www.eclipse-digital.eu

25 February 2025

Deliverable 2.1: Analysis of existing energy monitoring applications and services in the market and of the legal framework

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them. DIGITAL EUROPE Grant agreement N° 101158494.

Deliverable details

Title	WP	Version
Deliverable 2.1: Analysis of existing energy monitoring applications and services in the market and of the legal framework	1	1.0

Contractual delivery date	Actual delivery date	Delivery type*	Dissemination**
28/02/2025 (M6)	28/02/2025 (M6)	R	PU

* Delivery type: R: Document, report; DEM: Demonstrator, pilot, prototype; DEC: Websites, patent fillings, videos, etc; DMP: Data management plan.
** Dissemination Level: PU - Public; SEN – Sensitive, limited under the conditions of the Grant Agreement.

Author(s)	Organization
Lola Alacreu	ETRA

Version	Date	Person	Action	Status
0.1	15.10.2024	Lola Alacreu (ETRA)	Document created	Draft
0.2	15.11.2024	Lola Alacreu (ETRA), Raúl Peña (i-DE), Katerina Drivakou (Ubitech), Dune Sebilleau (Trialog), Kashyap Shievam and Georg Hartner (FHOOE).	Table of contents of the different sections.	Draft
0.3	15.01.2025	All	Contributions from all the partners in the different sections.	Draft

0.4	31.01.2025	Uršula Krisper (EL), Andrzej Szyp (TAURON), Raúl Peña (i-DE), Mihai Sanduleac and Andreea Iantoc (UNTSPB), Lola Alacreu (ETRA), Eleonore Glendinning (Voltalis).	Revision of the deliverable.	Draft
0.5	15.02.2025	Lola Alacreu (ETRA), Raúl Peña (i-DE), Katerina Drivakou (Ubitech), Dune Sebilleau (Trialog), Kashyap Shievam and Georg Hartner (FHOOE).	Modification and finalization of the contributions based on partners revision.	Draft
1.0	28.02.2025	Lola Alacreu (ETRA)	Final version of the document	Final

KEYWORDS

Market analysis, Applications, legal framework, projects, platforms, policies, standards, landscape, protocols.

EXECUTIVE SUMMARY

This deliverable analyses lessons from energy applications, platforms, initiatives, and regulations to design a sustainable, consumer-focused energy ecosystem. The insights support the development of the ECLIPSE Common European Reference Framework (CERF), which will be tested in pilot sites.

The analysis shows that energy monitoring has the potential to save energy and reduce energy billing. The applications and platforms provide personalised data in real-time, mostly from smart meters, such as energy consumption, historical data, carbon footprint, energy costs, and power demand. The applications also provide information about the customer's environmental impact, power outages, energy-saving recommendations, and smart consumption advice. To improve existing Apps and platforms, new features such as energy efficiency benchmarks, billing simulations, consumption alerts, and maintenance tools are recommended. User-friendly design and open data formats will enhance transparency, security, and innovation. Real-time updates and IoT technologies will support data collection and monitoring.

On the regulatory side, CERF aligns with EU policies promoting consumer empowerment, energy sharing, and real-time data access. Key directives focus on decarbonization, grid resilience, and infrastructure security, but challenges like interoperability and technological gaps remain. The project emphasizes AI, smart contracts, digital infrastructure, and cross-border collaboration to accelerate the energy transition and meet EU climate goals.

In other words, the analysis of this deliverable suggests the importance of implementing a Common European Reference Framework that integrates different solutions in an efficient way to address the needs of all energy users and stakeholders and reach a win-win situation. Overall, the report highlights the importance of digital technology in mitigating the impact of environmental and geo-political challenges and engaging citizens as active participants in finding solutions to current problems.

The insights and recommendations from this analysis serve as a strong foundation for developing the ECLIPSE Common European Reference Framework (CERF), which will be designed and developed in the next stages of the project and tested and validated at the project's pilot sites.

INDEX

1. INTRODUCTION 15
1.1. PURPOSE OF THE DOCUMENT 15
1.2. SCOPE OF THE DOCUMENT 15
2. ENERGY MONITORING APPLICATIONS 16
2.1. TYPICAL FUNCTIONALITIES 16
2.1.1. APPLICATIONS FROM RETAILERS 17
2.1.1.1. FUNCTIONALITY DESCRIPTIONS 17
2.1.1.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF RETAILERS APPS 22
2.1.2. APPLICATIONS FROM DSO AND TSO 25
2.1.2.1. FUNCTIONALITY DESCRIPTIONS 25
2.1.2.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF DSOs AND TSOs APPS 30
2.1.3. APPLICATIONS FROM AGGREGATORS AND ENERGY EFFICIENCY APPS 34
2.1.3.1. FUNCTIONALITY DESCRIPTIONS 34
2.1.3.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES FROM AGGREGATORS AND ENERGY EFFICIENCY APPS 37
2.2. LESS FREQUENT FUNCTIONALITIES 39
2.2.1. FROM RETAILER 39
2.2.2. FROM DSO AND TSO 41
2.2.3. FROM AGGREGATORS AND ENERGY EFFICIENCY 44
2.3. PENETRATION LEVEL OF SOLUTIONS 46
2.4. FUNCTIONALITIES OF THE APPS IN RELATION WITH HLUCs 50
2.5. RECOMMENDATIONS & CONCLUSIONS 53
3. ENERGY DATA PLATFORMS 55
3.1. CEEPS 57
3.1.1. TECHNICAL INFORMATION 58
3.1.2. IMPACT 61
3.2. DATADIS 62
3.2.1. TECHNICAL INFORMATION 62
3.2.2. IMPACT 64
3.3. EDA 64
3.3.1. TECHNICAL INFORMATION 65
3.3.2. IMPACT 68
3.4. EDC 69

