European Common Energy Data Space Framework Enabling Data Sharing - Driven Across – and Beyond – Energy Services

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D7.2 ENERSHARE governance models and participatory business models (2nd version)

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List of Acronyms

AMI	Advanced metering infrastructure
APP	Application
B2B	Business-to-Business
B2C	Business-to-Consumer
B2G	Business-to-Government
BGT	Big-gain Table
BM	Business Model
BRS	Business Requirement Specification
CCC	Coordinated Capacity Calculation
CCR	Capacity Calculation Region
CEO	Chief Executive Officer
CGM	Common Grid Model
CHP	Combined Heat and Power
CIM	Common Information Model
CPO	Charging Point Operators
CSA	Coordinated Security Analysis
CSV	Comma-Separated Values
DB	DataBase
DESFA	Greece National Natural Gas System Operator
DS	Data Space

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DSO	Distribution System Operator
E.DSO	Europe's Distribution System Operators
ebIX	Energy Business Information eXchange
EC	European Commission
EDC	Electricity Distribution Company
EFET	European Federation of Energy Traders
EG	Expert Group
ENTSOE	European Network of Transmission System Operators for Electricity
ENTSOG	European Network of Transmission System Operators for Gas
ESCO	Electricity System Commercial Operator
EU	European Union
EV	Electrical Vehicle
EVSE	Electric Vehicle Supply Equipment
EVT	Slovenian National Data Hub
EWH	Electrical Water Heaters
GDPR	General Data Protection Regulation
GIS	Geographic Information System
GUI	Graphical User Interface
IDSA	International Data Spaces Association
IGM	Individual Grid Model
IPTO	Greece Independent Power Transmission Operator

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IT	Information Technology
JSON	JavaScript Object Notation
MILP	Mixed-Integer Linear Problem
ML	Machine Learning
NDA	Non-Disclosure Agreement
NILM	Non-Intrusive Load Monitoring
OPDE	Operational Planning Data Environment
P2G	Power-to-Gas
PV	Photovoltaic
R&D	Research and Development
RA	Remedial Action
RCC	Regional Coordination Centre
REC	Renewable Energy Certificate
ReLU	Rectified Linear Unit
RES	Renewable Energy Source
SCADA	Supervisory Control and Data Acquisition
SDO	Standard Development Organization
SGTF	Smart Grid Task Force
SSO	Single Sign-On
TL	Transfer Learning
TLS	Transport Layer Security

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TSO	Transmission System Operator
UC	Use Case
VPN	Virtual private network
WP	Work Package

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Executive summary

This deliverable is the second version of the analysis of the governance models and participatory business models, that covers the topics of data governance requirements from internal ENERSHARE Pilots, detailed information about the questionnaire, sent to the Pilot/Use Case Leaders, analysis of the identified gaps and improved sight on the data sharing incentives, comparing to the first version of the deliverable.

To make a clear view on the topic of the Energy Data Space Governance Models, the analysis of existing gaps was conducted, based on the information from different association such as International Data Spaces Association (IDSA), BRIDGE or GAIA-X, different initiatives and projects as FIWARE, OPEN-DEI, OneNet, BD4NRG. This analysis formed the basis for creation of the questionnaire, which is described in details in this Deliverable. This questionnaire template was developed in close collaboration with the remaining horizontal WPs and Pilot Leaders in order to incorporate and review governance-related key aspects that are essential for the pilot's perspective.

The detailed replies from the pilots are presented and the first analysis of the responds is conducted. These replies and an analysis, based on the replies, aimed to identify potential topics of the data governance in the scope of ENERSHARE project and provide recommendations for the comprehensive coverage of all aspects while designing the Data Governance Models.

In addition, the topic of data sharing incentive and business models design in the business-to-business (B2B) domain was analysed, focusing on both non-regulated and regulated (TSO, DSO, etc.) domains. Comparing to the first version of the Deliverable, more detailed analysis conducted in the topic of non-regulated domain, that covers the simple market mechanism where sellers define a fixed price for their data and also the topic of dynamic buyer budget is described in more details with an example, using the synthetic data. Both social welfare data monetization and data-by-data exchange mechanisms were improved: more advanced collaborative forecasting models were presented for data monetization mechanisms (social welfare maximization), which considers artificial neural networks, and a re-written optimization problem as a linear programming problem for data-by-data exchange mechanisms that is efficiently solved with existing algorithms implemented in Python libraries and already tested in real data. In addition, the Marketplace Business Model is described in the scope of non-regulated domain data sharing incentives, presenting the data value chain and all its key aspects.

As for data sharing incentives for regulated domain entities, more detailed analysis was conducted in mechanisms for data sharing in both TSO, DSO and multi-energy utility level, with examples of entities and associations both on national and EU level.

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1 Introduction

In today's data-driven world, data sharing has become a key aspect of driving innovation, making informed decisions and fostering collaboration. The sharing of information between organizations, governments and individuals has opened up unprecedented opportunities to harness the potential of data. However, as data sharing increases, the need for effective data governance becomes increasingly important. Data governance in the context of data sharing involves establishing robust frameworks that ensure responsible, secure and ethical practice. It addresses issues of data access, ownership, consent, privacy and fair use while complying with legal and regulatory requirements. Data governance plays a key role in overcoming the complexities of data sharing, balancing the benefits of data collaboration with protecting against potential risks.

Another important topic to consider in the context of data governance in data sharing is the concept of “Data Spaces”. Data Spaces (DSs) refer to interconnected ecosystems in which data is stored, managed, and distributed across different entities. These spaces foster a collaborative environment, allowing for seamless data sharing while maintaining control and compliance with governance principles. In data spaces, stakeholders including individuals, businesses, governments and research institutions engage in data sharing initiatives. Effective data governance models play an important role in defining the roles and responsibilities of these stakeholders, ensuring transparency and accountability in the use of data.

The main goal of the ENERSHARE project is the integration and customization of a data space specifically for the energy sector. This integration involves bringing together data, storage and computing infrastructures with the ultimate goal of creating compatible and interoperable resources. In addition, the project also focuses on developing data governance models in Work Package (WP) 7 ("Data Space and data sharing governance and business models") that are compliant with European requirements and applicable in different operational contexts across Europe. The ultimate goal is to create a neutral Energy Level Playing Field that facilitates data exchange between both regulated and non-regulated stakeholders. To achieve this goal, the project is analysing existing Energy Data Hub Governance Models, identifying any existing gaps. Based on these findings, the project proceeds to develop Data Space Governance Models and incentive mechanisms specifically designed to facilitate B2B data sharing.

In Month 19, the ENERSHARE project has made significant advances in the analysis of existing gaps in the data governance, based on the information from different initiatives and projects and gathered information from the Pilots within the project. In addition, the significant progress was done in the scope of the data sharing mechanisms, improving data monetization and data-by-data mechanisms for non-regulated domain entities and improved knowledge related to

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these mechanisms for such regulated domain entities, as Transmission System Operators (TSOs), Distribution System Operators (DSOs) and multi-energy utility level entities.

The following chapters are organized as follows:

- Chapter 2 provides a brief analysis from the previous version of the deliverable about the existing gaps in the scope of data governance and description of the questionnaire, which was sent to the Pilots in order to design adequate Data Space Governance Models within the project with detailed description and preliminary analysis of the responds;
- Chapter 3 provides the second phase of creating a set of incentive mechanisms for data sharing in the B2B domain, which cover both regulated and non-regulated domains.
- Chapter 4 presents the main conclusions of the analysis for the second version of the Deliverable.

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2 Data governance requirements from Pilots

In order to develop more detailed data governance models, a comprehensive analysis of data spaces and governance was necessary, utilizing pilot cases as the main focal points. By comparing different perspectives on the issue from the pilots, as well as the current situation in the projects and initiatives, it will be possible to provide more detailed results, and therefore more detailed data governance models.

Deliverable D7.1 "ENERSHARE governance models and participatory business models (1st version)" provides an introduction to the questionnaire prepared for the pilots' responses, including the detailed descriptions of the questions, possible answers and suggestions for the pilots. The main aim of the questionnaire was services and the requirements for data sharing within the developed services for each pilot.

2.1 Gap analysis and business requirements review

Deliverable D7.1 in Chapter 4 provides the gap analysis of requirements for data governance divided into six topics according to the questionnaire, which was explained in the Chapter 3. It focuses on the initiatives, platforms and projects and it was feasible to conclude that for each of the topic from the questionnaire it was possible to identify existing gaps and to highlight recommendations to overcome the existing gaps. One of the main identified gaps was the absence of distinguishing between regulated and non-regulated domain in all of the topics from the questionnaire and, in particular, in the topic of the ownership of the data. More detailed results for the topic of ownership of the data for initiatives, platforms and projects are presented in Table 1.

Table 1. Topic of an ownership of the data in existing initiatives, platforms and projects

Initiatives, platforms and projects	Requirements for the **Owner** of the data	Requirements for the **Provider** of the data	Requirements for the **Target Consumer** of the data	Requirements for the **Target User** of the data
Initiatives (BRIDGE [1], GAIA-X [2], IDSA [3])	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated

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Initiatives, platforms and projects	Requirements for the **Owner** of the data	Requirements for the **Provider** of the data	Requirements for the **Target Consumer** of the data	Requirements for the **Target User** of the data
				No, no distinction between Data Consumer or User
Platforms (Living lab, FIWARE [4])	no specific distinction between regulated and non-regulated no role apart from Data Provider and Data Consumer	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated, no role apart from Data Provider and Data Consumer
Project (OPEN-DEI [5], OneNet [6], BD4NRG [7])	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated No, no distinction between Data Consumer or User
Requirements for the **Owner** of the data	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated	no specific distinction between regulated and non-regulated

It can be noted, that the exception is the Health Data Space, which distinguishes between several categories of owners and providers and distinguishes between regulated and non-regulated domain entities.

2.2 Collection of data governance requirements from Pilots and analysis

The aim of this chapter is to collect the information provided by the project pilots in the form of responses to the prepared questionnaire that was mentioned in the previous Deliverable D7.1. The content of the document and the questions are expected to provide insight into data space governance models. All pilots were asked to answer the same questions, allowing the data space to be analysed from a single perspective.

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2.2.1 Pilots questionnaire description

The content of the questionnaire was prepared on the basis of publicly available documents concerning data spaces, pan-European data spaces and governance models [1], [2], [3], [4], [5], [6], [7]. When preparing questions to obtain quality answers, the questionnaire should include not only questions related to data, but it is also important to have the information about data-based services, about all the processes of connecting data with services, about the participating entities and technologies from a use case (UC) point of view and, finally, about all the participants involved in the complete data flow. With a complete picture in terms of data spaces, analysis could begin. Having a complete picture in terms of data spaces allows for thorough analysis.

The remaining horizontal WPs collaborated with the questionnaire authors to ensure that they were incorporated and reviewed all possible key governance-related aspects, essential for the pilot's perspective. The questionnaire consisted of introduction, a brief description of pilot data and services, and 11 questions prepared in tabular form.

In the introductory chapter, the questionnaire began with a brief description of the definitions that were used in the text and a request for providing the information about the pilot from the data perspective. The pilot representatives were asked to provide dataset description within UC (e.g., detailed data about the operation of Wind power Turbines, which are recorded and stored in Wind turbines local Supervisory Control and Data Acquisition (SCADA) system) and description of the service, related to the datasets, described in the questionnaire. This was necessary in order to thoroughly analyse the answers taking into account information about the pilot. In addition, this will be important for the visibility of the project and future use of the responses in other projects, related to data sharing, without deeper knowledge of the ENERSHARE project or pilots.

Then, there were 12 questions that represent 12 topics, which are:

- Question 1. Ownership of the data;
- Question 2. Security, protection, and sovereignty of the data;
- Question 3. Access / Consent of the data;
- Question 4. Flow of data;
- Question 5. Following the data from the beginning-source of data (device, internal memory, DataBase (DB), etc.) to its final destination;
- Question 6. Tracking of the data;
- Question 7. Inter-operability, portability and standardization of the data;
- Question 8. Data portability;
- Question 9. Data governance policy;
- Question 10. Usage of the application for the data flow;

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- Question 11. Actors in the use case;
- Question 12. Data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility).

The full version of the questionnaire is presented in the Annex I.

The questionnaire was sent to all the pilots according to the list, presented in Table 2.

Table 2. The list of pilots and use cases to be used for sending the questionnaire

Pilot	Use Case	Title
P1-ES		Wind farm integrated predictive maintenance and supply chain optimization
P2-PT	A	Leveraging on consumer-level load data to improve TSO's operational and planning procedures.
P2-PT	B	Instantiation of energy communities and digital simulation of business models
P2-PT	C	Detect irregularities in energy consumption in households with seniors living alone
P2-PT	D	Suggest maintenance of appliances based on Non-Intrusive Load Monitoring (NILM) data
P3-SI		Optimal multi-energy vector planning - electricity vs heat
P4-GR		Digital Twin for optimal data-driven Power-to-Gas planning
P5-IT	A	Cross-sector Flexibility Services for aggregators and DSO
P5-IT	B	Services for e-mobility Charging Point Operators (CPOs), EVs drivers and DSO
P5-IT	C	Flexibility provision for electricity grid with water pumps and predictive maintenance of the pumps
P6-SE		Flexibility aggregation from behind-the-meter consumers
P7-LV		Cross-value chain services for energy-data driven green financing

2.2.2 Results of the questionnaire

In total, 8 completed questionnaires out of 12 were received from 6 pilots. Since the majority of pilots responded, this shows the diversity of responses and the ability to analyse requirements from different perspectives. However, further contact with pilots will be undertaken to clarify responses. The results are shown below.

<u>Answers collected in the introductory chapter:</u>

P2-PT.A, Leveraging on consumer-level load data to improve TSO's operational and planning procedures

Service: Multivariate energy time series forecasting

1. Dataset description within UC:

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- Input data:
    - average active power measurements data, from individual consumers (provided by Smart Energy Lab)
    - average active power measurements data, from the TSO (data not shared with INESC TEC, but used by INESC TEC federated learning tools)
- Output data:
    - avg. active power consumption forecasts data for the TSO (to be processed by NESTER)

2. Service description:
    - INESC TEC Federated-learning collaborative forecasting tool that uses aggregated and individual consumer-level data, to improve net-load forecasting at the substation level

P2-PT.B, Instantiation of energy communities and digital simulation of business models

Service: Energy community sizing with assets sharing

1. Dataset description within UC:
    - Input data:
        - The characteristics of each potential participating member: consumption profiles, photovoltaic, battery and other production/storage systems owned and their technical characteristics, retailer, and grid access tariffs.
        - The chosen business model that dictates the objective function (e.g., maximize the self-consumed energy in the community, maximize the overall economic benefits, etc.) and the constraints of the problem.
        - The technologies characteristics and costs of the assets that will eventually be shared among the members and/or individually installed.
    - Output data:
        - The size of each shared and individual asset, as well as its operation (production profile and charge/discharge for production and storage systems, respectively).
        - The energy shared between the members (or within the community), which includes the results of the market/contracts that allow for this sharing.
        - The members’ energy bills.
2. Service description:

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- This service, developed by INESC TEC, is based on a tool that allows the sizing of a renewable energy community by computing a Mixed-Integer Linear Problem (MILP).

Service: Flexibility modelling of thermoelectric water heaters

1. Dataset description within UC:
   - Input data:
     - Binary domestic hot water usage calendar. Optional, but provides better result. Is not available, the service automatically approximates the usage calendar by converting the load diagram into a binary usage calendar.
     - Thermoelectric water heater load time-series with minute resolution, for a specified time-period (if the usage calendar is not provided).
     - A set of thermoelectric water heater specifications and user-defined parameters (Electrical Water Heaters (EWH) functioning power, EWH capacity, EWH maximum allowed temperature, and user-defined hot water comfort temperature)
   - Output data:
     - Optimized consumption time-series
     - Total consumption savings
2. Service description:
   - This service, developed by INESC TEC, aims to estimate load flexibility and energy savings by optimizing the EWH functioning calendar, and includes a built-in load to usage converter.

Service: Community market pool to estimate energy price of internal transactions

1. Dataset description within UC:
   - Input data:
     - The characteristics of each potential participating member: battery and other production/storage systems owned and their technical characteristics, retailer, and grid access tariffs.
     - Energy consumption and generation forecasts for each community member
     - The chosen community energy pricing mechanisms and type of local energy market (bilateral or pool)
   - Output data:

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- Local energy market prices
- ESS day-ahead scheduling
- The energy shared between the members (or within the community), which includes the results of the market/contracts that allow for this sharing.
- The members' energy bills.

P2-PT.C, Detect irregularities in energy consumption in households with seniors living alone

1. Dataset description within UC:
    - Input data:
        - Temperature and Humidity data
        - Meter Data from sensors installed in the electrical board.
    - Output data:
        - Consumption curve
        - Alarms if a deviation from routine is detected.
2. Service description:
    - This service aims to monitor seniors living alone by analysing their electrical consumption data and find a routine in their electricity consumption. When deviations from the routine are detected, an alarm will be triggered, and information will be sent to a caretaker.

