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Social, Ethical and Cultural Barriers to Innovation

D2.5

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Social, Ethical and Cultural Barriers to Innovation

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Statement of Originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Executive Summary

This report called Social, Cultural and Ethical Barriers to Innovation corresponds to the TwinERGY project deliverable D2.5. This report is part of the first group of deliverables being launched by the project, in the context of the Work Package 2 - Stakeholder Requirements, Obstacles to innovation and Business Models.

In this report, we perform an in-depth analysis of (a) the social aspects that will challenge and affect the development of the TwinERGY framework and (b) the main drivers for active customers, how these barriers affect them, and how they can be overcome. The focus of this report lies in particular with residential and small commercial customers, as the target customers of the TwinERGY framework. The document is centred on the four countries where the pilot sites can be found. However, a European perspective is given where possible, in views of replicability of the project's solutions.

The methodology to research this report was twofold. First, it includes a direct approach to customers, through consumer associations specialised in energy matters across Europe. The second pillar are the companies offering already Demand Side Flexibility (DSF) services, and have a privileged view on the concerns from consumers when approached with their services.

The following areas are covered by this report:

- The main prosumer models that can be found across Europe, specifically those that would be potential users of the TwinERGY project, the different drivers for these prosumer models and how the TwinERGY test sites fit inside those prosumer models.
- Analysis of the barriers related to social, cultural, ethical as well as regulatory barriers (those that have a direct impact on consumer acceptance):
    - Barriers are analysed mainly from the perspective of consumers and potential active customers, and how they could affect the solutions like TwinERGY.
    - A link between the social and cultural barriers and regulatory barriers is established.
- Analysis of potential solutions on how to overcome the barriers analysed and their viability in the context of the TwinERGY project.

While this report is focused on analysing barriers for adoption of Demand-Side Flexibility (DSF) by residential and commercial customers at large, where possible we tried to complement with particularities of the different pilot sites.

The goal of this report is to collect and try to understand the wide range of barriers that are limiting the decisions of consumers when deciding to become active customers and engage with DSF solutions. With that in mind, the work in this report will influence the development of the business cases in the TwinERGY. It also aims to help this and other project's test sites to overcome these barriers. Where these barriers are linked to regulatory limitations, we aim to provide ways to solve them through legislative changes.

Index

List of Figures

1 Introduction

1.1 Scope of Deliverable

Today the energy system is largely driven from the perspective of suppliers and only few consumers are able to actively participate in the market as providers of DSF. DSF includes a variety of different solutions that allow a portion of the demand to be reduced, increased or shifted, Demand Response (DR) is an example of it. While large commercial and industrial consumers are already engaged in DR programs, this is not the case today for most residential consumers in Europe. The cases where this is possible it is mostly through pilot projects or small start-ups that target a very niche market segment. Mass-market options are not available for residential consumers.

TwinERGY introduces a first of its kind DR framework, which enables the realisation of novel business models, allowing all actors in the energy sector, from retailers to end-consumers, to participate in energy markets as aggregators themselves or through third parties. The goal is to facilitate consumer representation in energy markets and facilitate the integration of distributed energy resources (DER) through DSF.

To this end, deliverable D2.5 intends in understanding the reasons why residential customers are still limited regarding the adoption of DSF and why commercial-level offers are not appearing across Europe on a consistent basis. This report presents the outcomes of a thorough study of social, cultural and ethical barriers to innovation carried out by smartEn, in collaboration with all project partners involved in this task. This report is focused on the four countries where the TwinERGY test sites are taking place: Germany, Greece, Italy and UK. However, sources all across Europe have been consulted to assess existing barriers in their respective countries.

1.2 Structure

This report has the following structure:

Chapter 1 introduces the scope of the report and its link to other tasks and deliverables of the TwinERGY project.

Chapter 2 explains the methodology followed for the data collection and analysis, literature review and interviews conducted. It also provides an overview of all the stakeholders involved in this report, and that are affected by the barriers listed in it.

Chapter 3 provides an assessment of the business cases and drivers on which this report is focused on. The different pilot sites are introduced, going over the particularities of the different social barriers they might observe. More broadly the different business cases and drivers for consumers to adopt them are presented.

Chapter 4 analyses the different barriers observed in our study. It provides feedback on social, cultural and ethical barriers and establishes links to existing regulation and the impact they have on the business cases presented in chapter 3. At the end of the chapter, high-level recommendations are provided to overcome these obstacles for DSF.

Chapter 5 provides the conclusions to this report and how it will feed different tasks and deliverables throughout the project's life.

1.3 Relation to Other Tasks and Deliverables

This report will be one of the first deliverables in the TwinERGY project and focuses on the social, cultural and ethical barriers that the implementation of the TwinERGY framework could face in different countries and in particular in the four test countries. For this reason, various other tasks and deliverables will be influenced by this report. More concretely, T2.3 Business models analysis includes feedback from this report's drafting team on how the business models could be affected by concerns from end-consumers. T2.5 Technical barriers analysis goes hand-in-hand with this report in identifying the technological obstacles that the business models could face. T12.3 Regulatory Recommendations and Standardization on the other hand will provide regulatory recommendations based on amongst others, the social barriers included in this report. Work packages involving interactions with other stakeholders and projects will also be affected by the outcomes of this study. In particular, WP3 and WP11, which will discuss the presented barriers in the context of other projects, and WP4, which will develop consumer engagement strategies based on behavioural analysis. WP 9, which aims to implement the TwinERGY framework in the four pilot sites, will be greatly influenced by this analysis together with the other deliverables of WP 2.

1.4 List of Acronyms

Term	Description
CEC	Citizen Energy Community

CEER	Council of European Energy Regulators
DER	Distributed Energy Resources
DR	Demand Response
DSF	Demand Side Flexibility
DSO	Distribution System Operator
ECRB	Energy Community Regulatory Board
ESCO	Energy Service Company
EV	Electric Vehicle
EVHS	Electric Vehicle Homecharge Scheme
FIT	Feed-in-Tarif
GDPR	General Data Protection Regulation
HP	Heat Pump
MEDREG	Association of Mediterranean Energy Regulators
NGO	Non-Governmental Organisation
NRA	National Regulatory Authority
SEG	Smart Export Guarantee
SME	Small and medium-sized enterprises
UK	United Kingdom
V2G	Vehicle to Grid
VPP	Virtual Power Plant
WP	Work Package

2 Methodology

Many different actors are involved in the creation of innovative products for Demand Response. Participants with different roles and interests interact in the energy market facing a variety of issues and challenges. Thus, a multifaceted methodological approach is key to correctly assess the barriers that new business models could encounter in the energy system.

2.1 Overview

For the purpose of this report, a multifaceted approach was taken involving different methods of research to achieve a comprehensive vision of the existing barriers for the development of innovative DSF services. Initial extensive desk research was conducted to analyse existing publications on the topic.

Based on initial research, a detailed questionnaire (see Chapter 8 – Annex A) was developed in coordination with the pilot sites, other consortium members and industry representatives from the smartEn membership. The objective of the questionnaire is to collect primary data through open questions and a rating system of different previously identified social, cultural and ethical barriers.

As a follow-up to the questionnaire and to complete the responses, individual interviews were conducted with project stakeholders. Both the desk research and the questionnaire focused on identifying the potential barriers that the project could face, and extracting recommendations and best practices to overcome them. The collected data was processed as described in the section 2.2 Research and Data Analysis. The collection of data has been a continuous process and subject to the revision of the Consortium and other stakeholders.

2.2 Research and Data Analysis

Literature Review

The literature review included: original articles, review articles, reports, previous smartEn publications and analysis conducted by consumer associations. Deliverables of similar projects within the BRIDGE Initiative (e.g., MERLON, CROSSBOW, WiseGRID, InteGRIDy) have been also analysed. The barriers to innovation observed by these projects have been complemented and tailored to the scope and specificity of TwinERGY. Literature was reviewed with a special focus on the barriers outlined by the interviews with stakeholders to try to assess the theoretical background behind these barriers. A list of reviewed literature can be found in chapter 7 - References.

The research was mainly performed using search engines such as Google using appropriate search inputs.

- Social and cultural barriers to Demand Response
- Barriers to Demand-side Flexibility
- Social barriers to prosumers
- Demand Response challenges for households
- Smart technologies for energy vulnerable consumers
- Data privacy of smart technologies

The literature review focused mainly on DR solutions, but major barriers to different low-carbon technologies (i.e., EVs, smart charging of EVs, rooftop solar panels, Heat Pumps, storage) have also been analysed. Literature reviewed was used to establish the main categories in barriers and drivers, as seen in their respective chapters. It also provided a base on which to create the questionnaire, as seen in the next section, to assess if the barriers identified in literature would also translate into practice.

Questionnaire

Over 20 energy market participants provided written answers to the questionnaire (see Chapter 8 – Annex A) or were interviewed. Interviewed participants included consumer associations, energy communities, energy cooperatives, Distribution System Operators (DSOs), trade associations, energy retailers, service providers, technology providers and consultants.

The responses collected through the questionnaire are the key source of information that shaped the assessment of the different barriers (see Chapter 4 – Analysis of barriers) that the TwinERGY business model could face. The responses to the open questions have been gathered in three main categories: social and cultural, ethical and regulatory barriers. The information extracted from the questionnaire has been analysed in order to understand the importance of a specific barrier, its roots and its relevance in certain European countries. The questionnaire also included a grading system (from 1 (not important) to 5 (very important)) to assess the level of importance of different barriers and drivers for DSF. The results that stem from the grading system are also presented in section 3.3 – Drivers and chapter 4 – Analysis of Barriers. In particular, the barriers/drivers that were rated by participants with the highest values (4 and 5) are shown in Figure 1 and Figure 2. Suggestions on how to overcome these barriers (see Chapter 5 – How to overcome barriers) stem also from the responses collected through the questionnaire and from best practices that are already present in the market.

The four TwinERGY pilot sites and their preliminary observations of the potential barriers to the Digital Twin framework were a key source of information. The main focus of the report is dedicated to the four countries where the pilot sites take place: Germany, Italy, Greece and UK.

Nevertheless, other European countries were included, to understand the challenges that replicability efforts of the four pilot test sites could face. Countries analysed include: Austria, Denmark, Finland, France, Great Britain, Spain, and Switzerland).

2.3 Stakeholders

The conclusions of this research benefit firstly the Consortium in understanding the challenges that the project could face during its lifetime. It will specifically help with the successful implementation of the pilot sites and enhance the engagement of its participants. Furthermore, it should provide a starting point for all market participants interested in replicating the project outcomes in different European countries. Stakeholders benefitting from the outcomes of this deliverable include, but not exclusively, consumers/prosumers, energy services companies, NRAs, European and national institutions, NGOs, business associations, think tanks and energy communities. Many dissemination activities and outreach strategies are implemented within WP 11 to ensure that project findings are available to a broader public. The collaboration with other H2020 projects and with the BRDIGE initiative is also envisioned in WP 11 and this will facilitate the exchange of the findings with similar research activities and projects.

3 Assessment of business cases and drivers

In this chapter, the four main pilot sites are described, highlighting the types of consumers involved, the barriers they face and how they try to overcome them. This chapter also addresses the main business models and drivers for residential and small commercial consumers to become prosumers and engaged in providing DSF services like the ones proposed by the TwinERGY project. Based on their specificities, the four pilot sites are suitable to adopt and deploy some of the prosumers business models presented in this section.

By understanding consumer's drivers, we aim to identify the sources of the societal barriers for the adoption of DSF services and/or DERs. Through a structured research, analysing different business cases already active, a series of prosumer models surfaced that bring together consumers from different backgrounds but with common goals. These different models will also provide insight onto their drivers, on how dependent they are on different types of rewards or how vulnerable they are to barriers, which in many cases will be of social and cultural origin.

