*COMPILE*
	IANOS
	MAESHA
	REACT
	SMILE
Flexibility provision for grid services / flexibility market	*X-FLEX*
	BD4OPEM
	FlexiGrid - 864048
	FLEXIGRID
	MERLON
	PARITY
	OneNet
	MAGNITUDE
Demand response	*iFlex*
	SENDER
	TIGON
RES Bulk selling	*SYNERGY*
	Trinity

While these clustering helped to extract key elements of different project types, the group was aware that there is overlap.

1.1 Business model analysis per cluster

1.1.1 Cluster flexibility provision: value propositions for various market actors

Cluster Flexibility provision: value propositions for various market actors

The analysis of the cluster demand response showed a wide variety of projects in terms of value propositions for different market actors and applied technologies in this sector. Business Models (BM) were proposed for aggregators, retailers, or Energy Serving Entities (ESCOs). Some projects started with technology to derive Business Model Canvases (BMC) other projects created BMCs for market actors such as aggregators. While a few projects saw the development of algorithms as a key output (activity) others took them as given and considered them as a key resource to gain additional value. Reduced grid imbalance risks and optimized building energy efficiency demonstrate the effectiveness of DR programmes. The core value proposition is to lower energy costs of consumers, partly by co-creation with consumers, partly by empowering them with new tools. For suppliers, the value is higher customer loyalty and thus secured revenue streams. Technologies applied improve power quality, reliability or monitoring capabilities and allow to reduce imbalance costs. Cybersecurity was mentioned as key to realize the mentioned use cases. Regarding key resources most projects are quite aligned, including the metering data market access, but projects also mentioned the need of sensors and actuators with the goal to develop a digital twin of consumers and, therefore, mirror customer behaviour. Key customers are quite homogenous across the projects, one project focuses on building owners and managers as well as SMEs and prosumers. Central revenues for all projects are payments from BRPs, TSO and DSOs for flexibilities.

There are overlaps between the cluster demand response and the flexibility clusters. This is not surprising as DR is an important way for flexibility provision, along with flexible electricity generation, electricity storage, and their combinations.

Table 1-2: *BMC of demand response projects*

Demand response projects		
Key Partners	**Key Activities**	**Value Propositions**
Energy Market Parties: TSOs, DSOs, BRPs, ESCOs, aggregators, trading companies, energy communities & cooperatives, prosumers / consumers, grid operators. ***“Influencers”:*** EU policy makers, public bodies, citizen / consumer associations, scientists, media, journalists. ***Technology developers and users:*** Hardware vendors (heat pump producers, EV charging point suppliers), software	Customer segmentation & load profile optimisation algorithm development Portfolio imbalance reduction, platform-based electricity procurement/trading, Development of BMs with attractive compensation schemes, Consumer recruitment (energy & beyond-energy), Asset investment consulting, Risk management.	***Market values:*** Increased consumption & environmental awareness combined with lower/competitive energy cost for consumers, that are empowered for the energy transition; increased customer loyalty; reduced imbalance risk demonstrating DSM effectiveness. ***Technology values:*** Improvement of smart grid power quality, reliability, and safety based on improved control and monitoring; higher performance levels of electricity systems; improved PV efficiency; EMS for safer operation

developers, building managers/developers.		of hybrid grids; higher cybersecurity defence ability.
Customer Segments	**Customer relationships**	**Channels**
Energy Market Parties: TSOs, DSOs, BRPs, ESCOs, retailers, aggregators, trading companies, SMEs, energy communities & cooperatives, prosumers / consumers. ***Tertiary sector:*** building owners & managers, technology providers, technology providers such as PV manufacturers & PV plant developers (TIGON)	• Existing customers as starting point • Market-based bilateral contracts • Web-based consumer(-centric) platforms	***Online:*** Websites, webinars, advertisement mailings, social media presence, blogs. ***"Traditional" media:*** TV, radio, print media advertisements. ***Scientific community:*** publications, conference / event presentations. ***Direct marketing:*** towards existing, trusting customers; via involvement of HW supply partners (e.g. heat pump producers, EV charging point suppliers).
Key Resources	**Cost Structure**	**Revenue Streams**
Consumer portfolio, meter data access, wholesale and flexibility market access, staff (solution installation, customer acquisition and support), sensors/actuators. PV manufacturers & PV plant developers (TIGON).	Licenses for back-end systems. Internal staff (e.g., of aggregators), external consultants, internet access, servers, SW/data licences, market access (e.g., exchange membership). SW/HW solution installation, imbalance penalties, flexibility prices, aggregator services, consumer royalties.	***Fees:*** Payments from TSOs, DSOs, BRPs for avoided imbalance costs, avoided grid reinforcement cost, avoided peak power generation cost, price arbitrage (e.g. using the difference between the price for the electricity consumed from the grid and the price for the electricity injected in the grid) aggregators; member participation fee. ***Sales:*** equipment sales to consumers; white label sale of the platforms/technologies developed during the projects; building operation & automation revenues; third party fees for platform integration/offering of additional services.

Cluster flexibility provision: value propositions for specific market actors

In this cluster, BMCs were established for ESCOs and local flexibility market providers. While also aggregators, suppliers, retailers are important actors, we have grouped them in the Cluster demand response, as their value proposition is similar. One project introduced the term Flexibility energy service company (FLESCO) for ESCOs that increase services by using the flexibility of the building to reduce energy costs in dynamic tariff set-ups.

It is important to note the difference between the role of FLESCO, enabling of flexibility through investment, and that of a flexibility aggregator which is aggregating flexibility services from prosumers (which can shift their demand, by activating appliances at another time, or offer battery energy storage), small producers, and storage operators. Aggregators typically enable the aggregated flexible energy to access the markets. The roles could also be combined, but flexibility investment and aggregation would likely be pursued by large energy companies branching out their business and harvesting the synergies among the activities.

Table 1-3: *BMC of ESCO as flexibility provider*

ESCO as flexibility provider		
Key Partners	**Key Activities**	**Value Propositions**
• Technical service companies • Equipment installers	• Refurbishment and smartification of infrastructure e.g. boilers • Prefinancing • One-stop shop for energy efficiency improvement and flexibility exploitation	The ESCO guarantees a level of cost savings and achieves them by improving energy efficiency and by making use of flexibility from the prosumer's DERs.
Customer Segments	**Customer relationships**	**Channels**
• End-users: they purchase the device and get access to the smartphone app • Prosumers • Technical service companies: access to real-time fault detection and maintenance management dashboard • TSO/DSO	• B2C: direct sale to end-users • B2B2C: indirect sales through the customer networks of partners (e.g., via aggregators).	
Key Resources	**Cost Structure**	**Revenue Streams**
• IT for Communication and remote control of prosumers assets • Technological know-how • Central data collection and device management platform	• HW: fixed device cost (volume pricing) • Services: pay per use based on the partner's portfolio	The ESCO receives the energy efficiency service fees from the prosumer. The ESCO receives revenues for selling flexibility on explicit flexibility markets (in the role of an aggregator) and shares part of the revenues with the prosumer; or achieves cost savings for prosumers from energy efficiency measures or price arbitrage.

Table 1-4: *BMC of local flexibility market operator*

Local flexibility market operator		
Key Partners	**Key Activities**	**Value Propositions**
• IT partner • Provider of flexibilities (e.g., Energy Communities)	Platform (LEM) for prosumers to virtually exchange electricity via the supplier	• P2P marketplace for RES • Personal relations • Autonomy • Transparency
Customer Segments	**Customer relationships**	**Channels**
• Private electricity generators • Electricity consumers • DSOs	• Digital platform	• Newsletters • Members/meetings • Regional actions /events
• Key Resources	• Cost Structure	**Revenue Streams**
• IT for Communication and remote control	• IT • Personnel	• Supply price for energy supplied centrally and a transaction fee on each LEM trade

1.1.2 Cluster energy communities

Business Models for energy communities have several differences from classical business models as the key consumers of the benefits are citizens, and not mainly market actors as in classical BM. This affects the customer relationship, key activities and the value proposition. Next to well-known key activities of energy communities such as generation and supply, one project also mentions services to the DSO and improvement of security of supply. However, their implementation is not yet possible due to missing regulation in most countries. Also, the value proposition does not only focus on the economic value but also social and environmental benefits. This entails the question if energy communities that come without a clear business models can have transformative power or will remain a niche concept. This will certainly also depend on European/national regulation. The customer relationship describes the governance of the community and membership relationship. Regarding costs energy communities often have high upfront costs but encounter difficulties getting loans from banks. It is mentioned that P2P trading can produce revenues, where flexibility trading can contribute with a small share.

Table 1-5: *BMC of energy communities*

Energy communities		
Key Partners	**Key Activities**	**Value Propositions**
• Community members • DSOs • Municipalities • LEC operators / managers	• Generation and supply Aggregation • Service provision • Services to DSO • Awareness raising	• Economic value (e.g., increased self-consumption within the community thanks to P2P trading). Price security. • Environmental value (e.g., increased renewables deployment in the community) • Social value
Customer Segments	**Customer relationships**	**Channels**
• Households • SMEs	• Governance of the community • Membership	• Meetings to raise awareness • Building programmes • Municipalities initiatives
Key Resources	**Cost Structure**	**Revenue Streams**
• Human capital • Unused space (e.g., building roofs)	• Non-profit models • High technology upfront costs for communities • Sharing of assets to optimize infrastructure	• Sale and sharing of energy • Flexibility provision • Community-based services

1.1.3 Cluster bulk RES selling

Both projects mention as key activities the optimization of power purchase agreements (PPA) for large RES producers. While this is currently the dominant way of financing for large RES producers, in the future RES producers could penetrate more into day ahead/intraday market participation. Key activities include the establishment of close contact with customers, compliance with different national regulations and market conditions of the different customers as well as understanding the variables that influence the pricing of the PPAs in various markets.

Table 1-6: *BMCs of bulk RES selling*

BULK RES selling		
Key Partners	**Key Activities**	**Value Propositions**

• Large RES promoters
• Cloud service providers
• Forecast service providers
• Wholesale market data Providers
	• Optimization of power purchase agreements (PPA) for large RES producers, including:
	  • RES SCADA and metering data acquisition
	  • Price prediction development
	  • Risk assessment calculation development
	  • GUI development
	  • Software integration with other platforms of the RES Manager
	• Complementary activities:
	  • Adaptation to national regulations and requirements
	  • Adaptation to different EU electricity markets
	  • Evident analysis of price, duration and volume to be negotiated per individual PPA.
		• The Business application that will facilitate the realization of this business model aims at properly guiding decisions on the RES Operators side with regards to evidently placing their bids in PPA markets by considering the volatility of wholesale market prices and the demand forecasts of retailers that can directly point out to their requirements for getting involved in a PPA.