P2-PT.D, Suggest maintenance of appliances based on NILM data

1. Dataset description within UC:
    - Input data:
        - Smart Plug Data
        - Consumer Metering Data
    - Output data:
        - Maintenance suggestion alarms.
2. Service description:
    - This service aims at detecting problems and suggesting maintenance to appliances based on NILM data.

P3-SI, Optimal multi-energy vector planning - electricity vs heat

1. Dataset description within UC:
    - Data used in the UC is related to the multi-energy usage of the end users (Heat and electric). Different data is available especially for creating the models. Data needs to be anonymized before sharing. The models created with the data will be the final source of information for the planning tool.

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P4-GR, Digital Twin for optimal data-driven Power-to-Gas planning

Datasets, used in the pilot, and their description:

1. Electricity datasets:
   I. Total Load – Actual
      - Average of real-time load values per market time unit (60m). Actual total load (including losses without stored energy) = net generation – exports + imports – absorbed energy
   - Total Load - Day Ahead Forecast
      - Day-ahead forecast of average total load per market time unit (60m)
   - Total Load - Week Ahead Forecast
      - Week ahead forecast of maximum and minimum load values per day
   - Total Load - Month Ahead Forecast
      - Month ahead forecast of maximum and minimum load values per week
   - Total Load - Year Ahead Forecast
      - Year ahead forecast of maximum and minimum load values per week
   - Day-ahead Aggregated Generation Forecast
      - An estimate of the total scheduled Net generation (MW), per each market time unit (60m) of the following day
   - Day-ahead/Intraday Generation Forecasts for Wind and Solar
      - Averages of forecasts of wind and solar power net generation (MW), per each market time unit (60m) of the following (day-ahead) or same (intraday) day
   - Actual Aggregated Generation per Production Type
      - The actual aggregated net generation output, computed as the average of all available instantaneous net generation output values on each market time unit (60m)
   - Day-ahead Prices
      - The day-ahead prices for each market time unit (60m). Day-ahead prices refer to the price per MWh as it is settled each hour in the energy market. In Greece, that is HEnEx. European Network of Transmission System Operators for Electricity's (ENTSOE) data probably comes from there, as Greece Independent Power Transmission Operator (IPTO) does not list them.
   - Cross-Border Physical Flows
      - The measured real flow of energy between neighbouring bidding zones. Average values per market time unit (60m). One column for

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each directional flow (e.g., gr_al indicates energy flow from Greece to Albania)

- Aggregate Filling Rate of Water Reservoirs and Hydro Storage Plants
    - Aggregated weekly average filling rate of all water reservoir and hydro storage plants (MWh) including the figure for the same week of the previous year
- Actual Generation per Generation Unit
    - The actual net generation output per generation unit >= 100MW, as averaged per market time unit (60m)
- IPTO Day Ahead Load Forecast
    - Provided by IPTO 3 times per day for the following day, and once at the start of the day (intraday)
- IPTO Day Ahead Renewable Energy Source (RES) Forecast
    - Provided by IPTO 3 times per day for the following day, and once at the start of the day (intraday)
- IPTO Week Ahead Load Forecast
    - Provided by IPTO's ISP once a day for the following week
- IPTO Net Interconnection Flows
    - Provided by IPTO once a day (SCADA). One column per neighbouring country with net flow of energy per hour
- IPTO RES Injections
    - Energy generated by renewables, provided by IPTO (SCADA) once a day
- IPTO Unit Production and System Facts
    - Energy generated by each production unit (lignite, hydro, RES, gas) per hour, provided by IPTO (SCADA) once a day
- IPTO Daily Energy Balance
    - Daily Energy Balance report with aggregated energy values for each production type

2. Gas datasets:
    - European Network of Transmission System Operators for Gas (ENTSOG) Daily Flows
        - Deliveries / Off-takes (imports for entry points/off-takes per exit points) per day since 2017 (Flows per day from 2017-2022. Greece National Natural Gas System Operator (DESFA) stopped reporting physical flows to ENTSOG in Sept. 2022).
    - ENTSOG Daily Nominations
        - Daily nominations for entry and exit points since 2017
    - ENTSOG Daily Allocations

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    - Daily allocations for entry and exit points since 2017
- ENTSOG Daily Renominations
    - Daily renominations for entry and exit points since 2017
- DESFA Daily Flows
    - Deliveries / Off-takes (imports for entry points/off-takes per exit points) per day since 2008
- DESFA Hourly Flows
    - Deliveries / Off-takes (imports for entry points/off-takes per exit points) per hour since 2008
- DESFA Natural Gas Quality
    - Various NG quality indicators at entry points per year since 2008. The WDP and HCDP values are the mathematical average of the real values, while the values of the other quality data are the weighted average (to flow)
- DESFA Natural Gas Pressure
    - Monthly Data of Natural Gas Pressure in Entry Points since 2008
- DESFA Gross Calorific Value
    - Daily Data of Natural Gas GCV (Gross Calorific Value) in Entry/Exit Points since Nov. 2011
- DESFA Nominations
    - Daily nominations data of Entry/Exit Points since Nov. 2011

A part of these datasets will be used as input to the Digital Twin simulations that will take place in the context of this use case.

Simulation results:

- These datasets contain the setups and results of each simulation scenario.

It can be seen, that the responds were different from the quality perspective, it can be concluded, that these responds highlight the variety of the datasets, which are used in the pilots.

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Question 1. Ownership of the data

Responds collected in the chapter 1 “Ownership of the data” are presented in Table 3.

Table 3. Responds for the questionnaire, “Ownership of the data”

Pilot title	Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power measurements from consumers	Data Owner: Smart Energy Lab (SEL) Data Service: Smart Energy Lab (SEL)	Data Provider: Smart Energy Lab (SEL) Service Provider: INESC TEC	Data Consumer INESC TEC Service consumer: TSO (NESTER)	Service User: INESC TEC / TSO (NESTER)
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	Data Owner and Community Manager: Smart Energy Lab (SEL) Service Owner: INESC TEC	Data Provider and Community Manager: Smart Energy Lab (SEL) Service Provider: INESC TEC	Data Consumer: INESC TEC Service Consumer: Consumer / Community Manager (SEL)	Data User: INESC TEC Data/Service User: Community Manager and Consumer
	Active power consumption from thermal loads	Data Owner: Smart Energy Lab (SEL)	Data Provider: Smart Energy Lab (SEL) Service Provider: INESC TEC	Data Consumer: INESC TEC	Service User Consumer
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature	Data/Service Owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Caretakers of seniors living alone	Data user: SEL Service user: Caretakers of seniors living alone

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Pilot title	Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
	Humidity	Data/Service Owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Caretakers of seniors living alone	Data user: SEL Service user: Caretakers of seniors living alone
	Current	Data/Service Owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Caretakers of seniors living alone	Data user: SEL Service user: Caretakers of seniors living alone
	Voltage	Data/Service Owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Caretakers of seniors living alone	Data user: SEL Service user: Caretakers of seniors living alone
	Consumer Metering Data	Data/Service Owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Caretakers of seniors living alone	Data user: SEL Service user: Caretakers of seniors living alone
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	Data/Service owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Off-takers	Service User: Consumer
	Consumer Metering Data	Data/Service owner: SEL	Data/Service provider: SEL	Data consumer: SEL Service consumer: Off-takers	Service User: Consumer
P3 SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	Private: KPV	Private: KPV	Forecasting service (COMS)	District Heating Operators

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Pilot title	Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
	Potential district heating systems	Private: KPV	Private: KPV	Forecasting service (COMS)	District Heating Operators
	Weather data	Open API	Open API provider	Forecasting service (COMS)	General Public
	Advanced metering infrastructure (AMI) data (end-user data)	Private: ELCE	Private: ELCE	Energy Forecasting service (COMS) Simulation service (TNO)	DSO
	AMI Data (secondary substation data)	Private: ELCE	Private: ELCE	Federated transfer learning flexibility potential assessment (COMS)	DSO
	Topology	Private: ELCE	Private: ELCE	Simulation service (TNO)	DSO
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	Data owners: Data primarily owned by regulated sources: Electricity datasets from: -IPTO (Greek electricity TSO) ENTSO-E (European electricity TSOs federation) Natural gas datasets from: -DESFA (Greek gas TSO)	Data providers: NTUA / DEPA However, data are primarily owned by regulated sources: Electricity datasets from: - IPTO (Greek electricity TSO) ENTSO-E (European electricity TSOs federation) Natural gas datasets from:	Private: Researcher, Data scientist setting up the simulations, Investor	Private: Investor, Researcher, Data scientist setting up the simulations

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Pilot title	Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
		-ENTSO-G (European gas TSOs federation) Service owner: NTUA	-DESFA (Greek gas TSO) -ENTSO-G (European gas TSOs federation) Service provider: NTUA		
	Simulation results	Service NTUA Data: NTUA, DEPA	Service NTUA Data: NTUA, DEPA	Private: Researcher, Data scientist setting up the simulations, Investor	Private: Investor, Researcher, Data scientist setting up the simulations
P6-SE: Flexibility aggregation from behind-the-meter consumers	Electrical Vehicle (EV) and Electric Vehicle Supply Equipment (EVSE) telemetry data	Equipment manufacturer	EV aggregator	Our Demand Response service	EV aggregator
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum	Private: -Thermal insulation material producers, window producers -Owner of a private house Institutions: -Municipalities Other public entities	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum

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Pilot title	Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
	Solar panels data	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum	Private: -Solar panels producers -Owner of a private house Institutions: -Municipalities Other public entities	Private: Owner of a private house Institutions: -Ministry of Economics -Financial institution Altum

As it can be seen, the requested description of the data and services ownership, provision, exploitation and usage is defined and presented in details.

Question 2. Security, protection, and sovereignty

Responds collected in the chapter 2 "Security, protection, and sovereignty" are presented in Table 4:

Table 4. Responds for the questionnaire, "Security, protection, and sovereignty of the data"

Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
P2-PT.A: Leveraging on consumer-level load data to improve TSO's	Active power measurements from consumers	-Personal data -Confidential -Restricted	privacy-preserving algorithms (raw data does not leave data owner servers)	Registration of service connector via Dataspace	Authentication of service connector via Dataspace Identity provider	One (dataspace)	Managed by Dataspace identity provider (certificate authority)

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Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
operational and planning procedures				Identity provider			
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	-Personal data -Non personal data -Open -Confidential -Restricted		Yes. Registration of service connector via Dataspace Identity provider	Yes. Authentication of service connector via Dataspace Identity provider	One (dataspace)	Managed by Dataspace identity provider (certificate authority)
	Active power consumption from thermal loads	-Personal data -Confidential -Restricted		Yes. Registration of data provider service connector via Dataspace Identity provider	Yes. Authentication of data provider service connector via Dataspace Identity provider	Two (dataspace and user interface)	Managed by Dataspace identity provider (certificate authority) SSL certificate for user interface
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature	-Non personal data -Anonymized	Transport Layer Security (TLS) encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication	Admin roll based access	yes e.g., each participant sensor or device uses a certificate for authentication Specify the certificates: X.509

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Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
	Humidity	-Non personal data -Anonymized	TLS encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication.	Admin roll based access.	yes e.g., each participant sensor or device uses a certificate for authentication Specify the certificates: X.509
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Current	-Non personal data -Anonymized	TLS encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication.	Admin roll based access	yes e.g., each participant sensor or device uses a certificate for authentication Specify the certificates: X.509
	Voltage	-Non personal data -Anonymized	TLS encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication.	Admin roll based access	yes e.g., each participant sensor or device uses a certificate for authentication

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Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
							Specify the certificates: X.509
	Consumer Metering Data	-Personal data -Confidential	TLS encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication.	Admin roll based access	yes e.g., each participant sensor or device uses a certificate for authentication Specify the certificates: X.509
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	-Non personal data -Anonymized	TLS encryption of communication channel, device authentication and/or certificate authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication	yes e.g., each participant sensor or device uses a certificate for authentication Specify the certificates: X.509	(yes/no) e.g., each participant must be uniquely identified using certification. Specify the certificates:
	Consumer Metering Data	-Non personal data - Anonymized	TLS encryption of communication channel, device authentication	No (not required)	No direct user access required. Staff/Admin user access requires authentication	yes e.g., each participant sensor or device uses a certificate	

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Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
			and/or certificate authentication			for authentication Specify the certificates: X.509	
P3 SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	Personal, Anonymized and confidential data					
P3 SI: Optimal multi-energy vector planning - electricity vs heat	Potential district heating systems	Non personal data, Confidential					
	Weather data	Non personal data, Open					
	AMI data (end-user data)	Personal, Anonymized and confidential data					
	AMI Data (secondary substation data)	Non personal data, Confidential					
	Topology	Non personal data, Confidential					

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Pilot Title	Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	-Non personal data -Open	Private server Virtual private network (VPN) Authentication Identity management	E-mail	Single Sign-On (SSO) User name password	One	Unknown
	Simulation results	Non personal data	Private server VPN Authentication Identity management	E-mail	SSO User name password	One	Unknown
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetry data	Non personal data, Confidential	Encryption in transit and at rest	No, Manual	Yes: OAuth2-based	One	No. certificates: token-based
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Personal, Anonymized		Yes	No	No	No
	Solar panels data	Personal, Anonymized		Yes	No	No	No

It can be seen, that different use cases utilize different data access modes. Some of the use cases use one level authentication, however, two level authentication must be used in order to secure the data sharing mechanisms.

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Question 3. Access / Consent of the data

Responds collected in the chapter 3 “Access / Consent of the data” are presented in Table 5:

Table 5. Responds for the questionnaire, “Access / Consent of the data”

Pilot title	Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power measurements from consumers	-Confidential -Restricted	Other: Dataspace Connector self-descriptions published in Dataspace metadata broker. Should only contain service Application (APP) general information.	-Offline*** retention/only via DS	Other agreement: Limited by INESC TEC dataspace connector policies for data sharing	-Download-read only.
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	-Public -Confidential -Restricted	-Public Other: REC equipment details / characteristics / parameters / contracts with energy retailers are shared with restricted access	-Open, public available -Offline*** retention/only via DS	Other agreement: Limited by INESC TEC dataspace connector policies for data sharing	-Download-read only.
	Active power consumption from thermal loads	-Confidential -Restricted	-Limited to owner -Limited to provider	-Offline*** retention/only via DS	Other agreement: Limited by INESC TEC dataspace connector policies for data sharing	-Download-read only.

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Pilot title	Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature	-Confidential	-Limited to provider	-Different by different types of users -Limited by the duration of access from date A to date B	-General Data Protection Regulation (GDPR)	-Download-read only.
	Humidity	-Confidential	-Limited to provider	-Different by different types of users -Limited by the duration of access from date A to date B	-GDPR	-Download-read only.
	Current	- Confidential	-Limited to provider	-Different by different types of users -Limited by the duration of access from date A to date B	-GDPR	-Download-read only.
	Voltage	- Confidential	-Limited to provider	-Different by different types of users -Limited by the duration of access	-GDPR	-Download-read only.

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Pilot title	Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
				from date A to date B		
	Consumer Metering Data	- Confidential	-Limited to provider	-Different by different types of users -Limited by the duration of access from date A to date B	-GDPR	-Download- read only.
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	- Confidential	Limited to provider	-Different by different types of users Limited by the duration of access from date A to date B	-GDPR	-Download- read only.
	Consumer Metering Data	- Confidential	Limited to provider	-Different by different types of users Limited by the duration of access from date A to date B	-GDPR	-Download- read only.
	Heat use of buildings	Confidential	Limited to source location			Read only

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Pilot title	Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Potential district heating systems	Restricted	Limited to source location	Offline		Read only
	Weather data	Public	Public	Open publicly available		Read only
	AMI data (end-user data)	Confidential	Limited to owner	Offline		Read only
	AMI Data (secondary substation data)	Restricted	Public	Offline		Read only
	Topology	Restricted	Public	Offline		Read only
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	Public	Public	Open, public available	Other agreement: TBD	Download-read only.
	Simulation results	Case dependant confidential	Public	Different by different types of users	TBD	Download-read only.
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetry data	Confidential	Limited to owner	Different by different types of users	Agreement NDA	Read & write
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Case dependant confidential	Limited to owner Limited to provider	Open, public available Different by different types of users	No	Download-read only.
	Solar panels data	Case dependant confidential	Limited to owner Limited to provider	Open, public available	No	Download-read only.

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Pilot title	Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
				Different by different types of users		

It can be seen, that the section related to access and consent of the data is described in details, from both data and services perspective.

<u>Question 4. Flow of the data</u>

Responds collected in the chapter 4 "Flow of the data" are presented in Table 6:

Table 6. Responds for the questionnaire, "Flow of the data"

Pilot title	Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
P2-PT.A: Leveraging on consumer-level load data to improve TSO's operational and planning procedures	Active power measurements from consumers	Entity: Smart Energy Lab (SEL) Role: Data Owner / Data Provider Entity: NESTER Role: Data Owner / Data Provider	Entity: NESTER Role of this entity: TSO – receives forecasts computed by the federated learning APP	Yes. INESC TEC Federated learning tool computes forecasts using local data and 1) ingests local measurements data 2) stores forecasts data for local data assets	end-to-end but no raw data is shared (only encrypted coefficients for the FL models)	Yes INESC TEC will contain an internal database.

