D1.1

DATA CELLAR potential users' wishes and needs collected via a participatory approach also for LEC self-assessment tool development

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Table of contents

List of figures

List of tables

List of abbreviations and acronyms

Acronym	Description
AI	Artificial Intelligence
AMQP	Advanced Message Queuing Protocol
API	Application Programming Interface
AWS	Amazon Web Services
csv	Comma Separated Values
D	Deliverable
DC	Direct current
DLT	Distributed Ledger Technology
DR	Demand response
DSO	Distribution System Operator
DSS	Decision Support System
EC	Energy Community
EE	Energy Efficiency
EMS	Energy Management System
EU	European Union
EV	Electric Vehicle
FTP	File Transfer Protocol
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
HEEHC	High Efficiency Electricity-Heat Cogeneration
HVAC	Heating, Ventilation and Air Conditioning
http	Hypertext Transfer Protocol
ICT	Information & Communication Technology
IoT	Internet-of-Things
ISA	Interoperability Solutions for Public, Administrations, Businesses and Citizens
json	JavaScript Object Notation
kVA	Kilovolt-ampere
kW	Kilowatt
kWel	Kilowatt electric
kWh	Kilowatt-hour
kWp	Kilowatt-peak
kWth	Kilowatt thermal
LD	Linked Data
LEC	Local Energy Community

Li-io	Lithium ions
MQTT	Message Queuing Telemetry Transport
MSc.	Master of Science
MW	Megawatt
MWh	Megawatt-hour
MWhth	Megawatt-hour thermal
NAS	Network-Attached Storage
OWL	Ontology Web Language
Ph.D	Philosophy Doctor
PV	Photovoltaic
Q	Quarter
RDF	Resource Description Framework
REC	Renewable Energy Community
RES	Renewable Energy Source
ROI	Return on Investment
SCADA	Supervisory Control And Data Acquisition
SME	Small and Medium-Sized Enterprise
SSL	Secure Sockets Layer
T	Task
TSO	Transmission System Operator
UK	United Kingdom
US	United States
V2G	Vehicle-to-Grid
VC	Validation Case
W	Watt
W/T	Wind Turbine
Wh	Watt-hour
WP	Work Package
Wp	Watt-peak
XML	Extensible markup Language
y	Year

1. Executive Summary

The present document constitutes the Deliverable 1.1 "DATA CELLAR potential users' wishes, and needs collected via a participatory approach also for Local Energy Communities (LEC) self-assessment tool development" in the framework of the project titled "Data hub for the Creation of Energy Communities at Local Level and to Advance Research on them" (Project Acronym: DATA CELLAR, Grant Agreement No. 101069694).

This document has been prepared to provide a detailed description of the activities within Task 1.1 (T1.1), entitled "Users and Market Needs Characterization via a participatory approach", on the scope of Work Package 1 (WP1), entitled "DATA CELLAR Specs: Boundary Conditions and Engineering Requirements". An overview of the project and the involved partners in this task are presented in section 2.

2. Introduction

2.1. Project Summary

A greener energy system is crucial for the future prosperity and liveability of European citizens. This requirement is at the heart of the DATA CELLAR approach where LECs have been recognised by the European Commission as a pivotal measure to play a key role in driving the energy transition of the European Union (EU). At the same time, the digitisation of the EU energy system and the proper exchange of data between energy actors appear crucial to foster the exchange of best practices and the creation of a knowledge community to tackle one of our society's most pressing global crises: climate change.

Figure 1: DATA CELLAR Rationale

In this context, DATA CELLAR aims to implement a collaborative platform that will provide an interoperable and secure energy data space capable of delivering access to datasets and Artificial Intelligence (AI) models to serve and support the spread of energy communities in the EU, leveraging on experience gained during the development of other European projects.
DATA CELLAR will create a decentralized data space to store streams or historical data coming from private metering, but it will also provide a data federation integrating data coming from both external companies and EU federation spaces. The data space will be populated by a series of services dedicated to energy utilities, energy communities, private businesses and citizens. Furthermore, DATA CELLAR will provide a decentralized and open marketplace for energy datasets and pre-trained AI models to serve and support LECs.
To achieve its objectives, DATA CELLAR is divided into 9 WPs with different objectives, tasks and deliverables. This document is on the scope of WP1, which has, as main objective, the assessment of the Validation Cases (VCs) and of other existing dataspace / ongoing energy communities experiences. This WP aims to define the initial reference framework of the project and to sustain the project activities on the remaining WPs, coordinate the dataspace development, clarify the partners role, qualify the data most probably managed by DATA CELLAR and guide the validation phase.

2.2. Deliverable overview and structure

The aim of T1.1 is to identify the needs of the most relevant users of the DATA CELLAR data space (e.g., managers and administrators of Energy Communities (ECs) along with its members) and to define the data to be collected in/by the DATA CELLAR including market requirements and gaps to cover, existing benchmarks and associated databases. The results of these activities are contained in the present report D1.1, structured as follows: section 2 brings an introduction to the project as a whole, and provides information on how this deliverable is organized. In section 3 the users' requirements and needs are defined, collected via an online survey, designed specifically for this purpose. In section 4 the investigation of the current data spaces is summarized, highlighting their advantages, disadvantages and possible improvements. In section 5, an overview of a series of EC in Europe is presented, with information regarding the tools and services, and the engagement process of their associated members. Section 6 describes the concept of the following tools: the assessment tool, created by EDP, able to identify potential services and engagement methods (to be further developed in WP5 and deployed in WP7), and the self-assessment tool, created by RINA-C, to understand the level of maturity and which could be the purpose/most urgent actions needed for that specific LEC in order to be guided in the data space and towards the most appropriate services to meet their objectives. Lastly, section 7 presents the main conclusions of the task activities. The remaining sections of this document refer to the references (section 8), appendices (section 9), and annexes (section 10).

3. DATA CELLAR potential users' wishes and needs

In order to be able to act by maximising the impact of DATA CELLAR on LECs, it is first essential to have an overview of what the needs of the users involved in using the platform might be. This activity has been conducted through a Design Thinking approach involving Validation Cases (VCs), technical (architectural) partners and consortium members who are involved in other database projects and external stakeholders.
Some key concepts and terms useful for a better understanding of this document are introduced below.

- **End-users**: represent are all those who might interact with the platform using the data space and services in DATA CELLAR. This includes, for example, private citizens who are part of a LEC, managers and/or administrators of the LEC, but also the scientific community and Data Analytics Developers.
- **Market needs**: consisting in the opportunities that the implementation of DATA CELLAR can offer in relation to market demands, in terms of partnerships and contract negotiations.
- **User needs**: what the end-users of DATA CELLAR need beyond the benefits of its use, in terms of energy management and cost savings, participation in local energy markets and flexibility, and the possibility of establishing a LEC in their area.
- **Stakeholders**: every person, public entity or company that may be impacted by the implementation of DATA CELLAR.

3.1. DATA CELLAR Target

During the activities of T1.1, a workshop was organised to collect the VCs' points of view and to have an alignment with the proposals made by DATA CELLAR. Each VC presented its objectives regarding the use of DATA CELLAR and the most important data set that, according to all VCs, must be collected by DATA CELLAR. Based on the outcomes of this meeting along with the answers from the survey, there were also identified other stakeholders. Table 1 summarizes the possible type of identified stakeholders:

Table 1: Identified Stakeholders

Stakeholder	Identified at
LEC members	Grant Agreement
LEC administrators	Grant Agreement
Technology goods and services' provider	VC's alignment meeting
DSOs	Grant Agreement
TSOs	Grant Agreement
Energy market operators	VC's alignment meeting
Flexibility market operators	Grant Agreement
Electric mobility charging stations' operators	Grant Agreement
Municipalities	VC's alignment meeting
Energy goods and services' providers	VC's alignment meeting

EC investors	VC's alignment meeting
Public entities	VC's alignment meeting
Scientific Community	Grant Agreement VC's alignment meeting
ECs already operational	VC's alignment meeting
General population of European Union	VC's alignment meeting
Potential data owners	VC's alignment meeting

3.1.1. Validation Cases (VCs)

Nine (9) LECs, which differ in their stage of development, type (rural, urban or industrial), size and location, were involved to test and validate the functionalities of DATA CELLAR. These communities are spread in different countries around Europe: Bulgaria, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain and, Switzerland.
In addition to the ECs, two other Validation Cases have also been involved that do not strictly fall under the category of Energy Communities, but are players in the flexibility market and public EV charging points. In this way, each VC will interact on two different levels with DATA CELLAR: as a data provider and to drive business. Each DATA CELLAR VC is described below:

- **AEM in Switzerland**: As a Swiss DSO, Azienda Elettrica di Massagno (AEM) completed the smart grid transition of its entire grid, introducing smart metering devices and implementing a dedicated communication infrastructure along with algorithms for managing load profiles. In addition, it worked on introducing several Energy Communities (ECs) within its grid based on the current Swiss law that requires both physical and electrical continuity. The purpose of ECs is to better manage decentralized generation and provide benefits to citizens.
With the support of AEM, two Energy Communities (EC) have been involved in the DATA CELLAR project:
a) "Arena Innovation Community, AIC" is a suburban EC under the municipality of Capriasca. It can be defined as a self-consumption community with the goals of reducing energy waste through intelligent and demand response (DR) algorithms, increasing awareness and transparency among members, helping people to be informed about the challenges of the energy transition, and enabling the study and validation of innovative energy solutions.
The community is composed as follows:

- 11 single-family houses and 3 buildings for a total of 100 residents (total area of roughly 10.000 m2);
- A football field with a parking lot;
- A public swimming pool (total area roughly 8.000 m2).

Most households cover their energy needs with electricity, reaching a total consumption of about 107 MWh/y. The public swimming pool consumes 325 MWh/y of electricity during the summer, whereas the football field that includes the field facilities (e.g., lights), a small food court, Civil Protection, and fire station, consumes 98 MWh/y.
In terms of assets the EC provides:

- Two PV systems with 30kWp and 60kWp (Q1-2023) on the football field and public pool respectively. The public pool PV system plans to supply mainly the pool utilities in summer and the nearby district heating plant in winter;
- An air-water heat pump of 11 kW, as a central system supplying one residential building of 3 apartments;
- A district battery (54kWh / 50kW) to enable peak-shaving strategies and the self-consumption of the EC;
- A Car-sharing EV charger 11kW DC with V2G function – car has 37kWh battery (Honda-E);
- A biomass district heating plant (wood chips based) promptly connected to the public pool, football field building, and 3 residential buildings (as well as other buildings that are outside the EC) with an annual energy production of 2,300 MWhth with an output of 550 kWth. Furthermore a 40 m^3 thermal storage tank has been installed in the biomass plant for storage purposes.

b) "Motta District" is an urban EC located in Via Motta under the municipality of Massagno. It includes different types of prosumers, such as residential buildings, offices, warehouses, and an elderly care home. All users belong to the AEM distribution grid, and they are connected to a 400 kVA substation located in the centre of the neighbourhood. Users have been equipped with smart meter devices that communicates the net data (both injection and withdrawal) every 15 minutes to AEM's central servers (2 years of historical data available). A V2G-enabled charging station, operated by AEM, is already integrated at the pilot site, and will be used to optimize the EC's self-consumption as well as flexibility service to the aggregator/balancing group.
The community is composed as follows:

- 20 residential flats and single-family houses. The building stocks are three multi-family buildings with five floors and three typical two-store family houses, for a total number of residents around 100 (total area of roughly 8,000 m2);
- A large office building (with an engineering and a legal office);
- A warehouse used daily;
- An elderly care home (Casa Girasole) with 60 single-bed rooms and approximately 94 workers.

In terms of annual consumption data, the total consumption for residential dwellings is 90 MWh/y, while office premises have a total consumption of 193.5 MWh/y (two large offices each and one small office) and the elderly care home with a total consumption of 316 MWh/y.
In terms of production and services, the EC provides:

- A PV system with 60kWp on the roof of the local shelter for elderly people;
- A Car-sharing EV charger 11 kW DC with V2G function – car has 37 kWh battery (Honda-E);
- Several heat pumps (for drying and conditioning) with a total electrical power of 15 kWel, several electric boilers and electric heating devices;
- A thermal plant heating oil based with 100 kWth / 600 MWhth.

- **CFOAT in Ireland** is a community owned energy community: This EC wishes to carry out an in-depth study on domestic and commercial PV potential on the Aran Islands, including bespoke solutions to include battery storage and power diversion technology, where appropriate. This will allow the EC to promote the roll out of a large-scale PV installation project on the islands thus enabling members and island residents to participate actively in the transition to clean energy. It would also enable the EC to put forward a business proposal for commercial customers using actual local weather and PV data gathered from existing installations and building surveys.
The EC also requires the capacity to estimate the impact the electrification of transport and heating on the islands will have on the local electricity network. The islands are currently powered by a 3MW subsea power line. In order to plan responsibly and adequately for the transition to clean energy, the impact on this local network must be considered carefully in order to plan upgrades in advance. Analysing datasets through this energy space would allow the EC to build a clearer picture of where and when upgrades may be required, allowing for a more effective planning of projects.

The goals of the LEC are:

- To increase the share of self-consumption from PVs;
- To secure the future energy needs of the three Aran Islands by gaining a controlling interest in the local sources of alternative energy production;
- To reduce and gradually remove the dependency of the Aran Islands communities on fossil fuels (oil, gas, coal, including transport) by replacing them with alternative and more sustainable sources of energy;
- To preserve the islands' unique language, heritage and culture by providing sustainable employment and a sustainable environment for people to live in;
- To facilitate the conversion of homes and other buildings on the three islands to be more sustainable in their energy usage;
- To provide low-cost energy to industry so as to create employment on the islands;
- To create, provide and encourage employment in projects of sustainable energy;
- To facilitate and at least part-own initiatives and projects in research and development into sustainable energy;
- To provide education and training to both residents and non-residents in sustainable living;
- To create on the three Aran Islands an example of best practice in sustainability to the rest of Ireland and to the world.

To use the three Aran Islands as a platform from which to promote sustainability and environmental protection worldwide.

- **EDG W in Bulgaria,** the electricity Distribution Operator of Bulgaria: responsible for the operation and management of the electricity distribution network, consisting of MV, LV and HV electricity power lines and electricity systems, which is used for transmission and distribution of electric power in order to supply electricity to supplier companies. Regarding electricity distribution, it comprises the territory of the districts Sofia-city, Sofia, Blagoevgrad, Kyustendil, Pernik, Pleven, Lovech, Vratsa, Montana, Vidin. EDG-W is also responsible for the construction of new electricity distribution and metering systems and maintenance of the operated facilities and equipment.

EDG W possess the historical data for hourly load per transformer (LV/MV) of the small town of Bankya, located on the outskirts of Sofia in the western region of the country. The community is not considered a LEC. However, it bears valuable assets. The Bulgarian VC has, as main characteristics:

- It is urban EC;
- In an entry level stage;
- Users involved: 500, identified among 1.3 million users;
- Direct ownership of data;

In terms of assets the EC provides:

- A biomass power plant with 30 kWp installed;
- Two EV charging points: one with 25 kW (DC) and one with 22 kW (AC);
- Mineral bath, public mineral pool, a hospital with mineral poor, and a hotel with mineral pool.