Customer Segments	**Customer relationships**	**Channels**
Bulk RES Companies: • RES Operation department. • RES promotion department. • RES market departments.	• Contact with pre-sales engineer/project manager and sales engineer/field engineer or • contact with project manager/product manager/field engineer.	• Direct contact of commercial contracts and new research pilots. • Contact through some company's part of the holding (platform main developer is part of a big construction holding) and through current customers using the platform.
Key Resources	**Cost Structure**	**Revenue Streams**

• Local offices (local vendors and local bulk energy producers).
• Deployment of local HW (servers) and 24/7 support.
	• Initial: Personnel (field engineers for deployment).
	• Maintenance: Personnel in case of 24/7 in house engineers and support.
	• Operation: HW (Local servers or cloud servers).
		Various options:
		• Maximizing revenues from energy sales
		• For software developers:
		  • Software license, Consultancy service (in-house engineers), Turnkey solution project (SW + HW).
		  • Updates for the platform (new functionalities).
		  • Integration of new RES units in the platform.

1.2 Trends and barriers

Trends influencing the feasibility of the above-mentioned business models include an increase in the electricity price and a growth in the gap between the peak load and the base load electricity prices. Both trends could make flexibility trading more interesting in the future.

However, there are also regulatory barriers to be considered that currently reduce the leverage of the BMs' full potential. Furthermore, the added value for consumers and a higher customer loyalty might be created by combined offerings in the energy- and other sectors.

1.2.1 Cluster Flexibility provision: value propositions for various market actors

Current situation:

Mostly industry offers DR. Small scale demand response is foreseen in policies but not yet operationalized in many countries such as Austria or even does not have an existing framework such as in Spain. DR needs to be separated from energy efficiency, often it is mixed in discussions. DR could even increase energy consumption.

Barriers:

Main barriers to explicit demand response include prequalification barriers and minimum capacities accepted on markets, often 1 MW. But also, economic barriers are prevailing mostly low revenues. Among the systemic barriers is the lack of market to offer DR to DSOs. For implicit demand response, fixed prices or a small difference between peak and base load prices hinder the actual implementation.

Trends:

Future trend for DR is to move "beyond energy services" in buildings (e.g., employing additional smart sensors for water leakage, smoke detectors, unexpected movement, elderly). Demand response could become a side service as part of a bigger portfolio of services offered to consumers that increase quality and convenience of living. Importantly new ways to automatization are emerging that will enable DR.

1.2.2 Cluster flexibility provision: value propositions for specific market actors

Current situation:

Dynamic tariffs are usually more expensive for consumers, and this makes it hard for providers to compete for consumers. Dynamic tariffs however take away the market and price risks from the electricity provider. In Northern Europe household electricity prices are closely interlinked with spot market prices. This is not yet the case in central Europe but expected to change in the future.

Barriers:

The main barrier is that there is a highly regulated market with a dominance of big companies.

Trends for 'implicit' demand response:

There is an increased market for flexibility provision due to:

- Obligation to offer dynamic tariffs,
- Increasing gap between base and peak load,

- Increasing electricity prices, with its direct effect: the on-going mindset change in population, and
- Household electricity prices are increasingly linked to spot market prices, spot markets become more expensive.

The markets potential was seen as promising, as the focus on energy efficiency will increase on the policy agendas.

1.2.3 Cluster energy communities

Current situation:

So far there are very limited revenues mainly consisting of increased self-consumption within the community thanks to P2P trading, which increases the revenues from local renewables (assuming the energy injected in the grid is not remunerated at the same price as the energy consumed from the grid). Also, it is still not clear if Energy Communities provide real value to the grid while they contribute to stimulating positive attitudes through prosumption, and more generally to renewable energy sources. As of today, Energy Communities mostly focus on electricity, but should also focus on other energy carriers in the future. Cluster energy communities is important to traditional actors to keep clients, and to offer new services and build customer relationships rather than offering (relatively modest) savings.

Barriers:

- Regulatory uncertainties in many EU countries,
- Regulatory frameworks for RECs often focus on electricity only,
- Energy communities mostly focused on PV, opposed production / demand profiles for PV and heating.

Trends:

- Energy communities could be of interest for citizens caring about environmental issues,
- Despite a limited impact, they are essential as relays and showcases for the energy transition,
- Utilities to initialize Energy communities to establish a good customer relationship,
- The perceived relevance of energy communities is expected to rise among citizens given the current energy crisis and the aim to be more independent from international energy market developments,
- Rising electricity prices may increase the saving for energy community participants.

1.2.4 Cluster bulk RES selling

Current situation:

Funding in this area is either:

- Completely driven by the government via Feed-in Tariffs (FiT) or premiums,
- Mixed, combining bilateral PPA and participation in the markets, or
- Completely self-sufficient with participation on Day-ahead market (DAM)/Intraday market (IDM)/bilateral agreements.

Barriers:

- In Member States where Feed in tariffs aren’t applicable, this leads to reduced revenues for bulk RES producers, and
- There is often a lack of transmission system capacity that could prevent the establishment of large-scale production facilities such as new wind farms.

Trends:

- There are few main enablers,
- The participation in ancillary services markets and the electricity spot markets should be facilitated, and
- Importantly also there is a need to increase accuracy of production forecasting - significant developments in the smart4RES project are expected due to the convergence of domains such as big data, RES and weather forecasting techniques.

2. Best practice for monitoring and impact analysis of Use Case demonstrations using standardized Key Performance Indicators.

2.1 Review of projects and literature

The activities of Task 2 started with an analysis of BRIDGE outputs of 2021 complemented by a literature review of standard procedures for monitoring and impact analysis. Then an evaluation was carried out of how the research projects address this issue (both the ones involved in BM WG as well as from a more general point of view) highlighting the possible best practice examples.

2.1.1 Value Chains as the basis for Key Performance Indicators (KPIs)

New business models, such as a prosumer-based model, result in new value chains and use cases (see Chapter 3). These value chains have become the basis for identifying KPIs that can be used to track these value chains from the perspectives of different actors/stakeholders.

2.1.2 KPIs as a function of actors/stakeholders

The value chains (and therefore the KPIs) must be evaluated with respect to the different stakeholders in the business model. Examples of value chains that can be evaluated are indicated in the table below.

Table 2-1: *Value chain examples as a function of stakeholders for prosumer-based business model*

Stakeholder	Value Chains
TSO	Security of supply Flexibility services Market functioning
DSO	Security of supply and quality of service Local flexibility services Market facilitation (local and wholesale) Efficiency
Aggregator/Retailer	Optimize energy consumption for prosumers Demand response Flexible electricity tariffs to support market conditions
VPP	Flexibility of energy generation Market access for prosumers
ESCO	Energy efficiency Energy performance contracts Reduced energy costs

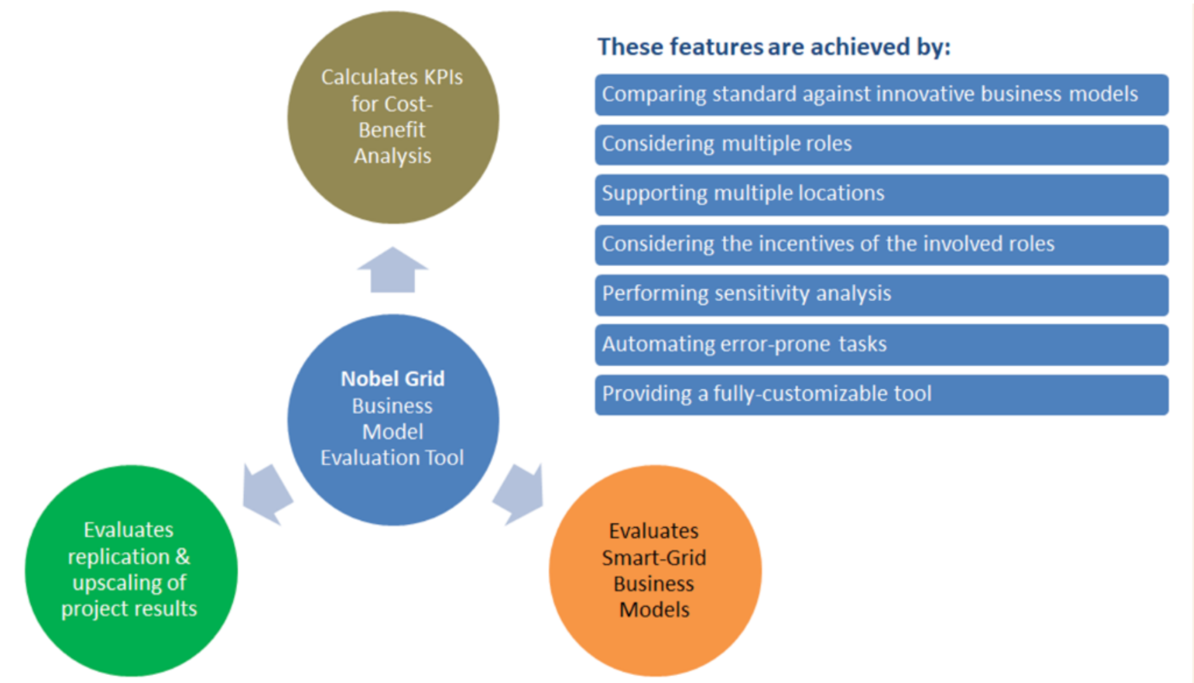
2.1.3 Evaluating Business Models: Key concepts

In this chapter we present an example how business models were evaluated in a selected BRIDGE project. The NOBEL GRID project[1] (New cost-efficient business models for flexible Smart grids) developed the NOBEL GRID Business Model Evaluation tool.[2] This is a "what-if" scenario tool for the techno-economic evaluation of innovative smart grid technologies. The NOBEL GRID Business Model Evaluation tool allows the user to model value networks of multiple roles/actors, aiming at:

- Evaluating business models enabled by innovative smart grid technologies (e.g., those by H2020 EU-funded projects);
- Evaluating the replication & upscaling of technologies, such as those empowered by H2020 EU-funded projects, and
- Evaluating the Cost-Benefit of technologies, such as those empowered by H2020 EU-funded projects (but not limited to those).

This techno-economic evaluation is done by:

- Comparing standard/existing against new innovative business models using several financial metrics based on data inputs supplied by the user. The future versions will be integrated with smart grid simulation modules for reducing the inputs required.
- Considering multiple roles organized into value networks in any context where multiple roles/business actors interact, including technology providers, thus not restricted to smart grid markets.
- Supporting multiple locations simultaneously, such as pilot sites, regions or countries.
- Considering the incentives of the roles when deciding how money flows within the value network (e.g., how revenues should be split, how services should be charged, etc).
- Performing sensitivity analysis for cost items and revenue streams whose magnitude is not known a-priori.
- Automating error-prone tasks.
- Providing a fully customizable, transparent and flexible tool based on Microsoft Excel (e.g., the user can see under the hood, add features and update formulas).



