D2.4 Socio-economic and regulatory analysis of obstacles to innovation.v2

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Big Energy Data Value Creation within SYNergetic enERGY-as-a-service Applications through trusted multi party data sharing over an AI big data analytics marketplace

Deliverable nº:	**D2.4**
Deliverable name:	**Socio-economic and regulatory analysis of obstacles to innovation.v2**
Version:	**0.8**
Release date:	**15/11/2021**
Dissemination level:	**Public**
Status:	**Submitted**
Author:	**VERD, UCY, GECO**

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Document history:

Version	Date of issue	Content and changes	Edited by
0.1	02/04/2021	TOC	VERD
0.2	18/05/2021	Updated TOC	VERD
0.3	20/10/2021	Document containing updates from UCY	UCY, VERD
0.4	27/10/2021	Draft sent for final editing to UCY and GECO	VERD
0.5	01/11/2021	First finalized draft with updates from GECO and UCY sent for peer review	GECO, UCY, VERD
0.6	3/11/2021	Draft reviewed by IPTO and comments have been addressed	IPTO, VERD
0.7	11/11/2021	Draft reviewed by S5 and comments have been addressed	S5, VERD
0.8	15/11/2021	Final version submitted to the EC	VERD

Peer reviewed by:

Partner	Reviewer
IPTO	Dimitris Skipis 03.11.2021
S5	Tasos Tsitsanis 10.11.2021

Deliverable beneficiaries:

WP / Task
WP2 / T2.2

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Table of contents

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Abbreviations and Acronyms

Acronym	Description
AUT	Austria
CA	Consortium Agreement
CHP	Combined Heat and Power
BAU	Business As Usual
BDA	Big Data Analytics
BMs	Business Models
CAPEX	Capital Expenditure
DAO	Decentralized Autonomous Organization
DC	Demo Case
DoA	Description of Action (annex I of the Grant Agreement)
DR	Demand Response
DSO	Distribution System Operator
D&T	Distribution & Transmission
EaaS	Energy as a Service
EC	European Commission
eIDAS	Electronic Identification Authentication and Trust Services
EEM	Energy Efficiency Management
ESCO	Energy Services Company
ESP	Spain
EU	European Union
FIN	Finland
GA	Grant Agreement

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

GDPR	General Data Protection Regulation
GRC	Greece
HRV	Croatia
IES	Innovative Energy Services
ICT	Information and Communication Technology
IT	Information Technology
LLs	Living Lab activities
NIAS	National Identification and Authentication System
OR	Organizational
PC	Project Coordinator
PMB	Project Management Board
PO	Project Officer
PV	Photovoltaic
RES	Renewable Energy Resources
SD	Standard Deviation
SE	Socio-economic
SH	Stakeholder
TSO	Transmission System Operator
SOTA	State-of-the-Art
QM	Quality Management
TC	Technical Coordinator
TL	Task Leader
VPP	Virtual Power Plant
WP	Work Package
WPL	Work Package Leader

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Executive summary

The present deliverable is an update on deliverable D2.3 ("Socio-economic and regulatory analysis of obstacles to innovation.v1") which presented a comprehensive analysis on the existence and importance of various regulatory and socio-economic obstacles regarding innovative energy services, data exchanges & synergies and new business models promoted by SYNERGY.

Research performed during the development of T2.2, provided a list of current European policies and regulations pertinent to SYNERGY's demo cases. These European Policies are clustered as either a) horizontal, affecting the whole electricity data value chain, b) vertical, when linked to specific technologies and applications or c) hierarchical, which mainly fall under the horizontal category but are facilitated by the vertical ones. This bundle of EU regulations addresses issues that span across a variety of electricity data value chain elated domains such as transmission, distribution and cross-border grid operation, RES operation and market participation, smart metering, data protection (GDPR), trust services for electronic transactions, smart contracts and blockchain energy consumers rights and more.

In the framework of the previous version of this deliverable (D2.3), a comprehensive, survey-based data gathering exercise was designed, formulated and conducted across the project's demo partners in order to assess, at a national level (demo countries), certain aspects related to the aforementioned European regulations, such as: the existence (or absence) of relevant laws that enforce the European policies, their importance in the implementation of the SYNERGY demo cases towards facilitating smarter, digitized innovative energy services provided by online platforms, data sharing platforms and creation of data economies around electricity data. This process has been repeated in the context of D2.4 in order to identify any changes in the regulatory framework of the demo countries, during the time between the submission of the two versions of the deliverable.

During the first analysis (D2.3), we identified key obstacles and barriers that may have an impact to the realization of the demo cases, towards enabling proactive decisions both referring to the design of the SYNERGY platform/ applications and the way demonstration activities will be implemented in order to overcome them. The surveys verified that all regulations identified at an EU-level, are closely related to SYNERGY's demo cases and as such, their existence or absence at a national level is highly important for their implementation. Moving further, the survey revealed different regulatory gaps in most of the demo countries. The results of the survey were again shared with all the participants during the development of D2.4, requesting their confirmation on whether the results of the first round of the survey were still applicable to their demo cases and countries, or to update them with any changes occurred within the last year.

During the first round of iterations for T2.2 (as reported in D2.3), it was identified that among the five demo countries, Finland was the only one that presented no missing regulations relative to the identified EU directives, as opposed to the other four countries (Greece, Spain, Austria, Croatia), which lacked the implementation of different EU directives at a national level. Particularly Spain, was found to be the country that currently misses the most regulations pertinent to SYNERGY innovation, compared to Greece, Austria and Croatia. It was also shown, that policies related to the introduction of new technologies such as Electronic Identification,

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Authentication and Trust Services (eIDAS), smart contracts & blockchain or ethics in artificial intelligence were missing from almost all demo countries.

During the updating process reported in this deliverable, the Austrian input has been updated to indicate that the eIDAS regulation exists in Austria. Specifically, a central eIDAS node exists, that enables EU citizens to log in to Austrian online applications with the electronic identity (eID) of their EU country of origin.

Similarly, on the Greek Demo Cases (DCs), the eIDAS regulation was originally reported to be missing in Greece. However, it has now been reported that a new regulation on digital governance, including all aspects of eIDAS, has been released in September 2020. Regarding the Croatian DC21, a correction was made to indicate that eIDAS is not missing at a national level and more specifically, starting in September 2018, a Croatian eIDAS node has been established and put into full function. As such the National Identification and Authentication System (NIAS) national authorization services were made compliant with eIDAS at that time. Regarding the Spanish DCs, an update has been provided to indicate that all regulations that were missing during the first round of the questionnaires, are now in place. Additionally, an update has been provided in the relevance of the Energy consumers rights (particularly DC 9, 10, 11, 12), since the Spanish demo site is focused in a rural community area with real customers. Finally, on the Austrian DCs 13 to 16 the Energy communities' legislation has been updated as a currently existing legislation since the Renewable Energies Expansion Act has been adopted.

Finally, within the context of this deliverable, an additional analysis has been performed to get the partners' feedback on an upcoming regulation regarding the Artificial Intelligence Act, that has been recently proposed aiming to lay down harmonised rules on artificial intelligence. The results from the iterative process showed that most of the demo cases fall under the category that poses low or minimal risk regarding the use of AI. DCs 12 and 17 have not been indicated as any of the three categories meaning that these DCs either do not use any AI systems or their use falls under the category of no risk. None of the DCs fall under the unacceptable risk category, however, DCs 1,2,4,5,6, 9, 10, 11, 12, and 21 fall under the category of high-risk AI systems.

Following a similar methodology, a state-of-the-art analysis on socio-economic and organizational aspects related to Innovative Energy Services (IES) evaluated by SYNERGY during the development of D2.3, revealed a plethora of such potential obstacles that could affect, in various degrees, the realization of the project's objectives, both at a prototyping and a market replication level. In this direction, D2.3, comprehensively presented a relevant literature review, offering valuable insights, based on the experience acquired through previous prominent research studies. This literature review has been reviewed and updated for the current version of the deliverable.

Although, naturally, different barriers apply to different demo cases, some barriers were repeatedly highly ranked by the different demo partners of the same country, potentially verifying a common understanding at a national level. i) Neglecting the value of system flexibility in Greece, Austria and Finland, ii) Concerns on the conversion process of innovation into "business as usual" in Spain, iii) Lack of consideration for diversity of interests in Finland, iv) lack of Capital Expenditure (CAPEX) sponsorship for investments in Croatia, are some of those examples. This ranking has been confirmed during the updating process for this deliverable.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

On the organizational level, identifying the most important organizational barriers for each individual partner can be mostly exploited in the direction of driving implementation decisions for the SYNERGY platform and elaborating on the way the different demonstration cases will need to be implemented and validated, so as that obstacles are removed (e.g. through hybrid approaches combining real-life demonstrations with simulation, or through proceeding with the obtainment of special permit and approvals by local or national authorities for the conduction of the SYNERGY demo cases in the form of research experiments). Although, cross-evaluation of barriers scores is not the main objective in this level, some barriers were commonly highlighted in the results of D2.3 across almost all organizations. Such barriers, as resulting from the second survey conducted amongst the partners during the development of the current deliverable are i) the lack of data governance in place to identify the value in vast data quantities generated, ii) the lack of compatibility of multi-source data and iii) inability to deal with overly complex data and models promoted in platforms like the one envisaged by SYNERGY.

In the previous version of this deliverable (D2.3) our socio-economic and organizational analysis showed that a number of issues exist that are particularly related to the perception of the value that data sharing and data analytics can bring to organizations and their customers via the utilization of currently unused data, either by increasing internal business intelligence or by enabling the provision of innovative energy services.

During the updating process, the analysis showed that only 3 out of 11 partners indicated any change in their responses (VERD, EPA, EEE) for both the socioeconomic and organisational barrier questions. With regards to the demo cases, for the socioeconomic barriers 16 of the 21 demo cases indicated no change in any of the questions and 13 of the 21 demo cases indicated no change for the organisational barriers. With regards to the responses that did indicate a change in impact rating in the second iteration, out of the 65 questions, 42 changed in score by 1 point on the 5-point Likert scale. The other 23 question responses changed by 2 points; to ensure that our platform design encompasses business-wide perspectives and is validated from the whole electricity data value chain, we utilised our tri-level analysis (i.e. partner, stakeholder type, demo country) to formulate new qualitative interviews with business experts from each stakeholder type within SYNERGY consortium (namely TSOs, DSOs, Aggregators/ESCOs, Facility Managers/Urban Planners, RES Operators). This activity concludes T2.2 and the final results will be utilized to feedback to our finalised platform design which will be reported in D2.7 SYNERGY Framework Architecture_v2 due in M24.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

1 Introduction

1.1 Scope of the document

This deliverable presents a thorough analysis on the regulatory and socio-economic obstacles to innovation regarding innovative energy services, data exchanges & synergies and new business models in Europe with a particular focus on the demonstration countries. It provides an updated view after the experience acquired from the prototyping phase of the project and reports on any evolution in the regulatory domain relative to SYNERGY's objectives.

Regarding the regulatory aspect of this work, this document provides a state-of the-art analysis on the current European policies in force (regulations, legislation, rights and guidelines) which relate to all aspects of SYNERGY project's objectives. Through the interaction with the SYNERGY partners by utilizing appropriately formulated questionnaire-based surveys, the deliverable proceeds with highlighting the relevant regulatory framework, currently available or missing at a national level, for the countries that will demonstrate SYNERGY innovative services (namely Greece, Spain, Austria, Finland, Croatia).

On the socio-economic part of the deliverable, stepping on previous experience and relevant literature review, an aggregation of a wide range of obstacles is presented, with the aim to investigate in further detail which of those possibly apply to the demonstrator countries' energy data value chain. Special attention is provided to the inter-organizational obstacles which might be hindering the implementation of SYNERGY objectives, as part of the socio-economic analysis conducted within T2.2. Similar to the regulatory part, all partners of the consortium directly associated with the implementation of the demonstrator activities, were reached through detailed questionnaires with the aim to provide their updated views on the most important relevant barriers against the project's objectives both at a country and an organizational level.

A continuous validation activity that involved a new round of interactions has been carried out, comprising additional interviews with business experts from all stakeholder types within SYNERGY consortium (namely TSOs, DSOs, Aggregators/ESCOs, Facility Managers/Urban Planners, RES Operators).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

1.2 Structure of the document

This document is structured as follows:

Chapter 2 introduces the methodological approach that has been followed throughout this staged deliverable involving the acquiring information strategy through literature review, survey conduction, results analysis, designing of interviews with internal stakeholders and implementation. The mapping between SYNERGY's demo partners and demo cases that has been provided in the previous version of the deliverable is shown here for consistency

Chapter 3 provides a thorough mapping of the current policies and directives as well as strategies at the EU level, which are relevant to SYNERGY's context. Comprehensive summaries for the identified EU policies as well as clear references to their relation with SYNERGY's context is provided. An analysis on the identification of social, economic and organizational barriers to SYNERGY innovation is also presented, facilitating a comprehensive targeting of the considerations to be further analysed through interactions with stakeholders. Any new regulations that have been established since the delivery of D2.3 are hereby presented and analysed.

Chapter 4 is dedicated at reviewing the regulatory domain and its linkages with SYNERGY. All aspects associated with the interaction with the different partners of the consortium, linked to the implementation of the demo cases, as well as with the qualitative and quantitative analysis and conclusions stemming from the results of this interaction, are presented.

Chapter 5 is dedicated at the socio-economic and organizational domain and presents all aspects associated with the interaction between SYNERGY partners, providing qualitative and quantitative insight stemming from the results of this interaction.

Chapter 6 presents the process and the results followed during the internal validation of the effort conducted to verify the quantitative and qualitative analysis of the regulatory and socio-economic domains via the SYNERGY Living Labs (LLs).

Chapter 7 provides the conclusions emerging from the analysis performed in both domains (regulatory and socio-economic) and presents the main updates since the delivery of the previous version of this document (D2.3).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

2 Methodology

This section is dedicated to the presentation of the methodological approach followed throughout the development of this task, with the focus on the processes, tools, dependencies and interactions associated specifically with D2.4.

An illustration of this methodology is provided in Figure 1.

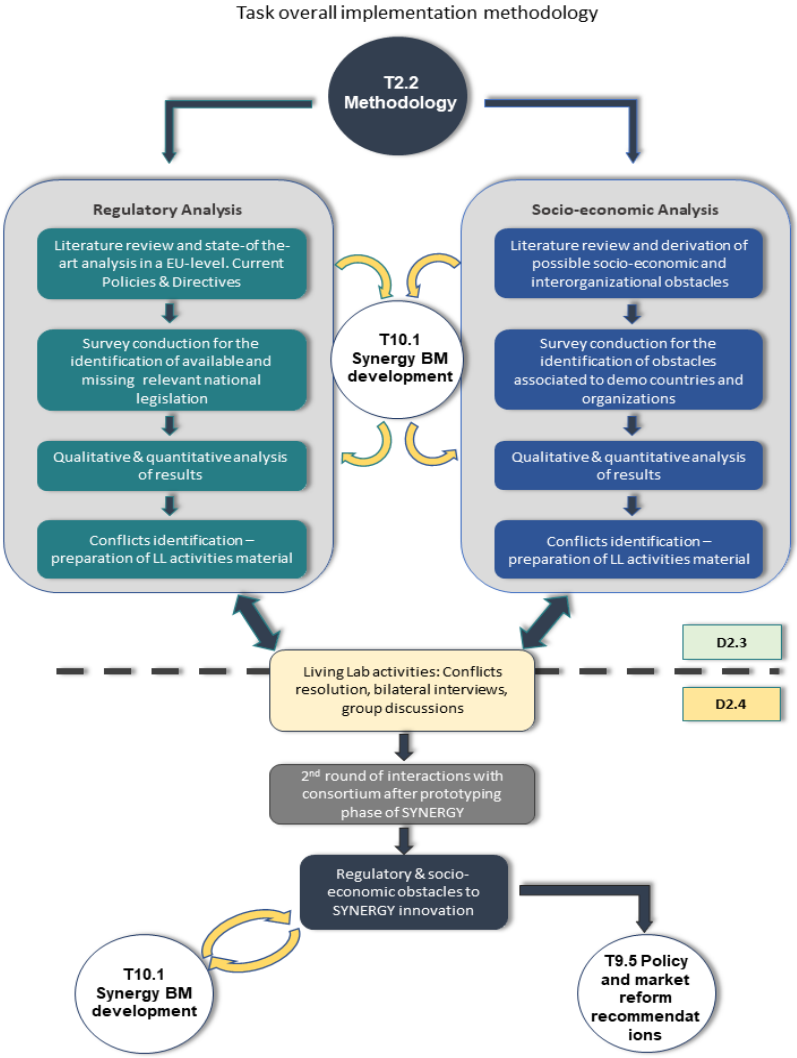


Figure 1 High-level task implementation methodology

The research for the definition of possible barriers to SYNERGY innovation presented in this deliverable, was performed in two complementary domains; the regulatory and the socio-economic domains. Both research directions evolved simultaneously with parallel, yet similar activities. The primary and fundamental action in both research topics was a thorough background literature review. This work provided valuable and necessary findings on top of which the interactive part of this research was established.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

2.1 Regulatory Domain

Initially, a detailed analysis was performed over the 21 different demo cases in order to extract the list of aspects pertaining to the current or anticipated regulatory and legislative framework. Subsequently, a thorough investigation was performed on the current policies and directives at a European level, that are in principle associated with the various objectives and means of realization of the SYNERGY project, thus leading to the derivation of a SYNERGY-specific policies list.

Based on the aforementioned findings, a survey was formulated and conducted amongst the demo partners of the consortium - representing various types of stakeholders in the electricity value chain, with a large geographical and regulatory regime diversity. The aim of this survey was to:

- verify or overthrow the relevance of these EU policies to the different SYNERGY demo cases
- quantify the importance of each regulation/policy in the demo cases they are associated with
- provide currently existing national legislation in all demo countries corresponding to the EU policies and
- identify missing regulatory and legislative framework in all demo countries with respect to the associated EU policies

Ultimately, a regulatory landscape was built, aiming at mapping the European policy and directives with the actual national regulatory regime of each country and enable a wider understanding on immediate steps that need to be undertaken to facilitate innovative energy services and business models that use data exchange in their core and put the end customer in the forefront of the energy transformation.

A quantitative and qualitative analysis was performed on the survey results in order to derive the final list of existing and missing national legislation in the demo countries that are expected to either enable or hinder the realization of SYNERGY innovation inherent to the demo cases. Parallel to the importance of quantification of the different policies across the demo partners, interesting contradictions/conflicts emerged through the qualitative analysis performed.

The results of the aforementioned methodology have been presented in deliverable D2.3.

Within the current deliverable, an updated view on the regulatory landscape is presented, resulting from a thorough review of current policies and directives at a European level, with the aim to add any new or updated regulations in the regulatory landscape built within the context of D2.3.

The second round of interactions with the partners was conducted focusing mostly on the points below:

- Getting feedback on the importance and relevance to the demo cases of the new or upcoming regulations identified after the submission of D2.3
- Updating the views of the partners on the current regulatory framework given their experience from the prototyping phase of the SYNERGY platform and the updated demo cases.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

A questionnaire has been distributed to the partners aiming at capturing feedback from all demo partners on the aforementioned points. The responses to the questionnaire were analysed both in a qualitative and quantitative way and the results are presented in section 4.

2.2 Socio-economic Domain

On the socio-economic domain, the initial step of the research was a state-of-the-art analysis, through a thorough review on literature related to the socio-economic aspects pertained to the main pillars of SYNERGY innovation, namely Innovative Energy Services (IES), Big Data analytics (BDA), data sharing and associated business models (BMs). As a result, a list of identified barriers was compiled addressing socio-economic aspects. In addition to that, an explicit list of barriers was compiled, specifically aiming to identify inter-organizational characteristics across the energy value chain, that potentially constitute hindering factors against SYNERGY's proposed innovation.

A survey was formulated to include and categorize the socio-economic and inter-organizational aspects identified from prominent literature sources on IES, BDA and BMs. The survey was conducted amongst the demo partners of the consortium - representing various types of stakeholders across the electricity value chain with increased diversity over geography and operating regimes. The ultimate aim of this survey was to enable understanding of the existing barriers that relate to the realization of the SYNERGY objectives, rate them accordingly and consider them in the whole SYNERGY design exercise so as to facilitate their overcoming.

Subsequently, similarly to the survey on regulatory aspects, a quantitative and qualitative analysis were performed, through which valuable conclusions were extracted on a country, application (demo case) and organizational level. Nevertheless, apart from directly presentable outcomes stemming from the answers of the consortium participants, the outcomes unveiled interesting discrepancies among the perspectives of the different types of stakeholders which were later utilized as input for the first round of the Living Lab activities related to this task.

The results of the aforementioned methodology have been presented in deliverable D2.3.

For the development of the current deliverable, a survey was designed and circulated to get the partners' feedback and updated views on the socio-economic and organisational barriers identified within D2.3. The survey contained a summary of the results reported in the previous version of the deliverable and the partners were asked to provide their feedback on whether their views on the socio-economic and organisational barriers pertaining SYNERGY remain the same after the first release of the platform and the finalisation of the description of the demo cases.

Again, a qualitative and quantitative analysis of the updated feedback have been performed and was followed-up with a second round of interviews, where further analysis was necessary. The results of this process are presented in section 5.

2.3 Interactions – Dependencies with other tasks

A substantial characteristic of this task's proceedings is the significant correlation and interaction with the SYNERGY business models developing process, which has been growing under WP10 ("*Exploitation and Business Innovation*") and especially within T10.1 ("*New business models driven by data sharing approaches between energy market actors*"). The business models developed in

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

T10.1 define the practical aspects that need to be considered regarding data exchanges as well as the intended value that each organization is expected to gain from the SYNERGY platform.

- The landscaping of the regulatory environment conducted under T2.2 on the one side provides EU-wide and national policy related inputs to the formulation of business models developed in T10.1.
- The socio-economic and inter-organizational analysis on the other side, provide external, customer-related inputs (i.e. pull factors) as well as internal, business strategy-related inputs (i.e. push factors) that are revealed through the analysis of socio-economic and organizational obstacles pertaining to the creation and adoption of data-driven business models.

Throughout T2.2's proceedings, a close collaboration and data exchange between the leading parties of these tasks is undertaken, with the aim to ensure the adaptation of SYNERGY to national regulatory frameworks for the large-scale demonstration under real-life conditions.

T2.2 has also a strong relation with WP9 ("*Dissemination, Communication and Stakeholder Engagement*") and especially with T9.5 ("*Policy and market reform recommendations*"). Specifically, a subsection of T2.2's outcomes, namely the definition of regulatory barriers or gaps, will be the main input of T9.5 which in turn will offer targeted recommendations in order to address such issues and enable a smooth adoption of SYNERGY added value services and business models in real-life energy markets and energy systems operation.

Finally, findings of this deliverable offer invaluable insights to the SYNERGY technical partners, towards prioritizing the development activities and releases of the platform and addressing the key challenges identified by the demo partners and external experts (as part of the Living Lab interviews) with regards to the organizational obstacles' analysis, with the objective to remove any concerns on their side and ensure a barrier-free operation of the platform both during the execution of the project's demonstration activities and beyond (as part of the exploitation period of the project).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

3 Innovative Energy Services, Data Exchanges and new Synergetic Business Models in the EU level: State of the Art Analysis on Regulation and Socio-economic aspects related to data-driven services enabled by data sharing and analytics

3.1 Introduction

Under the traditional top-down business model, power system optimization relied on centralized decisions based on data silos preserved by stakeholders. SYNERGY aims to actively contribute in the transition from this obsolete model to a more synergetic one in which optimization decisions are based on interconnected data assets and collective intelligence. In the same direction, SYNERGY, also aims to offer innovative energy services that will transform energy market decision making and overall participation attitude for all types of relevant stakeholders, by establishing new principles that promote extroversion, collaboration and benefit sharing.

Such transformation will be leveraged through the development of a single platform that will constitute a one-stop shop for all kinds of stakeholders in the energy industry. As such, SYNERGY platform aims to provide a wealth of data, analytics and applications that will rely on data sharing and exchange between the beneficiaries, utilizing smart energy contracts and blockchain technology that will ensure secure and transparent transactions across the Electricity value chain.

SYNERGY will be validated in 5 large scale demonstrators, in Greece, Spain, Austria, Finland and Croatia. These 5 distinct ecosystems, present heterogeneous regulatory, infrastructure, climatic, demographic and cultural characteristics. That, combined with the plethora of demo cases that are under development in these countries, constitute a solid testbed scenery for SYNERGY innovation. Apart from the technical expectations of the project, SYNERGY is aiming to confront and address the regulatory, socio-economic or organizational barriers that exist in various compositions across these countries. To facilitate comprehension of the relevant analysis presented in chapters 4 and 5 respectively, Table 1 to Table 5 present a mapping of demo cases versus involved stakeholders per demonstrator country. The surveys performed and presented in the following chapters were organized in accordance with these tables. The full description of all SYNERGY Demo Cases is given in ANNEX B, and has been updated according to the most recent changes and feedback from the prototyping phase.

Table 1 Mapping of demo cases vs stakeholders for the Greek demonstrator

Demo country	DC	Description	Stakeholder map			
			TSO	DSO	Energy Retailer	Aggr/tor
	1	Innovative Flexibility-based Network Management	ipto	HEDNO	ΦΥΣΙΚΟ ΑΕΡΙΟ	verd
	2	Common Operational Scheduling of power grids	ipto	HEDNO	ΦΥΣΙΚΟ ΑΕΡΙΟ	verd

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo country	DC	Description	Stakeholder map			
			TSO	DSO	Energy Retailer	Aggr/tor
GRC	3	Enhanced Network Asset Management and Planning (Lead: HEDNO-IPTO)	ipto	HEDNO		
	4	Retailer portfolio analytics and elasticity (price-based flexibility) estimation for the provision of services to network operators		HEDNO	ΦΩΣΦΩΣ ΔΕΡΙΟ	
	5	Flexibility segmentation, classification and clustering towards VPP configuration for demand response	ipto	HEDNO		verd
	6	Local Flexibility Sharing for Self-Consumption Optimization at Local Community Level				verd

Table 2 Mapping of demo cases vs stakeholders for the Spanish demonstrator

Demo country	DC	Description	Stakeholder map			
			DSO	Energy Retailer	RES Operator	Aggr/tor
	7	Enhanced PV Plant Asset Management			cobra	
	8	Advanced RES Forecasting for improved market positioning and optimized flexibility activation for the provision of services to network operators			cobra	URBENER
		Optimizing Power Purchase Agreement between RES		Cuerva	cobra	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo country	DC	Description	Stakeholder map			
			DSO	Energy Retailer	RES Operator	Aggr/tor
ESP	9	Operators and Electricity Retailers, towards Greening Electricity Supply and reducing associated tariffs and costs				
	10	Transformation of the Retailer business model from Commodity to EaaS providers for the implementation of energy efficiency campaigns	Cuerva	Cuerva		
	11	Enhanced Distribution Network Asset Management and Reinforcement	Cuerva			
	12	Innovative Flexibility-based Distribution Network Management	Cuerva			URBENER

Table 3 Mapping of demo cases vs stakeholders for the Austrian demonstrator

Demo country	DC	Description	Stakeholder map			
			DSO	Aggr/tor	Tech Provider	Retailer
AUT	13	Innovative Flexibility-based Distribution Network Management	Energie Güssing		energy services	
	14	Local Energy System Optimization and Enhancement of Security of Supply through Islanding	Energie Güssing		energy services	
	15	Flexibility segmentation, classification and clustering towards VPP configuration for flexibility activation and explicit demand response	Energie Güssing		energy services	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo country	DC	Description	Stakeholder map			
			DSO	Aggr/tor	Tech Provider	Retailer
	16	Local Flexibility Market for network services and self-consumption through blockchain-enabled smart contract establishment and handling				

Table 4 Mapping of demo cases vs stakeholders for the Finnish demonstrator

Demo country	DC	Description	Stakeholder map	
			Facility Manager	Urban Planner
FIN	17	Optimized Urban Energy Performance Monitoring and Optimization	Caverion	FORUM VIRIUM HELSINKI
	18	Advanced Urban Planning for long-term sustainability targets realization	Caverion	FORUM VIRIUM HELSINKI
	19	Evidence-based renovation support for optimized and accurate energy-efficient design of buildings	Caverion	FORUM VIRIUM HELSINKI
	20	Holistic Real-time Facility Energy Management Optimization	Caverion	FORUM VIRIUM HELSINKI

Table 5 Mapping of demo cases vs stakeholders for the Croatian demonstrator

Demo country	DC	Description	Stakeholder map	
			ESCO	Facility Manager
HRV	21	Self-Consumption Optimization for Energy Poverty Alleviation and Sustainable Local Energy Communities	ponikve.krk EKO OTOK KRK	ponikve.krk EKO OTOK KRK

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

3.2 Regulatory Framework – Current policies and directives

This chapter provides the analysis of the regulatory and legislation context that is related to the innovative services, data exchanges and other actors' synergies across the electricity data value chain. The analysis will be based on both state-of-the-art review at the EU level and knowledge acquired from the five pilots of the SYNERGY project. These two approaches are complementary with each other as they are addressing both EU level and national level to come to safe conclusions.

The main objective of this chapter is to enlighten the status of the regulations and legislations at both EU and national level. Under this analysis, the main barriers/ omissions for implementing innovative services related to data management/exchange will be highlighted.

The integrated electricity system ecosystem suggests different active actors throughout the energy value chain. Different actors that interact with each other assume vast amounts of data with different characteristics that need to be processed, analysed and exchanged. Under this reality, different issues arise related to how data should be managed, protected or exchanged.

Under this prism, different regulations and directives that affect the SYNERGY deployment and the realization of the project's demo cases are overviewed. They can be categorised as follows and graphically shown in Figure 2:

- The horizontal applied regulations that affect the whole energy value chain and all directives/regulations are following i.e. Regulation on the Governance of the Energy Union.
- The vertical applied regulations that act as facilitators through the value chain and can be either linked to technologies, applications or concepts.
- The hierarchical approach regulations that are under the horizontal regulations and facilitated by the vertical ones. These are applied in different levels of the power system and value chain.

Vertically applied regulations are of utmost importance as they may affect the whole chain and the interactions among the actors. GDPR is of great significance as out of all directives is the one that affects the whole chain. Especially for the SYNERGY project and the demo cases has a great impact as it directly affects the objectives of the project in sharing and storing securely and efficiently the data coming from the different actors of the electricity data value chain. In the following subsections, the related EU regulation is quoted.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

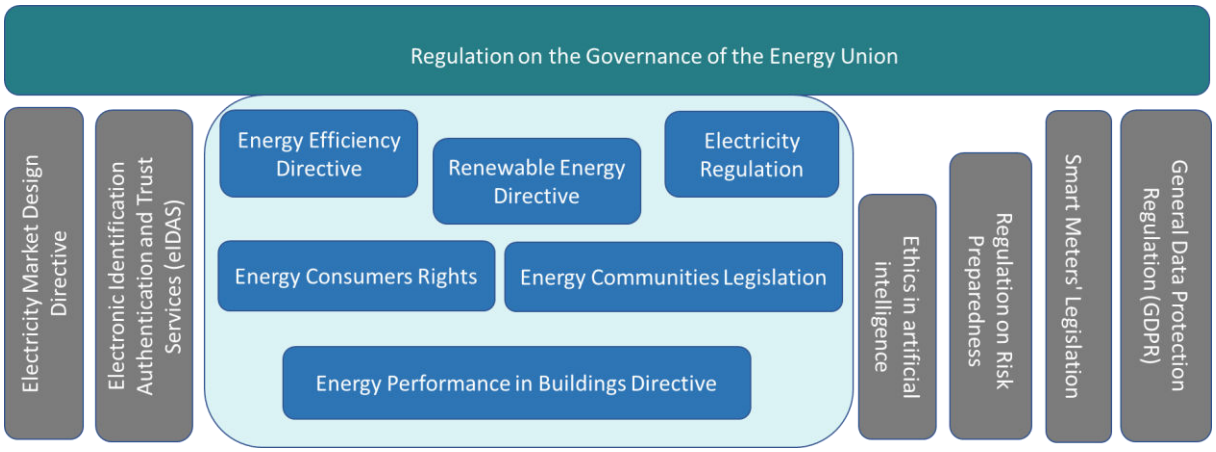


Figure 2 Regulations and Directives that enable SYNERGY demo cases

3.2.1 Horizontally Applied Regulations

3.2.1.1 Regulation on the Governance of the Energy Union

This regulation is under the horizontal approach category as it ensures that the objectives of the Energy Union, especially the EU's 2030 energy and climate targets will be achieved by setting out a political process defining how EU countries and the Commission work together, and how individual countries should cooperate, to achieve the Energy Union's goals (e.g. reduction of 40% of greenhouse gas emissions, a minimum of 32 % renewables in the EU energy mix etc.) (Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, 21.12.2018, p. 1–77).

3.2.2 Vertically Applied Regulations

3.2.2.1 Regulation on Risk Preparedness

This regulation focuses on the internal electricity market which establishes regional operating centres in order to facilitate cross-border management of the electricity grid and cooperation of transmission system operators. The proposed regulation on risk-preparedness further details the role of the regional operating centres in case of an electricity crisis (2005/89/EC, 14.6.2019, p. 1–21).

3.2.2.2 General Data Protection Regulation (GDPR)

With respect to smart metering and all the data collected from the electricity data value chain stakeholders that are characterized as confidential or private (also focusing on information collected from prosumers and are of personal nature), the processing may be based on various purposes such as the improvement of energy efficiency, metering accuracy, customer information, grid stability, as well as timely billing etc. Therefore, the data collected by smart meters and from other sources of the integrated electricity data value chain could be legitimately processed for different purposes and, as a consequence, might be subject to different restrictions of processing and transmission (Protection, 04.05.2016, pp.1-99).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

3.2.2.3 Smart Meters' Legislation

Smart metering legislation (and underlying infrastructure) is possibly one of the most important enablers out of the vertical applied regulations of the energy transformation in a European and worldwide level. Its development is associated with the liberation and realization of a number of innovative services. The recording of measuring data in intervals of 15 minutes is currently being discussed at the European level, as well as in many of the Member States. From such detailed metering data precise graphs of the actual consumption can be easily drawn up (Trieb, Volume 1, Issue 2, May 2011, Pages 121–128).

3.2.2.4 Electronic Identification Authentication and Trust Services for Electronic Transactions in the Internal Market and Repealing Directive (eIDAS)

The Regulation aims to enhance trust in electronic transactions between businesses, citizens and public authorities by providing a common legal framework for the cross-border recognition of electronic ID and consistent rules on trust services across the EU. The main aspects addressed by eIDAS are:

- Trust service: an electronic signature, electronic seal, electronic time stamp, electronic registered delivery service or website authentication certificate, designed to show that electronic data is authentic and can be trusted.
- Qualified trust service: a trust service that meets extra authentication and security standards and is offered by a 'qualified' provider.
- Trust service provider: any organization providing trust services.
- Qualified trust service provider: an organization providing qualified trust services and granted qualified status by the ICO.

3.2.2.5 Electricity Market Design Directive

The Electricity Market Design Directive introduced a fair deal for consumers and focused on defining new rules for the wholesale and retail energy markets functioning, while promoting consumer empowerment to participate in energy markets through Demand Response in an effort (among others) to also fight energy poverty around the EU. (DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal market in electricity 30.11.2016, pp1-124)

3.2.2.6 Ethics in artificial intelligence

The guidelines contained in this regulatory text, are addressed to all AI stakeholders designing, developing, deploying, implementing, using or being affected by AI in the EU, including companies, researchers, public services, government agencies, institutions, civil society organizations, individuals, workers and consumers (EU guidelines on ethics in artificial intelligence: Context and implementation Service, European Parliamentary Research, 2019, pp1-13).

Under this broad category, smart contracts and blockchain aspects that are of high relevance with SYNERGY are additionally included.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Smart legal contracts are contracts on a blockchain that represent (or aim to represent) a legal contract (or a contract with legal implications), which are artefacts/constructs based on smart technology, for instance in the form of digital assets, or decentralized autonomous organizations (DAOs) or other kinds of autonomous agents (Legal and regulatory framework of blockchains and smart contracts, 2019, pp1-38).

This reference document highlights that, no specific regulation is in force with regards to Smart Contracts and Blockchain at EU level; nevertheless, it provides the following important aspects and considerations which are relevant to SYNERGY:

- The decentralisation, pseudonymise/anonymity, immutability and automation that are inherent characteristics of blockchain can perplex regulation and legal aspects as well.
- Regulators are best positioned to choose appropriate regulatory approaches and provide guiding principles to attract private-sector investors, ensure consumer protection and citizens' rights, and provide safeguards against anticompetitive practices as long as a mature blockchain market is built.
- Individual approaches that are adopted by regulators, by means of national law and their interpretation need to be harmonised across the EU.
- Closely monitor developments in less mature use cases and encourage self-regulation where appropriate.

3.2.3 Hierarchical Applied Regulations

3.2.3.1 Renewable Energy Directive

The Renewable Energy Directive establishes an overall policy for the production and promotion of energy from renewable sources in the EU aiming at the increase of renewable energy use in Europe. The original version of this document sets as target the following: At least 20% of EU total energy needs is fulfilled with renewables by 2020. All EU countries must also ensure that at least 10% of their transport fuels come from renewable sources by 2020. In December 2018, the revised renewable energy directive 2018/2001/EU entered into force, as part of the Clean energy for all Europeans package. As such, it sets a new, binding, renewable energy target for the EU for 2030 of 32%, including a review clause by 2023 for an upward revision of the EU level target (Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable, 21.12.2018, p. 82–209, 2018).

3.2.3.2 Energy Consumers Rights

The hierarchically applied regulations usually affect only one type of actors of the chain. Yet, energy consumers rights are quite important as the horizontal regulations and the energy transition goals of the EU imply that the energy consumer is at the middle of the chain and valorizes the effort of system decarbonization. So, as the role of the active consumer emerges, their clear role definition and their rights need to be highlighted. Under this prism, the Commission has summarized the ten main European Energy Consumers' Rights established under EU law:

1. Right to have your home connected to the local electricity network
2. Choice of supplier from full range of EU suppliers offering their service in your area

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

3. Easy and fast switch of supplier (changes to take place within three weeks of request)
4. Clear contract information and right of withdrawal
5. Accurate information on consumption (including competitively priced individual meters for electricity and gas in all new, or extensively renovated, buildings)
6. Information on how to use energy more efficiently (including the EU energy label) as well as the benefits of renewables to be provided by all energy suppliers
7. Vulnerable consumers to be identified and measures put in place to protect them
8. Easy resolution of complaints or disputes (including an independent out-of-court dispute settlement body and not only through legal channels)
9. Energy performance certificate for every home to buy or rent
10. Single national contact point for energy, consumer rights set out in national laws (Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable, 21.12.2018, p. 82–209, 2018)

3.2.3.3 Energy Performance in Buildings Directive

The Directive aims at improving energy efficiency in buildings and encourages building renovation. This is of high importance as the energy consumption in buildings comprise over 40% of the total EU stock. This fact makes them an excellent active actor of the smart grids for enabling services and supporting the grid. Decarbonizing the existing, highly inefficient European building stock is one of its long-term goals. It promotes cost-effective renovation work, introduces a smartness indicator for buildings, simplifies the inspections of heating and air conditioning systems and promotes electro-mobility by setting up a framework for parking spaces for electric vehicles (Directive 2018/844/EU of the European Parliament and of the Council on the energy performance,2018, p. 13–35).

3.2.3.4 Electricity Regulation

It aims to make the electricity market fit for flexibility, decarbonization and innovation by providing for undistorted market signals, revises the rules for electricity trading, clarifies the responsibilities of the market participants, and defines principles for assessing capacity needs and for market-based capacity mechanisms (e.g. All market participants should take responsibility for balancing of supply and demand in the grid, The proposal sets out a process for defining regional electricity markets (bidding zones) (REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal market for electricity, 23.2.2017, pp1-32).

3.2.3.5 Energy Communities Legislation

The Energy Community (EC) is a city-wide cooperative with the sole purpose of promoting social -solidarity economy and innovation in energy sector. The concept aims at tackling energy poverty while promoting energy sustainability through RES production, storage and self-consumption at the same time. This way, the energy efficiency in local and regional use is increased through the activation of Renewable Energy (RES) and optimal cooperation of different carriers i.e Cogeneration and Heat Efficiency (CHP), thermal gas and transport (Law on Energy communities,2018, pp 1-20).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

3.2.3.6 Energy Efficiency Directive

The Revised Energy Efficiency Directive, setts a binding 30% EU energy efficiency target for 2030 through (among others) consumer awareness, behavioural change and participation in Demand Response transactions (Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency).

Table 6 presents a mapping between the identified regulations and the references on why a regulation was included in the questionnaire.

Table 6 Regulatory barriers questionnaire.

Question number	Question	Reference
RE-Q1	Regulation on the Governance of the Energy Union	(Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, 21.12.2018, p. 1–77)
RE-Q2	Regulation on Risk Preparedness	(2005/89/EC, 14.6.2019, p. 1–21)
RE-Q3	General Data Protection Regulation (GDPR)	(Protection, 04.05.2016, pp.1-99).
RE-Q4	Smart Meters' Legislation Identification	(Trieb, Volume 1, Issue 2, May 2011, Pages 121–128).
RE-Q5	Electronic, Authentication and Trust Services (eIDAS)	
RE-Q6	Electricity Market Design Directive	(DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal market in electricity 30.11.2016, pp1-124)
RE-Q7	Ethics in artificial intelligence	(EU guidelines on ethics in artificial intelligence: Context and implementation Service, European Parliamentary Research, 2019, pp1-13), (Legal and regulatory framework of blockchains and smart contracts, 2019, pp1-38).
RE-Q8	Renewable Energy Directive	(Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable, 21.12.2018, p. 82–209, 2018)
RE-Q9	Energy Consumers Rights	(Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Question number	Question	Reference
		the use of energy from renewable, 21.12.2018, p. 82–209, 2018)
RE-Q10	Energy Performance in Buildings Directive	(Directive 2018/844/EU of the European Parliament and of the Council on the energy performance,2018, p. 13–35)
RE-Q11	Electricity Regulation	(REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal market for electricity, 23.2.2017, pp1-32)
RE-Q12	Energy Communities Legislation	(Law on Energy communities,2018, pp 1-20).
RE-Q13	Energy Efficiency Directive	(Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency)

3.2.3.7 Additional Regulation to be considered in the project

It has to be mentioned that SYNERGY, as an online data analytics and data sharing platform, is obliged to comply with some regulations. Particular focus is placed on the "Regulation laying down harmonised rules on artificial intelligence (Artificial Intelligence Act)" since SYNERGY on its core uses machine learning and artificial intelligence (AI) software tools and control systems to unlock valuable insights and drive operational efficiencies. Additionally focus is also placed on "A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives" since changes on building requirements might affect pilot installation and operation activities. The AI regulation has been proposed in April of 2021 where the Renovation wave has been introduced in October of 2020. Therefore, the two regulations have been included as an update to this deliverable.

1. Regulation laying down harmonised rules on artificial intelligence (Artificial Intelligence Act)

The EU Commission, on 21st of April, 2021 adopted a proposal for a regulation in an effort to regulate "artificial intelligence systems (AI)" that establishes an adequate, well functioned regulatory framework which will allow scientific innovation to benefit human's lives without infringements of any basic rights that we all have agreed upon. An AI system is a fast-evolving family of technologies that, for a given set of human-defined objectives, can bring a wide array of economic and societal benefits across the entire spectrum of industries and social activities, provided that it captures software embodying machine learning, rule-based AI approaches, and also traditional statistical techniques.

The proposal sets a robust and flexible legal framework that instead of opting for a blanket regulation covering all AI systems, it puts in place a proportionate regulatory system centred on a well-defined risk-based regulatory approach consisting of three tiers: (i) unacceptable risk,

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

(ii) high risk, (iii) low risk. Unacceptable risk refers to AI systems that violate fundamental rights, manipulate persons through subliminal techniques beyond their consciousness, or exploit vulnerabilities of specific vulnerable groups. This also includes AI systems that use 'real time' remote biometric identification in publicly accessible spaces for the purpose of law enforcement. High risk refers to AI systems intended to be used as a safety component of products that are subject to third party ex-ante conformity assessment. This also includes other stand-alone AI systems with mainly fundamental right implications. Low risk refers to AI systems not likely to pose high risks on the fundamental rights and safety as defined by the EU.

The use of unacceptable-risk AI systems is simply banned. Specifically, the regulation bans AI systems that contravene with Union values, such as causing or are likely to cause "physical or psychological" harm using "subliminal techniques" or by exploiting vulnerabilities of a "specific group of persons due to their age, physical or mental disability." The focus of the regulation are the high-risk AI systems, which are heavily regulated by being subject to extensive technical, monitoring and compliance obligations. Those AI systems will have to comply with a set of horizontal mandatory requirements for trustworthy AI where the providers and users of high-risk AI systems have to comply with rules on data and data governance; documentation and record-keeping; transparency and provision of information to users; human oversight; and robustness, accuracy and security. Certain systems in the low-risk category are lightly being regulated by being subject to transparency obligations. Specifically, the low-risk category is encouraged to self-regulate by implementing codes of conduct for instance by adopting some of the requirements that are imposed on high-risk AI systems [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206].

2. A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives

The Renovation Wave Strategy published by the European commission in 14 October 2020 aims to propose stronger regulations, standards and information on the energy performance of buildings to set better incentives for public and private sector renovations. The motivation behind this strategy is the fact that the building sector is one of the largest energy consumers in Europe, responsible for more than one third of the EU's emissions. The renovation wave strategy aims to at least double renovation rates in the next ten years since refurbished and improved building stock in the EU will help pave the way for a decarbonised and clean energy system along with enhanced quality of life for people living in and using the buildings.

It is therefore urgent for the EU to focus on how to make our buildings more energy-efficient, less carbon-intensive over their full life-cycle and more sustainable. As such this strategy aims to put 'Energy efficiency first' as a horizontal guiding principle of European climate and energy governance and beyond, to make sure we only produce the energy we really need. Following affordability will make energy-performing and sustainable buildings widely available. Additionally, building renovation should speed up the integration of renewables in particular from local sources, helping to decarbonise transport as well as heating and cooling. Life-cycle thinking and circularity will minimise the footprint of buildings, for example through the promotion of green infrastructure and the use of organic building materials that can store carbon, such as sustainably-sourced wood. This strategy also aims to set high health and environmental standards such as ensuring high air quality, good water management, disaster prevention and protection against climate-related hazards, removal of and protection against harmful substances such as asbestos and radon, fire and seismic safety. Additionally, it aims at

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

tackling the twin challenges of the green and digital transitions together where smart buildings can enable efficient production and use of renewables at house, district or city level. All these will be achieved by respecting aesthetics and architectural quality.

The renovation wave initiative will build on measures agreed under the 'Clean energy for all Europeans' package that will be considered in the 2021 revisions of the Renewable Energy and Energy Efficiency Directives and the EU ETS, the application and further development of eco-design and labelling measures, as well as support to district approaches. Specifically, all the aims proposed by the strategy will be achieved by strengthening information, legal certainty and incentives for public and private owners, by providing funding tools, by attracting private investment and stimulating green loan financing, and by scaling up technical assistance to make it closer to regional and local actors [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0662].

3. **EU Regulation on fairness and transparency in online platform-to-business relationship.**

This entered into force in July 2019, is the first-ever set of rules creating a fair, transparent and predictable business environment for smaller businesses and traders on online platforms. With this regulation, the Commission delivers on this commitment to take actions on unfair contracts and trading practices in platform-to-business relations. [Regulation (EU) 2019/1150 of the European Parliament and of the Council of 20 June 2019 on promoting fairness and transparency for business users of online intermediation services, p. 57–79].

4. **Recommendation on measures to effectively tackle illegal content online**

Online platforms need to be more responsible in content governance. The recommendation proposes a common approach to quickly and proactively detect, remove and prevent the reappearance of illegal content online [Commission Recommendation of 1.3.2018 on measures to effectively tackle illegal content online (C (2018) 1177 final)].

5. **Digital Services Act package**

As part of the European Digital Strategy, the European Commission has announced a Digital Services Act package to strengthen the Single Market for digital services and foster innovation and competitiveness of the European online environment.

6. **Algorithmic transparency**

At the request of the European Parliament, the Commission is carrying out an in-depth analysis of algorithmic transparency and accountability. The pilot project will provide an in-depth study of the role of algorithms in the digital economy and society. In particular, how they shape, filter or personalise information flows. This is far from forming a regulatory context but by the end of this study, useful insights on the platforms' operation shall be obtained.

7. **The e-commerce Directive**

It establishes harmonised rules on issues such as:

- transparency and information requirements for online service providers,
- commercial communications,
- electronic contracts and limitations of liability of intermediary service providers.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

[Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market]. This Directive has been updated by the Digital Act Services package.

8. **Smart contracts**

In addition, it is of the interest of SYNERGY to address the regulatory issues referring to the implementation of **Smart Contracts** (based on DLT/ blockchain technologies), around the EU, in an effort to legitimately address the data sharing (and associated data contracts) functions introduced in the SYNERGY project. Smart legal contracts are contracts on a blockchain that represent - or aim to represent - a legal contract as well as smart contracts with legal implications, which are artefacts/constructs based on smart technology that clearly have legal implications, for instance in the form of digital assets, or decentralized autonomous organizations (DAOs) or other kinds of autonomous agents (Legal and regulatory framework of blockchains and smart contracts, 2019, pp1-38). Even though no specific regulation is in force with regards to Smart Contracts and Blockchain at EU level it is important to highlight at this point the main legal-related issues that need to be tackled and addressed by upcoming regulations and, as SYNERGY, to provide specific recommendations on how we are addressing them as part of our project activities.

Overall, these regulations may be independent to the demo cases, however, they apply horizontally over the core big data platform and data sharing developments that will be delivered by the project. In this context, they have not been subject of the survey conducted with the demo partners, but still remain relevant and are briefly analyzed in relation to the project in the next chapter.

3.3 Socio-economic and organizational considerations

In the context of D2.3, the purpose of this sub-chapter has been to review the current literature to identify the potential socio-economic and organizational obstacles to the implementation of innovative technologies and business models. The focus of this review included investigating factors related to socioeconomics, IES, business models and big data analytics.

3.3.1 Review of the socio-economic and organizational barriers for innovative energy services, business models and data analytics

The same socioeconomic and organisational barriers which were identified in the literature review conducted as part of the first iteration of task T2.2 (for full details see D2.3) were used in the second iteration.

A summary of these barriers is displayed in Table 7 and Table 8.

Table 7 Summary of socio-economic barriers identified in the literature review of D2.3

Socioeconomic Barrier	Reference
Upfront costs (CapEx) for implementing innovative energy services (e.g. smart meters, smart appliances, etc.)	(Russom, 2011)

Socioeconomic Barrier	Reference
Lack of financial support/business sponsorship to deal with CapEx	(Russom, 2011)
Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	(Clegg & Mancarella, 2015)
Increased risks and lack of hedging strategies for the viability of Energy Performance Contracting	Boroumand, Goutte, Porcher & Porcher, 2015
Lack of holistic regulatory framework that fosters innovation providing whole system benefits (e.g. no mechanisms for trading and remunerating flexibility)	Lennon et al. 2019
Lack of equal opportunities for all parties with regards to investing and the benefits of generated wealth	Lennon et al. (2019) (Hertel and Menrad, 2016)
Concerns for the process of moving innovative energy services into "business as usual"	(Kane & Ault, 2014)
Lack of a true participation from ALL actors in the energy chain (e.g. is there a clear pathway for consumer/prosumer representation through aggregation and are there viable business cases for aggregation in existence)	Lennon et al. (2019) Cohen et al., 2014; Enevoldsen & Sovacool, 2016
Lack of belief from consumers/prosumers in the narrative of empowerment described in the SYNERGY project, i.e. instead they believe 'empowerment' is not a consumer/prosumer focussed initiative and is in fact merely a tool to promote business agendas	(Lennon et al., 2019; Wright et al., 2006) (Newell & Mulvaney, 2013)
Insufficient understanding of the risks versus potential of financial benefits of innovate energy services in contrast to commodity sales	Raisbeck, 2008; Barlow and Köberle-Gaiser, 2008ab; Stephens & Jiusto, 2010
Lack of robust auditing procedures and/or lack of penalties of non-compliance with energy efficiency obligations resulting in reluctance to switch to innovative energy services	Fleiter, Schleich & Ravivanpong, 2012
Lack of sustained commitment due to innovative energy services being introduced in stages over a long period	(Kornmeier, 2008; Rogers, 2010, Pohl, 1996)
Lack of trust between local users/consumers and professional stakeholders (e.g. DSO/TSO)	(Huijts et al., 2012) Walker et al., 2010

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Socioeconomic Barrier	Reference
Perceived lack of democratic legitimacy within the energy system (e.g. lack of; a clear cost of infrastructure and operations framework, stakeholder engagement, communication between utilities and consumers)	Peter 2007 and 2009
Lack of clarity with regards to profit and losses from innovative energy services (e.g. lack of regulatory and national planning, lack of clear pathways to innovation adoption)	Lennon et al., 2019
Lack of consideration towards diversity of interests from various stakeholders in new innovative energy services	Lennon et al., 2019; (Alexander et al., 2013; Firestone et al., 2012). Rogers et al., 2008; Goedkoop & Devine-Wright, 2016
Lack of awareness from consumers towards flexibility, opportunity, cost saving and revenue generation	Lennon et al. (2019) Cohen et al., 2014; Enevoldsen & Sovacool, 2016
Exclusion of societal groups (e.g. vulnerable groups such as elderly) due to lack of knowledge, capability or access to innovative energy services	Wagner et al., 2016
Perception that the energy system is vulnerable to cyber-attack or data security issues	(Lorie, 2014)

Table 8 Summary of organisational barriers identified in the literature review of D2.3

Organizational Barrier	Reference
Lack of agency in the business (e.g. Lack of ownership of building and/or supply equipment)	Olsthoorn et al. (2017)
Lack of appropriate systems or professionals to recognise data value	Olsthoorn et al. (2017)
Lack of energy management personnel/management systems	Olsthoorn et al. (2017)
Lack of skilled professionals for combining energy data	Russom (2011)
Lack of knowledge and familiarity with renewable energy systems	Olsthoorn et al. (2017)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Organizational Barrier	Reference
I.T. infrastructure insufficient for data processing and storage	Zhou et al. (2016)
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Zhou et al. (2016)
Lack of compatibility of multi-source data	Zhou et al. (2016)
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Zhou et al. (2016)
Reluctance to adopt new business models (inertia) in favour of current model	Hughes (1993) Geels et al. (2008)
Focus placed on daily operations leading to neglection of value of external data	Günther et al. (2017)
Data Interoperability not being perceived as an important issue	Günther et al. (2017)
Reluctance to abandon closed ICT systems	Zhou et al. (2016)
Perception that sharing data means data leaving premises	Zhou et al. (2016) Khurana, Hadley, Lu and Frincke (2010)
Concerns over GDPR and associated penalties	Khurana, Hadley, Lu and Frincke (2010)
Lack of knowledge with regards to new secure data sharing technologies	Khurana, Hadley, Lu and Frincke (2010)

3.3.2 Formulation of questionnaires on socioeconomic and organisational barriers

The barriers investigated in the socioeconomic and organisational domains are displayed in Table 9 and Table 10, respectively. To investigate if the impact of these individual barriers had changed since the first iteration, partners were sked to indicate which barriers they felt had changed and to provide both a new impact score on the same scale of 1 – 5 (1 = Not impactful, 5 = Very impactful) and provide an explanation for the change in rating.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Table 9 Socio-economic barriers questionnaire

Question number	Barrier	Question (Short version)
Q1	Upfront costs (CapEx) for implementing innovative energy services (e.g. smart meters, smart appliances, etc.)	CapEx
Q2	Lack of financial support/business sponsorship to deal with CapEx	No sponsorship for CapEx
Q3	Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	Neglecting value of system flexibility
Q4	Increased risks and lack of hedging strategies for the viability of Energy Performance Contracting	Energy performance contracting risk
Q5	Lack of holistic regulatory framework that fosters innovation providing whole system benefits (e.g. no mechanisms for trading and remunerating flexibility)	No holistic regulatory framework
Q6	Lack of equal opportunities for all parties with regards to investing and the benefits of generated wealth	Lack of equal opportunities in wealth
Q7	Concerns for the process of moving innovative energy services into “business as usual”	Converting innovation into business as usual
Q8	Lack of a true participation from ALL actors in the energy chain (e.g. is there a clear pathway for consumer/prosumer representation through aggregation and are there viable business cases for aggregation in existence)	No true participation for all actors
Q9	Lack of belief from consumers/prosumers in the narrative of empowerment described in the SYNERGY project, i.e. instead they believe ‘empowerment’ is not a consumer/prosumer focussed initiative and is in fact merely a tool to promote business agendas	No belief in consumer empowerment
Q10	Insufficient understanding of the risks versus potential of financial benefits of innovate energy services in contrast to commodity sales	Understanding financial risk vs potential
Q11	Lack of robust auditing procedures and/or lack of penalties of non-compliance with energy efficiency	Lack of auditing procedures

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Question number	Barrier	Question (Short version)
	obligations resulting in reluctance to switch to innovative energy services	
Q12	Lack of sustained commitment due to innovative energy services being introduced in stages over a long period	No sustained commitment
Q13	Lack of trust between local users/consumers and professional stakeholders (e.g. DSO/TSO)	Lack of trust
Q14	Perceived lack of democratic legitimacy within the energy system (e.g. lack of; a clear cost of infrastructure and operations framework, stakeholder engagement, communication between utilities and consumers)	Perceived lack of democratic legitimacy
Q15	Lack of clarity with regards to profit and losses from innovative energy services (e.g. lack of regulatory and national planning, lack of clear pathways to innovation adoption)	Lack of clarity in profit & loss
Q16	Lack of consideration towards diversity of interests from various stakeholders in new innovative energy services	No consideration for diversity of interests
Q17	Lack of awareness from consumers towards flexibility, opportunity, cost saving and revenue generation	No consumer awareness of benefits
Q18	Exclusion of societal groups (e.g. vulnerable groups such as elderly) due to lack of knowledge, capability or access to innovative energy services	Exclusion of societal groups
Q19	Perception that the energy system is vulnerable to cyber-attack or data security issues	Perception of data security vulnerability

Table 10 Organisational barriers questionnaire

Question number	Barrier	Question (Short version)
Q1	Lack of agency in the business (e.g. Lack of ownership of building and/or supply equipment)	Lack of agency
Q2	Lack of appropriate systems or professionals to recognise data value	Inability to recognise data value

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Question number	Barrier	Question (Short version)
Q3	Lack of energy management personnel/management systems	No energy management personnel/systems
Q4	Lack of skilled professionals for combining energy data	Inability to combine energy data
Q5	Lack of knowledge and familiarity with renewable energy systems	No knowledge of renewable energy
Q6	I.T. infrastructure insufficient for data processing and storage	I.T infrastructure
Q7	Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Lack of data governance
Q8	Lack of compatibility of multi-source data	No compatibility for multi-source data
Q9	Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Data complexity
Q10	Reluctance to adopt new business models (inertia) in favour of current model	Inertia
Q11	Focus placed on daily operations leading to neglection of value of external data	Neglecting external data value
Q12	Data Interoperability not being perceived as an important issue	Data interoperability
Q13	Reluctance to abandon closed ICT systems	Closed ICT systems
Q14	Perception that sharing data means data leaving premises	Data sharing
Q15	Concerns over GDPR and associated penalties	GDPR
Q16	Lack of knowledge with regards to new secure data sharing technologies	No knowledge of data technology

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

4 Regulatory analysis of obstacles pertaining to SYNERGY

4.1 Introduction

In this subsection, the process of extracting information on regulatory regime at national level based on the feedback of the pilots will be investigated. The legislation classification that the demo cases are categorized under is depicted in Figure 3. The questionnaires were circulated to all partners of the five pilots of the SYNERGY project.

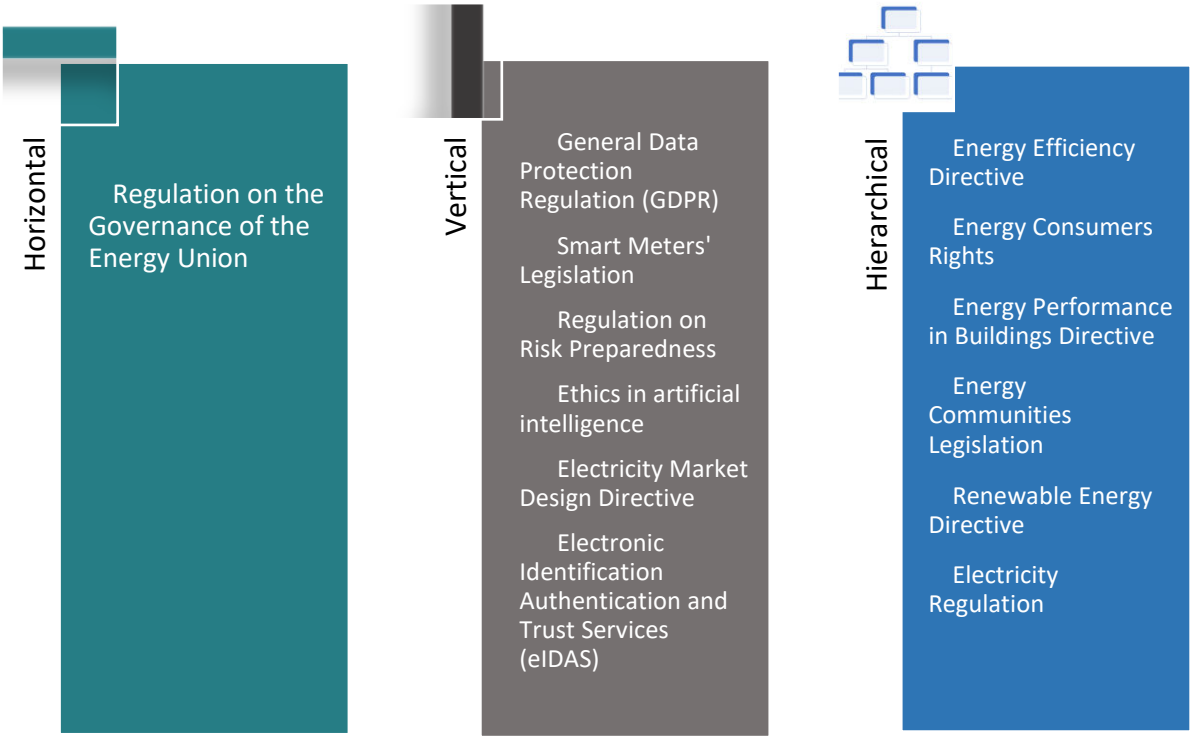


Figure 3 Regulations Categorization

4.2 Quantitative analysis

In the following section, the questionnaire and its different parts are analysed. It is crucial for the SYNERGY project to have an eye bird's view on the regulatory issues that may hinder the demo cases implementation at a national level. This analysis specifically highlights:

- the status of the regulations in each demo and thus the level of preparedness for SYNERGY solutions implementation
- the regulatory barriers or omissions under the prism of the demo cases
- Any discrepancies of perception for the use cases among partners.

Therefore, the above analysis can provide a solid input for T9.5 for suggesting ways to overcome the discrepancies or regulatory framework omissions as highlighted here.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

4.2.1 Formulation of questionnaires

Within this section the process of the questionnaire is presented. The main parts and the rationale behind are presented as shown in Figure 4.

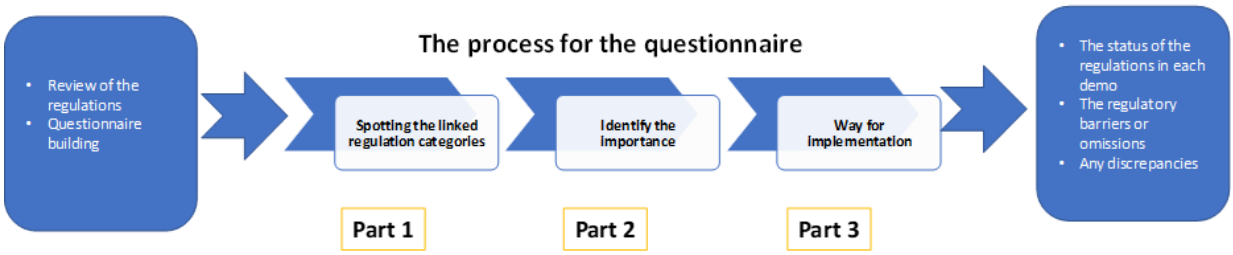


Figure 4 The process of the questionnaire

a) Spotting the linked regulation categories

The first part of the questionnaire was dedicated to identify the linking of the different demo cases to the regulation categories of the previous sections. So, the demo partners were asked to check which categories were relevant to each demo case and identify if these regulations are missing or not at national level.

b) Identify the importance

The second part of the questionnaire was dedicated to identify the importance of each regulation in the implementation of the Demo Cases. The partners were asked to rank the importance of each regulation/directive for each demo case from 1 to 5 (1 being of least and 5 of highest importance). This is quite enlightening in the extreme cases where:

- A regulation is of high importance but is missing in the national context.
- A regulation is of low importance and is already implemented in the national context.

In the first case, the demo case implementation can be severely jeopardized and remedies and alternative solutions should be introduced and will be discussed later in the conclusions. In the second extreme case, although the national regulation is in place the impact is quite low as the linking with the demo case implementation has been characterized low.

c) Way for implementation

The third part of the questionnaire is open for the demo leaders in order to identify the following:

- If there is any barrier or hindering regulation
- If there is any approach that can offer tentative solution
- If there is any provision of new national regulations in the near future

The main objective of this part is to identify if the demo cases can be implemented and in case that any barrier exists, how it should be lifted. Also, we need to make sure if the national regulatory context remains the same or it will be enriched by the time of SYNERGY pilot's deployment.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

4.2.2 Results analysis

In the following, the summary of results is presented under the three parts of the questionnaire and some analysis is conducted. The results were extracted in two phases. All the results extracted in the first phase were presented in D2.3 which was the first version of this deliverable associated with task T2.2. During the second phase, the aggregated results extracted from the first phase were presented to the questionnaires' participants in order to indicate whether they agree or disagree along with an explanation of any changes that have occurred and how these relate to their demo cases.

a) Spotting the linked regulation categories

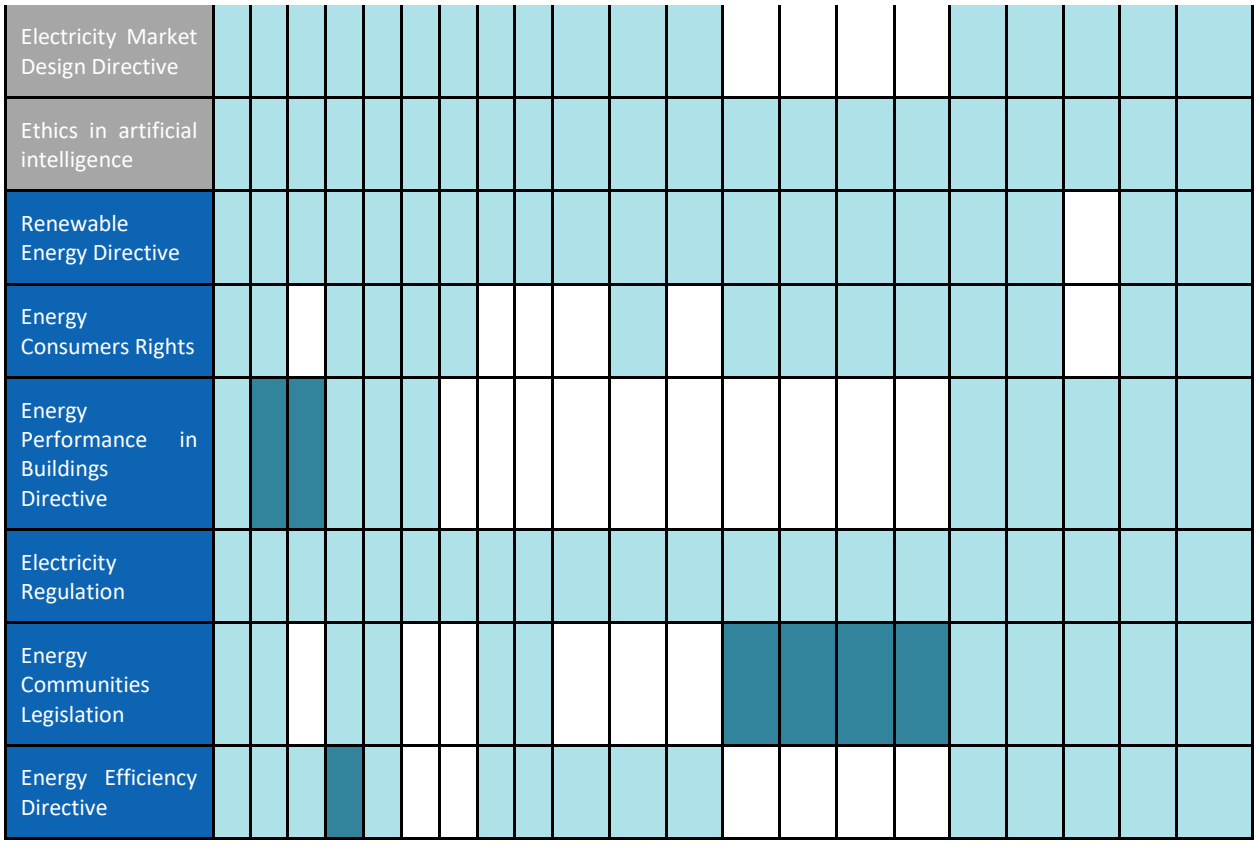
In Table 11, the linking of the demo cases with the regulation categories are shown. Light blue indicates the regulations that have been linked to demo cases during the first round of the questionnaires, where dark blue indicates regulations that have been reconsidered during the second round of the questionnaires and are now considered to be relevant.

A general comment would be that all regulations are important for the SYNERGY demo cases and linked with the pilots. As it is expected, the horizontal approach regulation, i.e. Regulation on the Governance of the Energy Union, is relevant for all Demo Cases. Also, the vertical approach regulations such as smart meters' regulations, electricity regulation or GDPR are of great significance as expected. Some regulations under the hierarchical approach category are the ones that are not always linked to the demo cases e.g. regulations on buildings, energy communities' legislation etc. This is expected as they have a narrower implementation and they are connected to the specificities of each case. Also, concepts that are relatively new such as energy communities or blockchain technology are linked fewer times to the demo cases.

Table 11 The regulations linking to the demo cases

Country	GRC						ESP						AUT				FIN				HRV
Regulations/DCs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Regulation on the Governance of the Energy Union																					
Regulation on Risk Preparedness																					
General Data Protection Regulation (GDPR)																					
Smart Meters' Legislation Identification																					
Electronic, Authentication and Trust Services (eIDAS)																					

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



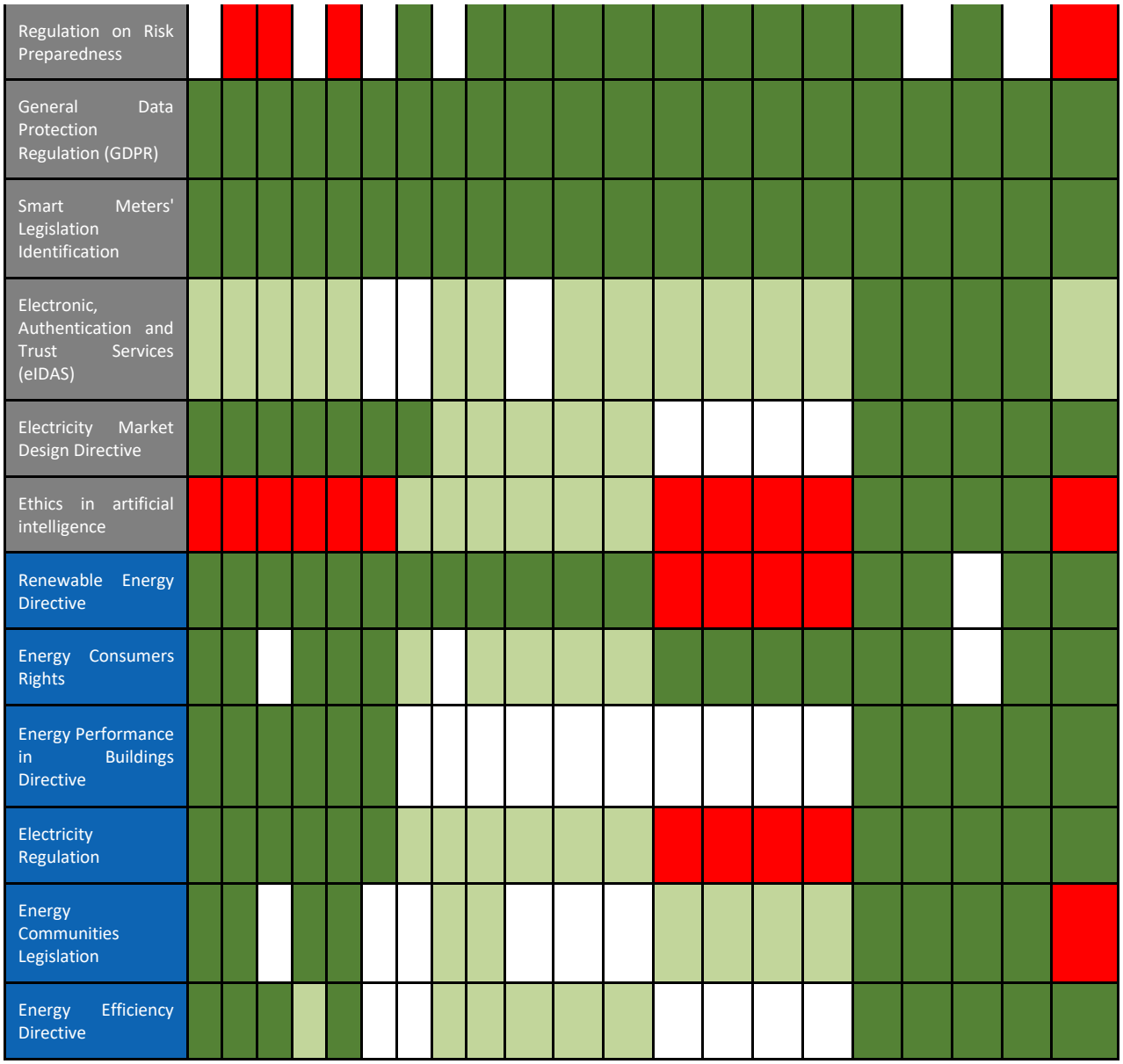
According to the updated Table 11 eIDAS along with the energy communities' legislation have been reconsidered as relevant regulations to all DCs of the Austrian pilot. Similarly, on the Greek pilot the energy performance in buildings directive has been reconsidered as a relevant directive for DCs 2 and 3 along with the energy efficiency directive which is now considered to be relevant to DC4 along with the rest of the Greek DCs.

The next step of this part of the questionnaire is to identify if national regulations that can facilitate the implementation of the abovementioned linked EU regulations are in place in the demo countries. Table 12 shows the existence or not of the regulations at national level based on the feedback of the partners. The table's legend is as follows: The green colour means that the regulation exists while the red colour means that the regulation is missing. The lighter shade of green indicates regulations that during the first distribution of the questionnaires were considered to be missing which however during the second round have taken place.

Table 12 ***Existing regulations at national level***

Country	GRC						ESP						AUT				FIN				HRV
Regulations/DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Regulation on the Governance of the Energy Union																					

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.



During the first round of questionnaires no input was given for the Austrian DC 13-16 regarding eIDAS, which has now been updated to indicate that the eIDAS regulation exists in Austria. Specifically, a central eIDAS node exists in the Republic of Austria, that enables EU citizens to log in to Austrian online applications with the electronic identity (eID) of their EU country of origin. Mutual recognition of national eIDAS is taking place gradually.

Similarly, on the Greek DCs, the eIDAS regulation was originally reported to be missing in Greece. However, it has now been reported that a new regulation on digital governance, including all aspects of eIDAS, has been released in September 2020. Regarding the Croatian DC21 a correction was made to indicate that eIDAS is not missing at a national level and more specifically starting in September 2018, a Croatian eIDAS node has been established and put into full function. As such the NIAS national authorization services have been made compliant with eIDAS at that time. Regarding the Spanish DCs an update has been provided to indicate that all regulations that were

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

missing during the first round of the questionnaires have now taken place. Additionally, an update has been provided in the relevance of the Energy consumers rights and DC 9, 10,11,12 since the Spanish demo site is focused in a rural community area with real customers. Finally, on the Austrian DCs 13 to 16 the Energy communities' legislation has been updated as a currently existing legislation since the Renewable Energies Expansion Act has been adopted.

In general, it is shown that Greece, Austria and Croatia have a high preparedness level as far as the national regulation is concerned. There are some gaps in regulations but these will be evaluated in the next subsections of this deliverable, as far as if they potentially can affect the implementation. The Spanish pilot seems to have the biggest gaps as far as the existing national regulation is concerned. In the next section, a solid analysis on the related questionnaire findings will be presented. This will serve as an input for the mitigation plan that will be developed by the corresponding partners. As far as the Finish pilot is concerned, it has all relevant national regulations in place and aligned with the EU directives.

4.2.3 Identification of different perception among actors in the electricity value chain of SYNERGY

Within this section the second part of the questionnaire is analysed:

a) Identify the importance

As already mentioned, during the first round of the questionnaires the partners that were related to the demos were asked to evaluate the importance of the regulation in implementing each demo case. Of course, this process is subjective, but it is of crucial importance to observe any dispersions of the importance ranking. The legend for Table 11 is the following: in each cell a ranking from 1 (less important) to 5 (most important) is given based on the average of all answers. In case a partner does not see relevance of the regulation, the average is calculated based on the average of the rest of the partners.

During the second round of questionnaires the aggregated results per country in Table 13 were presented to the questionnaire's participants. Based on these they were asked to indicate whether they still agree with the aggregated results they have provided during the first round of questionnaires or whether they disagree, in which case they should provide a new rating.

Table 13 Average impact score of regulatory barriers for each country.

		Country				
Question Numbers	**Regulation**	**Greece**	**Spain**	**Austria**	**Finland**	**Croatia**
RE-Q1	Regulation on the Governance of the Energy Union	3.12	3.08	3.00	3.00	3.00
RE-Q2	Regulation on Risk Preparedness	1.83	2.75	3.00	2.00	2.00
RE-Q3	General Data Protection Regulation (GDPR)	4.05	3.50	5.00	2.88	5.00

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

		Country				
Question Numbers	**Regulation**	**Greece**	**Spain**	**Austria**	**Finland**	**Croatia**
RE-Q4	Smart Meters' Legislation Identification	4.72	3.33	5.00	3.75	5.00
RE-Q5	Electronic, Authentication and Trust Services (eIDAS)	2.92	2.25	-	3.75	3.00
RE-Q6	Electricity Market Design Directive	4.47	4.42	-	3.38	2.00
RE-Q7	Ethics in artificial intelligence	3.00	2.63	3.00	3.38	3.00
RE-Q8	Renewable Energy Directive	3.77	4.42	3.00	2.38	4.00
RE-Q9	Energy Consumers Rights	3.22	0.83	3.00	2.63	5.00
RE-Q10	Energy Performance in Buildings Directive	2.08	-	-	4.63	5.00
RE-Q11	Electricity Regulation	4.58	4.67	3.00	3.38	5.00
RE-Q12	Energy Communities Legislation	2.25	0.67	-	3.13	4.00
RE-Q13	Energy Efficiency Directive	2.62	3.25	-	3.63	4.00

When observing the results of Table 11 and Table 12, we are able to highlight the regulations' absence in relevance to the country by disregarding the relation with the low importance-rated directives i.e. lower than 4. The mapping is an insight on the emphasis where each country should give in adopting each of the missing regulations. This includes the absence of "Electricity Market Design Directive" and "Electricity Regulation" in Spain and "Energy Communities Legislation" in Croatia. Extra care should be given in these extreme cases where the regulations are important, yet they are not in place.

Figure 5 displays the average impact scores rating the regulatory barriers when responses are aggregated across all questionnaires. As shown the most impactful barrier is "Smart Meters' Legislation Identification" followed by the "Electricity Regulation" and "General Data Protection Regulation (GDPR)". The lowest rated barrier is that of "Regulation on Risk Preparedness" along with "Energy Communities Legislation".

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

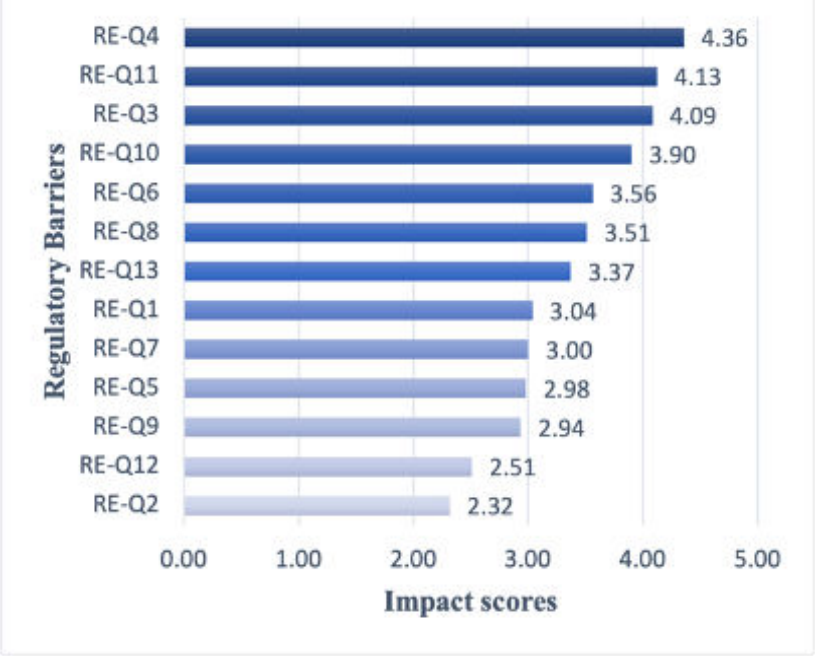


Figure 5 Impact rating of all RE barriers averaged across all countries

As such, from the second round of questionnaires an updated Table 14 was extracted where the light green and light red colouring indicate the updated ratings that have occurred during the second round of the questionnaires.