The data to be provided to DATA CELLAR mainly concerns the evaluation of ancillary and grid flexibility services via LEC.

- **EMAC in Portugal**, an urban cleaning and waste collection services in the municipality of Cascais: The Cascais town hall aims to develop a local strategy for energy communities. As the local government owns numerous buildings and infrastructures, it hopes to create a replicable model to accelerate the implementation of solar production units in rooftops and to provide a feeling of "safe partnerships" to engage citizens and stakeholders.
These are high profile buildings which contribute for the project's visibility such as museums, office buildings and citizen shops, sport centres, to name a few.
This will ensure a diversity of purposes. As it is in the town's centre, the abundant parking can also benefit EV vehicles' charging. This variety of usage, hourly variation on energy demand (housing vs public buildings vs EV charging) will allow us to understand how energy can be stored for different urban living purposes and ensure all the potential of the renewable production. The energy flow (production and consumption) will be thoroughly studied to ensure a proper distribution as needs arise.
This also includes the consideration of changing some of the building's management (machinery usage, visiting hours, etc.). We also aim to prove the efficiency of the system in diverse urban management: public buildings, EV Charging and even in public lightning. As of now, there is yet any other energy community in Portugal. By developing this pilot project, we can merge the challenges both public and private entities and owners face when transitioning to sustainable energy sources.
The envisioned implementation is sized according to:

- Install PV panels aiming to produce between 50 kW to 100kW;
- Potential RES assets to be installed Large PV plant in carpark, as well as additional capacity in the surrounding buildings, (combined 100kW capacity);
- EV charging ports (for at least 5 cars) and residential houses (at least 10);

- Use existing Smart Meters installed in existing public and private buildings, The Mobi Cascais program gathers costumer travel information and route demand as well as EV charging port information;
- Use available building management systems (with needed upgrades) to retrieve specific and live information;
- Assess the energy storage potential for buildings.

- **EUNICE in Greece**: The Thoi Renewable Energy Community, as an Energy Community of the Eunice Energy Group aims to promote a social and solidarity economy and innovation in the energy sector, tackling energy poverty, promoting energy sustainability, production, storage, self-consumption, energy distribution and supply, while improving Energy Efficiency (EE) for the end user at a local and regional level.
The EC is comprised by up to 20 members of the Eunice Energy Group staff with the below objectives among others:

- The installation of Renewable Energy Sources (RES) stations, High Efficiency Electricity-Heat Cogeneration (HEEHC) stations and Hybrid Stations for the production of energy, storage, self-consumption and/or sale of electricity or thermal or refrigeration energy from RES stations and HEEHC stations within the Attica Region;
- The management (collection, transport, processing, storage and disposal) of raw materials for the production of electrical or thermal or refrigeration energy from biomass or bioliquids or biogas or through the energy recovery of the biodegradation fraction of urban waste;
- The utilization of energy-efficient products, devices and facilities (e.g., smart power meters, smart relays, smart plugs, CO2 sensors temperature sensors, microgrid monitoring and automation systems, radiator valves) and the integration of them with energy storage and RES, in order to reduce energy consumption and improve EE, as well as the utilization of electric vehicles in order to reduce energy consumption from conventional fuels;
- Demand management services aiming at reducing the end consumption of electricity primarily and for the moment and the representation of producers and consumers in the electricity market and in general the ECs' activity in the representation market (aggregation). In the near future, the consideration of additional energy vectors is foreseen, i.e., heat or green hydrogen.

The EC is characterised in a twofold manner as it is both industrial and urban. The industrial part of the LEC is referred to the factory premises of Eunice in Mandra, Attiki Greece, with approximately 30 users, where small wind turbines of installed power 50 kW and EV chargers (one socket or two socket AC 22 kW) are produced. The urban part is at an Early-Stage Level (some preliminary energy demand profiles/production opportunities are already identified) and planned to begin its operation between Q2 of 2022 and Q1 of 2023. The expected number of members will be approximately 20-30. The scope is to install up to 500 kW PV and potential small wind turbines in a residential district in the Attica region, in order to provide with renewable energy, local buildings of the LEC's members.
The data to be provided by Thoi Renewable Energy Community (REC), to populate DATACELLAR, will be both real time data from smart meters as well as historical data. The data are stored in a cloud platform as well as in local Supervisory Control And Data Acquisition (SCADA) system. Regarding the General Data Protection Regulation (GDPR) rules, there are

encrypted communication protocols between IoT devices and Watt-peak (Wp)/PV inverters with the cloud platform, Secure Sockets Layer (SSL) encryption and login infrastructure for the members (authorization and authentication). This includes:

a) Factory Premises:

- RES assets and Information & Communication Technologies (ICT) currently available and operational:
  - Factory rooftop PVs (40 kW peak) for self-consumption and metering (20kW out of 40kW) linked to the in-house developed S4S Platform (Energy Management System);
  - Li-Ion Battery (62 kWh Capacity) for energy storage – to be extended;
  - Hybrid Inverters for smart interaction of inverter both with the grid and the battery system;
  - Smart meters and smart power relays, as well as Temperature and CO2 sensors;
  - Local Energy Management System.
- Member's energy consumption data in Watt-hour (Wh) (available for each member);
- Environmental and Meteorological Data (temperature, humidity, solar irradiation, air quality, CO2 emissions) (available for each member);
- Load Control (smart plugs with measurable energy data and smart relays) (available for each member);
- Wind turbine (W/T) power generation timeseries (data for power in Watt (W), stored in local SCADA system);
- PV power generation timeseries per inverter (data for power in W, stored in local SCADA system);
- Tentatively charging data from EC members' household connected EV chargers.

- **FAEN in Spain**: LEC Moal will be a rural Energy Community supplied by local renewable energy resources. It will be implemented in Moal, a village with 76 inhabitants located in a rural area of Asturias (Spain) within a Just Transition Zone. This area is suffering a depopulation process and is also directly affected by coal activity closures. For this reason, this initiative has been selected by the regional Government of Asturias for developing a testbed for checking the feasibility of actions to re-activate the economy in these Energy Transition areas and to improve the conditions of the rural areas.

The LEC includes an energy system for electrical self-consumption that will be set up in two phases. At a first stage, a solar PV plant (about 90 kWp) integrated with a BESS (about 130 kWh) will be installed. In a second stage a micro-hydro plant (about 10 kW) will be added to the LEC. This energy system will supply electricity to 38 consumption points, mostly residential buildings. Current consumption is around 150 MWh/year.

Additionally, the possibility of installing a biomass district heating (about 500 kW) for suppling the heat demand has been considered as a third stage. In any case, the second and third stages will not be included in the DATA CELLAR project because it is sure that they will be done beyond the end of the project.

This action will allow to increase knowledge about energy communities, to improve the security of energy supply in the village and to act as a demonstration case that could be replicated in other rural areas.

The main stakeholders involved in this project are: Moal inhabitants (LEC promoters and consumers), they will provide the testbed for the demonstration; Government of Asturias (LEC

promoter); FAEN (regional energy agency and LEC promoter); CTIC (ICT service provider); ESCO (energy service provider and energy system builder); DSO (electrical supplier).

- **IREN in Italy**: For the Italian context, Iren will provide two VCs, an urban EC and a rural/extra-urban EC:
a) The Lingotto Energy Community is a prospect urban LEC located in the city of Turin, in the Piedmont region. The EC is comprised by 5 stores (about 7000 m2) and 1 shared Heating, Ventilation and Air Conditioning (HVAC) facility, responsible of about 2500 MWh of consumption. The RES asset is a PV of about 400 kWp (currently in design and construction phase) installed on the rooftop of two outdoor walkways of a shopping mall.
b) The Leap Factory Energy community is a prospect rural/extra-urban LEC located in Chamois, a village in Valle d'Aosta region. The EC consists in 3 high efficiency prosumer single-family houses, mainly used as second homes, with an annual consumption estimated of about 500-1000 kWh/y per house, and the adjacent restaurant as additional only consumer member, with an annual consumption of about 30.800 kWh. Respectively 1,32 kWp, 4,74 kWp, and 2,37 kWp PV systems will be installed as RES asset over each prosumer housing unit (the systems are already under installation). The data (either aggregated or anonymous) to be provided by the Lingotto EC and the Leap Factory EC to populate DATACELLAR, will be:

- Energy consumption;
- Production of renewable energy;
- Physical and virtual self-consumption of energy;
- Consumption of electricity from the grid;
- Electricity fed into the grid;
- Prices of electricity in the Italian market;
- Solar radiation (for PV plant).

- **MRAE Netherlands**: MRA-E is a cooperation of local and regional governments that stimulates electromobility. By developing, managing, and monitoring a network of charging stations, MRA-E aims to contribute to the accessible and affordable charging for electric vehicle drivers. Datasets that are available within the public charging infrastructure include for example:

- User information (location, availability, pricing);
- Monitoring data (energy delivered, charging time etc.).

These and other datasets are managed by different parties and some important data are only made accessible through commercial parties. This is undesirable since EV-drivers, new market players and developers of the current infrastructure have limited access to useful information with numerous use cases. The current inadequate access to these data also leads to undesirable difficulties to address and act upon incomplete, inaccurate or outdated data. Therefore, MRA-E is working on the harmonisation of data inputs and outputs and on designing EU/national/regional solutions to improve the data delivery and manage the appropriate level of access.
Through the participation in DATA CELLAR MRA-E aims to contribute to an open, well-structured data space that enables access to different datasets based on one's needs. As one of DATA CELLAR's data providers, MRA-E can provide insights and input on charging infrastructure data,

developments within this field and data protocols to achieve a well-founded framework as the basis for a secure and open energy datahub.

- **NODES Norway** Flexibility Market: NODES is a flexibility marketplace providing the framework for an EC that consists of buyers and sellers of flexibility and energy.
Flexibility markets are implemented to enable access for grid operators to available flexibility from local/regional resources (production/consumption assets). Grid operators can use this flexibility to solve grid constraints. The EC around a flexibility market consists of grid operators as buyers and flexibility service providers/aggregators as sellers. These market participants meet on NODES market platform to communicate the characteristics of the flexibility service in need or to offer, respectively, through price, volume and location of flexibility.

3.2. The Survey

To assess the interests of the potential users of DATA CELLAR, an online survey was created by the T1.1 members. The objective of this survey is twofold: firstly, to question the potential end-users of DATA CELLAR, and other identified stakeholders on their expectation and needs regarding using DATA CELLAR data space and/or its functionalities. Secondly, to map the profile of the potential end-users, through the questions regarding their literacy in Energy Communities and data space, in order to find knowledge gaps to be covered by the project consortium.
The questions of the survey are divided into 4 sections, and focus on the users' point of view, and in their possibilities to create an EC. To achieve this objective, the questions developed address the following themes:

- **Data Space and Data Management Literacy**: questions regarding their knowledge in data space, their expertise in using a data base, their energy and non-energy data availability and willingness to share it, their wishes on acquiring and viewing data in the DATA CELLAR environment;
- **LEC Literacy and Survey**: questions regarding the stakeholders' knowledge on the concept of EC and questions to assess the status of their infrastructure for a proper LEC creation during the DATA CELLAR project life cycle;
- **Demographics**: questions regarding the profile of the DATA CELLAR potential users, in terms of their annual incomes and energy costs, age, gender, quantity of people in each dwelling that join the LECs;
- **Data Technology**: the available data technology present in the potential LECs and how it is used to manage data among the created LECs.

The following potential users were identified during the activities of T1.1:

- **DATA CELLAR VCs pilot members**: the residents and users of the buildings that will form the LECs created during the project life cycle;
- **DATA CELLAR VCs pilot LEC managers**: the entities that manage the LECs created during the project life cycle, which can be a person, or a company hired for this activity;
- **LEC members outside DATA CELLAR VCs**: residents and users of LECs already operational, or to be formed and are not part of the DATA CELLAR environment;

- **LEC managers outside DATA CELLAR VCs**: the entities that manage LECs already operational, or to be formed, that are not part of the DATA CELLAR environment;
- **Data space users outside DATA CELLAR VCs**: persons or entities that are part of data spaces other than DATA CELLAR;
- **Data space administrators outside DATA CELLAR VCs**: persons or entities that manage data spaces other than DATA CELLAR;
- **DSO representatives**: persons that answer for the interests of a DSO, which can be part of DATA CELLAR, or other energy data spaces, as data owner and can provide energy-related data to populate data spaces, including DATA CELLAR;
- **Local energy market representative**: persons that answer for the interest of energy traders in local markets, which can be part of DATA CELLAR as data owner, or even as member of data spaces, including DATA CELLAR;
- **Energy services/tools provider**: representatives of companies that sell energy services and management tools for energy users;
- **LEC enthusiast**: people interested in ECs, such as Master of Sciences (MSc.) and Philosophy Doctors (Ph.D.) candidates, professors, and researchers.

The survey was answered by 37 people, from August 22nd to September 30th. It was developed using the "EU Survey" platform, supported by the European Commission´s Interoperability Solutions for Public, Administrations, Businesses and Citizens ("*ISA²*") programme, that promotes interoperability solutions for European public administrations.
The identification was used as the first question of the survey. Each class of stakeholder answers only the related selection of questions developed for the survey, described in subsection 10.1.

3.3. Users' needs

Based on the answers provided by answering the survey, it is possible to conclude that:

- Most people do not have a formal knowledge on data space;
- There is no data sharing environment;
- There must be an educational effort by DATA CELLAR to educate their users;
- The most important interest in sharing data is for research purposes, and not for economic profit;
- People are willing to provide data if their community can benefit from it;
- Energy consumption and generation are the main concerns for a user;
- People are interested finding data space tools associated with energy flexibility, energy management and energy generation forecasting;
- People are not aware of services based on data. Consequentially, there are not such services available for them;
- Regarding their EC and dwellings:
    - People are aware of the general concept;
    - People are aware of the boundaries of their EC (number of members, energy carriers and assets), but are not aware on the area occupied by their communities;
    - People are aware that there are data availability, they can access it and they are willing to share it for the benefit of their communities;

  - There is a lack on weather data for the end-users. To the ones who have access, the most common data are related to indexes associated with ambient temperature, atmospheric pressure, and wind speed;
  - Most users do not have any local energy generation source and/or energy storage units;
  - The electric cars are not spread among the stakeholders.
- Considering the majority of the survey answers, the typical user profile can be illustrated. Thus, the typical user:
  - Is male;
  - Is between 50 and 59 years old;
  - His monthly income is between 2,000 and 2,500 €;
  - The yearly energy cost of his building is between 500 and 1,000 €;
  - Lives in his own building;
  - Lives and/or works in an urban area;
  - His building is for a single family to live in it;
  - His building is constructed between 2001 and 2010, and it was refurbished at least once;
  - In average two people uses his building, both are adults.
- The data technology is not developed for EC management.

The complete statistics on the answers are described in section 10.2.