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Pilot title	Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	Entity: Smart Energy Lab (SEL). Role: Data Owner / Data Provider Entity: Community Manager – Role: Data Owner / Data Provider	Entity: INESC TEC Role: Service Provider Entity: Community Manager Role: Data/Service User	Yes. (Between INESC TEC and Community Manager)	-platform-to-platform	No. Data is ingested, fed to the service unaltered, and result is returned after service call.
	Active power consumption from thermal loads	Entity: Smart Energy Lab (SEL) Role: Data Owner / Data Provider	Entity: INESC TEC Role: Service Provider Entity: end user Role: Service User	No	-platform-to-end	Yes.
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	Entity: SEL Role: Data Provider	Entity: SEL Role: Service developer	No	end-to-end	Yes
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	Entity: SEL Role: Data Provider	Entity: SEL Role: Service developer	No	end-to-end	Yes
	Consumer Metering Data	Entity: SEL Role: Data Provider	Entity: SEL Role: Service developer	No	end-to-end	Yes
P3-SI: Optimal multi-energy	Heat use of buildings	Metering device	Energy forecasting tool (service provider)	No	No	No – used for training

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Pilot title	Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
vector planning - electricity vs heat	Potential district heating systems buildings	Metering device	Energy usage prediction tool (service provider)	No	No	No – used for training
	Weather data	API Servers	Energy forecasting tool, Energy usage prediction tool, Federated TL flexibility potential tool, multi-energy flexibility potential assessment (service providers)	No	No	No
	AMI data (end-user data)	End-user Meters	Energy forecasting tool, Energy usage prediction tool, Federated TL flexibility potential tool (service providers)	No	No	No
	AMI Data (secondary substation data)	Substation Meters	Federated TL flexibility potential tool (service providers)	No	No	No
	Topology	Network Operator Databases	Simulation Services (service provider)	No	No	No

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Pilot title	Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Forecasted energy	Energy forecasting tool (service)	Multi-energy flexibility potential assessment (service provider)	No	End-to-end	No
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	Timescale DB Role of this entity: Database@NTUA	Entity: DEPA Role of this entity: Data provider, Beneficiary of the service Entity: External stakeholders Role of this entity: Investors, researchers	No	Maybe	Yes
	Simulation results	Entity: Postgres DB Role of this entity: Database@NTUA	Entity: DEPA Role of this entity: Data provider, Beneficiary of the service Entity: External stakeholders Role of this entity: Investors, researchers	No	Yes	Yes
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV & EVSE telemetry data	Entity: EV aggregator Role of this entity: Aggregating EVs and EVSEs	Entity: Our Demand Response service Role of this entity: Use the telemetries to perform real-time control of EVs and	No	Aggregator to platform	No

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Pilot title	Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
			EVSEs for Demand Response			
	EV & EVSE charging commands	Entity: Our Demand Response service Role of this entity: Real-time control of EVs and EVSEs for Demand Response	Entity: EV aggregator Role of this entity: Aggregating EVs and EVSEs	No	Platform to aggregator	No
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Entity: 03.2022. Role of this entity: data on the activities carried out in the residential house of private individuals during this time period	Entity: 04.2023. Role of this entity: data on the activities carried out in the residential house of private individuals during this time period			Yes, Institutions: Ministry of Economics, Financial institution Altum
	Solar panels data	Entity: 03.2022. Role of this entity: data on the activities carried out in the residential house of private individuals during this time period.	Entity: 04.2023. Role of this entity: data on the activities carried out in the residential house of private individuals during this time period.			Yes, Institutions: Ministry of Economics, Financial institution Altum

It can be seen, that the responds do not cover all the topics that should be tackled in this section.

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<u>Question 5. Following the data from the beginning-source of data (device, internal memory, DB, etc.) to its final destination</u>

Responds collected in the chapter 5 “Following the data from the beginning-source of data (device, internal memory, DB, etc.) to its final destination” are presented in Table 7:

Table 7. Responds for the questionnaire, “Following of the data”

Pilot title	Dataset name (raw or related to the service)	Comprised of different data formats? (Y/N)	Description: end-end, end to platform, platform-platform Labels	Conversion of Data (if there is any)	Final destination of the Data
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power measurements from consumers	No. Only time series (measurements) data (Time, value, unit)	End-end	Local encryption of raw data. Forecasts generated by Machine Learning (ML) models	Forecasts computed at the Data APP level, and can later be exported to local file system.
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	Different data sources / formats are combined to build the service input dataset: Time-series (dynamic) data (e.g., energy consumption profiles, electricity prices, etc.) Static data (e.g., cost structures, REC configuration, etc.)	platform-to-platform	No.	INESC TEC service output is published in the data space with restricted access policies so only community manager has access to the output data.
	Active power consumption from thermal loads	Different data sources / formats are combined to build the service input dataset: Time-series (dynamic) data (e.g., energy consumption time-series, binary	platform-to-platform	Yes	INESC TEC service output is published in the data space with end-user access.

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Pilot title	Dataset name (raw or related to the service)	Comprised of different data formats? (Y/N)	Description: end-end, end to platform, platform-platform Labels	Conversion of Data (if there is any)	Final destination of the Data
		hot-water usage calendar) Static data (e.g., EWH functioning power, EWH capacity, EWH maximum allowed temperature, and user-defined hot water comfort temperature)			
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	No	End-end	No	SEL DB
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	No	End-end	No	SEL DB
	Consumer Metering Data	No	End-end	No	SEL DB
P3-SI: Optimal multi-energy vector planning - electricity vs heat P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	N	End-end	Anonymization	Service
	Potential district heating systems	N	End-end	No	Service
	Weather data	N	End-end	No	Service
	AMI data (end-user data)	N	End-end	Anonymization	Service
	AMI Data (secondary substation data)	N	End-end	No	Service

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Pilot title	Dataset name (raw or related to the service)	Comprised of different data formats? (Y/N)	Description: end-end, end to platform, platform-platform Labels	Conversion of Data (if there is any)	Final destination of the Data
	Topology	NY	End-end	No	Simulation Services
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	No		No	Unknown
	Simulation results	No		No	Unknown
P7-LV: Cross-value chain services for energy-data driven green financing	Meter data on energy consumption, reduction	Time, status, value		Yes	Institutions: Ministry of Economics, Financial institution Altum
	The work done in the building	Time, status, value		Yes	Institutions: Ministry of Economics, Financial institution Altum
	Building energy efficiency data	Time, status, value		Yes	Institutions: Ministry of Economics, Financial institution Altum

It can be seen, that this section is filled in details for most of the use cases, however, some of the data is missing.

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Question 6. Tracking of the data

Responds collected in the chapter 6 “tracking of the data” are presented in Table 8:

Table 8. Responds for the questionnaire, “Tracking of the data”

Pilot title	Dataset name (raw or related to the service)	Tracking or any other possible methods on how to guarantee a track.	Logs tracking enabled	Methods/strategies for dataflow tracking.	Information needed to be tracked
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power measurements from consumers	No raw data is shared between DS connectors, only encrypted coefficients. Service and DS connectors logs are maintained, for internal control.	Yes.	Service logs and DS connector logs.	internal control
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	Service and DS connectors logs are maintained, for internal control.	Yes.	Service logs and DS connector logs.	internal control
	Active power consumption from thermal loads	Service and DS connectors logs are maintained, for internal control.	Yes.	Service logs and DS connector logs.	internal control
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	Yes; If yes, specify: Gathering the sensor logging on SEL DB	Yes	Sensor Logs	internal control
	Smart Plug Data	Yes; If yes, specify:	Yes	Sensor Logs	internal control

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Pilot title	Dataset name (raw or related to the service)	Tracking or any other possible methods on how to guarantee a track.	Logs tracking enabled	Methods/strategies for dataflow tracking.	Information needed to be tracked
P2-PT.D: Suggest maintenance of appliances based on NILM data		Gathering the sensor logging on SEL DB			
	Consumer Metering Data	Yes; If yes, specify: Gathering the sensor logging on SEL DB	Yes	Sensor Logs	internal control
P3-SI: Optimal multi-energy vector planning - electricity vs heat P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings, Potential district heating systems, Weather data, AMI data (end-user data), AMI Data (secondary substation data), Topology	No	No		
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	Application logs	Planned	Application logs	Data push Data pull along with user transaction properties
	Simulation results	Application logs	Planned	Application logs	Data push Data pull along with user transaction properties
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetries and commands	Yes, logging.	Yes	Logging and saving logs in cloud.	internal control
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Yes, it is necessary that institutions can see the information entered by	yes		internal control

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Pilot title	Dataset name (raw or related to the service)	Tracking or any other possible methods on how to guarantee a track.	Logs tracking enabled	Methods/strategies for dataflow tracking.	Information needed to be tracked
		households			
	Solar panels data	Yes, it is necessary that institutions can see the information entered by households	yes		internal control

It can be seen, that this section is filled in details for most of the use cases, the data flow tracking is controlled. The missing responds appear only in the situations of use cases, which use specific data and services.

Question 7. Inter-operability, portability and standardization of the data

Responds collected in the chapter 7 "inter-operability, portability and standardization of the data" are presented in Table 9:

Table 9. Responds for the questionnaire, "Inter-operability, portability and standardization of the data"

Pilot title	Dataset name (raw or related to the service)	Need for conversion of data formats (interoperability)?	Use converters from DS?	Needed conversions (WP3)?	Are data ready to be used by several entities?	Is the dataset standardized to be reused in other UCs?	Is the dataset representative to be replicable in other UCs?
P2-PT.A: Leveraging on consumer-level load data to improve TSO's operational and planning procedures	Active power measurements from consumers	No	No				

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Pilot title	Dataset name (raw or related to the service)	Need for conversion of data formats (interoperability)?	Use converters from DS?	Needed conversions (WP3)?	Are data ready to be used by several entities?	Is the dataset standardized to be reused in other UCs?	Is the dataset representative to be replicable in other UCs?
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	Yes	Yes	TBD			
	Active power consumption from thermal loads	Yes	Yes	TBD			
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	No	No	-	No	No	No
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	No	No	-	No	No	No
	Consumer Metering Data	No	No	-	No	No	No
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings, Potential district heating systems, Weather data, AMI data (end-user data), AMI Data (secondary substation data), Topology		No				
P4-GR: Digital Twin for optimal data-	All electricity and gas datasets	No	No	No	No	No	Yes

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Pilot title	Dataset name (raw or related to the service)	Need for conversion of data formats (interoperability)?	Use converters from DS?	Needed conversions (WP3)?	Are data ready to be used by several entities?	Is the dataset standardized to be reused in other UCs?	Is the dataset representative to be replicable in other UCs?
driven Power-to-Gas planning	Simulation results	No	No	No	No	No	Yes
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetries and commands	No	No	No	No	No	No
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	Yes	Yes	No			
	Solar panels data	Yes	Yes	No			

It can be seen, that the responds from use cases are not complete, it can be assumed that this question was over the scope of the pilots' data.

Question 8. Data portability

Responds collected in the chapter 8 "data portability" are presented in Table 10:

Table 10. Responds for the questionnaire, "Data portability"

Pilot title	Dataset name	Data format	Open	Standard	Proprietary data Format
P2-PT.A: Leveraging on consumer-level load data to improve TSO's operational and planning procedures	Active power measurements from consumers	JSON			

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Pilot title	Dataset name	Data format	Open	Standard	Proprietary data Format
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	JSON File with service-specific input/output structure	No	No	Yes
	Active power consumption from thermal loads	JSON File with service-specific input/output structure	No	No	Yes
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	Comma-Separated Values (CSV) File	No	Yes	No
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data	CSV File	No	Yes	No
	Consumer Metering Data	CSV File	No	Yes	No
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	XLSX, CSV	No	Yes	No
	Potential district heating systems	XLSX, CSV	No	Yes	No
	Weather data	API, JSON	Yes	Yes	No
	AMI data (end-user data)	XLSX, CSV	No	Yes	No
	AMI Data (secondary substation data)	XLSX, CSV	No	Yes	No
	Topology	Geographic Information System (GIS)	No	Yes	No
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets	CSV / DB		Partially (T3.1)	YES
	Simulation results	CSV / DB		Partially (T3.1)	YES
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetries and commands	Data is exchanged in JSON format, but operational logs can be exported to CSV	Yes	JSON, CSV	
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data	CSV File	Closed	Standard	No
	Solar panels data	CSV File	Closed	Standard	No

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As it can be seen, the requested description of the data portability is defined and presented in details.

Question 9. Data governance policy

Responds collected in the chapter 9 “data governance policy” are presented in Table 11:

Table 11. Responds for the questionnaire, “Data governance policy”

Pilot title	Dataset name (raw or related to the service)	Data governance policy
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power measurements from consumers	SEL internal policy
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power measurements per consumer and DER	SEL internal policy
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	Temperature, Humidity, Current, Voltage, Consumer Metering Data	SEL internal policy
P2-PT.D: Suggest maintenance of appliances based on NILM data	Smart Plug Data, Consumer Metering Data	SEL internal policy
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	Internal policies adhering to data protection and privacy regulations (e.g., GDPR), anonymization
	Potential district heating systems	
	Weather data	Open data policy, no specific governance required
	AMI data (end-user data)	Internal policies for data security, anonymization, and user consent
	AMI Data (secondary substation data)	Internal policies for secure data handling and exchange
	Topology	Internal policies for data confidentiality and secure access
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets, Simulation results	TBD

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Pilot title	Dataset name (raw or related to the service)	Data governance policy
P6-SE: Flexibility aggregation from behind-the-meter consumers	EV and EVSE telemetries and commands	Internal doc
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data, Solar panels data	Internal doc

It can be seen, that for some of the use cases, the internal documents are used to identify the data governance policy. These documents will be analysed in order to develop the data governance models and presented in the next version of the deliverable.

Question 10. Usage of the application for the data flow

Responds collected in the chapter 10 “usage of the application for the data flow” are presented in Table 12:

Table 12. Responds for the questionnaire, “Usage of the application for the data flow”

Pilot title	App name	OS (IOS, Android, Windows…)	Where to find it?
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	TWINP2G	Ubuntu	online
P6-SE: Flexibility aggregation from behind-the-meter consumers	N/A		
P7-LV: Cross-value chain services for energy-data driven green financing	EEF	Windows	web

It can be seen, that only a few pilots use applications or have developed a service, which is also available as an application. The applications are shortened versions of conventional web based solutions and therefore, as an end product, designed to be as easy as possible for end users of the services to use. This result is expected, since most of the developed solutions in the scope of ENERSHARE project have TRL not higher than 8.

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Question 11. Actors in the use case

Responds collected in the chapter 11 “actors in the use case” are presented in Table 13:

Table 13. Responds for the questionnaire, “Actors in the use case”

Pilot title	Regulated Entities: Agencies, TSO, DSO, Ministries, Municipalities	Non regulated entities: suppliers, communities, aggregators, energy trading companies, grid, users, energy consumers, prosumers, producers
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	TSO	Energy prosumers, Data aggregator, Energy service provider
P2-PT.B: Instantiation of energy communities and digital simulation of business models	DSO	Energy community manager, Energy service provider, Energy prosumers, Data aggregator
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone	DSO	SEL, Monitored people, Service users
P3-SI: Optimal multi-energy vector planning - electricity vs heat	TSO, DSO, utility	Prosumers
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	Gas and electricity TSOs, DEPA (pilot 4)	Users, photovoltaic (PV) and Power-to-Gas (P2G) investors, data scientists
P6-SE: Flexibility aggregation from behind-the-meter consumers	TSO	EV Aggregator, Balance Service Provider
P7-LV: Cross-value chain services for energy-data driven green financing	Agencies, Ministries, Municipalities	suppliers, communities, aggregators, energy trading companies, grid, users, energy consumers, prosumers, producers

It can be seen, that different use cases have different actors. Additionally, it can be noted, that some data and services are market based and some regulated.