3.4.1. TECHNICAL INFORMATION 70
3.4.2. IMPACT 73
3.5. EDSN ENERGIE DATA SERVICES 73
3.5.1. TECHNICAL INFORMATION 73
3.5.2. IMPACT 74
3.6. ELHUB 74
3.6.1. TECHNICAL INFORMATION 75
3.6.2. IMPACT 76
3.7. ENEDIS DATAHUB 76
3.7.1. TECHNICAL INFORMATION 76
3.7.2. IMPACT 77
3.8. ENERGINET DATAHUB 78
3.8.1. TECHNICAL INFORMATION 78
3.8.2. IMPACT 79
3.9. ESTFEED 80
3.9.1. TECHNICAL INFORMATION 80
3.9.2. IMPACT 82
3.10. FINGRID DATAHUB 83
3.10.1. TECHNICAL INFORMATION 84
3.10.2. IMPACT 85
3.11. REN DATAHUB 86
3.11.1. TECHNICAL INFORMATION 86
3.11.2. IMPACT 90
3.12. SIORD 90
3.12.1. TECHNICAL INFORMATION 91
3.12.2. IMPACT 94
3.13. MYTILINEOS SMART CITIES PLATFORM 95
3.13.1. TECHNICAL INFORMATION 95
3.13.2. IMPACT 98
3.14. EDDIE 98
3.15. INSIGHTS TOWARDS ECLIPSE 98

4. BEST PRACTICES FROM OTHER PROJECTS AND INITIATIVES 100

4.1. OPENTUNITY – OPENING THE ELECTRICITY ECOSYSTEM TO MULTIPLE ACTORS IN ORDER TO HAVE A REAL DECARBONIZATION OPPORTUNITY 100
4.1.1. Project description and objectives. 100
4.1.2. Project demo sites. 101
4.1.3. Project solutions relevant to ECLIPSE. 101
4.2. INTERCONNECT - INTEROPERABLE SOLUTIONS CONNECTING SMART HOMES, BUILDINGS AND GRIDS 102
4.2.1. Project description and objectives. 102

4.2.2. Project demo sites. *102*
4.2.3. Project solutions relevant to ECLIPSE. *103*
4.3. ODEON - FEDERATED DATA AND INTELLIGENCE ORCHESTRATION & SHARING FOR THE DIGITAL ENERGY TRANSITION 103
4.3.1. Project description and objectives. *104*
4.3.2. Project demo sites. *104*
4.3.3. Project solutions relevant to ECLIPSE. *104*
4.4. SYNERGIES - SHAPING CONSUMER-INCLUSIVE DATA PATHWAYS TOWARDS THE ENERGY TRANSITION, THROUGH A REFERENCE ENERGY DATA SPACE IMPLEMENTATION 105
4.4.1. Project description and objectives. *105*
4.4.2. Project demo sites. *105*
4.4.3. Project solutions relevant to ECLIPSE. *106*
4.5. STREAM - STREAMING FLEXIBILITY TO THE POWER SYSTEM 106
4.5.1. Project description and objectives. *106*
4.5.2. Project demo sites. *107*
4.5.3. Project solutions relevant to ECLIPSE. *108*
4.6. EDDIE - EUROPEAN DISTRIBUTED DATA INFRASTRUCTURE FOR ENERGY 108
4.6.1. Project description and objectives *109*
4.6.2. Project Demo sites *109*
4.6.3. Project solutions relevant to ECLIPSE *110*
4.7. BEFLEXIBLE - BOOSTING ENGAGEMENT TO INCREASE FLEXIBILITY 110
4.7.1. Project description and objectives. *111*
4.7.2. Project demo sites. *111*
4.7.3. Project solutions relevant to ECLIPSE. *111*
4.8. REEFLEX - REPLICABLE, INTEROPERABLE, CROSS-SECTOR SOLUTIONS AND ENERGY SERVICES FOR DEMAND SIDE FLEXIBILITY MARKETS 112
4.8.1. Project description and objectives. *112*
4.8.2. Project demo sites. *112*
4.8.3. Project solutions relevant to ECLIPSE. *113*
4.9. OMEGA-X - ORCHESTRATING AN INTEROPERABLE SOVEREIGN FEDERATED MULTI-VECTOR ENERGY DATA SPACE BUILT ON OPEN STANDARDS AND READY FOR GAIA-X 113
4.9.1. Project description and objectives *113*
4.9.2. Project Demo sites *114*
4.9.1. Project solutions relevant to ECLIPSE. *115*
4.10. BUNGEES - BUILDING UP NEXT-GENERATION SMART ENERGY SERVICES OFFER AND MARKET UP-TAKE VALORISING ENERGY EFFICIENCY AND FLEXIBILITY AT DEMAND-SIDE 115
4.10.1. Project description and objectives. *116*
4.10.2. Project demo sites. *116*
4.10.3. Project solutions relevant to ECLIPSE. *116*
4.11. DR-RISE - DEMAND RESPONSE – RESIDENTIAL INNOVATION FOR A SUSTAINABLE ENERGY SYSTEM 117

4.11.1. Project description and objectives. *117*
4.11.2. Project demo sites. *118*
4.11.3. Project solutions relevant to ECLIPSE. *118*
4.12. ACCEPT – ACTIVE COMMUNITIES & ENERGY PROSUMERS FOR THE ENERGY TRANSITION 119
4.12.1. Project description and objectives. *119*
4.12.2. Project demo sites. *120*
4.12.3. Project solutions relevant to ECLIPSE. *120*
4.13. ENERSHARE - EUROPEAN COMMON ENERGY DATASPACE FRAMEWORK ENABLING DATA SHARING-DRIVEN ACROSS- AND BEYOND- ENERGY SERVICES 121
4.13.1. Project description and objectives. *121*
4.13.2. Project demo sites. *122*
4.13.3. Project solutions relevant to ECLIPSE. *122*
4.14. HEDGE-IOT - HOLISTIC APPROACH TOWARDS EMPOWERMENT OF THE DIGITALIZATION OF THE ENERGY ECOSYSTEM THROUGH ADOPTION OF IOT SOLUTIONS 123
4.14.1. Project description and objectives. *123*
4.14.2. Project demo sites. *124*
4.14.3. Project solutions relevant to ECLIPSE. *125*
4.15. ENFLATE - ENABLING FLEXIBILITY PROVISION BY ALL ACTORS AND SECTORS THROUGH MARKETS AND DIGITAL TECHNOLOGIES 126
4.15.1. Project description and objectives. *126*
4.15.2. Project demo sites. *127*
4.15.3. Project solutions relevant to ECLIPSE. *127*
4.16. SENDER - REVOLUTIONIZING THE ENERGY GRID FOR A GREENER TOMORROW 128
4.16.1. Project description and objectives. *128*
4.16.2. Project demo sites *129*
4.16.3. Project solutions relevant to ECLIPSE. *131*
4.17. OPENCONTINUUM - AN OPEN ECOSYSTEM FOR EUROPEAN STRATEGIC AUTONOMY AND INTEROPERABILITY ACROSS THE COMPUTING CONTINUUM INDUSTRY 131
4.17.1. Project description and objectives. *132*
4.17.2. Project demo sites *132*
4.17.3. Project solutions relevant to ECLIPSE. *132*
4.18. PARMENIDES - PLUG&PLAY ENERGY MANAGEMENT FOR HYBRID ENERGY STORAGE 133
4.18.1. Project description and objectives. *133*
4.18.2. Project demo sites. *134*
4.18.3. Project solutions relevant to ECLIPSE. *134*
4.19. RESONANCE - FACILITATING DEMAND-SIDE FLEXIBILITY MANAGEMENT AT A LARGE SCALE 135
4.19.1. Project description and objectives. *135*
4.19.2. Project demo sites. *135*
4.19.3. Project solutions relevant to ECLIPSE. *136*
4.20. INSTAR - INTERNATIONAL COOPERATION FOR DIGITAL STANDARDISATION 136