3.1 TwinERGY Pilot Sites

Four pilot sites across Europe have been chosen to trial the key use cases of the TwinERGY project:

- Hagedorn Village, Germany
- City of Athens, Greece
- Benetutti Smart Community, Italy
- City of Bristol, United Kingdom

Each pilot site has its specific energy requirements, geographical characteristic, regulatory framework, consumer profiles and ways to address energy poverty. They are all striving to become smart cities and have already engaged in some activities to deploy smart energy solutions and engaging consumers in the process. The analysis conducted in this report identifies the most important social, cultural and ethical barriers that the four pilot sites could face in the implementation of the TwinERGY business models and how they are linked to regulation. Even if the pilot sites have been already involved in other energy-related projects, the analysis has shown that social, cultural and ethical barriers are still very relevant when it comes to DER and DSF. Therefore, this report's findings could also apply to different cities and regions across Europe, where smart development is at an early stage or has not started yet. The success stories and lessons learned by the pilot sites will allow them to upscale the most viable solutions and be a model for their replicability across different European regions. It is therefore key to carefully identify and understand the particularities of these sites and the needs of the stakeholders that interact in their ecosystems (e.g., end-users, municipalities, service providers, system operators, energy communities, organizations and other non-government actors).

Hagedorn Village, Steinheim, Germany

The village of Hagedorn in Steinheim is located in the district of Höxter in North Rhine-Westphalia and has 38 houses with 103 inhabitants. Some of its inhabitants are already prosumers. Nine houses have a private solar PV system with an output of between 8 kWp and 38 kWp. A smaller subarea of the village, the Hofquartier, connected to the low-voltage grid, could already be considered a small smart grid. This area covers part of its supply with solar power and it is provided with a central smart meter. All the facilities of this subarea share a charging station for EVs. The city of Steinheim aims to achieve a higher degree of integration of variable RES and enhance the engagement of its citizens in energy-related issues. The TwinERGY project will help achieve these goals and develop personalized services to strengthen the already created prosumer environment. A broad set of tools are developed for the pilot site, including advanced measurement technology, electrical circuit technology, communication technology and electrical storage. This will make this micro-grid highly flexible and help developing and testing modern energy management systems. The use of electric vehicles with smart charging and V2G in combination with an energy management system will also be tested in the German pilot.

Hagedorn faces two main challenges. One rooted in social acceptance and knowledge of the possibilities that DSF can provide, and a second one rooted on regulatory barriers limiting the roll-out of DSO-issued smart meters. The main findings of this report will allow the community of Hagedorn to overcome social concerns and misconceptions about DSF and successfully implement this broad set of technological solutions.

City of Athens, Greece

The Greek pilot site involves a group of residential and commercial buildings customers of Mytilineos, a Greek supplier and project partner of TwinERGY. All the participants are located in the broader area of Athens, in the districts of Chalandri, Vrilissia and Agia Paraskevi. The residential segment is composed of approximately 150 residents. Most of the buildings involved are already equipped with sensors, including temperature, humidity, luminance and CO2 sensors, smart thermostats, smart dimmers, plug meters and smart meters. These devices enable the measurement of electricity consumption and allow for the accurate profiling of consumers energy behaviour and their flexibility, in a non-intrusive and highly effective manner. The pilot site engages local consumers in implicit demand response programs that are realized through the combination of dynamic pricing schemes, feedback mechanisms and human-centric features that allow consumers to alter their energy consumption patterns and provide flexibility to the electricity retailer (Mytilineos), without compromising their comfort and well-being. The pilot site activities benefit firstly the consumers, regarding their energy savings, energy cost reduction, comfort preservation and smart home services. It also benefits the business processes and operation of Mytilineos, which established an innovative Virtual Power Plant that clusters and segments flexibility profiles based on their actual, locally estimated flexibility.

This report and lesson learned from previous H2020 projects will benefit the Greek pilot site in strengthening the engagement of its participants. Barriers like data privacy issues and disengagement of energy vulnerable consumers are major concerns in this pilot., These can be addressed and overcome based on mitigating measures like increased transparency about data protection and foster participation through favourable grants or loans, further developed in Chapter 5of this report. Electro-mobility and smart charging in residential blocks, as well as the use of stationary small-scale storage are an integral part of the TwinERGY business models. However, the deployment of electric vehicles is still at its infancy, due to regulatory barriers across many European countries and these are specifically address in the analysis (see Chapter 4).

Benetutti Smart Community, Italy

Benetutti is a municipality in the province of Sassari, Sardinia. It is considered the first Sardinian Smart Community and it has a population of 2 000 people. The municipality owns the concession for the medium and low voltage distribution networks, and it is in charge of the delivery to the final customers. This represents a peculiarity that has to be taken into account in the evaluation of the pilot site specific needs. The poor connection of the municipality with the national power grid and the non-existent connection to the natural gas network has pushed the region to already shift part of their thermal needs to electrification. This makes Benetutti and in general Sardinia a perfect environment for smart energy solutions. 70% of total generation is dedicated to self-consumption, driven by the large deployment of solar PV plants, solar thermal units and storage facilities, both private and owned by the municipality. Benetutti aims to develop a flexible and sustainable energy grid and solve power fluctuation problems. Through TwinERGY, the pilot will fully exploit the various devices already installed, involving a group of 20 buildings both residential and public, increasing the effectiveness of RES and strengthening the citizens' participation in energy-related processes. Within the project, real-time power loads, RES generation and the grid's storage capacity of the whole community are monitored and controlled by demand response programs, aiming to reduce consumption during the peak hours while increasing it during low energy cost periods.

Consumers remain engaged through economic incentives, that stem from a dynamic pricing mechanism, and through a decision support system with the use of user-friendly interfaces. A particular focus on the comfort of consumers and improving their living conditions tackles the social aspects of the project and fosters a sense of community.

The outcomes of this task will help Benetutti to engage especially the private facilities involved in the project and overcome public perception issues. Since the municipality is the distributor and retailer of electricity to its citizens, the level of trust of the community regarding energy topics is relatively high. Nevertheless, awareness of flexible solutions and new business models like the ones proposed by TwinERGY could increase through the adoption of different strategies proposed in this report (see Chapter 5).

City of Bristol, UK

Bristol has a long history of innovation in digital solutions, that culminated in2017 with the leading position in the UK Smart Cities Index. In January 2019 the city launched the first iteration of its One City Plan[1], a 2050 roadmap towards a digitalisation of services and electrification of mobility. TwinERGY directly supports this objective through its suite of tools for active energy management. The pilot site explores the use of Digital Twin technologies for consumer and citizen engagement, improved energy efficiency and sustained behavioural change towards more green and sustainable attitudes of energy use. The work with local residents to identify their issues and concerns around energy consumption and supply and define the use cases of the TwinERGY is conducted following the Bristol Approach[2], which is a people and issue-led participatory design approach.
The pilot site activities are initially focused in the South Bristol area, which ranks highly in the English Indices of Deprivation[3]. Thus, the City Council is particularly interested in the involvement of energy vulnerable consumers in the project. The pilot will work with 12 households which could include both, owner occupied home as well as social housing (including those owned by the Council) and the project will also involve the University of Bristol campus.

The social, cultural and ethical barriers identified by this report will help the pilot site to strengthen its citizen engagement activities and understand what the role of the Council should be in energy service innovation and public value creation. Particularly important for the UK pilot is also the identification of current regulatory barriers and possible improvements.

[1] https://www.bristolonecity.com/about-the-one-city-plan/
[2] https://www.bristolapproach.org/bristol-approach/
[3] https://www.bristol.gov.uk/documents/20182/32951/Deprivation+in+Bristol+2019.pdf/

Regulation could represent a limit to innovation in the energy space and the creation of new value streams for local authorities.

3.2 The Prosumer Models

While the development of industrial prosumers is fairly advanced, with access to several revenue streams facilitated through their large capacity or consumption, for residential and commercial customers the offers are much more limited. However, a record number of houses and buildings are now installing solar PV panels and combining them with home storage systems, EVs with charging stations, and smart energy management systems. These technologies can help them optimise the use of the different assets according to price signals and grid requirements. This chapter starts out by looking at the most common prosumer models for residential and commercial customers, and by analysing what is driving the business case for each model. By understanding their drivers, we aim to understand where the barriers for development and innovation are rooted.

To better understand the different prosumer models a three-step approach was followed:

- Scoping phase: Identifying the different types of prosumers active in the market based on case studies and the TwinERGY test sites
- Driving factors: analysis on the drivers for the different models
- Reflection: what is limiting the development of residential and commercial prosumers.

Households

Grid-connected households with onsite PV, storage, and/or flexible load

Households that have three main ways to become prosumers and take advantage of flexibility offers: installing generation capacity (PV, storage, flexible loads), shifting their electricity consumption based on price signals or offering their flexibility to the grid through an aggregator. As defined by the Electricity Market Directive[4], an aggregator is a natural or legal person who combines multiple customer loads or generated electricity for sale, purchase or auction in any electricity market. Households with onsite generation maximise their revenues through self-consumption or selling electricity back to the grid, especially if favourable feed-in tariffs and net metering schemes are in place. It can be expected that most of the residential participants of the pilot sites could fall into this active customer category or at least have a high interest in becoming one, although not all the participants have been identified at this stage of the project. In particular the ones in Benetutti and Hagedorn Village, which are already

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3A4404055

equipped with onsite PV generation. They can greatly benefit from self-consumption to reduce their electricity bills and be more self-reliant. In regions with a high level of electrification, like the specific case of Benetutti, implicit flexibility could be fully deployed if also strong price signals are present. Explicit residential flexibility is more present in markets that are more open to aggregated loads. Smart charging of Electric Vehicles (EV) could also be an important source of flexibility for households. EVs increase substantially the electricity consumption of a household but are also suitable to offer all the above-mentioned services to the grid. This aspect is particularly relevant for the German pilot that is planning to explore the use of EVs with smart charging and V2G.

Grid-connected households with offsite DERs

Citizens that are not able to install their own onsite DER, could invest in offsite generation through citizens energy communities, peer-to-peer trading or crowdfunding for DERs. This allows them to collectively own solar PV panels, a wind turbine or potentially a storage facility. The households could benefit from this type of investment through retailers (e.g., the German Enyway)[5], which discount the electricity generated by the DER from the energy bill, or through "virtual net metering" schemes. These business models represent a very inclusive and easy way to participate in the energy transition and they could be particularly interesting for the Athens pilot site, which is planning to involve residential multi-dwelling units. The local authorities could also explore it for social housing projects, in case they are included in the pilot sites activities, and to involve energy vulnerable consumers. Also, the offsite generation assets owned by the City Council have a flexibility potential that could be valorised through the exploitation of these business models.

Commercial Buildings

Commercial buildings with onsite DERs and flexible load

Buildings that have commercial purposes like offices and commercial centres use a considerable amount of energy and can therefore benefit from adopting DERs and flexibility solutions to reduce their energy consumption and at the same time increase their level of comfort and air quality. Commercial buildings usually operate during the day, when Renewable Energy Sources (RES) production is at its highest. This will help them benefit greatly from onsite generation and self-consumption by reducing their energy bills. Becoming prosumers, they could also increase their resilience in case of power outages and prove their leadership in climate and sustainability. These broad set of benefits could be important in the Bristol pilot site, which involves a University of Bristol campus building. It is important to highlight that commercial buildings have a significant flexible capacity to serve the electricity system with their flexibility, participating in ancillary markets through a VPP (see also Chapter 5).

[5] https://www.enyway.com/de/power

Communities

Energy communities (virtual or based on proximity)

Energy communities could be virtual (based on membership) or share a part of the grid (based on proximity). Citizen Energy Communities (CECs) and Renewable Energy Communities (RECs), as defined respectively in the Electricity Directive and the Renewable Energy Directive, are legal entities based on open and voluntary participation. They are controlled by their shareholders or members, who are citizens, SMEs and/or local authorities. Communities have the same benefits as single households, but they flexibility resources can be pooled together and be sold to aggregators. An example of virtual energy community already present in the market is the sonnenCommunity[6], in which battery owners share their self-produced energy with the other members of the community. Communities are not primarily driven by profit, which is usually reinvested in the community, but by environmental or social goals. Business models that stem from energy communities are particularly relevant for some TwinERGY pilot sites, for example Benetutti could be already considered an energy community. The municipality indeed, which has been the DSO for the local community for many years, wants to involve more closely its citizens in the decision-making process and democratize the use of energy resources through the community.