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Question 12. Data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility)

Responds collected in the chapter 12 “data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility)” are presented in Table 14:

Table 14. Responds for the questionnaire, “Data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility)”

Pilot title	Dataset name	Give examples of incentives that would foster consumers/grid users to share their energy data (e.g., behind-the-meter data) with regulated entities (TSO, DSO, multi-energy utility)	Which data would you like to get from TSO, DSO, or multi-energy utilities?	Are you willing to pay for data from TSO, DSO, or multi-energy utilities?	Is there any data sharing incentive in the Pilot?
P2-PT.A: Leveraging on consumer-level load data to improve TSO’s operational and planning procedures	Active power consumption from prosumers	Awareness of social good: Improved predictability of the grid operating conditions	n.a.	No	Access to an energy monitoring dashboard, Coupons
P2-PT.B: Instantiation of energy communities and digital simulation of business models	Active power consumption from prosumers/consumers, PV generation	Allows the optimization of the community planning and study new business models. Direct benefit to consumers	Secondary substation transformer loading	No	Access to an energy monitoring dashboard, Coupons
P2-PT.C: Detect irregularities in energy consumption in households with seniors living alone					Access to an energy monitoring dashboard, Coupons

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Pilot title	Dataset name	Give examples of incentives that would foster consumers/grid users to share their energy data (e.g., behind-the-meter data) with regulated entities (TSO, DSO, multi-energy utility)	Which data would you like to get from TSO, DSO, or multi-energy utilities?	Are you willing to pay for data from TSO, DSO, or multi-energy utilities?	Is there any data sharing incentive in the Pilot?
P2-PT.D: Suggest maintenance of appliances based on NILM data					Access to an energy monitoring dashboard, Coupons
P3-SI: Optimal multi-energy vector planning - electricity vs heat	Heat use of buildings	Reduced tariffs, enhanced services	usage data, consumption patterns		
	Potential district heating systems	Financial benefits, access to improved grid services	Operational data		
	Weather data	Not applicable, as it's public data	Not applicable		
	AMI data (end-user data)	Reduced tariffs	Detailed energy usage data, outage information		
	AMI Data (secondary substation data)	Improved energy management services	Substation performance data, maintenance schedules		
	Topology	Access to advanced grid analytics	capacity information		
P4-GR: Digital Twin for optimal data-driven Power-to-Gas planning	All electricity and gas datasets, Simulation results	Run simulations for potential investments on renewables or P2G that they may be profitable to them.	Real-time data of what we already have	No	No

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Pilot title	Dataset name	Give examples of incentives that would foster consumers/grid users to share their energy data (e.g., behind-the-meter data) with regulated entities (TSO, DSO, multi-energy utility)	Which data would you like to get from TSO, DSO, or multi-energy utilities?	Are you willing to pay for data from TSO, DSO, or multi-energy utilities?	Is there any data sharing incentive in the Pilot?
P7-LV: Cross-value chain services for energy-data driven green financing	Energy efficiency data Solar panels data	There isn't any.	There isn't any data that we need from TSO, DSO, or multi-energy utilities.	No	No

It can be seen, that it is necessary to explore the potential of data sharing. Table 14 shows that in use cases where specific closed services are considered during development, it was not possible to receive responds. In contrary, it was possible to receive responds in use cases, where there are more datasets and more participants involved. It can be highlighted, that firstly there is no need or knowledge that some data is collected and stored by system operators, and secondly that each of the pilot projects does not identify any incentives for data sharing, since it seems to be out of the scope of the use cases.

Detailed analysis of the responds will be conducted and presented in the final version of the Deliverable along with the Energy Data Space Governance Models, based both on the analysis from existing initiatives and projects and the analysis of the replies for the questionnaire.

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3 Data sharing incentive and business models design for regulated and non-regulated domains

This section focuses on Task 7.3, which aims to create a set of incentive mechanisms for data sharing in the B2B domain. These mechanisms cover non-regulated and regulated (DSOs, TSOs, etc.) domains, and the main goal is to attract data consumers while increasing the revenue or benefits for data providers.

Considering non-regulated domain entities, to achieve the goal, described above, two main types of incentive mechanisms will be considered for each business model or use case:

- **Data-by-money (monetary incentive):** data owners accept to share their data because they are monetarily compensated (considering fairness) if their data is relevant for solving analytics/optimization tasks and pay in case data from others is relevant to their own tasks.
- **Data-by-data (non-monetary incentive):** barter trading, specifically a data-by-data exchange scheme. There is no money involved and data owners agree to share and receive data with approximately the same value.

In what follows, the developments and expected contributions of ENERSHARE are presented for both non-regulated (Section 3.1) and regulated (Section 3.2) domains.

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3.1 Non-regulated domain

Table 15. Overview of the ENERSHARE incentive mechanisms for non-regulated domain

		Data split	Forecasting task: Regression	Forecasting task: Classification	Bid structure: Seller	Bid structure: Buyer	Models
Data monetization	Fixed price markets	Features			• Fixed price per feature	• Fixed price per forecast or • Price depending on forecasting accuracy	• B-spline LASSO (logistic) regression • Neural Networks
	Social Welfare Maximization	Features			• Minimum price, and a value function that reflects satisfaction with a certain price/relevance	• Maximum price and a value function that reflects satisfaction with a certain price/accuracy improvement	• Linear models • Neural networks … that maximize the sum of value functions restricted to min/max bids
		Observations					
	Data-value driven markets	Features			• Fixed price • Price depending on data value	• Fixed price • Price depending on data value	• Agents buy data or • Any model
		Observations					
Data-by-data		Features			There are no bids (only data exchange according to value)		No model
		Observations					

Accuracy improvement = 100*(error(colaborative model)-error(local model)) / error(local model), error=Mean Squared Error, True Positives, etc
Data relevance = how much of the accuracy improvement is because of my data (measured by correlation coefficients, Shapley, permutation importance)
Value = Partial correlation (or mutual information or ...) between my target and market features given my own variables
Implemented (being tested with synthetic data, GEFCom2014 wind power data and/or Norway data)
Expected extensions (for observations/classification case, synthetic data from the digital twin – TECNALIA and ENGIE)

Table 15 summarises the algorithmic solutions developed (and expected) in ENERSHARE, for the non-regulated domain. Concerning the monetary incentives, different perspectives are considered:

1. **Fixed price (forecasting) markets:** suitable for use cases where data owners want to buy forecasts and/or sell data and they prefer simple bid strategies. The sellers' rationale is "if my data are used, I want to receive x" and the buyers' rationale is "I am willing to pay y for a prediction". Then, the market operator estimates the most accurate forecasting model, whose total price of the allocated data does not exceed the buyer's bid. An extension was also developed that allows buyers to bid more flexibly, i.e., "I am willing to pay according to my improvement in forecasting accuracy".

2. **Social welfare maximization:** this is the most sophisticated approach for the cases where data owners want to buy forecasts and/or sell data. The sellers' rationale is "if my data is used, I want to receive at least x, but I also want my payment to depend on the importance of my information". Similarly, the buyers' rationale is "I am willing to pay at most y for a prediction, but my willingness also depends on the accuracy of that prediction." It is then up to the market operator to estimate the model and prices that maximize the sum of all these preferences (declared as value functions).

3. **Data-value-driven markets:** the previous alternatives depend on the choice of a collaborative prediction approach. Here, the idea is to allocate data without training a prediction model. Instead, data is allocated according to similarity metrics such as correlation or mutual information. These metrics are indicators of data value. Data buyers can have a fixed or dynamic budget, data sellers can also have a fixed or dynamic

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bid, and the market operator tries to allocate the maximum value possible while respecting the restrictions of both buyers and sellers.

For the non-monetary incentives, each data owner aims to provide and receive data with approximately equal value. The focus shifts from monetary incentives to a more equitable exchange of information, where participants strive to contribute and gain data of comparable significance.

Assume data are collected by N data owners. The n-th data owner has a set of $|\Omega_n| \geq 1$ covariates, denoted by $\mathbf{X}_{\Omega_\mathrm{n}}$, and wants to predict $\mathrm{Y_n}$. A summary of the main algorithmic improvements post-Deliverable 7.1 is presented next. So far, the focus has been on cases in which data owners observe different features, and their variables are continuous, but as depicted in Table 15 extensions are expected to accommodate other data properties.

3.1.1 Simple market mechanism where sellers define a fixed price for their data

After discussing the incentive mechanisms with the ENERSHARE consortium, the need for an analytics/data marketplace with a simpler bidding strategy became clear. A simple solution is for the sellers to fix a price for their data and for the buyer to fix price-to-buy forecasts. Then the market operator is left with the task of fitting the most accurate collaborative model that satisfies the buyer budget constraint.

Consider p_s^j represents the payment that s-th seller wants to receive if its j-th variable X_s^j is used and let p_b represent the buyer budget. If the collaborative forecasting model is a linear regression, with a regularization term to perform automatic feature selection, then the market operator estimates a cost-constrained linear regression, i.e.,

$$\min_{\beta} \sum_t \mathcal{L}\left(y_{b,t}, \sum_s \sum_{j=1}^{\Omega_s} x_s^j \beta_{s\to b}^j\right) + \lambda \sum_s \sum_{j=1}^{\Omega_s} |\beta_{s\to b}^j| \text{ s.t.} \sum_s \underbrace{\sum_{j=1}^{\Omega_s} p_s^j I_{\beta_{s\to b}^j \neq 0}}_{\substack{\text{cost of using} \\ \text{data from} \\ \text{the } s-\text{th seller}}} \leq p_b,$$

where $\beta_{s\to b}^j$ is the coefficient associated to X_s^j when predicting Y_b , and $I_{\beta_{s\to b}^j \neq 0}$is the indicatrix function. However, since many real-world applications rely on non-linear relationships, an extension was considered where features X_s^j are transformed via B-spline transformers [8], and additive models are used. In this case, each variable X_s^j is transformed into M new variables, $X_s^{j,1}, \dots, X_s^{j,M}$, and an additive linear collaborative forecasting model is considered, i.e., $y_{b,t} \approx \sum_s \sum_{j=1}^{\Omega_s} \sum_{m=1}^{M} x_s^{j,m} \beta_{s\to b}^{j,m}$.

Regarding the price per feature, if at least one of the variables $X_s^{j,1}, \dots, X_s^{j,M}$ is used, then s-th seller receives p_s^j. For each buyer b, the data market operator solves the problem:

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$$\min_{\beta} \sum_{t} \mathcal{L}\left(y_{b,t}, \sum_{s} \sum_{j=1}^{\Omega_s} \sum_{m=1}^{M} x_s^j \beta_{s\to b}^{j,m}\right) + \lambda \sum_{s} \sum_{j=1}^{\Omega_s} \sum_{m=1}^{M} |\beta_{s\to b}^{j,m}|$$

$$\text{subject to} \sum_{s} \underbrace{\sum_{j=1}^{\Omega_s} p_s^j \prod_{m=1}^{M} \left(1 - I_{\beta_{s\to b}^{j,m} \neq 0}\right)}_{\substack{\text{cost of using} \\ \text{data from} \\ \text{the } s\text{−th seller}}} \leq p_b.$$

As shown in [9], if the loss function $\mathcal{L}(\cdot)$ follows the Lipschitz condition, and the second derivative is bounded by a constant term L, the coefficient vector ($\boldsymbol{\beta}$) can be obtained by solving a sequence of 0-1 knapsack problems, as depicted in **Algorithm 1**. Notice that logistic regression is also supported by this formulation.

Algorithm 1 Spline Bid-Constrained LASSO Regression.

Input: $\boldsymbol{y}_b = \{y_{b,t}\}_{t=1}^{T}$, $\mathbf{X} = \{\mathbf{X}_{\Omega_1}, \ldots, \mathbf{X}_{\Omega_N}\}_{t=1}^{T}$, p_b, p_s^j, ε, $maxiter$, L
Output: $\boldsymbol{\beta}$
$\tilde{\boldsymbol{X}} \leftarrow SplineTransformer(\boldsymbol{X}, M)$ ▷ M estimated through Bayesian Optimization
$\boldsymbol{\beta}^{(0)}$ such that $\sum_s \sum_{j=1}^{|\Omega_s|} p_s^j \left[1 - \prod_{m=1}^{M} \left(1 - \mathcal{I}\left(\beta_{s\to b}^{j,m}\right)\right)\right] \leq p_b$ ▷ local model's coefficients
$k \leftarrow 1$
while $\mathcal{L}(\boldsymbol{\beta}^{(k)}) - \mathcal{L}(\boldsymbol{\beta}^{(k-1)}) > \varepsilon$ and $k < maxiter$ **do**
  $\boldsymbol{a}^{(k)} \leftarrow \boldsymbol{\beta}^{(k-1)} - \frac{1}{L}\frac{\partial \mathcal{L}}{\partial \boldsymbol{\beta}}(\boldsymbol{\beta}^{(k-1)})$ ▷ if $\mathcal{L}$ is the RMSE, then $\boldsymbol{a}^{(k)} \leftarrow \boldsymbol{\beta}^{(k-1)} + \frac{1}{TC}\tilde{\boldsymbol{X}}^{T}\left(\boldsymbol{y}_b - \tilde{\boldsymbol{X}}\boldsymbol{\beta}^{(k-1)}\right)$
  $\boldsymbol{\mu}_s^{j(k)} \leftarrow \sum_m \frac{\left(a_s^{j,m(k)}\right)^2 - 2\lambda|a_s^{j,m(k)}| + \lambda^2}{2} \cdot \frac{1 + \text{sign}\left(|a_s^{j,m(k)}| - \lambda\right)}{2}$
  $\mathbf{w}^{(k)} \leftarrow DynamicKnapsack(\boldsymbol{\mu}^{(k)}, \{p_s^j\}_{\forall s,j}, p_b)$ ▷ dynamic 0-1 Knapsack
  $\boldsymbol{\beta}^{(k)} \leftarrow \text{sign}(\boldsymbol{a}^{(k)} - \lambda) \circ \left(|\boldsymbol{a}^{(k)}| - \lambda\right)_+ \circ \left(w_{1,1}\mathbf{1}_M, w_{1,2}\mathbf{1}_M, \ldots, w_{jk}\mathbf{1}_M\right), \mathbf{1}_M = (1, \ldots, 1) \in \mathbb{R}^M$
  $k \leftarrow k + 1$
end while

Dynamic buyer budget. An alternative was also developed where buyer budget/bid depends in the error improvement, i.e., $p_b(gain)$. In this case, the market operator solves the previous optimization problem for a set of possible prices $\boldsymbol{p} = [p_0, p_0 + \delta, p_0 + 2\delta, \ldots, p_{max}]$ and register the buyer gain for each $\tilde{p} \in \boldsymbol{p}$ in a Bid-gain table (BGT). Then, the final model corresponds to the one that maximizes the buyer gain, while respecting the budget $p_b(gain)$. The price definition is illustrated in Figure 1. In the first plot, for budgets up to 31, the gains estimated by the market operator are higher than the ones requested by the buyer, meaning the buyer is comfortable with such prices. For a budget higher than 31, the estimated gain is lower than the one requested by the buyer, meaning the buyer is unwilling to pay a final price higher than 31. In the second plot, bids up to 10 and higher than 40 respect the minimum estimated gain required by the buyer, while the bids between 10 and 40 do not. Finally, in the third plot, none of the bids have an estimated gain that satisfies the minimum acceptable gain for the buyer. In such cases, the data market operator decides on a zero price and communicates that no forecasts respect the value function.

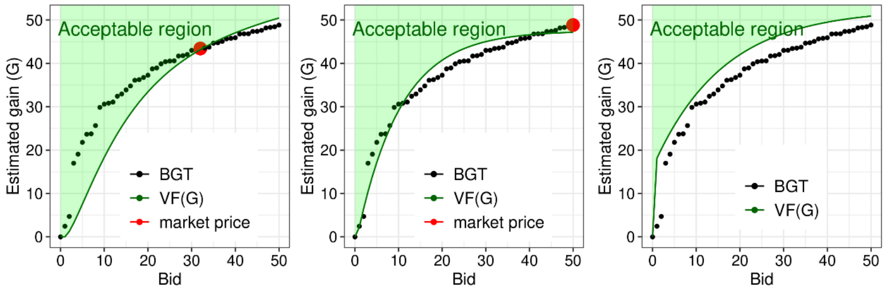

Figure 1. Illustration of price definition, p_b*(gain)* is represented as *VF(G)*

Extension to neural network-based models. Currently, more complex models such as multi-layer perceptron are being used in the literature. In this case, the coefficients of the models are usually estimated through gradient descent-based algorithms. To estimate the most accurate neural network model constrained to a certain budget, we propose to minimize a regularized loss function. The regularization term is a smooth approximation of the budget restriction of the model (Lagrange multipliers),

$$\mathcal{R} = \max\left\{0\,,\left[\sum_{s}\sum_{j}^{\Omega_s} p_s^j \times \sigma\left(\sum(\text{coefficients that multiply } X_s^j)^{\,2}\right)\right] - p_b\right\}$$

where σ is the sigmoid function applied to the model's squared coefficients ($\sigma\colon \mathbb{R} \to [0,1]$). Tests are being performed to test the convergence of this approach.

3.1.2 Improvements in the social welfare data monetization mechanism

As explained in Deliverable 7.1, INESC TEC's team previously formulated an algorithm where linear collaborative forecasting models are estimated taking into account that data owners set their value function for such a model as well as the minimum amount of money they want to receive $\underline{\mathrm{p}}_{\mathrm{i}}$ (if their data are used to improve others' forecasting model), and the maximum value they are willing to pay $\overline{\mathrm{p}}_{\mathrm{i}}$ (if there are useful collaborative data for them). The developed algorithm aims to maximize the sum of all value functions (social welfare maximization) while ensuring the minimum and maximum acceptable prices, as depicted in Figure 2. In the first approach, the value function of buyers was related to the relative error improvement of such collaborative model when compared to a model fed with local data, while the value function of buyers was related to the model's coefficients (and the corresponding prices). In this way, while maximizing social welfare, the linear collaborative forecasting model (data allocation and coefficients) and data prices are optimized.