3.3.1. Validation Cases specific needs

Since DATA CELLAR will be validated by existing LECs, managed by the VCs partners, using the DATA CELLAR data space and the developed infrastructure, it is important to understand the links of the VCs with the DATA CELLAR data space. This was the main objective of the alignment meeting. The outcomes of this meeting are summarized as follows, regarding the VC's clear expectations and what they want to find by being part of DATA CELLAR:

AEM's desired objectives related to the DATA CELLAR project are:

- Development of innovative business models/services for LECs:
  - Haas and Baas optimization;
  - IoT integration;
  - Flexibility forecasting and planning.
- Benchmarking against similar LECs in terms of self-consumption, flexibility, energy savings;
- Dynamic tools for LEC planning (before) and optimization (after);
- Improve and enhance both recruitment and engagement;
- Automatic creation of a digital twin of the LEC based on data.

MRAE, as data provider (and possible future end-user of DATA CELLAR), proposes the following requirements regarding the DATA CELLAR data space:

- A basic and fully open service that allows any user to reuse aggregated data, provided that:

  - The data source / owner is acknowledged;
  - Data use / download are registered;
  - Metadata on usage is downloadable for the data provider / owner.
- A secure data sharing solution in which data owners / providers can approve applications and assign different permissions to data applicants;
- The commonly applied electromobility data formats are used in the data space;
- As an end-user: transparency on sources, quality, errors and corrections of the data, in terms of descriptive and administrative metadata.

NODES, as a flexibility market operator, aims to connect to or integrate with DATA CELLAR through its participation to the project. The primary goals are to ensure:

- Fast and secure access to metering data needed for settlement calculations;
- Replicability and usage of Data Cellar in NODES flexibility market;
- Enabling more widespread use of local flexibility markets;
- A source of historic data that can be used for baselining/forecasting;
- Compatibility between Data Cellar and NODES.

EUNICE, as one of the VCs, which will form a multi-purpose buildings' LEC, its expectations via the participation in the DATA CELLAR project are separated in two categories:
a) Data utilization:

- Weather forecasting engines for data forecasting, due to dependence of RES generation on weather phenomena and conditions;
- Data emerging from other ECs and EC-profiles;
- Data for Electricity Spot-Price from other EU members.

b) Data Space utilization:

- Future development of PV, Wind Parks and Storage;
- General energy generation and management techniques;
- Increased profit of EC members through advanced forecasting techniques, Spot-Price, and integration of similar practices;
- Data sources connected to EV charging behaviour or tourism, for the validation of the mobility platform;
- Drive business as the different stakeholders will have access to both usable data in an aggregated way for their business, as well as the different data-driven services that will be developed within DATA CELLAR;
- Development of Digital Twin Models, Decision Support Systems, and new Business Models;
- Promotion of LECs and development of new LEC-oriented contracts.

FAEN, as one of the VCs, which will form a rural LEC, described the main expected benefits that DATA CELLAR could bring for LEC Moal as follows:
a) Direct benefits: the digitalization of the LEC is a great opportunity to improve its management and to provide new tools and services for the consumers:

- To provide an optimized smart regulation system for the LEC (more interoperability and proactive demand management);
- To improve the security of energy supply (prioritizing self-consumption and minimizing network consumption);
- To increase the availability of flexibility sources that enable the interaction with many distributed resources at the same time;
- To reduce the energy costs;
- To facilitate the implementation of potential new services for the village (ICT technologies, electric car etc.).

b) Indirect benefits:

- DATA CELLAR will offer new opportunities for citizens to get actively involved in energy matters;
- DATA CELLAR will make the energy facilities more cost-efficient and more attractive for consumers, becoming more sustainable the business model;
- DATA CELLAR will contribute to engage citizens through collective energy actions that can reinforce positive social norms;
- DATA CELLAR will contribute to increase the technical knowledge about the LEC and its operation (this is important to be replicated in other rural areas);
- These aspects are important to retain population in a rural area and reduce the current demographic problem of these territories.

IREN, one of the VCs, which will form two LECs (an urban and a rural/extra urban LECs) states that the expected benefits from DATA CELLAR for both VCs are:

- Studying dynamic methods for allocating self-consumption incentives;
- Explore potential of monitoring and control technologies for energy consumption/production in ECs;
- Identify areas for potential improvement of ECs management;
- Performing actions on future adjustable electrical loads;
- Develop innovative business models/services for ECs.

EDG-W, as one of the VCs, which will form an urban LEC, expects that DATA CELLAR:

- Valorise existing data space towards a federated data space;
- Facilitate data sharing both from users and grid / market / energy community operators also via specific business models;
- Exploit data from metering.

Regarding the remaining VCs, and despite their non explicit feedback on their expectations and needs through the use of DATA CELLAR, it is indirectly identified that, in general, they want to find in DATA CELLAR functionalities for:

- Accelerating digital transition of the energy sector;
- Innovative and new business models:

    - Energy management optimization techniques;
    - Shared mobility;
    - Flexibility for ancillary services.
- Benchmarking:
    - Identification of areas for potential improvement;
    - Identification of laws impact.
- Dynamic tools for LEC planning and optimization:
    - Optimal dimensioning;
    - Potential for new developments;
    - ROI calculation.
- Recruitment and engagement of LEC members;
- Monitoring and controlling of devices and RES assets;
- EMS;
- Data using:
    - Weather forecast engines;
    - Data from other ECs for benchmarking;
    - Data for energy spot prices.
- Data space using:
    - Development of RES parks and storage location;
    - Increase LEC members' profit:
        - Forecasting techniques;
        - Spot prices;
        - Integration of best practices;
        - Data using for EV charging;
        - Data-driven services;
        - LEC-oriented (smart) contracts.
- Monitor and control of KPIs;
- Friendly dashboard;
- Reference for an optimized Smart Regulation System;
- Increase of flexibility sources;
- Engage citizens to act collectively;
- Increase technology literacy of users and stakeholders.

3.3.2. Data to be collected by DATA CELLAR

To map the type of data that might be useful to find in the data space from the point of view of LECs, the following multiple-choice question was asked: "What type of data would you like to find on a data space related to energy?". The possible answers were:

a) Energy consumption
b) Energy generation
c) Power demand (load diagram)
d) Weather data
e) Other (_____)

All the presented choices were marked, and the most selected attributes were "Energy consumption", "Local energy generation" and "Power demand (load diagram)". It is important to note that the most mentioned words in the "Other" answers were:

- Flexibility;
- Household;
- Subject;
- System;
- Prevalence;
- Gender;
- Heating;
- Devices;
- Temperature;
- Services;
- Correlated.

One of the outputs of the workshop with the VCs representatives was related to the data that the VCs pilots are expecting to provide to the DATA CELLAR environment and to exploit for acquiring their improvements. The participants mentioned data related to:

- Weather;
- Energy consumption;
- Local energy generation;
- Self-consumption;
- Energy storage;
- Users' profile;
- LEC buildings' characteristics;
- Energy grid layout;
- LEC members' profiles (age, gender etc.);
- Controllable devices (individual devices' consumption);
- Renewable Energy Sources (RES) assets (rated power, technology, location etc.).

3.4. Market needs

In general, a DATA CELLAR should also create value by enabling new partnerships and businesses. Therefore, DATA CELLAR should attempt to not only provide relevant data, but also to help potential new partners to assess benchmarking in terms of LEC management, in order to drive these potential users to join DATA CELLAR.
As one identified example, consider NODES, a flexibility market operator. On a local market operated by them, DSOs can buy flexibility from distributed flexible energy resources to solve grid constraints. For NODES, metering data is crucial to ensure correct operation of the marketplace. This involves validation and settlement of transactions done on the market. A metering data hub such as DATA CELLAR or similar, would be an important component for flexibility markets ensuring secure and fast data exchange.

In a future scenario, DATA CELLAR could act as a re-usable access point to such data. Data will be stored and used based on consent. If consent is given, the flexibility market can retrieve the metering data from DATA CELLAR. DATA CELLAR will store and transfer data securely and in line with GDPR. Each time a new local flexibility market is set up, the same routines can be followed to obtain data. This would be a huge improvement for both market participants and market operators compared to the current situation, where each new location involves getting the metering data from a new source.
An even further improvement would be if DATA CELLAR also made it possible to locate potential flexibility providers suitable for selling their flexibility on a flexibility market. As an example, local flexible asset owners (consumption and production) could register their assets in DATA CELLAR. By using DATA CELLAR, this would then give local DSOs a way of estimating the potential flexibility at hand. Further it would greatly reduce the time needed to set up a flexibility market afterwards.

3.5. Business opportunities

It is important to assess how DATA CELLAR can impact its users and stakeholders. This assessment is made through the definition of business cases. A business case brings together the benefits, disadvantages, costs and risks of the current situation and future vision so that the executive management can decide if the project should go ahead. It is developed during the early steps of the project and outlines the why, what, how and who necessary to decide if it is worthwhile continuing a project.
According to D8.1 – Dissemination and Communication Plan, the target audience of DATA CELLAR is composed by:

- Energy communities;
- Energy utilities;
- ICT / AI / Data Analytics developers;
- Scientific Community;
- EC Platforms not involved in the DATA CELLAR project;
- Policy makers.

It also identifies the following targets of DATA CELLAR:

- Flexibility Market Operators;
- Electric Mobility Operator.

From this list, it is decided that the following targets will have a business case assessed at this stage:

- Data analytics developers;
- Electric mobility operators;
- Energy communities;
- Energy consumers and prosumers;
- Flexibility market operators;

- Policy makers;
- Scientific community.

Notice that the actual EC Platforms are not considered, at this point, a considered target for the development of the business cases. This occur due to interoperability issues, which are been investigated by the DATA CELLAR consortium. As soon as this issues are solved, and the DATA CELLAR consortium have a clear vision on how to interact with this target, the business case will be properly assessed.
From this stage of the project activities, it is only defined, for each target, what are the business problem or opportunity that may arise by using DATA CELLAR and potential benefits or costs for these actions. The technical solutions and how to be demonstrated will be defined in the future, when the functionalities of DATA CELLAR have been developed. Table 2 summarizes the general description of the identified business cases.

Table 2: Business cases' general description

TARGET: Data analytics' developers
a) **Business problem / opportunities** The market for Data has been increasing at a fast pace in the last decade. In this context, DATA CELLAR will enable the exchange of large amount of data in the energy sector that will sustain the development of related businesses. Data analytics' developers might decide to buy datasets from the DATA CELLAR Platform to: • Forecast electricity production and demand; • Balance peaks on electric grids; • Perform predictive maintenance on LEC assets; • Reduce electricity transmission losses by better managing local energy sources; • Develop smart grids; • Power better customer experience and marketing strategies;
b) **Benefits / Costs** To purchase datasets from the DATA CELLAR Platform, a data analytics' developer will have to: • Register to the DATA CELLAR Platform; • Browse the Data Catalog; • Purchase the Dataset of interest using tokens. Regarding the tokens, it is still unclear at this stage of the project, how they will be implemented.
TARGET: Electric mobility operators
a) **Business problem / opportunities** Electric mobility operators can contribute to the accessible and affordable charging for electric vehicle drivers by developing, managing, and monitoring a network of charging stations. Datasets involved are for example User information (location, availability, pricing), and Monitoring data (energy delivered, charging time, etc.). These and other

datasets are managed by different parties and some important data are only made accessible through commercial parties. This causes problems such as:

- EV drivers, new market players and developers of the current infrastructure have limited access to useful information with numerous use cases;
- The current inadequate access to these data leads to undesirable difficulties to address and act upon incomplete, inaccurate, or outdated data.

To solve these problems, the harmonisation of data inputs and outputs and on designing EU/national/regional solutions is needed. This way we can improve the data delivery and manage the appropriate level of access.

b) **Benefits / Costs**

Through the participation in DATA CELLAR, MRA-E aims to contribute to an open, well-structured data space that enables access to different datasets based on one's needs. DATA CELLAR also provides opportunities for MRA-E to address the important share of electric mobility data in public energy data that is essential to understand, develop and manage local energy communities. On top of that, a decentralized dataspace provides opportunities to gain insights regarding the usage, usability and availability of electro-mobility data. This could improve the development of monitoring, tracking and reporting processes regarding the data accessibility (who sees what) and usage (what is downloaded by whom, how is it used).

The foreseeable costs for MRA-E at this point in the construction of the data space relate to:

- Project management;
- Data management and data access control;
- Maintenance of data connections.

TARGET: Energy Communities

a) **Business problem / opportunities**

Energy communities are one of the critical aspects in achieving the EU's energy transition by 2050. Half of the European citizens will be able to produce up to half of EU energy from renewable sources. Identifying the essential role of local players in the energy transition process - especially for residents - the EU local communities to take ownership of the energy transition through the concept of energy communities. They are indicated as one of the means to help democratize, decarbonize, and decentralize the energy sector across Europe. The European Commission define two different kind of energy communities: the Renewable Energy Community and the Citizen Energy Community.

Energy communities are prominent initiatives to provide end consumers an active role in the energy sector, raise awareness on the importance of renewable energy (RE) technologies and increase their share in the energy system thus reducing greenhouse gas (GHG) emissions. The importance of economic benefits, the return of investment and job creation among the community, are some of the main determining factors for members to enter an energy community. Also, another important driver is the environmental and social factor.

As defined in the recast of the European Renewable Energy Directive (Directive 2018/2001), a Renewable Energy Community (REC) is a legal entity entitled to produce, consume, store, and sell renewable energy between geographically co-located private citizens, public entities, SMEs and municipalities. Their objectives are to create economic, environmental, and social benefits to the community members, as well as to increase local acceptance of renewable energy projects. On the other hand, the Citizen Energy Community (CEC) has a similar definition, stated in the Electricity Directive (Directive 2019/944). However, the CECs are also entitled to act as DSO, operating their own electricity distribution grid.

The emissions reduction, self-consumption, self-sufficiency and the economic variability and profitability of energy communities depends on multiple interdependent factors. So, RECs users and managers want to have access to data concerning electricity tariffs, flexible assets (i.e., heat pumps, electric vehicles), demand-response schemes, prices for renewable energy technologies and energy storage systems and internal electricity exchange prices to better develop and manage their activities and minimize the energy provision costs.

DATACELLAR aims to create a public energy data space that will support the creation, development, and management of LECs in EU. The data space will be facilitated with different energy data via an innovative rewarded private metering approach. Data space users, providing energy data to the platform, can have access to both data from other RECs profiles and services and tools, such as forecasting tools, energy planning and management tools, AI models and Digital Twins, which can further help them to optimally plan their activities and promoting LECs' development at EU level.

b) **Benefits / Costs**

A LEC can be viewed as economically viable when the total energy cost for the community members is at parity with or lower than other options for energy supply. Electricity tariff directly affects the economic viability of a LEC. Based on the literature electricity tariffs have a high impact in renewable investments, except from cases with full load hours of operation and favourable weather conditions. New network tariff structures may also impact the LEC business case. So, LECs via net-metering schemes are aiming to decrease their energy costs reducing their dependency from the electricity grid making themselves self-sufficient via renewable energy production and utilisation. Tariffs for prosumers and energy communities should reflect the fact that these types of consumers have an alternative energy supply while being connected to the grid, resulting in a bidirectional power flow. Results from recent research articles indicate that even though user type, user consumption and electricity tariffs are important factors, the amount of flexible technology in a LEC is the most important factor to reduce operational costs. Energy Communities in the future could play a key role in providing the flexibility required by the power system through demand-response mechanisms, EVs or other flexible assets.