4.20.1. Project description and objectives. *137*
4.20.2. Project demo sites. *137*
4.20.3. Project solutions relevant to ECLIPSE. *137*
4.21. SMART GRIDS TASK FORCE 138
4.21.1. Description and objectives. *138*
4.21.2. Tasks *138*
4.21.3. Solutions relevant to ECLIPSE. *139*
4.22. BRIDGE INITIATIVE 139
4.22.1. Project description and objectives. *139*
4.22.2. Project solutions relevant to ECLIPSE. *140*
4.23. LESSONS LEARNED AND CONCLUSIONS 141

5. LEGAL FRAMEWORK AND POLICIES 143

5.1. TOWARDS A COMMON EUROPEAN DATA SPACE 148
5.2. DIGITALISATION OF THE ENERGY SECTOR ACTION PLAN (DESAP) 149
5.3. COMMON EUROPEAN REFERENCE FRAMEWORK FOR CONSUMER APPLICATIONS 150
5.3.1. Common European Energy Data Space *150*
5.4. PRIMARY LEGISLATION 151
5.4.1. Energy-related Primary Legislation *151*
5.4.1.1. Directive (EU) 2018/2001amended by Directive (EU) 2023/2413 on the Promotion of the Use of Energy from Renewable Sources (Renewable Energy Directive) 151
5.4.1.2. Regulation (EU) 2019/943 on the Internal Market for Electricity 153
5.4.1.3. Directive (EU) 2019/944 on Common Rules for the Internal Market for Electricity 154
5.4.1.4. Revised Renewable Electricity Directive (2024) 155
5.4.2. Environmental Primary Legislation *157*
5.4.2.1. General Data Protection Regulation (GDPR) 157
5.4.2.2. Data Governance Act (DGA) 158
5.4.2.3. Data Act 160
5.4.2.4. Digital Markets Act (DMA) 161
5.4.2.5. Digital Services Act (DSA) 161
5.4.2.6. Artificial Intelligence Act 162
5.4.2.7. Implementing Act on High-Value Data Sets 163
5.4.2.8. Security and Resilience of Energy Systems 166
5.4.2.9. Energy Performance of Buildings Directive (EPBD) 166
5.4.2.10. EIDAS Regulation and electronic IDs, and the European Digital Identity Framework 167
5.4.3. Secondary Legislation of Relevance *168*
5.4.3.1. The (upcoming) Network Code on Demand Response [Index 14] 168
5.4.3.2. Implementing Acts as mandated by Article 24 of Directive (EU) 2019/944 172
5.5. CONCLUSIONS AND RECOMMENDATIONS 174

6. DATA PROTECTION ACTIVITIES 177

6.1. ACCESS CONTROL 177

6.2. DATA ANONYMISATION 178
6.3. ENCRYPTION 178
6.4. SECURE DATA COLLECTION AND SHARING 179
6.5. DATAOPS 179
6.6. GLOBAL ANALYSES 180
6.7. EXAMPLES OF IMPLEMENTATION 180
6.8. RECOMMENDATIONS 184
7. KPI IDENTIFICATION AND MONITORING PREPARATION 184
8. SUMMARY AND LESSONS LEARNT 193
9. ACRONYMS 195
10. REFERENCES 197

LIST OF FIGURES

FIGURE 1. METLEN (GREECE) – ENERGY STATUS OF HOME DEVICES. THE APP SHOWS THE ENERGY EXCHANGED WITH THE GRID, THE GENERATION FROM THE PV, THE HOME CONSUMPTION, THE ENERGY DELIVERED FROM THE BATTERY AND THE ENERGY CONSUMED BY EV. 17

FIGURE 2. LEFT. FLOWERHUB (SWEDEN) – ENERGY CURVES. THE USER CAN FILTER TO OBTAIN THE PV GENERATION, THE ENERGY IM/EXPORTED FROM/TO THE GRID, THE ENERGY OBTAINED FROM THE BATTERY, THE STATE OF CHARGE OF THE BATTERY AND THE HOME CONSUMPTION. RIGHT. MYLUMINUS (BELGIUM) – CUSTOMER CONSUMPTION DEPENDING ON THE PERIOD OF TIME FILTERED BY THE USER (WEEK, DAY/NIGHT). 18

FIGURE 3. PROTERGIA APP (GREECE) – HISTORICAL CONSUMPTION (BY MONTH), ACTUAL VS ESTIMATED BILL, PAYMENT SECTION, LAST METER READING. 18

FIGURE 4. M-HEPI (CROATIA) - USERS CAN CALCULATE POTENTIAL SAVINGS ON THEIR ELECTRICITY BILLS AND SEND ALERTS AND REMINDERS ABOUT CONSUMPTION AND BILLS 19

FIGURE 5. ONEMETER (POLAND) – HISTORICAL USER CONSUMPTION AND PV GENERATION ALONG ONE DAY (ESTIMATED VS REAL). 19

FIGURE 6. EAC (CYPRUS) - SUBMISSION OF NETWORK PROBLEM (LEFT) AND SCHEDULED INTERRUPTIONS IN LEFKOSIA REGION(CENTER). PROUD (CZECH REPUBLIC) – BREAKDOWNS VISUALIZATION (RIGHT) 20

FIGURE 7. LEFT. SMARTENERGY (AUSTRIA) – BILLS DOWNLOADING. RIGHT. EDF (FRANCE). ECONOMIC CONSUMPTION EVOLUTION. INVOICES PER MONTH, PRICES PER HOUR AND ANNUAL CONSUMPTION DISTRIBUTION PER DEVICES 20

FIGURE 8. IBERDROLA CLIENTES (SPAIN) – CONTRACTUAL PLANS FOR CUSTOMERS. 21

FIGURE 9. I-DE (SPAIN) – HISTORICAL CONSUMPTION DURING THE DAY (PEAK, PLAIN, VALLEY). 25

FIGURE 10. I-DE ACCESS ON-LINE TO THE COUNTER I-DE – SPAIN (LEFT) AND UFD – SPAIN (RIGHT). 26

FIGURE 11. E-REDES (PORTUGAL) – INCIDENTS: SCHEDULED MAINTENANCE, COMMUNICATION, AND LOCALIZATION. 26

FIGURE 12. EDP (SPAIN) – REQUESTS FOR NEW ACCESSES, MODIFICATION OF POWER, URBAN ACTIONS. 26

FIGURE 13. LEFT. RTE-ECO2MIX (FRANCE) – ELECTRICITY GENERATION MIX THROUGHOUT THE DAY. RIGHT. ELIA (BELGIUM) – SOLAR PV AND WIND FORECASTING, FILTERED BY REGION AND TIMESTAMP. 29

FIGURE 14. ECÓWATT (FRANCE) – CUSTOMER TIPS BASED ON ELECTRICAL SYSTEM STATE. THE USER CAN SEE THE PREVISION OF GRID STATE DURING THE FOLLOWING DAYS, AND ITS EVOLUTION DURING THE DAY. 29

FIGURE 15. LEFT. RTE-ÉCOMIX (FRANCE) – HOME TIPS FOR ENERGY EFFICIENCY. RIGHT. ELIA (BELGIUM) – ON-TIME ELECTRICITY GENERATION MIX. 30

FIGURE 16. MYVOLTALIS (FRANCE) – MANUAL AND PROGRAMMED HOME TEMPERATURE ADJUSTMENTS. 34

FIGURE 17. TIKO (FRANCE) – DAILY CONSUMPTION EVOLUTION VS INDOOR TEMPERATURE. THE CHANGES IN CONSUMPTION ARE RELATED WITH THE OUTDOOR TEMPERATURE. 35

FIGURE 18. MONITOR SMART (SPAIN) – REAL-TIME MEASUREMENTS FROM HOME DEVICES AND HISTORICAL CURVES 35

FIGURE 19. VIRTUOSO (FRANCE) – HISTORICAL EV CHARGING OR CONSUMPTION PROGRAMS, COST SAVINGS, CO_2 SAVINGS. 36

FIGURE 20. HELLOWATT (FRANCE) – HISTORICAL COSTS, CONSUMPTION COMPARISON BETWEEN DWELLINGS AND TIPS. 36

FIGURE 21. EAC (CYPRUS) - ENERGY CALCULATION FOR APPLIANCES 39

FIGURE 22. "MONITOR SMART" FROM IBERDROLA. CONSUMPTION BY DEVIDES ON STAND-BY 40

FIGURE 23. E-REDES INTERACTIVE MAP SHOWING PROBLEMS IN THE GRID. 41
FIGURE 24. ELECTRICITY CONSUMPTION ESTIMATIONS AND MONTHLY BENCHMARKING 42
FIGURE 25. TADO (FRANCE) - GEOLOCATION: THE SYSTEM AUTOMATICALLY ADJUSTS THE HEATING OR COOLING SETTINGS BASED ON YOUR LOCATION 44
FIGURE 26. CEEPS OVERALL CONCEPT 58
FIGURE 27. THE EVT/CEEPS MULTI-LEVEL ARCHITECTURE FUNCTIONING AS A NATIONAL DATA HUB 60
FIGURE 28. DATADIS UI VIEW 63
FIGURE 29. EDA PLATFORM OVERALL CONCEPT 65
FIGURE 30. USER EDA PORTAL GROWTH FROM NOVEMBER 2023 TO OCTOBER 2024 69
FIGURE 31. FUNCTIONALITIES IN FUTURE VERSIONS OF THE EDC. CURRENTLY ONLY ENERGY SHARING (YELLOW CIRCLE) IS IN PLACE. 70
FIGURE 32.: EDC UI VIEW 72
FIGURE 33.: DATA FLOWS AND ACCESS MANAGEMENT SCHEME OF ESTFEED 82
FIGURE 34.: REN DATAHUB UI VIEW 89
FIGURE 35.: SIORD OVERALL CONCEPT 91
FIGURE 36. A SCREENSHOT OF MYTILINEOS SMART HOME DASHBOARD 97
FIGURE 37. EDDIE ARCHITECTURE 109
FIGURE 38.: EU REGULATORY FRAMEWORK SUMMARY 144
FIGURE 39.: COMMON EU DATA SPACES SUMMARY. SOURCE: HTTPS://EC.EUROPA.EU/DIGITAL-SINGLE-MARKET/EN/POLICIES/BUILDING-EUROPEAN-DATA-ECONOMY 149
FIGURE 40.: NETWORK CODE ON DEMAND RESPONSE SCHEMA 171

TABLE 1. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF RETAILERS APP 22
TABLE 2. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF DSO AND TSO APPS 31
TABLE 3. SUMMARY OF THE TYPICAL FUNCTIONALITIES FROM AGGREGATORS AND ENERGY EFFICIENCY APPS 37
TABLE 4. SUMMARY OF LESS FREQUENT FUNCTIONALITIES FROM RETAILERS APPS 40
TABLE 5. SUMMARY OF LESS FREQUENT FUNCTIONALITIES FROM DSOS AND TSOS APPS 43
TABLE 6. SUMMARY OF LESS FREQUENT FUNCTIONALITIES FROM AGGREGATORS AND ENERGY EFFICIENCY APPS 45
TABLE 7. NUMBER OF DOWNLOADS REGISTERED ON EACH OF THE APPS 46
TABLE 8. ENERGY DATA PLATFORMS 55
TABLE 9. CEEPS PLATFORM TYPE OF DATA 59
TABLE 10. DATADIS TYPE OF DATA 62
TABLE 11. EDA TYPE OF DATA 66
TABLE 12. EDC TYPE OF DATA 71
TABLE 13. ELHUB TYPE OF DATA 75
TABLE 14. ENERGINET DATAHUB TYPE OF DATA 78
TABLE 15. ESTFEED TYPE OF DATA 81

TABLE 16. REN DATA HUB TYPE OF DATA 87
TABLE 17. SIORD TYPE OF DATA 92
TABLE 18. MYTILINEOS SMART CITIES PLATFORM TYPE OF DATA 95
TABLE 19. INITIATIVES AND REGULATIONS SUMMARY 144
TABLE 20. KPI INITIAL LIST 185
TABLE 21. ACRONYMS 195

1. INTRODUCTION

1.1. PURPOSE OF THE DOCUMENT

This deliverable effectively analyses and summarizes the potential and best practices of energy monitoring applications and platforms, alongside the importance of an integrated legal and technological framework. The findings and recommendations from this analysis provide a foundational understanding for the design and development of the ECLIPSE Common European Reference Framework (CERF), that will be demonstrated and evaluated in the project pilot sites.

1.2. SCOPE OF THE DOCUMENT

The deliverable sets the groundwork for ECLIPSE by analysing five aspects:

- **Existing energy monitoring applications** that the retailers, energy efficiency services providers, Distribution System Operators (DSO), Transmission System Operators (TSO) and aggregators provide to the domestic final consumers. The applications provide several information, such consumption and billing information, that help them to modify their energy behaviour and decisions.
- **Energy data platforms** that make available for the end user raw metering data, which can be accessed by manually downloading data files or automating the process via API.
- **Relevant Research and Innovation projects** that are aligned with ECLIPSE objectives, focusing on energy efficiency, real-time monitoring, and consumer engagement.
- **Analysis of the current legal framework and policies** related to energy monitoring, examining the regulations, and directives, aimed at ensuring efficient energy use, transparency, and environmental sustainability.
- **Data protection actions and best practices** to address data collection and analysis concerns in energy monitoring.

Finally, the deliverable includes a section that provides a set of KPIs identified for the evaluation of the overall progress of the project. The aim is to identify and define the metrics/indicators that will evaluate the impact of ECLIPSE project and will serve as the basis for WP6.

2. ENERGY MONITORING APPLICATIONS

The work done in this chapter consists of gathering information about energy efficiency applications present in each of the consortium countries. The objective is to establish which similarities and differences exist among the set of applications and what novel functionalities have been introduced with respect to the general scheme of the others. Furthermore, it has been denoted which applications introduce a flexibility component or that promote consumer participation in energy efficiency. At the end of the document, some functionalities are detailed, which could improve the CERF App and are not currently widely implemented.

The general scheme of the Apps has been divided into the following categories, depending on the entity that develops each of them:

- Retailers
- Distribution System Operators (DSOs) and Transmission System Operators (TSOs)
- Aggregators and Energy Efficiency services providers.

For each category, the following information has been detailed throughout the document:

- General description of the App.
- Description of the App's functionalities.
- Special functionalities that promote active consumer participation.
- Level use of the App.
- Interface (App screenshots).
- Benefits for the client while using the App.

Finally, a set of recommendations are detailed, which are not contemplated in the common applications and that could be useful to integrate in the CERF App.

2.1. TYPICAL FUNCTIONALITIES

The most common functionalities between the different applications are described below. These functionalities are the most common ones among the countries participating as project partners. Nevertheless, depending on the owner of the App, there are some differences among the functionalities developed, which are detailed in this chapter. For example, among retailer Apps, the most widespread functionalities refer to the economic aspect to optimize the energy costs of an installation targeting energy efficiency (by orchestrating PV panels, heat pump, EV charger, ...). Regarding

DSOs/TSOs, the focus is on the access to the measurement equipment, visualization and download from consumption recordings and online management of the grid connection contract. Finally, the aggregator Apps focus on the energy monitoring functionality and the integration with home IoT devices.

2.1.1. APPLICATIONS FROM RETAILERS

2.1.1.1. FUNCTIONALITY DESCRIPTIONS

The most developed functionalities in the ecosystem of applications developed by retail companies are the following. The penetration level is listed from highest to lowest:

1. Energy usage monitorization: allows the user to monitor the current consumption/generation data at home (disaggregated by essential or specific devices, in some cases). If the client has photovoltaic generation, he/she can consult data regarding the amount of energy consumed/produced into the grid or the energy stored on the battery. Furthermore, it is also possible to filter the data by specific time periods (daily/weekly/monthly/yearly). Figure 1 and 2 show examples of this approach.

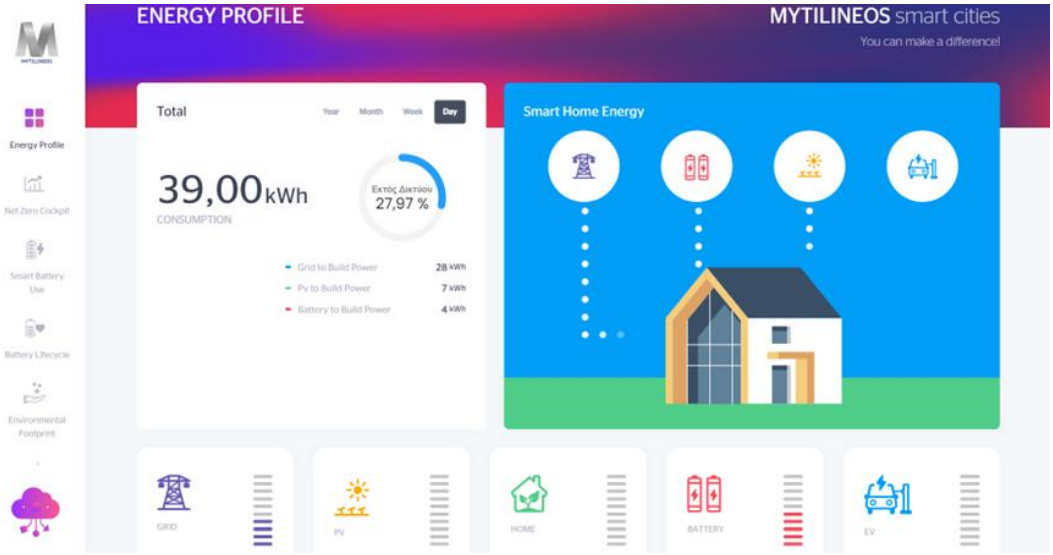

Figure 1. METLEN (Greece) – Energy status of home devices. The App shows the energy exchanged with the grid, the generation from the PV, the home consumption, the energy delivered from the battery and the energy consumed by EV.

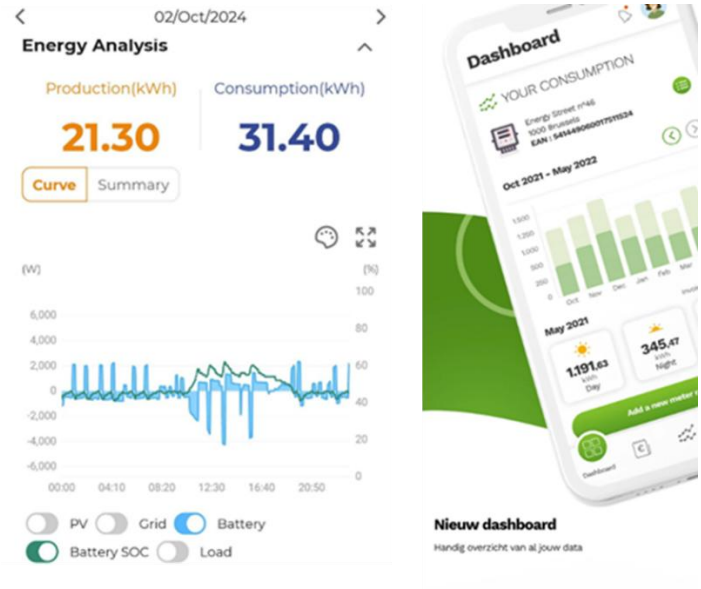

Figure 2. Left. FlowerHub (Sweden) – Energy curves. The user can filter to obtain the PV generation, the energy im/exported from/to the grid, the energy obtained from the battery, the state of charge of the battery and the home consumption. Right. MyLuminus (Belgium) – Customer consumption depending on the period of time filtered by the user (week, day/night).

2. Historical consumption: the user can consult the active power consumption (kWh) over various periods (monthly/daily/hourly). In certain applications the user can compare the predicted consumption versus the actual one, as well as with the photovoltaic generation expected for the day. Figures 3 and 4 show examples of UI's which provide such historical information.

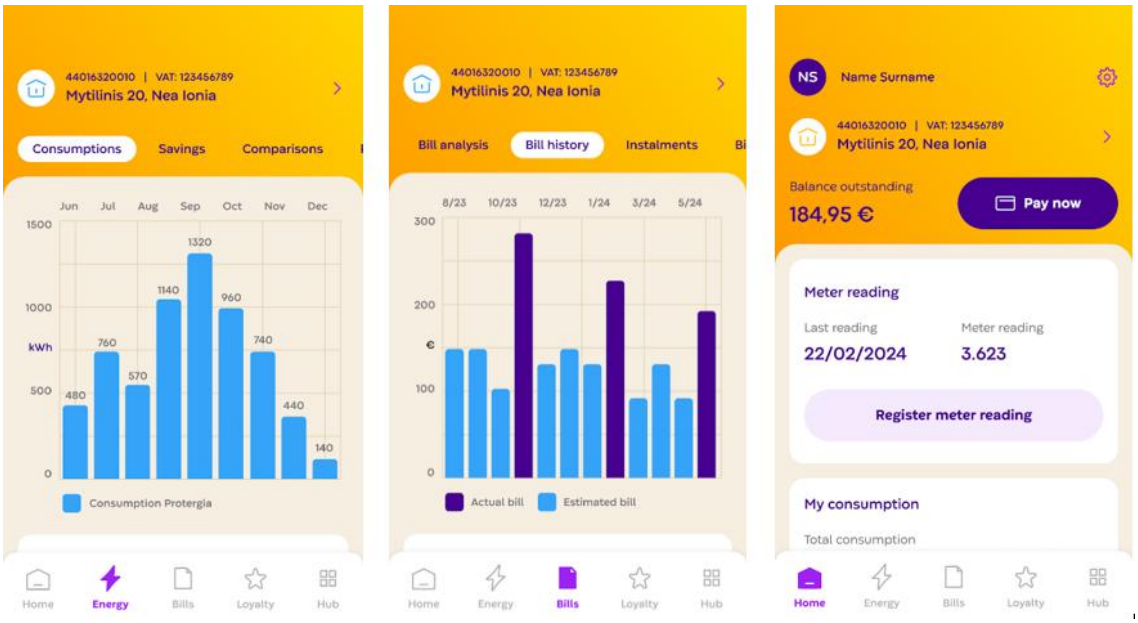

Figure 3. Protergia App (Greece) – Historical consumption (by month), actual vs estimated bill, payment section, last meter reading.

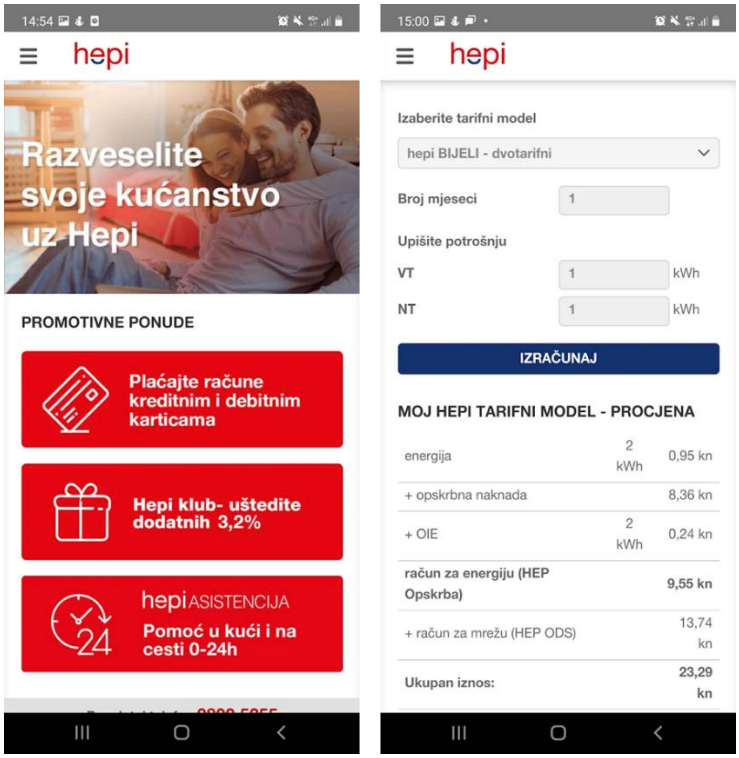

Figure 4. m-Hepi (Croatia) - Users can calculate potential savings on their electricity bills and send alerts and reminders about consumption and bills

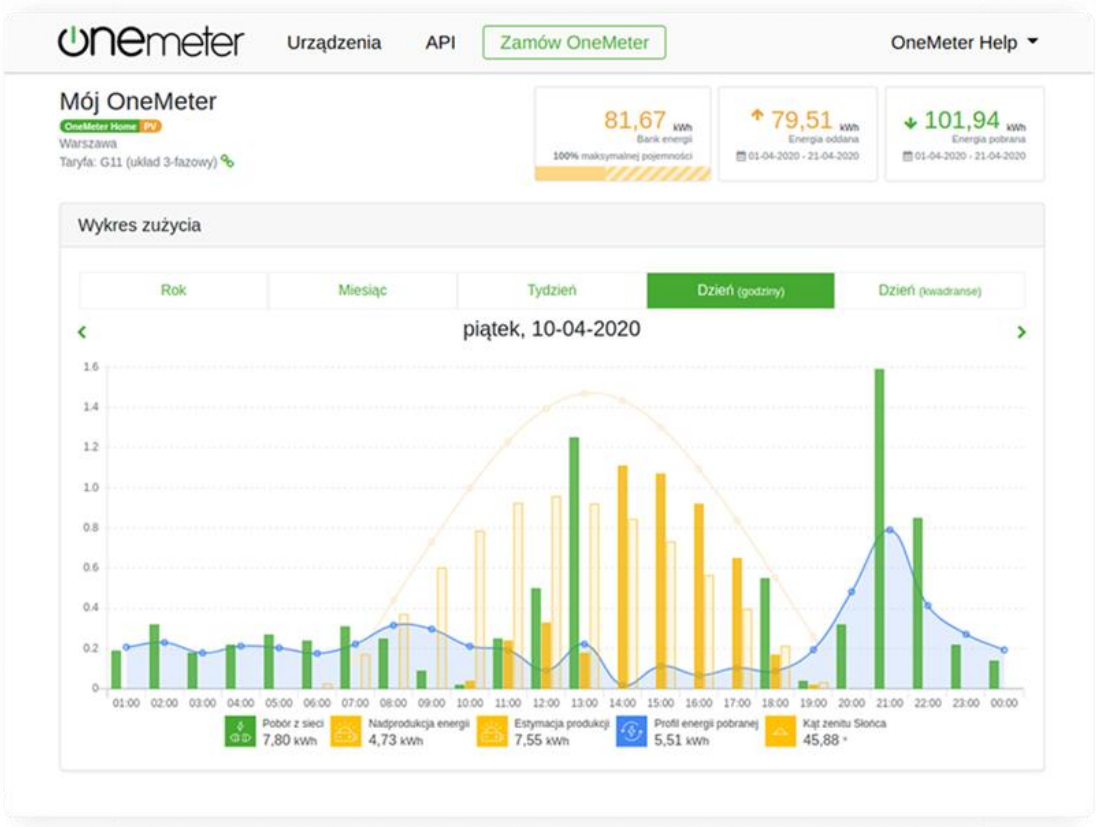

Figure 5. OneMeter (Poland) – Historical user consumption and PV generation along one day (estimated vs real).

3. Customized notifications and incidents: once the customer´s supply point is registered on the DSO platform, the DSO is responsible for forwarding the planned network incident to the retailer hired by the client. In many applications, the customer can also report a problem on the network and indicate its location.

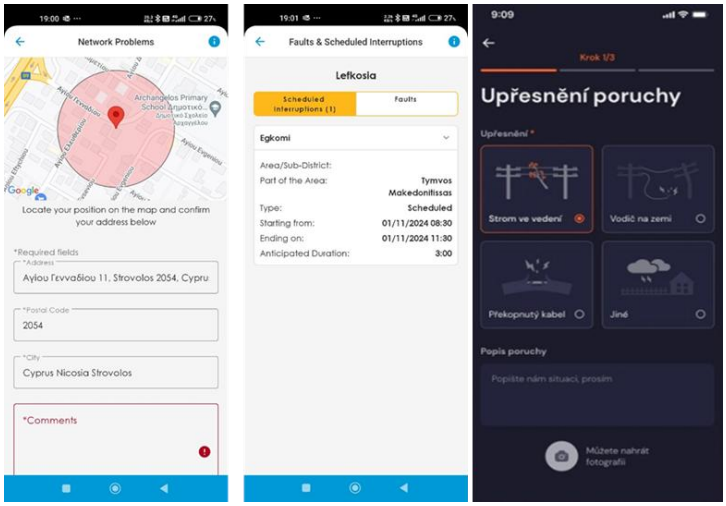

Figure 6. EAC (Cyprus) - Submission of network problem (left) and scheduled interruptions in Lefkosia region(center). Proud (Czech Republic) – Breakdowns visualization (right).

4. Economic information: in most applications, the user can consult the invoices already issued, see the evolution of the monthly cost, contract new services, and even calculate an estimate of the cost at the end of the month.

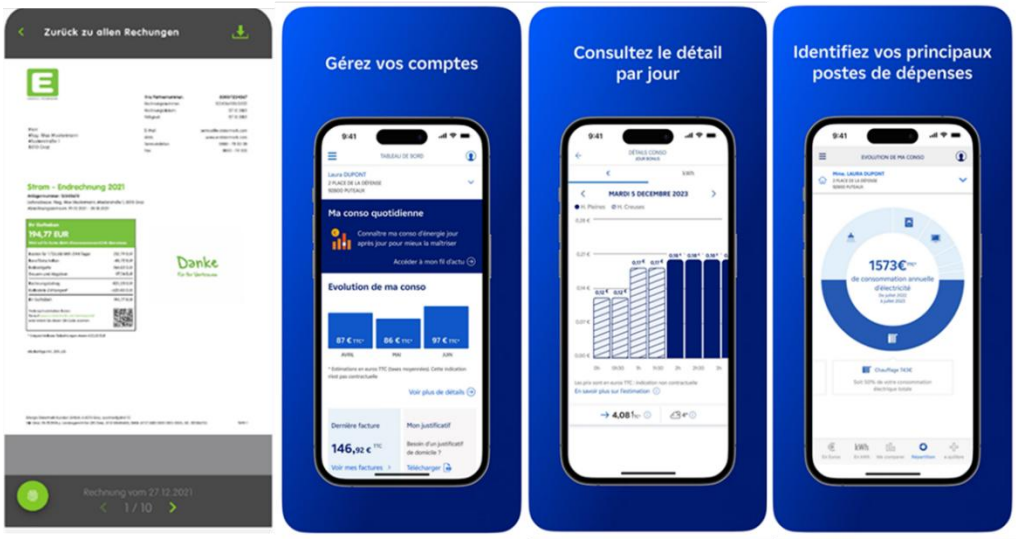

Figure 7. Left. SmartEnergy (Austria) – Bills downloading. Right. EDF (France). Economic consumption evolution. Invoices per month, prices per hour and annual consumption distribution per devices.

5. Access and modification of the contract: In this functionality the user can see active contracts (i.e. first/second residence), different products they have

contracted or manage their electronic invoice (change bank account details).

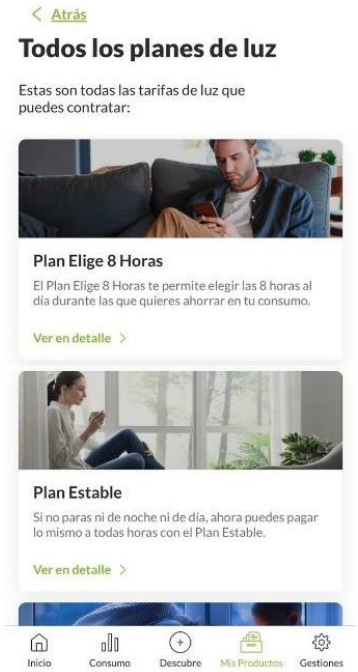

Figure 8. Iberdrola Clientes (Spain) – Contractual plans for customers.

6. Others

- Comparison with other dwellings: comparison of consumption with other similar clients. Usually in the same location, with similar rates and similar homes. Data is anonymized (consumption averages are usually shown).
- Help and assistance: request help by phone, Q&A, chatbot…
- Consumption alerts: reception of alerts in the event of exceeding a certain consumption threshold compared to the historical average.
- Suggestions for efficiency improvements: general tips for energy savings at home (air conditioning temperature, kitchen…).
- Claims: register and follow-up a claim.
- Integration with another devices: thanks to IoT technology, devices that interact with the App can be connected. The most common case is the room temperature sensors, PV generation, EV charging, …
- Submit reading: clients can submit readings taken from measurement equipment when remote reading is not available. The objective is to avoid accumulations of consumption (and €) on the next bill.
- Contract new services consist of receiving offers to contract new products or services offered by the retailer (digital home, smart home assistant, home electrical protection, etc.).

- Consumption forecasting: forecasting consumption in the next periods based on the customer´s historical readings.
- e-mobility: The App can control the charging process of the EV at home using: Instant charge, scheduled charge, stop charge, data analytics, etc.

2.1.1.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF RETAILERS APPS

In this chapter, a summary table (Table 1) from the typical functionalities is shown, with the following information:

- Functionalities found in the different Apps.
- Country to which they belong.
- Percentage of them that have the function.

Those functionalities that exceed a 40% implementation of the total of applications analyzed, have been highlighted in blue. Additionally, there are functionalities with lower level of implementation that have been highlighted in green because of the useful additional value that its implementation in a common CERF could entail.

Table 1. Summary of the typical functionalities of retailers App

Functionality	Apps with functionality	Countries	Apps with functionality / Total Apps [%]
Energy usage monitorization	Iberdrola Clientes, CUREnergia, MonitorSmart, MojE.On, mHepi, Total Energies, EDF, Protergia APP, Heron app/Eco-advisor, PPC app/MyEnergy Coach, ELPEDISON app/ MyElpedison, FlowerHub, ENGIE, EDP Solar,	Spain, Croatia, France, Belgium, Greece, Sweeden, Portugal, Slovenia	67,9

Access and management of contractual data	Iberdrola Clientes, CUREnergia, MojE.On, EDF, Total Energies, ENGIE, Protergia APP, Muj CEZ, EAC**, EDP Solar	Spain, Croatia, France, Belgium, Greece, Czech Republic, Cyprus, Portugal	50,0
Historical consumption	smartENERGY, Bessere Energie, ENGIE, Iberdrola Clientes, CUREnergia, MonitorSmart, Protergia APP, Heron app/Eco-advisor, ELPEDISON app/MyElpedison, Muj CEZ, EAC**, EDP Solar	Austria, France, Belgium, Spain, Greece, Czech Republic, Cyprus, Portugal, