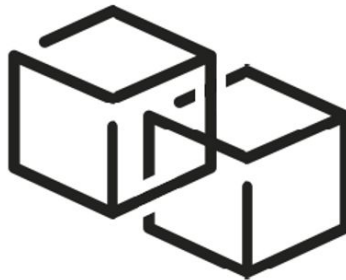


# T4.1 - Supporting materials for the Delphi process



**PARITY**

Project Acronym:	<b>PARITY</b>
Project Full Title:	<b>Pro-sumer AwaRe, Transactive Markets for Valorization of Distributed flexibility enabled by Smart Energy Contracts</b>
Grant Agreement:	<b>846319</b>
Project Duration:	<b>42 months (01/10/2019 – 31/03/2023)</b>

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# Task to carry on

As member of the panel of expert for the Delphi process, you have been provided a google folder with three files:

- the presentation of the activity made on the 27th of April
- a document describing the barriers subcategories and the 8 actors identified in the project
- a template to grade the importance of the category of barriers for every actors.

Please read carefully the instructions below before starting the tasks:

- Read carefully the description of the category of barriers and actors.
- Please fill a sentence describing yourself. For example: Researcher on energy behaviour; CEO of a DSO; developer of some cool technology; etc.
- For every actor, you have to grade the relevance of the barrier subcategory for them using whole numbers from -5 (not relevant at all) to 5 (extremely relevant). The spreadsheet is locked, so only information in the grey cells could be provided.
- If you are not sure about a grade, please LEAVE THE CELL EMPTY. Moreover, AVOID USING 0 (neutral) as a grade.

Please complete this task no later than 19:00 hours of Monday 5th of May.

Thanks for participating in this task.

Deusto Team

# Description of the barriers

## Taxonomy of barriers and explanation

Using a combination of in-depth workshops, expert interviews and literature research, Balta-Ozkan and colleagues (2013)<sup>1</sup> investigated social barriers to the introduction of smart homes in the UK. They found the next 7 categories: (1) fit to current and changing lifestyles, (2) administration, (3) interoperability, (4) reliability, (5) privacy and security, (6) trust, and (7) costs. We followed a similar approach but we came out with 6 categories for LFM instead as can be observed in Fig. 1. Each of these categories are explained in detail throughout this document. Finally, Fig. 2 represents the entire taxonomy in a diagram.

Figure 1: This figure indicates the number of barriers within each of the categories identified. As we can observe we found more barriers related to social and behavioral aspects and less related to the final cost or because of technical issues.

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<sup>1</sup> Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Social barriers to the adoption of smart homes. *Energy Policy*, 63, 363-374.



Figure 2: Diagram of the complete taxonomy

## Current Lifestyles

Balta-Ozkan and colleagues (2013) found that experts identified a lack of fit to current and changing lifestyles as one of the most important barriers to adopt these cutting-edge smart homes. The researchers from that study concluded that “there was a gulf between those developing the technology and what people actually want in their homes or districts”. We opine that this can be clearly brought to the LFM adoption. Therefore, we apply this category to understand the social and behavioural aspects that present a barrier for the purposes of the PARITY project.

Within this category we found some subcategories that will help to better understand the emerging barriers in order to give a context to them.

- **Adoption:** Technology adoption is a process. It usually starts with the user becoming aware of the technology, and ending with the user embracing the technology and making full use of it. Someone who has embraced a technology is likely to replace the item if it breaks, find innovative uses for it, and cannot contemplate life without it. Within this subcategory the most prominent barriers found were:
  - *People have to change the habits of consuming and sharing energy.*
  - *Meeting the evolving needs, demands and preferences of its occupants.*
  - *Integration of technology and services into the design, lifestyle and general sense of home.*
- **Ideology & involvement:** An ideology is a set of beliefs and values attributed to a person or group of persons. Specifically, a system of ideas and ideals, especially one which forms the basis of economic or political theory and policy. While involvement refers to the willingness of people to participate in the LFM. It is a synonym of engagement. Within this subcategory the most prominent barriers found were:
  - *People are not interested in becoming a prosumer as they are habituated to centralized markets and traditional infrastructure providers. People might not want to depend on other participants of their local area.*
  - *Interdependency among consumers in an individualist society.*
  - *Adoption of flexibility seems to be a political option and a bottom-up model which leaves more conservative people apart.*
- **Disillusion(ment):** disappointment resulting from the discovery that something is not as good as one believed it to be. According to the hype cycle, it refers to interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investment continues only if the surviving providers improve their products to the satisfaction of early adopters.
  - *Smart technology leaving people ‘constantly worrying’ and feeling guilty*
  - *Perceived inconvenience of these emerging technologies*
- **Reluctance and lack of trust:** Unwillingness or disinclination to do something because there is no confidence in the technology. This can be observed for different reasons such as feelings of inequality, resistance to change, fear of digital technologies, an inability to keep up with digital transformation initiatives and disruptions, a feeling of not

being taken into account by any given 'power', prejudice and the failure of organizations and governments to inform, educate and regulate in a proper and transparent way.