TARGET: Energy consumers and/or prosumers

a) **Business problem / opportunities**

Energy ecosystems are evolving into smart grids systems, incorporating digitalized components that can provide big data collection and intelligence. Smart grids can provide many benefits as they enable a better match between energy production, especially from renewable sources, and energy demand. Smart grids intelligence can

be also conceived as instrumental in the stabilization of power grids, congestion alleviation and load levelling that become more insecure with greater renewable sourcing and greater penetration of distributed generation resources, such as PV.
Following the war in Ukraine and the RepowerEU Plan, the Commission proposes to enhance long-term energy efficiency measures, including an increase from 9% to 13% of the binding Energy Efficiency Target under the 'Fit for 55' package of European Green Deal legislation.
A massive scaling-up and speeding-up of renewable energy in all economic sectors will promote the green transition and reduce energy prices over time. The Commission proposes to increase the headline 2030 target for renewables from 40% to 45% under the Fit for 55 packages. Specifically, a Solar Rooftop Initiative has been set with a phased-in legal obligation to install solar panels on new public and commercial buildings and new residential buildings. The rate of deployment of heat pumps should double, and measures to integrate geothermal and solar thermal energy in modernized district and communal heating systems.
In this respect, the DATA CELLAR project will provide an Energy Data Space ecosystem that will ensure a stronger availability and cross-sector sharing of data, in a customer-centric, secure, and trustworthy manner. The consumers and prosumers of energy will benefit significantly, especially in the below mentioned aspects.

b) **Benefits / Costs**

- **Improving energy efficiency**. The DATA CELLAR platform will organize and manage the consumers/prosumers energy data, identify trends and particularities across different regions and enable the development of solutions for improving the energy efficiency.
- **Increase of self-consumption**, participation in flexibility markets and P2P local trading. The energy data collected from consumers and prosumers energy behavior can provide valuable insight of energy flows in the electricity grid. It can mobilize potential increase in the self-consumption practices of consumers, their participation in auction-based flexibility markets (e.g., Piclo, Nodes etc) for congestion management, peer-to-peer trading platforms etc.
- **Improve energy forecasting** accuracy to make better investment planning. The advanced big data analytics provided through the DATA-CELLAR platform along with efficient AI-based forecasting technology can provide improved energy forecasting and decision-making support for grid renewable investments.
- **Price of electricity** – Lowering energy bills. The above-mentioned capabilities of the DATA-CELLAR platform, along with specific energy-pricing schemes and incentives provided to consumers and prosumers, can provide recommendations/pathways for lowering the energy bills of the citizens, with proper quantifications of the benefits, in relation with the different tariffs.

TARGET: Flexibility market operator

a) **Business problem / opportunities**

Context: In a congested transmission network, the network operator can buy flexibility (production or consumption) from flexible asset owners. This is done to avoid blackouts or expensive grid investments. The buying/selling happens on a flexibility market.
Primary problem: To verify that flexibility was delivered, the flexibility market operator needs access to metering data. For instance, there is a need to study the metering

data to verify if a local swimming pool has shut down their heating for one hour according to the buy/sell agreement they entered for that hour. After verification is done, the flexibility market operator can collect and distribute the correct payments. As of today, each new flexibility market requires us to set up a new solution for obtaining metering data from that area.
Secondary problem: To participate on the flexibility market, each flexible asset must register their information (name, location, type etc.) on the marketplace. Registration of assets is time consuming in the lack of a central registry.

b) **Benefits / Costs**
Primary: If DATA CELLAR can act as a re-usable access point to such data, it would be very beneficial for flexibility market operators. Each time a new local flexibility market is set up, the same routines can be followed to obtain needed metering data. This would be a big improvement compared to the current situation, where each new location involves getting the metering data from a new source. Sharing metering data will of course require consent from data owner. The data should not be used for other purposes unless further consent is given.
Secondary: If DATA CELLAR can act as a flexible asset registry, asset owners can register once independently of the flexibility market operator. If a flexibility market is set up, the market operator can then easily import those assets wanting to take part. It would also make it possible to locate potential flexibility providers suitable for selling their flexibility. This would then give local DSOs a way of estimating the potential flexibility at hand in each area.

TARGET: Policy makers

a) **Business problem / opportunities**
Policy makers in the EU should have a vested interest in the proliferation of Energy Communities (EC) to advance towards common goals such as energy security and the European Green Deal. Subsidies or tax deductions could be implemented to help communities in this regard. However, public funds should be optimized to ensure the economic sustainability of these EC development efforts. Policy makers face a serious challenge in this regard due to the lack of hard data and the nature of EC.

b) **Benefits / Costs**
The main benefits would be the availability of Decision Support Systems (DSS) in the domain of EC which would provide policy makers with costs savings forecasts, aggregated historical data and simulations of the possible benefits of deploying an EC in a particular location.
Furthermore, the availability of the data could potentially help policy makers to identify the legislative gaps.
The costs emanate from the fact that the development of these DSS demands a significant number of researchers and engineers specialized in multiple areas, including, for example, energy, regulatory frameworks, and data science. Furthermore, as a research effort, it carries an inherent risk.

TARGET: Scientific community

a) **Business problem / opportunities**
DATA CELLAR will provide interoperability among different data spaces to allow sharing of data and services between stakeholders and promote innovative new

services. DATA CELLAR associates will work towards wider industry, allowing straightforward and smooth integration and energy data exchange for all stakeholders, likewise, scientific domains are recognized to be Science, Technology, Engineering and Mathematics (STEM). with a precise integration of Energy (especially) and Social Sciences and Humanities (SSH) (secondarily). Furthermore, it is reserved to use the assignment's outputs to shape the policy plan and ideals of the European Commission.
Presently, energy data are not widely available, and usually, their usage is limited to companies developing internal solutions and services. Moreover, most data could be protected and cannot be made openly available. DATA CELLAR aims to identify solutions to overcome these barriers developing a platform where stakeholders and citizens can share data ensuring privacy and security. The increase in data sharing will also affect AI solutions development since the ability to learn and generalize the models depends on the available data. Equally, available data is rarely reused for purposes other than those initially conceived. Data is a powerful resource that, if properly treated, can unlock unprecedented economic and social benefits. One of the main reasons for the current situation is the lack of technological solutions that allow a safe playground where companies and citizens feel comfortable trading their data.
DATA CELLAR will follow all the practices of OPEN SCIENCE. During the assignment, all partners will follow procedures and practices that assure the early opening and sharing of the project outcomes. Advanced results of the research plan and registered reports will be submitted to Open Access Repositories. The repetition is based on reproduction replication and re-use. All the research outputs will be aligned with the EU's Open Access and Open Science regulations. More specifically, some publications of the project will be published in Open Access Journals, which will be initially checked from the SHERPA/RoMEO platform and DOAJ and Open Access Repositories (e.g., PubMed, Zenodo, arXiv, etc.), which will be identified through platforms such as ROAR, Open DOAR, Open AIRE and OAD.

b) **Benefits / Costs**

DATA CELLAR will create a global ecosystem of data owners and providers to enable them to collaborate and fully exploit the potential of data to develop innovative products and services. It will lead to developing and improving market participation by SMEs, start-ups, and public authorities. Moreover, it will support research where citizens can share energy data themselves, where more data being produced will also be of higher quality. Artificial intelligence algorithms will be improved, and new data mining techniques will emerge. In addition, the reuse of the data after the approval of the data subjects will result not only in the continuation of the research by other researchers with the same data but also in the validation of the results to bring accurate outcomes.
The cost is the creation of the VCs and the data to be produced, collected, and maintained as the cost of the smart meters, the platform, and the data storage.

4. Investigation on current data spaces

The first movement of the European Union to establish common data spaces for Europe was the publication of the "COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS – A European strategy for data", on February 19th, 2020. In this document, the proposed key actions in this regard are:

- Propose a legislative framework for the governance of common European data spaces**, Q4 2020**;
- Adopt an implementing act on high-value datasets, **Q1 2021**;
- Propose, as appropriate, a Data Act, **2021**;
- Analysis of the importance of data in the digital economy (e.g., through the Observatory of the Online Platform Economy), and review of the existing policy framework in the context of the Digital Services Act package (**Q4 2020**).

In this sense, some initiatives to develop data spaces started, mainly by attending the EC Funding and Tenders calls. Therefore, this investigation is mostly focused on funded projects which have, among specific objectives, the development of data spaces in their area. The majority of the initiatives studied are related with the energy industry. However, some of them are broader in scope, aiming to join different data spaces (focus on the GAIA-X Initiative). The investigated initiatives are:

- **BD4OPEN** (Big Data For Innovative and Sustainable Energy Solutions): Offers innovative AI-based services to enable the efficient management of energy distribution grids and associated assets. BD4OPEM will develop products and services to improve the planning, monitoring, operation and maintenance of electrical distribution grids, all made available at an open innovation marketplace. BD4OPEM will create a seamless link between energy stakeholders and solutions developed. The Marketplace will ensure secure data flows between data providers and solution providers, resulting in new data-driven business models, enhanced asset management and consumer participation in energy balancing. Target user groups will be able to find relevant solutions provided by different specialized companies. The process will be demonstrated at five pilot sites (Spain, Turkey, Slovenia, Belgium and Denmark), who provide the initial input data and who will also trial and validate the usefulness and the usability of the services being developed.
- **COORDINET** (TSO-DSO-Consumer: Large-Scale Demonstrations Of Innovative Grid Services through Demand Response, Storage and Small-Scale – RES – Generation): The purpose of CoordiNet is to establish different collaboration schemes between TSOs, DSOs and consumers to contribute to the development of a smart, secure and more resilient energy system. Special emphasis will be on the analysis and definition of flexibility in the grid at every voltage level ranging from the TSO and DSO domain to consumer participation. Three large scale TSO-DSO-Consumer pilots in Greece, Spain and Sweden.
- **IDSA** (International Data Space): aims to create a global standard for International Data Spaces (IDS), as well as fostering technologies and business models that will drive the data economy of the future in Europe and around the globe.

- **SYNERGY** (Big Energy Data Value Creation within SYNergetic enERGY-as-a-service Applications through trusted multi party data sharing over an AI big data analytics marketplace): introduces a novel reference big data architecture and platform that leverages data, primary or secondarily related to the electricity domain, coming from diverse sources (APIs, historical data, statistics, sensors/ IoT, weather, energy markets and various other open data sources) to help electricity stakeholders to simultaneously enhance their data reach, improve their internal intelligence on electricity-related optimization functions, while getting involved in novel data (intelligence) sharing/trading models, in order to shift individual decision-making at a collective intelligence level.
- **openEntrance** (open ENergy TRansition ANalyses for a low-Carbon Economy): aims at developing, using and disseminating an open, transparent and integrated modelling platform for assessing low-carbon transition pathways in Europe. The openENTRANCE modelling platform will shed light on the implications and economic costs associated to the different energy pathways that Europe could take towards its climate goals. With this scientific basis, openENTRANCE aims at helping social, economic, and political actors in a better decision making.
- **GAIA-X**: a project initiated by Europe for Europe and beyond. Representatives from business, politics, and science from Europe and around the globe are working together, hand in hand, to create a federated and secure data infrastructure. Companies and citizens will collate and share data – in such a way that they keep control over them. They should decide what happens to their data, where it is stored, and always retain data sovereignty. The architecture of GAIA-X is based on the principle of decentralisation. Gaia-X is the result of a multitude of individual platforms that all follow a common standard – the Gaia-X standard. Partners are collectively developing a data infrastructure based on the values of openness, transparency, and trust. So, what emerges is not a cloud, but a networked system that links many cloud services providers together.
- **OPENDEI** (Aligning Reference Architectures, Open Platforms and Large-Scale Pilots in Digitising European Industry): aims to the creation of common data platforms based on a unified architecture and an established standard. Manufacturing, agriculture, energy and healthcare represent key fields for the deployment of the EU strategy for digitalisation. In this framework, the EU-funded OPEN DEI project aims to detect gaps, encourage synergies, support regional and national cooperation, and enhance communication among the Innovation Actions implementing the EU Digital Transformation strategy.
- **PLATOON** (Digital platform and analytics tools for energy): aims to digitalise the energy sector, enabling thus higher levels of operational excellence with the adoption of disrupting technologies. PLATOON will deploy distributed edge processing and data analytics technologies for optimised real-time energy system management in a simple way for the energy domain expert. The data governance among the different stakeholders for multi-party data exchange, coordination and cooperation in the energy value chain will be guaranteed via IDS based connectors.

These initiatives comprise a variety of objectives and use cases. On a common basis, some positive aspects can be highlighted. BD4OPEN focus on AI-based services for their pilots, which the future public dissemination of results can be exploited for the development of some of the DATA CELLAR functionalities. A positive aspect of COORDINET is the aiming of the project to provide favourable conditions to all involved actors. The interoperability is mentioned by several of

initiatives, which can drive future initiatives to foresee and use the already developed interoperable data formats and databases to their endeavours. The newer initiatives has, since their beginning, a strong relation with the biggest dataspaces initiatives (GAIA-X and IDSA). All the initiatives have a common strategy to set common policy rules, which will ensure reliable data, the representation of data knowledge, and the security for the provided services, assuring interoperability and portability. The data space experts are also involved in the first definition of cross-sectorial initiatives, to build the fundamental design principles to build data spaces. Furthermore, the main concern of these initiatives the way to ensure data sovereignty and to allow the secure exchange of data between trusted parties.

On the other hand, there are some restrictions on the applicability of these data spaces initiatives. For instance, some of them (e.g., COORDINET) focuses its initiative focuses on electricity. Therefore, it's not available for other energy carriers, used in some European countries. Regarding standards, despite their goal to create a common standard, IDSA been an international alliance, their goals might not be in line with Europe's interests on data spaces' development. The United States-based clouds appear as a fierce competition for the data spaces since they are already operational and able to provide a series of services of their users. The European federated and interoperable data spaces

There are already learned lessons, mainly on projects that aims to create energy data spaces and can be extended to other business' data spaces. In this sense, it is important to note that one of the main features of a potential data space, the data security, is not easy to develop and improve. Furthermore, since there is no standard way to perform a security assessment for the information exchanged between data providers and users.

The amount and variety of initiatives to create data spaces is important evidence stating the IDSA has been chosen as a data space standard to be followed. However, challenges are stated in the report on EU data sharing spaces. Some of them are applicable to DATA CELLAR. For instance, the BDVA Consortium states that "ownership is a difficult concept to legally-define", "no clear guidelines or consensus on how to implement data sovereignty", and "gap between the rights introduced by the GDPR and the average citizens' and companies' understanding of their implications". These challenges could be useful to consider in the design of DATA CELLAR.