3.3 Drivers

Based on the results of the literature review[7] and professional experience of the drafting team, a series of driving factors were established for the adoption of DSF and DERs. These driving factors are tightly linked to the previously presented prosumer models that were established based on the literature review and analysis of existing business cases. Interviews, with consumer organizations in particular, confirmed the accuracy of the identified drivers and highlighted the importance of differentiating between the origins of the drivers. Overall, drivers can be divided into two main categories: financial drivers and non-financial drivers. In this section, some of the questionnaire results are also graphically presented to analyse the drivers that are perceived as most important by the participants (see Figure 1).

Financial drivers

Remaining feed-in-tariffs and net metering schemes

In countries where feed-in-tariffs (FiT) and net metering schemes are still in place, it could be more profitable to sell the electricity through a feed-in-tariff, and then purchase it more cheaply from the grid instead of prioritizing self-consumption. Solar PV benefits from FiT

[6] https://sonnengroup.com/sonnencommunity/
[7] smartEn, Smart Energy Prosumers (2019)

schemes, even if they have been significantly reduced in the last years. In Germany, feed-in-tariff programmes are still active in the medium-term, most of them are valid for solar PV installations until 2030. In Italy, the most significant financial benefits for prosumers are FiT and premiums from grid injection and self-consumption, as well as the net-metering scheme *Scambio sul Posto*. In the UK, the feed-in-tariff mechanism has been replaced by the Smart Export Guarantee (SEG), in which a payment is issued by the utilities, based on electricity injected in the grid, rather than the government as with other feed-in-tariff mechanisms. Net metering schemes, even if not commonly adopted until now in the UK, are increasing with the introduction of SEG.[8] In Greece, since 2014 a net-metering scheme has been in force in parallel to the existing support scheme based on FiT.[9]

Offsetting electricity bill through increasing rates of self-consumption

Savings on energy bills that stem from optimal self-consumption could be the optimal solution for commercial buildings that are also prosumers. Because of considerable daytime use, these buildings can often consume 100% of the electricity they generate. DER home systems are also usually sized to optimally match self-consumption, making this revenue stream more profitable than grid injection.

Avoiding/minimising taxes and network charges

The different kinds of taxes and network charges have a significant influence on the payback period of any DER investment. Taxes and charges influence which prosumer models are predominantly adopted or viable in a certain country or region and whether self-consumption or reduced peak load is more profitable. There is no perfect design for network tariffs that accomplishes all goals at the same time. These depend on a cost-reflective use of the grid, the types of energy sources mostly used, the electrification and congestion present etc. However, whether focused on capacity, volumetric or fixed tariffs, a general approach to maximise the use of flexibility is for them to be dynamic and linked to the CO2 content of the energy more prevalent at any given time. If the regulated tariff components of the bill are not dynamic, the price signals for consumers will be very limited, reducing the interest to provide flexibility services. This case is in particular evident in Germany, the EU country with the highest energy prices, and the largest part of them, linked to fixed taxes and charges, leaving only 22,4% of the final electricity bill for the actual energy consumed. In countries with these tariff and taxes structures, the incentives will lean heavily towards self-consumption rather than providing services to the grid.

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[8] smartEn, The smartEn Map, Prosumers (2020)

[9] HOLISDER Project - D3.1. Regulatory, Market, Socio-economic and ethical context analysis in the pilot sites and anticipated (short and mid-term) evolutions (2017)

Time of use/price arbitrage

If the energy consumption is shifted to periods with lower electricity prices, this could represent a significant financial benefit of DER and DSF solutions. However, this revenue stream is tied to the availability of price signals and dynamic tariffs offered by retailers.

Participation in new and existing markets

Households and commercial buildings can offer their flexibility into various markets through an aggregator. Many European balancing markets for example are now open to aggregated loads, and this allows households to participate in these markets. Nevertheless, a market-based procurement and non-discriminatory participation of all DERs to all markets and mechanisms, as established by the Electricity Regulation, has not been implemented equally in every European market[10]. With regard to the four pilot countries, Italy and the UK have allowed DSOs to procure flexibility services but only on a pilot basis, local flexibility markets are therefore still immature. Day-ahead and intraday markets are also open in Germany and Italy, even if for bid sizes higher than foreseen by the Regulation. Limits to the participation of independent aggregators are still a major issue in Germany and the UK, and a level playing field for all DERs is still not guaranteed in Greece. Regarding electro-mobility and smart charging in particular, legislation in Greece enables market players to invest in charging infrastructure in a competitive way, limiting the ownership and operation by DSOs, but this is not the case in the other countries. The barriers limit the possibilities for service providers to build a business case, limiting the possibilities and drivers for the end-consumer.

Long-term price stability

Price stability is one of the main drivers for industrial consumers with energy-intensive processes to engage in DR services. This incentive should be applicable also for households and small commercial consumers. This is apparent in several countries where the dynamic-price contracts overly expose consumers to price-spikes or are not beneficial enough. For example, in Spain, a majority of consumers still prefer the price stability from the non-dynamic offerings to the PVPC tariff linked to wholesale prices. One of the reasons is the fixed price that the non-dynamic price offers regarding price hikes linked to the wholesale markets. However, with well designed, cost-reflective products, consumers might be drawn to DSF offerings that act as an insurance against future price increases. Products that might offer these kinds of services include reliability options, that act as a hedging product using flexibility against price peaks.

[10] smartEn, The Implementation of the Electricity Market Design to drive Demand-Side Flexibility (2020)

Non-financial drivers

Contribution to clean energy transition and system efficiency

One of the main non-financial drivers for adoption of DERs/DSF solutions is the consumers' motivation to participate in the energy transition and reduce their carbon footprint. This driver has been usually observed to be secondary to financial drivers but still very relevant. Society greatly benefits by consumers' contributing towards decarbonisation, and as the interviews conducted reflected, consumers are willing to participate if they perceive that they are contributing in solving climate issues. In addition to climate-oriented contribution, it is important to highlight that consumers also contribute to overall system efficiency and in lowering system costs. This can in turn revert to them with lower tariff prices or more services.

Climate and energy leadership

Small businesses and corporations have started purchasing their electricity directly from suppliers that offer green tariffs to show their commitment to sustainability. The growing public concern about renewable energy is one of the main drivers to green corporate sourcing. One example of these initiatives is brought forward by the RE-100 platform, a global corporate renewable energy initiative bringing together hundreds of companies committed to 100% renewable electricity[11]. Green sourcing is increasingly relevant for local commercial buildings like supermarkets, or entertainment venues to demonstrate their climate leadership and engage people who are sensitive to sustainability topics. As observed from the questionnaire responses, for households, climate leadership is very much linked with aspirational goals, and could have a significant impact with the "neighbour-effect", where consumers try to emulate their peers.

Enhanced capabilities and performance

Interviewees in the service provider segment established, that for households, enhanced capabilities and performance are a non-financial incentive linked usually to consumers in the early-adopter category. DSF services provides increased control over home appliances and home energy management systems provide a wide range of possibilities to optimise energy consumption. For commercial buildings and energy communities, increased capabilities and performance are a key incentive, very much linked to the financial incentives, as control over performance will be mostly used for a more efficient energy consumption.

Increased comfort

Households and commercial buildings that become prosumers and adopt flexibility solutions are often able to optimise comfort levels in the building and create a healthier living

[11] https://www.there100.org/

environment though optimal heating levels and enhanced air quality, for example. One of the most expressed social concerns before adopting DSF solutions is the impact they could have on comfort levels, in particular for heating or state-of-charge in EVs, as also evidenced by the participants of the FRED trial, a DR project for smart charging[12]. However, once adopted, most consumers see an increase in comfort levels, with steadier temperatures and more control over their needs.

Increased autonomy and independence

An increased sense of autonomy is an important driver especially for households and off-grid systems. This is especially relevant for islanded communities or consumers in areas where frequent blackouts and/or brownouts[13]. Based on interviews with commercial partners, their experience reflects that consumer in such areas, in countries where independence from the system is valued, lie higher importance in the autonomy that DERs provide. It can have a significant impact as well in countries or consumers with a general distrust towards authorities or energy companies, as they see an increased autonomy from them as an advantage. In general, DSF solutions strive to keep consumers connected to the grid, as it is multiplying the opportunities for them to take advantage of their flexibility.

Security of supply, resilience

If there is a power outage, prosumers that have their own onsite installations are less exposed to the risks of blackouts and/or brownouts, or may be able to operate in islanded mode for a short period of time. This is especially relevant for commercial buildings like supermarkets, or services like hospitals that usually depend on fossil-fuel back-up generators for emergencies. DERs like battery storage can be a substitute to generators, with the additional benefits in flexibility they can provide.

Assessment of drivers from the questionnaire results

Figure 1 shows the drivers that have scored with the highest level of importance (rated 4 and 5) from the questionnaire participants. Financial benefits and ease of use are the two most important drivers to adoption of DSF solutions, followed by reliability, enhanced comfort and resiliency. From the questionnaire results it could be observed that environmental benefits and energy efficiency are also considered important for adoption of DSF technologies, but they are secondary drivers.

[12] Energy Systems Catapult - Demand Side Response, Putting consumers in the driving seat (2020) https://es.catapult.org.uk/impact/projects/consumer-insight-exploring-routes-to-market-for-dsr-technology/

[13] Brownout: partial outages by the system operator through a reduction of system capacity.

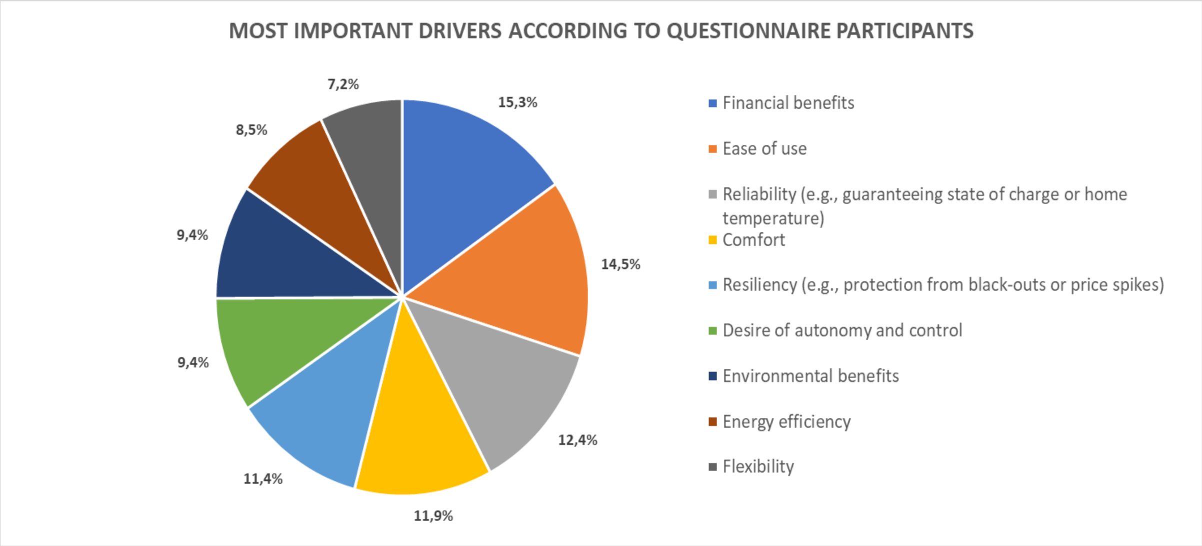

Figure 1 - Questionnaire results, assessment of drivers

4 Analysis of Barriers

In this section, an assessment of the socio-cultural, ethical and regulatory barriers to innovative DSF business models is presented. Each section contains:

- a general description of the barrier;
- its roots, if they can be identified;
- information about regional or country specificities;
- the main impacts of each barrier to innovative business models, like the ones proposed by TwinERGY.