[1] https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-energy/grids/nobel-grid

[2] Nobel Grid Horizon 2020 Project, D2.3. Business Models & Incentive Schema Definition

Figure 2-1: *Nobel Grid Business Model Evaluation* Tool[3]

The evaluation methodology depends on the definition of use cases, referred to as High Level Use Cases (HLUCs) that are the basis for value streams for the actors/stakeholders. KPIs can be defined associated with the assessment of these HLUCs. The value stream and the KPIs will depend on the perspective of the stakeholder. Nobel Grid defined seven key roles for the smart grid business models - 1) Power Producer, 2) Power Transmitter, 3) Power Distributor, 4) Power Retailer, 5) Power Consumer, 6) Wholesale Market Operator and 7) Aggregator. The figure below illustrates the procedure for defining the business models as a function of the HLUCs and the stakeholder role. The KPIs are then defined based on these business models.

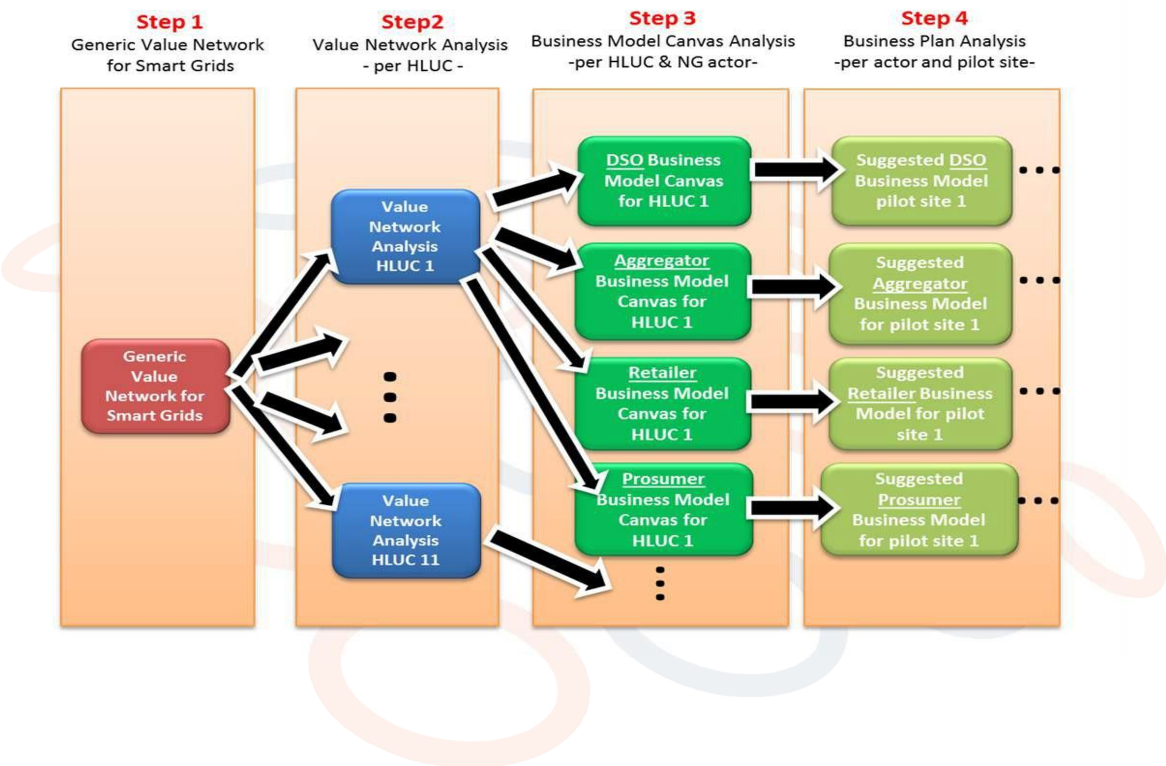


Figure 2-2: *Defining business models as a function of high level use cases and stakeholder perspective.*

2.1.4 Hierarchical Structure for KPIs

Characterizing KPIs for smart grid evaluation was described Pramangioulis et al[4], including an evaluation of the technology assessment methodologies used in several different European-funded research projects and demonstrations. The concept is based on domains for the KPIs - **technical, economic, environmental, social, legal.** Four categories of stakeholders are defined - **TSOs/DSOs, Market Operators, Consumers, Institutions -** and the interests of each stakeholder can be defined for each domain. Then the KPIs to measure these interests can be defined for each domain along with the stakeholders involved.

The concept of a hierarchy for performance indicators was applied in the Smart City Malaga project. The hierarchy involves definition of Macro objectives (MOs), Objectives (Os), Indicators (Is) and finally Measurements that are used to characterize the indicators. An example of how this hierarchy was applied for the Main Macro objectives and the Secondary objectives in the SmartCity Malaga project is shown in **Figure 2-3**.

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[3] Ibid

[4] D. Pramangioulis et al, A Methodology for Determination and Definition of Key Performance Indicators for Smart Grids Development in Island Energy Systems, Energies 2019, 12, 242.

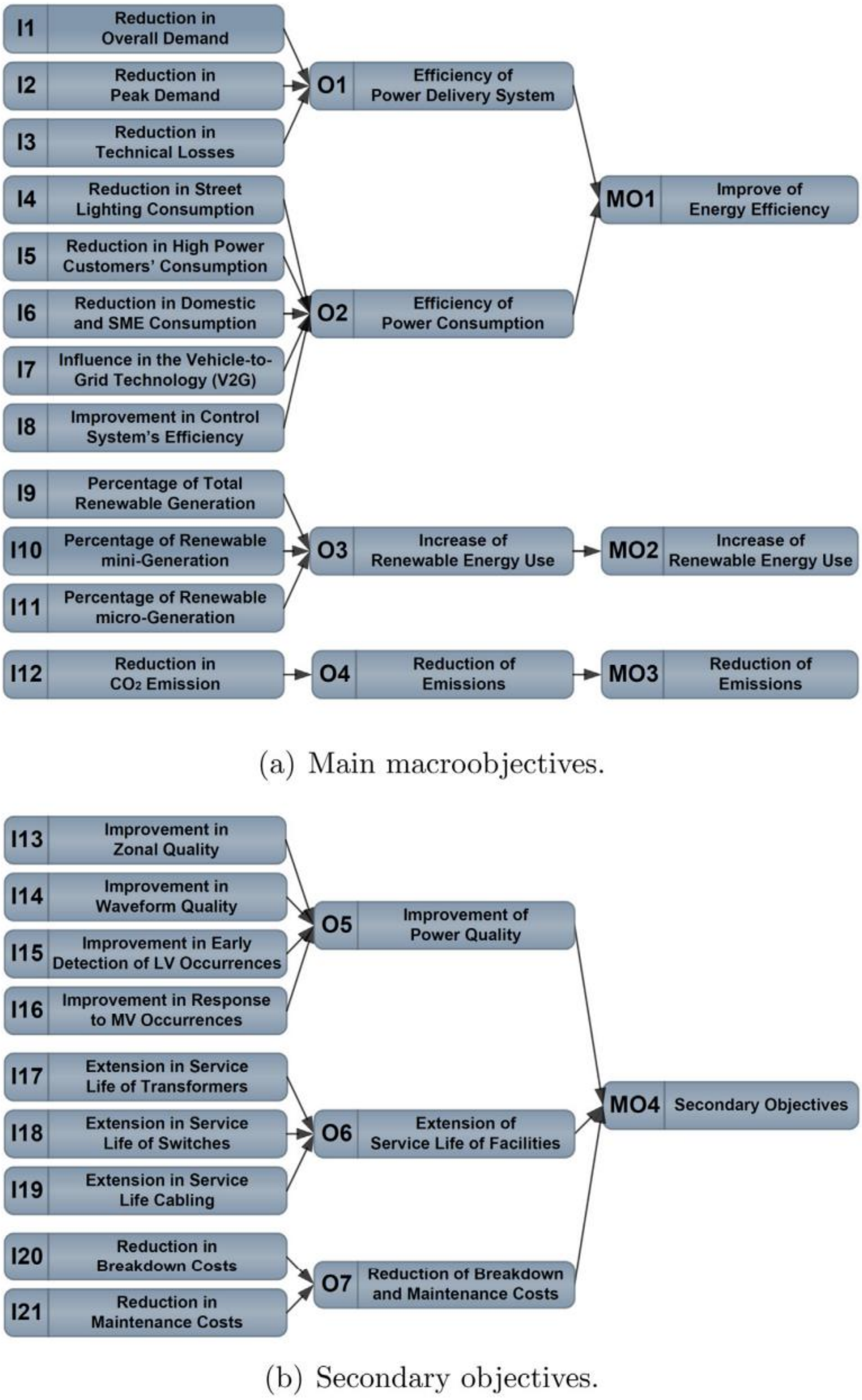

Figure 2-3: *Hierarchy of KPIs and Objectives from SmartCity Malaga project*

2.1.5 DSO and TSO Perspectives

TSO and DSO Joint Task Force created in March 2020 under the initiative of ENTSO-E and the four European Associations representing DSOs - CEDEC, E.DSO, Eurelectric and GEODE - created guidelines for key performance indicators related to DSO challenges[5]. The report describes a set of key performance indicators - seven of them for the DSO perspective and one for the common TSO-DSO perspective. It also provides guidelines for the selection, definition and implementation of these KPIs and their corresponding key indicators (KIs). The figure below shows how the seven DSO KPIs relate to the common challenges identified by the DSOs.