Although most projects that have been considered as initiatives to assemble a data space are on initial development stages, there are some addressed potential for optimization of the initiatives, despite their scientific and business findings are still pending on the launching of their pilots and publication of operational results. Regarding DSOs and their interaction with energy data spaces, it is possible for them to use flexibility services and gains the ability to use grid more efficiently. This can provide them more gains through new possibilities to use the infrastructure for electricity and heating in a more coordinated manner, unlocking already existing flexibility. In the future this will also strengthen the capability to cope with new types of loads in the grid, such as electric vehicles and local renewable energy sources. Lastly, on a Position Paper regarding the Data Sharing Coalition, authors stated that to optimize the impact of use cases, there must be a collaboration among them, so each initiative can effectively contribute by using existing expertise and learn. They also stated that scalable data sharing, and reusability must be enabled throughout the data economy by alignment and working together to ensure interoperability between the considered initiatives. Lastly, there must be an effort to communicate alignment to a wider spreading of information.

5. Energy Communities Initiatives in Europe

According to the Directive (EU) 2018/2001, on the promotion of the use of energy from renewable sources, "Member States should ensure that renewable energy communities can participate in available support schemes on an equal footing with large participants. To that end, Member States should be allowed to take measures, such as providing information, providing technical and financial support, reducing administrative requirements, including community-focused bidding criteria, creating tailored bidding windows for renewable energy communities, or allowing renewable energy communities to be remunerated through direct support where they comply with requirements of small installations". In this sense, this legal document provides a general definition of RECs, which is a legal entity that has, as main characteristics:

- They are based on an open and voluntary participation, are autonomous, and are effectively controlled by shareholders or members that are in the proximity of the renewable energy projects that are owned and developed by that legal entity;
- Their shareholders can be natural persons, Small and Medium-Sized Enterprises (SMEs) or local authorities, including municipalities;
- Their primary purpose must be to provide environmental, economic, or social community benefits for its shareholders or members or for the local areas where they operate, rather than financial profits.

In this sense, Member States must transpose this directive to their local legal framework for enabling the formation of such entities.

There are already some energy communities operating in Europe. They are spread along all the EU-members and deals with a wide selection of renewable energy sources, and management strategies. Also, each of them has their specific ways to engage their members. Table 3 shows some examples of operating energy communities initiatives in Europe. The table has information regarding their location, the main features of the initiatives, such as renewable sources and objectives, main services provided to their users, and how they engage actual and potential users. This list is just a small excerpt of the actual initiatives.

Table 3: Energy Communities' initiatives

INITIATIVE	LOCATION	MAIN FEATURES	TOOLS & SERVICES	ENGAGEMENT PROCESS
ASEC – Association Suisse pour l'énergie citoyenne	St-Ursanne, Switzerland	- Solar energy - Wind energy - Community development	- Citizen engagement in energy transition through awareness raising and information - Represents the stakeholders' interests in society	- Organization of workshops and seminars with the stakeholders (internal and external) - Newsletter on the webpage - Media news hub on the webpage - Pages on social media: Facebook, and LinkedIn
BHESCO	Brighton, UK	- Energy efficiency	- Project consultancy - Project finance	- Energy surveys - Telephone / Video Call

			- Energy surveys - Project management - Retrofit design - Monitoring	Consultancy - Energy bill support and advice - "FAQ" area on the cooperative webpage - Pages on social media: LinkedIn, Facebook, Twitter, Instagram - Newsletter sent to interested people
Brixton Energy	London, UK	- Solar energy - CHP - Energy storage - Energy efficiency - Renewable gas production (anaerobic digestion)	- Community meetings organizations - Mentoring sessions for partners - Training for partners - Energy advice - Solar panel-making workshops - Home energy audits - Job creation (internship for young people living on the state project sites)	- Press releases - Hub for news on the webpage - Publication of all general meetings on the webpage - A blog with initiatives' stories - Pages on social media: LinkedIn, Instagram, YouTube,
Cleanwatts	Antanhol, Portugal	- Flexibility - Energy efficiency	- Management platform for buildings and communities' energy assets: generation, storage, consumption, trading and energy balancing	- Newsletter sent to interest people - Pages on social media: LinkedIn, Facebook, YouTube
Coopernico	Lisbon, Portugal	- Solar energy	- Energy communities' formation - Initial investment for energy communities - Raise awareness for its members	
Ecopower	Antwerp, Belgium	- Solar energy - Wind energy - Small hydro - Pellet factory	- Collaborative participation - "Solidaire financing" label for financial products	- Education, training, and information provision - Cooperation between cooperatives - Community attention - Pages on social media: Facebook, Twitter, LinkedIn, YouTube

Edinburgh Community Solar Co-Operative	Edinburgh, Scotland	- Solar energy	- Development, installation, management, operation, generation, transmission and provision of RES and low carbon sources - Provide education for schools under the areas of actuation - Educational guide on PV installation at community-level	- "News" area on the webpage, with newsletters and other sources of information - Pages on social media: Twitter, Facebook
Electra Energy Coop	Athens, Greece	- Mobility - Solar energy	- Research - Project development - Educational activities - Advocacy	- News and updating on projects and other initiatives on the cooperative webpage - Pages on social media: Facebook, LinkedIn
Energiecoöperatie WPN	Nijmegen, Netherlands	- Solar energy - Wind energy	- Provide solar and wind farms for the cooperative members	- Integrity Committee - Public dissemination of the cooperative results - Newsletter sent to interested people - Member area on the cooperative webpage - Pages on social media: Facebook, Twitter
Energy Communities Tipperary Cooperative	Nenagh, Ireland	- Solar energy - Wind energy	- Promotion of grants for RES generation, energy efficiency services and automation control of energy and non-energy assets - Organization of webinars and meetings (online and presential) for non-members awareness raising	- A blog on the webpage with a sort of community energy-related topics - Pages on social media: Facebook, Twitter, YouTube
Izgrei BG	Plovdiv, Bulgaria	- Solar energy	- The first private platform working with all licensed electricity suppliers in Bulgaria - Choosing of the	- Pages on social media: Facebook, Instagram, LinkedIn,

			most suitable electricity provider to its members (non-residential)	
Jurascic	Lons-le-Saunier, France	- Solar energy - Wind energy	- Help players to get involved and invest in renewable energy projects in their area - Community energy project management	- Educational information on the webpage - Pages on social media: Facebook, Instagram, YouTube
MegaWattPuur	Sint-Niklaas, Belgium	- Solar energy - Wind energy	- RES generation units installation to increase their share on its area of actuation - Communication activities for members - Market research for possible projects - Education activities to raise awareness - Legal expertise consultancy	- Democratic controls by the members - Members and directors are periodically training - Pages on social media: Twitter, Facebook, Instagram - Newsletter sent to interest people
NAFARKOOP S.Coop.	Iruñea, Spain	- District heating - Hydropower - Mobility - Solar energy	- Collective RES generation - Technical Office - Self-consumption prevision for members - Advice on technical and management aspects of mobility	- All members received periodic information of projects' development status - "FAQ" area on the cooperative webpage - "News" area on the cooperative webpage - Periodic meetings ("General Assembly") - Pages on social media: Facebook, Twitter, LinkedIn, YouTube, Telegram
Ötzi Genossenschaft - Oetzi Soc Coop	Bolzano, Italy	- Hydropower - Solar energy - Wind energy	- Energy provider management for members - Connecting members (consumers and/or producers) to form energy communities	- "FAQ" area on the cooperative webpage - "News" area on the cooperative webpage - Pages on social media: Facebook, Instagram, LinkedIn, YouTube
Somenergia	Cataluña,	- Solar energy	- Renewable energy	- General assembly with

	Spain	- Wind energy - Biogas - Biomass	production - Energy management of members - Contract management	members' participation - Blog to share information - Virtual office for member active participation - Pages on social media: Facebook, Twitter, YouTube, Flick, Telegram
Zelena Zadruga – Green Coop	Kumanovo, Macedonia	- District heating - Hydropower - Mobility - Solar energy - Wind energy	- Assistance on interested people into participating in energy communities - Contact point between energy providers and energy communities - Crowfunding administrator for energy communities' purposes	- Newsletter to members - Pages on social media: Facebook, LinkedIn

6. Assessment tools

An assessment tool is a technique or method to evaluate information with the objective to determine how much a person knows and whether this knowledge aligns with the bigger picture of a theory or framework. It is also known as "evidence-gathering tool", which includes the instrument and the instructions for collecting and interpreting evidence in an assessment.
There are several tools available for concepting an assessment tool, such as grading rubrics (a grading guide that makes explicit the criteria for judging a person's work on discussion, paper, a performance, product, show-the-work problem, portfolio, presentation essay etc.), canvas assignment, plagiarism detection, self-assessment and peer assessment, surveys and pooling. However, among all the concepts for an assessment tool, the interview is probably the most commonly tool used.
The different tools are made up of the following components:

- The context and conditions for the assessment;
- The tasks to be administered to the learner;
- An outline of the evidence to be gathered from the learner;
- The evidence criteria used to judge the quality of performance, for example, the decision-making.

Despite the selected tools designed for an assessment tool, there must be some evidence of their application. This evidence is made by using the assessment instruments, any documented activities developed to support the assessment method and used to collect the evidence of a person's objectives regarding the assessment. These instruments could include oral and written questions; observation and demonstration checklists; projects, case studies, scenarios; and recognition or workplace portfolio. Furthermore, they must include: the tasks to be implemented to the person; an outline of the evidence to be gathered from the candidate; and the evidence criteria used to judge the quality of performance (i.e., decision-making rules). The assessment tool comprises the assessment instrument and the context and conditions of assessment.

6.1. LEC Assessment Tool

An assessment tool is designed in the context of T1.1, able to identify potential services and engagement methods for users and potential users of DATA CELLAR. This assessment tool will be developed as a (?) scope of WP5, specifically T T5.3, and deployed during the activities of WP7, mainly T7.3.
The first stage of the assessment tool, prior to the DATA CELLAR deployment, is to identify how the potential users can use DATA CELLAR for their benefits in terms of the LEC deployment, management and exploitation. For this purpose, the initial survey, which questions are described in section 10.1, will be selected and adapted, to be applied specifically for a potential user. This adaptation is needed since the survey conducted with internal and external stakeholders has a generic approach, with other objectives. However, the selected questions are suited for an assessment framework. An overview of the assessment is shown in Figure 2.

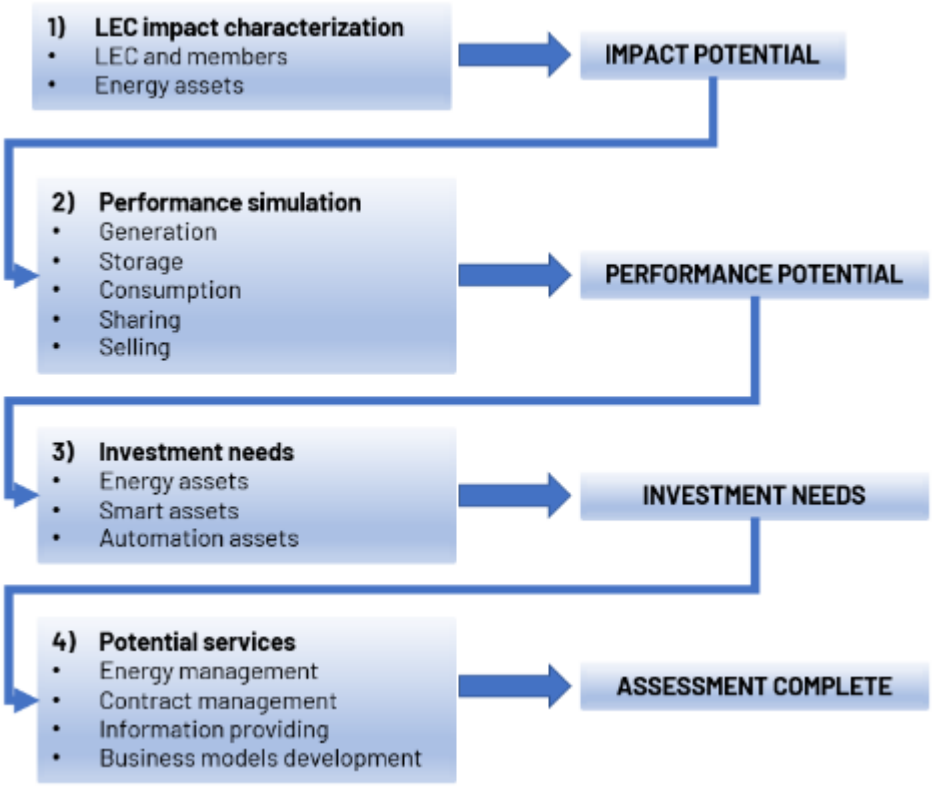

Figure 2: LEC assessment tool overview

The first part of the assessment is to identify if the LEC can have a positive impact on its members. To verify this potential impact, a series of questions will be presented to the person who is interested in creating a LEC. The subjects of the questions are:

- LEC and members:
  - The types of buildings that will be part of the LEC;
  - The number of buildings that will be part of the LEC;
  - The main usage of the buildings;
  - The buildings' ownership status;
  - Where the LEC will be created.
- Energy assets:
  - The presence of local energy generation units for sharing among the LEC members;
  - The presence of local energy storage units (both static and Electric Vehicles);
  - The presence of energy management infrastructure in the buildings;
  - The availability, type, and quality of data to manage the energy consumption and generation in terms of energy imports and exports.

The answers will be weighted according to a series of requirements, and an indicator will inform the potential gain of the LEC after its creation. This first part of the tool is independent of the remaining activities of the DATA CELLAR project and can be delivered to interested people as a web-based questionnaire.
After the interested person answer the first set of questions, there will be a solicitation to provide some preliminary dataset, if available, of energy consumption and generation of LEC members.

These data will be used to perform an initial simulation of the LEC performance, to engage the creation of the LEC and the usage of DATA CELLAR to manage its operation. For this purpose, the main tools are the outputs of T5.2 – "Data-Driven-Digital-Twin Modelling of Energy Communities" and T5.3 – "Holistic DSS Tool based on DATA CELLAR for Energy Community development".
The results from the initial questionnaire and performance simulation are the inputs for the next phase of the assessment: a screening of energy assets (generation and storage units, smart appliances, EV chargers etc.) that can be purchased in order to increase the LEC performance, such as increasing the locally generated energy self-consumption, allow energy sharing among members and energy trade between EVs and the grid, in a V2G framework. These recommendations are followed by the needed associated costs, based on market trends.
Lastly, a list of potential services can be showed to the assessed LEC. According to the VCs initial expectations regarding DATA CELLAR, the potential services can be:

- Smart assets monitoring and management;
- LEC energy import, sharing and export management, with the needed communications with the energy carriers' operators;
- Engagement tools for LEC members retain and participation (e.g., gamification strategies);
- Benchmark analysis among the DATA CELLAR population;
- Smart contract management;
- EV and V2G management;
- Information of LEC performance via dashboard;
- Digitalization of information;
- LEC virtualization via digital twin or virtual power plant;
- Business models development.

6.2. LEC Self-Assessment Tool

6.2.1. Purpose and usefulness of the tool

The idea of creating a self-assessment tool comes from the need to provide Local Energy Communities (LECs) with the opportunity to assess their own performance against a defined standard for sustainable development (Standards for Sustainable Development, conference paper, United Nations, 2015). This tool will help the LECs to understand the level of maturity and the purpose/most urgent actions needed for their LEC project, to be guided towards the services proposed in DATA CELLAR that best suit their objectives. Currently, managers and representatives of LECs need tools to support their understanding of the framework, development, strengths, and shortcomings of their communities to become more proactive in the implementation of energy production and consumption processes that improve energy efficiency. The services proposed through the DATA CELLAR project will enable to reach sustainability targets and could be an incentive for people to create LECs to manage their energy supply chain.
Having a self-assessment tool can be a meeting point for both users and service providers providing a matching point between demand and supply based on the information provided. To orient efficiently the users through the different DATA CELLAR services, their situation will be evaluated according to a set of common, clear, and objective questions and at the same time, the

application should allow the exclusion of indicators that are totally irrelevant to a LEC's development priorities.
Inside DATA CELLAR, it will be possible for each LEC to compare its performance with others LECs with a similar development status or demographic size (among other characteristic), to identify areas where the LEC could have some scope for improvement, or further development. Through the data shared within DATA CELLAR by the Validation Cases (VCs) through Task 1.1, as well as those made available by other identified datasets, it will be possible to make a comparison with the characteristics provided by the self-assessment tool users to identify the most useful actions to be taken for their purpose and give support during the development phase through the services developed within the platform. The self-assessment tool users will also receive a comprehensive analysis of many sustainability factors and will be directed towards the range of services within DATA CELLAR that best fit their situation. Since the self-assessment tool will be developed as an application to be integrated within the platform, it will offer the users the opportunity to learn from other LECs without sharing sensitive data. Another key aspect is that the online self-assessment tool is designed to help Energy Communities (ECs) to self-assess their level on knowledge supporting to enhance information and engagement of private citizens to become more responsible consumers of energy as well as more aware of their LEC. Improving the knowledge of stakeholders and citizens by providing feedback on areas, mechanisms and procedures that need to be strengthened leads to improved performance and maximised impact of measures.
The tool will not be a stand-alone tool but will interact with the overall DATA CELLAR Human Machine Interface (HMI) to guide the user in a 360° experience. This tool will first be used in the VCs of the DARTA CELLAR project and then presented on the project website as the "starting point" of the user experience on DATA CELLAR. Using the tool should therefore be easy, fast, intuitive, and effective. This tool will be available in all ten languages of the consortium (Bulgarian, Dutch, English, French, German, Greek, Italian, Norwegian, Portuguese and Spanish).

6.2.2. About the Tool

The LEC self-assessment tool consists in an online service that assesses the main characteristics of the users' LEC to orient them towards the most suitable DATA CELLAR services. It is structured in three phases as visible in Figure 3, in general, and in Figure 4, in a more detailed way. The first one consists in a survey dedicated to defining the type of user and LEC, the second is dedicated to the type of services offered by the Data Space and strictly depends on the type of available information provided in the previous section, finally the third one is related to the data that the user should share in order to benefit from the services.

Figure 3: Structure of the Self-assessment Tool

The self-assessment tool maps users' requirements with DATA CELLAR's service offerings and with information coming from other LECs. It will guide the users in:

- Facilitating the understanding of the data needed from the LEC stakeholder/Dataspace user that access to DATA CELLAR to make data sharing via DATA CELLAR clearer; the tool aims to guide the user in understanding what data they may need to provide depending on their purpose;
- Facilitating the understanding of the needed services: depending on the type and volume of available data and the needs, the users will be guided through the available services;
- Understanding if the LEC has the specific requirements needed to implement a certain service, especially in terms of infrastructure, such as smart meters;
- Making the user able to evaluate the level of maturity of its LEC;
- Guiding the users towards the assets from which they might benefit in case of implementation, according to their LEC profile.

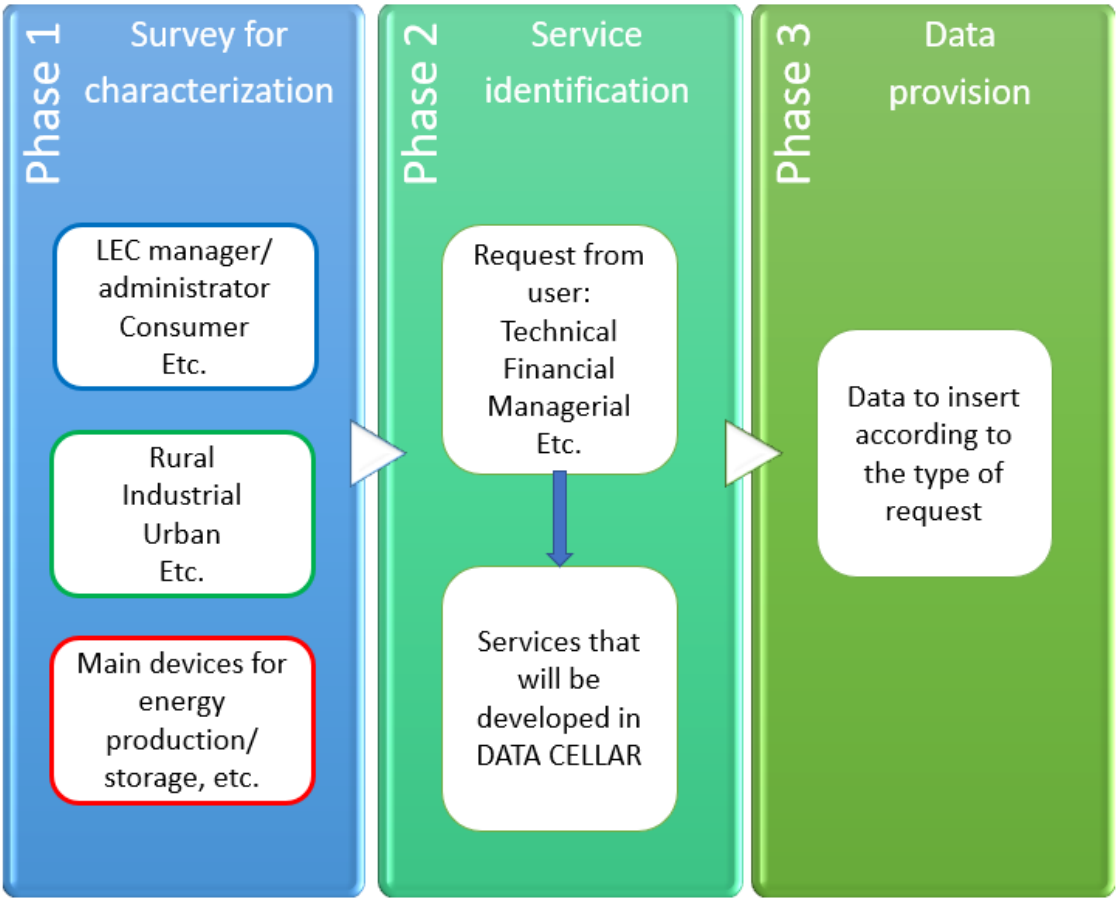

Figure 4: Detail on the structure of the Self-assessment Tool

1) **Type of user and LEC interested in DATA CELLAR**:

The first phase consists in a survey to understand which type of user is interacting with the tool and to characterize better his/her LEC for a better orientation in the next phases. It aims to categorize the user and his LEC. A short survey is proposed to the user to determine his role and the LEC's main characteristics.

In detail, once the user enters into the tool, he/she will specify what type of user he/she is (manager, legal entity, service provider (DSO, etc.), consumer, etc.) and provide a description of the his/her LEC; in the survey he will be asked to precise: the main characteristics of the LEC: rural/urban/industrial, population (size, active/inactive), buildings type (private/public, residential, non-residential (offices, shops, etc.), administrative (schools, etc.). Questions will also focus on the main existing infrastructures related to the user's objectives (PV, charging stations, etc).
Table 4 presents the questionnaire for profiling the user and his/her LEC.

Table 4: Survey for user/LEC profiling

Category	Question	Answer
Stakeholder Category Identification	What kind of user are you?	• LEC manager/administrator • Private Citizen • Building owners • Other (specify)
Main LEC Characteristics	Type of LEC:	• Rural • Urban (residential) • Urban (tertiary or commercial) • Urban (mixed) • Industrial • Suburban • EV
	Number of users Involved (Persons who benefit from the LEC):	• < 10 • 11-50 • 51-100 • 101-500 • 500<
	Size of the area (Km2):	• 1 - 10 • 11 - 50 • 51 - 100 • 101 - 200 • 200 <
	Status of the EC	• Entry level (nothing developed, identified, there is an intention to setup an EC) • Early-stage level (something already developed/identified – some preliminary energy demand profiles/production opportunities already identified – some economic evaluations already performed) • Pre-implementation level (the project is somewhat set up, hardware installation needed identified and planned, overall contractual and regulatory framework identified) • EC on-going (everything is set up/defined

		from the technical, regulatory, contractual point of view, the EC is currently on-going and data monitored)
	Where is located your LEC?	Indicate Country and City
Current available assets (heat, hot water, and electricity local production)	Heating production	• Boiler (gas, fuel, wood) • Heater (coal, wood, biomass (pellet, waste)) • Heat pump (air-air, air-water, geothermal, reversible) • PVs
	Hot water production	• Water heater (electricity, gas, wood, oil, PVs, heat pump) • Boiler with storage
	Electricity	• PVs (individual or solar park) • From national grid (DSO) • Wind turbine
	Heat and Power	• Combined Heat and Power (CHP) from gas, oil, biomass, or renewable energy
	Current available storage options	• Battery Energy Storage System (BESS) • Vehicle to Grid (V2G), Charging station (EV, LEV), Aquifer Thermal Energy Storage, heat/cold (ATES)

2) Services

In the second phase of the survey, the user will be asked to precise the type of information he/she is looking for. According to the type of request and considering the information provided in the first phase, the user will be oriented toward specific services that are labelled into the tool in different macro-categories: technical/ financial/ social/ managerial etc, as can be seen in Figure 5.
At the end the user will get as feedback from the tool:

- A list of tools/services proposed by DATA CELLAR;
- A list of existing LECs/use cases that have the same specificities and with which they can be compared.

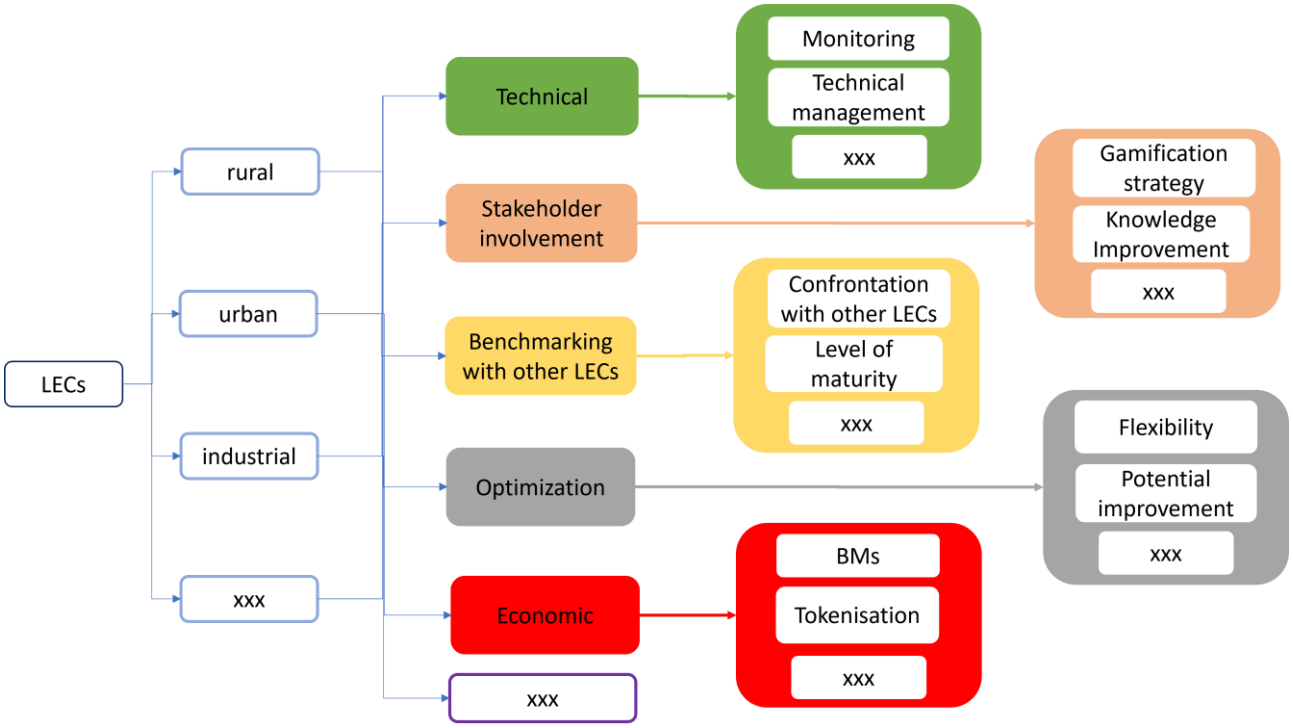

Figure 5: Self-assessment Tool scheme

Table 5 shows the grouped questions extracted from VCs surveys (performed during Task 1.1 activities).