- *Loss of control and apathy, inertia*
- *Information and Response fatigue for elderly in particular*
- *Rejection of an intervention that will not last in the mid/long term*
- **Perceived Usefulness:** From the TAM model, This was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether or not someone perceives that technology to be useful for what they want to do. Within this subcategory the most prominent barriers found were:
  - *Not clear the framing effects and the benefits over population: global (e.g. climate change) vs local (e.g. reduced cost or autarky).*
  - *Technologies are either little known or still not developed enough to attract the attention of customers.*
- **Ignorance / lack of expertise:** Lack of knowledge or information. Not only of how things work, but even the very fact that things are far more complex than we might realize. Within this subcategory the most prominent barriers found were:
  - *Lack of access or difficult user interfaces to understand necessary information.*
  - *Lack of previous user experience in a new business market.*
  - *DER or Flexibility markets. Too complex for their everyday living. People hesitate to understand if their electric power will be ensured.*

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

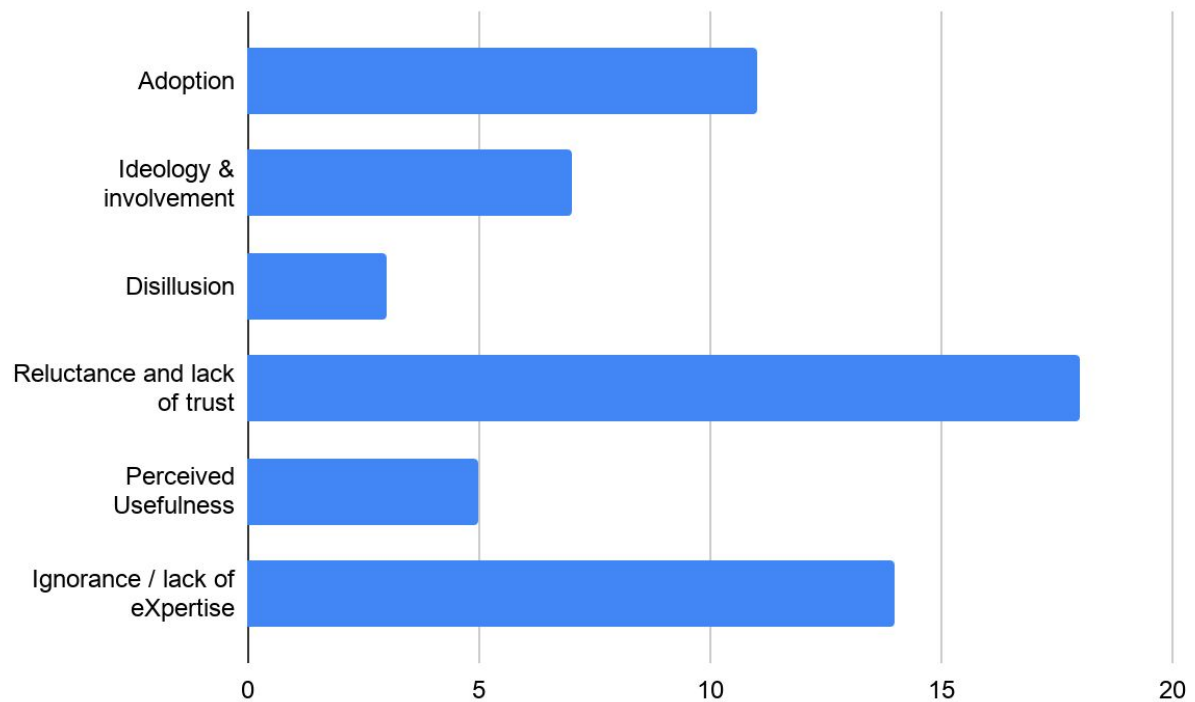


Figure 3: Distribution of barriers over the subcategories of type current lifestyles

And, finally, in the next table a list of barriers detected on every subcategory.

Adoption	Legal framework is difficult to understand
	People have to change the habits of consuming and sharing energy
	Meeting the evolving needs, demands and preferences of its occupants
	Smart technology as divisive (exclusive to tenants, elderly, computer illiterate, smartphone users, people living in older house)
	Integration of technology and services into the design, lifestyle and general sense of home
	Accommodating the integration and installation of new technological components
	Accepting automation and contributing to network flexibility (lack of perfect information)
Ideology & involvement	People are not interested in becoming a prosumer as they are habituated to centralized markets and traditional infrastructure providers. People might not want to depend on other participants of their local area
	Primary Energy Factor (PEF) methodology does not separate the sources of electricity, including electricity from renewable resources
	Lack of local initiatives to engage citizens overall in cities
	Interdependency among consumers in an individualist society.



	Adoption of flexibility seems to be a political option and a bottom-up model which leave more conservative people apart
	Besides cash cost minimisation, consumers may be influenced by their values (e.g., environmental values, energy conservation values)
Disillusion	Technical gap between expectations and current solutions
	Smart technology leaving people 'constantly worrying' and feeling guilty
	Perceived inconvenience of these emerging technologies
Reluctance and lack of trust	Values, beliefs and norms do not match with emerging technologies (DER, DR, Flexibility)
	Rejection of an intervention that will not last in the mid/long term
	Usually users struggle appropriating technology even that benefit them (socially diverse context present a major challenge)
	The reluctance of employees or family units. You have to explain they are going to lose the control but comfort level will be the same
	Loss of control and apathy, inertia
	Smart homes making more affluent people less conscientious regarding energy saving
	Smart home services as non-essential, luxurious, or 'gadgetry'
	Lack of trust that financial savings made by utility companies will be passed onto the consumers
	Veto over third party control of personal devices
	People need some evidence of value. This is not usually demonstrated in Business cases. Chicken-egg paradox
	Less control over electricity use
	Information and Response fatigue for elderly in particular
	People do not have time to think in this new distributed market.
Perceived Usefulness	Declining customer engagement over time
	the benefit to the individual when adopting Flexibility markets is not clear
	Not clear the framing effects and the benefits over the population: global (e.g. climate change) vs local (e.g. reduced cost or autarky)
	Technologies are either very little known or still not developed to attract the attention of customers
	Environmental and economic concerns are not generally regarded as important within the organisation / family unit
	Inference of householders' desired outcome
Ignorance / lack of	Consumers are facing difficulties to choose among the high amount of low-carbon energy solutions and understand the benefits (e.g. renewable energy system, home insulation, or an EV)

expertise	lack of access or Difficult user interfaces to understand necessary information
	Knowledge deficit
	Lack of previous user experience in a new business market.
	Energy managers lack power and influence to end users. Organizational culture leads to neglect of energy/environmental issues
	Markets for energy trading at local/community level are at an early stage with only a small number of such communities in existence today.
	DER or Flexibility markets are too complex for their everyday living. People hesitate to understand if their electric power will be ensured

# Trust

Several studies conducted to study technology adoption showed that rather than 'educating customers' on the benefits of smart grids, houses, energy demand, etc., industry should focus more on reassuring them that they can and should trust utility companies or vendors. As we can see for this conclusion this category refers to the Trust among end-users (customers), companies, industry and across all relevant actors and stakeholders. Within this category, the following subcategories emerged from the study we have conducted:

- **Security:** It refers to the defense of digital information and IT assets against internal and external, malicious and accidental threats. This defense includes detection, prevention and response to threats through the use of security policies, software tools and IT services.
  - *Cyber attacks that threaten the smart grid and the energy IoT devices.*
  - *Unauthorized access to LFM services.*
- **Privacy:** Human beings value their privacy and the protection of their personal sphere of life. They value some control over who knows what about them. They certainly do not want their personal information to be accessible to just anyone at any time. But recent advances in information technology threaten privacy and have reduced the amount of control over personal data and open up the possibility of a range of negative consequences as a result of access to personal data. Within this subcategory the most prominent barriers found were:
  - *Possible misuse of customers' personal data.*
  - *Big brother-like monitoring was too intrusive.*
  - *Combining two sets of innocent data leading to 'non-innocent' data.*
- **Stakeholders Cooperation:** this subcategory refers to the interaction that stakeholders have to hold to provide overall confidence across all involved agents. Within this subcategory the most prominent barriers found were:
  - *Lack of information about the partners (e.g. neighbours, DSO...) who participate in the flexibility market and revenue streams.*
  - *Imperfect information, asymmetric information, hidden costs, risk*
- **Communication strategy:** is designed to help you and your organisation communicate effectively and meet core organisational objectives of the service or good provided. Within this subcategory the most prominent barriers found were.
  - lack of trust in the form/medium/channel of information received to end-users about tarification
  - How the recipient of information regards the sender will dictate how such information will be perceived.
- **Emerging Technologies:** are technologies whose development, practical applications, or both are still largely unrealized, such that they are figuratively emerging into prominence from a background of nonexistence or obscurity
  - Lack of transparency of market rules and remuneration settlements.
  - Lack of transparency of the contract and the remuneration.

- Dependent on closed and open or untrusted and reliable networks and vendors

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

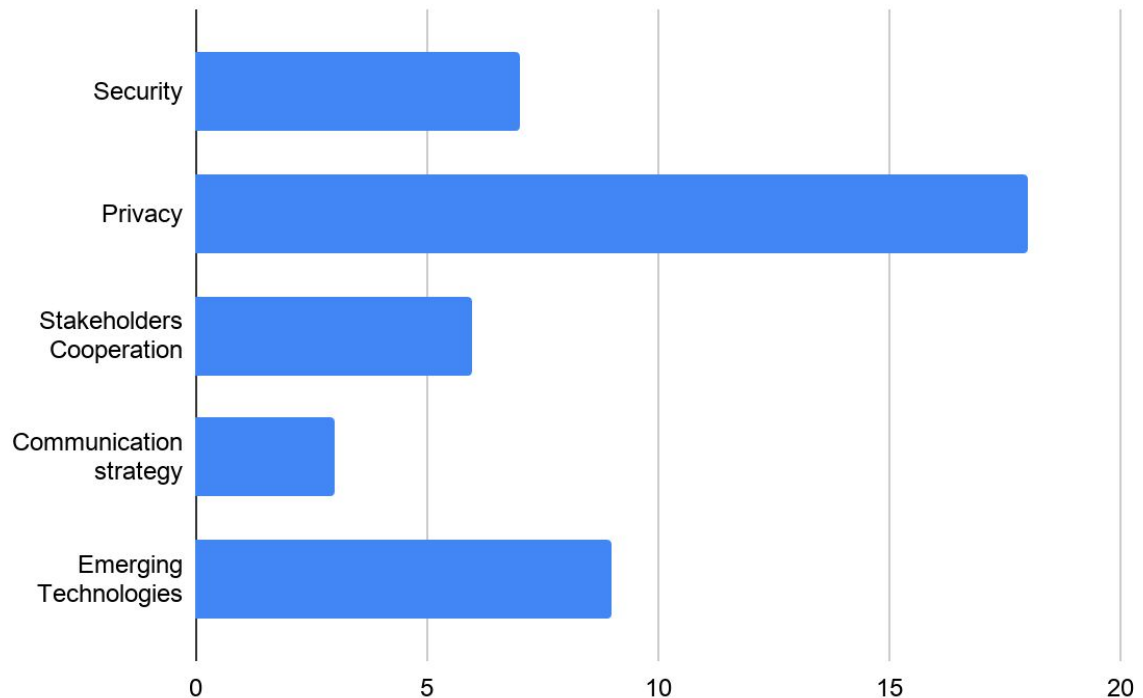


Figure 4: Distribution of barriers over the subcategories of type standardization

And, finally, in the next table a list of barriers detected on every subcategory.

Security	Cyber attacks that threaten the smart grid and the energy IoT devices / Cybersecurity - Attacks
	Unauthorized access to LFM services
	Systems being compromised
Privacy	Violations of privacy
	Combining two sets of innocent data leading to 'non-innocent' data
	Lack of perceived privacy would not worth it for lower bills
	Data falling into wrong hands
	Data sharing
	Big brother-like monitoring as too intrusive
	Concerns over third parties knowing daily routines and occupancy
	Companies responsible for smart home services selling on personal data
	User of personal data in an ethical way is a major impediment for adoption.

	Possible misuse of customers' personal data.
Stakeholders Cooperation	Lack of trust among involved community agents (e.g. if they have to get into home-owners' premises)
	Lack of information about the partners (e.g. neighbours, DSO...) who participate in the flexibility market and revenue streams
	Imperfect information, asymmetric information, hidden costs, risk
	Aggregator does not behave in a way which is in the interest of the consumer
	Some parties free-riding (get economic benefits of other actions)
Communication strategy	If information is not regarded as intended by the sender, the corresponding behaviour of the recipient will not as expected by the sender.
	lack of trust in the form/medium/channel of information received to end-users about tariffication
	How the recipient of information regards the sender will dictate how such information will be perceived.
Emerging Technologies	Lack of transparency of market rules and remuneration settlements.
	Lack of trust on the potential value of DR
	Lack of transparency of the contract and the remuneration.
	Difficulty finding a reliable vendor
	Physically distributed devices
	Mixture of very small to very large devices
	Large-scale deployments
	Dependent on closed and open or untrusted networks

## Administrative

This category comprises all barriers that have a relation with legislation, regulation or policy at all levels. This is one of the most diverse category as barriers of all types can be found among its subcategories:

- **Lack of regulation:** this category contains all barriers related to the lack of regulation around the flexibility market. Innovation in the energy sector (which is one of the most regulated) is seriously hindered by the slow pace that regulations impose. This is clearly seen in this review as this is one category with the biggest amount of barriers found. For example, barriers in this category include:
  - *lack of legislation regarding flexibility markets, blockchain and energy communities.*
- **Market restrictions:** in opposition to the previous category, this one contains regulations that hinder the possibility of operating a flexibility market. The biggest amount of barriers in this category relates to the restrictions imposed on DSOs and TSOs. Examples of barriers in this category are:
  - *DSO is not allowed to operate freely on the market or the exert market power of utilities.*
- **Policy/regulatory incentives:** this category contains the barriers related to the lack of incentives or the unintended effects they have over the deployment of the flexibility market. Examples of this category are:
  - *the lack of funding schemes to deploy the equipment needed.*
  - *the fact that the actual regulatory framework incentivises investment in grid expansion.*
- **Charging/cost rules:** this category is related to the previous one, but instead of focusing on the incentives (or lack of them), focus on how actual tariff schemes are a barrier to develop flexibility markets. Examples of barriers in this category are:
  - *the different regulations that do not allow to increase peak charges in different countries.*
- **Decision making:** this category reflects all barriers that the different stakeholders face when deciding to participate or deploy a demand response strategy or solution on its company or to their clients. Examples of barriers in this category are:
  - *the lack of power of technical staff in companies or the lack of a clear leadership.*

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

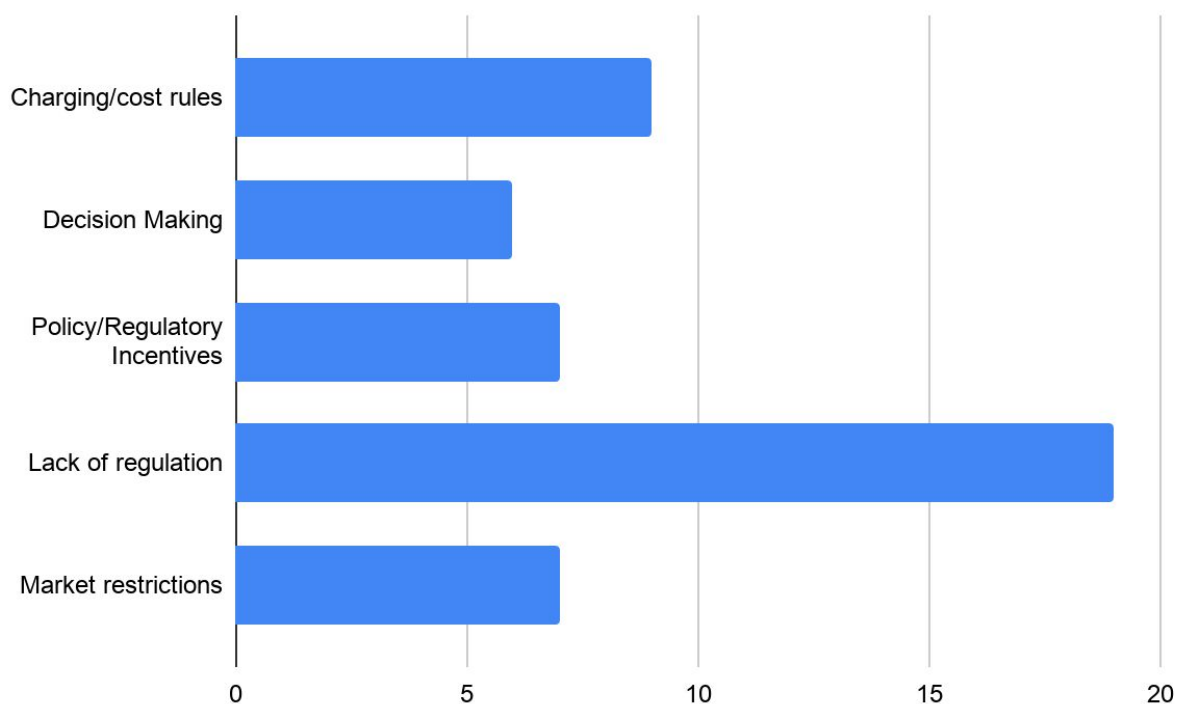


Figure 5: Distribution of barriers over the subcategories of type administrative

And, finally, in the next table a list of barriers detected on every subcategory.

Charging/cost rules	Taxation issue for battery storage behind the meter (tax is charged the same as for actual consumption)
	Regulated consumer prices preventing market price signals reaching ultimate consumers
	High threshold of power capacity required in order to participate in ancillary services market for TSOs
	Peak charges (kW/€) are limited by law to a specific share of the grid tariff (in Switzerland 30%)
	liberalization of energy system markets or absence of significant market failures (such as non incorporation of externalities related to CO2 emission).
	Critical peak tariff schemes are needed to offer incentives for the prosumers to engage in flexibility management scenarios
	Need for a bigger price gap between peak and off-peak periods in energy markets
	Pre-qualification processes (certifications to be available to trade) de-facto lock out small DERs from participating in ancillary services markets (for both TSO and DSO), conditions on minimum unit size or telemetry may be unnecessarily restrictive (particularly for small consumers with DR capabilities)

	Currently the funding scheme focuses on suppliers delivering the energy efficiency measures. A transition of focus towards users (other than levies on energy bills), and tools in the housing sector, financial incentives including tax exemptions is important.
Decision Making	People do not have a clear idea about who should pivot the flexibility: From the country (governments), to ESCOS, to SMEs, municipalities or themselves.
	Power (lack of it) to decide to adopt/implement DER, DR or Flexibility measures. Overall in organizations or neighbourhoods or flats.
	Not clear who owns the technology and systems
	Power inside a organisation to take decisions
	Lack of intermediary agents to bridge the whole chain (close the gaps between business models, citizens and technical solutions)
Policy/Regulatory Incentives	Regulatory framework for grid operators incentivises investments in grid expansion rather than operational expenditures for making use of DR
	The current Primary Energy Factor is impacting negatively the competitiveness of technologies such as electric heat pumps or smart heat storage, to the benefit of fossil heating technologies.
	Set targets and objectives for DSOs, instead of specifying actions and expenditure for particular projects or activities, will enable DSOs to have greater control over their specific environments.
	Curtailing renewables discourages development of alternative solution
	Current Directive does not set an adequate framework to incentivise the growth of electric vehicles (EVs).
	Lack of funding schemes from local and global administration
	The gap and ineffective EV charging planning strategies across Europe (e.g. some EU members NPF does not even include a 2020 target for charging points.)
Lack of regulation	Lack of p2p legislation
	The NPFs Directive does not provide accurate information on charging infrastructure, since the number of charging points today equals that of the vehicles.
	A differentiation between DC (direct current) and AC (Alternating Current) is not currently reflected in the Directive and neither are the expected technological evolutions of batteries and vehicles.
	Lack of legislation regarding the new services of the Balancing market
	Lack of legislation regarding the rules of the Ancillary services market for DSOs
	Lack or not settled legislation regarding the flexibility markets in most of European Union' countries
	Non established financial regulation regarding Blockchain
	Policy (weak legislation, limited or perverse incentives)
	Regulatory framework at EU level to increase the implementation of smart metering



	solutions
	Missing a regulatory framework for local energy communities which incorporate storage
	Lack of regulation concerning the rights and obligations of the entities that control customers' loads
	Delay in adoption of the EU Target Model
	Legal relationship between prosumers and aggregators
Market restrictions	DSOs are obliged to act as neutral market facilitators without end-consumer contact; this limits DSO involvement in LFM
	Regulatory barriers because the DSO is not allowed to operate freely on the market and offer services,
	National Regulatory Authorities (NRAs) need to update their regulations to support the roles of DSOs as market facilitators.
	The principle of BRPs' complete balance responsibility does not allow real P2P trading
	Exert market power of utilities
	Regulations enabling peer-to-peer trading, new energy communities, and active operation of the distribution network are uneven and unfamiliar.
	DERs are not defined as tools for balancing the local grid, but rather as a commodity to be traded with the TSO

## Standardization

This category comprises all barriers that have a relation with standardization at all levels. This is also a diverse category as it comprise technical, legal and administrative barriers among its subcategories:

- **Diversity:** as in all new markets, there is a myriad of technologies and markets schemes proposed or implemented. This category includes the examples found for the flexibility market.
- **Interoperability:** for the same reason as before, given the novelty of the market, no official or de facto standard has emerged, so every solution implements it on technology stack that is not interoperable. In this category we list them. The most important example is:
  - *the intercommunication problems between the different components in a house or building.*
- **Business models:** as before, the novelty of the technology made that there is not a clear business model for selling these types of markets in several use cases. Examples of this category is:
  - *the conflicts between different markets or the lack of previous experience to assess the participation.*
- **Roles and objectives:** finally, there is a lack of definition on what a flexibility market should provide to the different stakeholders.

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

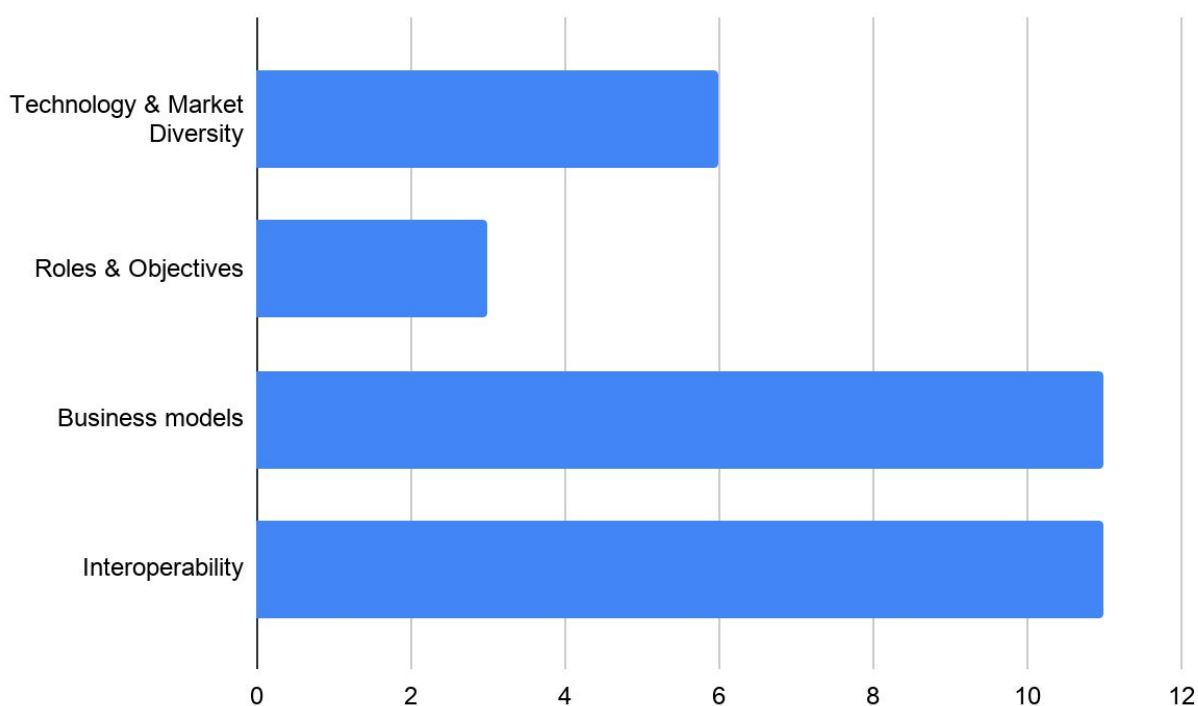


Figure 6: Distribution of barriers over the subcategories of type standardization

And, finally, in the next table a list of barriers detected on every subcategory.

Technology & Market Diversity	Multiple technology requirements in multiple regions
	Diverse technologies in the LFM infrastructure
	Different standards and pre qualification methods
	Structural differences in support measures between countries do not exist and in turn lead to diverse market conditions, characterised by different market actors' roles, electricity system operation procedures, and administrative requirements
Roles & Objectives	There is a mismatch between the idea that policy-makers, energy agents and end users have over the expectations of flexibility markets and DER
	Too much standardization for businesses that might develop a technology-based platform
Business models	Conflicts with demand flexibility services already existing in some of European countries
	Heterogeneous regulatory situation for second life battery installations around the EU
	Expertise for operational and management needs of smart homes
	Current business models are not reliable since they are sustained on the uncertainty of demand
	Lack of previous aggregator experience in a new business market.

	Baselines models are usually difficult to be created to assess the performance and potential enhancements of the emerging technology related to energy
	Roles and responsibilities of DSO/aggregators/retailers/prosumers are different in each EU MS, which makes it difficult to apply standard LFM business models
	New contract types between prosumers and consumers (Business model)
<b>Interoperability</b>	Communicating with other devices and technologies
	Complexity related to ownership and control of district devices
	Interference of devices with each other in a home setting
	Strong path-dependencies and lock-ins (tech is intertwined with user practices and life styles, business models, value chains, organizational structures, regulations, and institutional and political structures)
	Integration of heterogeneous equipment from diverse vendors / Difficulty of managing the integration between all the components.

## Technical

This category comprises all barriers that have a relation with the technical issues that could appear at all levels, from component to overall system. Technical category have been divided in the following subcategories:

- **System:** as in all new markets, there is a myriad of technologies and markets schemes proposed or implemented. This category includes the examples found for the flexibility market.
- **Communication:** There are many components (own and external) that will be part of the final solution and they will have to communicate between them. This communication should overcome barriers such as:
  - *the security, the balance and the high availability of the network.*
- **Algorithms:** The implementation of new algorithms should overcome some barriers for optimum performance. Example of this subcategory is:
  - *the lack of historical data to predict the demand.*
- **Deployment:** The deployment of the final system in a test or real escenario could have new barriers such as low speed of the transactions in Blockchain or an increase of resources needed.
- **Maturity:** finally, as this is a research project there are some components that are new and the probability of having problems are higher. Examples of this category are:
  - *the integration of these new elements in the existing grid.*
  - *the need of having more real cases and scenarios are needed to prove the feasibility of the idea.*

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

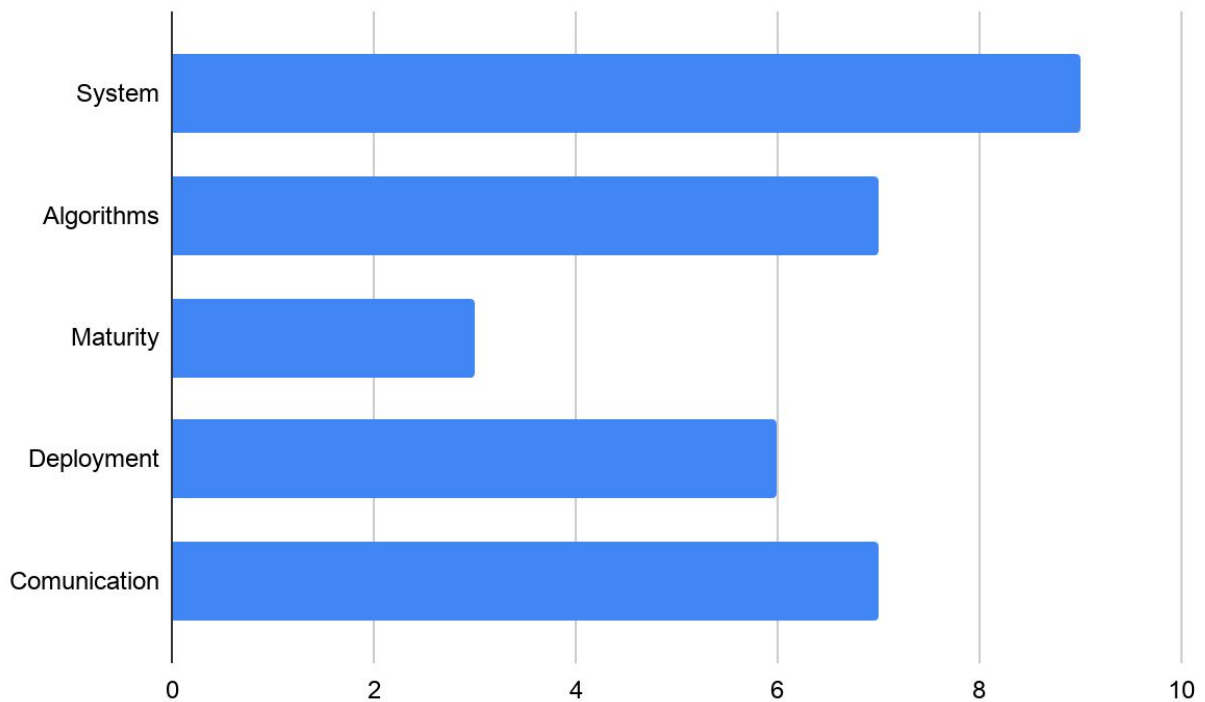


Figure 7: Distribution of barriers over the subcategories of type technical

And, finally, in the next table a list of barriers detected on every subcategory.

System	Malfunctioning
	scepticism regarding the functionality of the system
	Sensors going off by mistake
	Due to break down of remote control units house going in limbo
	Technology readiness issues
	Speed of transactions a blockchain system can support
Algorithms	Lack of historical data needed for the forecast algorithm
	inadequate data acquisition and actuation infrastructure
	Behaviour recognition forming key aspect of smart homes
	Development of energy optimization algorithms through the rise of domestic participants in demand response programs
	Accessing reliable and right signaling information to take action is not clear.
Maturity	DES and flexibilities are not mature enough for end-user adoption (emerging technologies)
	Integration of Renewable Energy into the Grid
	Estimations of EV infrastructure sufficiency, are currently based on literature and are more indicative for average trends, so these cannot be conclusive for all locations and

	countries
	More real cases and scenarios are needed to prove the feasibility of the idea
Deployment	Communications network breaking down and other systems getting out of control
	A technology adaptation regarding advanced control, monitoring, communication and IT infrastructure is needed
	Increasing levels of resources and flexible loads responding to dynamic price signal
	Speed of transactions a blockchain system can support
Communication	Network balancing and supply security
	secured/encrypted communication required
	Highly available and reliable communication networks required
	Efficient communication network scaling bandwidth and real-time data
	Not use of standardized communication protocols and data models

## Cost

This category comprises all barriers that have a relation with the economical cost that customers and companies have overcome. Cost category have been divided in the following subcategories:

- **Investment:** The initial and maintenance investment that must be done should be taken into account by customers and companies.
- **Pricing:** These new markets will carry new contacts and the costs related to them. Example of this subcategory is “Supply contracts for LFM members may be expensive if suppliers are not responsible for their customers' imbalances”.
- **Margin:** Finally, the situations that affect the margin will have barriers that will difficult the system adoption. An example is a minimum unit size (families) are needed to adopt DR, DER or flexibility benefits

In the following figure we can observe the distribution of barriers identified within each of the subcategories.

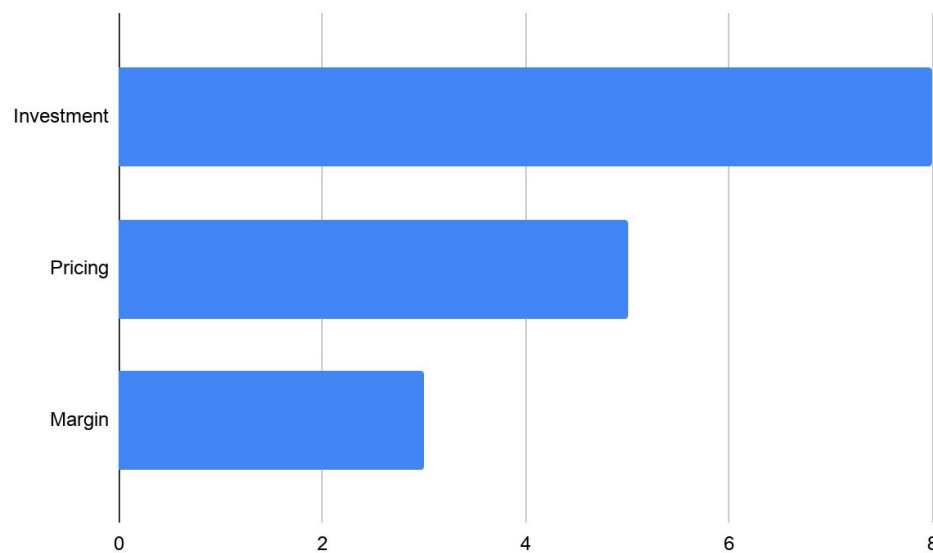


Figure 8: Distribution of barriers over the subcategories of type cost

And, finally, in the next table a list of barriers detected on every subcategory.

Investment	High initial investment costs
	People do not have a clear idea about the potential cost on investment/savings
	Hidden costs related to the costs associated with participation in markets ( negotiation and enforcement transaction costs)
	High repair and maintenance costs
Pricing	Lack of dynamic tariff systems or mechanism for signaling the value from relevant markets to consumers



	Grid tariffs charged may be higher for LFM members if local grid constraints cannot be avoided persistently
	Currently the regulated costs (network charges and levies) are charged to consumers impacting the price increase
	Supply contract for LFM members may be expensive if suppliers are not responsible for their customers' imbalances
Margin	Manufacturers are competing with very low margins
	Small margins for prosumers and service providers in the flexibility services market
	need for a minimum unit size (families) to adopt DR, DER or flexibility benefits

# The USEF role model

Adapted from USEF White Paper on Energy and Flexibility Services for Citizens Energy Communities<sup>2</sup>

## Prosumer

A Prosumer can be regarded as an end-user that no longer only consumes energy, but also produces energy. USEF does not distinguish between residential end-users, small and medium-sized enterprises, or industrial users; they are all referred to as Prosumers. In this text we also use the term Prosumer for end-users that have controllable assets (Active Demand & Supply) and are thereby capable of offering flexibility.

## Distributed Energy Resources (DER)

In USEF, Distributed Energy Resources (DER) represents all types of systems that either demand or supply energy which can be actively controlled. This enables the DER device to respond to price and other signals from the Aggregator and to provide flexibility to the energy markets via the Aggregator. The Prosumer owns the device and defers responsibility for controlling its flexibility to the Aggregator. The Prosumer has final control over its assets, which means the Aggregator's control space is limited by the Prosumer's comfort settings. Hence the Prosumer is always in control of its comfort level; if the associated remuneration is high enough however, the Prosumer might be willing to compromise on its comfort levels. In this context we also use the terms units, assets or resources when referring to DER.

## Aggregator

The role of the Aggregator is to accumulate flexibility from Prosumers and their DER and sell it to the BRP or Supplier, the DSO, or (through the BSP) to the TSO. The Aggregator's goal is to maximize the value of that flexibility by providing it to the service defined in the USEF Flexibility Value Chain that has the most urgent need (or value) for it. The Aggregator must cancel out the uncertainties of non-delivery from a single Prosumer so that the flexibility provided to the market can be guaranteed. This prevents Prosumers from being exposed to the risks involved in participating in the flexibility markets. The Aggregator is also responsible for the invoicing process associated with the delivery of flexibility. The Aggregator and its Prosumers agree on commercial terms and conditions for the procurement and control of flexibility.

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<https://www.usef.energy/app/uploads/2019/02/USEF-White-Paper-Energy-and-Flexibility-Services-for-Citizens-Energy-Communities-final-CM.pdf>

## Supplier

The role of the Supplier is to supply energy, to buy the energy, hedge its position across all timeframes, manage the energy and the associated risks, and invoice energy to its customers. The Supplier and its customers agree on commercial terms for the supply and procurement of energy. A Supplier is a specialization of the Trader role as it exchanges energy with Prosumers as well.

## Balance Responsible Party

A Balance Responsible Party (BRP) is responsible for actively balancing supply and demand for its portfolio of Producers, Suppliers, traders, Aggregators, and Prosumers, with the means granted by those actors. In principle, everyone connected to the grid is responsible for his individual balance position and hence must ensure that at each imbalance settlement period, the exact amount of energy consumed is somehow sourced in the system, or vice versa in case of energy production. The Prosumer's balance responsibility is generally transferred to the BRP and this is usually contracted by the Supplier. Hence, the BRP holds the imbalance risk for each connection in its portfolio of Prosumers.

## Distribution System Operators

The Distribution System Operator (DSO) is responsible for the active management of the distribution grid and introduces the system operation services defined in the USEF Flexibility Value Chain. The DSO is responsible for the cost-effective distribution of energy while maintaining grid stability in each region. To this end the DSO will 1) check whether demand-side flexibility activation within its network can be safely executed without grid congestion and 2) may purchase flexibility from the Aggregators to execute its system operations tasks.

## Transmission System Operator

The role of the Transmission System Operator (TSO) is to transport energy in each region from centralized Producers to dispersed industrial Prosumers and Distribution System Operators over its high-voltage grid. The TSO safeguards the system's long-term ability to meet electricity transmission demands. The TSO is responsible for keeping the system in balance by deploying regulating capacity, reserve capacity, and incidental emergency capacity.

## Energy Service Company

The Energy Service Company (ESCO) offers all kinds of energy-related services to Prosumers. These services include insight services, energy optimization services, and services that facilitate the joint purchase and maintenance of (shared) assets. If the Supplier or DSO is applying

implicit demand-side flexibility through (for example) Time-of-Use or kWmax tariffs, the ESCO can provide energy optimization services based on these tariffs. Unlike the (role of) Aggregator, the ESCO is not active (nor exposed) to wholesale or balancing markets.