Table 2-2: *Interlinks between DSO KPIs and common challenges*

THE SIX COMMON CHALLENGES	KPI 1: System Observability	KPI 2: System Controllability	KPI 3: Active System Management	KPI 4: Smart Grid Planning	KPI 5: Transparency in Data Access and Sharing Between Relevant Stakeholders	KPI 6: Local Flexibility Markets and Customer Inclusion	KPI 7: Smart Asset Management
Cooperation in network operation	X	X	X		X	X	
Cooperation in planning the networks				X			X
Exchange all necessary information regarding the long-term planning of network investments			X	X			X
Exchange all necessary information regarding the generation assets and demand side response for the daily operation of their networks	X		X		X	X	
Cooperate with each other in order to achieve coordinated access to resources	X		X		X	X	
Ensure cost-efficient, secure and reliable development and operation of their networks	X			X	X	X	X

The report also identified some basic requirements for KPIs that are relevant regardless of the stakeholder perspective. Generally, a KPI should be meaningful, understandable, and quantifiable. Essential requirements for the smart grid KPIs are:

- Definition of a KPI must be done on the basis of unambiguous terms (e.g. clear definition of smart meter: does a meter with an automatic meter reading fall under this definition or not?).
- KPI must be influenceable by the system operator. If necessary, it should be indicated if there is only partial or complete influenceability.
- KPI is linked only to regulated activities of the DSO.
- KPI must be sufficiently pragmatic and significant to be able to make effective use of them.
- KPI needs to focus on functionality and outputs, rather than on specific technologies that realise this functionality (technology neutral).
- The data needed to calculate the KPIs must be available and collectable with reasonable effort.
- In certain cases, it can be useful to split a KPI in two sub-KPIs, e.g. interruption time for LV and MV.
- KPIs must be futureproof as much as possible, to ensure the evolution of a KPI can be tracked for a longer period.

The EU SysFlex project[6] provided an excellent overview of KPI selection for demonstrations that have a system operator focus.[7] The KPIs are broken down into seven categories as indicated in the table below. Calculation specifications for each of these KPIs are provided in the document.

[5] https://cdn.eurelectric.org/media/5272/smart_grid_key_performance_indicators__a_dso_perspective-2021-030-0129-01-e-h-B85F16BF.pdf
[6] https://eu-sysflex.com/
[7] http://eu-sysflex.com/wp-content/uploads/2019/02/EU-SysFlex-D10.1-Report-on-the-selection-of-KPIs-for-the-demonstrations.pdf

Table 2-3: *Proposed KPIs from EU-SysFlex project demonstrations*

	Finland	Italy	Germany	Portugal Flexhub	Portugal VPP	France
Economic impacts						
Increase in revenue of the flexibility provider	■			■	■	■
Decrease in cost for flexibility service provision	■		■			
Cost sharing between TSO and DSO for congestion management				■		
Opportunity cost of providing a flexibility service				■		
Meet SO's needs						
Compliance of existing services provision by new assets to SO's requirements			■			■
Tracking error between a set-point requested by the SO and the measure		■		■		
Increase in flexibility service provision capability		■		■		
Compliance of new services provision (e.g. FFR) to SO's requirements						■
Impacts on the power system						
Line voltage profiles		■				
Hosting capacity variation		■				
Grid efficiency			■			
Impacts on markets						
Reactive power market utilization factor	■					
Variation in the imbalances in participation of RES in energy markets					■	
Reliability						
Availability of the flexibility services	■		■		■	
Availability of the aggregation platform	■					
Availability of the communication infrastructure		■				
Forecast quality		■	■		■	■
Flexibility services re-dispatch success rate						■
Impacts on customers						
Customers' acceptance	■					

2.2 Key Exploitable Results (KERs) vs Key Performance Indicators (KPIs): Project examples

It was noted that most of the focus on performance documentation in these projects is around Key Exploitable Results (KERs). These are not the same as Key Performance Indicators (KPIs) although they can be related. In general, KERs will tend to be commercially viable solutions of projects rather than KPIs that can be related to specific objectives and business models. However, there have been several valuable contributions that help with development of best practices around KPIs. A few examples are included here to illustrate the approaches being taken.

2.2.1 EUniversal

The EUniversal[8] project is defining a market enabling interface to unlock flexibility solutions for cost-effective management of smarter distribution grids (UMEI). Deliverable 6.2 of the project defines the KPIs being used for the demonstrations. Both common KPIs and demo-specific KPIs are defined. As illustrated in the figure below, the

[8] https://euniversal.eu/

process used followed the general approach of defining use cases, connecting the use cases to project objectives, thematic pillars, groups of stakeholders and KPI domains in order to identify the matrix of KPIs.

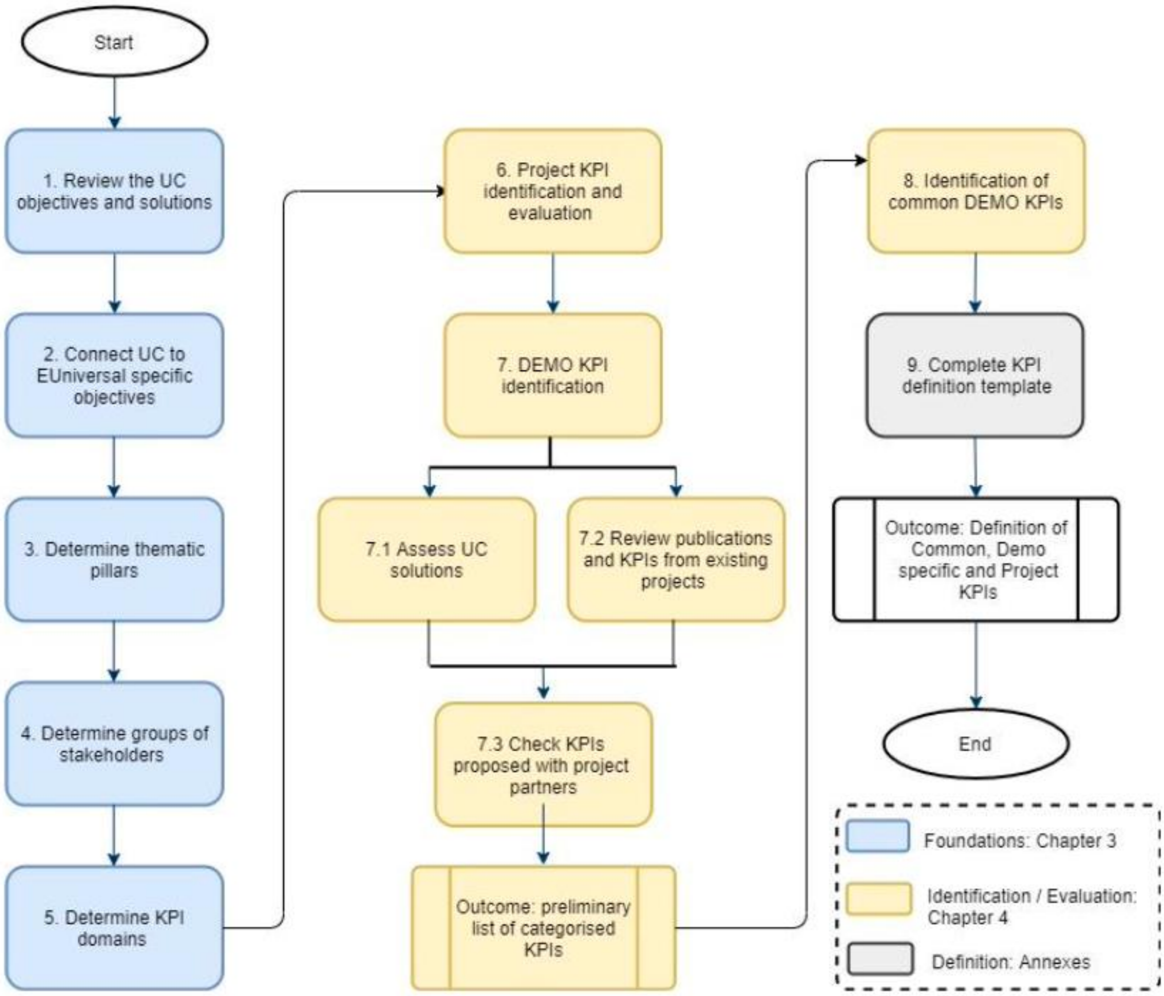

Figure 2-4: *Process for identification of KPIs in eUniversal project (D6.2)*

As a result of this process, a total of 24 KPIs were identified for the eUniversal project to enable the evaluation of the project performance. These KPIs can be classified in four domains:

- Technical Domain (19 KPIs) - related to the KPIs measuring the technical performance such as the fulfilment of voltage limits (Polish DEMO).
- Economic Domain (3 KPIs) - related with the KPIs that are measuring the economic and regulatory performance such as the costs of congestion management with flex Market vs Curtailment (German DEMO).
- Environmental Domain (1 KPI) - related to the KPIs measuring the avoided CO_2 emissions from increased Renewable Energy Sources (RES) and Distributed Energy Resource (DER) hosting capacity (Portuguese DEMO).
- Social Domain (1 KPI) - related to the KPI measuring the variation of the resource provider’s consumption due to the flexibility services activation, as a way to deliver further information to consumers on how the flexibility provided impacted their consumption, and ultimately their energy bill (Portuguese DEMO).

KPIs depend on the stakeholder perspective. Each KPI defined the stakeholders that are impacted. The stakeholders for the eUniversal project included:

- The DSOs are responsible to operate and manage the distribution electricity grid, with specific responsibilities for flexibility markets added in the project.
- The Flexibility Market Operator (FMO) as a transparent party is responsible for proving a central service between buyers and sellers to facilitate the communication and coordination of all processes related to the procurement of capacity and/or energy bids
- The Resource Aggregator (RA) is responsible for aggregating resources for usage by a service provider for energy market services.
- The Institutions group which includes policy, law and regulation bodies at the EU, national and local level. This group is responsible for monitoring and enforcing the rules under which the energy market is working. They are also responsible for linking the EU regulations to the institutions at the national level.
- Flexibility Service Providers (FSP) offer explicit flexibility services of one resource managed by a Resource Provider or multiple resources aggregated by a Resource Aggregator to system operators, directly via bilateral agreements or through market operators.
    - The Producer is described as a natural or legal person that generates electricity.
    - The Customers (or end-users) can have two kinds of roles, the role of a passive user (consumers) or the role of an active user (prosumers). The end-user simply consumes the energy from the electrical grid. The prosumer actively participates in the energy.

KPI definition templates are included for each KPI which provide the data requirements and calculations to track the KPI.

The procedure used in the EUniversal project was based on a foundation of work in other research projects. The projects and publications that were identified as most useful for the project were the following:

1. The publication (Pramangioulis et al. 2019), that contains a detailed methodology.[9]
2. PlatOne D1.2 ‘Project KPIs definition and measurement methods’ was used to incorporate an analogous clear layout and concise summary tables (PlatOne 2020).[10]
3. InteGrid D2.6 ‘Preparation and Monitoring of Demonstration Activities’ (Integrid 2020)[11]
4. UPGRID D1.4 r2 ‘Report on common KPIs’ (UpGrid 2020).[12]
5. CoordiNet D1.6 ‘List of KPIs: KPI and process of measures,’(Coordinet 2020).[13]

2.2.2 FLEXGRID

The FLEXGRID[14] project is defining a smart grid architecture that facilitates high renewable penetration through innovative markets towards efficient interaction between advanced electricity grid management and intelligent stakeholders. Deliverable 8.2 provides an intermediate version of the business modelling, dissemination and exploitation of results[15]. The use cases and business case analyses are based on the actors considered in the FlexGrid business ecosystem as illustrated below.