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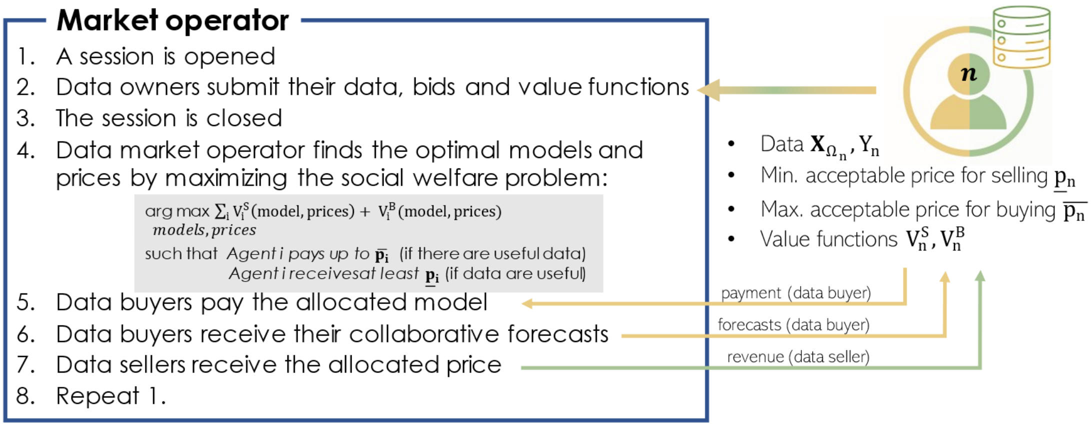

Figure 2. Social welfare auction mechanism.

ENERSHARE presents an advancement in this solution by accommodating more complex collaborative forecasting models, such as neural networks. The main challenge is that sellers are confronted with the obstacle of using neural network coefficients, which are considered black box models – the coefficients themselves offer no discernment of a variable's significance, and thus hinder the seller's ability to interpret the model.

As mentioned in the previous subsection, neural networks are commonly estimated through gradient descent methods. A solution was developed and is currently being tested where the value functions of sellers depend on the feature relevance, obtained through the gradients of the output with respect to the inputs, and the corresponding prices. Literature value functions are being considered, and two common choices are the linear, $V_i(x, y) = ax + by$ and Cobb-Douglas, $V_i(x, y) = x^a y^b$, where a and b are parameters tunned according to the preferences of data owners.

The estimation of model and prices employs gradient descent. Each training epoch focuses on optimizing the collaborative loss function, which involves summing the value functions. Furthermore, during each epoch, adjustments are made to the model weights. A decision on whether to buy or sell a feature is determined using a sigmoid function σ applied to the squared coefficients. The maximum and minimum acceptable price constraints, depicted in Figure 2, are introduced with a Rectified Linear Unit (ReLU) function on the deviation between the bids and the model cost.

3.1.3 Data-value-driven markets

The previous alternatives depend on the choice of a collaborative prediction approach, motivating us to design an algorithm that allocates data without training a prediction model. This idea was inspired by a combination between the fixed bid approach in Section 3.1.1, and

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the data-by-data mechanism (detailed in the next subsection) that tries to measure the value of data with literature metrics such as conditional mutual information.

Consider p_s^j represents the payment that s-th seller wants to receive if its j-th variable X_s^j is allocated and let p_b represent the buyer budget. The data-value-driven market allocates the most valuable variables while respecting both sellers and buyer bids, i.e.,

$$\max_{z_{s\to b}^j \in\{0,1\}} \underbrace{\sum_{s\neq b} \sum_{j\in\Omega_s} \text{Value}(\mathrm{Y_b}, X_s^j \,|\, \mathbf{X}_{\Omega_b})\ z_{s\to b}^j}_{\text{value received by agent b}} \ \textit{subject to} \sum_{s} \underbrace{\sum_{j=1}^{\Omega_s} p_s^j z_{s\to b}^j}_{\substack{\text{cost of using}\\ \text{data from}\\ \text{the s−th seller}}} \leq p_b,$$

where $\text{Value}(\mathrm{Y_b}, X_s^j \,|\, \mathbf{X}_{\Omega_b})$ represents the value of variable X_s^j to predict $\mathrm{Y_b}$, given the local data $\mathbf{X}_{\Omega_b}$. $z_{s\to b}^j = 1$ if the j variable of s-th data seller is allocated to b-th data buyer, $z_{s\to b}^j = 0$ otherwise. However, the value of a feature X_s^j highly depends on other potentially correlated available data. That said, each time a new variable is allocated to the b-th buyer, the value of the remaining variables should be updated, i.e., $\text{Value}(\mathrm{Y_b}, X_s^j \,|\, \mathbf{X}_{\Omega_b} \cup \mathbf{X}_{\text{allocated}})$. To proceed with an iterative allocation, a rule must be defined to sort the features iteratively according to their value, $\text{Value}(\mathrm{Y_b}, X_s^j \,|\, \mathbf{X}_{\Omega_b} \cup \mathbf{X}_{\text{allocated}})$, and cost, p_s^j. Three main rules may apply:

1. The cheapest variable first
2. The most valuable variable first
3. The best value/cost ratio first (greedy search)

Dynamic bids for data sellers and buyers. An alternative was also developed where sellers and buyer bids depend on the estimated value, i.e., $p_b(\text{Value}(\mathrm{Y_b}, \mathbf{X}_{\text{allocated}} \,|\, \mathbf{X}_{\Omega_b}))$ and $p_s^j(\mathrm{Y_b}, X_s^j \,|\, \mathbf{X}_{\Omega_b} \cup \mathbf{X}_{\text{allocated}})$, respectively. The iterative allocation process is like the previous one.

Extensions. Next steps include binary and categorical problems. Lastly, the case where data owners observe different instances of the same features will also be covered, since it represents a simpler scenario.

3.1.4 Improvements in the data-by-data exchange mechanism

ENERSHARE propose an algorithm to maximize the multilateral data exchange while ensuring each data owner provides and receives data with approximately the same value, as illustrated in Figure 3. Two main challenges were identified in D7.1 for this data-by-data formulation: how to measure the value of the data and how to solve the optimization problem that efficiently allocates data.

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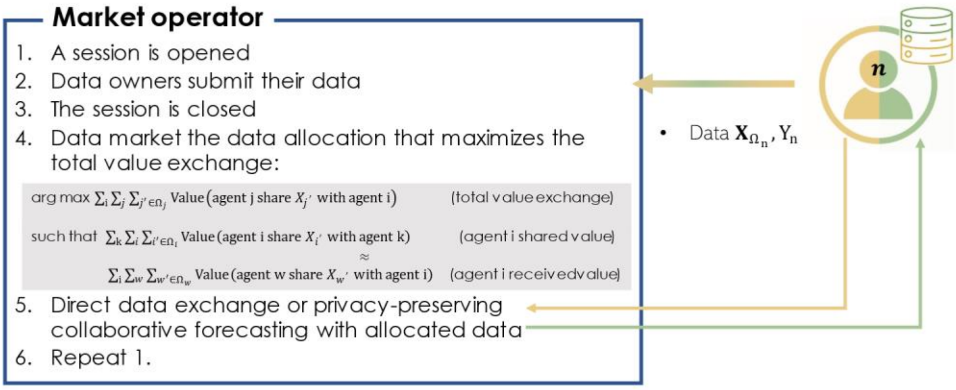

Figure 3. Data-by-data exchange.

Let assume data are collected by N data owners, and the n-th data owner has a set of $|\Omega_n| \geq 1$ covariates, denoted by $\mathbf{X}_{\Omega_n}$, and wants to predict $\mathrm{Y_n}$. Let $\mathrm{Value}(\mathrm{Y}, \mathrm{X}|\mathbf{Z})$ measure the value of acquiring the variable X when predicting Y, taking into consideration a pre-existing set of variables, denoted by $\mathbf{Z}$. The current developed solution allocates data by solving the following optimization problem:

$$\max_{z_{j\to i}^{j'} \in \{0,1\}} \overbrace{\underbrace{\sum_i \sum_{j \neq i} \sum_{j' \in \Omega_j} \mathrm{Value}(\mathrm{Y_i}, \mathrm{X_{j'}} \,|\, \mathbf{X}_{\Omega_\mathrm{i}})\ z_{j\to i}^{j'}}_{\text{value received by agent i}}}^{\text{total value exchanged}}$$

$$s.t. \underbrace{\sum_{i' \in \Omega_i} \sum_{j \neq i} \mathrm{Value}\left(\mathrm{Y_j}, \mathrm{X_{i'}} \middle| \mathbf{X}_{\Omega_j}\right) z_{i\to j}^{i'}}_{i-th \text{ data owner } \textbf{shared} \text{ value}} \approx \underbrace{\sum_{k \neq i} \sum_{k' \in \Omega_k} \mathrm{Value}(\mathrm{Y_i}, \mathrm{X_{k'}} | \mathbf{X}_{\Omega_i}) z_{k\to i}^{k'}}_{i-th \text{ data owner } \textbf{received} \text{ value}}, \forall i$$

$$\underbrace{\sum_k \sum_{k' \in \Omega_k} \sum_j \sum_{j' \in \Omega_j} \mathrm{Value}(\mathrm{Y_i}, \mathrm{X_{k'}} | \mathbf{X}_{\Omega_i}, \mathrm{X_{j'}}) > 0 \ , \forall k', j' : z_{k\to i}^{k'} = z_{j\to i}^{j'} = 1 \,,}_{\text{(ensure non−redundant data allocation)}}$$

where $z_{j\to i}^{j'} = 1$ if the j' variable of j-th data owner is allocated to i-th data owner, $z_{j\to i}^{j'} = 0$ otherwise. The value of data is estimated with conditional Spearman correlation and conditional mutual information. The previously described optimization problem was re-written as a linear programming problem and is being efficiently solved with existing algorithms implemented in Python libraries, e.g., *scipy* library allows to use highs-ds [10] ref, an improved version of simplex.

Tests are being conducted in real wind power data from Norway to confirm the significance of the results. These tests include, for example, training models with local data, the entire data,

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and with the data allocated by the market. The idea is to compare the magnitude of the improvements per data owner.

Extensions. Next steps include the fair exchange of data for other problems: a review of the exiting metrics to measure the relation between other variable's types (binary, categorical) is being conducted. Lastly, the case where data owners observe different instances of the same features will also be covered, since it represents a simpler case.

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3.1.5 ENERSHARE Marketplace Business Model

According to the last project results, mainly reported in the D5.1 and D5.2, ENERSHARE exploits the Data value chain via the ENERSHARE Marketplace. Besides the showcase where energy data/data service/apps are shown for sale, Marketplace allows to access the auction mechanisms for exchanging assets published in the Marketplace with energy and non-energy resources, tangible, and intangible assets (ranging from RES and energy consumption data models, grid operation, to social assistance or care services to more vulnerable people, etc). Moreover, the Marketplace allows to access to the barter, where valuable data for a specific service (e.g., load and renewable energy time series forecasting) are distributed across multiple owners/devices and monetary and non-monetary (barter) incentive mechanisms foster data sharing and enable collaborative data analytics. Minor modifications could occur in the future to the Business Model (BM) presented, according to the further progress on the topic.

The BM Canvas has been used as handy tool for building the ENERSHARE Marketplace BM. Before exploring this specific BM, it is reported a brief recap of the meaning of the 9 building blocks of the BM Canvas to make clearer the comprehension of Figure 4. According to [11], **Customer Segments** block defines the different groups of people or organizations that a business plan aims to reach. The second block is the **Value Proposition** which reports the products and/or services offered to meet the customer segment's needs creating a unique value for customers. The **Channels** building block describes how a company communicates with and reaches its Customer Segments to deliver a Value Proposition. The **Customer Relationships** building block describes the types of relationships a company/organization establishes with specific Customer Segments. The **Revenue Streams** building block represents the cash a company generates from each Customer Segment. The **Key Resources** building block describes the most important assets required to make a business model work. The **Key Activities** building block describes the most important things that are needed to do to make a business model work. The **Key Partnerships** building block describes the network of suppliers and partners that make the BM work. The **Cost Structure** describes all costs incurred to operate a BM.

Figure 4 illustrates the BM Canvas based on the services provided by the ENERSHARE Marketplace. The platform, developed within the project, especially in WP5, has been designed as a suitable tool for market operators.

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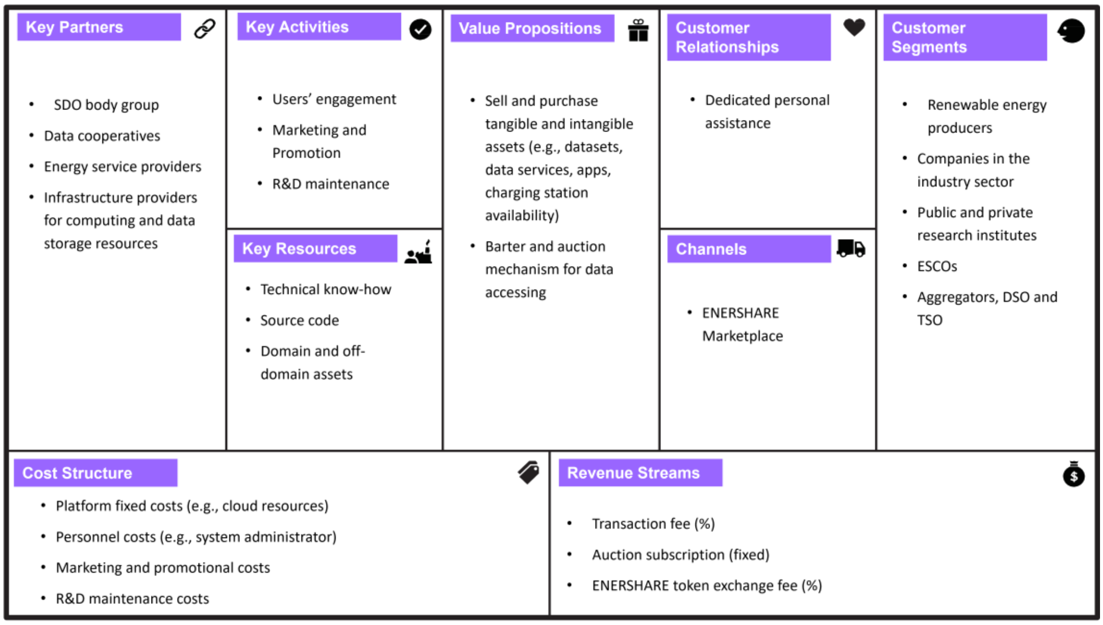

Figure 4. ENERSHARE Data value chain BM

- **Customer segments**

  The potential customers identified for utilising the ENERSHARE Marketplace are:
  - Renewable energy producers who could provide data on energy production or services (e.g., flexibility) either by publishing them or participating in barter and auctions.
  - Companies/organizations in the industry sector that can both sell and purchase data and services that could be used to optimise their energy efficiency.
  - Research institutes that could acquire data for research purposes choosing through the Marketplace Graphical User Interface (GUI).
  - Energy service providers, service operators (DSO, TSO, Aggregators) and Electricity System Commercial Operators (ESCOs) that could offer energy services, data, and consultancy through the platform.

- **Value proposition**

  The ENERSHARE Marketplace includes notable features: on one hand it allows participants to sell assets published on the GUI, such as datasets, data services, apps, charging station availability etc; on the other hand, they can purchase these assets. The ENERSHARE Marketplace gives also access to other features: the auction and the barter.

  Participants can initiate auctions for specific data or data services, indicating a duration for the auction. Participants can propose cross-sector assets for the exchanges, and

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once the auction concludes, the initiator can decide to accept an offer or reject all received offers. Barter module makes at disposal valuable data for specific services (e.g., load of renewable energy time series forecasting) distributed across multiple owners/devices and monetary and non-monetary (barter) incentive mechanisms which encourage data sharing and enable collaborative data analytics.

- **Channels**

The ENERSHARE Marketplace can be viewed as a showcase where participants can publish the assets they wish to sell (e.g., datasets, data services, apps, charging station availability), and other participants can select and purchase them. It serves as the channel that enables the customers identified in the customer segments block to access the services/products mentioned in the value proposition block. The platform also provides information to raise awareness among customers about a company's products and services.

- **Customer relationships**

This building block deeply influence the overall customer experience. In the ENERSHARE Marketplace BM, it consists of dedicated personal assistant service.

- **Revenue streams**

To generate revenues from the platform for the Market Operator, the BM includes transaction fees. In other words, the platform charges a small percentage as a transaction fee for each transaction. This remuneration mechanism is applied to the Barter module as well which uses the ENERSHARE token for allowing users to purchase the forecasting services. As the platform also accommodates auctions, which do not involve token transactions, a fee is applied for the participation in it. To incentivize platform usage, a strategy could be to offer free access to auctions for a user initial participation and then, a fixed subscription cost.