This information has been extracted from the primary and secondary research process conducted for the analysis. The assessment of these barriers stems also from the results received through the questionnaire; Figure 2 shows a comparison of the barriers that have been rated with the highest importance by the questionnaire participants.

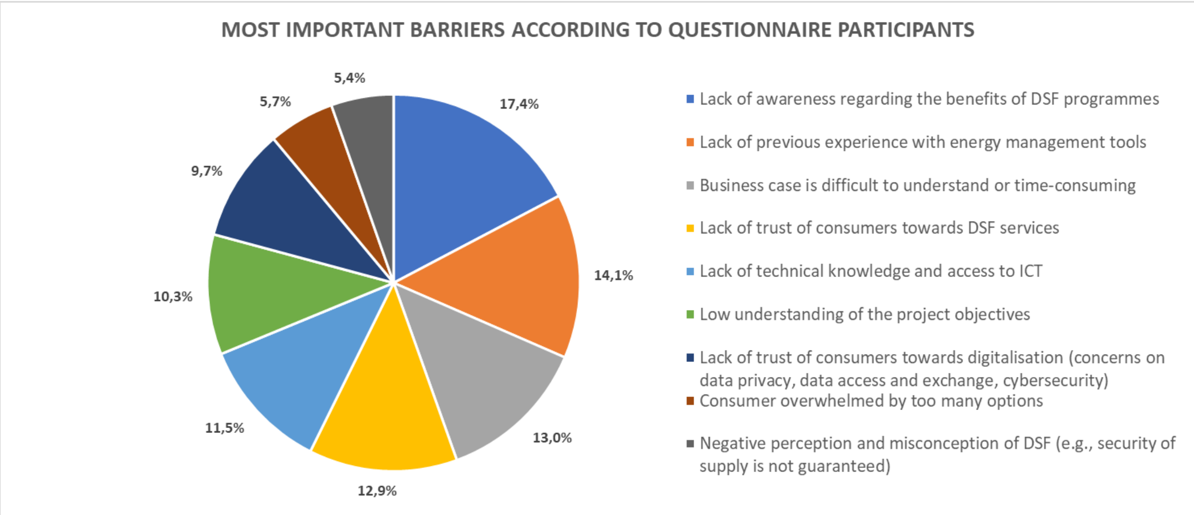

Figure 2 - Questionnaire results, assessment of barriers

4.1 Social and cultural barriers

Consumer awareness

The concepts of demand response, flexibility services and smart integration of renewable energy sources in the grid still lag behind in the common narrative. Lack of consumer awareness regarding innovative DSF business models is one of the major barriers observed in this study and it is prevalent across many European countries. This is also evident from Figure 2, where "lack of awareness'' has the highest share (17,4%) of importance among all the barriers. Energy consumers in the residential and commercial sectors are mostly not aware of flexibility offers and don't understand the complexities of demand-side management. This has also been confirmed by a beta testing conducted in the context of the 3rd interim report on the Smart Readiness Indicator (SRI) for buildings. The testing highlighted that the majority of surveyed citizens are not familiar with the concept of flexibility. [14]

Potential benefits of flexibility are not easily perceived by end-users, since they cannot easily understand how such factors affect them directly. This problem is aggravated by the fact that such benefits are difficult to quantify and communicate in a comprehensive and straightforward fashion. An average customer feels more attracted to benefits that are, immediately at a first glance, perceived as attainable, tangible, and easily quantifiable[15] (e.g., a feed-in tariff or discounts in the energy bill). In a recent study on energy home technologies conducted by Citizens Advice[16], it has been found that householders feel that navigating the current market demands a level of knowledge they do not have. This can apply even to early adopters who are better-placed due to their background, contacts, and approach to researching new products.

It is important to meet consumer's information requirements to make DSF solutions accessible to a broader range of end-users. An incremental approach is usually found to be appropriate to gradually demonstrate the positive impact of emerging innovative concepts. Starting small, implementing, learning and then upscaling across relevant socio-technical contexts makes possible to leverage the first experience as demonstrator.

DR services are sometimes associated with negative perceptions and misconceptions:

- Comfort: in many occasions, consumers believe that such schemes will be detrimental to their comfort and service levels and they will overcomplicate their daily activities.
- Reliability: there is also a wide concern that new smart appliances may not operate as reliably as legacy appliances and even than DSR schemes may leave them without electricity or heating in certain periods.
- Affordability: economic concerns also emerge, some consumers believe that DSR schemes may increase their energy bills, instead of reducing them. [17]
- Durability: a significant concern, in particular for EV users is that V2G services will reduce the life-span of their batteries.

[14] 3rd Interim Report of the 2nd Technical Support Study on The Smart Readiness Indicator For Buildings (2020)
[15] MERLON Project, Imperial College London, D3.2 – Socio-Economic and Regulatory Obstacles to Innovation on Integrated Local Energy Systems, (2019)
[16] https://www.citizensadvice.org.uk/about-us/our-work/policy/policy-research-topics/energy-policy-research-and-consultation-responses/energy-policy-research/navigating-net-zero-a-framework-to-give-people-the-confidence-to-invest-in-home-energy-technologies/
[17] MERLON Project, Imperial College London, D3.2 – Socio-Economic and Regulatory Obstacles to Innovation on Integrated Local Energy Systems, (2019)

Lack of consumer awareness has an important effect to the pace at which DSF services can be rolled out, it is slowing down DR development, affecting negatively especially independent (mostly small) players, which might struggle in building a long-term business plan.

Inertia and slow behavioural changes

Energy consumption has historically been perceived by end-users, in particular in the residential segment, as passive rather than the consequence of many of individual choices and practices.[18] Some of DSF solutions and technologies still require a certain level of consumer engagement to be performed. Therefore, inertia and slow behavioural changes have been observed as important limitations to consumer participation across Europe. This barrier has shown to be intertwined with consumer's lack of awareness because a behavioural shift requires a strong prior effort in changing cultural and social norms.

In most cases, household consumers tend to stick with the tariff they have or whatever tariff the supplier provides them with, compromising cost with simplicity. For example, in Spain, consumers subscribed to the PVPC tariff, a regulated tariff with dynamic pricing, is still reduced (42% of consumers) compared to the standard free-market tariff offerings. The main reason being that, even if the regulated tariff is cheaper, it requires switching suppliers, which is cumbersome. In the case of more advanced DSF solutions, users need to invest time and go through a learning curve to fully enjoy their potential benefits.

Other Horizon 2020 projects (e.g., HOLISDER) have shown that many end-users are not willing to change their energy behaviour even when the financial benefits linked to this change are significant. The main reason for that is complexity of the solutions and time-consuming practices, that can lead to quick disengagement of the consumers. This has also been confirmed by a study on smart grids conducted in Toronto, Canada[19]. Although participants were financially motivated, norms of lifestyle and convenience, as well as competing household values of energy management were the largest barriers to home energy management. Families with children are particularly inflexible in their energy consumption patterns due to a lack of time and stricter schedules. Existing studies have also highlighted tremendous opportunities for residential energy savings by engaging children, for example relating their allowance and activities to an efficient and responsible energy consumption.[15] In conclusion, energy services need to be simple and effortless for customers to make the change. In this regard, business models that entail full automation could help overcome the barrier of behavioural inertia, reducing the interaction of the end-consumers to the minimum. Some programmable smart utilities can smooth the changing process. Nevertheless, the full automatization in DR is still a

[18] Fröhlich et al., Towards a Social License to Automate in Demand Side Management: Challenges, Perspectives and Regional Aspects (2020)
[19] Lazowski et al., Towards a smart and sustainable residential energy culture: assessing participant feedback from a long-term smart grid pilot project (2018)

far scenario in some European countries, for example the data collection of this report has shown that the Italian regulation does not allow it. In the commercial sector, great reluctance of site managers could be overcome with endorsement by top management and an economic stimulus.

Technical knowledge

Digitalization is a key component for the deployment of DSF solutions. Many flexibility offers in the market require a certain level of technical knowledge and understanding from the consumers. If digital interfaces are too complex, there is a high risk that only tech-savvy consumers are able to choose DSF products. The design of these solutions, for example automated appliances, should be in line with the needs and expectations of the average customer. As also evidenced by a study of the JRC on smart homes, there is still a Do it Yourself (DiY) mentality for smart solutions and unless the consumer is someone with a natural appetence for home work and tech oriented, this can become a deterrent of a full transition into having a smart home.[20] Interviews conducted for this report show that the lack of technical knowledge has not been observed to be a limiting factor for large industrial consumers but rather for the residential and small commercial sector. Large industrial and medium-sized commercial consumers can usually count on energy managers in their staff with the required technical knowledge and dedicated time to assess these offers.

The digital divide poses a risk of exclusion especially to elderly consumers, or consumers with no interest in learning the new technologies. The development of new business models could be limited by the technical knowledge barrier, but it is up to the solution providers to make their DSF offerings as seamless as possible (see chapter 5). A thorough market research conducted by the provider, addressing collaborations with established partners that can deliver smooth and easy access to new services, is key to address this obstacle. Simplicity of solutions and a comprehensive presentation of the benefits help the customers in their decision-making process.

Energy poverty

There is still no common European definition of energy poverty, despite the problem is widespread across Europe. In literature, different terms are used to describe affected citizens: fuel poor, energy poor, vulnerable energy consumers or, to a larger sense, at-risk-of-poverty or low-income people.[21] All of them with different circumstances that define them. Thus, it is important to avoid generalisation in the assessment of this barrier.

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[20] JRC – Smart home and appliances: State of the art (2019)
[21] https://ec.europa.eu/energy/eu-buildings-factsheets-topics-tree/energy-poverty_en

Projects that propose DSF solutions or technologies for DERs usually target those who have already invested in some form of renewable energy technology or have already technical expertise on the matter. This could create a high-risk of exclusion of energy vulnerable consumers. A common criticism against DER, that is applicable also to DSF services, is the risk of increasing the gap between vulnerable customers and those that can afford the change. As the amount of end consumers that adopt DSF solutions, or DERs used for self-consumption (e.g., solar PV), increases, the number of consumers interacting with the grid decreases, and thus paying less network tariffs and taxes Energy vulnerable consumers could end up having to contribute more to maintain grid costs, increasing the divide. For this reason, it is important that network tariff and taxes design keep up with the evolution of consumer profiles, so that they remain cost-reflective and fair.

A recent study from Energy Systems Catapult shows that vulnerable households are not all the same and their behaviours, needs and attitudes vary as much as those of other consumers.[22] In Germany, energy vulnerable consumers with a negative credit score have only access to the basic tariff of the primary energy retailer. These basic tariffs do not support DSF or demand-response schemes. Some consumers would need financial support to overcome the upfront costs of DSF solutions. Those that can't afford to have the fundamental building blocks, such as a stable and reliable internet connection, a smartphone supporting the latest applications etc., could face exclusion. Finally, those whose buildings and homes have been equipped with DSO-provided smart meters can potentially achieve greater advantages than those without, this could potentially increase the social divide.

Business models that require upfront costs, e.g., solar PV or smart charging stations, are particularly affected by these obstacles. In order to tackle these barriers, financial incentives (grants and loans) could be provided by governments to incentivise energy-vulnerable consumers to participate. Governments could also provide such implementation services free of charge to social housing, if the social housing providers are publicly owned, or through specific support mechanisms. An interesting approach in this regard has been adopted by the Greek energy community Hyperion[23], that is planning to supply for free energy vulnerable participants with a small percentage of the renewable energy produced by the community. It is worth to highlight also that a fair share of the energy system costs could be achieved via equal rights and responsibilities for market parties (i.e., no financial support to any group of market actors funded by other energy users via, for example, biased balancing cost allocation or social tariffs) and more cost reflective network tariffs.

[22] Amal Anaam, Rose Chard and Rowanne Fleck, Fuel poverty in a smart energy world How vulnerable energy consumers could benefit from smarter heating controls (2020)
[23] https://electraenergy.coop/here-comes-the-sun-first-community-solar-farm-in-greece/

Ownership vs. rented home

Data collected in this report has shown that homeowners and renters have different attitudes and incentives towards DSF solutions. Renters are often excluded for a set of different reasons. If the DSF solution requires an investment or a permitting process, landlords and owners are more prone to undertake that investment because the decision is not limited to the length of the lease agreement. If the equipment that provides the DSF solution is not easy to install, set up and remove if desired, this could also discourage adoption from renters. The landlords are often responsible for the technical equipment (e.g., heating appliances) but have no incentives to change them, renters on the other hand, are responsible for paying the bills and have interest in minimizing their fuel costs. This is usually addressed as "split incentive issue" and it represents an important barrier to the deployment of DSF solutions. There are tools to overcome these barriers, in the form of support mechanisms, as seen in chapter 5.
The impact of this barriers on business models is very high, in fact ca. 30% of Europeans are tenants but this percentage increases significantly in certain countries like Germany (50%), Austria (45%) and Denmark (39%). [24] In order to overcome this barrier, the approach proposed by RAP and E3G for heat pumps could be extended to DSF solutions: requirements on landlords for low carbon heating could be used in a similar way as they are currently used for energy efficiency. For example, homes could not be rented unless they were fitted with low-carbon heating. An option to require improvements in both the energy and carbon performance of rental properties is being considered by the British government[25].

4.2 Ethical barriers

Data privacy

DSF services collect a wide range of data from smart appliances, wearable devices, smart meters and EVs for the most efficient delivery of flexibility services. The data collected for this report shows that this is a concern for many energy consumers across Europe, with varying levels of concern in the countries involved in this study. In Germany for example, data privacy is a very sensitive topic while in Finland it has been a high priority in the electricity markets and customers have higher levels of trust, in the careful treatment of data by market actors. This has been a result of considering data privacy of high priority in the last years. In the specific case of the Benetutti pilot site, where the municipality itself acts as energy retailer, from the questionnaire results, data privacy concern has been observed to be really low.

[24] https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1a.html
[25] Richard Lowes, Jan Rosenow and Pedro Guertler, Getting on track to net zero: A policy package for a heat pump mass market in the UK. Regulatory Assistance Project (2020)

Some DSF solutions are not perceived to be risky from a privacy perspective, as they mostly truck energy consumption patterns (e.g., when dishwasher and laundry machine are activated). However, as DSF solutions start to include more connected home devices (e.g., windows, kitchen appliances, electric vehicles, wearables etc.) a more careful approach should be dedicated to these devices and the data that they generate. From the perspective of BEUC, the European consumer association, consumers right to privacy and data protection are not in conflict with innovative energy services. The legal framework established in the General Data Protection Regulation (GDPR) already draws a good balance between consumers' interests in data protection and companies' interests in developing and marketing innovative products. BEUC recently analysed the terms and conditions of six offers for services for flexible electricity consumption in 5 countries[26]. They observed poor privacy provisions and lack of compliance with the GDPR, some companies adapted their terms and conditions following BEUC's recommendations. .[27] The concern about data privacy could impact TwinERGY business models if consumers perceive that their data are misused or their scepticism towards big tech increases. This could potentially reduce the market for DSF and smart homes, which in turn limits innovation.

Control of devices

Similarly, to what has been observed for data privacy concerns, energy consumers could be reluctant to let third-parties control their devices. Automation is however a key component of new and successful DSF business models. 12% of respondents to the questionnaire have shown that consumers are willing to delegate control if they know that they can regain it at any moment and if they have a guarantee that their needs are satisfied (e.g., if they can set an hour at which a minimum level of EV charge needs to be reached or if temperature in their home remains at a satisfactory level). In a trial conducted by Energy Systems Catapult[28] on EV charging and demand-response, some drivers wanted charging to be simple, others were happy with more complexity if it helped them feel more in control. From the consumer associations´ perspective, control of devices should not be mandatory, and consumers should be able to easily override automated decisions without too excessive penalties, if they have unexpected needs (e.g., consumer may need to warm their home more than usual if they have health issues). This barrier could impact the business model in the design phase, if the service or product takes into account the control reversibility.

Transparency

Lack of transparency and availability of information have been observed to be very important barriers for the deployment of flexibility offers across every European country included in this

[26] BEUC - Fit for the consumer? Do's and don'ts of flexible electricity contracts (2019)
[27]BEUC, The Future of Energy Consumers. Bright or Burdensome? (2019)
[28] http://www.peoplelab.energy/wp-content/uploads/2020/08/FRED-Insight-Main-Report-FINAL.pdf

study. The questionnaire responses showed that currently, many consumers are not aware of their energy consumption, unless they are already prosumers, in which case transparency is key to enable trust and a comprehensive understanding of their new role. However, not every energy consumer/prosumer wants detailed information on energy consumption or services that are offered to the grid; basic data are often enough for the average end-user. This barrier impacts new business models because the level of information required by the customers and mandated by regulation should be carefully assessed. In addition, it affects the possibility of developing new business cases. Flexibility providers and aggregators, to properly assess the flexibility potential of a customer, need access to a certain data related to consumption patterns. This data should be made available by the supplier to third parties, with previous consent from the consumer

Customers also fear hidden charges and costs, a thorough presentation of each service has been shown to be a positive approach to engage customers, as reported by one participant to the questionnaire. Although the necessary level of information often depends on the interests of the individual consumer, it has been observed that is important to reassure consumers with transparent reporting and access to their consumption data. The interviews conducted for this analysis show that availability of information is not only a concern of single consumers but also of energy communities and cooperatives, that in some cases have still limited access to smart metering due to slow national roll outs. Smart metering plays an important role to unlock the data access for customers. In Finland, all electricity customers have smart metering and access to their hourly metering data. Second generation of smart meters will also provide a standardized interface for near-real time data (as required by Electricity Market Directive), that could improve different flexibility services for the customer. A standard level of information agreed by national professional associations and regulatory authorities has been suggested to be a possible solution to overcome this barrier.

Trust in authorities and utilities

The data collection of this study, specifically the review of the questionnaire responses, has shown that lack of trust towards authorities and energy utilities is perceived as a significant barrier to DSF in different countries across Europe. Indeed, consumers who trust their governments, utilities and private companies, are more likely to engage in DSF solutions. Given the importance of interactions between DR providers and buyers, the credibility of the relevant parties and the level of trust between such parties are crucial. Low levels of credibility and trust can pose a barrier to DR. An example of the importance of trust and credibility could be found in the preference of DR providers to interact with smaller, local DR buyers, who they identify with and trust, rather than large, impersonal energy utilities.[29] This barrier could find its roots

[29]Good, N., Ellis, K., & Mancarella, P., Review and Classification of Barriers and Enablers of Demand Response in the Smart Grid. Renewable & Sustainable Energy Reviews (2017)

in the lack of transparency that has historically prevailed in the energy sector before its liberalisation. Innovative business models are impacted by this barrier because people´s early experience of a market could shape their engagement, it important that new players (i.e., independent aggregators) are perceived as trusted entities from the beginning. Customers who do not trust the electricity industry to act in their personal interest may not be the only party to hesitate to make the accommodations required for DSM to flourish; established participants such as distribution networks, retailers and regulators may as well be wary of the wholesale changes implied.[30]

4.3 Regulatory Barriers

As highlighted in the previous section, many social barriers are rooted in the existing regulation and in the opportunities the regulation provides DSF service providers to access consumers with their offerings. Almost the entirety of concerns by consumers that could be considered as social barriers, can be overcome with a tailored offering by a market participant trying to exploit a certain consumer niche. However, even if many existing barriers were addressed by the 2019 Electricity Market Directive and Regulation, they have still not been overcome on a Member State level. The main regulatory barriers affecting social acceptance and access to DSF services can be grouped in the following categories.

Access to markets

The financial viability of the business case for DSF is very much linked to the different markets where it can be monetised, the revenue streams available and very importantly, whether stacking of services is permitted, i.e., that a DSF provider can be active in several markets at the same time.

- Transmission System Operator (TSO) procurement of flexibility

DSF is already available in many ancillary services markets, provided mostly by large pools and industrial consumers, with very slow progression for households. Households could benefit equally from providing DSF services, however, stringent technical requirements designed for traditional generation, the inability to pool generation and demand, large minimum bid sizes and other barriers limit the business cases for service providers. The TwinERGY platform could be viable on a commercial basis in all four pilot countries but with significant caveats. The UK does not use a formal merit order to purchase balancing services at transmission level, it is at the sole discretion of National Grid who chooses the products it needs. These could provide DSF or not. Participation in Italy and Greece is possible, but in the case of Italy limited to the

[30] Fröhlich et al., Towards a Social License to Automate in Demand Side Management: Challenges, Perspectives and Regional Aspects (2020)

UVAM product, and in Greece only through aggregation (no individual units). These barriers limit considerably the viability of a business plan for residential customers, as reaching the minimum bid sizes (1 MW) is challenging, other technological barriers notwithstanding. Participation of DSF in wholesale markets is still very limited across many European countries, where the implementation of the Electricity Regulation provisions for Day-Ahead and Intraday Markets[31] is still slow. The non-discriminatory participation of DERs to these markets is not possible for example in Spain, Greece and the UK, while some countries (e.g., Italy, France) allow participation but with a minimum bid size of 1 MW (higher that the prescribed 500 kW).

- DSO procurement of flexibility

The Electricity Market Directive and Regulation incentivises the procurement of flexibility services by DSOs[32], but so far, no country has fully developed a framework to facilitate this. In the TwinERGY pilot countries, only Italy and the UK have market-based procurement of flexibility by DSOs, and only on a pilot project basis. The main concern is the lack of appropriate remuneration for DSOs to procure flexibility services. The remuneration of regulated actors is focused on capital expenditures, CAPEX. DSF does not follow the same incentive structures, more focused on operational expenditures, OPEX. A combination of the two would facilitate DSOs purchasing flexibility services, and opening up new revenue streams for flexibility providers.
The potential for DSF is evident by the participation of large loads to ancillary services markets at transmission level. This potential remains untapped at residential and small commercial level, in particular at distribution level. To bring DSF solutions closer to the consumer, and address social barriers like energy poverty and knowledge, the business cases for the service providers must be viable.

Access to consumers

The Electricity Directive enshrined in law[33] the need to guarantee fair access to consumers by third parties. Prior consent by suppliers has been a significant barrier for DSF offerings and social visibility of the possibilities. Suppliers usually reduce their offerings to implicit DR and time of use tariffs. With significant difficulty for independent aggregators and other service providers to have access to consumers and their data, developing a business case becomes challenging without the possibility to study a consumer's potential. Only France has so far enshrined in national law the requirements present in the Electricity Directive of removing prior consent by the suppliers. Germany has taken steps in that direction, but only for the provision of services in the balancing markets. Greece, Italy, and UK, the other three countries with pilot sites have still requirements of previous consent from a supplier to access the customers.

[31] Article 7-8 Electricity Regulation
[32] Article 32 Electricity Directive
[33] Article 13 Electricity Market Directive

A second barrier limiting access to consumers is the possibility of suppliers to discriminate against consumers engaging with an aggregator. This usually comes in the form of higher fees or a compensation that consumers need to pay for flexibility activity. In Germany, Greece and the UK this is still the case, reducing significantly the potential for households providing flexibility services, although changes on this matter are upcoming in the UK. Only Italy has banned any kind of discrimination for consumers engaging with aggregators.

Both these barriers limit significantly the potential business case for service providers engaging with households in particular, as consumers will not engage if they will suffer penalties from their suppliers. This also affects the potential of the TwinERGY solution to expand to a commercial level in these countries.