[9] D. Pramangioulis et al, A Methodology for Determination and Definition of Key Performance Indicators for Smart Grids Development in Island Energy Systems, Energies 2019, 12, 242.
[10] https://www.platone-h2020.eu/data/documents/864300_M12_D1.21.pdf
[11] https://integrid-h2020.eu/uploads/public_deliverables/D2.4_Implementation%20Plan%20for%20Demonstration.pdf
[12] http://upgrid.eu/wp-content/uploads/2018/01/151104_UPGRID_WP1_D14_KPIs_v14_final.pdf
[13] https://private.coordinet-project.eu/files/documentos/5d724189a008fCoordiNet_Deliverable_1.6.pdf
[14] https://flexgrid-project.eu/
[15] https://flexgrid-project.eu/assets/deliverables/FLEXGRID_D8.2_v2.0_20210421-Clean.pdf

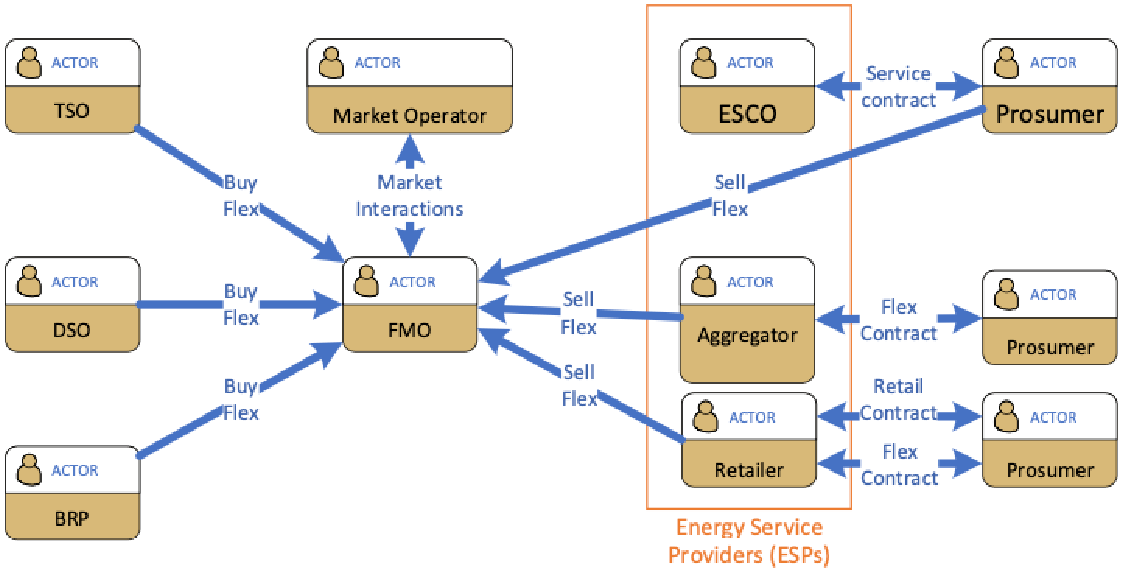

Figure 2-5: *Actors (stakeholders) from the FLEXGRID business ecosystem.*

Four high level use cases are defined for the project. Each of the use cases involves the provision of flexibility services with respect to a specific actor. The report provides the detailed business case analysis for each of the high-level use cases. A summary of the business models is provided, broken down for each of the actors/stakeholders.

The value propositions that derive from the business case analysis can be grouped according to the target stakeholders that they address. This breakdown is shown in the table below. Each of these high-level groupings are elaborated with a long list of FLEXGRID value propositions in the report. The value propositions and intermediate business models are analysed using the business model canvas for each of the stakeholders' perspective.

Table 2-4: *High Level FLEXGRID Value Propositions*

No.	High-level Value Proposition	Target customer
1	FLEXGRID ATP enables more efficient operation of a DLFM and its integration in today's market architecture and regulatory framework	FMO, MO
2	FLEXGRID enables DSOs to better leverage flexibility to accommodate a larger share of RES in the DN and also confront local congestion and voltage control issues	DSO
3	FLEXGRID enables TSOs to increase the available ancillary service capacity by procuring additional flexibility from DERs	TSO
4	FLEXGRID enables aggregators to improve business case of Flex Suppliers	ESP/Aggregator

Finally, the impact analysis section of the report outlines the use of KPIs to support the documentation of project achievements. Three categories of KPIs are included:

1. Overarching KPIs
2. Specific KPIs by Smart Grid related projects
3. FLEXGRID specific KPIs

FLEXGRID uses the methodology for impact analysis proposed by the Joint Research Council (JRC), which presented a unique framework for assessing the innovation impact in the national member states of the EU: The Regional Innovation Impact Assessment (RI^2A) framework[16]. This concept of tracking the KPIs for the impact analysis is illustrated in the following figure, where KPIs specified in the development of research WPs and documented in deliverables D3.3[17], D4.3[18] and D5.3[19] are mapped to project-level KPIs before being linked to the expected project impacts. This is ultimately tied to the broader impact that the FLEXGRID outcomes can bring to the greater society.

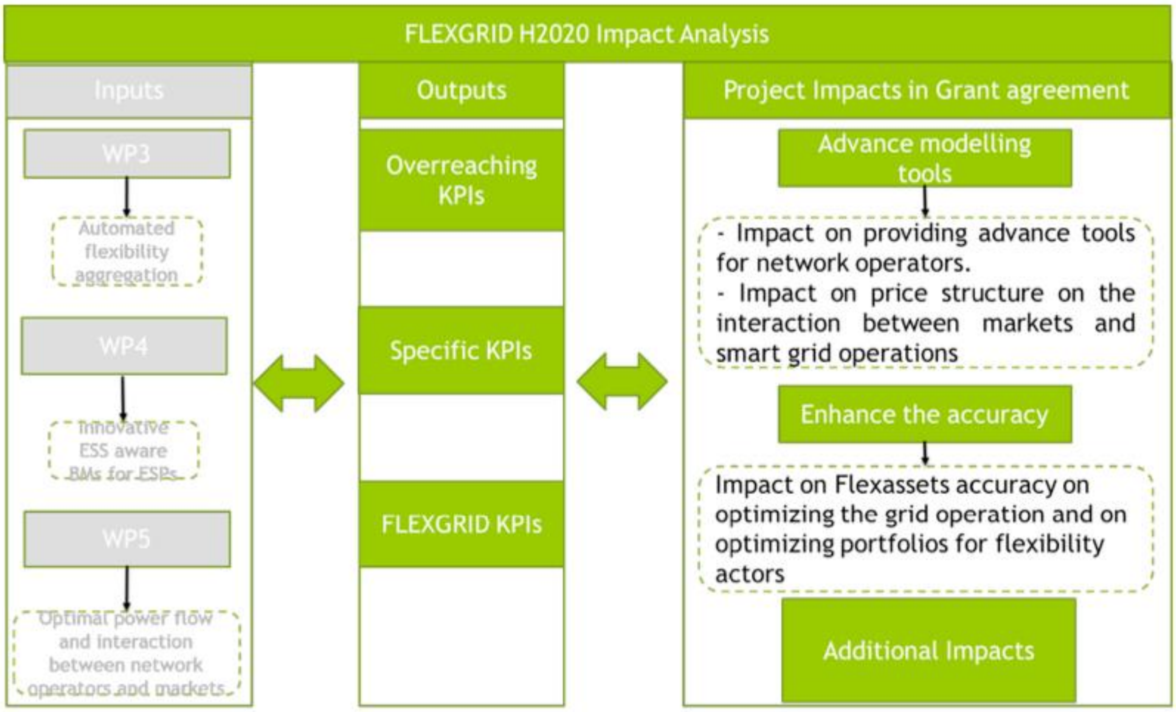

Figure 2-6: *Evaluating the impacts of the FLEXGRID projects using KPIs*

2.2.3 eNeuron

The eNeuron[20] project involves optimising the design and operation of local energy communities (LECs) based on multi-carrier systems. LECs are a key component in the transition to green, decarbonised power from local and renewable sources. However, business models, infrastructure and wide ranges of objectives among community members all need to be addressed, balanced and managed. The project focuses on advanced approaches and tools for design, planning and operation of LECs.

KPIs are key to tracking the success of the project and demonstrations. 19 KPIs have initially been defined by the project team and they are correlated with the Key Exploitable Results (KERs) and the project objectives. The KPIs include both global and project-specific KPIs:

- Global KPIs to assess the technical contribution of the project concept to the European decarbonising targets, boosting the integration of local energy sources and activating local demand-response;

[16] A regional Innovation Impact Assessment Framework for Universities by JRC (2018)
[17] https://flexgrid-project.eu/assets/deliverables/D3.3_final_30112021_corrected.pdf
[18] https://flexgrid-project.eu/assets/deliverables/FLEXGRID_D4.3_30112021.pdf
[19] https://flexgrid-project.eu/assets/deliverables/FLEXGRID_D5.3_final_01122021.pdf
[20] http://eneuron.eu/

- Project KPIs to assess the contribution to the project commitments (such as number of technological solutions to be introduced in the pilots).

The KPIs are characterized by domain as has been discussed previously - technical, environmental, economic, social.

3. Benchmarking: identification of good practices and barriers

3.1 Lessons learned

The following chapter provides insights and lessons learnt, as gleaned from the BM WG online questionnaire sent to all partners. The questionnaire can be found in Annex 1.

3.1.1 Value proposition and revenue models for energy communities

For question Nr. 52 four possible answers were given (Increasing self-consumption; Increasing grid reliability; Reducing energy related costs; Other:) with the request to choose only one. 22 from 30 projects replied to this question and 13 projects stated energy communities as field of main innovation as answer to question Nr. 6. All of them saw an interesting value proposition. According to all projects, increasing self-consumption was the most important value proposition out of all answers (11 counts) followed by reducing energy related costs (5 counts) and increasing grid reliability (4 counts). Projects with energy communities as main innovation strongly tend towards increasing self-consumption (8 of 11 counts) in comparison to projects without energy communities tend towards reducing energy related costs (4 of 5 counts).

Related revenue models (question Nr. 53) are mainly based on savings from energy (16 counts), services to external stakeholders (10 counts) and sales to community members (9 counts). Data valorisation (4 counts) and flexibility trading (1 count) were not mentioned very often.