Users can participate in the Marketplace only using ENERSHARE tokens. To do so, participants need to exchange fiat currency for cryptocurrency. When a user wants to exit the Marketplace, the exchange from cryptocurrency to fiat incurs a fee (rather high) to discourage participants from exiting.

In summary, the current BM considers three revenue streams. The main one is represented by transaction fees for every successful exchange within the Marketplace. An additional revenue stream comes from users subscribing to the auction services offered in the Marketplace. The last stream arises from the exchange of ENERSHARE tokens into fiat currency.

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- **Key resources**

  The value proposition requires key resources for delivery. In this BM, technical expertise in both the energy and computer science sectors have been identified, as well as the source code of the IT infrastructure, beyond the assets that will be provided by the participants (datasets, services, apps, etc.).

- **Key activities**

  In this context, users' engagement is crucial; indeed, the sharing by the participants of tangible and intangible resources can be considered the fuel of the platform. Without the active contribution of customers and stakeholders, the marketplace cannot be carried on. Among other things, marketing, and promotion, as well as R&D maintenance can be found in this building block.

- **Key partnerships**

  In some circumstances, partnerships can become a cornerstone of a BM. Creating alliances to optimize business, reduce risks, or acquire resources is a key point in the marketing process. In the case of the ENERSHARE marketplace, different actors have been identified as key partners: Standard Development Organizations (SDO); Data cooperatives, Energy service providers, and Infrastructure providers for computing and data storage resources.

- **Cost structure**

  The most important costs incurred in the context of the blocks already defined are: platform fixed costs, such as cloud resource costs; costs related to personnel, both for system administrators and customer relationships; marketing and promotion costs (approximately 7-8% of the of the gross revenues [12]); and R&D maintenance costs.

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3.2 Regulated domain

This section contains the data sharing incentives for regulated domain entities, such as transmission system operators (TSO), distribution system operators (DSO) and entities that operate at the multi-utility level.

3.2.1 Incentive mechanisms for data sharing at TSO level

In this section, two considered incentive mechanisms from the section 3 are observed from the point of view of transmission system operator.

Considering the data-by-money mechanism (monetary incentive), TSO can pay for the data in case this data can improve the internal procedures of the TSO, such as grid planning, improvement of the forecasts, etc. However, when it comes to monetary compensation of the possibility to share the data, TSO as a regulated domain company cannot obtain the money for sharing the data. This happens because of these reasons:

- The income of the TSO comes from regulated assets for regulated activities (the main source of the income is taxes, defined by the regulator);
- The data, that is generated by TSO's assets, mostly belong to the client (generation units' owners, for example);
- The main objectives of the TSO are real-time operation and control of the transmission grid, development of the transmission grid to meet the growing demand for electricity and to ensure the reliability and efficiency of the overall system, maintenance of the security and stability of the transmission grid, but not to get monetarily compensation for sharing the data.

Thus, TSO can have a role of Data Consumer in the DS in the scope of data-by-money incentive mechanism.

Considering the data-by-data mechanism (non-monetary incentive), even if no money is involved in the procedures, TSO cannot share the data by the same reasons as written previously in data-by-money incentive mechanism. Thus, TSOs cannot play any role in the DS in the scope of data-by-data incentive mechanism.

Nevertheless, TSOs are obliged by the European and national regulations to share some data free. Different types of the data were described in Deliverable D7.1 using the example of a Portuguese TSO, such as development plans of the national transmission network, annual reports, characterisation of the national transmission network, etc. This data mainly published in the report formats (PDF or Word). Although some of the data presented in these reports provides information on generation mix, the scenarios of the grid for different seasons, this

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data is the result of an assessment by TSO and is not personal information that cannot be disclosed.

In addition, TSOs in European area need to share the data to ENTSO-e [13] and Coreso [14].

As for the ENTSO-e, TSOs need to share the data directly to ENTSO-e using an electronic highway platform to be published in ENTSO-e Transparency Platform. It was launched in compliance with Regulation (EU) No 543/2013 [15] on the submission and publication of data in electricity markets in 2015 and aims to provide free, continuous access to pan-European electricity market data for all users, across six main categories: Load, Generation, Transmission, Balancing, Outages and Congestion Management. The main reasons to share the data in ENTSO-e Transparency Platform are:

- Sharing data on the ENTSO-E Transparency Platform enhances market transparency. This transparency fosters fair competition and helps prevent market manipulation.
- TSOs need to have a clear and comprehensive understanding of the current state of the transmission grid and the overall electricity system. By sharing data on the platform, TSOs contribute to a collective understanding of the grid's operational status, helping all stakeholders, including neighbouring TSOs and market participants, to be aware of real-time and historical system conditions.
- Access to data on the ENTSO-E platform supports grid planning and development. TSOs can use this data to assess the performance of the transmission system, identify areas with increased demand, and plan for necessary grid expansions or upgrades to ensure the reliability and efficiency of the overall system.
- In a region with interconnected power systems, effective cross-border coordination is crucial. TSOs need to share data on cross-border flows, interconnection capacities, and system conditions to ensure the secure and efficient operation of the entire electricity network.
- Regulatory authorities often require TSOs to provide certain information to demonstrate compliance with regulations and standards. The ENTSO-E Transparency Platform serves as a centralized mechanism for TSOs to fulfil these reporting requirements, making it easier for regulators to monitor and enforce compliance.
- TSOs, as entities responsible for the reliable operation of the transmission grid, have a responsibility to be accountable to the public. Sharing data on the transparency platform contributes to openness and accountability, allowing the public to access information about the performance and reliability of the electricity system.

As can be seen, ENTSO-e have incentives to share the data that are not based on the monetary topics. Although TSOs in European area are obliged to share this data, they can also get a better view on the operational and planning procedures of the whole European network.

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As for Coreso, TSOs also need to share the data directly to Coreso so it can be used in different services, provided by Coreso, such as:

- Common Grid Model [16];
- Coordinated Security Analysis [17];
- Coordinated Capacity Calculation [18].

To allow operational coordination and to ensure security of supply on a European level, TSOs share information with Regional Coordination Centres (RCCs). Each TSO publishes its Individual Grid Model (IGM), which represents the best detailed forecast of its electricity grid. Afterwards, RCCs merge about 40 TSO IGMs to create a pan-European Common Grid Model (CGM) representing the European electricity network.

The CGM service consists in different tasks performed by RCCs:

- Checking quality and plausibility of IGMs provided by TSOs and facilitating their improvement to meet the criteria of quality and plausibility;
- Merging of IGMs into CGM;
- CGM model improvement.

The CGM service also includes the use of a harmonised data format (CGMES) allowing precise description of the network. The exchange of files is supported by the Operational Planning Data Environment (OPDE) which is a platform to exchange data and which contains central business applications to support RCC services.

Thanks to this process, all European TSOs and RCCs benefit from the same overview on the pan-European electricity network and the same accurate view on the flows of high-voltage lines. This process is presented in Figure 5.

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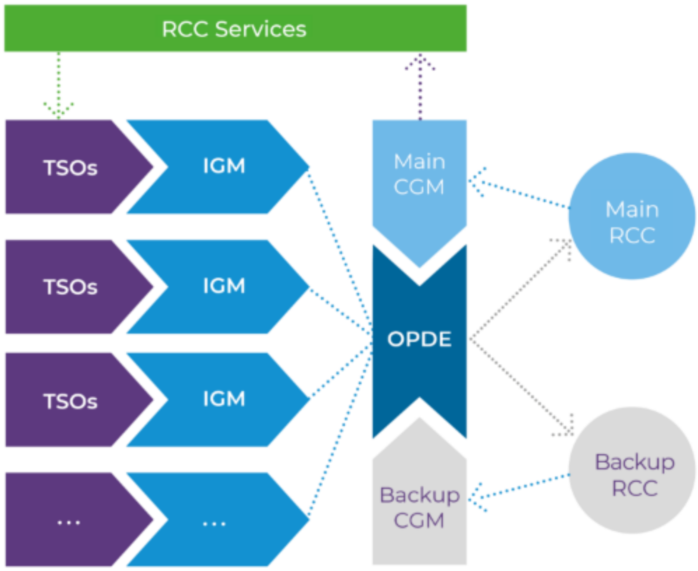

Figure 5. Common grid model (CGM) service

As can be seen, TSOs provide IGM on OPDE. RCCs can retrieve these IGMs from OPDE in order to create a CGM and provide this CGM back on OPDE.

Grid incidents in one area may have major consequences for neighbouring zones, requiring TSOs to regionally coordinate the security calculations. This is why the Coordinated Security Analysis (CSA) service aims at:

- Performing analysis to detect operational security violations on the grid;
- Proposing coordinated remedial actions to TSOs to solve the identified constraints.

A violation of operational security limits is a flow that is above the capacity of a circuit and that needs to be reduced to an acceptable level. To enable RCCs to perform the CSA service, the CSA process requires TSOs to provide RCCs with different inputs:

- Their Individual Grid Models (IGMs) that will be merged into a Common Grid Model (CGM);
- The list of their assessed elements;
- The contingencies that need to be simulated;
- The available Remedial Actions (RAs).

In case of a violation of operational security limits on cross-border relevant network elements, multiple measures in multiple TSO networks may be necessary. As a result, a close coordination between TSOs and RCCs is essential to ensure the most effective and economically efficient Remedial Actions (RAs).

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When the operational security violations have been resolved in each region, the residual violations in the overlapping zones between regions will be addressed through a cross-regional process.

CSA service helps optimize the utilization of ancillary services, to ensure the smooth and secure operation of the electricity grid. By coordinating ancillary services effectively, CSA contributes to the overall reliability of the power system, reducing the risk of disruptions and ensuring a stable electricity supply.

Coordinated Capacity Calculation (CCC) also plays an important role in the European interconnected system. In order to ensure the security of the electrical system, a preparation is needed before electricity delivery. This is the role played by Coreso as nominated Capacity Calculation Coordinator for three regions in Europe.

As RCC, Coreso calculates the cross-border capacities between countries using technical data from Transmission System Operators (TSOs). Furthermore, after optimisation and ensuring the security of the EU grid, we provide the results (cross-border capacities) to the market energy platforms. On these power exchange platforms, market parties can trade using a secure space to exchange energy within European grid.

Concretely, the CCC service consists in:

- Applying approved regional coordinated methodologies to compute parameters defining available capacity (either Net Transfer Capacity (NTC) or Flow Based (FB) parameters), based on CGM. The previously mentioned methodologies aim at optimizing cross-border capacities while ensuring coordinated security.
- Providing improvement proposals to optimise computation quality and/or available cross-border capacity.

This CCC service is requested for the following timeframes: day-ahead, intraday capacity and long-term (yearly and monthly). Coreso must perform this service for the South-West Europe (SWE) Capacity Calculation Region (CCR) as well as for the Italy North CCR and Core CCR in collaboration with TSCNET.

As can be seen, Coreso, like ENTSO-e, have incentives to share the data that are not based on the monetary topics. Although TSOs in European area are obliged to share this data to Coreso, they can also get a better view on the operational and planning procedures of the whole European network.

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3.2.2 Incentive mechanisms for data sharing at DSO level

In this chapter, the main focus is given to the data sharing incentive mechanisms from the regulated domain in distribution level, where two entities might be present: distribution system operators (DSOs) and electricity distribution companies (EDC - organisation structure of electricity distribution in some EU countries). These companies divide their activities and services into two basic domains: regulated and market based. It is important to note, that the roles and activities of the DSO and EDC differentiate per each of the EU member states. The differences might not be significant, but have definitely an influence on the concept of data sharing. In general, under regulated domain, data sharing distinguishes between the obligatory provided data and these data and information, which are provided based on a request (typically: 15 min data from a smart meter for past 3 years). It is also important to count on, that the data always have an owner.

Some of the European DSOs joined to the Europe's Distribution System Operators (E.DSO), who gathers 36 leading electricity DSOs, including 2 national associations, cooperating to ensure the reliability of Europe's electricity supply for consumers and enabling their active participation in the energy system. E.DSO and its members are committed to taking on the huge challenges associated with realising the Energy Union, built on the EU's ambitious energy, climate, security of supply, jobs and growth objectives. This involves ensuring the reliability and security of Europe's electricity supply to consumers while enabling them to take a more active part in our energy system. E.DSO focuses on guiding EU research, demonstration and innovation (RD & I), policy and Member State regulation to support smart grids development for a sustainable energy system.

On their Web pages, E.DSO published main findings on a study "State of European Energy Data Maturity", major research released by Opendatasoft, in conjunction with E.DSO and GEODE. In-depth Opendatasoft research "European Energy Sector Increasing Data Usage, But Not Yet Fully Data-Centric" finds challenges centred on culture, data quality, and complex technology. The study reveals the following narrative: 66% of these companies fervently advocate for increased data sharing to accelerate decarbonisation efforts. However, 73% of European energy companies are struggling with significant challenges as they aim to embrace a data-centric approach and promote wider access to data. The primary obstacles include widespread problems like poor data quality affecting 84% of companies, a lack of emphasis on fostering a data-centric culture reported by 73%, and the complexities associated with technical tools acknowledged by 64% of entities. This in-depth examination of the European energy sector's data dynamics emphasizes these factors' critical influence in moulding the industry's trajectory. These are the headline findings of the State of European Energy Data Maturity Study, major research released today by Opendatasoft, in conjunction with E.DSO and GEODE.

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The study shed light on the acknowledgment among European energy entities regarding the substantial advantages of leveraging data. A unanimous 100% affirm the critical role of data in enhancing efficiency, followed closely by 98% recognising its importance in facilitating digital transformation, and 96% attributing it to increased transparency. However, despite the recognition of these benefits, a full embrace of a data-centric approach is yet to be achieved. Only 33% base their decisions on data analysis, and a mere 31% have an open data portal. Consequently, while 86% share data internally among employees, a less impressive 71% extend this practice to sharing with customers or partners. This limitation in data sharing hinders the potential for collaborative efforts across the industry. "The European energy sector is transforming to meet key objectives around decarbonisation, digitisation, security of supply and greater efficiency," said Jean-Marc Lazard, Chief Executive Officer (CEO) and co-founder of Opendatasoft. "Data sharing across the wider ecosystem is critical to enabling them to meet their pressing challenges. It enables them to collaborate, build trust and make better decisions. On the positive side our study shows that energy players understand the benefits of putting data at the heart of their operations. However, they still have a way to go to achieve data democratisation and make data access and reuse simple and seamless for everyone, inside and outside the organisation." Christian Buchel, Chair of E.DSO stated: "European DSOs are remodelling their businesses through data gathered by serving customers, from smart meters, grid capacity analysis and planning, infrastructure operations, system operations, and market facilitation. These efforts show the need for a smart digital infrastructure based on data exchange that ensures observability and control of energy flows in the future energy system." The State of European Energy Data Maturity Study is based on a survey of 51 executives from across the European energy sector, carried out in Q3 2023. They included representatives from DSO, energy producers, TSO and other players (including tech providers, public energy authorities, and other utilities).

E-REDES, showcases data democratisation through its 2022 Open Data Portal, fostering innovation and engagement in the energy transition. The Open Data Academy Challenge awards monetary prizes for top dissertations using portal data, while E-REDES' Municipality Dashboard offers comprehensive energy metrics for Portugal's 278 municipalities, enhancing collective action for the energy transition.

To also give a national aspect, another source of information will be taken from the public documents available on the pages of **Slovenian Agency of Energy (AGENRS)**. Indeed, Slovenia had made a step further in this topic. We have taken information from the REPORT ON THE ENERGY SITUATION IN SLOVENIA for the year 2022 [19] (2023 is not yet available).

3.2.2.1 Effective Data Exchange in Key Market Processes in Slovenia

As part of the measures implemented in line with its competencies aimed at unifying the most important data exchange processes at the national and regional levels, the AGENRS has been

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establishing efficient data exchange between market participants, steering the participants towards the use of open standards and the reuse of generic models of the European Forum for Energy Business Information eXchange (ebIX®) and ENTSO-E models to the greatest extent possible.

The new regulatory framework and the vision for the evolution of energy networks by 2050 envisage the full integration of energy networks (electricity, gas and heat) and the consumers' complete engagement (development of a flexibility market). The harmonisation of data exchange processes using open standards in energy markets is thus becoming even more important and a crucial action to eliminate certain barriers to entry for new market participants and to reduce entry costs. Data exchange has been becoming more and more complex and is usually required in near real-time or real-time. Due to the development of new business models and energy services, based on access to detailed metering data, there is also a distinctive need in the retail markets to harmonise access to and exchange of data on consumption or production, as access to this data must be ensured centrally or locally (using a metering device) for users eligible to access data (aggregators, suppliers, energy service providers, etc.), subject to the customer's authorisation. To support green transformation, regulatory frameworks must ensure a sufficient level of data protection and privacy, tools for the empowerment and promotion of active consumption, a non-discriminatory environment and a level playing field for all the stakeholders, a technologically neutral regulatory framework, and recognise the new roles of traditional actors. Besides the requirements regarding efficient and safe data exchange, Directive (EU) 2019/944 also defines the context for ensuring interoperability for the first time.

EU countries are expected to enable the full interoperability of energy services across the EU to stimulate competition and avoid excessive administrative costs. The Commission's strategy is to ensure harmonisation based on the introduction of a process reference model[1], which can, to a considerable extent accommodate national practices and particularities. A proposal for an implementing act on interoperability requirements for data access and exchange was submitted for discussion [20]. Following a public consultation, which closed in January 2022, and a public hearing of proposals that closed in September 2022, the act proposal was submitted to the comitology procedure to be adopted in the second quarter of 2023. In their proposal of the definition of the work scope, the Smart Grid Task Force Expert Group 1 (SGTF EG1) proposed flexibility - the flexibility register domain as the next area of work.

On the other hand, the field of flexibility has been developing very intensely on the basis of the new regulatory framework: there are many ongoing research projects and studies and the first implementations have also been taking place. Through the EG on the DSF expert group, ACER

[1] A series of reference procedures for access to data describing the exchange of information between roles (not actors). This includes a semantic model of the data being exchanged, as well as a description of and connections between systems and procedures used for the control of, access to and exchange of that data.

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carried out the defining of the general flexibility framework at the EU level (vocabulary, principles, requirements for processes and processes of exchanging experience, best practices and areas where further harmonisation is necessary)[2]. They took into account the interaction of existing codes, guidelines and implementing acts[3]. Although the European Commission (EC) had originally planned to start implementing a network code for resilience [21] based on the ACER general framework ("Framework Guideline on Demand Response" [22]), in 2022, it was only published at the end of December 2022 due to the market situation and the energy crisis.

The implementation of data exchange between the participants in the Slovene electricity market is predominantly carried out in compliance with the relevant reference models (e.g. the ENTSO-E/ebIX/European Federation of Energy Traders (EFET) harmonised model of roles in the electricity market, etc.). In 2022, the processes of the updated market model were intensely adapted to the concept of split supply[4], which is based on the introduction of a metering point[5], and eliminated incompatibilities with the reference model at the national level and provide the optimum possibilities for the development of energy services and for strengthening the competition in the retail market.

The National Data Hub online data portal mojelektro.si is designed to ensure the compatibility of centralised data access with the draft implementing act on access to the data on consumption (Business-to-Consumer (B2C) segment). The areas with the most incompatibilities are as follows: ensuring interoperability at the level of local access to data (I1 interface on the smart meter); implementation in the field of flexibility where planned deviations from the reference models can be identified, starting with unsuitable definitions of roles and responsibilities. As this is a developing area, the Energy Agency assumes that those incompatibilities are of a transitional nature.

The Act on the Identification of Entities in the Data Exchange Among Participants in the Electricity and Natural Gas Markets requires market participants to use standardised identifiers of key data entities in the electronic exchange of data in the market. In accordance with the Energy Agency's general act, all the key data entities in an electronic data exchange have to be determined with standardised identifiers.

[2] In 2021, the EG on DSF, established by ACER, defined the scope of flexibility.

[3] The areas of metering, validation, settlement, baseline methodology and aggregation are mutually interconnected by the implementing acts on interoperability.

[4] See the USEF report.

[5] Implementation of the Metering Point domain in compliance with the reference model.

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The Energy Agency has been implementing its harmonisation strategy through public consultations, bilateral cooperation and participation in professional platforms, such as the IPET Section and ebIX®.

In 2022, the following key issues were considered in the framework of the IPET Section:

- Introduction of a metering point;
- Technical aspects of the relocation of metering points of small business consumers with an installed capacity equal to or less than 43 kW to the metered diagram, with a focus on the timely communication of the relocation of metering points and the pressing dilemma of the new diagram of the remaining consumption that will be created after the relocation of these metering points;
- New rules on the functioning of the EE market, introducing a new imbalance settlement method with a single imbalance price from 1 January 2023;
- A new model of calculating the network charge that will become operational in 2024;
- Improvements to the single entry point of the National Data Hub;
- Consideration of self-supply in the imbalance settlement.

Within the ebIX, the focus was on modelling processes in the area of flexibility by developing and publishing data exchange models at the level of the Business Requirement Specification (BRS) for distributed flexibility and on the active contribution to the emerging EU Interoperability Assurance Framework through participation in the EU SGTF Expert Group 1 (EG1). The ebIX published a new version of the Harmonised Gas Role Model and a status report on the alignment of the two harmonised role models, i.e., for the electricity and natural gas markets [23].

3.2.2.2 Providing Consumers with Standardised Data Services

The Government Decree on Measures and Procedures for the Introduction and Interoperability of Advanced Electric Power Metering Systems (hereinafter the Decree) and the Plan for the Introduction of an Advanced Metering System in the Slovenian Electricity Distribution System (hereinafter the Plan) define, among other things, the advanced metering system architecture, roles and responsibilities, its minimum functionalities, and some aspects of the implementation of data exchange based on relevant standards (Common Information Model (CIM), etc.). The Decree requires the DSO to establish a single access point for accessing data in the advanced metering system. Based on the Plan mentioned above, the system is implemented as a central system for accessing metering data (national data warehouse), which is managed by the DSO and provides data exchange services among business entities and network users in the B2B and B2C domains, with a plan to further extend the area of exchange to the Business-to-Government (B2G) segment.

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The development was carried out within an initiative by distribution companies, united under the Electricity Distribution Economic Interest Grouping, with the participation of the DSO. The single entry point of the national data hub (EVT) is a hub ensuring the exchange of data among distributors and suppliers of electricity, final consumers and their authorised representatives (e.g. aggregators, ancillary services providers) and at the same time, the central data hub for the exchange of data in the electricity market. This EVT's high-level architecture is presented in Figure 6.

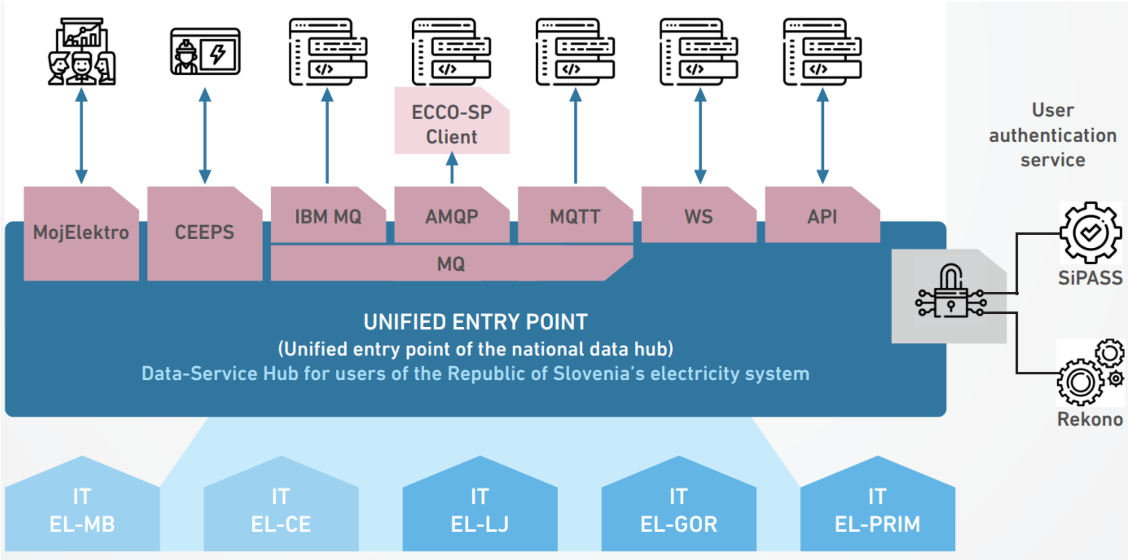

Figure 6. High-level architecture of the EVT National Data Hub

The EVT provides a safe (two-step verification of a user's electronic identity) and unified registration and authentication process with the Rekono application, as well as the autonomous management of authorisations and user rights. It is composed of the following building blocks:

- The MojElektro Portal – online user portal intended for all end-users and their authorised representatives who can access all the metering points and metering and accounting data that they are entitled to, regardless of their supplier or distribution area. It enables an overview and export of all the available 15-minute data by metering points (received and delivered active/reactive power, possibility of aggregation by hour, day, month, etc.), monitoring the consumption and production above the self-supply metering points, the submission of a new tax ID number on a metering point, the submission and entry of the meter reading at a metering point;
- CEEPS Portal – for users eligible to access data, it fully replaces the PERUN[6] in terms of functionality. All the electricity suppliers, Borzen, the Centre for RES/CHP support, the

[6] All PERUN portal functionalities have been terminated and transferred to CEEPS as of 1 March 2021.

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closed distribution systems and the distribution system operator are registered on the portal. It enables centralised imbalance settlement, access to and export of 15-minute data based on balance sheet eligibility, the submission and entry of meter readings on behalf of end-users, carrying out the supplier switching process in line with the SONDSEE requirements, access to accounting data (the so-called Annex A), management of all the changes on the metering points, etc.

- Massive data exchange - B2B Type - MQ services: continuous daily massive data exchange for individual eligible users, the daily transmission of the available 15-minute metering data for the previous day, the addition of new measuring points to the daily transmission and specific request for the available 15-minute metering data.
- WS/REST-API are data access services for the Distribution System Operator (WS) and planned restAPI services for accessing end-user or proxy data without having to register on the MyElektro portal. The introduction of the restAPI services is foreseen in 2023 and will allow the further development and usability of the data from the advanced metering system in consumption monitoring and in analysis carried out for the purpose of the new tariff systems.

In 2022, development activities in this area[7], which all distributors in Slovenia were involved with, included:

- As part of the introduction of the metering point, the MojElektro and CEEPS portals and the data services for suppliers were upgraded. The key changes:
    - The MojElektro.si Portal:
        - Enabled overview of data on the metering point or metering points at a single metering point;
        - Enabled overview of technical data on the metering point (meter, status of metrological control, verification of metrological accuracy via the Metrology Institute, etc.);
        - Enabled overview of the so-called hierarchy of the connection of the metering point, so that the end-user can access the information on the metering point's affiliation to the parent asset;
        - Enabled overview of the data from the metering post register and the metering points register.
    - The CEEPS.si Portal:
        - Transfer of functionality for suppliers and SODO from the PERUN portal to the CEEPS portal;
        - Enabled submission of all service requests via a metering point or metering post (depending on the request);

[7] Metering data single access system (SEDMP) with B2B data services for suppliers and other eligible users.

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        - Ordering and organising the priority of the metering data for D-1 transmission to the MQ of a specific supplier;
    - B2B Services:
        - Upgrade of data services for the D-1 and M-1 transmission of metering data through the associated metering point;
        - Transmission of metering data according to the priorities set by the supplier;
        - Upgrade of the message structure in line with SONDSEE.

Thus, the number of users of the Moj Elektro portal has constantly been growing. At the end of 2022, 50,000 metering points were registered in the Moj Elektro portal, which is 150% more than the year before. The monthly increment of newly registered users is more than 1200.

In addition, one of the platforms, where it is possible to access the distribution data from Slovenia, is OPSCI [24]. OPSCI - Open SCI stands as a comprehensive platform designed to facilitate the sharing of technical data specific to Low Voltage (LV) distribution networks.

This inclusive portal extends its reach beyond conventional LV networks, incorporating non-synthetic LV setups, and areas where the collection of voltage and power measurement data is feasible. Open SCI provides a multifaceted repository of information, covering a spectrum that spans from detailed Common Information Model (CIM) documents to real-time measurements obtained from smart meters embedded within the LV network infrastructure. This rich and varied content serves as a valuable resource for professionals, researchers, and enthusiasts alike, offering an unparalleled opportunity to delve into the intricacies of LV distribution networks.

The portal fosters an environment where industry experts can access crucial technical insights, fostering collaboration and innovation in the field. From the foundational principles embedded in CIM documents to the dynamic data derived from smart meter readings, Open SCI serves as a nexus for the exchange of knowledge and advancements within the realm of LV distribution networks.

Open SCI portal is committed to promoting transparency and accessibility, empowering stakeholders with the tools and information necessary to navigate the complexities of LV networks. Whether you are engaged in research, system optimization, or simply seeking to deepen your understanding of LV distribution networks, Open SCI invites you to explore the wealth of resources it offers, bridging the gap between theory and practical application in the ever-evolving landscape of electrical distribution.

The data that can be found, Real non-synthetic LV network named TP Gradisce:

- Topology data in a CIM document export from SCADA ADMS 3.8.3 Schneider Electric.

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- Phase voltages from smart meter data
    - Description: Data starts from cca. 2019 until nov. 2023; User side data has 10 min time resolution with subsequent phase voltages V_L1, V_L2 and V_L3 if three phase and only V_L1 if one phase user; Supply side (summary smart meter at transformer station) noted in data as user157 with 1 min time resolution voltage. All the data is per phase in V.
- Active and reactive powers from smart meter data at supply side (transformer station 20/0.4 kV) and user side
    - Description: Active and Reactive power in both directions from cca. 2019 until nov. 2023. Both supply side (at transformer station) noted in data as user 157 and all user data have 15 min time resolution. The data is in kW and kVAr in both directions; for example, Pplus_kW_ and Pminus_kW_ for the active power represent the power consumed and generated, respectively. The same accounts for the reactive power. According to the arithmetic method of measurement where the direction of electrical flow (A+ or A- or R+ or R-) has been adopted by most European countries during the transition from the traditional to advanced metering systems, the direction of power flow is determined for each phase separately. In three-phase meters, the arithmetic method of recording electrical energy and power is required. For the arithmetic registration, a three-phase meter simultaneously records the measured quantities in registers for received and delivered power and also for in the event that power is being generated in one of the phases. For example, if power flows in L1 and L3 towards user and in L2 power flows from user, in that case Pplus_kW_ sums L1 + L3 (the power of the phases that deliver to final user) and Pminus_kW_ sums the power of phase L2 that flows from the user (generation).

The challenge comes up with the needs to convert and make the CIM extract compatible with the Load Flow tools such as Matpower, Panda power, Open DSS etc. All these tools require a specific CIM input and making the standard CGMS compatible with the distribution CIM is the challenge to be exceeded. Other data is relatable and compatible with the users in the LV network extract. Moreover, according to the needs of the extraction and partial development of some kind of LV network, this OPSCI portal can be used to get real, non-synthetic data.

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3.2.3 Incentive mechanisms for data sharing at the multi-energy utility level

Designing effective incentive mechanisms for data sharing is paramount to fostering collaboration and maximizing the potential benefits derived from shared information.

Financial incentives stand out as primary pillars for encouraging stakeholders to participate actively in data-sharing initiatives. A transparent framework, such as revenue sharing and performance-based rewards, ensures that entities contributing valuable data receive a fair share of the benefits generated from its utilization. This financial reciprocity serves as a compelling motivation for ongoing collaboration.

When it comes to the ownership of data, keeping it straightforward is crucial. Clearly define data rights, ownership, and access privileges (who owns what and who gets to see what) ensures that everyone feels in control, eliminates concerns about data misuse, and ensures access to relevant information for operational effectiveness.

Collaborative research and development initiatives play a crucial role in fostering a culture of shared responsibility at EU level. Joint projects that bring together diverse resources and data to address common challenges become catalysts for innovation and mutual growth. In a similar way, organizing innovation competitions within the EU framework can as well incentivize participants to contribute data for specific purposes, aligning with the broader goals of energy optimization and system efficiency.

Securing regulatory support is instrumental in embedding incentives within the EU's multi-energy landscape. Advocating for incentive-based regulations that offer preferential treatment, reduced compliance burdens, or other regulatory advantages for entities actively engaged in data-sharing endeavours ensures alignment with broader policy objectives. Complementary compliance credits could further bolster the attractiveness of data sharing, reinforcing positive practices.

Educational initiatives assume a critical role in fostering a collaborative data-sharing culture within the EU. Training programs that evidence the benefits of data sharing and provide guidance on secure practices, contribute to building trust and understanding among stakeholders. Establishing knowledge exchange platforms, where stakeholders share best practices and challenges, adds a layer of collective learning to the EU's multi-energy ecosystem.

Investment in robust technology infrastructure emerges as a primary requirement. Establishing secure, interoperable data-sharing platforms at the EU level simplifies the exchange process and bolsters trust among diverse stakeholders. At the same time, implementing mechanisms for data quality assurance ensures that shared information is reliable and accurate, amplifying its value within the EU's multi-energy utility framework.

To conclude, a comprehensive approach that incorporates financial incentives, clear control structures, collaborative initiatives, regulatory support, educational programs, and robust

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technological infrastructure is essential for incentivizing data sharing within the complex and interconnected multi-energy utility landscape of the European Union.

As for Slovenian example, KPV, which is a district heating network operator in Slovernia, is not included in any scheme or platform for data exchange with stakeholders in the energy sector from the point of view of energy distribution (heat, electricity, gas...). In the framework of national legislation, heat distribution systems are obliged to report (transmit data) only to the Energy Agency and other state authorities. The transmission of data is carried out on an annual or monthly basis and includes aggregated data, while the provision of real-time data to consumers or other institutions in the field of heat distribution is currently not yet legally prescribed.

The district heating system is a unified closed system, currently not technically operationally connected to other energy systems, which means that there are still no reasons to promote the transparency of the energy market at a wider local level, to promote data coordination and standardization among distribution network operators.

The strategic goal of KPV is to assess the future long-term needs/capacity of the distribution network for the transmission of thermal energy, to identify possible bottlenecks and to launch infrastructure projects to ensure the integration of renewable resources into the distribution system. The plan is to introduce a mixture of sources for the production of heat energy, where the introduction of mechanisms for the exchange of operating data will be absolutely necessary in order to achieve optimal management of all heat sources and, consequently, the heat distribution system.

Data-by-money (monetary incentive): as data owners, they would join the sharing of their data, where monetary compensation is received, where the data is important for solving analytical/optimization tasks, and with payment, if the data of other organizations is important for KPV tasks.

Data-by-data (non-monetary incentive): a data-for-data exchange scheme for non-monetary compensation would be acceptable to our organization. There is no exchange of payments and data owners agree to share and receive data in roughly equal value.

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4 Conclusion

This deliverable contains a brief analysis of the gaps, presented in the first version of the deliverable. Based on this analysis and in close collaboration with the remaining horizontal WPs, the detailed questionnaire was prepared and sent to the pilot leaders. The detailed description of the questionnaire is presented in this deliverable, which contains 13 topics:

- Basic information about the pilot, datasets and services
- Ownership of the data;
- Security, protection, and sovereignty of the data;
- Access / Consent of the data;
- Flow of data;
- Following the data from the beginning-source of data (device, internal memory, DB, etc.) to its final destination;
- Tracking of the data;
- Inter-operability, portability and standardization of the data;
- Data portability;
- Data governance policy;
- Usage of the application for the data flow;
- Actors in the use case;
- Data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility).

In total, 8 completed questionnaires out of 12 were received and presented in this deliverable. From the responds it could be seen that some of the topics were described in details by pilot leaders, for others the replies were not complete. As an example, the topic of the usage of applications was not covered by many pilots, however, this result is expected, since most of the developed solutions in the scope of ENERSHARE project have TRL not higher than 8. The detailed analysis of the responds will be conducted and presented in the final version of this deliverable along with the Energy Data Space Governance Models, based both on the analysis from existing initiatives and projects and the analysis of the replies for the questionnaire.

Regarding the topic of data sharing incentives and business models design for regulated and non-regulated domain, the significant improvement has been achieved in the non-regulated domain incentive mechanisms.

The simple market mechanism where sellers define a fixed price of their data was introduced, which was asked to be developed by ENERSHARE consortium. This simple market mechanism was validated with synthetic and real wind power data along with more complex dynamic buyer budget, where buyer budget/bid depends in the error improvement.

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The social welfare data monetisation mechanism was improved by introducing more complex collaborative forecasting models, such as neural networks. However, the main challenge is that sellers face a hurdle when using neural network coefficients, which are considered black box models: the coefficients themselves do not allow the significance of the variable to be determined and thus hinder the seller's ability to interpret the model.

The data-value-driven markets was introduced, which is a combination between the fixed bid approach and the data-by-data mechanism. These mechanisms will be extended by including binary and categorical problems in the next deliverable.

The data-by-data exchange was also improved by addressing challenges, identified in the first version of the deliverable. Tests are being conducted in real wind power data to confirm the significance of the results.

According to the last project results, mainly presented in D5.1 and D5.2, ENERSHARE uses a Data value chain through the ENERSHARE Marketplace. It allows access to auction mechanisms for exchanging assets published in the Marketplace with energy and non-energy resources, tangible, and intangible assets. In addition, the Marketplace allows access to the barter, where valuable data for a particular service is shared among multiple owners/devices and monetary and non-monetary incentive mechanisms foster data sharing and enable collaborative data analytics. The Business Models (BM) and BM Canvas are presented in this deliverable, describing such topics as:

- Customer segments;
- Value proposition;
- Channels;
- Customer relationships;
- Revenue streams;
- Key resources;
- Key activities;
- Key partnerships;
- Cost structure.

In addition, a more detailed analysis was conducted on mechanisms for data sharing in both TSO, DSO, and multi-energy utility levels, with examples of entities and associations on both the national and EU levels. Different services and related data exchange mechanisms were presented, as well as improved knowledge of data sharing and possible solutions for the incentive mechanisms for regulated domain entities. Different platforms were presented, where TSO and DSO shares the data, both at pan-European and national level. It can be seen, that the main incentives to share the data by regulated domain entities are not selling data or getting monetary gain, but fostering collaboration and innovation among the TSOs and DSOs, enhancement of market transparency and support for grid planning and development.

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5 References

[1] BRIDGE, “European Commission Initiative,” [Online]. Available: https://bridge-smart-grid-storage-systems-digital-projects.ec.europa.eu/.

[2] GAIA-X, “A Federated and Secure Data Infrastructure,” [Online]. Available: vhttps://gaia-x.eu/.

[3] International Data Spaces Association (IDSA), [Online]. Available: https://internationaldataspaces.org/.

[4] FIWARE, “A curated framework of Open Source Platform components,” [Online]. Available: https://www.fiware.org/.

[5] OPEN-DEI Project, [Online]. Available: https://www.opendei.eu/.

[6] OneNet Project, [Online]. Available: https://www.onenet-project.eu/.

[7] BD4NRG Project, [Online]. Available: https://www.bd4nrg.eu/.

[8] Perperoglou, A., Sauerbrei, W., Abrahamowicz, M. et al., “A review of spline function procedures in R.,” *BMC Med Res Methodol 19, 46,* 2019.

[9] Yu, Guan, Haoda Fu, and Yufeng Liu., “High-Dimensional Cost-constrained Regression Via Nonconvex Optimization,” *Technometrics 64.1,* pp. 52-64, 2022.

[10] Huangfu, Q., Galabova, I., Feldmeier, M., and Hall, J. A. J., “HiGHS - high performance software for linear optimization”.

[11] A. O. &. Y. Pigneur, Business Model Generation, Hoboken, New Jersey: John Wiley & Sons, 2010.

[12] George Boykin, “What Percentage of Gross Revenue Should Be Used for Marketing & Advertising?,” CHRON Newspaper, 1 March 2019. [Online]. Available:

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https://smallbusiness.chron.com/percentage-gross-revenue-should-used-marketing-advertising-55928.html.

[13] European Network of Transmission System Operators for Electricity, [Online]. Available: https://www.entsoe.eu/.

[14] CORESO, [Online]. Available: https://www.coreso.eu/.

[15] European Commission, "Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council Text with EEA relevance," [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0543.

[16] CORESO, "Common Grid Model," [Online]. Available: https://www.coreso.eu/services/cgm/.

[17] CORESO, "Coordinated Security Analysis," [Online]. Available: https://www.coreso.eu/services/csa/.

[18] CORESO, "Coordinated Capacity Calculation," [Online]. Available: https://www.coreso.eu/services/ccc/.

[19] Slovenian Agency of Energy, "Report on the energy situation in Slovenia," [Online]. Available: https://www.agen-rs.si/documents/54870/68629/Report-on-the-energy-situation-in-Slovenia-2022/d72a2865-931f-441d-b8a3-0346eac0e59a.

[20] European Commission, "Access to electricity metering and consumption data – requirements," [Online]. Available: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13200-Access-to-electricity-metering-and-consumption-data-requirements_en.

[21] European Commission, "Tackling rising energy prices: a toolbox for action and support," [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A660%3AFIN&qid=1634215984101.

ENERSHARE has received funding from European Union's Horizon Europe Research and Innovation programme under the Grant Agreement No 101069831

[22] ACER, "Framework Guideline on Demand Response," [Online]. Available: https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_DemandResponse.pdf.

[23] "European Forum for energy business information exchange," [Online]. Available: https://www.ebix.org/artikel/home.

[24] Elektro Ljubljana, "OPSCI - Open SCI," [Online]. Available: https://www.elektro-ljubljana.si/projekti/ArtMID/1374/ArticleID/2156/OPSCI-Open-SCI.

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Annex I – Data Space Governance Models Questionnaire Template

Partners or Pilots inputs

Data space is a total set of:

- Interoperable data sharing applications, by
  - Actors,
  - Domain,
  - Sector specific entities.

GAIA-X definition: A federated, open infrastructure for sovereign data sharing based on common policies, rules, and standards.[8]

Our aim is harmonization of common aspects in every data space INTO soft infrastructure (infrastructure ensuring cross sectoral data space interoperability): users stay in control over their data, even if data is crossing sector or applications levels.

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In order to design the data space governance models, which is the task of ENERSHARE WP7, without having information from pilot leaders and holders of the specific use cases, we could very limited design and propose it, so this why we would like, event it is necessary, that we gather information from the EnerShare pilots. Namely pilots, based on each use case deal or use data.

Mark please with **Bold** letters, to which ENERSHARE pilot belongs your responds on this questionnaire:

Pilot	Use Case	Title
P1-ES		Wind farm integrated predictive maintenance and supply chain optimization
P2-PT	A	Leveraging on consumer-level load data to improve TSO's operational and planning procedures.
P2-PT	B	Instantiation of energy communities and digital simulation of business models
P2-PT	C	Detect irregularities in energy consumption in households with seniors living alone
P2-PT	D	Suggest maintenance of appliances based on NILM data
P3-SI		Optimal multi-energy vector planning - electricity vs heat
P4-GR		Digital Twin for optimal data-driven Power-to-Gas planning
P5-IT	A	Cross-sector Flexibility Services for aggregators and DSO
P5-IT	B	Services for e-mobility CPOs, EVs drivers and DSO
P5-IT	C	Flexibility provision for electricity grid with water pumps and predictive maintenance of the pumps
P6-SE		Flexibility aggregation from behind-the-meter consumers
P7-LV		Cross-value chain services for energy-data driven green financing

Dear ENERSHARE project UC leader/holder, please provide the following information, per UC (e.g. A,B, ...) and perhaps also per each UC entity (owner or provider) separately. Please for your UC consider the services and/or datasets and answer the following questions by creating a new row for each one of them.

Basic information:

Dataset description within UC: <u>e.g. detailed data about the operation of Wind power Turbines, which are recorded and stored in Wind turbines local SCADA system. There are available different technical data, which are also important for the entities who offer to the owner of the Wind</u>

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turbines a maintenance services, usually this is the Original Wind Turbine Equipment manufacturer (SCADA in bought and runs based on the data & information gathered from the turbines).

Dataset description: here an example for our invited partners: wind turbine operational data

Service description: an example for our invited partners: based on the proceeded operational data, an entity who is not data owner, can offer a service to the data owner. In general, it is about data driven business model.

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1. For each of the data, data sets, per name, please provide:

Ownership (as in the previous table), who is the data provider, who is the data consumer and who is the data user. Some explanations: Data Consumer (data is send directly), Service Consumer (data is processed by Service Provider upon reception) and Data User (legal entity that uses the data in accordance with usage policies).

Dataset name (raw or related to the service)	Owner of Data/Service	Data/Service provider	Data/Service consumer	Data/Service user
Text: e.g. wind turbine operational data	Non regulated: Private: Wind turbine owner Regulated: - DSO __NA - TSO __NA - Municipality __NA - Other public entities __NA	Non regulated: Private: Wind turbine owner Regulated: - DSO __NA - TSO __NA - Municipality __NA - Other public entities __NA	Non regulated: Private: Wind turbine producer Regulated: - DSO __NA - TSO __NA - Municipality __NA - Other public entities __NA	Non regulated: Private: Wind turbine producer Regulated: - DSO __NA - TSO __NA - Municipality __NA - Other public entities __NA

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2. Security, protection, and sovereignty

Dataset name (raw or related to the service)	Personal/non personal data	Cybersecurity measures	User' registration	Users' authentication	Levels of authentication	Certificates
Text: e.g. wind turbine operational data	Please underline the right one: - Personal data - Non personal data Please underline the right one: - Open - Confidential - Restricted - Anonymized - Other: ______________________________	e.g. FW, 2FW (other)	(Yes/No) Specify the ways of registration:	(yes/no) Specify the ways of authentication:	One Two(mandatory) Other	(yes/no) e.g. each participant must be uniquely identified using certification. Specify the certificates:

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3. Access / Consent

Dataset name (raw or related to the service)	Confidentiality level of data	Confidentiality level of meta-data	Specific rules for access	Access grants requirements	Data rights
Text: e.g. wind turbine operational data	Please underline the right one: - Public - Case dependant confidential - Confidential - Restricted - Other: ______________________________________	Please underline the right one: - Public - Limited to owner - Limited to provider - Limited up to date - Limited to source/location- data available at specific location - Other:______ ____________________________________	Please underline the right one: - Open, public available - Different by different types of users - Limited by the duration of access from date A to date B - Data are on disposal limited time, e.g. overwritten by next package of new data set - Offline*** retention/only via DS - Derivation - Reproduction - Distribution	Please underline the right one or write: - No - Licensing - Agreement "Non-Disclosure Agreement" (NDA) - Agreement MSA - Agreement SOW - Agreement SLA - GDPR - Other agreement: ____	Please underline the right one: - See, observe. - Download-read only. - Read & write - Read & write + manage

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			- Re-context - Other:		

*** Data can be available on shared location, build up on request, or send afterward by mail confirmation where the link to the data is sent via mail. This can mean offline

4. Flow of data

Dataset name (raw or related to the service)	Data starting point? (Entity/Role)	Data final destination? (Entity/Role)	Access is bidirectional?	Planning to use Data Space?	Are local storage infrastructures used?
Text: e.g. wind turbine operational data	Please write down: - Entity: ___________________________ ___________ - Role of this entity: ___________________________ ___________	Please write down: - Entity: __________________________ ____________ - Role of this eentity: __________________________ ____________	(Yes/No)	Please underline the right one: - end-to-end - end-to-platform - other:	(Yes/No)

5. Following the data; from the beginning-source of data (device, internal memory, DB...) to its final destination. If data faces with any conversion, during its flow, please inform us. Please inform us also if your data set is comprised- aggregation of different data formats, at the very beginning of the process. Add rows if necessary!

Dataset name	Comprised of different data formats?	Description: end-end, end to	Conversion of Data (if there is	Final destination of the

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(raw or related to the service)	(Y/N)	platform, platform-platform Labels	any)	Data
Meter data	e.g. Time, status, value	e.g. End-end	(Yes/No)	e.g. AMI DB

6. Please inform us about on how you track data flow:

Dataset name (raw or related to the service)	Tracking or any other possible methods on how to guarantee a track.	Logs tracking enabled	Methods/strategies for dataflow tracking.	Information needed to be tracked
Text: e.g. wind turbine operational data	(yes/no) If yes, specify:	(yes/no)	Please write down:	Please underline the right one: - internal control - billing - conflicts solving - other: ___________ _________________________________

7. Inter-operability, portability and standardization

Dataset name (raw or related to the service)	Need for conversion of data formats (interoperability)?	Use converters from DS?	Needed conversions (WP3)?	Are data ready to used by several entities?	Is the dataset standardized to be reused in other UCs?	Is the dataset representative to be replicable in other UCs?

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Text: e.g. wind turbine operational data	(Yes/No)	(Yes/No)	Specify the needed conversions	(yes/no) Specify entities:	Please specify	Please specify

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8. Data portability: is the format of the data opened, is standard or a proprietary one:

Dataset name	Data format	Open	Standard	Proprietary data Format
Text: e.g. wind turbine operational data	e.g.CSV File			

9. Data governance policy: Data governance is a principled approach to managing data during its life cycle, from acquisition to use to disposal. Please provide us the data governance policy which you plan to incorporate when preforming your UC:

Dataset name (raw or related to the service)	Data governance policy
Text: e.g. wind turbine operational data	Internal doc, Wind turbines SCADA specifications

A data governance policy is a document that puts in writing an organization's approach to data governance. Data management represents data governance in action – all of the processes and tools that a company uses to make data governance possible.

10. UC is for providing data using following Applications:

UC name	App name	OS (IOS, Android, Windows…)	Where to find it?

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11. Actors of your UC:

Regulated Entities: Agencies, TSO, DSO, Ministries, Municipalities	Non regulated entities: suppliers, communities, aggregators, energy trading companies, grid, users, energy consumers, prosumers, producers

12. Data sharing incentives with regulated entities (TSO, DSO, and multi-energy utility)

Dataset name	Give examples of incentives that would foster consumers/grid users to share their energy data (e.g., behind-the-meter data) with regulated entities (TSO, DSO, multi-energy utility)	Which data would you like to get from TSO, DSO, or multi-energy utilities?	Are you willing to pay for data from TSO, DSO, or multi-energy utilities?	Is there any data sharing incentive in the Pilot?
Text: e.g. wind turbine operational data	Please write down: ______________________________________	Please write down: ______________________________________	(Yes/No), reason, clarification: ____	(Yes/No) If yes, specify:

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