Table 14 Importance identification of regulations in relevance to the demo cases

Country	GRC						ESP						AUT				FIN				HRV
Regulations/ DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Regulation on the Governance of the Energy Union	3.3	3.3	3.0	2.5	3.6	3.0	2.0	2.5	3.5	4.0	4.0	4.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Regulation on Risk Preparedness		4.3	5.0		1.7		2.0		2.5	4.0	4.0	4.0	3.0	3.0	3.0	3.0	4.0		4.0		2.0
General Data Protection Regulation (GDPR)	4.3	4.0	2.5	5.0	4.5	4.0	3.0	3.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.0	3.0	3.5	3.0	5.0
Smart Meters' Legislation Identification	5.0	4.6	4.0	5.0	4.7	5.0	2.0	5.0	2.0	5.0	3.0	3.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	3.0	5.0

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Electronic, Authentication and Trust Services (eIDAS)	3.5	4.0	3.0	4.0	3.0			5.0			4.0	4.5	2.0	2.0	2.0	2.0	4.0	3.0	3.0	5.0	3.0
Electricity Market Design Directive	4.3	4.8	4.0	4.0	4.7	5.0	4.0	4.5	3.5	5.0	5.0	4.5					3.5	3.0	4.0	3.0	2.0
Ethics in artificial intelligence	3.0	3.0	3.0	5.0	2.0	2.0	2.0	2.0	2.8	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.5	5.0	3.0	3.0
Renewable Energy Directive	4.0	4.3	3.5	3.0	3.8	4.0	4.0	4.0	4.5	5.0	4.0	5.0	3.0	3.0	3.0	3.0	3.0	2.5		4.0	4.0
Energy Consumers Rights	4	3.2		3.2	4	3.2	1.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.0		4.0	5.0
Energy Performance in Buildings Directive	1	1	2.1	2.1	1	4											4.5	5.0	5.0	4.0	5.0
Electricity Regulation	4.5	4.5	4.5	5.0	4.0	5.0	4.0	4.5	4.5	5.0	5.0	5.0	3.0	3.0	3.0	3.0	4.0	3.5	3.0	3.0	5.0
Energy Communities Legislation	4.0	1.0		1.0	5.0			2.0	2.0				4.0	4.0	4.0	4.0	4.0	3.1	4.0	3.1	4.0
Energy Efficiency Directive	3.0	3.7	5.0	4.0	4.0			2.0	3.5	5.0	5.0	4.0					4.5	3.0	4.0	3.0	4.0

Since the Austrian DCs 13-16 have been updated to indicate that eIDAS is currently regulated in Austria a rating of its importance relating to the DCs has also been provided. The Austrian partners have indicated a rating of 2 for all DCs showing that eIDAS is neither irrelevant nor relevant to these DCs. Regarding the Greek DCs an update has also been reported on the eIDAS regulation as it was originally reported to be missing in Greece. However, the ratings of this regulation for the Greek demo cases have been reported to be the same. Regarding the Croatian DC21 a correction was made to indicate that eIDAS is not missing at a national level with the rating remaining the same.

The aggregated result for the Greek DCs of the relevance of the Energy Consumers rights regulation is equal to 3.2. However, this regulation is of higher importance for DC1 and DC5 compared to the averaged number per country because the regulation focuses on the rights of consumers mostly regarding their relationship with retailers.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Regarding the Energy Performance in Buildings directive of the Greek DCs 1,2,5,6 an update was given to indicate that this directive is not relevant to DCs 1,2,5 and is highly relevant to DC6. Specifically, this regulation is not relevant to DC1,2,5 since these DCs are not examining the energy performance of the building but just the potential of the flexible assets of the building in participating in the flexibility market. However, DC6 deals with energy performance of the building and energy communities hence this regulation is of higher importance in DC6 than shown in the average score 2.1.

Since the Energy Communities Legislation has been reported to exist in the Austrian DCs 13-16 only during the second round of the questionnaires, an impact rating of 4 has also been provided during this round. This high importance is due to new possibilities on the energy market as well as regarding data accessibility etc. An update on this legislation has also been provided for the Finnish DCs 17 and 19 with a rating of 4 indicating an increase in the relevance of this legislation compared to the other Finnish DCs (DCs 18,20). This legislation has been in place since 1.1.2021 so it has recently raised more interest. The Energy Communities Legislation has also been updated in the Greek DCs 2 and 5 as a decrease in its value to a rating of 1, whereas an increase in its value is provided for DC6 with a rating of 5. The reasoning behind these updates for the Greek DCs is similar to that of the Energy Performance in Building directives since only DC6 deals with energy performance of the building and energy communities hence this regulation is of higher importance.

Regarding the Spanish DCs, the rating of the Regulation on the governance of the Energy Union, the rating for GDPR, and the rating for Energy consumer rights have been updated in DC9, 10, 11, and 12 to indicate an increase in relevance.

Following, the regulations' absence in relevance to the demo cases by disregarding the relation with the low importance-rated directives i.e. lower than 4, is summarised.

- The Regulation on Risk Preparedness is absent with regards to demo cases DC2 and DC3
- The Ethics in Artificial Intelligence is absent with regards to DC4
- The Energy Communities Legislation is absent with regards to DC21

The above summary is an insight on how the implementation should be treated in the next phase of the project i.e. the pilots' deployment. Extra care should be given in the extreme cases where the regulations are important yet they are not in place.

Under this prism, two scenarios should be investigated: the first is if there are regulations that are hindering the demo cases or if there are missing regulations that can be treated otherwise. Regarding the first case, SYNERGY will employ approaches that will facilitate their implementation either by demonstrating them in a hybrid manner that combines real-life demonstration with simulation processes, or by establishing dedicated experimental test-beds in the demo sites (following official permitting processes that need to be performed at local, national or even at organizational level). Missing regulations, on the other hand, will lead to the demo cases implementation based on the provisions of the EU-wide regulations that MS are obliged to adopt in any case. In the extreme that a DC requires the national regulation to be in place, then the approach described before (for the hindering ones) shall be followed. Overall, missing regulations on a national level, will need to be treated in a way that any demonstration activity fully complies with EU Directives provisions.

In Table 15, the following are highlighted:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- With yellow the cases where we spotted some discrepancies (above 2 out of the 5-rate ranking) among partners. By the term discrepancy, we mean that different ratings on the importance of the regulations among partners have been identified. The number within the cell is the largest deviation of ranking among partners.
- With purple the cases where we spotted some differences in perception among partners i.e. one partner finds relevance of a certain regulation with the demo case whereas others don't.

It is seen that there are some discrepancies among partners regarding the perception of some regulation and their implementation, relevance or impact within the demo cases. This table, has served as an input for the relevant LLs activities performed and reported in Chapter 6 of this document. The aim has been to clarify any opposing perceptions and enable the establishment of common understanding between the involved stakeholders on the relevance and important of certain regulations with regards to the different demo cases they are jointly involved. However, the initial engagement performed in this reporting period for T2.2, revealed no major obstacles imposed by active regulations on the implementation of the Demo Cases as far as the interviewed stakeholders (namely IPTO, EEE and CAV) are concerned. Contrariwise, where impactful regulations exist, the interviewed business experts reassured that appropriate measures are in place to ensure that barriers can be overcome either by relevant disclosure measures or by entering relevant experimentation status to facilitate the implementation of the Demo Cases and the identification of recommendations needed to inform regulation from the SYNERGY validation activities.

Table 15 Spotting discrepancies or differences among partners

Country	GRC						ESP						AUT				FIN				HRV
Regulations/DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Regulation on the Governance of the Energy Union																					
Regulation on Risk Preparedness		2			2				3												
General Data Protection Regulation (GDPR)	2		4															2			
Smart Meters' Legislation Identification												4						2		2	
Electronic, Authentication and Trust Services (eIDAS)																					
Electricity Market Design Directive																					
Ethics in artificial intelligence																					

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Country	GRC						ESP						AUT				FIN				HRV
Regulations/DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Renewable Energy Directive	2			2																2	
Energy Consumers Rights	2	2																			
Energy Performance in Buildings Directive																				2	
Electricity Regulation					2														2	2	
Energy Communities Legislation																				2	
Energy Efficiency Directive									3										2		

Although the SYNERGY Living Lab activities will continue throughout the duration of the project, the discrepancies shown in the table above have been attributed to the perception of the questionnaire respondents, either from a personal capacity in their business role and their comprehension of each regulation, or the perceived impact that each regulation has on their company as part of a specific Demo Case. For example:

- one of the largest discrepancies shown in the table above refers to Demo Case 3 and GDPR. The stakeholders associated with this Demo Case are a TSO and a DSO. As the Demo Case is concerned with Asset Management and Network Planning, proprietary, asset related data will be used in combination with consumer data (i.e. smart meter data). In this specific Demo Case it is apparent that GDPR might be highly impactful for the DSO who manages the smart meters, i.e. third party data, but might be of much less importance to the TSO who is concerned with proprietary data whose utilization may be internally governed, following already existing rules based on regulatory reporting standards;
- perception differences in the way that respondents understand the existing impact or the potential impact that a directive might have could be seen in Demo Case 9 concerned with Green Power Purchase Agreements (GPPAs) between RES Operator COBRA and Retailer CUERVA in Spain. The difference in perception on whether the Energy Communities Directive has significant impact on this Demo Case could be attributed to the fact that currently that directive does not affect per se the establishment of GPPAs using energy coming from PV plants owned/operated by a RES Operator; however if the Energy Communities Directive will not facilitate explicitly the participation of energy communities in such agreements, it might restrict the scalability of such agreements as a potentially large green energy production segment such as energy communities, might be excluded from appropriate regulation concerning certification of GPPAs.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

b) Way for implementation

In Table 16, a preliminary analysis is performed per demo based on the national regulatory context. Focus was given in the identification of any regulation that may hinder the implementation whereas links on the national regulation is given in ANNEX A.

Table 16 Pilots and hindering regulations or omissions

Greece	
Demo Case 1	Flexibility related regulation/legislation in Greece (Law 4425/2016), allows the National TSO to rely on the flexibility offered by flexibility asset owners in order to safeguard network resilience and power adequacy. This has been realized through the implementation of flexibility power auctions. At the same time, although there is no blocking regulation for the establishment of a flexibility market for the distribution level, there is the lack of appropriate regulatory framework which will enable the launch of a flexibility market in the LV and MV level and (lack of) relevant incentives towards the D&T network operators. Such a regulatory framework would be necessary to establish participation rules, treat operational aspects, compensation schemes etc. As such, the Regulatory Authority of Energy in Greece is currently working on the activation of Demand Response (DR) Aggregators through which DR market schemes will be enabled. It is yet to be seen whether this will initiate the launch of a flexibility market both in a distribution and a transmission level however it is announced that consumers will be able to actively participate (and benefit from) the Balancing Market through aggregators. It is yet to be defined whether this will initiate the launch of a flexibility market both in a distribution and a transmission level. According to announced estimations, the enforcement of this regulation and the subsequent launching of Demand Response market scheme is expected within 2021. Since no draft version of the new regulation has been released, it is difficult to foresee in which ways the DC would be affected.
Demo Case 2	The integrated approach of the grid dictates coordination and communication among operators such as Distribution System and Transmission System operators. This may also include active entities that may play an important role in the operational scheduling such as Energy Communities as suggested by the related Directive. In any case there is no blocking regulation for the establishment of a cooperation context between operators but there is a lack of appropriate regulatory framework. In Greece there has recently been proposed a regulation that considers eIDAS related aspects which is however not expected to hinder the implementation of any of the Greek DCs. In particular, specific departments have already been set up to deal with document validation and trust that use platforms for daily nomination through the use of digital signatures.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo Case 3	Same as previous demo case, the integrated approach of the grid and the unified energy value chain dictates coordination and communication among operators for addressing operational challenges such as network asset management and planning (under the optimal techno-economical perspective). The energy value chain includes important players such as Energy Communities that can be responsible for managing their own assets as suggested by the related Directive that is in place. Regarding the missing regulations, they will be treated as mentioned in the previous DC while the related context will be complemented with GDPR regulation in place No specific restrictions or hindering factors are present in relation to Network Asset Management that may be dictated by EU directives, and to this end SYNERGY introduces specific services that will enable readiness at the operators' side once the relevant EU directive is transposed to the national context.
Demo Case 4	Retailer needs to have access to the data of their customers either as a sole party or as an aggregated entity through other players in order to estimate/manage the given services to the network operators either through bilateral contracts or through the market. This DC will be implemented in full compliance with the Ethics in AI directive until it is transposed to the national context. The establishment of a regulation enabling flexibility services' provision at the distribution level by local energy consumers/producers is necessary. In the upcoming years a new regulatory framework in the form of the balancing market is expected to take place by mainly involving medium voltage large consumers. The solid and long-term relations of retailers and consumers can be used in a partnership between aggregators and retailers that will enable demand side aggregation of small consumers. As such, the daily operations of retailers will most likely be affected since energy data of clients will need to be forecasted and segmented in order to participate in a close to real time market. Thus, a potential market scheme between aggregators and retailers is expected where additional contracts and types of offerings can be provided as part of a bundle of products in collaboration with an aggregator.
Demo Case 5	A VPP configuration in general is realized by aggregators, a type of stakeholder which is provided by the Greek law since 2016. However, current legislation in Greece limits aggregators to the representation of distributed RES generation in the Greek Energy Market (Day ahead, balancing) and does not support the full implementation of the VPP concept, where aggregated flexibility (from generation, storage and demand response) can be utilized to provide services to D&T networks (load shedding/shifting) and remuneration to the aggregator. Even though demand response is not officially introduced in the Greek Energy/ Flexibility Markets, it is expected that an experimentation case will be set up as part of this Demo Case for the purposes of the validation activities of the project.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo Case 6	The main targets in the energy domain of demo case 6 (Energy Community self-consumption maximization and energy costs reduction) could be realized according to the existing regulatory framework since they refer to the very essence of the Energy Communities. However, currently, this demo case could be implemented by combining real-life and simulation actions in a hybrid framework until all relevant regulations are in place in order to support transparent benefit sharing through the use of blockchain technology. Furthermore, GDPR and blockchain technology as complementary to each other will be considered to safeguard data protection and transparency.
Spain	
Demo Case 7	Regulation on energy communities in Spain has been implemented in 1 year from the first round of the questionnaire circulation and the rest of originally missing regulations have been approved by the end of 2020. List of operation proposals has been conducted by the system operator regarding balancing services. In this context and since all missing regulations are in place the Spanish regulatory context, no specific barriers are expected for the realization of the respective demonstration cases.
Austria	
Demo Cases 13-16	At this point there is no barrier identified for the pilot. More specifically regulation such as ethics in AI and the renewable energy directive are currently missing on national level and are considered to be relevant to the Austrian DCs. Data are collected from smart meters in substations and residential buildings in order to facilitate the forecasting of dynamic profiles. Specifically, an energy service of 40 DSOs in Austria is provided, that offers the structure of the grid as a combination of all the DSOs to achieve energy data management and grid profiling for improved grid operation. There is a significant concern towards IoT services that could be related to ethics in AI and GDPR since only the use of smart meters is currently implemented and IoT devices will take place as part of the SYNERGY project. However, the Austrian pilots already follow EU regulations even without the regulations being in place due to the Renewable Expansion Act that has been proposed in September 2020. Additionally, it is expected that when the regulations have taken place, they will provide new incentives that will bring the system to a more economic and sustainable state.
Finland	
Demo Case 17	In general, there is no local Finnish regulation/legislation that contradicts EU regulation/legislation. Demo case 17 is about collecting data. The General Data Protection Regulation needs to be considered as some of the collected data can be viewed as personal data especially if different registers are combined. Needs and specifications related to second generation energy meters are not defined in Finnish legislation and will be defined later on, however the lack these legal clarifications won't pose a problem for the project. The specifications for second generation meters have been openly "agreed upon" in a document by the Ministry of Economic Affairs and Employment of Finland, but not forced in legislation. Neither of the Finnish demos should be hindered by this (as neither one is an electricity provider).

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

	These specifications might impact the metering system used in the demos. A working group (Smart Grid Working Group) has been established to study the minimum requirements and installation of Generation II meters. For example, this is recorded in the Long-Term Renovation Strategy as an action. No further specifications are available. First-generation smart meters are already widely installed in Finland. The hourly metering obligation was laid down in the Government Decree on the settlement and metering of electricity supply (66/2009) 1, which entered into force in March 2009. According to the decree, 80 per cent of electricity use points had to be in hourly measurement by 1 January 2014. Meters allow hourly measurement, but not more accurate measurement.
Demo Case 18	In general, there is no local Finnish regulation/legislation that contradicts EU regulation/legislation. Demo case 18 is about utilizing data collected in demo case 17 in simulation tools. General Data Protection Regulation needs to be considered as some of the collected data can be viewed as personal data especially if different registers are combined.
Demo Case 19	The analytics used in this demo case is to develop a baseline for buildings is located in the Synergy platform. Therefore, some ownership question related to the near real-time data provided to the platform can be identified. Laws that have been recognized to have an impact are related to metering, information security and the Finnish electricity market law. No clear contradictions or problems with these related to the demo cases have so far been found.
Demo Case 20	The Finnish electricity market directive does not yet recognize energy communities, e.g. related to renewable energy system performance of one RES that shares the energy to multiple buildings. (related to 944/2019 and 2019/943) The law needs to be updated so that roles related to the market are more clearly specified (related to aggregators, energy communities and other market actors). The regulation is supposed to be updated during 2020, so the problem should not be hindering the project. Neither does the demo case currently include a RES that shares the produced energy to multiple buildings. The new Finnish legislation (Energy Communities). Derived from https://www.finlex.fi/fi/laki/alkup/2020/20201133
Croatia	
Demo Case 21	Smart meters are only mentioned in the Croatian Energy Efficiency law, however this is incomplete and the smart metering directive is not completely implemented. There is no law or bylaw directly governing smart meters. A rollout of smart meters is ongoing and the DSO is expected by the regulator to complete the rollout by 2027. Even though the regulation on Local energy communities is not yet transposed to the Croatian Regulatory framework, the Demo Case implementation is not directly affected, since it is only focused on intra-community optimization functions (not addressing any critical synergy with overlay grids for ancillary services provision). The implementation of the demo case is expected to provide valuable conclusions and recommendations for fine-tuning the market design directive which is currently implemented as Energy

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

	market law and related bylaws, while offering invaluable insights as part of the transposition of the Energy Communities regulation in the national context.

4.3 Additional and missing directives for online platforms

Within this subsection, a brief analysis is made on the upcoming, additional and/or missing directives that are related with SYNERGY. Specifically, this section aims to identify any issues pertaining to additional regulation that needs to be considered in relation to the SYNERGY platform as a whole (i.e., Artificial Intelligence Act) and more specific mechanisms and tools that the SYNERGY platform will offer and/or facilitate (i.e., analytics toolkit and data sharing mechanisms).

Regulation laying down harmonised rules on artificial intelligence (Artificial Intelligence Act)

An upcoming regulation regarding artificial intelligence has been recently proposed aiming to lay down harmonised rules on artificial intelligence. The regulation follows a risk-based approach, differentiating between uses of AI that create (i) an unacceptable risk, (ii) a high risk, and (iii) low or minimal risk. Specifically,

Unacceptable risk:

- AI systems that violate fundamental rights, manipulate persons through subliminal techniques beyond their consciousness, or exploit vulnerabilities of specific vulnerable groups.
- AI systems that use 'real time' remote biometric identification in publicly accessible spaces for the purpose of law enforcement.

High risk:

- AI systems intended to be used as a safety component of products that are subject to third party ex-ante conformity assessment.
- Other stand-alone AI systems with mainly fundamental right implications.

Low or minimal risk:

- AI systems not likely to pose high risks on the fundamental rights and safety as defined by the EU.

Based on the descriptions of these categories Table 17 indicates under which category the use of AI in each demo site falls. N (No) indicates that the use of AI in this DC does not fall under this category whereas Y(Yes) indicates that the use of AI falls under this category.

It should be noted here that this table is a summary of the responses provided by the demo partners based on their perceptions and interpretation of what a high-risk AI system might be.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Table 17 Categorization of the use of AI in each demo case

Country	GRC						ESP						AUT				FIN				HRV
Regulations /DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Unacceptable risk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
High-risk	Y	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
low or minimal risk	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Most of the DCs fall under the category that poses low or minimal risk regarding the use of AI. DCs 12 and 17 have not been indicated as any of the three categories meaning that these DCs either do not use any AI systems or their use falls under the category of no risk. None of the DCs fall under the unacceptable risk category, however, DCs 1,2 and 5 fall under the category of high-risk AI systems.

Table 18 provides the partners' responses on why each DC falls under the corresponding categories and which of the tasks performed in this DC are related to the category.

Table 18 Partners' responses of use of AI in each demo case

Country	DC	Partners' responses
GRC	1	High risk: Processes that will allow flexibility provision to the distribution network could be considered high risk in terms of network management in the case where flexibility provision hinders the stability of the electricity network, risking sudden brownouts and black-outs.
	2	High risk: Processes that will allow flexibility provision to the distribution network could be considered high risk in terms of network management in the case where flexibility provision hinders the stability of the electricity network, risking sudden brownouts and black-outs.
	3	Low or minimal risk: No risk related to AI systems are identified as part of this DC
	4	Low or minimal risk: AI systems may be used in the algorithms of SYNERGY tools, but are not expected to cause any risk.
	5	Low or minimal risk: The AI analytics that will be performed for this DC, which will provide the segmenting and classifying flexibility profiles at different spatio-temporal granularity and clustering/ managing them in order to establish optimal Virtual Power Plant (VPP) composition for the delivery of grid services to TSOs and DSOs, does not pose high risks on the fundamental rights and safety as defined by the EU

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

		High risk: Processes that will allow flexibility provision to the distribution network could be considered high risk in terms of network management in the case where flexibility provision hinders the stability of the electricity network, risking sudden brownouts and black-outs.
	6	Low or minimal risk: DC6 does not involve any network management function, therefore no significant risk is identified from the use of AI in this particular DC.
ESP	7	Low or minimal risk: Operating data will be used by AI algorithms to improve the operation and maintenance of the asset with the intention of decreasing the risk investment.
	8	Low or minimal risk: Climatic and electricity prices data will be used by AI algorithms to improve the operation of the asset with the intention of decreasing the risk investment. AI will be used to provide the RES operator with improved forecast of price differences within the various time horizons of the wholesale electricity markets. However, these algorithms are not expected to cause any risk.
	9	Low or minimal risk: Climatic data will be used by AI algorithms to improve the operation of the asset with the intention of decreasing the risk investment. However, these algorithms are not expected to cause any risk.
	10	Low or minimal risk: Climatic data will be used by AI algorithms to improve the operation of the asset with the intention of decreasing the risk investment. However, these algorithms are not expected to cause any risk.
	11	Low or minimal risk: Climatic data will be used by AI algorithms to improve the operation of the asset with the intention of decreasing the risk investment. However, these algorithms are not expected to cause any risk.
	12	Low or minimal risk: AI will aim to provide local aggregators and distribution operators with accurate demand and generation forecasts to improve network resilience and efficiency.
AUT	13	Low or minimal risk: The AI systems provided by SYNERGY, are not seen as a risk, but more as an opportunity to improve operations and demo activities (if necessary).
	14	Low or minimal risk: AI systems provided by SYNERGY, are not seen as a risk, but more as an opportunity to improve operations and demo activities (if necessary)
	15	Low or minimal risk: AI systems provided by SYNERGY, are not seen as a risk, but more as an opportunity to improve operations and demo activities (if necessary)
	16	Low or minimal risk: AI systems provided by SYNERGY, are not seen as a risk, but more as an opportunity to improve operations and demo activities (if necessary)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

FIN	17	Low or minimal risk: This DC does not use any AI algorithms.
	18	Low or minimal risk: This DC will use AI systems regarding urban energy monitoring, planning support application, advanced renovation support application, self-consumption optimization & predictive Maintenance application, which however are not likely to cause any risk.
	19	Low or minimal risk: This DC uses AI systems regarding baseline personal AI analytics for occupants' behaviour and comfort profiles, AI-RDSS, DA-ICE-RAS, which however are unlikely to cause any risk.
	20	Low or minimal risk: This DC uses AI systems regarding BL-EPOM, DL-EPOM, HVAC-PMS, eDECs Calculation Engine, and SRI Calculation Engine are not likely to cause any risk.
HRV	21	Low or minimal risk: We do not foresee the AI algorithms in the SYNERGY platform to affect individual user risks. The decisions based on AI derived data in the SYNERGY apps we're designing should have minimal impact to user comfort and should have close to no impact to users' wellbeing.

Following you can find the sets of rules as presented in the regulation with a more detailed explanation of what specific AI tasks are related to these sets of rules.

Prohibitions of certain unacceptable AI practices:

- Practices that have a significant potential to manipulate persons through subliminal techniques beyond their consciousness or exploit vulnerabilities of specific vulnerable groups such as children or persons with disabilities in order to materially distort their behaviour in a manner that is likely to cause them or another person psychological or physical harm.
- AI-based social scoring for general purposes done by public authorities.
- Use of 'real time' remote biometric identification systems in publicly accessible spaces for the purpose of law enforcement.

Requirements for high-risk AI systems:

- Data governance: high quality of data used for training AI models.
- Documentation and recording keeping information about the models and algorithms that are utilized and trained with the use of the data provided to the system.
- Transparency and provision of information to users: explainability of results of trained models.
- Human oversight: monitoring of the analytics process and the different steps involved both in the training and execution of AI models and algorithms.
- Robustness, accuracy, and security: resilience against risks connected to the limitations of the system (e.g., errors, faults, inconsistencies) as well as malicious actions that may compromise the security of the AI system.

Harmonised transparency rules for AI systems:

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Systems that interact with humans.
- Systems that are used to detect emotions or determine association with (social) categories based on biometric data.
- Systems that generate or manipulate content ('deep fakes').
- Systems intended to interact with natural persons.
- Emotion recognition systems and biometric categorisation systems.
- AI systems used to generate or manipulate image, audio or video content.

Rules on market monitoring and surveillance:

- Post-market monitoring and reporting and investigating AI-related incidents and malfunctioning.
- Public authorities have the powers and resources to intervene in case AI systems generate unexpected risks, which warrant rapid action.

Table 19 indicates if these sets of rules are related to each demo case and could be considered as a potential barrier. N denotes that this set of rules is not associated to the demo case where Y denotes that it is.

Table 19 Rules for AI systems in relation to demo cases

Country	GRC						ESP						AUT				FIN				HRV
Regulations /DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Prohibitions of certain unacceptable AI practices	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Requirements for high-risk AI systems	Y	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Harmonised transparency rules for AI systems	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N
Rules on market monitoring and surveillance	Y	Y	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y

As indicated by the table above, only 3 out of the 21 DCs can possibly be affected by the provided sets of rules. Specifically, on DC1,2 and 5 can be affected and mostly by the sets of rules regarding the requirements for high-risk AI systems and the rules on market monitoring and surveillance.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

An explanation was given in the following table specifying which AI tasks related to the rules are performed in each demo case and an explanation what potential barriers these rules might impose (e.g. additional financial costs, additional personnel or training, reconsideration of already implemented tasks etc.).

Table 20 Explanation of why each set of rules should be followed in each demo case

Country	Regulations /DC	Explanation
GRC	1	Requirements for high-risk AI systems: Aggregators need to manage large sets of data from different customers, the quality of which will be crucial in order to reach reliable AI trained models relevant to the provision of optimized matching between flexibility needs and capabilities. As such, it will be important to comply to the specific requirements mentioned within this set of rules. In order to be able to comply with these rules, specific mechanisms that will ensure data robustness, accuracy and security as well as AI systems' relevant documentation are expected to be in place within the framework of SYNERGY. Rules on market monitoring and surveillance: This set of rules include the occasion whereby public authorities are allowed to intervene-react in light of AI generated insight (e.g. emergency occasions). In such - potentially rare – occasions, BaU could be affected for the involved parties of DC1, namely DNOs, aggregators and retailers.
	2	Requirements for high-risk AI systems: Aggregators need to manage large sets of data from different customers, the quality of which will be crucial in order to reach reliable AI trained models relevant to the provision of optimized matching between flexibility needs and capabilities. As such, it will be important to comply to the specific requirements mentioned within this set of rules. In order to be able to comply with these rules, specific mechanisms that will ensure data robustness, accuracy and security as well as AI systems' relevant documentation are expected to be in place within the framework of SYNERGY. Rules on market monitoring and surveillance: This set of rules include the occasion whereby public authorities are allowed to intervene-react in light of AI generated insight (e.g. emergency occasions). In such - potentially rare – occasions, BaU could be affected for the involved parties of DC1, namely DNOs, aggregators and retailers.
	3	-
	4	-
	5	Requirements for high-risk AI systems: Aggregators need to manage large sets of data from different customers, the quality of which will be

		crucial in order to reach reliable AI trained models relevant to the provision of optimized matching between flexibility needs and capabilities. As such, it will be important to comply to the specific requirements mentioned within this set of rules. In order to be able to comply with these rules, specific mechanisms that will ensure data robustness, accuracy and security as well as AI systems' relevant documentation are expected to be in place within the framework of SYNERGY.
	6	-
ESP	**7**	-
	8	-
	9	-
	10	-
	11	-
	12	-
AUT	**13**	-
	14	-
	15	-
	16	-
FIN	**17**	-
	18	-
	19	-
	20	-
HRV	**21**	-

A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives

The Renovation Wave Strategy published by the European commission aims to propose stronger regulations, standards, and information on the energy performance of buildings to set better incentives for public and private sector renovations. The updates presented in the following table will be considered in the proposed revisions of both the energy efficiency directive and the

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

energy performance of buildings directive in 2021. Thus, Table 21 indicates if any of the following updates will affect the implementation of each demo case.

Table 21 Potential barriers from the proposed changes in the renovation wave

Country	GRC						ESP						AUT				FIN				HRV
Regulations/ DC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Introduction of mandatory minimum energy performance standards for existing buildings	Y	N	N	N	N	Y	N	N	N	-	-	N	N	N	N	N	N	N	N	N	N
Updated rules for Energy Performance Certificates	N	N	N	N	N	N	N	N	N	-	-	N	N	N	N	N	N	N	N	N	N
Extension of the energy audits requirements to larger and more complex non-residential buildings	N	N	N	N	N	N	N	N	N	-	-	N	N	N	N	N	N	N	N	N	N
Extension of building renovation requirements for the public sector	N	N	N	N	N	N	N	N	N	-	-	N	N	N	N	N	N	N	N	N	N

The SYNERGY partners were asked to explain each of the answers in the previous table by specifying what potential barriers these updates might impose (e.g., additional financial costs, reconsideration of use cases, renovations on already approved buildings etc.). Only DC1 and 6 could be possibly affected by this upcoming regulation in regard to the introduction of mandatory minimum energy performance standards for existing buildings. Superficially, in both DC1 and 6 these changes might alter the flexibility requirements, whereas in DC6, new standards and

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

constraints in energy performance at a building level might need to be taken under consideration in the process of designing and implementing strategies to maximize energy efficiency (energy transactions) at a community level.

Additionally, DC21 considers none of these changes to be a barrier. On the contrary, the introduction of mandatory minimum energy performance standards for existing buildings might actually increase the attractiveness of data driven solutions such as the ones offered on SYNERGY platform.

Smart contracts and blockchain

SYNERGY will attempt to highlight the key issues that any relevant regulation needs to tackle and provide recommendations on how policy makers might go about the adaptation over the short to mid-term to a concrete regulation about smart contracts and blockchain (that is currently absent at EU level and in most of the involved Member States). Such issues include:

- Reinforcing the binding character of smart contracts over blockchain: Just because blockchain is a means to prove that a transaction is valid, involving the knowledge of who is the owner of the data saved in a blockchain ledger and the reassurance that such data has not been tampered, does not however mean that blockchain-based transactions or registration of ownership is by itself legally binding. Among the prerequisites for blockchains acquiring legal status would be the legal recognition of blockchain-based signatures (who did the transaction), timestamps (when it was carried out), validations (who validated the transactions) and "documents" (that is, the data associated with a transaction or contract). This is an aspect that needs to be addressed in complementarity with the eiDAS regulation (or as part of it) to ensure the legal force of such contracts and enable the definition of the **digital assets involved in an advanced approach to ensure the application of KYC (know-your-customer) policies, which is a key issue when transactions are performed (as part of anti-fraud shielding of smart contracts)**. This also points to technology-related requirements for introducing appropriate **access policy strategies and tools for ensuring that only approved and authorized users and organizations can be involved in blockchain-enabled transactions, especially when it comes to the electricity domain**.
- It is really important to address to cross-territorial and, possibly, cross-country of blockchain-based transactions and legal force of smart contracts by introducing a harmonized framework that can be applied at EU-level, which in turn requires regulators and lawmakers to collaborate across national borders to harmonize legal and regulatory regimes, while managing potential risks, including issues of monopolies and market manipulation. Addressing these would require significant legal and organizational changes and a mechanism for collaboration to ensure alignment.
- Provision of appropriate identification tools (in full conformance with the GDPR and potentially under the control of courts or through the private sector on a payment basis) towards enhancing the legal force of blockchain-based contracts that may be questioned or hindered by the pseudonymization or anonymization features that blockchain involves.
- Introducing comprehensive guidance on how **formal legal requirements can be transformed in a smart contract**, to address cases that, for example, only paper-signed contracts are acceptable by law, or only NDAs in paper are acceptable for sharing data with 3rd parties. Harmonization needs to be performed with other laws and regulations so that smart contracts obtain a legal force and cannot be disputed.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Introducing additional guidance for addressing **signing requirements of smart contracts**, in synergy with the eIDAS regulation, to ensure that only authorized users can sign a smart contract. **Immutability of smart contracts** is a key issue that shall be tackled by regulation, ensuring the legal force of smart contracts that can be updated while in force, either following regulatory changes or to reflect changes in the agreement between the signatories of the contract. This should be associated by relevant features (on the technical side) that allow such updates to be introduced in a "running" contract and become binding between the parties. All the aforementioned issues are considered critical for the demonstration of the value that can be obtained out of the SYNERGY project for the electricity data value chain stakeholders (and the energy system in whole), mainly with view to the commercialization period and the post-project exploitation of the SYNERGY platform, the Data Analytics Toolkit, the Data Sharing Mechanisms and the associated Energy-as-a-Service End-User Applications. In this context, all such issues will be highly considered and taken into account during the design activities of the project, while being validated extensively in the project demonstrators, in order to deliver invaluable findings and insights that will be fed and communicated to the relevant regulatory bodies of the EC for the formulation or adaptation of relevant directives and regulations in this area.

EU Regulation on fairness and transparency in online platform-to-business relationship

Within SYNERGY, different actors of the electricity data value chain either as physical or as legal entities shall perform trades/transactions and business interactions through the tools of the online SYNERGY platform. Under this approach, this regulation is highly relevant and the SYNERGY platform will comply with the rules creating a fair, transparent and predictable business environment for all associated users and stakeholders, or, in other words, ensuring that business users of online platforms (data platforms, analytics platforms, data sharing platforms) are granted appropriate transparency, fairness and effective redress possibilities.

Recommendation on measures to effectively tackle illegal content online

The SYNERGY platform will employ appropriate mechanisms to continuously evaluate its stored and used content and secure its proper governance. The development of function of the SYNERGY platform throughout the course of the project, will ultimately result to recommendations of how detection, removal and prevention of the reappearance of illegal content.

Algorithmic transparency

The SYNERGY project will provide an in-depth analysis of the algorithms that will be used throughout the data analytics and other tools of the platform. By the end of this project, useful insights on the platforms' operation shall be obtained.

The e-commerce Directive

The SYNERGY project reassures that it will comply with the rules on transparency of information, the rules for online service providers and the electronic contracts for data that will be put forward through the SYNERGY platform.

4.4 Conclusions

In the previous section, the regulatory context at national level of the pilots was provided under the prism of SYNERGY demo cases implementation. Under this context, the following was presented:

- The questionnaire and its objective.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- The analysis of the regulatory regime at national level of the pilots.
- The analysis of the pilots' feedback.

The main conclusions drawn from this analysis are:

- The regulatory status at national level for all demos is satisfying and in a good level of completeness.
- With respect to the AI related risk assessment of the demo cases, no significant barriers are identified since most of AI systems are low or no risk, while for those characterized as high risk, relevant requirements have been introduced by the partners in terms of documentation provision. This means that all demo cases can be implemented and the risk of non-implementation is quite low. For the case of missing regulation, the applied solutions are discussed below.
- The importance of the regulations in demo case is ranked by the pilots' partners. Although this is subjective, all partners are aligned and the ranking has low dispersion showing a common understanding.
- An update for the implementation of the demo cases in relevance to the regulations has been performed from all pilots.

Regarding the main omissions of the national regulations, the following summary points have been deduced based on the conducted analysis:

Greek Demo: It is foreseen that no big barriers for Greek Demo Cases will be confronted. Some legislations that are missing seem to be relevant but not of high importance for Demo Cases implementation. On the other hand, some relevant regulations that are missing at national level such as the eIDAS, have been adopted under the National Regulatory Framework, as imposed by the EC. Regarding the Smart Contracts and Blockchain regulation, it is worthwhile mentioning that is not perceived of critical importance by the demo partners of the project, since:

1. Several legal issues pertaining to smart contracts and blockchain engines are addressed in the eIDAS and GDPR regulations.

2. Once a specific regulation is enforced at EU level, it is not expected to introduce any significant constraint to the SYNERGY demo cases (rather it will facilitate their deployment and the realization of the novel business models of the project upon the principles of data sharing) and is expected to be directly adopted to national frameworks without any significant alterations.

The SYNERGY platform and data sharing mechanisms, will, in any case, ensure total compliance with eIDAS and GDPR, while having the flexibility to easily address any additional regulatory requirement enforced by upcoming regulations, to safeguard the smooth deployment of the SYNERGY solutions and implementation of the demonstration activities in the demo counties. Further support to this direction will be provided by the LEPI Officer (Legal and Policy Officer) of the project to ensure compliance with existing regulations and address critical legal issues in the establishment of smart contracts but also proactively perform technological adaptations to comply with forthcoming ones; and this holds true for all the demos as well.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Spanish Demo: It seems that the omissions in regulations reported within D2.3, are now in place at national level and no obstacles nor issues are expected in the implementation of the respective Demo Cases.

Austrian Demo: Most regulation is in place. Electricity Regulation and RES Directive that are of medium importance are missing so it is expected that an alternative solution will be proposed in case that these regulations are still missing by the pilot deployment. Also, it is worth mentioning that Gussing area has the experimental status from the Austrian Government, which gives SYNERGY enough freedom to apply innovative concepts even in the case some regulations are missing.

Finish Demo: All regulation is in place, so no regulatory barriers are foreseen.

Croatian Demo: Most regulations are in place. The omission of the energy communities' legislation does not affect the implementation of the demo case as already described in previous Table. Regarding the eiDAS omission, provisions of the eIDAS regulation will be considered in the design of the platform even if it has not been adopted to the national framework.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

5 Socio-economic and organizational analysis of obstacles pertaining to SYNERGY

5.1 Methodology

The purpose of the second iteration of the socio-economic and organisational barrier analysis was to assess if there was any change in the perspective of the pilot partners with regards to the impact of each of the identified barriers. To assess this change, within the questionnaire used for the second iteration, partners were provided with a benchmark score from the first iteration. For the second iteration of the socioeconomic questionnaire, the benchmark score provided to partners was the average impact rating of each barrier calculated at the national level. For example, if three Greek partners provided scores of 3, 4 and 5 for Q1 in the first iteration, in the second iteration questionnaire, partners were asked if they disagreed with an impact score of 4.

The same methodology for presenting a benchmark score from the first iteration was also used for the organisational barriers, the only exception was that scores were averaged across organisation type (e.g. DSO, RES operator, etc.) rather than at the national level (questionnaires issued to partners are provided in ANNEX C for the socioeconomic and organisational barriers).

5.2 Quantitative analysis

5.2.1 Socio-economic barriers

Table 22 to Table 26 display the changes indicated by partners for the socioeconomic barriers for each demo case. Each table shows the previous rating from the first iteration in the second column, each subsequent column displays any change in score and the explanation for change provided by partners. If no change in response was provided it is omitted from the tables below.

No changes were indicated for demo cases 3 and 7-21, hence the tables are not hereby presented to avoid repetition.

Table 22 Changes in socio-economic barriers – DC1

Column A Potential Barrier	Column B Previous rating	Column C VERD
Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	4	5 - In our case this barrier is of high importance since we are exploring local flexibility
Lack of holistic regulatory framework that fosters innovation providing whole system benefits (e.g. no mechanisms for trading and remunerating flexibility)	4	5 - As per our answer in the previous round we consider this barrier of high importance in DC1

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A Potential Barrier	Column B Previous rating	Column C VERD
Concerns for the process of moving innovative energy services into “business as usual”	3	1 - We do not believe there are concerns on how innovation is going to disrupt BAU if an enabling regulatory framework exists
Lack of a true participation from ALL actors in the energy chain (e.g. is there a clear pathway for consumer/prosumer representation through aggregation and are there viable business cases for aggregation in existence)	3	5 - From our perspective a clear setting of the electricity market in terms of flexibility regulatory framework is currently missing thus posing a socio-economic barrier to all participants to be able to enter the market

Table 23 Changes in socio-economic barriers – DC2

Column A Potential Barrier	Column B Previous rating	Column C VERD
Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	4	5 - In our case this barrier is of high importance since we are exploring local flexibility
Lack of equal opportunities for all parties with regards to investing and the benefits of generated wealth	3	5 - As per our answer in the previous round we consider this barrier of high importance in DC2
Concerns for the process of moving innovative energy services into “business as usual”	3	1 - We do not believe there are concerns on how innovation is going to disrupt BAU if an enabling regulatory framework exists

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Table 24 Changes in socio-economic barriers – DC4

Column A Potential Barrier	Column B Previous rating	Column C EPA
Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	4	3 - DC4 focuses on portfolio analytics for new services by retailers, therefore neglection of the value of distributed flexibility is not as important as it is for DCs that affect network management.

Table 25 Changes in socio-economic barriers – DC5

Column A Potential Barrier	Column B Previous rating	Column C VERD
Upfront costs (CapEx) for implementing innovative energy services (e.g. smart meters, smart appliances, etc.)	4	5 - In our case this barrier is of high importance since we are exploring local flexibility
Lack of holistic regulatory framework that fosters innovation providing whole system benefits (e.g. no mechanisms for trading and remunerating flexibility)	4	5 - As per our answer in the previous round we consider this barrier of high importance in DC5
Lack of equal opportunities for all parties with regards to investing and the benefits of generated wealth	3	5 - From our perspective a clear setting of the electricity market in terms of flexibility regulatory framework is currently missing thus posing a socio-economic barrier to all participants to be able to enter the market
Concerns for the process of moving innovative energy services into “business as usual”	3	1 - We do not believe there are concerns on how innovation is going to disrupt BAU if an enabling regulatory framework exists
Lack of a true participation from ALL actors in the energy chain (e.g. is there a clear pathway for consumer/prosumer representation	3	5 - From our perspective a clear setting of the electricity market in terms of flexibility regulatory framework is

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A Potential Barrier	Column B Previous rating	Column C VERD
through aggregation and are there viable business cases for aggregation in existence)		currently missing thus posing a socio-economic barrier to all participants to be able to enter the market

Table 26 Changes in socio-economic barriers – DC6

Column A Potential Barrier	Column B Previous rating	Column C VERD
Lack of belief from consumers/prosumers in the narrative of empowerment described in the SYNERGY project, i.e. instead they believe 'empowerment' is not a consumer/prosumer focussed initiative and is in fact merely a tool to promote business agendas	2	3 - We think that the residents of a community might be reluctant to participate in an energy community project without having been given a clear and convincing narrative as to how their investment could benefit them rather than the operator of the community's assets
Lack of trust between local users/consumers and professional stakeholders (e.g. DSO/TSO)	4	2 – This is applicable to aggregators and prosumers but not related to DSO/TSO in the context of DC6
Perception that the energy system is vulnerable to cyber-attack or data security issues	3	1 - We think this is of lower importance as we don't see how participants of the energy community would be worried about data security issues

5.2.2 Organisational barriers

Table 27 to Table 34 display the changes indicated by partners for the organisational barriers for each demo case. Each table shows the benchmark rating from the first iteration in the second column, each subsequent column displays any change in score and the explanation for change provided by partners. If no change in response was provided it is omitted from the tables below.

No changes were indicated for demo cases 3, 4, 7-12 and 17-21, hence the tables are not hereby presented to avoid repetition.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

DC1

For EPA, all changes in rating are explained by the following statement:

"Facility managers/ESCOs rated as impactful. They indeed lack appropriate systems and personnel for data analysis, however their role is limited in this DC (maintain metering equipment and informing other stakeholders about flexibility potential), so lack of data-related expertise is not very impactful. For this reason, we suggest rerating in all potential barriers that they had received a 4."

Table 27 Changes indicated by partners for the organisational barriers – DC1

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	4 - New market rules are being established at the moment in Greece which means that professionals need to be constantly up-to-date.
	Facility manager/ESCO	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
	Aggregator	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Reluctance to abandon closed ICT systems	Aggregator	2	4 - We have increased importance here, as we believe that energy users in Greece would be highly reluctant to abandon well known technologies such as closed ICT systems and move into something innovative.
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		
	Retailer	3	
	Urban planner	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	2	

DC2

For EPA, all changes in rating are explained by the following statement:

"Facility managers/ESCOs rated as impactful. They indeed lack appropriate systems and personnel for data analysis, however their role is limited in this DC (maintain metering equipment and informing other stakeholders about flexibility potential), so lack of data-related expertise is not very impactful. For this reason, we suggest rerating in all potential barriers that they had received a 4."

Table 28 Changes indicated by partners for the organisational barriers – DC2

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management	Aggregator	3	
	Facility manager/ESCO	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
personnel/management systems	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	4 - New market rules are being established at the moment in Greece which means that professionals need to be constantly up-to-date
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	4 - We have increased importance here, as we believe that energy users in Greece would be highly reluctant to abandon well known technologies such as closed ICT systems and move into something innovative.
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	3	
	Urban planner	2	
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	2	

DC5

Table 29 Changes indicated by partners for the organisational barriers – DC5

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	4 - New market rules are being established at the moment in Greece which means that professionals need to be constantly up-to-date.
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
	Aggregator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of compatibility of multi-source data	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	4 - We have increased importance here, as we believe that energy users in Greece would be highly reluctant to abandon well known technologies such as closed ICT systems and move into something innovative.
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	2 - As per our response in the previous round of questionnaires we believe that data sharing would be managed under specific agreements hence this barrier would be easy to overcome
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		
	Retailer	3	
	Urban planner	3	
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	2	

DC 6

Table 30 Changes indicated by partners for the organisational barriers – DC6

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
Lack of agency in the business (e.g. Lack of ownership of building and/or supply equipment)	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator		
	RES operator		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	4	
	Urban planner	3	
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	
	Facility manager/ESCO	3	
	Network operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models	Aggregator	3	
	Facility manager/ESCO	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
(inertia) in favour of current model	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	4 - We have increased importance here, as we believe that energy users in Greece would be highly reluctant to abandon well known technologies such as closed ICT systems and move into something innovative.
	Facility manager/ESCO	2	
	Network operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	2 - This is of low importance for this demo case as concerns over GDPR associated penalties could be easily eliminated if we introduce consent forms signed by the participants of an energy community
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		
	Retailer	3	
	Urban planner	3	
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	VERD
	Retailer	2	
	Urban planner	2	

DC 13

Table 31 Changes indicated by partners for the organisational barriers – DC13

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	2	
	Retailer	2	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		
	Retailer	3	
	Urban planner	3	
Lack of knowledge with regards to new	Aggregator	3	
	Facility manager/ESCO	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
secure data sharing technologies	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	2	

DC 14

Table 32 Changes indicated by partners for the organisational barriers – DC14

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for	Aggregator	3	
	Facility manager/ESCO	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
combining energy data	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Retailer	3	
	Urban planner	2	
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		3 - GDPR and associated penalties might also impact RES operators
	Retailer	3	
	Urban planner	3	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	2	

DC 15

Table 33 Changes indicated by partners for the organisational barriers – DC15

Column A	Column B		Column C	Column D
Potential Barrier	Organisation	Previous rating	EEE	Explanation for change in rating
Lack of appropriate systems or professionals to recognise data value	Aggregator	2		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	2		
	Retailer	2		
	Urban planner	2		
Lack of energy management personnel/management systems	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	3		
	RES operator	1		
	Retailer	2		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C	Column D
Potential Barrier	Organisation	Previous rating	EEE	Explanation for change in rating
	Urban planner	2		
Lack of skilled professionals for combining energy data	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	3		
	RES operator	2		
	Retailer	2		
	Urban planner	3		
I.T. infrastructure insufficient for data processing and storage	Aggregator	2	4	Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	3		
	Network operator	4		
	RES operator	2		
	Retailer	4		
	Urban planner	2		
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	4	Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	3		
	Retailer	4		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C	Column D
Potential Barrier	Organisation	Previous rating	EEE	Explanation for change in rating
	Urban planner	2		
Lack of compatibility of multi-source data	Aggregator	4		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	2		
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	4		
	Urban planner	2		
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	2		
	Urban planner	3		
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2		
	Facility manager/ESCO	4		
	Network operator	4		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C	Column D
Potential Barrier	Organisation	Previous rating	EEE	Explanation for change in rating
	RES operator	4		
	Retailer	3		
	Urban planner	2		
Data Interoperability not being perceived as an important issue	Aggregator	3		
	Facility manager/ESCO	3		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	2		
Reluctance to abandon closed ICT systems	Aggregator	2		
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	3		
Perception that sharing data means data leaving premises	Aggregator	3	4	Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator	4		
	Retailer	3		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C	Column D
Potential Barrier	Organisation	Previous rating	EEE	Explanation for change in rating
	Urban planner	2		
Concerns over GDPR and associated penalties	Aggregator	4		
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator	-		
	Retailer	3		
	Urban planner	3		
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	2		
	Urban planner	2		

DC 16

Table 34 Changes indicated by partners for the organisational barriers – DC16

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
Lack of agency in the business (e.g. Lack of ownership of building and/or supply equipment)	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	-	
	RES operator	-	
	Retailer	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Urban planner	3	
Lack of appropriate systems or professionals to recognise data value	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	2	
	Retailer	2	
	Urban planner	2	
Lack of energy management personnel/management systems	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	1	
	Retailer	2	
	Urban planner	2	
Lack of skilled professionals for combining energy data	Aggregator	3	4 - Developments during the project phase showed, that a higher impact might be given by this aspect
	Facility manager/ESCO	4	
	Network operator	3	
	RES operator	2	
	Retailer	2	
	Urban planner	3	
I.T. infrastructure insufficient for data	Aggregator	2	4 - Developments during the project phase showed, that a

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
processing and storage			higher impact might be given by this aspect
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	2	
	Retailer	4	
	Urban planner	2	
Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	4	
	Urban planner	2	
Lack of compatibility of multi-source data	Aggregator	4	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Retailer	4	
	Urban planner	2	
Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	2	
	Urban planner	3	
Focus placed on daily operations leading to neglection of value of external data	Aggregator	2	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Data Interoperability not being perceived as an important issue	Aggregator	3	
	Facility manager/ESCO	3	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	2	
Reluctance to abandon closed ICT systems	Aggregator	2	4 - Developments during the project phase showed, that a

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
			higher impact might be given by this aspect
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	3	
	Retailer	3	
	Urban planner	3	
Perception that sharing data means data leaving premises	Aggregator	3	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator	4	
	Retailer	3	
	Urban planner	2	
Concerns over GDPR and associated penalties	Aggregator	4	
	Facility manager/ESCO	2	
	Network operator	4	
	RES operator		
	Retailer	3	
	Urban planner	3	
Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3	
	Facility manager/ESCO	4	
	Network operator	4	
	RES operator	4	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Column A	Column B		Column C
Potential Barrier	Organisation	Previous rating	EEE
	Retailer	2	
	Urban planner	2	

5.2.3 Summary of socioeconomic and organisational quantitative analysis

Results showed that only 3 out of 11 partners indicated any change in their responses (VERD, EPA, EEE) for both the socioeconomic and organisational barriers. With regards to the demo cases, for the socioeconomic barriers 16 of the 21 demo cases indicated no change and 13 of the 21 demo cases indicated no change for the organisational barriers. With regards to the responses that did indicate a change in impact rating in the second iteration, out of the 65 questions, 42 only changed by a value of 1 point on the 5-point Likert scale while the other 23 question responses changed by a value of 2 points.

Due to the minimal changes in response, there was no significant change in the impact ratings from the quantitative analysis. Therefore, focus was placed on pursuing a qualitative analysis that would provide more beneficial and actionable information.

5.3 Qualitative analysis

Follow-up interviews were prepared with partners who indicated a change in impact score for the socioeconomic and organisational barriers. The questions in these follow-up interviews were based around the barriers in the questionnaire which received a change in impact rating of 2 or more points.

5.3.1 Socio-economic barriers

The final list of the socioeconomic barrier questions and responses for the follow-up interviews are shown by country in Table 35.

Table 35 Socio-economic follow-up interview questions and responses

Pilot region	Related demo case	Question from survey	Follow-up interview questions and response
Greece (VERD)	DC1 & 5	Q8 - No true participation for all actors	In the questionnaire, you indicated there is an issue with regards to a lack of a true participation from ALL actors in the energy chain. You stated that from your perspective, a clear setting of the electricity market in terms of flexibility regulatory framework is

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Pilot region	Related demo case	Question from survey	Follow-up interview questions and response
			currently missing, thus posing a socio-economic barrier to all participants to be able to enter the market.
		Question	1. Does this mean a centralised structure would remain?
		Partner response	A centralised structure would help create a market and allow participation from all actors as a first step. Once the centralised structure has been established then perhaps, we could consider other decentralised approaches as well.
		Question	Are there any frameworks or other potential solutions in development that could mitigate this
		Partner response	No other frameworks exist at the moment. There is no potential solution to the unavailability of a market that doesn't exist, however since the development of the framework is currently on the way, prosumers could start investing in flexible assets targeting self-consumption optimisation in their premises. This would allow them to understand the concept of flexibility and the technology behind it, thus being able to participate in a more centralised market when it is structured and available to all energy actors.

5.3.2 Organisational barriers

The final list of the organisational barrier questions and responses for the follow-up interviews are shown by stakeholder in Table 36.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Table 36 Organisational follow-up interview questions and responses

Stakeholder	Related demo case	Question from survey	Follow-up interview questions and response
Aggregator (VERD)	DC1, 2, 5 & 6	Q13 - Reluctance to abandon closed ICT systems	You suggested that there would be a reluctance to abandon closed ICT systems as energy users in Greece would be highly reluctant to abandon well known technologies such as closed ICT systems and move into something innovative.
		Question	What do you think is the main reason not to abandon the current systems?
		Partner response	The main reasons for not abandoning well established systems are typically related to additional investment needed in time and capital expenses in order to transition to a new system. For the energy users in Greece, abandoning closed ICT systems and moving into something more innovative would mean that they would need to bring in new personnel to manage the new systems or train the existent personnel, thus increasing the cost of their operation for a short period of time and also potentially disturbing Business-As-Usual for the transitioning period. However, we think that the reluctance applies more to larger, often institutional organisations, which present higher inertia in changing their business practices. Smaller and more agile companies would be more flexible in adopting modern technologies and transition to more innovative ways of operating.
		Question	What sort of incentives or motivation would promote change?
		Partner response	Government funding mechanisms New regulation making the new systems necessary

Stakeholder	Related demo case	Question from survey	Follow-up interview questions and response
			Placement of personnel with more innovative mentality in managerial positions, to encourage existing personnel to adopt modern technologies and understand their advantages and potential benefits.
Aggregator (VERD)	DC6	Q15 - Concerns over GDPR and the associated penalties	You stated that concerns over GDPR and the associated penalties is of low importance for Demo case 6 in SYNERGY as GDPR issues could be easily eliminated if we introduce consent forms signed by the participants of an energy community.
		Question	Do you think it would be easy to implement consent forms and how could you ensure users would sign them?
		Partner response	We think that it would be easy to introduce consent forms as part of the agreement to an energy community scheme, thus including them in the contract signing process which would mean that we would ensure that the users are legally bound to sign them.
		Question	Would there be any reluctance from the users to give consent and how could you encourage compliance - would they require additional reassurance/information
		Partner response	One way to reassure the customers that where would be no GDPR issues, would be that the aggregator managing the customers' data would ensure their anonymisation before uploading them into any online platform or market tool. Another way to encourage end-customers to provide their consent in sharing their data would be to adopt shared-benefits schemes between the relevant parties of an agreement in the case where data would be purchased

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Stakeholder	Related demo case	Question from survey	Follow-up interview questions and response
			through SYNERGY's marketplace but outside the scope of Demo Case 6.
Aggregator and RES operator (EEE)	DC13, 14, 15 & 16	Q6 - I.T. infrastructure insufficient for data processing and storage	You indicated that I.T. infrastructure being insufficient for data processing and storage has the potential to be highly impactful as a barrier due to developments in the SYNERGY project.
		Question	What developments during the projects related to I.T. infrastructure have led to this being a more potentially impactful barrier?
		Partner response	In the pilot we faced different challenges that became more important, such as often missing infrastructure or devices to communicate to access the data. Furthermore, access via web portals is not sufficient for extracting data. Therefore, there is a need to communicate with those who collect and store data externally, which has been a challenge. There is no plug and play solution so I.T companies and manufacturers have to be communicated with, which is challenging
		Question	What do you think are the potential solutions to avoid this problem?
		Partner response	A trial-and-error approach for solutions to see which system works best to get access to data is being attempted at EEE. There is a homing-system, which is a gateway/cloud that can communicate with other installations and I,T equipment, so they have a plug and play solution that can be installed in the houses. Hopefully one adapter can be developed that makes this communication problem easier, this has been installed in one house and it

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Stakeholder	Related demo case	Question from survey	Follow-up interview questions and response
			is currently being tested. They are also trying a commercial gateway product that can be installed in the home that works with variety of vendor interfaces such as heating, PV, etc.
Aggregator (EEE)	DC16	Q13 - Reluctance to abandon closed ICT systems	You stated that the reluctance to abandon closed ICT systems also has the potential to be highly impactful due to developments during the project phase.
		Question	What sort of developments led you to believe this barrier has the potential to be more impactful?
		Partner response	If the ICT system is closed then data communication and access to things such as API becomes problematic, they cannot communicate change or give commands. It is difficult to access API. If access is limited to web platforms, this is not optimal. This problem is due to the vendors, not the internal operations of companies such as EEE or the customer
		Question	What are the potential solutions to encourage the use of open systems?
		Partner response	A solution might be to inform vendors of the potential business interest and opportunity. Furthermore, informing them of the benefit being part of something innovative and the future market. If they have closed systems, they shut this option down of being part of an innovative transition.
RES operator (EEE)	DC13, 14 & 15	Q15 - Concerns over GDPR and the associated penalties	You highlighted the concerns over GDPR and the associated penalties might also impact RES operators.
		Question	How does GDPR impact RES operators?
		Partner response	This related to the project, the RES operators in general do not have insight or knowledge on GDPR – it does

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Stakeholder	Related demo case	Question from survey	Follow-up interview questions and response
			not affect them in general, but they are insecure about who has access to the data and who uses it within the energy community. From the perspective of the prosumer, consumer or RES operator, they do not know who accesses and uses their data, they have uncertainty. Although the existence of GDPR intends to lift those concerns, I think people do not pay attention to the details of consent forms, the more they pay attention or address the topic of GDPR it creates insecurity as a general topic

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6 Living Lab Activities (GECO, VERD)

This chapter describes the approach followed, the activities performed and the results obtained from the qualitative approach followed as part of the SYNERGY Living Labs pertaining to the proceedings of T2.2 of the project during both phases of the task. It is as such structured to provide the purpose of the internal validation activities and process followed, the structuring of the interviews and the results of the internal validation.

6.1 Purpose of the Internal Validation Activities and Process Followed

The collaborative approach utilised in the SYNERGY project was extended in the proceedings of T2.2 by formulating an appropriate process to increase the information sourcing, acquiring further feedback as well as validating the main conclusions stemming from the survey and questionnaire-based analyses.

The validation activities were conducted in two phases.

During the first phase of the task, the issues that have been identified by the SYNERGY partners as potential obstacles in driving the energy transition via the SYNERGY concept were analysed and the Living Lab validation process has been developed with the aim to:

- Identify appropriate partners from the SYNERGY consortium that represent the full electricity data value chain;
- Evaluate comprehensively their responses from the initial questionnaire-based engagement;
- Engage with appropriate business leaders from their organisations that could offer an expert view on regulatory and organisational barriers that embody as well a national landscape of their industry;
- Define, structure and perform dedicated interviews that aimed at revealing the main pains of the electricity data value chain stakeholders as well as provide further input, separate to the input provided by the business contacts working in the SYNERGY project, regarding gains expected to be achieved by a data value intensive project applied in their domain.

An initial stakeholder group was as such created, involving partners from IPTO, CAV, EEE, CUERVA and HEDNO representing the TSO, Facility Manager, Aggregator, RES Operator and DSO industry respectively. Appropriate business leaders from IPTO, CAV and EEE were engaged by their respective colleagues that are directly associated with SYNERGY and interviews were arranged. The coincidence of the summer period, the pandemic and potential inter-organisational During the second phase of the task, and aiming at updating deliverable D2.3, a new round of validation activities has been conducted with the aim to:

- Clarify the feedback from some of the partners on the updated questionnaires and evaluate comprehensively their responses engagement;
- Discuss in more detail the reasons why partners significantly changed their perspective on the impact of barriers in the second iteration

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

- Engage with internal stakeholders we weren't able to reach during the first round of interactions

The feedback from the additional activities is reported in sections 4 and 5 of the current deliverable.

6.2 Interview Structuring

Appropriate planning was undertaken to help the interviewees prepare for the interview and acquire the envisaged feedback by the industry experts in both phases of T2.2. Specifically, during the first phase of the task, the interviews were structured to contain:

- A generic presentation of the SYNERGY project that focusses on the benefits (i.e. data pre-processing services, data outreach increase, analytics and services) that SYNERGY partners can enjoy by being part of the SYNERGY ecosystem.
- A structured part that comprised:
    - Generic questions aimed at identifying the perception of the interviewee regarding the value of SYNERGY for their organization as well as identifying any blocking issues on data exchanges or additional considerations that SYNERGY could undertake further from its initial objectives provided in the presentation.
    - Partner specific questions which were formulated to elaborate on the main barriers identified through their questionnaire responses as well as discuss any additional aspects that could enhance the design of the SYNERGY platform to help them overcome their identified constraints. For this reason, the respective Use Cases that relate to their identified, most impactful barriers, were communicated in advance of the interview.
- An unstructured part that aimed to provide the time and environment to the interviewee to bring up any open feedback, concerns or considerations related to their view as an industry representative and the SYNERGY project overall.

During the second round of interactions for the updating process of D2.3., the structure of the interviews has been simplified to contain specific follow-up questions to consortium partners whose feedback on the questionnaires distributed could be discussed further. As stated in the previous section, the follow-up interviews were structure aiming at clarify the feedback from some of the partners on the updated questionnaires and discussing in more detail the reasons why some of them s significantly changed their perspective on the impact of barriers in the second iteration.

6.3 Results from the Internal Validation Process

Results from the first round of the internal validation process are reported as per bellow:

The interviewees who were engaged comprised internal experts from the SYNERGY partner organisations IPTO, EEE and CAV with business roles related with market functions, business development and international projects.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

The main outcomes from the interviews conducted in this phase of T2.2 are summarized as follows.

1. The value of data from various sources is currently not recognized and customers are reluctant to provide their data if the value of such provision is not clear. In addition, there is lack of understanding and skills in combining multi-source data and analysing/deriving insightful value from such processes.
2. The access and handling of large volumes of data could be potentially minimized by using data platforms such as the SYNERGY platform, specifically when such platforms are compatible with Smart City platforms which are currently under development. The internal effort required in organisations for performing such big data handling processes could potentially be deferred, while additional overheads could be minimized by using technology on secure, automated contracts.
3. Users are not usually positive in sharing their data if their use is not clearly anonymised and/or remunerated.
4. Data sharing from utilities has additional complexities that require alignment with internal policies and National/EU regulations which contain various levels of interorganizational constraints reflecting the numerous data owners (such as customer data, public infrastructure data, national interconnections data, market data etc). Furthermore, different approval levels for data sharing might exist as European utilities are in the verge of digital transformation nowadays and data from different systems and users might require different approvals from various departments as well potential non-disclosure agreements with legal departments for particular data use.
5. Regulation is driving innovation in flexibility of energy systems and when existing frameworks do not promote nor facilitate such innovation, it is hard for regulated entities and aggregators to create the necessary skills and processes required to facilitate such developments.
6. Innovative data-driven business models need to take into account also the cost of accessing of assets that are not “connected assets” and as such require further infrastructure to enable data sharing driven business cases.
7. Data quality, accuracy and multi-source compatibility (particularly related with data from different systems and subsystems with different formatting, timestamping etc) are blocking the identification of value of data. Data linking (e.g. information coming from asset management, operations, customer support, accounting etc) inter-organizationally is not always exploited.
8. Data security aspects particularly related to the advancements of communications technology (e.g. 5G) requires further understanding. The translation and secure use or compliant co-functioning of legacy protocols requires further understanding.
9. Demo partners of SYNERGY require early engagement to help drive the implementation of the SYNERGY Use Cases and align with their organizational strategy and relevant departments, which for large and/or regulated industries presents additional complexities.

Results from the second round of the internal validation process are reported as per below:

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

1. In the Greek region, the lack of true participation for all actors has the potential to be problematic. This is due to no clear setting of the electricity market in terms of flexibility regulatory framework. The creation of such a framework can be initiated in the current centralised structure and once this has been established then decentralised approaches can be considered. Although no such flexibility framework currently exists, it is under development. The opportunity for prosumers may reside in investing in flexible assets targeting self-consumption optimisation in their premises which would allow them to understand the concept of flexibility and the technology behind it and subsequently, participate in the market.
2. Regarding the upcoming AI regulation, from the retailer's side in Greece, AI and analytics are already used in-house to analyse patterns and customers' behaviours as well as to run forecasting algorithms but doesn't at the moment affect any operation. Any analytics currently performed are on anonymised data following the GDPR regulation, hence generally considered low risk.
3. Energy users in Greece would be highly reluctant to abandon familiar ICT systems due to the fear of additional investment needed in time and capital expenses in order to transition to a new system. This expense would include hiring new personnel to manage the new systems or train the existent personnel. This innovative switch from their perspective not only incurs additional cost, but also disturbs business-as-usual during the transition period. This issue is a more impactful barrier for larger organisations reluctant to change business practices, smaller companies are more flexible and open to innovative change.
4. An additional barrier of closed ICT systems is related data communication. Data communication and access to API becomes problematic due to the lack of ability to change or give commands. If access is limited to web platforms, then data communication is sub-optimal. This problem resides in the procedures and restrictions that comes from vendors. A solution might be to inform vendors of the potential business interest and opportunity. Therefore, a potential solution would be to inform vendors of the benefits of an open system in an innovative future market.
5. Related to closed ICT systems, I.T. infrastructure being insufficient for data processing and storage has the potential to be highly impactful. Problems were encountered in the Austrian pilot related to missing infrastructure or devices that permit communication and access to the data. This created a barrier of needing to communicate with those who collect and store data externally as there is no plug and play solution. A trial-and-error approach for solutions to see which system works best to get access to data is being attempted at the Austrian pilot. There is a homing-system, which is a gateway/cloud that can communicate with other installations. In addition, a commercial gateway product that can be installed in the home that works with variety of vendor interfaces such as heating, PV, etc. is being trialled.
6. A barrier may exist with regards to GDPR and RES operators. At a high-level RES operators do not have insight or knowledge on GDPR. Consequently, they are insecure about who has access to the data and who uses it within the energy community. Despite the purpose of GDPR being to protect privacy and data access, these details are not understood. Therefore, without proper attention to the details of consent forms and knowledge on what GDPR is intended for, attention towards GDPR instead creates insecurity and reluctance.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

7. At a more specific level on the topic of GDPR, this barrier became less significant in the second iteration of the barriers' investigation compared to the first for DC 6. This decrease in impact is explained by a simple mitigation strategy of introducing consent forms in the contract signing process for the participants of an energy community. Encouraging participants to sign this consent form can be done through reassuring the customers that where would be no GDPR issues and the aggregator managing the customers' data would ensure their anonymisation before uploading data onto an online platform or market tool.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

7 Conclusions and next steps

This work instantiates the current national regulatory regimes on one hand and the organizational culture of the project's consortium on the other, prior to the implementation phase of the various demo cases of the project. D2.4, reports the initial work conducted in T2.2 of SYNERGY concerning the regulatory, socio-economic and interorganizational aspects which might pose obstacles to the innovations promoted by SYNERGY and updates the previous version of this deliverable (D2.3), as indicated by the task (T2.2) implementation methodology.

The study and analysis of the regulatory domain comprised an extensive literature review to identify relevant regulations at the European level and formulate a detailed survey which was circulated to all SYNERGY pilot partners who participate in the SYNERGY Demo Cases during the first phase of the task. The aim of the survey has been to identify whether or not appropriate regulations exist at a national level and their impact on the respective Demo Cases. The analysis of the survey results showed that the compilation of European Policies (regulations/directives) related to Innovative Energy Services and Data Exchanges, gathered by the regulatory state-of-the-art analysis, are directly related to the SYNERGY Demo Cases. The overall regulatory analysis has been updated with feedback acquired from prototyping phase of the project and report on any evolution in the regulatory domain relative to SYNERGY's objectives

- Considering the national enforcement of the EU policies in the demo countries of SYNERGY's consortium, Spain, is found to be the one that currently presents the most regulatory gaps pertinent to SYNERGY innovation, compared to Greece, Austria, Croatia. It was also shown, that policies related to the introduction of new technologies such as Electronic Identification, Authentication and Trust Services (eIDAS), smart contracts & blockchain or ethics in artificial intelligence were missing from almost all demo countries.

- During the updating process reported in this deliverable, the Austrian input has been updated to indicate that the eIDAS regulation exists in Austria. Specifically, a central eIDAS node exists, that enables EU citizens to log in to Austrian online applications with the electronic identity (eID) of their EU country of origin. Similarly, on the Greek Demo Cases (DCs), the eIDAS regulation was originally reported to be missing in Greece. However, it has now been reported that a new regulation on digital governance, including all aspects of eIDAS, has been released in September 2020. Regarding the Croatian DC21, a correction was made to indicate that eIDAS is not missing at a national level and more specifically, starting in September 2018, a Croatian eIDAS node has been established and put into full function. As such the National Identification and Authentication System (NIAS) national authorization services were made compliant with eIDAS at that time. Regarding the Spanish DCs, an update has been provided to indicate that all regulations that were missing during the first round of the questionnaires, are now in place. Additionally, an update has been provided in the relevance of the Energy consumers rights (particularly DC 9, 10, 11, 12), since the Spanish demo site is focused in a rural community area with real customers. Finally, on the Austrian DCs 13 to 16 the Energy communities' legislation has been updated as a currently existing legislation since the Renewable Energies Expansion Act has been adopted.

The overall analysis as well as the updating process indicated that no significant barriers exist in implementing the Demo Cases of SYNERGY in the pilot-related countries of Greece, Spain, Finland,

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Austria and Croatia; For the regulatory aspects where there is still absence of related regulation, such as for blockchain, the consortium will ensure that the SYNERGY platform will be developed to facilitate transparency and flexibility in complying with future regulations.

The impact and relevance of existing regulations on the SYNERGY Demo Cases was also analysed by means of perception analysis of the SYNERGY demo partners via their responses on the survey-based quantitative study. The initial engagement through the Living Labs showed that no major barriers exist, or where there are complexities, measures such as internal governance procedures and experimental agreements can be put in place to overcome these barriers, these discrepancies were attributed to the personal perception of the survey respondents as part of their business role or the specific role of their organization in each specific Demo Case.

With respect to the AI related risk assessment of the demo cases, no significant barriers are identified since most of AI systems are characterized as “low or no risk”, while for those characterized as “high risk”, relevant requirements have been introduced by the partners in terms of documentation provision.

The socio-economic and organizational aspects related to SYNERGY were studied by means of an initial comprehensive literature review targeting at identifying such barriers through prominent literature sources. This state-of-the-art analysis was complemented by the relevant survey towards the demo partners which offered results that relate to three distinct levels; the national level, the organizational level and the stakeholder-type level.

- On the national level of this analysis, common ground was found in terms of the barriers that exist, such as i) Neglecting the value of system flexibility in Greece, Austria and Finland, ii) Concerns on the conversion process of innovation into “business as usual” in Spain, iii) Lack of consideration for diversity of interests in Finland, iv) lack of CAPEX sponsorship for investments in Croatia, are of particular importance across the electricity value chain in the respective countries.
- On the organizational level, some barriers are commonly highlighted in the results across almost all organizations. Such barriers are mainly i) the application and various considerations of GDPR, ii) the lack of data governance in place to identify the value in vast data quantities generated, iii) the lack of compatibility of multi-source data and iv) inability to deal with overly complex data and models promoted in platforms like the one envisaged by SYNERGY.
- In the stakeholder-type level, there are important indications that barriers such as: i) the lack of consumer awareness on the benefits on the various innovative energy services and ii) the lack of a true and viable (business-wise) pathway for the participation of all actors in the energy chain, constitute serious obstacles against the uptake of innovative projects, such as SYNERGY, almost across the electricity value chain.

The socio-economic analysis highlighted three main barriers that were raised among all participants and primarily relate to the lack of consumer awareness of benefits from the applications envisaged by SYNERGY as well as the exclusion of societal groups in the definition and targeting of innovative energy services. The neglection of value of system flexibility was additionally highlighted as an aspect that requires consideration. These highlights along with the remaining points raised from our analysis provided in Chapter 5, provide useful inputs for the SYNERGY platform design, as well as further focus points on identifying and facilitating ways to overcome them using the collaborative SYNERGY Living Labs.

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

In the previous version of this deliverable (D2.3) our socio-economic and organizational analysis also showed that a number of issues exist that are particularly related to the perception of the value that data sharing and data analytics can bring to organizations and their customers via the utilization of currently unused data, either by increasing internal business intelligence or by enabling the provision of innovative energy services. During the updating process, the analysis showed that only 3 out of 11 partners indicated any change in their responses (VERD, EPA, EEE) for both the socioeconomic and organisational barrier questions. With regards to the demo cases, for the socioeconomic barriers 16 of the 21 demo cases indicated no change in any of the questions and 13 of the 21 demo cases indicated no change for the organisational barriers. With regards to the responses that did indicate a change in impact rating in the second iteration out of the 65 questions in total, 42 only changed the score by 1 point on the 5-point Likert scale, while the other 23 question responses changed by 2 points.

The Living Labs approach of SYNERGY was utilized in the proceedings of T2.2 and extended to formulate an approach to gather qualitative inputs from partner entities of the project and validate internally the findings from this task's analyses.

During the first round of iterations, the inputs from the regulatory, socio-economic and organizational analyses were utilized to design interviews that aimed to specifically address any discrepancies identified from the above analyses, elaborate on any other barriers that partners may foresee, as well as provide the opportunity to discuss specific Use Cases which break-down the practical implementation aspects of the Demo Cases and have been in parallel developed in T2.1. An initial stakeholder group was created with the aim to include a diversified and complete cluster of representative experts from the European electricity data value chain from partner organizations participating in SYNERGY.

The initial round of engagement that occurred in this reporting period of T2.2 included interviews with business experts from the TSO (partner IPTO), Aggregation (partner EEE) and Facility/Building Management (partner CAV) functions of the electricity data value chain. A number of useful outputs were obtained and summarized in deliverable D2.3.

The second round of engagement, has been simplified and was aiming at following-up on the specific partners, whose feedback during the updating process of the deliverable needed further discussion. In some cases emails with some additional questions have been sent out to the relevant partners (VERD, CUE, HEDNO, FVH, URB), while in others short interviews were conducted with relevant partners (EPA, EEE). Feedback from both rounds of engagement is provided in section 6 of this deliverable.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

8 References

SYNERGY Consortium. (2019). *SYNERGY GA - ANNEX 1.*

SYNERGY Consortium. (2020). D2.3 Socio-economic and regulatory analysis of obstacles to innovation.v1

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0001.01.ENG. (n.d.).

https://gdpr-info.eu/. (n.d.).

http://www.preslmayr.at/tl_files/Publikationen/2011/Article_Smart_Metering.pdf. (n.d.).

https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-864-F2-EN-MAIN-PART-1.PDF. (n.d.).

https://www.eublockchainforum.eu/sites/default/files/reports/report_legal_v1.0.pdf. (n.d.).

https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/640163/EPRS_BRI(2019)640163_EN.pdf. (n.d.).

https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive_en?redir=1. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0031. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016PC0861R(01)&from=EN. (n.d.).

https://www.energypoverty.eu/measure-policy/law-energy-communities. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32018L2002. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0662. (n.d.).

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206. (n.d.).

Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action. (21.12.2018, p. 1–77). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL.

2005/89/EC, R. (.-p. (14.6.2019, p. 1–21). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0001.01.ENG.

Protection, R. (. (04.05.2016, pp.1-99). https://gdpr-info.eu/.

electricity, D. O. (n.d.). *30.11.2016, pp1-124.* https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-864-F2-EN-MAIN-PART-1.PDF.

contracts, L. a. (2019, pp1-38). *THE EUROPEAN UNION BLOCKCHAIN.* https://www.eublockchainforum.eu/sites/default/files/reports/report_legal_v1.0.pdf.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Service, E. P. (2019,pp1-13). *EU guidelines on ethics in artificial intelligence:Context and implementation.* https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/640163/EPRS_BRI(2019)640163_EN.pdf.

renewable, D. (. (2018). *21.12.2018, p. 82–209.* https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive_en?redir=1.

performance, D. 2. (n.d.). *8.6.2010, p. 13–35.* https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0031.

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCILon the internal market for electricity. (n.d.). *23.2.2017,pp1-32.* https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016PC0861R(01)&from=EN.

Law on Energy communities. (n.d.). *2018, pp 1-20.* https://www.energypoverty.eu/measure-policy/law-energy-communities.

Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency. (n.d.). *21.12.2018, p. 210–230.* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32018L2002.

Trieb, R. K. (Volume 1, Issue 2, May 2011, Pages 121–128). *Smart metering under EU data protection law.* International Data Privacy Law,.

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal market in electricity 30.11.2016, pp1-124. (n.d.). https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-864-F2-EN-MAIN-PART-1.PDF.

Legal and regulatory framework of blockchains and smart contracts, 2019, pp1-38. (n.d.). *THE EUROPEAN UNION BLOCKCHAIN.* https://www.eublockchainforum.eu/sites/default/files/reports/report_legal_v1.0.pdf.

EU guidelines on ethics in artificial intelligence:Context and implementation Service, European Parliamentary Research, 2019, pp1-13. (n.d.). https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/640163/EPRS_BRI(2019)640163_EN.pdf.

Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable, 21.12.2018, p. 82–209. (2018). https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive_en?redir=1.

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance,8.6.2010, p. 13–35 . (n.d.). https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0031.

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal market for electricity, 23.2.2017, pp1-32. (n.d.). https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016PC0861R(01)&from=EN.

Law on Energy communities,2018, pp 1-20. (n.d.). https://www.energypoverty.eu/measure-policy/law-energy-communities.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Directive 2018/844/EU of the European Parliament and of the Council on the energy performance,2018, p. 13–35. (n.d.). https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0031.

Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

Hertel, M., & Menrad, K. (2016). Adoption of energy-efficient technologies in German SMEs of the horticultural sector—the moderating role of personal and social factors. *Energy Efficiency*, *9*(3), 791-806.

Gross, C. (2007). Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. *Energy policy*, *35*(5), 2727-2736.

Fournis, Y., & Fortin, M. J. (2017). From social 'acceptance' to social 'acceptability' of wind energy projects: towards a territorial perspective. *Journal of environmental planning and management*, *60*(1), 1-21.

Alexander, K. A., Wilding, T. A., & Heymans, J. J. (2013). Attitudes of Scottish fishers towards marine renewable energy. *Marine Policy*, *37*, 239-244.

Firestone, J., Kempton, W., Lilley, M. B., & Samoteskul, K. (2012). Public acceptance of offshore wind power: does perceived fairness of process matter?. *Journal of environmental planning and management*, *55*(10), 1387-1402.

Wright, L. T., Shankar, A., Cherrier, H., & Canniford, R. (2006). Consumer empowerment: a Foucauldian interpretation. *European Journal of Marketing*.

Newell, P., & Mulvaney, D. (2013). The political economy of the 'just transition'. *The Geographical Journal*, *179*(2), 132-140.

Peter, F. (2007). Democratic legitimacy and proceduralist social epistemology. *Politics, philosophy & economics*, *6*(3), 329-353.

Peter, F. (2009). *Democratic legitimacy*. Routledge.

Walker, G., Devine-Wright, P., Hunter, S., High, H., & Evans, B. (2010). Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy policy*, *38*(6), 2655-2663.

Huijts, N. M., Molin, E. J., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and sustainable energy reviews*, *16*(1), 525-531.

Cohen, J. J., Reichl, J., & Schmidthaler, M. (2014). Re-focussing research efforts on the public acceptance of energy infrastructure: A critical review. *Energy*, *76*, 4-9.

Enevoldsen, P., & Sovacool, B. K. (2016). Examining the social acceptance of wind energy: Practical guidelines for onshore wind project development in France. *Renewable and Sustainable Energy Reviews*, *53*, 178-184.

Rogers, J. C., Simmons, E. A., Convery, I., & Weatherall, A. (2008). Public perceptions of opportunities for community-based renewable energy projects. *Energy policy*, *36*(11), 4217-4226.

Goedkoop, F., & Devine-Wright, P. (2016). Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects. *Energy Research & Social Science*, *17*, 135-146.

Wagner, A., Grobelski, T., & Harembski, M. (2016). Is energy policy a public issue? Nuclear power in Poland and implications for energy transitions in Central and East Europe. *Energy Research & Social Science*, *13*, 158-169.

Zou, C., Zhao, Q., Zhang, G., & Xiong, B. (2016). Energy revolution: From a fossil energy era to a new energy era. *Natural Gas Industry B*, *3*(1), 1-11.

Kornmeier, K. (2009). *Determinanten der Endkundenakzeptanz mobilkommunikationsbasierter Zahlungssysteme: Eine theoretische und empirische Analyse* (Doctoral dissertation, Duisburg, 2009).

Pohl, A. (2013). *Leapfrogging bei technologischen Innovationen: ein Erklärungsansatz auf Basis der Theorie des wahrgenommenen Risikos* (Vol. 227). Springer-Verlag.

Olsthoorn, M., Schleich, J., & Hirzel, S. (2017). Adoption of energy efficiency measures for non-residential buildings: technological and organizational heterogeneity in the trade, commerce and services sector. *Ecological Economics*, *136*, 240-254.

Russom, P. (2011). Big data analytics. *TDWI best practices report, fourth quarter*, *19*(4), 1-34.

Clegg, S., & Mancarella, P. (2015). Integrated electrical and gas network flexibility assessment in low-carbon multi-energy systems. *IEEE Transactions on Sustainable Energy*, *7*(2), 718-731.

Boroumand, R. H., Goutte, S., Porcher, S., & Porcher, T. (2015). Hedging strategies in energy markets: The case of electricity retailers. *Energy Economics*, *51*, 503-509.

Stephens, J. C., & Jiusto, S. (2010). Assessing innovation in emerging energy technologies: Socio-technical dynamics of carbon capture and storage (CCS) and enhanced geothermal systems (EGS) in the USA. *Energy Policy*, *38*(4), 2020-2031.

Raisbeck, P. (2008). Perceptions of architectural design and project risk: understanding the architects' role in a PPP project. *Construction Management and Economics*, *26*(11), 1145-1157.

Barlow, J., & Köberle-Gaiser, M. (2008). The private finance initiative, project form and design innovation: The UK's hospitals programme. *Research Policy*, *37*(8), 1392-1402.

Fleiter, T., Schleich, J., & Ravivanpong, P. (2012). Adoption of energy-efficiency measures in SMEs—An empirical analysis based on energy audit data from Germany. *Energy Policy*, *51*, 863-875.

Kane, L., & Ault, G. (2014). A review and analysis of renewable energy curtailment schemes and Principles of Access: Transitioning towards business as usual. *Energy Policy*, *72*, 67-77.

Khurana, H., Hadley, M., Lu, N., & Frincke, D. A. (2010). Smart-grid security issues. *IEEE Security & Privacy*, *8*(1), 81-85.

Hughes, T. P. (1993). *Networks of power: electrification in Western society, 1880-1930*. JHU Press.

Geels, F. W., Hekkert, M. P., & Jacobsson, S. (2008). The dynamics of sustainable innovation journeys.

Günther, W. A., Mehrizi, M. H. R., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems*, *26*(3), 191-209.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

ANNEXES

ANNEX A - Completed questionnaires for regulatory analysis

In the following tables, the links with the national regulatory regime for the SYNERGY pilots are presented.

Greek pilot

Regulations Categories	Links
Regulation on the Governance of the Energy Union	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL national legislation 4001/2011: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wFYAFdDx4L2G3dtvSoClrL8tvmGnUriqnd5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS_18kAEhATUkJb0x1LIdQ163nV9K--td6SIuS3v_yXlRgG0hVreKJgD7OpdVXDm-LoqkiNWh4xJjj-C Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE
Energy Performance in Buildings Directive	http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEaosRGzKxO6XdtvSoClrL8FRqs4cKiLsftIl9LGdkF53UIxsx942CdyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijNOx90sA8OQhY7bGxs0Y1yLFurA-Dngtvhp1hq0kdTFY
Smart Meters' Legislation	https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0072 national legislation A 143/09.11.2015: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wE4q6ggiv8WTXdtvSoClrL86BYA0d1yFht5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS_18kAEhATUkJb0x1LIdQ163nV9K--td6SIuQpuAYsfWnZnOjEVWl0sgT4NCgtlEtCJDePk6QIHe_RU

	Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE
Energy Consumers Rights	https://eur-lex.europa.eu/legal-content/LV/TXT/?uri=CELEX:52007DC0386 Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE RAE's rulling on guaranteed services towards consumers: http://www.rae.gr/site/categories_new/about_rae/factsheets/2020/maj/0304_1.csp
Renewable Energy Directive	https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32018L2001 Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE
Electricity Regulation	national legislation 4001/2011: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wFYAFdDx4L2G3dtvSoClrL8tvmGnUriqnd5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS_18kAEhATUkJb0x1LIdQ163nV9K--td6SIuS3v_yXlRgG0hVreKJgD7OpdVXDm-LoqkiNWh4xJjj-C Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE
General Data Protection Regulation (GDPR)	https://eur-lex.europa.eu/eli/reg/2016/679/oj http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wFqnM3eAbJzrXdtvSoClrL8WkQtR1OJjJd5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS_18kAEhATUkJb0x1LIdQ163nV9K--td6SIuYy4kEHGmkxu249n-Zw2yYl0mZ9eBCztpQxx39TqtEEk

Energy Communities Legislation	Greek Legislation: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wG3UHk-ZeQumndtvSoClrL8yDC9E5e67ropCCmqt4mgGEHlbmahCJFQEmRQwePEviF8EeCoaT0MAKztT3Sb63xk3VkL3PiCQ3RLoVYQqjKiogfu8Gq1RKKQmyoZK8o4WQMHaONAnxBSKvUvMD4Dsd_dlomlbtDwoPoK4sfzgA8tUg.. Greek network management code: http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wEsrjP0JAlxBXdtvSoClrL8I8z79QigGevtIl9LGdkF52dKwsMi1xmmyqxSQYNuqAGCF0IfB9HI6qSYtMQEkEHLwnFqmgJSA5WIsluV-nRwO1oKqSe4BlOTSpEWYhszF8P8UqWb_zFijBbsyirP3bcZ2sTnzNcfCrrRhg2oFfww3ITf3sOQ0miE
Energy Efficiency Directive	EU Directive: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0027 1st AMD :https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0210.01.ENG http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wE4q6ggiv8WTXdtvSoClrL86BYA0d1yFht5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS
Electronic Identification and Trust Services for Electronic Transactions in the Internal Market and Repealing Directive (eIDAS)	http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wHUdWr4xouZundtvSoClrL8yb7l1HobT0h5MXD0LzQTLWPU9yLzB8V68knBzLCmTXKaO6fpVZ6Lx3UnKl3nP8NxdnJ5r9cmWyJWelDvWS_18kAEhATUkJb0x1LIdQ163nV9K--td6SIuamaZppf1YGuFqs-72Wsfr7c7-sBp-O-Xlfrl56OkYmC

Spanish pilot

Regulations Categories	Links
Regulation (EU) 2018/1999	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL
Energy Performance in Buildings Directive	RD 235/2013 (https://www.boe.es/buscar/act.php?id=BOE-A-2013-3904) RD 1027/2007, por el que se aprueba el Reglamento de Instalaciones Térmicas en los Edificios (https://www.boe.es/buscar/doc.php?id=BOE-A-2007-15820)

	RD 314/2006 por el que se aprueba el Código Técnico de la Edificación (DB HE sobre Ahorro de Energía) https://boe.es/buscar/pdf/2006/BOE-A-2006-5515-consolidado.pdf CTE-HE-2: Ahorro de energía (https://www.codigotecnico.org/images/stories/pdf/ahorroEnergia/DBHE.pdf
Smart Meters' Legislation	-> Real Decreto 1110/2007 del 24 de agosto, por el que se aprueba el Reglamento Unificado de puntos de medida del sistema eléctrico (https://boe.es/buscar/doc.php?id=BOE-A-2007-16478) Orden ITC/3022/2007 por la que se regula el control metrológico del Estado sobre los contadores de energía eléctrica, estáticos combinados, activa y reactiva a instalar en suministros de energía eléctrica hasta una potencia de 15 kW de activa. (https://www.boe.es/diario_boe/txt.php?id=BOE-A-2007-18193
Energy Consumers Rights	Law 3/2014 (https://www.boe.es/buscar/doc.php?id=BOE-A-2014-3329)
Renewable Energy Directive	Law 24/2013 (https://www.boe.es/buscar/act.php?id=BOE-A-2013-13645)
Regulation on Risk Preparedness	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0941&from=EN
General Data Protection Regulation (GDPR)	Law 03/2018 (https://www.boe.es/buscar/act.php?id=BOE-A-2018-16673)
Energy Communities Legislation	RDL 15/2018 (https://www.boe.es/buscar/doc.php?id=BOE-A-2018-13593) RDL 244/2019 (https://www.boe.es/eli/es/rd/2019/04/05/244)
Electronic Identification and Trust Services for Electronic Transactions in the Internal Market and Repealing Directive (eIDAS)	Law 24/2013 (https://www.boe.es/buscar/act.php?id=BOE-A-2013-13645)
Electricity Market Design Directive	Law 24/2013 (https://www.boe.es/buscar/act.php?id=BOE-A-2013-13645) Resolution 11/12/2019

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

	(https://www.boe.es/boe/dias/2019/12/23/pdfs/BOE-A-2019-18423.pdf)
Energy Efficiency Directive	RD 56/2016 (https://www.boe.es/buscar/doc.php?id=BOE-A-2016-1460)

Austrian pilot

Regulations Categories	links
Regulation on the Governance of the Energy Union	is a regulation and therefore directly applicable – no national implementation necessary
Smart Meters' Legislation	IMA-VO (2011) – Intelligent Measuring Instruments Requirement Ordinance - Decree of E-Control on the definition of smart meter requirements https://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/20007497/IMA-VO%202011%2c%20Fassung%20vom%2029.07.2020.pdf**Error! Hyperlink reference not valid.** IME-VO - Intelligent Measuring Instruments Introduction Ordinance - Decree of the federal ministry on the rollout of smart meters https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007808https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007808
Energy Consumers Rights	ElWOG - Electricity Industry and Organization Act - Federal act on the new organization of the electricity sector (§ Paragraph 77 - basic principle)) https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045
Renewable Energy Directive	ÖSG - Federal Renewable Energy Act 2012 - Federal act on support schemes for electricity generation of renewable energy sources Renewable directive: not yet implemented, draft should come in summer 2020
Electricity Regulation	Electricity Directive: has not yet been implemented
Regulation on Risk Preparedness	The regulation is directly applicable and no national implementation is required

Regulations Categories	links
	https://eur-lex.europa.eu/legal-content/DE/TXT/?qid=1562756960456&uri=CELEX:32019R0941
General Data Protection Regulation (GDPR)	DSGVO - Basic data protection regulation (EU) 2016/679 DSG (BGBl. I Nr. 165/1999 idgF) - Federal Data Protection Act - Federal act on the protection of natural persons regarding the processing of personal data https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10001597 Data Protection Basic Regulation (DSGVO) directly applicable in Austria. The Data Protection Act only supplements the DSGVO
Energy Communities Legislation	Renewable Energies Expansion Act adopted - Federal Act on the Expansion of Energy from Renewable Sources (Renewable Energy Expansion Act - EAG) https://www.schoenherr.eu/content/the-renewable-energy-expansion-act/

Finnish pilot

Regulations Categories	Links
Regulation on the Governance of the Energy Union	https://www.finlex.fi/fi/laki/alkup/2015/20150609 Finnish Climate act
Energy Performance in Buildings Directive	EPBD 2018/844 (national implementation into several existing laws). No major changes expected. Proposal approved by the Finnish government: https://www.ym.fi/fi-FI/Ajankohtaista/Tiedotteet/Tiedotteet_2020/Hallitukselta_esitys_sahkoautojen_lataus(55837). Minimum level for the legislation is EU legislation.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Regulations Categories	Links
Smart Meters' Legislation	66/2009 https://www.finlex.fi/fi/laki/alkup/2009/20090066 Smart Meters: A working group (Smart Grid Working Group) has been established to study the minimum requirements and installation of Generation II meters. For example, this is recorded in the Long-Term Renovation Strategy as an action. No further specifications are available. First-generation smart meters are already widely installed in Finland. The hourly metering obligation was laid down in the Government Decree on the settlement and metering of electricity supply (66/2009) 1, which entered into force in March 2009. According to the decree, 80 per cent of electricity use points had to be in hourly measurement by 1 January 2014. Meters allow hourly measurement, but not more accurate measurement.
Energy Consumers Rights	Sähkömarkkinalaki 9.8.2013/588. https://www.finlex.fi/fi/laki/ajantasa/2013/20130588 Kuluttajansuojalaki 20.1.1978/38 https://www.finlex.fi/fi/laki/ajantasa/1978/19780038?search%5Btype%5D=pika&search%5Bpika%5D=20.1.1978%2F38
Renewable Energy Directive	https://finlex.fi/fi/laki/ajantasa/2010/20101396 Renewable Energy Production Aid Act. Implemented through voluntary actions.
Electricity Regulation	https://www.finlex.fi/fi/laki/ajantasa/2013/20130588 Sähkömarkkinalaki 9.8.2013/588.
Regulation on Risk Preparedness	Risk preparedness: Risk preparedness document is published every 3 years. https://intermin.fi/julkaisut/julkaisu?pubid=URN:ISBN:978-952-324-249-4 Sähkön toimitusvarmuus: Sähkömarkkinalaki 9.8.2013/588.
General Data Protection Regulation (GDPR)	https://www.finlex.fi/fi/laki/alkup/2018/20181050 GDPR: Tietosuojalaki 1050/2018.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Regulations Categories	Links
Energy Communities Legislation	Energy communities legislation is being prepared. Not ready yet (expected by end of 2020) The EU requires the enablement of energy communities in member states. Legislation in Finland will be changed by the end of 2020 on the basis of the EU electricity market and renewable energy directive reforms and the guidelines of the smart grid working group chaired by the Ministry of Employment and the Economy.
Electronic Identification and Trust Services for Electronic Transactions in the Internal Market and Repealing Directive (eIDAS)	https://www.finlex.fi/fi/laki/ajantasa/2009/20090617 Laki vahvasta sähköisestä tunnistamisesta ja sähköisistä luottamuspalveluista 7.8.2009/617
Electricity Market Design Directive	https://www.finlex.fi/fi/laki/ajantasa/2013/20130588
Energy Efficiency Directive	https://finlex.fi/fi/laki/alkup/2014/20141429
Smart Contracts & Blockchain	
Ethics in artificial intelligence	https://tem.fi/julkaisu?pubid=URN:ISBN:978-952-327-311-5 No national legislation at the moment. Working group set up by ministry of employment and economy to research work in the era of AI. Their report addressed ethics in AI.

Croatian pilot

Regulations Categories	links
Regulation on the Governance of the Energy Union	This is the link to the regulator web page where all the relevant energy laws are listed: https://www.hera.hr/hr/html/zakoni.html
Energy performance in buildings	Energy performance in buildings and energy efficiency are covered by the Energy Efficiency law and related bylaws (Zakon o energetskoj učinkovitosti). At the moment this is the most "advanced" implementation of the EU regulation above

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Regulations Categories	links
Smart Meters' Legislation	Smart meters are only mentioned there as well, however this is incomplete and the smart metering directive is not completely implemented. There is no law or bylaw directly governing smart meters. A rollout of smart meters is ongoing and the DSO is expected by the regulator to complete the rollout by 2027. A study on the smart metering deployment per the JRC methodology on the smart meter rollout has been delivered to the regulator (HERA - Hrvatska energetska regulatorna agencija = Croatian Energy Regulatory Agency). Details on metering are available in the Grid Code = Opći uvjerti za korištenje mreže i opskrbu električnom energijom Opći uvjeti za korištenje mreže i opskrbu električnom energijom (NN 85/15), https://narodne-novine.nn.hr/clanci/sluzbeni/2015_08_85_1666.html
Market design directive	The market design directive is implemented as Energy market law and related bylaws
Energy Efficiency	This is the link to the energy efficiency related laws and bylaws https://www.enu.hr/ee-u-hrvatskoj/nacionalni-dokumenti/
Renewable Energy Directive	This is the link to HEP, Croatian national energy company which includes the DSO, showing the legislation related to the grid. http://www.hep.hr/elektra/trziste-elektricne-energije/propisi-i-obrasci/1542
Electricity Regulation	This is the link to HEP, Croatian national energy company which includes the DSO, showing the legislation related to the grid. http://www.hep.hr/elektra/trziste-elektricne-energije/propisi-i-obrasci/1542
Electronic Identification and Trust Services for Electronic Transactions in the Internal Market and Repealing Directive (eIDAS)	https://www.hellosign.com/esignature-legality/croatia

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

ANNEX B – Demo Cases of the SYNERGY Project

This section has been updated with all recent changes to the demo cases, hence the finalised description of the demo cases is hereby reported.

Demonstrator 1: Greece, HEDNO-IPTO-EPA-VERD

Demo Case 1: Innovative Flexibility-based Network Management (Lead: HEDNO-IPTO)

The demo case will focus on shifting traditional network management approaches towards really innovative flexibility-based concepts. HEDNO in-house smart metering and distributed generation data will be further analysed to deliver more accurate demand and generation forecasts (in the short- and mid-term) and deliver a representative estimation of anticipated events in the distribution network (through their joint analysis with SCADA and GIS data). The resulting forecasts will be communicated to IPTO and merged with relevant information (referring to generation connected to the transmission network) in order to allow for a more accurate estimation of network status in the near future (utilizing also SCADA and GIS data from the transmission grid). This will allow for the identification of emerging network needs even in the short-term and the definition of the flexibility amounts (at different spatio-temporal granularity) to ensure resilient and stable operation of both transmission and distribution networks. Such flexibility requirements will be communicated to EPA and VERD, towards allowing them to design and deploy highly effective strategies towards their customers for the provision of balancing/ ancillary services to network operators. On the EPA side, smart metering data (coming from HEDNO), weather data and energy market data will be together processed and analysed (portfolio analytics application) to define the elasticity (price-based flexibility) of their clientele and define appropriate dynamic pricing strategies to satisfy the requested flexibility requirements. Similarly, on VERD side, smart metering data from HEDNO, smart home data from their customers and weather data will be properly fused and analysed (flexibility analysis and clustering app) towards extracting context-aware flexibility profiles and properly clustering them in order to deliver the needed flexibility amounts through direct and automated human-centric control over specific loads. Identified flexibility sources and their capabilities and characteristics will be communicated back to network operators and activated according to the initial requirements set with the ultimate target to increase network resilience and operational efficiency, maximize RES integration, minimize power losses, increase power quality and safeguard network availability against anticipated congestions, imbalances, frequency/ voltage violations.

Demo Case 2: Common Operational Scheduling of power grids (D&T) for TSOs and DSOs (Lead: HEDNO-IPTO)

This demo case will be realized with the participation of HEDNO and IPTO in the validation of a first-of-a kind collaborative tool for common operational scheduling, considering multi-diverse (and possibly conflicting) flexibility requirements of the two types of power networks. In this context HEDNO and IPTO are going to continuously exchange and update each other with SCADA information along with information regarding their short- and mid-term flexibility requirements, thus providing valuable insights to each other for their network status, anticipated events and measures to be taken for properly addressing them. Through an appropriately configured toolbox, providing common interfaces to both actors, HEDNO and IPTO will (i) gain increased visibility over available flexibility sources and proper clusters of them, based on information shared by EPA and

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

VERD and (ii) collaboratively rank their flexibility requirements to enable the highlighting of critical operational events at both levels of electricity grid operation and allow for their criticality prioritization and (iii) perform matching of available flexibility resources towards ensuring the smooth operation of power grids under evolving conditions through optimal operational scheduling and evaluation of offered flexibility capacity for potential capability exploitation. The tool will consist in a common interface for DSOs and TSOs for communicating between each other critical grid events, highlighting their priority and performing a joint assessment towards (at the same time) agreeing on flexibility priorities, identifying appropriate flexibility resources (e.g. for frequency response, voltage regulation, congestion management) according to their unique properties and response capabilities and commonly deciding on their optimal activation. In this way, DSOs (for example) will gain advanced insight on flexibility activation schedules of TSOs that could affect the operation of the distribution grid (flexibility coming from DERs residing at the level of the distribution grid) and will be able to proactively raise potential conflicts and facilitate alternative scheduling that is acceptable by both sides. In addition, the tool will allow both of them to create common event priority lists and accordingly schedule the potential capability exploitation of offered flexibility resources thus ensuring operational stability and resilience on both power grid levels and enabling collaborative and knowledge-based conflict resolution (e.g. avoidance of cascading effects in the distribution grid that could happen due to flexibility activation decisions taken by TSOs in an isolated manner).

Demo Case 3: Enhanced Network Asset Management and Planning (Lead: HEDNO-IPTO)

The main aim of this demo case is to equip HEDNO and IPTO with a unique toolbox for Asset Management, towards increasing Network Availability and improving Network Resilience. Smart metering data offered by HEDNO will be fused and analysed together with historical failures and interruptions data (residing in offline databases), visual and IR imagery coming from portable cameras employed for the network inspection, geo-spatial data from GIS servers correlating assets and events with the geographical areas and SCADA information (from both HEDNO and IPTO), to provide better visibility into the network assets and proactively predict asset life or anticipated failures, optimize asset investments, prioritize reliability planning and point out common causes of asset failures, thus bringing asset management to an even more advanced level than current practices.

The Asset Management application that will be delivered by SYNERGY (stepping on appropriate baseline preventive maintenance analytics residing in the SYNERGY analytics marketplace) will analyse historical loading profiles, overloading situations for various assets, and dig through tons of asset operational data to analyse asset loss of life. This will allow operators to right-size the assets, reduce total cost of ownership, and plan for predictive maintenance programs. Building on condition-based asset analytics, SYNERGY will further allow operators to define risk-based asset management strategies that include failure probabilities, criticality indexing, and device health indexing, thus gaining broader insight into the implications of their asset management decisions, improving maintenance plans as well as perform evidence-based network planning and infrastructure sizing (also considering future penetration of EVs, storage and distributed generation) towards further safeguarding network availability and resilience in the most cost-effective manner (deferral of unnecessary investments).

Demo Case 4: Retailer portfolio analytics and elasticity (price-based flexibility) estimation for the provision of services to network operators (Lead: EPA)

The realization of this demo case will be based on the validation of a complete toolbox for energy retailers enabling comprehensive portfolio analysis, towards optimizing a series of business

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

objectives. In more detail, the Portfolio Analysis toolbox will utilize smart meter, installation and consumption data provided by HEDNO, weather data, energy market/price data by IPTO and energy exchange as well as customer and building data to offer a holistic view and respective insights over the customer portfolio of electricity retailers. The tools will lead to improved business performance and the development of innovative products and services for customers. More specifically, the toolbox will improve retailers' daily operations, since better forecast tools will enable them to plan more accurately and efficiently energy transactions reducing the risk stemming from demand forecasting errors and imbalance charges. Moreover, customers will be segmented according to their characteristics, thus making it easier to identify their needs and patterns. These insights will make it for retailer to offer them customized products for lowering their financial costs and increasing their energy efficiency, as well as offering relevant services to network operators when needed.

Demo Case 5: Flexibility segmentation, classification and clustering towards VPP configuration for demand response (Lead: VERD)

The realisation of the demo case is based on the validation of the Flexibility Analytics and Consumer-Centric DR Optimization Application created within SYNERGY aiming at facilitating the management of demand and flexibility profiles in order to forecast and decide upon the optimal management of flexibility resources (demand, generation and storage).

The main inputs for the AI analytics that will be performed within the tool will be smart metering data from HEDNO, sub-metering data from one local prosumer (VERD's client), along with IoT from prosumer premises, local generation data, local energy storage data and weather data. HEDNO and IPTO will also provide flexibility requirements which, along with the aforementioned input data, will allow for the segmenting and classification of flexibility profiles at different spatio-temporal granularity in order to establish optimal VPP composition for the delivery of grid services to HEDNO and IPTO.

Demo Case 6: Local Flexibility Sharing for Self-Consumption Optimization at Local Community Level (Lead: VERD)

This demo case will complement Demo Case 5 and will aim at validating the Building- and District-level optimisation tools within SYNERGY platform that will allow local flexibility sources/ prosumers to engage for the establishment of local energy communities towards the realization of self-consumption maximization and energy cost reduction goals.

Energy consumption/ metering data, generation data and energy storage information, along with IoT data from prosumer premises will be shared with VERD for further analysis and extraction of local flexibility capabilities at different spatio-temporal granularity. Consequently, the resulting flexibility profiles will be utilized by VERD for properly matching demand and supply and improving their synchronization at the local level, while considering the significant flexibility that can be offered by local storage (storage of excess electricity during high RES-output periods and utilization at periods of low generation). In this way VERD will enable the maximization of local self-consumption and reduction of energy costs at local community level.

Common benefits (energy cost reductions) will be transparently and objectively shared among local community members.

Demonstrator 2: Spain, COBRA-CUE-URB

Demo Case 7: Enhanced PV Plant Asset Management (Lead: COBRA)

Traditional performance Monitoring PV plants will be improved by strategically monitoring a set of KPIs which allow the enhancement of the performance and operation of PV assets. One of the

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

results of this demo case will be a set of KPIs presenting important indexes about the health and status of the installation. This information will be additionally used for validating new approaches of predictive maintenance. The analysis of failures and reliability indexes will be assessed, presenting potential impacts of a single component failure to operation of the whole installation. This demo case will be led and performed by COBRA in one of its plants, as the solo partner involved on it.

Demo Case 8: Advanced RES Forecasting for improved market positioning and optimized flexibility activation for the provision of services to network operators (Lead: COBRA-URB)

This demo case will complement the previous one and will demonstrate the significant benefits that can be achieved through data sharing and data exchanges between electricity sector stakeholders. Advanced forecasting analytics will fuse and analyse COBRA's in-plant SCADA, with local and regional weather data to provide more accurate power forecasts. Such forecasting will feed into the flexibility segmentation, classification and clustering tool used by URBENER, enabling the further analysis of the flexibility that can be provided through curtailing the operation of the PV plant of COBRA. Through this data sharing approach, COBRA will gain further insights on the flexibility they can provide to overlay energy markets (balancing, ancillary services), while URBENER will obtain access to huge flexibility sources and will act as the facilitator for the participation of such flexibility sources to energy markets.

Demo Case 9: Optimising Power Purchase Agreement between RES Operators and Electricity Retailers, towards Greening Electricity Supply and reducing associated tariffs and costs (Lead: CUE-COBRA)

Establishment of Green Power Purchase Agreements (Green PPAs) relies on multiple factors such as the availability of renewable generation volumes and the volatility of wholesale market prices that favour (in several cases) the creation of bilateral agreements between RES Operators and Retailers (or other stakeholders). The further penetration of PPAs though requires a better understanding on the side of RES operators on the profitability of previous PPAs, the volume they shall make available into such bilateral agreements and the correct timing of establishing them in relation to prices offered in wholesale markets. This requires the execution of advanced analytics to reveal the best strategy a RES operator shall establish with regards to generation capacity building and price and duration negotiation in the frame of the agreement.

This demo case aims to promote the retailing and supply of green electricity and enabling the transition to Sustainable Energy Retailers. A power generation profile will be obtained per power unit at a pre-defined location where the PPA would be evaluated. Then, several user demand scenarios will be generated and crossed with the power production profiles and energy market prices in order to optimise the power for a potential PV plant as well as the PPA price. In the context of the demo case, metering data from different PV plants of COBRA will be fused together with localized weather data in order to enable more accurate generation forecasting. CUERVA will utilize demand profiles from its customers, together with generation and weather data to obtain accurate insights and forecasts about demand and flexibility over its portfolio. Forecasting data from both sides will be injected into an Analytics toolbox that will allow (among others) to effectively match demand and renewable/ green generation and define the amount of energy that should be traded between RES Operators and Retailers for the realization of the 100% green energy supply target. In case of demand forecasting deviations, local dynamic pricing strategies will be applied, incentivising prosumers to reduce their energy consumption and adapt to the renewable generation purchased by Retailers, so as to perform a perfect balancing between green supply and demand. Such dynamic pricing schemes design is further described in the following demo case 10 and will be facilitated by advanced AI flexibility/ elasticity analytics that will be delivered in the frame of the SYNERGY project. Additional benefits are expected for RES Operators since they will be given the opportunity to get involved into long-term energy purchase agreements with retailers, thus reducing related risks (renewable energy not being traded to energy markets) and hedging against market uncertainties. The demo case will assess the

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

feasibility of installing a PV plant at a specific location, whose power will be optimised depending on the optimal PPA price obtained for different demand scenarios.

Demo Case 10: Transformation of the Retailer business model from Commodity to EaaS providers for the implementation of energy efficiency campaigns (Lead: CUE)

The demo case will be implemented with the involvement of two discrete departments of the same entity (Cuerva acting as both local DSO and retailer) and enable the realization of data synergies between them for the realization of individual optimization goals. Focusing on market roles, the DSO will share with the retailer fine-grained smart metering data and relevant flexibility/ elasticity requirements for optimizing the operation of the local distribution network, in order to avoid congestions and unbalances utilizing features such as generation and demand short term forecasts. Advanced AI analytics will be performed over the available data to enable the retailer to extract the price-based flexibility (elasticity) of their consumer portfolio and enable the effective response to relevant flexibility requirements communicated by the DSO, towards ensuring the resilient and safe operation of the network. Additional value is expected to be generated for the retailer itself which will be equipped with additional analytics and applications for further improving the performance of their portfolio in terms of energy efficiency and, thus, achieving in (i) effectively hedging against imbalances and reducing respective charges through improved demand forecasting and mobilization of dynamic pricing schemes for short-term performance corrections, (ii) optimizing their energy trading/ power exchange functions through improved demand forecasting and avoidance of purchasing additional electricity volumes in highly expensive spot markets, and (iii) complying with Energy Efficiency Obligations imposed at EU and national level, thus avoiding unnecessary penalties. Moreover, retailers will be faced with a unique opportunity that will allow them to move away from the traditional commodity sales business model and adopt a more profitable business orientation that is based on EaaS offering towards their clients, spanning advanced and personalized energy analytics for energy efficiency, intelligent controls and (where possible) smart automation of consumer amenities.

Demo Case 11: Enhanced Distribution Network Asset Management and Reinforcement (Lead: CUE)

The main aim of this demo case is to equip CUERVA with a unique toolbox for Asset Management, towards increasing Network Availability and improving Network Resilience. Network data offered by CUERVA, in-house network data (failures and interruptions, SCADA/DMS information) and data provided by prosumers (smart metering data), will be fused and analysed to provide better visibility into the network assets and proactively predict asset life or anticipated failures, optimize asset investments, prioritize reliability planning and point out common causes of asset failures, thus bringing asset management to an even more advanced level than current practices.

The Asset Management application that will be delivered by SYNERGY (stepping on appropriate baseline preventive maintenance analytics residing in the SYNERGY analytics marketplace) will analyse historical loading profiles, overloading situations for various assets, and dig through tons of asset operational data to analyse asset loss of life. This will allow operators to right-size the assets, reduce total cost of ownership, and plan for predictive maintenance programs.

Building on condition-based asset analytics, SYNERGY will further allow operators to define risk-based asset management strategies that include failure probabilities, criticality indexing, and device health indexing, thus gaining broader insight into the implications of their asset management decisions, improving maintenance plans as well as perform evidence-based network planning and infrastructure sizing (also considering future penetration of EVs, storage and distributed generation) towards further safeguarding network availability and resilience in the most cost-effective manner (deferral of unnecessary investments)

Demo Case 12: Innovative Flexibility-based Distribution Network Management (Lead: CUE-URB)

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Smart metering data provided by local prosumers, together with distributed generation data (PV) and SCADA information from the DSO (CUERVA) will be jointly analysed to extract accurate demand and generation forecasts (in the short- and mid-term) and estimate anticipated events in the distribution network and the required flexibility to effectively address them.

Such flexibility requirements will be communicated to the local aggregator (URBENER), together with smart metering, distributed generation and local storage information, allowing for (i) analysis of the flexibility that can be provided by each type of DER at different spatio-temporal granularity, (ii) segmentation and classification of the different types of flexibility according to their characteristics and capability to provide alternative services to the grid operator, (iii) optimal clustering of local flexibility sources and formulation of dynamic VPPs to address evolving distribution grid needs and requirements.

Dynamic VPP schedules for flexibility activation will be communicated back to the DSO (CUERVA), allowing for the optimal scheduling of the distribution network operation with these additional flexibility amounts in hand. In turn, the DSO will generate the appropriate signals towards local prosumers and DERs (when required) to enable the provision of the available flexibility with the ultimate target to increase network resilience and operational efficiency, maximize RES integration, minimize power losses, increase power quality and safeguard network availability against anticipated congestions, imbalances, voltage violations, etc.

Demonstrator 3: Austria, GUS-EEE-ENES

Demo Case 13: Innovative Flexibility-based Distribution Network Management (Lead: GUS)

Smart metering and distributed generation data provided by ENES, together with low-level IoT (sensing and actuating data) provided from local prosumers and made available through EEE, will be shared and further analysed by the partners of the DSO (FIB through its sister company Netz Burgenland) to extract accurate demand and generation forecasts (in the short- and mid-term) and estimate anticipated events in the distribution grid (through their joint analysis with network data available in-house) and the required flexibility to address them.

Such flexibility requirements will be communicated to EEE, towards designing and deploying highly effective strategies towards local community (prosumers) for the provision of balancing/ ancillary services to FIB. In more detail, EEE will utilise smart metering data and local generation from ENES, smart home data from prosumers, in-house battery storage data and weather data towards extracting context-aware flexibility profiles and properly clustering them in order to deliver the needed flexibility amounts through direct control over flexibility (storage, generation) sources and automated human-centric control over specific demand assets.

Identified flexibility sources and their capabilities and characteristics will be shared back to FIB and activated according to the initial requirements set with the ultimate target to increase network resilience and operational efficiency, maximize RES integration, minimize power losses, increase power quality and safeguard network availability against anticipated congestions, imbalances, frequency/ voltage violations.

Demo Case 14: Local Energy System Optimization and Enhancement of Security of Supply through Islanding (Lead: GUS-EEE)

This demo case will validate an innovative concept for local energy systems optimization through isolation of specific parts of distribution grids and their operation in islanded mode. By utilizing consumption and generation data from ENES for performing accurate forecasts over demand and supply, together with operational data from the Netz Burgenland distribution grid (such as loading limits of transformers and cables) and contractual information of available flexibility resources (from EEE), dynamic security constrained optimal power flow methods will be investigated to formulate the appropriate economic dispatch schedule of the local flexibility resources considering environmental parameters and islanding requirement probabilities based on planned or unplanned events. The output of this process will be a DSO-defined horizon schedule (such as

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

a 48 half-hourly schedule) with control modes and parameters for each flexible asset (offered by EEE) that will facilitate the operational transition of specific parts of the local distribution grid into islanded operation.

Demo Case 15: Flexibility segmentation, classification and clustering towards VPP configuration for flexibility activation and explicit demand response (Lead: EEE)

This demo case will be implemented in a similar way with Demo Case 5 which comprehensively analyses the utilized data sources, data analytics and data sharing approaches, along with benefits achieved for local aggregators (in this case, EEE). In this context, smart metering and generation data from ENES, sub-metering data from local prosumers, IoT and sensing data from prosumer premises and in-house local storage data (EEE) and contractual data (as further analysed in Demo Case 13) will be analysed together with weather data and information shared by FIB (flexibility requirements), to segment and classify flexibility sources at different spatio-temporal granularity and clustering/ managing them in order to establish optimal Virtual Power Plant (VPP) composition for the delivery of grid services to the local DSO. Furthermore, energy performance optimization at building level and district level will be carried out in the scope of the Self-Consumption Optimization & Predictive Maintenance App.

Demo Case 16: Local Flexibility Market for network services and self-consumption through blockchain-enabled smart contract establishment and handling (Lead: EEE)

This demo case will complement demo case 15 and will aim at validating the SYNERGY mechanisms and tools that will allow local flexibility sources/ prosumers to engage in local flexibility market transactions. Data sharing will involve smart metering data (ENES) and prosumer data (IoT and smart devices) which will be properly analysed to extract local flexibility capabilities at different spatio-temporal granularity. Prosumers will then be able to publish their offers towards EEE and negotiate with them the terms of a flexibility activation contract. Alternative contract types and remuneration methods (both for standby and activated DERs) will be offered to prosumers, who will be given the opportunity to further negotiate and customize their contractual relationship with EEE not only in economic terms, but also regarding contract duration, number of DER activations, frequency of control dispatch, flexibility sharing, etc.

Once an agreement is established, prosumers will automatically provide EEE with direct access to the respective DERs, while contract information will be recorded in the SYNERGY Smart Contract Handling mechanism (blockchain-enabled), which will in turn allow for the establishment of an advanced Flexibility Settlement and Remuneration process. The process will utilize accurate baselines of energy performance/ consumption enabling EEE to measure and verify (in an objective and transparent manner) the flexibility (and relevant economics) that has been activated during an Energy Management/ Flexibility Control event and calculate respective remunerations.

This demo case will validate significant benefits with regards to Prosumer Empowerment, by offering them direct access into local flexibility markets and allowing them to benefit from power/ flexibility transactions with local aggregators, towards ultimately serving high-level operational requirements of overlay distribution networks.

Demonstrator 4: Finland, FVH-CAV

Demo Case 17: Optimized Urban Energy Performance Monitoring and Optimization (Lead: FVH)

FVH's role as a demo partner is foremost to provide access to the facility data and to make it available to other project partners via APIs. FVH makes sure that the data collected is interoperable and integrated. Furthermore, FVH acquires consent for data collection activities and manages pilot site communications. Cities are many times seen as a single entity with a single voice, but this is not the case of the ICT tools and platforms the cities operate on and it is essential to identify and include to right stakeholders from within the city organisation to the project.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Demo case 17 aims at facilitating the analysis of energy performance along whole districts in Helsinki to accomplish short-term objectives with regards to energy and environmental sustainability. The following data are offered to SYNERGY platform: 1. Both CAV and FVH will provide selected BEMS and local generation data, 2. CAV provides smart metering data from commercial and public buildings, whereas FVH provides smart metering data from public and residential buildings, 3. Low-level sensing and IoT data and 4. FVH provides district-level data for analytical needs that require benchmark data using data aggregated from residential buildings. Additionally, 5. FVH provides open urban environment data to enrich the analysis.

The analysis is done by VTT in Near Real-time City Monitoring and Visualization service (NRCMV) which is a component of Urban Energy Monitoring and Planning Support App. NRCMV will collect and visualize the data from SYNERGY platform and show, firstly, the energy performance of buildings and, secondly, offer advanced visual analytics on the energy performance of whole districts.

Demo Case 18: Advanced Urban Planning for long-term sustainability targets realization (Lead: FVH)

Demo Case 18 on Advanced Urban Planning for long-term sustainability targets realization provides the urban planners with new analytical tools that support decision making in the context of sustainable and energy efficient urban planning. The tool will utilize the datasets and algorithms provided by the SYNERGY platform through the API. The datasets and advanced analytics are aligned with the city existing geospatial services that are compliant with the INSPIRE and Public Sector Information -directives. With this approach, the Urban Planners are provided new perspectives and guidance that in the future can be combined with other types of analytical services that go beyond the scope of sustainability and energy efficiency. This approach is expected to raise the motivation and impact of using the tool.

Demo case 18 (Advanced urban planning for long-term sustainability targets realization) utilizes results from the other three Finnish demo cases (17, 19 and 20).

Firstly, FVH will extract the data and intelligence from the Near Real-time City Monitoring and Visualization component from demo case 17 for further analysis in SUPS component. CAV will analyse all data that are fed as an input to DC17 and will utilize them to pinpoint weak performance points that can to be addressed either by implementing renovation projects (DC19), or by energy management optimization in identified buildings (DC20).

Secondly, in demo case 19, CAV utilizes (among other sources described in DC19) the data from DC17 in VTT developed AI-RDSS tool and the results are incorporated in CAV Smartview UI provided by CAV. Additional simulations will be performed in the IDA-ICE-RAS tool to further analyse the suitable renovation approaches and scenarios identified by the AI-RDSS tool. Predicting accurately the energy performance of buildings enables optimizing the design of renovation projects. The results will be fed to DC18 as input. In some cases, the datasets may contain datapoints that can be used as KPIs by various applications and services without analytical services or algorithms.

Thirdly, in demo case 20, CAV utilizes (among other sources) the results from DC 17 to conduct detailed analysis and optimization of the buildings, through the use of SYNERGY Energy Apps. CAV will utilize the Self-Consumption Optimization & Predictive Maintenance Apps BL-EPOM and DL-EPOM tools to support the creation of flexibility control strategies through human-centric control of major business loads, and to maximize self-consumption of the demo sites, through real-time matching of demand and supply made possible by utilizing flexibility offered from the demand side. Similarly, the predictive maintenance tool (HVAC-PMS) is based on continuous building- and related HVAC-systems and energy data collection and related history data storage in the cloud in order to provide the app with near real-time metering data and history data from the demo sites.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

More detailed description the predictive maintenance tool and roles performed by partners can be found in section 4.4.3.1. Additionally, Real-time building energy performance (eDEC) and smart readiness certification (SRI) developed in T7.4 is derived from DC20 analysis done by CAV. The results will be fed to DC18 as input.

The results from Demo cases 17, 19 and 20 are fed to VTT to Urban Energy Monitoring and Planning Support App for to enhance the analysis of Strategic Urban Planning Supporter (SUPS) component which aims at supporting city planners to design alternative urban transformation strategies, to assess them and to decide optimal routes to satisfy target KPIs defined in the city's SECAP plan. More specifically, developed models will support city planners in studying the trends of changes and their causes, to understand the underling aspects of urban dynamics processes and the flow of information, and to model and simulate the consequences of technological innovation in the urban system.

Demo Case 19: Evidence-based renovation support for optimized and accurate energy-efficient design of buildings (Lead: CAV)

In demo case 19 building energy management data from buildings provided by both Caverion (CAV) and Forum Virium Helsinki (FVH), including for example sensor, metering and actuating data will be offered to the SYNERGY platform. This data will enable building of accurate occupants' behaviour and comfort profiles, that will be developed in task 4.2 by SUITE5.

These profiles together with real building energy management data, history data and country-level background data will be utilized by CAV as input in VTT developed AI-RDSS tool for pre-analysis and identification of alternative renovation scenarios for the selected buildings. The pre-analysed results are then published to the GUI. Additionally, the results can be made to be visualised for example in the SmartView user interface that is provided by CAV. As the last step, the pre-analysed results are published for IDA-ICE-RAS tool.

Additional simulations will be performed by VTT in the IDA-ICE-RAS tool to further analyse the suitable renovation approaches and scenarios identified by the AI-RDSS tool. The further analysis will enable identification of energy performance outliers and enables more comprehensive design of renovation approaches and scenarios, in order to achieve highly accurate optimization of anticipated energy performance, renovation project costs and occupants' comfort.

The results from this demo case will be shared with FVH to increase optimization and accuracy in their urban planning in demo case 18.

Demo Case 20: Holistic Real-time Facility Energy Management Optimization (Lead: CAV)

In demo case 20 near real-time BEMS, generation and IoT data from the demo sites provided by Caverion (CAV) and Forum Virium Helsinki (FVH) will be offered to the SYNERGY platform. CAV will use the data to conduct detailed analysis and optimization of the buildings, through the use of SYNERGY Energy Apps.

In this demo case, CAV will utilize the Self-Consumption Optimization & Predictive Maintenance Apps BL-EPOM and DL-EPOM tools to support the creation of flexibility control strategies, through human-centric control of major building loads, and to maximize self-consumption of the demo sites.

Similarly, the HVAC-PMS tool for predictive maintenance is based on continuous building- and related HVAC-systems and energy data collection and related history data storage in the CAV cloud in order to provide the app with near real-time metering data and history data from the demo sites through an oBIX or similar interface. CAV will utilize the tools different functionalities to enable accurate fault diagnosis and characterization over critical systems and equipment, probability assessment of fault occurrence, early prediction of faults and to facilitate increased

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

reliability and efficiency of building assets. The real-time monitoring of HVAC and building conditions and the displaying of results utilizes already existing upper-level building monitoring platform SmartView, which will be provided by CAV.

Near real-time field data of the building consisting of consumption, production and IoT data, together with static building data and benchmark values that are drawn from the SYNERGY platform, will be used by CAV in Real-time Building Energy Performance and Smart Readiness Certification to calculate the energy performance indicators associated with the Display Energy Performance certificate as per the standard that will be adopted. The application uses data retrieved from the SYNERGY platform, and manual data input to dynamically calculate the values. Manually entered data will be automatically uploaded to the SYNERGY platform. CAV will utilize the tool in order to calculate real-time energy performance certifications of the demo sites.

The results gained from this demo case will be shared with FVH to increase optimization and accuracy in their urban planning done in demo case 18

Demonstrator 5: Croatia, KRK

Demo Case 21: Self-Consumption Optimization for Energy Poverty Alleviation and Sustainable Local Energy Communities (Lead: KRK)

In this demo case, the focus is promoting the value of self-organized local energy communities for obtaining significant economic and sustainability benefits, primarily through maximizing self-consumption from own RES. This is in line with the net zero strategy that Krk island has adopted in 2010. In 2020 the largest municipality on the island, the City of Krk has also adopted a Smart City development strategy, focused on elevating the level of digital awareness and using the digital communication technologies as a catalyst of progress.

However, even with all the benefits of smarter energy in mind, the digital progress should not be creating a further divide. Smart energy that is simply unavailable to a part of the members of local energy community would increase the amount of energy poverty and split the local community into richer “haves” and poorer “have nots”, resulting in overall inefficiency and inability to hit the self-sustainability targets. In other words, optimizing a single prosumer does not necessarily translate into the optimal solution for the whole community. In fact, we have already seen the contrarian examples where a seemingly well-optimized user actually presents an overall burden on the local community infrastructure, and this is the problem Krk island already must cope with.

This use case is dedicated to self-consumption and local consumption optimization, to maximize the sustainable energy communities’ impact on the local community. For this, the data from energy consumption/ smart metering data (from consumers) is required, then the local renewable generation data as well as EV charging information is required too.

The island of Krk has a notable seasonality linked to tourism, and not surprisingly, as it is a summer destination, it is also heavily reflected in the electric energy usage. In peak summer tourist season, the population increases almost tenfold. This presents an additional stress on the infrastructure, and the self-consumption and satisfying the demand locally is especially important in these cases.

In order to correctly capture the effects of this seasonality, other data will also be used – such as the data from public illumination which is a large customer straining the energy budget of local communities, and the data from water usage which can be relatively easily obtained from the advanced metering and control systems in Ponikve voda, a sister water management company to Ponikve Eko otok Krk.

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Combined with weather and energy market data, these data will be utilized and analysed towards enabling improved forecasting and optimized balancing between demand and supply for maximizing self-consumption at the level of a local energy community organized in the island of Krk.

The advanced analytics for estimating and extracting the available flexibility from the various DERs involved, will enable their optimal orchestration and synchronization, towards (i) reducing dependence on energy flowing from the overlay distribution grid and reducing grid charges, (ii) optimizing energy management and increasing energy savings at the local level and (iii) facilitating the establishment of a parallel, local electricity market, where the local municipality equally shares the benefits stemming from self-consumption (reduced energy costs). This widens the concept of self-consumption from a single prosumer towards the local community. The eventual rebates would significantly reduce the electricity tariff for the members of the community. Reducing the infrastructural costs of local infrastructure would also help the alleviation of energy poverty. This will be preferentially available to consumers falling within the boundaries the energy poverty criteria. While this will improve the local social welfare, it has an indirect benefit of allowing these customers to increase their own energy efficiency. Instead of having a part of local community struggling with energy poverty, the whole community would benefit and increase its own self-consumption potential of the community, contributing to the net zero goals of the community.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

ANNEX C – Socioeconomic barriers questionnaire

Note, this is an example of the questionnaire used to assess the barriers for demo case 1, for each demo case, only the relevant barriers were included in the questionnaire.

DC1

Socio Economic Barriers

In the table below, Column A shows the various potential socio-economic barriers. Column B shows the average impact rating of this barrier on a scale of 1 – 5 (1 = Not impactful, 5 = Very impactful) previously indicated in your pilot region when the survey was completed in September 2020.

If you believe that the answer in Column B no longer represent your view on the socio-economic barrier for your demo case, please provide a new rating on the 1-5 scale in column C and explain the reason for this change in column D.

Column A	Column B	Column C	Column D
Potential Barrier	Previous rating	VERD	Explanation for change in rating
1. Neglection of the value of distributed, time-specific and location-based flexibility for system optimization, favouring centrally offered flexibility, even in cases where local-specific constraints need to be resolved	4	5	
2. Lack of holistic regulatory framework that fosters innovation providing whole system benefits (e.g. no mechanisms for trading and remunerating flexibility)	4	5	
3. Lack of equal opportunities for all parties with regards to investing and the benefits of generated wealth	3		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

4. Concerns for the process of moving innovative energy services into "business as usual"	3	1 - We do not believe there are concerns on how innovation is going to disrupt BAU if an enabling regulatory framework exists	
5. Lack of a true participation from ALL actors in the energy chain (e.g. is there a clear pathway for consumer/prosumer representation through aggregation and are there viable business cases for aggregation in existence)	3	5 - From our perspective a clear setting of the electricity market in terms of flexibility regulatory framework is currently missing thus posing a socio-economic barrier to all participants to be able to enter the market	
6. Lack of belief from consumers/prosumers in the narrative of empowerment described in the SYNERGY project, i.e. instead they believe 'empowerment' is not a consumer/prosumer focussed initiative and is in fact merely a tool to promote business agendas	2		
7. Lack of clarity with regards to profit and losses from innovative energy services (e.g. lack of regulatory and national planning, lack of clear pathways to innovation adoption)	3		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

8. Lack of consideration towards diversity of interests from various stakeholders in new innovative energy services	3		
9. Perception that the energy system is vulnerable to cyber-attack or data security issues	3		

II. ANNEX C – Organisational barriers questionnaire

Note, this is an example of the questionnaire used to assess the barriers for demo case 1, for each demo case, only the relevant barriers were included in the questionnaire.

DC1

Organisational Barriers

In the table below, Column A shows the various potential socio-economic barriers. Column B shows the average impact rating of this barrier on a scale of 1 – 5 (1 = Not impactful, 5 = Very impactful) previously indicated by the various types of company when the survey was completed in September 2020.

In Column C, could you please indicate next to your organisation type, whether you agree or disagree with this previous rating. If you agree, please type 'agree', if you disagree, please type the new rating on the same 1 – 5 scale. If you provide a new rating, please explain the reason for this change in Column D.

Column A	**Column B**		**Column C**	**Column D**
Potential Barrier	Organisation	Previous rating	Agree OR New rating	Explanation for change in rating
1. Lack of appropriate systems or professionals to recognise data value	Aggregator	2		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	2		
	Retailer	2		
	Urban planner	2		
2. Lack of energy management personnel/management systems	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	3		
	RES operator	1		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

	Retailer	2		
	Urban planner	2		
3. Lack of skilled professionals for combining energy data	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	3		
	RES operator	2		
	Retailer	2		
	Urban planner	3		
4. I.T. infrastructure insufficient for data processing and storage	Aggregator	2		
	Facility manager/ESCO	3		
	Network operator	4		
	RES operator	2		
	Retailer	4		
	Urban planner	2		
5. Lack of appropriate data governance in place to be able to identify valuable data from the vast quantities of data generated	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	3		
	Retailer	4		
	Urban planner	2		
	Aggregator	4		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

6. Lack of compatibility of multi-source data	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	2		
7. Data synergy being overly complex due to the variety of models, scales, parameters and outputs of data	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	4		
	Urban planner	2		
8. Reluctance to adopt new business models (inertia) in favour of current model	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	2		
	Urban planner	3		
9. Focus placed on daily operations leading to neglection of value of external data	Aggregator	2		
	Facility manager/ESCO	4		
	Network operator	4		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

	RES operator	4		
	Retailer	3		
	Urban planner	2		
10. Data Interoperability not being perceived as an important issue	Aggregator	3		
	Facility manager/ESCO	3		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	2		
11. Reluctance to abandon closed ICT systems	Aggregator	2		
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator	3		
	Retailer	3		
	Urban planner	3		
12. Perception that sharing data means data leaving premises	Aggregator	3		
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator	4		
	Retailer	3		
	Urban planner	2		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

13. Concerns over GDPR and associated penalties	Aggregator	4		
	Facility manager/ESCO	2		
	Network operator	4		
	RES operator			
	Retailer	3		
	Urban planner	3		
14. Lack of knowledge with regards to new secure data sharing technologies	Aggregator	3		
	Facility manager/ESCO	4		
	Network operator	4		
	RES operator	4		
	Retailer	2		
	Urban planner	2		

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.