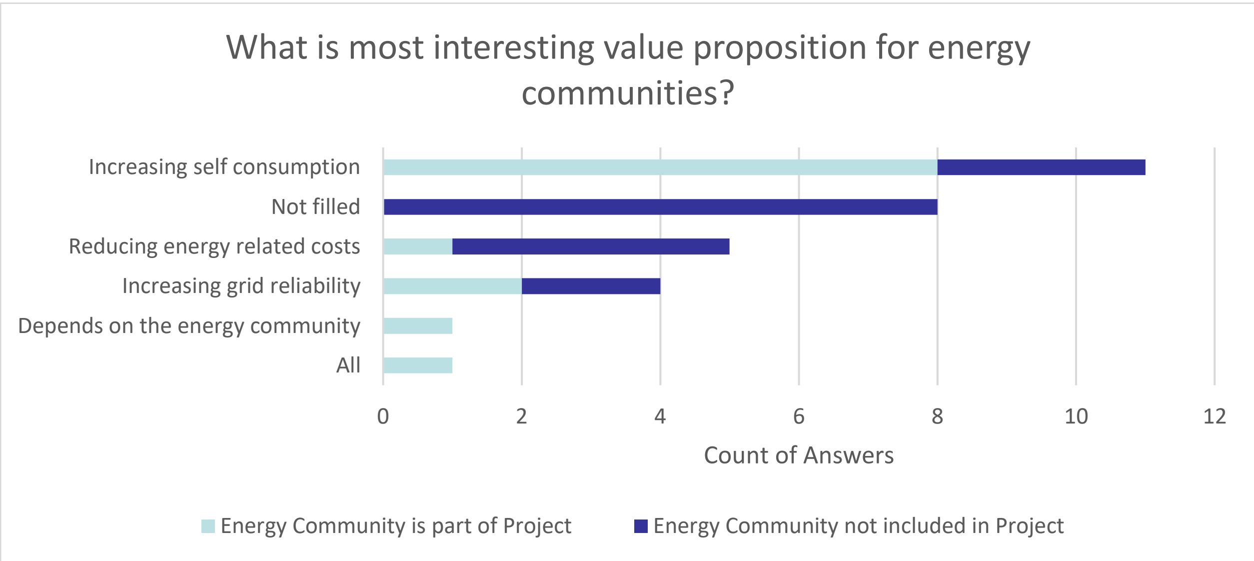

Figure 3-1: Value propositions for energy communities

While theoretically, there is a value proposition for the energy community members, a different one for the supply side (RES or services), and a third one for the DSO society at large. The above results verify the dilemma of which is the main value proposition of the energy communities to their members, as other value propositions than self-consumption often cannot be realized including providing flexibility to markets (See Chapter 3). Focusing only on self-consumption may lead to an overinvestment in technology which is from the societal point not the most cost-efficient way to decarbonise the economy.

3.1.2 Digitalisation

In all questions related to digitalization, “No answer” was given as a possible answer (Nr. 54 to Nr. 57). To analyse the open text answers given, buckets were formed. For question Nr. 54 regarding how the project business models and activities could benefit from digitalization, the buckets were: Aggregator platform; Not filled; Data handling; Energy controlling/Demand Response; Efficiency of business operation; Blockchain p2p platform.

Most common answer was related to some type of aggregator platform that can manage all information and devices (11 counts). Answers that are related more towards sole data handling (7 counts) and Energy controlling/Demand response (6 counts) without an overarching management system were second most common. Using/creating a blockchain p2p platform (1 count) and increasing the efficiency of business operations (1 count) came last. A closer look revealed that service-oriented projects favoured aggregator platforms, while product-oriented projects favoured data handling and energy control/demand response.

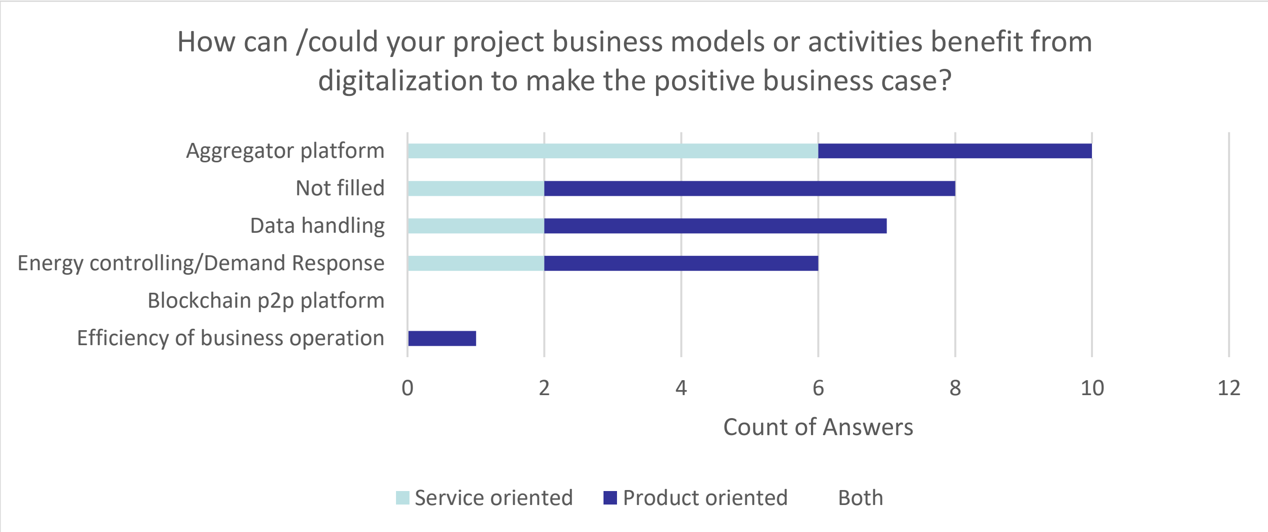

Figure 3-2: The benefits of digitalisation in BRIDGE projects’ business models

3.1.3 Barriers and how to overcome those in digitalisation activities

Question Nr. 55 on which barriers were faced during projects related to digitalization activities was answered by 20 of the 30 projects. The main barriers were related to integration and handling of data (11 counts), closely followed by privacy and data security issues (9 counts). A general lack of data was stated in 6 answers. One project stated the lack of profitability as barrier towards digitalization.

As result from question Nr. 56 on how to overcome the barriers a standardized data communication interface (8 counts) would be necessary. Privacy and security issues could be solved with data protection systems (3 counts) and open discussions with the stakeholders (3 counts). Two projects also stated that there is a need to upgrade the technology for metering and communication to be able to be used within the digitalization efforts.

3.1.4 What did you learn from your project, how digitalization could help in implementation?

Question Nr. 57 was the least filled question with only 12 projects giving answers. The two most common answers were related to benefits of collecting data for various applications while implementing digitalization (3 counts) and that digitalization will aid in creating interoperable systems (3 counts) by solving data communication issues, e.g. through standardization. Availability of data then opens opportunities to predict future behaviour of users (1 count), optimization of assets (1 count) and faster identification and solving of technical problems (1 count).

3.2 Good practices

3.2.1 BM tools

Among the 28 projects, the Business Model Canvas (BMC) is the most used tool for BM development, namely by 22 projects. Some of these projects use additional tools to complement the BMC, namely SWOT analysis, PESTLE analysis and lean canvases. One project indicates that it mainly focusses on value propositions and revenue blocks, and another project adds that it adapts the BMC as the classic canvas does not fit BMs that aim at value creation for the system including many stakeholders. The 6 projects that do not use BMCs have either developed their own BM tool (E-LAND project) or use other tools such as: e3value, excel, ppt, Service Dominant Business Model Radar and Data Value Network.

3.2.2 BM methodology

A large majority of the projects (19) indicate that organising workshops is an effective strategy to engage project partners and external stakeholders for business related activities, closely followed by one-to-one sessions (18) and questionnaires (11). 17 out of 27 projects consider it useful to regularly deliver progress reports on BMs during the project. Those that are against such reports argue that no fundamental changes on BM impact during the project are expected, it is too time consuming, and solutions are still at low TRL.

Only 12 projects include a deliverable dedicated to market research, while 16 projects do not produce such a deliverable. Most projects expect their exploitation to be supported by further research funds (21).

3.2.3 KERs & IPR

The average number of Key Exploitable Results (KERs) considered in the projects is 4,5. Most projects (13) were able to confirm their KERs in the 4th quarter of the project, where others confirmed them already in the 3rd quarter (6), or even 2nd or 1st quarter (3 and 1 project respectively).

Tools and methodologies used to identify and describe KERs in projects are diverse: IP Templates, Value Chain Design, Excel tables / Characterisation Table (often including useful info for IPR)**,** MIRO visual overviews, SWOT & PESTLE analysis, plain text and the methodology of the BRIDGE Taskforce on Replicability & Scalability.

Most projects discuss IPR at beginning of the project (18 out of 27) which should be considered a s best practice. 10 projects indicated that in developing the BMs there are issues regarding ownership: related to data sharing and operation, ownership and operation of market platform(s) and integrated toolboxes (combining IP of different partners), and roles and responsibilities: who should take care of guarantees and costs of assets.

3.3 Identified barriers

In question Nr.24 on whether there are existing constraints (technical, legislative, regulatory) that influence the ability to realize the multiple value streams, 19 projects gave a positive answer and 11 projects submitted a negative answer.

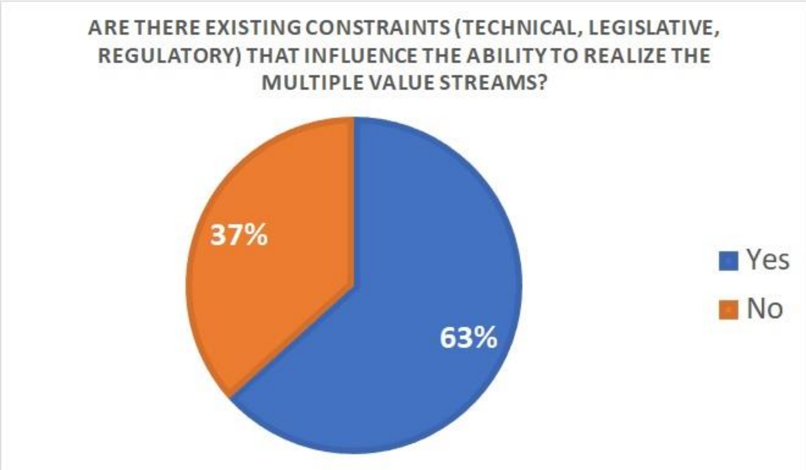

Figure 3-3: Percentage of projects facing barriers in realising value streams

The following have been identified as the key regulatory barriers faced by the projects in realising value streams:

- Market access barriers for aggregators, ongoing balancing market reforms in some EU countries.
- Legislation affecting aggregators' possibilities.
- In some national contexts, flexibility has not yet become a tradeable commodity (especially for small prosumers), while data transactions are not yet regulated.
- Regulatory framework is under development.
- Access to National flexibility markets is missing.
- Qualification for different markets is lacking.
- Poor participation of DERs in balancing markets.
- In some countries regulation does not allow for value stacking.
- Regulatory issues related to allowing the delivery of electricity to the grid.