Table 5: Type of request from the user

Possible questions	Category
The user wants to see examples of similar LECs in terms of geographical position, number of inhabitants and size but with other assets to understand if it could be interested in his/her LEC to install the same assets as that LEC	Benchmarking with other LECs
The user wants to see examples of similar LECs in terms of geographical position, number of inhabitants, size and with the same kind of assets to confront the consumption/production of her/his LEC and understand if he could improve some aspects.	Benchmarking with other LECs
The user wants to simulate the installation of some assets to understand how it would impact the consumption/production inside his/her LEC	Optimization
The user wants to optimize the consumption inside the LEC	Optimization
The user wants to identify area(s) of potential improvements (storage and/or PV installations for example)	Optimization
The user wants information on Business Models (BMs)	Economic
The user wants information on the ROI of new installations for decision-making purposes	Economic
The user requires information on education and training to both residents and non-residents in sustainable living.	Stakeholders' involvement
The user wants to improve the management of the LEC and to provide new tools and services for the consumers and ESCO such as: • Facilitating the monitor and control of KPIs of the LEC;	Optimization Stakeholders'

• Presenting in a friendly and attractive way the main data of the LEC for each end-user.	involvement
The user wants information that he/she could share with the LECs' residents/users on possible solutions to install	Stakeholders' involvement Technical
The user wants information on possible management solutions of the different assets in his/her LEC	Technical
The user wants information on citizen engagement	Stakeholders' involvement
The user wants information on how to increase the technical knowledge of the residents/operators/designers/etc.	Stakeholders' involvement
The user wants information on data sharing (interoperability, standardization, General Data Protection Regulation (GDPR) adherence, security measures for the data, etc.)	Stakeholders' involvement Technical
The user is interested in having information about policy recommendation and regulatory aspects about his/her LEC and country	Stakeholders' involvement
The user needs Information on possible fundings	Stakeholders' involvement
The user wants information about possible solutions for weather, solar/load forecasting	Optimization

The tool will then orient the user to the adequate service or functionality.
Among the services identified in the VCs survey and during the Workshop organised with the VCs involved in the project, the following services and tools emerged:

- Smart assets monitoring and management: DATA CELLAR must provide information about energy generation, storage, EVs and smart appliances (if available). Also, some recommendations on how to maintain these assets properly functional;
- Management of the import, sharing and export of energy from LECs, with the necessary communications with energy carrier operators: in this sense, the possible services provided by DATA CELLAR concern the management of the flow of energy to and from LECs, in terms of data on energy imported, generated, shared, and exported to networks, depending on the energy carrier;
- Smart contract management: by using DLT technologies, contracts regarding energy and/or flexibility trading can be signed by LECs operated by DATA CELLAR and the respective service provider;
- Engagement tools for LEC members involvement and recruitment (e.g., gamification strategies);
- Benchmark analysis among the DATA CELLAR population by comparing the different LECs that are already involved in DATA CELLAR, the best practices must be spread among all end-users, to collectively improve their operation and profits;

- EV and V2G management: this tool could be useful both to guide the user in making decisions through simulations to see if it is a viable option as well as to get information on storage;
- Information of LEC performance via dashboard: end-user could have a user-friendly dashboard to assess all the information provided by DATA CELLAR;
- LEC virtualization via digital twin or virtual power plant: with the virtualization, the visualization of data and management strategies can be easily achieved;
- Business models development.

The list of identified services is preliminary and subject to additions and modifications during the project, since this first phase aims to identify users' needs and wishes, but the services that might result will be developed at a later stage.
The service or tool in question could ask for some further data.

3) Data to be shared for evaluation

In the third phase, according to the type of demand and service required, the tool will invite the user to compile the table showed in Table 6, as a template, concerning the available and requested data to be shared and to upload this data on the platform:

- Type of data source available;
- Information on the assets from which this data was measured;
- The time granularity of the series;
- The format of the data;
- The quantity of data available;
- How the information is transmitted;
- The owner of the data.

Table 6: Type of request from the user

Current available IoT device	From which assets	Granularity	Data Format	Volume	Information retrieval through	Owner of the Data

6.2.3. Future developments

Mapping services provided by DATA CELLAR can make the user aware of new technologies that may be the solution to specific unaddressed problems, that can be faced and solved easily. The usefulness of the tool also relates to the fact that it is possible to get a clear picture of one's LEC by comparing it with others whose data are already in the data space. It is tailored on LEC and the service providers: that means that it will perfectly suit the needs on both sides. The tool facilitates the access to services for citizens for example, to have a common place in an easy and user-friendly solution.
The self-assessment tool offers a time efficient way for users to discover DATA CELLAR services and its potential. Moreover, users can assess the suitability of DATA CELLAR based on their

business needs and based on the results of the self-assessment, users can consult existing use cases of other projects that had similar business needs and how they met those needs.
In the course of the project the different types of services related to Data-Driven Energy Services will be developed with focus on the development of AI libraries, Digital-Twin Modelling of LECs, DSS Tool, Dashboard and Algorithmic transparency and explainability (WP5), Data Marketplace and Valorisation, Tokenization and Distributed Ledger Technologies (WP6) and finally, analyse the impact of energy communities in EU energy system thanks to DATA CELLAR and definition of a BM to attract new users in the use of DATA CELLAR (WP7).
Once the services have been developed and the type of data to be collected to implement each functionality has been identified, which are the underlying factors of this tool, a more concrete definition of the self-assessment tool and its evolution will be available. The idea is to test the tool within task 7.1 to get initial feedback from VCs and then extend it once validated to LECs that would like to approach DATA CELLAR. At this stage, therefore, it is intended to outline a preliminary framework for the development of the tool within DATA CELLAR. Considering that this deliverable is due at sixth month, little information has been collected on the data, but above all, the type of services to be developed currently is only based on the needs of the LECs but not on actual realised services, so it is possible that in the future some aspects outlined in this document may have to be refined or adapted. Furthermore, a tentative list of services has been generated, which shows the consistency of the concepts the projects intend to develop and demonstrate.
The development and updating of the self-assessment tool will be reported in the various periodic reports at the end of each reporting period.

7. Conclusions

This report summarizes the work conducted in Task 1.1 of DATA CELLAR, from June to November 2022. The focus of the task work focused on the assessment of the DATA CELLAR users and market needs. To achieve this objective two main initiatives were developed: an online survey applied to a series of identified stakeholders and potential DATA CELLAR users and an online alignment workshop with the participation of all the DATA CELLAR Validation Cases representatives, for their presentation of the Energy Communities that will be formed for the DATA CELLAR validation campaign and in the process describing expectations and wishes on the DATA CELLAR data space and functionalities. An important outcome of these activities relies on the data, related or not with energy, that must be collected by DATA CELLAR to populate the federated data space. Regarding the online survey, it is possible to verify, in this report Annex, the full list of questions and the answers provided by the people who participated on it.

In parallel, an investigation on current data spaces initiatives were conducted, to assess their advantages, disadvantages, lessons learned and optimization opportunities. This activity was conducted with the collaboration of the Task 3.1 members since some overlaps on the work to do were identified. The main initiatives were screened, and their features are described in Chapter 4 of this document. Also, an assessment of already operational Energy Communities was made, focusing on research of their main features, the tools and services provided to their members and the main engagement process.

Lastly, the design of two tools is described: an assessment tool, able to identify potential services and engagement methods for Energy Communities formation; and a self-assessment tool, applicable to LECs interested in joining the DATA CELLAR environment, to assess their level of maturity and purposes, and most urgent actions needed for them. This tool can serve as a guide to the data space itself and services provided by DATA CELLAR, to verify the most suitable ones for their needs.

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9. Annex

9.1. Online survey questions

The online questionnaire developed for the survey on the DATA CELLAR potential users wishes and needs has 4 sections, and a preliminary question for guiding which following questions the person will have to answer. The sections are:
1 – Data Space & Data Management Literacy
2 – Local Energy Communities Literacy and Survey
3 – Users' socioeconomics survey
4 – Data Technology on Local Energy Communities Management

Before starting to answer the questionnaire, each person must provide the information of their relationship with DATA CELLAR:

0. You are:
DATA CELLAR Validation Case's pilot member
DATA CELLAR Validation Case's pilot LEC member
LEC member outside DATA CELLAR Validation Cases
LEC manager outside DATA CELLAR Validation Cases
Data space user outside DATA CELLAR Validation Cases
Data space administrator outside DATA CELLAR Validation Cases
DSO representative
Local energy market representative
LEC enthusiast (student, researcher, professor etc.)
Other (_____)

Table 7 shows the questions that each stakeholder answered, based on the selection.

Table 7: Survey's question answered by each stakeholder

	a	b	c	d	e	f	g	h	i	j	K
1	X	X	X	X			X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X			X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X			X	X	X	X	X
8	X	X	X	X						X	X
9	X				X	X	X	X	X		X
10		X		X							X
11		X		X			X				X
12		X		X			X				X
13	X	X	X	X	X	X	X	X	X	X	X

14	X	X	X	X			X	X	X	X	X
15	X	X	X	X						X	X
16	X	X	X	X						X	X
17	X	X	X	X			X	X	X	X	X
18	X	X	X	X			X	X	X	X	X
19	X	X	X	X	X	X	X	X	X	X	X
20	X	X	X	X				X	X	X	X
21	X	X	X	X				X	X	X	X
22	X	X	X	X	X	X	X	X	X	X	X
23	X	X	X	X	X	X	X	X	X	X	X
24	X	X	X	X	X	X	X	X	X	X	X
25	X	X	X	X	X	X	X	X	X	X	X
26	X	X	X	X	X	X	X	X	X	X	X
27	X	X	X	X	X	X	X	X	X	X	X
28	X	X	X	X	X	X	X	X	X	X	X
29	X	X	X	X	X	X	X	X	X	X	X
30	X	X	X	X	X	X	X	X	X	X	X
31	X	X	X	X	X	X		X	X	X	X
32	X	X	X	X	X	X		X	X	X	X
33		X		X		X	X	X	X		X
34		X		X		X	X	X	X		X
35		X		X		X	X	X	X		X

The questions applied to the people are:

SECTION 1 – Data Space & Data Management Literacy

1. Do you know what a data space is?
   a) YES
   b) NO
   - If "YES", can you briefly describe it in a few words?

2. Have you shared data before?
   a) YES
   b) NO
   - If "YES", can you briefly describe it in a few words?

3. Would you require some training if involved in a data space project as "DATA CELLAR"?
   a) YES
   b) NO

4. Why are you interested in accessing and/or sharing your data?
   a) Research
   b) Personal
   c) Monetary

d) Other
- Other: _____

5. Are you interested in providing data if you and/or your community can achieve benefits (money, energy savings, knowledge etc.) with it?
a) YES
b) NO
- Why?

6. What type of data would you like to find on a data space related to energy?
f) Energy consumption
g) Energy generation
h) Power demand (load diagram)
i) Weather data
j) Other (_____)

7. What kind of tools would you expect to find in a data space?
a) Energy flexibility tools
b) Energy management tools
c) Energy generation forecast tools
d) "Tips & Tricks" on how to save energy and/or money
e) Other (_____)

8. Do you have experience with data-driven technology services?
a) YES
b) NO
- If "YES", to which one? _____
- If "YES", how did you rate your experience on a scale from "1" to "5" (where 1 is "very bad" and 5 is "very good")?
i.1
ii.2
iii.3
iv.4
v.5

SECTION 2 – LOCAL ENERGY COMMUNITIES LITERACY AND SURVEY (if you are not a LEC member, please consider your building/household to answer the questions)

9. Do you know what an energy community is?
a) YES
b) NO
- If "YES", can you briefly describe it in a few words?

10. What is/are the buildings' type(s) of you LEC?
a) Residential
b) Commercial

c) Industrial
d) Public buildings
e) Mixed (_____)

11. How many buildings (often referred as "members" are there in your LEC?
a) Don't know
b) 2 – 10
c) 11 – 50
d) 51 – 100
e) 100 – 200
f) 200 <

12. What is the total area of your LEC, in km^2?
a) Don't know
b) 1 – 10
c) 11 – 50
d) 51 – 100
e) 100 – 200
f) 200 <

13. In which country is your LEC located?
a) Bulgaria
b) Cyprus
c) Greece
d) Ireland
e) Italy
f) The Netherlands
g) Norway
h) Portugal
i) Spain
j) Switzerland
k) Other (_____)

14. What type of energy is used in your LEC? (You can select more than one answer)
a) Electricity
b) Heat
c) Natural Gas
d) Hydrogen
e) Solid Fuels (coal, pellets, peat etc.)
f) Liquid Fuels (gasoline, diesel etc.)
g) Other (_____)

15. Do you have a smart energy meter in your building?
a) YES
b) NO
- If "YES", what type of energy consumption is measured?

i. Electricity
ii. Gas
iii. Water
iv. Other (_____)

16. Do you have access to your energy consumption data??
a) YES
b) NO
- If "YES", what is the sampling interval of your energy consumption data?
i. Occasional
ii. Periodic (_____)
iii. Continuous (less than 15 minutes)
- If "YES", are you willing to share these data with a data space, for wider societal benefits?
i. YES
ii. NO
- If "NO", why not? (_____)

17. What is the frequency of your energy consumption data checking?
a) Don't check
b) Per day
c) Per week
d) Per 2 weeks
e) Per month
f) Per 2 months
g) Per 6 months
h) Per year

18. Do you know who manage or uses the data measured by your smart meter?
a) YES
b) NO

19. Do you have access to meteorological data of your location?
c) YES
d) NO
- If "YES", to which one? (Possibility for multiple answers)
a) Solar irradiation
b) Ambient temperature
c) Ambient humidity
d) CO2 concentration
e) Atmospheric pressure
f) Ambient noise
g) Wind speed
h) Other (_____)
- If "NO", would you find it useful for any purpose?
i. YES
ii. NO

20. Do you produce your own energy?
    a) YES
    b) NO
    - If "YES", what is the total installed power?
        i. Don't know
        ii. 1 – 10 kW (e.g., up to 35 residential PV panels)
        iii. 10 – 50 kW (e.g., up to 1 small wind turbine)
        iv. 50 – 100 kW (e.g., up to 2 small wind turbine)
        v. 100 – 150 kW (e.g., up to 3 small wind turbines)
        vi. 150 – 200 kW (e.g., up to 4 small wind turbines)
        vii. 200 kW < (e.g., PV solar farm up to 650 panels)
    - If "YES", what are the types of energy that are produced?
    (_____)
    (_____)
    (_____)
    (_____)
    (_____)
    - If "YES", what share of demand is supplied by this local production?
        i. Don't know
        ii. < 10 %
        iii. 10 – 25 %
        iv. 25 – 50 %
        v. 50 – 75 %
        vi. 75 – 100 %

21. Do you own an energy storage system?
    a) YES
    b) NO
    - If "YES", which one?
    (_____)
    (_____)
    (_____)
    (_____)
    (_____)
    - If "YES", is the of this usage being measured?
        i. Don't know
        ii. YES
        iii. NO
    - If "YES", can these data be shared?
        i. Don't know
        ii. YES
        iii. NO

22. Do you own a plug-in electric car?
    a) YES

b) NO

(22.1) If "YES", how many?

i.1
ii.2
iii.3 <

- If "YES", where do you charge it?

i.House
ii.Work
iii.School

- Elsewhere (_____)
- If "YES", is there any data related to the charging point?

i.Don't know
ii.YES
iii.NO

- SECTION 3 - DEMOGRAPHICS

23. What is the age of the energy account holder for the building?
    a) 18 – 29
    b) 30 – 39
    c) 40 – 49
    d) 50 – 59
    e) 60 – 69
    f) 70 <

24. What is the gender of the energy account holder for the building?
    a) Female
    b) Male
    c) Other
    d) Don't disclose

25. What is the sum of the building's account holder monthly income?
    a) 0 – 500 €
    b) 500 – 1,000 €
    c) 1,500 – 2,000 €
    d) 2,000 – 2,500 €
    e) 2,500 – 3,000 €
    f) 3,000 – 3,500 €
    g) 3,500 – 4,000 €
    h) 4,000 € <