Framework for energy communities

Energy communities are an integral part of the focus of TwinERGY as potential users of the platform. However, most Member State's regulation has not developed a comprehensive framework for citizen energy communities as the Electricity Directive envisions[34]. Greece, Italy and the UK are currently revising their framework for energy communities. The most advanced country being Italy, who is implementing with virtual energy sharing through the distribution network. Germany has so far made no efforts in implementing a framework for energy communities. This situation harms considerably the regulatory certainty of companies developing services for energy communities on a commercial basis. We currently only see energy communities in the context of pilot projects similar to TwinERGY.

Pricing, network tariffs and taxes

Financial incentives are one of the main drivers for consumers to engage in flexibility services, and one of the incentive structures most closely linked to the regulatory landscape. The Electricity Market Directive and Regulation included provisions to enhance the price signals received by consumers, by encouraging the move towards market-based prices and time differentiated network tariffs. This allows transparent access to price signals, the adaptation of energy consumption on the basis of external signals and drives innovative business models to automatically adjust the consumption of end-users while increasing comfort and efficiency. Thanks to the roll-out of smart metering technology, consumers can subscribe to dynamic electricity price contracts linked to wholesale and spot market prices. Eventually the possibility of time-differentiated network tariffs will make it possible for DSF service providers to exploit the consumers flexibility while providing a significant financial benefit.

So far, the four pilot countries have significant barriers on price signals. This limits the viability of the business case for flexibility products since benefits of engaging will be not evident for consumers. Germany and Greece in particular are more affected by these limitations, with a

[34] Article 16 Electricity Directive

limited smart meter roll out in Germany and no dynamic price contracts available to the general public. While in the UK and Italy dynamic price contracts are a reality, the dynamic part only applies to the energy component of the energy bill, limiting the benefits for the consumer. Consumers in Germany pay the highest electricity prices in the EU, but only 22,4% of their energy bill corresponds to the costs of generating electricity. The rest are linked to taxes, levies and network tariffs. As long as these components are not dynamic, variations in energy prices will have a very limited impact on the consumer's energy bill, making any commercial proposition uninteresting for the residential and commercial consumer.

Smart meter deployment

Smart meters are the main gateway for households to become active consumers, and their availability heavily dictates the options they have. It is not necessary for customers to have a DSO-issued smart meter, they could also provide flexibility through an energy management system (EMS) provided by their aggregator or service provider. However, presence of a smart meter still dictates the availability of flexibility services on a commercial level. Smart meter roll-out in Europe is quite uneven and only around 37% of customers had smart meters installed by the end of 2019[35], and in some countries, like Germany no specific plans for national roll-outs exist. Front runners in the roll-out race are Spain, Italy, Estonia, Finland, Sweden and Norway, having reached (very nearly) 100% coverage of smart meters. However, many of these smart meters are first-generation metering devices, that are not compliant with the technical requirements established in the Electricity Market Directive[36], e.g., measurement. From the pilot countries, Germany and Greece are lagging behind. No roll-out is planned in the short-term for Greece, and Germany has an 8-year delay in its roll-out over technical discussions.
The lack of appropriate metering devices, increases the costs of flexibility service providers that have to develop, produce and install their own energy management systems. Consumers have shown reluctancy when installing third party measurement devices in some cases, with trust of regulated and state-run roll-outs being higher in most countries.

V2G and smart charging

Electric vehicles will play a key role in the electrification of the European economy, and their integration in existing grids could become a challenge for system operators if the appropriate measures are not taken to guarantee grid stability. The cheapest alternative to grid reinforcement is flexibility services like smart-charging and vehicle-to-grid (V2G). These services, like deployment of electric vehicles are still at its infancy, mostly due to regulatory barriers. The main regulatory concern is the limitation for aggregators to pool EVs and provide services to the grid with them. Most charging stations in Europe are still being managed by

[35] smartEn, The smartEn Map, Network Tariffs and Taxes (2019)
[36] Article 19 Electricity Market Directive

DSOs, even if this contravenes Article 33 of the Electricity Market Directive. From the TwinERGY pilot countries, only Greece has introduced legislation to limit DSOs from owning or operating charging stations, unless it is for their own use. The rest of the countries either do not have any plans in the short-term to introduce such legislation or are in preparatory phases.

If charging is done smartly, EVs become DERs which:

- extensively interact with homes, buildings, the grid,
- align with variable renewable electricity generation patterns,
- provide a full range of flexibility services to the benefit of end-users and the entire energy system[37].

The European Commission, in its proposal for the Electricity Market Design 2016, calculated that 5.6 bn Euros could be saved annually by avoiding investments in unnecessary grid reinforcements, back-up generation capacity and fuel costs related to electro mobility. The current lack of offers for V2G and smart charging have a significant effect, not only on the future necessary investments in grid reinforcement, but on innovation and integration of millions of consumers as active players.

[37] BloombergNEF, EATON, Statkraft, Sector Coupling in Europe: Powering Decarbonisation – Potential and Policy Implications of Electrifying the Economy, February 2020 (section 7)

5 How to overcome barriers

5.1 Engagement Strategies

Lack of awareness and scepticism towards innovative energy solutions are one of the most impacting social barriers limiting the development of new DSF business models. The results of the primary and secondary research conducted for this analysis have shown that different engagement strategies could be adopted to overcome these barriers. Different solutions can be implemented to raise consumer awareness on the value of DR and the potential benefits in becoming prosumers (see chapter 3 - Assessment of business cases and drivers). According to the data collected for this report, different communication campaigns (through newsletters, social media, websites etc.), workshops and dissemination projects open to potential customers have been found to be effective approaches by the participants. It is important to highlight that in the particular case of energy communities and microgrids, like some of the pilot sites, these activities are mostly successful if linked to a festive atmosphere and if they foster a common vision for the community. From the perspective of energy cooperatives that have been interviewed, the emotional involvement of the majority of the participants is sometimes more important than financial incentives and the technical background of the project technical background and organizational matters are more relevant for the core group of cooperative organizers, rather than its participants.

For users that are not a part of an energy community or cooperative, engagement strategies are focussed on increasing accessibility and control over their energy consumption. A study from Citizens Advice[38] on energy management systems for households has shown that consumers could be helped to make an informed choice through a central information hub: a central resource that is run by an organisation they trust that brings together all the information they need. An example of such approach is the Finnish government owned company Motiva[39], which is running a project that aims to improve customers knowledge in DSF by providing guidance and advice to consumers.

Consumers engaged in improving their energy consumption and efficiency through DSF are at this stage early adopters or early majority-type consumers, with high engagement with other innovative technologies and online content. User-generated content like online reviews or social media content could help the purchase of new energy technologies. However, to reach mass-market status, it has also been observed that offline support, before and after

[38] Citizens Advice, Navigating net zero. A framework to give people the confidence to invest in home energy technologies (2021)

[39] https://www.motiva.fi/en/home_and_household

purchase, should not be omitted, so that DSF solutions can be accessed by people who are digitally excluded. In order to foster participation in energy projects, it is also important to identify and engage the community leaders and provide advice at a local level. Local advice can also better take into account specific local conditions, such as housing types and planning rules. As a result, the engagement strategy can be more accurate and relevant to people's needs, benefitting as well from the higher degree of trust people have in local organisations.[40]

5.2 Simplicity of Products

In the analysis of the barriers, it has been observed that the commercial-level deployment of DSF solutions could be limited by lack of technical knowledge especially for residential and small commercial consumers. Several companies interviewed for this study (e.g., the smart-charging and V2G provider Nuvve, and the smart home energy management system provider tiko) are adopting strategies focused on implementing simple, highly automated solutions, that require very little action by the end-consumer after the first set-up. This "set and forget" approach could not only help to overcome the digital divide but also the behavioural inertia, limiting interaction with the technology to the minimum. A successful strategy is also to embed DSF solutions by default (e.g., delayed start of dishwashers, EVs with delayed charging option, smart meters embedding a relay to control appliances based on day/night tariffs). A risk observed by service providers and other pilot projects is the disengagement after an initial "honeymoon" phase. Easy-to-use technical solutions could also avoid disengagement of customers with time. It's up to the DSF provider to design simple to use and non-time-consuming solutions and services for their customers. The CLEAR2.0 Horizon 2020 project focuses on providing advice and support to consumers who want to produce electricity and heat from RES. In its conclusions based off their interaction with consumers that were already interested in these solutions, they stress the importance of consumer access to seamless and reliable products.[41]

5.3 Incentives for Renters and Energy Vulnerable Consumers

To make energy innovative solutions accessible to every energy consumer and fully deploy the potential of flexibility, it is important to tackle obstacles that exclude certain categorizes like energy vulnerable consumers and renters. In chapter 4 we observe how these two groups could face exclusion for a set of different reasons like the burden of up-front costs and the

[40] Citizens Advice, Navigating net zero. A framework to give people the confidence to invest in home energy technologies (2021)
[41] CLEAR2.0 Project - What Clear 2.0 Project taught us: results and recommendations (2020)

"split incentive issue" for tenants. Our research has shown that dedicated financial incentives are possible solutions to incentivize participation.

Financial incentives can be in the form of optimisation of self-consumption, governmental programmes or monetisation of flexibility through implicit or explicit DR. Governmental support mechanisms have been the cornerstone of the development and growth of RES technologies like solar PV in the EU. Currently support mechanisms are focussed on EVs, smart-charging stations, heating renovations, and installation of storage assets. All pilot countries have some form of governmental support mechanism in place. In Germany EVs, charging stations and battery storage benefit from significant direct investment subsidies and avoided taxes. Low interest rates are also available for customers purchasing solar PV systems and battery storage. In the UK, the Renewable Heat Incentive represents the main financial incentive for installation of flexible heating.[42] The British government also provides grant funding of up to 75% towards the cost of installing electric vehicle charge points at domestic properties through the Electric Vehicle Homecharge Scheme (EVHS).[43] In Italy, EV buyers benefit of an "eco-bonus" up to 6 000€ and a tax relief, where EVs do not pay for road tax for the first five years of ownership alongside free parking in numerous city centres [3].

Through the questionnaire it has also been suggested that governments could provide such services free of charge to social housing. A notable example of governmental initiatives in the energy sector, is the Social Housing Decarbonisation Fund, which is a demonstration project that aims to catalyse innovation for retrofitting social housing at scale in the UK[44]. If the DSF offer entails an upfront cost, this could be eliminated giving for free certain devices, tools or a portion of energy supply in case of an energy community (virtual or based on proximity). In a study conducted by Energy Systems Catapult[45] they showed that vulnerable households can be supported by energy innovators in many ways: using innovation to help people get the heating experiences they value, rather than focusing only on minimising what they spend, giving them better control of their heating system and providing information on the costs of using energy to help them choose how much to spend.

Renters usually lack incentives to invest in permanent improvements to their homes or buildings. To encourage DSF adoption by renters, regulatory requirements on private and public landlords could be implemented by governments in order to incentivize improvements in the energy and carbon performance of the rental properties.[46] Alternatively other

[42]smartEn, The smartEn Map, Prosumers (2020)
[43]https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles
[44] https://www.gov.uk/government/publications/social-housing-decarbonisation-fund-demonstrator-successful-bids
[45] Amal Anaam, Rose Chard and Rowanne Fleck, Fuel poverty in a smart energy world How vulnerable energy consumers could benefit from smarter heating controls (2020)
[46] Richard Lowes, Jan Rosenow and Pedro Guertler, Getting on track to net zero: A policy package for a heat pump mass market in the UK. Regulatory Assistance Project (2020)

approaches exist to encourage peer-to-peer trading in buildings even if installation of DERs is not viable. For example, Switzerland has implemented the Zusammenschluss zum Eigenverbrauch (ZEV) programme, that allows residential consumers in apartments to be connected through a single point to the grid and manage either offtake or injection from that single point. This enables renters and owners to benefit from solar PV and reduce their energy consumption.

5.4 Data Privacy Protection and Flexibility of Solutions

In previous sections we observed that data privacy concerns and reluctance to allow control of devices are important barriers for the adoption of flexibility solutions. Some existing EU legislation offers the tools to ensure data integrity and reinforce the customers security. Consumer's data privacy is already protected by the GDPR regulation, which does not limit the offerings of innovative solutions by service providers. Further regulation was encouraged by the European Commission to ensure interoperability and cybersecurity in energy services. Following the recommendation in the Electricity Market Design[47], a new network code on cybersecurity and an implementing act on interoperability is currently being developed by the Agency for the Cooperation of Energy Regulators (ACER) and will be published in the coming years. These efforts will further strengthen consumer protection and bring it to the forefront of every energy service offering. These legislative files will address two of the biggest concerns regarding data security for consumers: who has access to the data and what can they use it for? To overcome concerns regarding data privacy we will need, clear rules for data ownership (always with the consumer), consumer consent regarding who he shares his data with and data portability, to facilitate the switching of suppliers or engaging with third party service providers.

It is important that data protection is also strongly perceived by consumers. From BEUC's perspective, new energy services, such as smart charging for EVs, will only be embraced if consumers have assurances that company practices are both transparent and aligned with the GDPR.[48] Many DSF solutions could also be limited by the reluctance of giving control of devices to third parties, which is an important aspect of automation and flexibility offers. In this analysis, we observed that consumer's acceptance is higher if they are given the option to easily override the automated decisions, in case of an emergency or a special need. In addition, communication with consumers on what data is collected and how is necessary to comply with GDPR guidelines. These options should be implemented by design in the different services offered by the TwinERGY business models.

[47] Articles 23 and 24, Electricity Directive (EU) 2019/944
[48] Europe's Energy System Needs Household Flexibility to Go Carbon Neutral, BEUC (2020)

5.5 Transparency

A significant concern by consumers is the lack of trust in their energy supplier and transparency concerns. To overcome these barriers, it is important that information is made readily available to consumers in an easy to read and reliable manner. When it comes to DSF and DR schemes, utilities, energy retailers and in general market actors should make it easy for consumers to compare and evaluate offers. In Sweden for example, Ei, the Swedish energy regulator, has observed a great need for ongoing information from electricity retailers to customers about DSF. It also recommends that the consumer's flexibility potential is included in the energy declaration that since 2009 has to be provided for new buildings. The declaration promotes efficient energy use and good indoor environment in buildings through a classification of the building and could potentially include information about flexibility (i.e., alternative heating sources, access to storage, own electricity production)[49].

Property owners and businesses (large, small and medium-sized) should also be informed on the DSF potential when supported in the energy mapping of their companies. This is an additional advantage that aggregators like Entelios, are already offering to their industrial consumers.

Furthermore, the Electricity Market Design already states several important principles regarding transparency by energy suppliers. Article 12 of the Electricity Market Directive aims to facilitate the switch of suppliers. So far in all pilot countries the supplier-switching period lies between one and three weeks, but no specific rules have been set yet for aggregator switching. Article 13 of the Electricity Directive eliminates the requirement of prior consent by the supplier to access consumers by an aggregator, as well as the possibility for a supplier to discriminate against customers engaging with aggregators. From the four pilot sites, only Italy has enshrined in national law protection for consumers engaging with aggregators and only in the UK changes are planned. To overcome transparency concerns, and to facilitate consumers benefitting from DSF, these articles need to be fully implemented.

5.6 Efforts from Regulated Bodies and Governments

Regulated bodies and European institutions have made efforts to engage citizens and support them to become active energy market participants. Notably, a trilateral workshop was

[49] Swedish Energy Markets Inspectorate, Measures to increase demand side flexibility in the Swedish electricity system (2017)

organised in May 2021 by the Council of European Energy Regulators (CEER), the Energy Community Regulatory Board (ECRB) and the Association of Mediterranean Energy Regulators (MEDREG). The workshop focused on regulatory means to foster active customer engagement – Flexibility, demand response, prosumers. Special attention was given to commercial quality, prosumers and active self-consumption, billing and digitalisation.[50] In the joint press release they stated that: "Active consumer engagement plays a vital role in driving strong competition, ensuring markets work effectively and making the energy transition a reality. This, in turn, raises questions regarding which regulatory measures can be used to extend these benefits to all consumers and how to engage all consumers. Making sure that no one is left behind is a fundamental guiding principle for CEER, ECRB and MEDREG in their regulatory responsibilities and their work relating to consumer protection.''[51]

Moreover, it is worth highlighting the study conducted by the Swedish Energy Markets Inspectorate (Ei) to propose a package of measures to increase demand side flexibility in the Swedish electricity system.[52]

5.7 Strategies Adopted by TwinERGY Pilot Sites

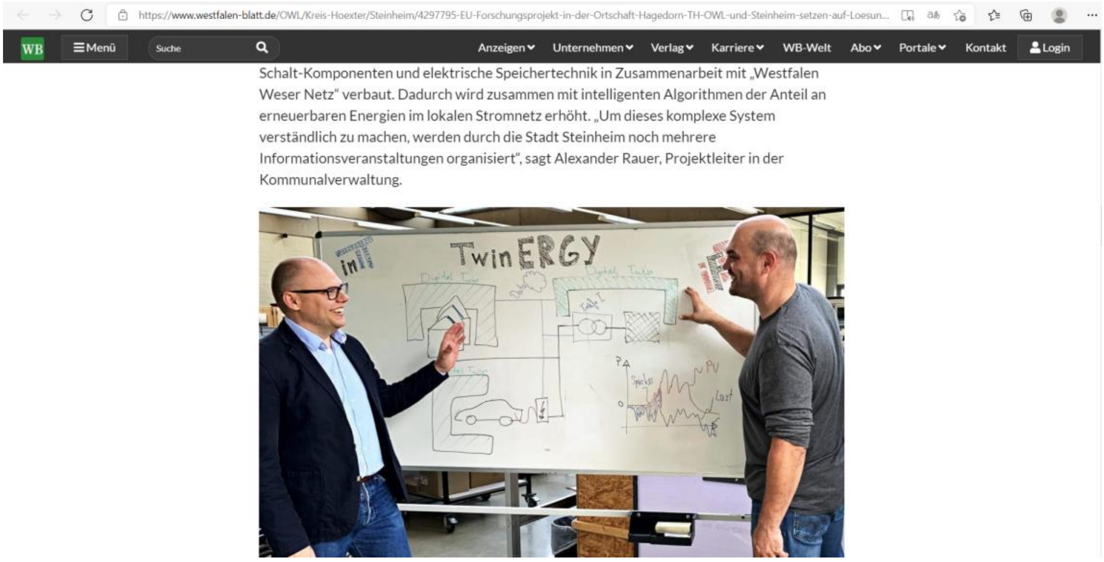
Even if the TwinERGY project is at an early stage, the pilot sites (see chapter 3 - Assessment of business cases and drivers) have already implemented some strategies to engage participants. Some best practices that are described here have also been collected from previous H2020 projects (e.g., UtilitEE and HOLISDER) completed in these same test sites.

In Task 2.1 of TwinERGY KWMC and IFC are working with the four pilots to develop the Citizen Engagement and Co-design: framework and guidance, which will be published in a report in month 8 (June 2021). This will provide a knowledge base, which includes best practice, guidelines, training materials and tools about how to apply participatory and inclusive methods in the energy domain. This task will also provide guidance on metrics around diversity and inclusion. This will help to ensure the participants within each of the four pilots includes a wide demographic, and the topics addressed in the pilots comprise a wide range of social challenges.

- Dissemination activities

[50] 3rd Trilateral CEER-ECRB-MEDREG Online Workshop - ceer.eu
[51] 20cf0fe0-3058-7700-3ccf-071085fc8d87 (ceer.eu)
[52] Swedish Energy Markets Inspectorate, Measures to increase demand side flexibility in the Swedish electricity system (2017)

Pilot sites are following different strategies to increase their dissemination efforts, focused on approachable formats and media platforms generally used by local citizens. For example, the Hagedorn test site has published articles and advertised online workshops through the local online newspaper (see Figure 3).[53] They have also planned in person activities for the near future to share the latest developments of the project and engage potential consumers. The city of Steinheim is also planning to establish a social group, which will regularly discuss the use of renewable energies in a self-organized way.


https://www.westfalen-blatt.de/OWL/Kreis-Hoexter/Steinheim/4297795-EU-Forschungsprojekt-in-der-Ortschaft-Hagedorn-TH-OWL-und-Steinheim-setzen-auf-Loesun...

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Schalt-Komponenten und elektrische Speichertechnik in Zusammenarbeit mit „Westfalen Weser Netz" verbaut. Dadurch wird zusammen mit intelligenten Algorithmen der Anteil an erneuerbaren Energien im lokalen Stromnetz erhöht. „Um dieses komplexe System verständlich zu machen, werden durch die Stadt Steinheim noch mehrere Informationsveranstaltungen organisiert", sagt Alexander Rauer, Projektleiter in der Kommunalverwaltung.

Figure 3 - Article on TwinERGY with Steinheim and TH-OWL

The Benetutti municipality has also been engaged in many interviews in local newspapers and has produced a video to present its project and innovative smart grid (see Figure 4).[54]

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[53] https://www.westfalen-blatt.de/OWL/Kreis-Hoexter/Steinheim/4297795-EU-Forschungsprojekt-in-der-Ortschaft-Hagedorn-TH-OWL-und-Steinheim-setzen-auf-Loesungen-vor-Ort-Stromnetz-fit-machen-fuer-Energiewende

[54] https://sardegnarinnovabile.org/best-practice/

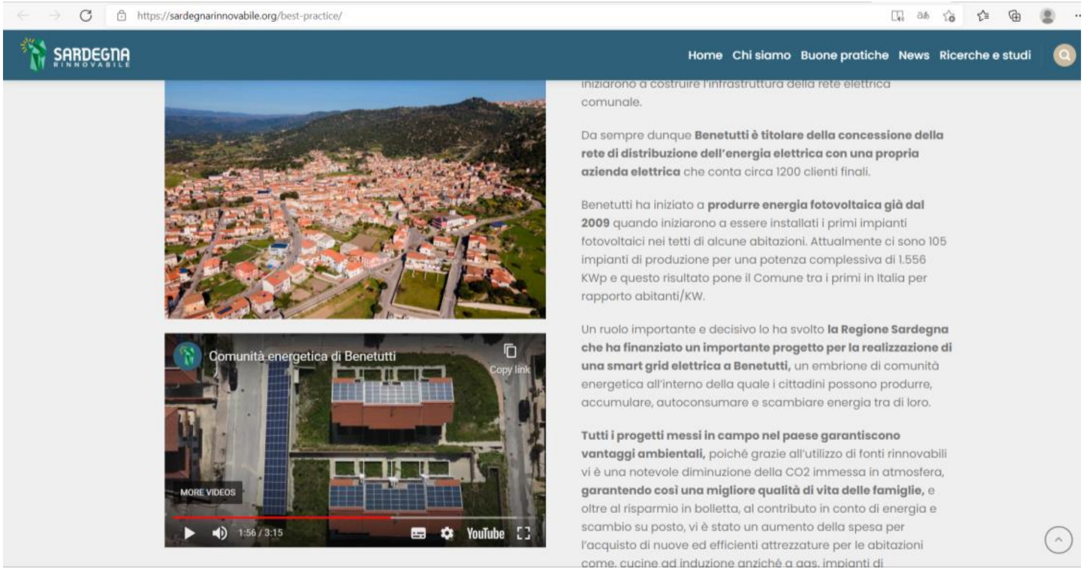

Figure 4 - Article and video on the energy community of Benetutti

The Greek test site organised by Mytilineos has also implemented previous experience gained from a previous European project, UtilitEE, and plans to use a similar approach for TwinERGY (see Figure 5). They have organised living labs for their business premises, distributed newsletters and conducted interviews with pilot participants for further feedback and commenting regarding the solution tested.

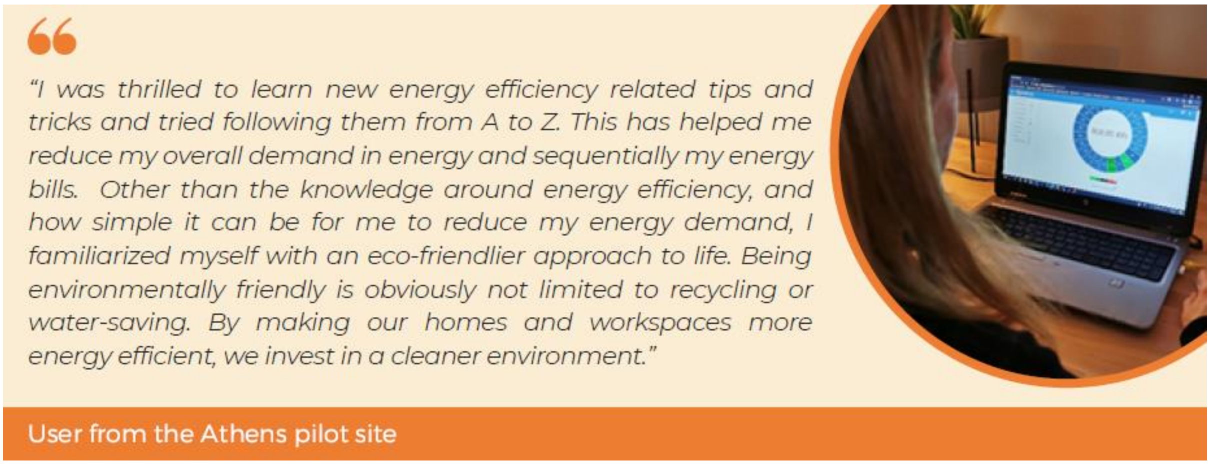

Figure 5 - UtilitEE project - Meet the User Campaign

Twinergy has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 957736

5.8 Overcoming Social Barriers in Practice

Households

Some notable examples of business cases that try to overcome the barriers analysed in the previous chapters exist already in the market. Joulie[55], an innovative DSF offer by the Austrian utility EVN, has been developed in the attempt to enhance trust between consumers and utilities.

Joulie's concept is based on four pillars:

- Online and easy-to-use configuration for solar PV
- Setting of the appropriate electricity tariff (dynamic pricing if smart meters are present)
- Home energy management tool (see Figure 6) and demand response platform (through VPP)

  Integration of larger electric devices like Heat Pumps, Heating Rods, EV charging or battery storage

From Joulie's experience, it is still hard for the customers to grasp the concept of DR and how shifting energy consumption could reduce their energy bills. Availability of dynamic tariffs and regulatory measures could help increase understanding and acceptance and therefore help the business model deployment. To overcome these barriers the current business model offers the advantages of the home energy management tool and the DR platform almost for free to the customers when buying a PV plant or other "all-electricity" devices.

Figure 6 - Example of self-consumption optimisation with Joulie's platform

[55] https://www.joulie.at

One of the main drivers that Joulie is leveraging for its business case is the consumer´s valorisation of the environmental benefits (in a recent survey conducted by EVN, ca. 70% of the participants stated to be happy to help the energy transition if there are no up-front costs for the proposed DSF solutions).

Commercial Buildings

Another relevant example could be taken from the largest Finnish shopping centre, Sello, a collaboration together with Siemens.[56] For over ten years Sello has been working with Siemens on innovative building automation and energy projects that increase sustainability and add to the perfect shopping experience. Siemens solutions deliver a comprehensive optimisation program for Sello's building systems focused on reducing energy consumption and improving air quality through:

- A cloud-based energy and sustainability platform, to monitor and optimise the centre's ventilation units, room sensors and lighting systems;
- Development and maintenance of the microgrid based on Sello's building technology, a 550 kW peak solar PV system, intelligent LED lighting, and about 2 MW in electricity storage capacity;
- The virtual power plant that optimises energy consumption and reduces the load on the main grid.

The solution offers to the shopping centre many advantages: improved building performance and level of comfort, savings in energy, reduced operating costs and reduced emissions. It is worth highlighting that the participation in the balancing markets, through the virtual power plant, is a significant financial benefit for the shopping centre and it helps the Finnish electricity grid to develop and secure the self-sufficiency of its energy production.

[56] https://new.siemens.com/global/en/company/stories/infrastructure/2020/sello-virtual-power-plant.html

6 Conclusions

The European Commission's Clean Energy Package tried to empower active customers and citizen energy communities through legislation. Now the EU Green Deal wants to go further and put active customers in the forefront of the new energy legislative packages. Consumers will play an active role in decarbonisation, providing important flexibility to stabilise the increasing amount of variable RES being introduced in the grid. What is more important, they can do it in a cost-effective way, both for the system at large and for themselves. Legislation needs to empower them to play an active role in the decarbonisation of the energy system. However, in this report we have seen that numerous social concerns affect consumers and their drivers to undertake these challenging changes in consumption patterns might not be aligned with what the current legislation allows. To fully empower them, we need to understand these social, cultural and ethical barriers, and how they are linked to the existing regulation.

This report's analysis revealed the importance of social, cultural and ethical barriers in the adoption of DERs and DSF services, in particular by residential and commercial consumers. Some of these barriers also affect industrial consumers. However, the larger potential benefits from using the flexibility in those customers, quickly trump other concerns. These higher potential benefits are rooted in the easier market access they have, and the possibility to monetise their flexibility.

Having this difference between residential and commercial consumers with industrial consumers points directly to the importance that regulatory barriers play in social acceptance of different solutions. If there is an open and accessible market, and system operators have a need for flexibility, service providers like aggregators will make sure to approach and market flexibility services to as many potential customers as possible. The fact that mostly households are underrepresented can be explained by the limitations that service providers face to access this consumer segment.

Disassembling the results from interviews and desk research, the divide between financial and non-financial drivers became apparent. Contrary to popular belief, non-financial drivers had more weight than financial drivers. Consumer associations and companies highlighted that the most prevalent barrier was the lack of awareness of consumers as to what DSF is and what it can do for them. This barrier was followed closely by the lack of previous experience with energy management tools. Consumers don't know what DSF does and they are hesitant to engage with these new technologies. However, once engaged with DSF services, consumers highlighted as the most valuable traits the financial benefits, the increase in comfort and the reliability of the different solutions. The benefits are apparent and highly appreciated.

In short, the main social barriers to overcome are knowledge and the simplicity of the offered solution. Both barriers that can be easily dissolved by a service provider with an attractive offering and a tailored marketing plan. However, for those service providers to be active in the residential and commercial customer segment, significant regulatory changes will be necessary to guarantee a fair and equal access to the energy markets to be able to monetise flexibility.

The TwinERGY pilot sites are in an enviable position to further explore the drivers, barriers and solutions proposed in this report. The experiences collected through the pilot sites during the duration of the TwinERGY project will be a valuable resource for the commercial launch of similar offerings and for other projects. Specific tasks throughout the project (e.g., T11.3 Citizen Learning & Dissemination), will serve to disseminate these experiences. These activities will be designed together with citizens involved in the pilot sites, to ensure they meet local needs and are inclusive and accessible to all types of consumers. TwinERGY has the opportunity to provide many lessons learned to facilitate replicability in different countries, and over the course of the project we will continue to enact the solutions proposed in this report to further engage with consumers and unleash their flexibility.

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Annexes

Annex A - Questionnaire

This questionnaire was developed in coordination with the TwinERGY pilot sites, other consortium members and industry representatives from the smartEn membership in order to collect primary data for this analysis. It has been circulated in form of a Word document and used as reference for single interviews with stakeholders.

"Analysis of social, ethical and cultural barriers to innovation in the EU"

Organisation responding:
Country for which you are responding:

About the TwinERGY project

smartEn is a member of the TwinERGY's consortium.

TwinERGY is a research project, which is run by a consortium of project partners and funded under the European Union Horizon 2020 research and innovation program under the grant agreement No. 957736 ('TwinERGY') that will develop, configure and integrate an innovative suite of tools, services and applications for energy consumers in order to:

1. empower citizens to track their energy use and actively participate in the energy market;
2. raise awareness and knowledge about consumption patterns and energy behaviours;
3. increase community participation in the energy market and engagement of consumers via the Digital Twin technology;
4. encourage a green ecosystem, more sustainable and accessible to all ('Research Project').

The Research Project will introduce a first of a kind demand response framework, which allows electricity retailers and local energy communities to introduce themselves in energy markets under the roles of an aggregator or a prosumer, facilitating consumer representation in the energy sector.

Please find more details on the website: https://www.twinergy.eu/.

About this questionnaire

smartEn will lead the development of a report on **socio-cultural, ethical** and **regulatory** barriers to innovation on Demand Side Flexibility (DSF). The report aims to **identify potential**

barriers and **suggest possible enablers** for the adoption of DSF. The scope of this questionnaire is to gather information from smartEn members, business and consumer associations regarding their experience with barriers and how to overcome them in different countries. Replying to all questions will take around 20 minutes.

We really appreciate your contribution!

Socio-cultural Barriers

- What are the main social barriers observed in your country for adoption and development of DSF business cases and projects?

How would you rate these potential barriers for the development and adoption of DSF and DSF solutions? (1 not important, 5 very important):

	1	2	3	4	5
Lack of previous experience with energy management tools					
Lack of awareness regarding the benefits of DSF programmes					
Low understanding of the project objectives					
Negative perception and misconception of DSF (e.g., security of supply is not guaranteed)					
Business case is difficult to understand or time-consuming					
Consumer overwhelmed by too many options					
Lack of technical knowledge and access to ICT					
Lack of trust of consumers towards DSF services					
Lack of trust of consumers towards digitalisation (concerns on data privacy, data access and exchange, cybersecurity)					

Other please state____________________________________

- How are these barriers affecting the development of innovative DSF services?

- If you are representing a company; how are these barriers limiting your growth and/or interactions with potential customers?
- Are you aware of any strategies implemented by organisations or governments (local/regional/national) to overcome the social-cultural barriers?
- How does your company or organisation try to overcome social acceptance and cultural barriers?
- Are any of the mentioned barriers linked to the existing regulatory framework and how?

From your observations of the market, what is the most relevant aspect for the end-user? (1 not important, 5 very important)

	1	2	3	4	5
Desire of autonomy and control					
Comfort					
Financial benefits					
Energy efficiency					
Environmental benefits					
Ease of use					
Flexibility					
Resiliency (e.g., protection from black-outs or price spikes)					
Reliability (e.g., guaranteeing state of charge or home temperature)					

Other please state________________________________

- Have you observed inertia and reluctance to behavioural changes as possible barriers for DSF services? If so, what would be your recommendations to overcome it?
- How significant is lack of technological knowledge a limiting factor for adoption of DSF services? How can this be overcome?

- Is environmental concern a clear incentive for consumers to adopt DSF services? What weight does it have in the overall decision-making process?
- What are the business models that have the highest acceptance rate with consumers in your experience? And why is that? (e.g., models with high interaction/low interaction, passive solutions like ToU tariffs, cash-back systems with little effort by consumers etc.)
- Have you observed any risk of exclusion for energy vulnerable consumers from using DSF? What are potential mitigating measures to this risk?
- Have you observed differences of adoption of DSF services by home owners compared to renters? Where are those differences rooted in?

Data Privacy and Ethical Barriers

- Is data privacy a significant concern for active customers that limits innovation?
- What role does transparency play in the aggregator/supplier/customer relationship? How much do consumers need/want to know about their consumption (storage and generation, if prosumers??
- Are there any efforts being undertaken to increase transparency and facilitate understanding of consumers?
- Might the control of smart devices by third parties be a possible barrier for consumers?
- Does trust in government, and institutions (like energy companies) play a significant role in the interest of consumers in adopting new innovative DSF solutions?
- Have you observed other ethical barriers that consumers are facing and possible solutions?

Regulatory barriers

- What are from your experience the regulatory barriers most limiting for innovation in the energy sector?

Feel free to mention any other relevant barrier that has not been mentioned in the questionnaire