These results confirm most of the barriers identified in Chapter 3. In question Nr.32 on whether they are facing barriers (e.g. technical / ownership of the technologies or components / regulatory / economic /social or other) that hold back the development of their business model, 19 projects answered positively and 11 projects answered negatively.

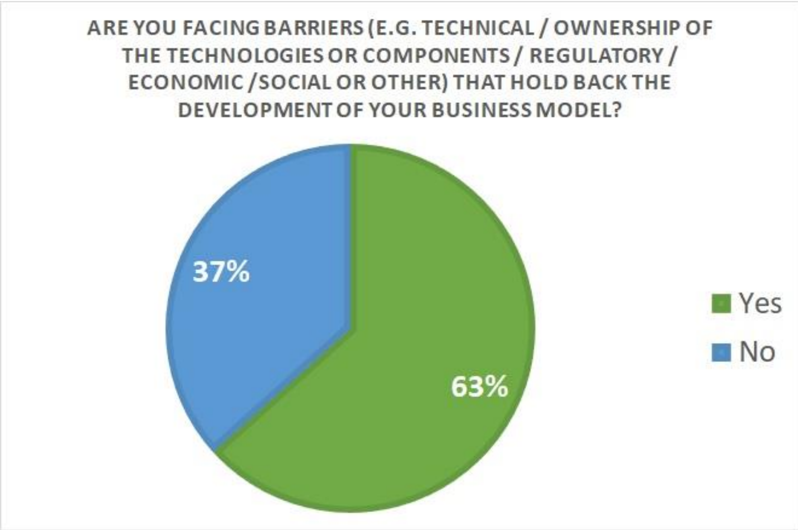

Figure 3-4: Barriers related to the development of business models

The following are the main regulatory barriers related to the development of business models that have been provided in the answers:

- A lot of regulatory requirements need to be implemented in order to comply with EU Directive figures like aggregators, community ownership models, the role of end users to be able to provide grid services to the DSOs/TSOs, etc.
- No clear legal and regulatory framework exists for the operation of storage systems and the services they can offer, the rules for connecting to the network.
- Lacking legislative framework for the participation on flexibility markets and for local flexibility markets.
- There are no clear laws, regulations on ENC and ancillary services for DSO.
- Lack of practical definition of Local Energy Communities.
- BM can be very location and legislative specific.
- Lack of Comprehensive DR-related policy/regulation.
- Unclear participation rules in the wholesale electricity market and especially in the Balancing and Ancillary Services Market for DR resources.
- Barriers are highly context specific towards National regulation but also regarding the aspired business model design.

Among the good practices and barriers identified by the Task 3 are:

- In BM tools, the BM canvas is the most frequently used tool.
- The most useful BM development approach are targeted workshops.
- Key Exploitable Results & IPR: while some projects have several well defined KERs from the very beginning, in most projects they are typically defined in the last third of the project duration.
- Common tools or methodologies to characterize KERs should be developed.
- The identified barriers include:
    - Regulatory barriers: market access, legislative, participation in markets.
    - Digitalization barriers: integration and handling of data, followed by privacy.

Identified barriers in digitalisation have been addressed in the lessons learned section above.

3.4 Current trends

The data collected by the BRIDGE BM WG members and the experts participating in their projects provided valuable information in terms of the current and future industry trends and their impact in Horizon projects. The data collected indicated three main trend categories identified by the experts: 1) Digitalisation, 2) Customer engagement and energy communities, and 3) Energy sector.

Through the data, various aspects of digitalisation emerged as the ones with the biggest impact for the BRIDGE projects. One of these aspects is Artificial Intelligence (AI) which is becoming more important in the energy industry and is having great potential for the future design of the energy system optimisation. At the same time, experts noted that the large amount of data generated by digitalisation also requires a different strategy to facilitate its management and exchange, such as the big data approach. Big data has been identified as a major trend in various industries, processes, and stakeholders. For instance, big data is penetrating the energy value chain, grid digitalisation and DSOs, particularly the smaller ones. Big data has also contributed to the increase of data sharing which slowly but steadily is becoming a reality for various stakeholders. On the same note, the deployment and increased investment of various technologies such as smart meters, EV chargers, and other infrastructure technologies related to the smart grid market technologies, are expected to boost its market growth. Due to these developments, further strategic infrastructural investment is anticipated by the governments which will aid in their long-term economic prosperity and thus will help them achieve the carbon emission targets.

The second category trend identified by the experts is the customer engagement and energy communities. Several experts recognised an increase in the number of initiatives aimed at developing energy communities, albeit many of them not particularly successful in terms of the favourability of the revenue streams for all the stakeholders involved. Similarly, experts identified several developments in the in the new business models around energy communities and the potential role an energy community could take. With regards to customer engagement, participants noted an improvement of customer engagement, particularly in terms of the user centric approach in product and service development, in terms of the enhanced role of the prosumers and also through innovative approaches of cascading funds, useful for buying hardware or software, with the purpose of engaging customers. At the same time though, the covid pandemic has also exposed various difficulties in engaging citizens-to-prosumers on the long run, in user engagement and bottom-up initiatives for energy communities.

The final trend identified by the experts is related to the energy sector. Several BRIDGE members pointed out that a great number of tools and platforms for Demand Response are being developed in EU projects, while at the same time they observed an increased coordination of the different electricity systems within Europe which can have implications at transmission, generation and market level. Finally, a number of experts noticed intensified synergies related to energy supply and demand-side optimisation, in the distribution grid state estimation and fault detection and lastly in the RES generation modelling and energy demand forecasting.

4. Synthesis of results and conclusions

The results of the work of the BRIDGE WG Business Models presented in this report show interesting new value chains (or streams) associated with the business models. This may include energy-related services that are embedded in non-energy-related services. Also, not all solutions are suitable for all geographies. In the Nordic countries for example the business model concepts that are strongly based on PV, such a solar self-consumption within energy communities, are less important and will not easily render a positive business case. To ensure viable business models for decentralized technologies in specific locations, a broader range of mature technologies than are currently available is therefore needed.

The focus on energy efficiency and decentralized energy supply models will increase on the Member State policy agendas given the rising energy prices. Reducing energy related costs will become an important feature of the business models, while among the projects with energy communities as main innovation we can observe a strong trend towards increasing self-consumption. Overall, however there seems to be a lack of understanding among national policymakers how decentralized energy systems should look like and which role they could take up. The emerging regulatory frameworks at the EU and national level and available mature technologies don't always match.

Regulatory frameworks need to enable sector integration (Power-to-X, EV mobility), where special attention should be paid to market design with multi-energy vectors (P2X, mobility, heating & cooling), multi-value chains within a single sector and cross-sector integration. However, research and innovation project need to provide viable solutions and focus more on the systemic dimension than on individual technologies. Several BRIDGE members have pointed out that a great number of tools and platforms for Demand Response are being developed in EU projects, while at the same time they observed parallel efforts by the professional bodies (e.g. ENTSO-E and EU DSO Entity) focussing on increased coordination of various electricity market types (especially cross-border ancillary service- and local markets) within Europe which will implications at transmission, generation, distribution and both wholesale and retail market level. The research community involved in BRIDGE projects needs policy-level support from the European Commission to share the results of the project research with these bodies with the objective to streamline the development of solutions in both tracks.

Several other trends were identified through a survey:

1. Digitalisation, Artificial Intelligence (AI) and Big Data are becoming more important in the energy industry and are promising great potential for the future optimal design of the energy system.
2. The main barriers to digitalisation were related to integration and handling of data, closely followed by privacy and data security issues.
3. Customer engagement and energy communities are key to energy supply democratization and customer acceptance of the technology solutions necessary for the decarbonization push.
4. Energy sector developments: Several BRIDGE members pointed out that a great number of tools and platforms aimed to support Demand Response and an increased coordination of the different electricity systems are being developed in EU projects.

Apart from currently still low revenue streams of decentralized energy solutions, a range of barriers is present that hamper their realisation, including regulatory, social and technical barriers. 63% of the BRIDGE projects stated that they face several barriers such as market access barriers, legislative, technology ownership, participation of DERs in balancing markets, and value stacking. Also improved flexibility remuneration schemes, focussing on Ancillary Services (AS), storage, and Demand Response are needed. Tariff schemes should aim to attract prosumers and all types of self-supply (individual, collective, and community). In addition to using Key Performance Indicators (KPIs), the best practices for evaluating Business Models were also highlighted through establishing their hierarchical structure them and providing robust baselines for them.

Two main concrete results were reported by BRIDGE projects, namely:

- Improvements and innovations using cascading funds (which can be useful for buying hardware or software) for customer engagement with replicability potential by other EU projects, and
- An innovative business model tool developed within a project with similarities to the BM Canvas which follows the approach of a morphological box with a set of 25 design options.
- Hierarchical KPI used in various projects.

With regards to customer engagement, the BM WG noted an improvement of customer activity and engagement, particularly in terms of the user-centric approach in product and service development, in terms of the enhanced role of the prosumers and also through innovative approaches.

Finally, the following overall insights could be distilled:

1. Business models are always highly context-specific and reflect the geographical, cultural as well as economic and regulatory aspects of any Member State.
2. There is a need to have new, innovative tools and solutions to facilitate the energy challenges, business models that facilitate the regulatory process and link these to specific KPIs to be utilized in the future by other EU projects.
3. A repository of use cases and business model patterns would be helpful for new projects as well as external stakeholders to see concrete examples that they can relate to in their own business.
4. KPI development: There is an opportunity for on-going library development identifying standards calculations for KPIs. KPI categorization will help but the KPI definitions should be dynamic as innovation happens both in business and technology. Definition of a standard process could be helpful for the creation of new business models and for capturing their benefits.
5. It is important to have different / multiple value streams and to identify the type of created value (energy, grid etc). This value should also consider social values and the revenue streams of non-energy (consumer oriented) services.
6. Due to the perceived lack of some regulatory aspects that could support such new BM, regulatory sand-boxes should be proposed that could facilitate the tests of new ideas/approaches.