26. What is the building's yearly energy cost?
    a) 0 – 500 €
    b) 500 – 1,000 €
    c) 1,500 – 2,000 €
    d) 2,000 – 2,500 €

e) 2,500 – 3,000 €
f) 3,000 – 3,500 €
g) 3,500 – 4,000 €
h) 4,000 €

27. What is the building's ownership status?
a) Purchase
b) Renting
c) Inheritance
d) Other (_____)

28. Building location:
a) Urban area
b) Rural area
c) Other (_____)

29. Building usage:
a) Single family household
b) Multifamily household
c) Commercial (_____)
d) Industrial (_____)
e) Public building (_____)
f) Other (_____)

30. Building construction date:
a) Before 1950
b) 1951 – 1960
c) 1961 – 1970
d) 1971 – 1980
e) 1981 – 1990
f) 1991 – 2000
g) 2001 – 2010
h) 2011 – 2020
i) 2021 – 2022

- (If your building was constructed before 2000) Was it refurbished?
  i. Don't know
  ii. YES
  iii. NO

31. How many energy users live in the household?
a) 1
b) 2
c) 3
d) 4
e) 5 <

32. How many underage (< 18 years) energy users live in the household?
    a) 1
    b) 2
    c) 3
    d) 4
    e) 5 <

- SECTION 4 – DATA TECHNOLOGY ON LOCAL ENERGY COMMUNITIES' MANAGEMENT

33. What types or file formats are used in your LEC to exchange data?
    a) Don't know
    b) No specific format (data is only viewed in a web application, using, for example, web charts and tables)
    c) Microsoft Excel
    d) CSV
    e) JSON
    f) XML
    g) An RDF serialization format (i.e., RDF/XML, JSON-LD)
    - Other (_____)

34. Do your LEC expose a machine-readable interface (i.e., http API)?
    a) Don't know
    b) YES
    c) NO
    (34.1) If "YES", what type of machine-readable interface?
    i. http API
    ii. FTP file server
    iii. Network-Attached Storage (NAS) server
    iv. Message broker (i.e., MQTT, AMQP)
    v. Direct access to an object storage service (i.e., AWS 33)
    vi. Direct access to a database (i.e., PostgresSQL, MongoDB)
    - Other (_____)

35. Do your LEC use semantic technologies (i.e., RDF, OWL) to model data?
    a) Don't know
    b) YES
    c) NO

9.2. Survey complete set of answers

Table 8: Survey's complete set of answers

You are:		
	Answers	Ratio
DATA CELLAR Validation Case's pilot member	8	21.622%
DATA CELLAR Validation Case's pilot LEC manager	1	2.703%
LEC member outside DATA CELLAR Validation Cases	0	0.000%

LEC manager outside DATA CELLAR Validation Cases	1	2.703%
Data space user outside DATA CELLAR Validation Cases	0	0.000%
Data space administrator outside DATA CELLAR Validation Cases	0	0.000%
DSO representative	4	10.811%
Local energy market representative	3	8.108%
Energy services/tools provider	2	5.405%
LEC enthusiast (student, researcher, professor etc.)	14	37.838%
Other	4	10.811%
No Answer	0	0.000%
- Do you know what a data space is?		
	Answers	Ratio
YES	14	37.838%
NO	23	62.162%
No Answer	0	0.000%
- Have you shared data before?		
	Answers	Ratio
YES	8	21.622%
NO	29	78.378%
No Answer	0	0.000%
- Would you require some training if involved in a data space project such as "DATA CELLAR"?		
	Answers	Ratio
YES	33	89.189%
NO	4	10.811%
No Answer	0	0.000%
- Why are you interested in accessing and/or sharing your data?		
	Answers	Ratio
Research	22	59.459%
Personal	7	18.919%
Monetary	4	10.811%
Other	4	10.811%
No Answer	0	0.000%
- Are you interested in providing data if you and/or your community can achieve benefits (money, energy savings, knowledge etc.) with it?		
	Answers	Ratio
YES	36	97.297%
NO	1	2.703%
No Answer	0	0.000%
- What type of data would you like to find on a data space related to energy?		
	Answers	Ratio
Energy consumption	32	86.486%
Local energy generation	31	83.784%
Power demand (load diagram)	28	75.676%

Weather data	21	56.757%
Other	2	5.405%
No Answer	0	0.000%
- What kind of tools you expect to find in a data space?		
	Answers	Ratio
Energy flexibility tools	22	59.459%
Energy management tools	30	81.081%
Energy generation forecast tools	23	62.162%
"Tips & Tricks" on how to save energy and/or money	20	54.054%
Other	1	2.703%
No Answer	0	0.000%
- Do you have experience with data services?		
	Answers	Ratio
YES	2	5.405%
NO	26	70.270%
No Answer	9	24.324%
If "YES", how did you rate your experience on a scale from "1" to "5" (where 1 is "very bad" and 5 is "very good")?		
	Answers	Ratio
1	0	0.000%
2	0	0.000%
3	1	2.703%
4	1	2.703%
5	0	0.000%
No Answer	35	94.595%
- Do you know what an energy community is?		
	Answers	Ratio
YES	15	40.541%
NO	6	16.216%
No Answer	16	43.243%
- What type(s) of buildings are within your LEC?		
	Answers	Ratio
Residential	4	10.811%
Commercial	2	5.405%
Industrial	2	5.405%
Public buildings	0	0.000%
Mixed	0	0.000%
No Answer	31	83.784%
- How many buildings (often referred as "members") are there in your LEC?		
	Answers	Ratio
Don't know	3	8.108%
2 - 10	1	2.703%
11 - 50	3	8.108%
51 - 100	1	2.703%

101 - 200	2	5.405%
200 <	0	0.000%
No Answer	27	72.973%
- What is the total area of your LEC, in km^2?		
	Answers	Ratio
Don't know	4	10.811%
1 - 10	3	8.108%
11 - 50	3	8.108%
51 - 100	0	0.000%
101 - 200	0	0.000%
200 <	0	0.000%
No Answer	27	72.973%
- In which country is your LEC situated?		
	Answers	Ratio
Bulgaria	3	8.108%
Cyprus	0	0.000%
Greece	1	2.703%
Ireland	6	16.216%
Italy	0	0.000%
Netherlands	1	2.703%
Norway	0	0.000%
Portugal	14	37.838%
Spain	3	8.108%
Switzerland	8	21.622%
Other	1	2.703%
No Answer	0	0.000%
- What type of energy is used in your LEC? (You can select more than one answer)		
	Answers	Ratio
Electricity	34	91.892%
Heat	8	21.622%
Natural gas	9	24.324%
Hydrogen	1	2.703%
Solid fuels (coal, pellets, peat etc.)	7	18.919%
Liquid fuels (gasoline, diesel etc.)	12	32.432%
Other	3	8.108%
No Answer	0	0.000%
- Do you have a smart energy meter in your building?		
	Answers	Ratio
Don't know	6	16.216%
YES	16	43.243%
NO	6	16.216%
No Answer	9	24.324%
If "YES", what type of energy consumption is measured?		

	Answers	Ratio
Electricity	16	43.243%
Gas	0	0.000%
Water	0	0.000%
Other	0	0.000%
No Answer	21	56.757%
- Do you have access to your energy consumption data?		
	Answers	Ratio
YES	19	51.351%
NO	9	24.324%
No Answer	9	24.324%
If "YES", how often is the energy consumption data generated?		
	Answers	Ratio
Occasional (daily or less frequency)	5	13.514%
Periodic (15 minutes)	11	29.730%
Continuous (less than 15 minutes)	3	8.108%
No Answer	18	48.649%
If "YES", are you willing to share these data with a data space, for wider societal benefits?		
	Answers	Ratio
YES	17	45.946%
NO	2	5.405%
No Answer	18	48.649%
- How frequently is your energy consumption data checked?		
	Answers	Ratio
Don't check	9	24.324%
Per day	5	13.514%
Per week	1	2.703%
Per 2 weeks	0	0.000%
Per month	13	35.135%
Per 2 months	4	10.811%
Per 6 months	4	10.811%
Per year	1	2.703%
No Answer	0	0.000%
- Do you know who manage or uses the data measured by your smart meter?		
	Answers	Ratio
YES	25	67.568%
NO	12	32.432%
No Answer	0	0.000%
- Do you have access to meteorological data of your location?		
	Answers	Ratio
YES	14	37.838%

NO	23	62.162%
No Answer	0	0.000%
If "YES", to which one? (You can select more than one answer)		
	Answers	Ratio
Solar irradiation	6	16.216%
Ambient temperature	13	35.135%
Ambient humidity	7	18.919%
CO_2 concentration	2	5.405%
Atmospheric pressure	10	27.027%
Ambient noise	2	5.405%
Wind speed	9	24.324%
Other	0	0.000%
No Answer	23	62.162%
If "NO", would you find it useful?		
	Answers	Ratio
YES	20	54.054%
NO	3	8.108%
No Answer	14	37.838%
- Do you produce your own energy?		
	Answers	Ratio
YES	6	16.216%
NO	27	72.973%
No Answer	4	10.811%
If "YES", what is the total installed power?		
	Answers	Ratio
Don't know	1	2.703%
1 - 10 kW (e.g., up to 35 residential PV panels)	3	8.108%
10 - 50 kW (e.g., up to 1 small wind turbine)	1	2.703%
50 - 100 kW (e.g., up to 2 smalls wind turbines)	1	2.703%
100 - 150 kW (e.g., up to 3 smalls wind turbines)	0	0.000%
150 - 200 kW (e.g., up to 4 smalls wind turbines)	0	0.000%
200 kW < (e.g., PV solar farm with up to 650 panels)	0	0.000%
No Answer	31	83.784%
If "YES", what share of the energy demand is supplied by this local production?		
	Answers	Ratio
Don't know	1	2.703%
< 10%	1	2.703%
10 - 25%	1	2.703%
25 - 50%	0	0.000%
50 - 75%	3	8.108%
75 - 100%	0	0.000%
No Answer	31	83.784%

- Do you own an energy storage system?		
	Answers	Ratio
YES	4	10.811%
NO	29	78.378%
No Answer	4	10.811%
If "YES", is the usage of this storage being measured?		
	Answers	Ratio
Don't know	1	2.703%
YES	2	5.405%
NO	1	2.703%
No Answer	33	89.189%
If "YES", can these data be shared?		
	Answers	Ratio
Don't know	3	8.108%
YES	0	0.000%
NO	1	2.703%
No Answer	33	89.189%
- Do you own a plug-in electric car?		
	Answers	Ratio
YES	12	32.432%
NO	25	67.568%
No Answer	0	0.000%
If "YES", how many?		
	Answers	Ratio
1	9	24.324%
2	3	8.108%
3 <	0	0.000%
No Answer	25	67.568%
If "YES", where do you charge it?		
	Answers	Ratio
House	9	24.324%
Workplace	6	16.216%
School	0	0.000%
Elsewhere	1	2.703%
No Answer	25	67.568%
If "YES", is there any data related to the charging point?		
	Answers	Ratio
Don't know	3	8.108%
YES	3	8.108%
NO	6	16.216%
No Answer	25	67.568%
- What is the age of the energy account holder for the building?		
	Answers	Ratio
18 - 29	2	5.405%

30 - 39	5	13.514%
40 - 49	8	21.622%
50 - 59	11	29.730%
60 - 69	7	18.919%
70 <	4	10.811%
No Answer	0	0.000%
- What is the gender of the energy account holder for the building?		
	Answers	Ratio
Female	7	18.919%
Male	25	67.568%
Other	1	2.703%
Do not disclose	4	10.811%
No Answer	0	0.000%
- What is the sum of the building's account holder monthly income?		
	Answers	Ratio
0 - 500€	3	8.108%
500 - 1000€	1	2.703%
1000 - 1500€	3	8.108%
1500 - 2000€	5	13.514%
2000 - 2500€	8	21.622%
2500 - 3000€	4	10.811%
3000 - 3500€	7	18.919%
3500€ <	6	16.216%
No Answer	0	0.000%
- What is the building's yearly energy cost?		
	Answers	Ratio
0 - 500€	2	5.405%
500 - 1000€	9	24.324%
1000 - 1500€	7	18.919%
1500 - 2000€	6	16.216%
2000 - 2500€	5	13.514%
2500 - 3000€	4	10.811%
3000 - 3500€	4	10.811%
3500€ <	0	0.000%
No Answer	0	0.000%
- What is the building's ownership status?		
	Answers	Ratio
Purchase	20	54.054%
Renting	11	29.730%
Inheritance	4	10.811%
Other	2	5.405%
No Answer	0	0.000%
- Where is the building located?		

	Answers	Ratio
Urban area	21	56.757%
Rural area	14	37.838%
Other	2	5.405%
No Answer	0	0.000%
- What is the main usage of the building?		
	Answers	Ratio
Single family household	18	48.649%
Multi family household	11	29.730%
Commercial	0	0.000%
Industrial	3	8.108%
Public building	1	2.703%
Other	4	10.811%
No Answer	0	0.000%
- When was the building constructed?		
	Answers	Ratio
Don't know	8	21.622%
Before 1950	5	13.514%
1951 - 1960	0	0.000%
1961 - 1970	2	5.405%
1971 - 1980	4	10.811%
1981 - 1990	2	5.405%
1991 - 2000	3	8.108%
2001 - 2010	8	21.622%
2011 - 2020	4	10.811%
2021 - 2022	1	2.703%
No Answer	0	0.000%
Was it refurbished?		
	Answers	Ratio
Don't know	2	5.405%
YES	8	21.622%
NO	6	16.216%
No Answer	21	56.757%
- How many energy users live in the household?		
	Answers	Ratio
1	5	13.514%
2	9	24.324%
3	7	18.919%
4	5	13.514%
5 <	7	18.919%
No Answer	4	10.811%
- How many underage (< 18 years) energy users live in the household?		
	Answers	Ratio
0	22	59.459%

1	5	13.514%
2	2	5.405%
3	1	2.703%
4 <	3	8.108%
No Answer	4	10.811%
- What data types or file formats are used in your LEC to exchange data?		
	Answers	Ratio
Don't know	5	13.514%
No specific format (data is only viewed in a web application, using, for example, web charts and tables)	4	10.811%
Microsoft Excel	1	2.703%
csv	0	0.000%
json	1	2.703%
xml	0	0.000%
An RDF serialization format (e.g., RDF/XML, json-LD)	0	0.000%
Other	0	0.000%
No Answer	26	70.270%
- Does your LEC expose a machine-readable interface (e.g., http API)?		
	Answers	Ratio
Don't know	6	16.216%
YES	2	5.405%
NO	3	8.108%
No Answer	26	70.270%
If "YES", what type of machine-readable interface?		
	Answers	Ratio
http API	0	0.000%
FTP file server	1	2.703%
Network-Attached Storage (NAS) server	0	0.000%
Message broker (e.g., MQTT, AMQP)	0	0.000%
Direct access to an object storage service (e.g., AWS 33)	0	0.000%
Direct access to a database (e.g., PostgreSQL, MongoDB)	1	2.703%
Other	0	0.000%
No Answer	35	94.595%
- Does your LEC use semantic technologies (e.g., RDF, OWL) to model data?		
	Answers	Ratio
Don't know	8	21.622%
YES	1	2.703%
NO	2	5.405%
No Answer	26	70.270%