5. Acronyms

AI	Artificial Intelligence
AS	Ancillary Services
B2C	Business to Customer
B2B2C	Business to Business to Customer
BM	Business Model
BMC	Business Model Canvass
BRP	Balancing Responsible Party
DAM	Day-ahead Market
DER	Distributed Energy Resources
DR	Demand Response
DSM	Demand Side Management
DSO	Distribution System Operator
EMS	Energy Management System
ESCO	Energy Serving Company
ESP	Energy Service Provider
EU	European Union
EV	Electric Vehicle
FiT	Feed-in Tariff
FLESCO	Flexibility Serving Company
FMO	Flexibility Market Operator
FSP	Flexibility Service Provider
GUI	Graphic User Interface
HLUC	High Level Use Case
HW	Hardware
IDM	Intra-day Market
IT	Information Technology
KER	Key Exploitable Result
KPI	Key Performance Indicator
LEC	Local Energy Community
LEM	Local Energy Market
MO	Market Operator
P2P	Peer to Peer
P2X	Power-to-X
PPA	Power Purchase Agreement
PV	Photovoltaic
RA	Resource Aggregator
RES	Renewable Energy Sources
SCADA	Supervisory Control and Data Acquisition
SME	Small and Medium Enterprise
SW	Software
TRL	Technology Readiness Level
TSO	Transmission System Operator
TV	Television
UC	Use Case
WP	Work Package

6. Annex 1 The BRIDGE BM WG Questionnaire

6.1 GENERAL QUESTIONS

1. Which project do you represent?
2. At which stage of your project are you?
   - Beginning (M1-M12)
   - Mid (M12-M30)
   - End (M30-M36/M48)
3. Is your project product oriented or service oriented?
   - Product oriented
   - Service oriented
   - Other (please specify): __________
4. What are your product(s)/service(s)? (describe up to three products/ services)__________
5. In which industry/field are the main innovations of your project?
   - Smart grid
   - Demand-side response
   - Energy storage
   - Islands
   - Digitalisation
   - Energy communities
   - Resilience/Microgrids
   - Other (please specify): __________
6. Which current trends do you see in the field of your project? (list up to three trends in the industry that affect your project, e.g. trends in business models, technology development, customer engagement, etc.)
7. What are your project's products'/services' main benefits for a market participant and for the system (economic and ecological)? __________
8. Which metrics would you choose to benchmark your project's products/services against other products/services?
   - Time
   - Cost
   - Quality
   - Efficiency
   - Impact (environmental, social, economic)
   - User uptake
   - Other (please specify): __________

6.2 BUSINESS MODELS

9. At the beginning of your project, did you already identify a preliminary business model(s)?
   - Yes
   - No
10. If yes, are you following it/them, or have you modified them in some way (please specify): __________

11. Please list up to 5 business models (BM) that have already been considered within your project.

____

12. Who are the main internal and external stakeholders involved in BM definition?
    - Small and Medium Enterprises (SMEs)
    - Distribution System Operators (DSOs)
    - Transmission System Operators (TSOs)
    - Local initiatives (e.g. energy communities, citizens, cooperatives)
    - Public sector institutions (municipalities etc.)
    - Universities
    - Investors
    - Advanced technology actors
    - Manufacturers
    - Energy providers
    - Energy users
    - Other (please specify): __________
13. What kind of subsidies or incentives might influence your business model? (i.e both positive and negative, such as gas subsidy, energy efficiency retrofit subsidy, etc. – please list up to 5) __________
14. Are there any issues with who is eligible for these subsidies or incentives that impacts your business model?
    - Yes
    - No
    -
15. If yes, please specify: __________
16. Do you think making progressive reports on Business Model development during the project is useful? (e.g., a Deliverable on the Business model every 12 or 18 months of the project).
    - Yes
    - No
17. If no, why not (please specify): __________
18. What are the boundary conditions (top 3) affecting the business model (e.g., things that are not allowed legally)? (list up to 3 for each business model)

    BM1: ________

    BM2: ________

    BM3: ________

    BM4: ________

    BM5: ________

19. When shaping business models, are you considering as key element the major trend of servitisation (Including elements like product as a service, energy as a service)?
    - Yes
    - No
20. If yes, please explain:__________
21. Does your project consider different value streams / value stacking?
    - Yes
    - No
22. If yes, which value streams / value stacking do you consider (up to 5):__________

23. Are there existing constraints (technical, legislative, regulatory) that influence the ability to realize the multiple value streams?
    a. Yes
    b. No
24. If yes, please explain:__________
25. In developing the business model for your project, is technology ownership an issue among partners?
    - Yes
    - No
26. If yes, please explain:__________
27. Is the business model canvas typical approach that you use for your business model development? If not, which other tools are you using?
    - Yes
    - No
28. If not, please specify any other tools used: __________
29. Have new innovative technologies like blockchain (if any other innovative technologies please name them), played a role in your business model definition?
    - Yes
    - No
    - If yes or no, please specify which tools played a role: __________
30. What is the most effective strategy in order to engage the project partners / external stakeholders in business related activities (e.g. for the purpose of collecting information from the project partners about the exploitation, business models etc)?
    - Organising workshops
    - One-to-one sessions
    - Questionnaires
    - Webinars
    - Other (please specify): __________

6.3 POTENTIAL BARRIERS (e.g. legislative/regulatory)

This section investigates whether it is currently possible to realize the benefits of your project's product(s)/ service(s).

31. Are you facing barriers (e.g. technical / ownership of the technologies or components / regulatory / economic /social or other) that hold back the development of your business model?

- Yes
- No

32. If yes, which (please specify): __________
33. Name the (3) most important lessons learned regarding the barriers encountered in your project in relation to Business Models?
    - Lesson 1: __________
    - Lesson 2: __________
    - Lesson 3: __________
34. How does the current legislation (market structures/regulatory environment) affect (support or hinder) the use of your project's products or services in the country/region where it is intended to be used?
    - Product/ service 1: __________
    - Product/ service 2: __________
    - Product/ service 3: __________
35. Are there any potential conflicts (misalignment between stakeholders' goals - e.g. public vs private)

Please specify: _________

6.4 FINANCING / ECONOMIC

36. What investment model (if any) has been applied for installing energy systems/technologies? (Please also specify which energy system or which technologies)?_________
37. Which investing schemes do you consider in your project (list up to 5)?
    - Please specify: _________
38. In your business model are you considering crowdfunding initiatives as source of financing?
    a. Yes
    b. No
39. What energy assets can be economically attractive (with or without available subsidies/incentives)? ***(answer if applicable to your project)***
    - Energy efficiency retrofits
    - Load management/demand response
    - Managed electric vehicle charging
    - Battery storage
    - Heat storage
    - PV
    - Wind
    - Biomass
    - Hydrogen
    - Other (please specify): ________

6.5 KEY EXPLOITABLE RESULTS (KERs)

We would like to know more about your project's Key Exploitable Results (KER). A KER is an identified main interesting result which has been selected and prioritised due to its high potential to be 'exploited' downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education. To select and priorities results, the EC recommends to projects to use the following criteria: degree of innovation, exploitability, impact.

40. How many KERs do you consider in your projects? (list up to 5)
    - 1
    - 2
    - 3
    - 4
    - 5+
41. How long after the start of the project are you able to confirm all the KERs that the project will have?
    - 1st quarter
    - 2nd quarter
    - 3rd quarter
    - 4th quarter
    - Other (please specify): _________
42. When you identify and describe the Key Exploitable Results of your project, do you organize the info using a tool (e.g. a draft Characterization Table useful for Intellectual Property Rights (IPR) Report, Exploitation Strategy but also for Business Model and Business Model Canvas)?
    - Yes

- No
- If yes, please specify which tool you are using: __________
- If not, please specify any other methods used: __________

43. Are IPR discussed at the beginning of your project regarding the exploitation of the Key Exploitable Results?
    - Yes
    - No

6.6 COMMERCIALISATION / EXPLOITATION

44. Which is the need that your project's product or service intends to meet or the problem it would solve? (Main reason why the client/user would pay for it)? **(please select up to three choices from the list for up to three products/ services)**

    Example: Service/product 1 intents to meet a, f, and g…

    a. Assist in decarbonisation efforts
    b. Reduced cost of energy for consumer/business
    c. Decrease in cost of current technologies
    d. Energy efficiency/energy savings
    e. Energy management optimisation
    f. Development of integrated energy systems
    g. Local energy independency
    h. Innovative approaches for energy storage systems
    i. Participating in energy and flexibility markets
    j. New tools and methods for monitoring/information services
    k. Increased collaboration/ synergies/ involvement
    l. User-personalized services
    m. Development of innovative power electronic solutions and/ or software systems

    - Other (please specify): __________
    - Product/ service 1: __________
    - Product/ service 2: __________
    - Product/ service 3: __________

45. Does your project include a Market research dedicated deliverable to precisely identify the potential clients/users of the proposed service or product?
    - Yes
    - No

46. Who are your competitors or what are competing technologies/developments? (please select up to three services/ products to describe)

    Example: Service/ product 1 has the following competitors/ competing technologies…

    ____

47. What advantage (+) do you have over your competitors? **(please select up to three choices from the list for up to three products/ services)**

    Example: Service/product 1 intents to meet a, f, and g…

    a. Lower costs and prices for goods and services

b. Better quality
c. More flexibility and choices
d. More technological innovation
e. Greater efficiency and productivity

- Other (please specify): _________
- Product/ service 1: _________
- Product/ service 2: _________
- Product/ service 3: _________

48. What disadvantage (-) do you have over your competition? **(please select up to three choices from the list for up to three products/ services)**

Example: Service/product 1 intents to meet a, d, and e…

a. Lower costs and prices for goods and services
b. Better quality
c. More flexibility and choices
d. More technological innovation
e. Greater efficiency and productivity

- Other (please specify): _________
- Product/ service 1: _________
- Product/ service 2: _________
- Product/ service 3: _________

49. Do you expect your project's exploitation to be supported by further research funds?
    - Yes
    - No
50. if yes: how? / if no: why not (please specify): _________

6.7 ENERGY COMMUNITIES / VALUE PROPOSITION/ REVENUE MODELS

51. What is most interesting value proposition for energy communities? ***(answer if applicable to your project)***
    - Increasing self-consumption
    - Increasing grid reliability
    - Reducing energy related costs
    - Other (please specify): _________
52. Which revenue models are applied in the community? ***(answer if applicable to your project)***
    - Savings from energy
    - Energy sales to community members
    - Energy/service to external stakeholders
    - Data valorisation
    - Other (please specify): _________

6.8 DIGITALISATION

53. How can /could your project business models or activities benefit from digitalization to make the positive business case? _________
54. What barriers did you face related to digitisation activities in your project?_________

55. Which solution involving digitalization would you need to overcome them?__________
56. What did you learn from your project, how digitalization could help in implementation?__________

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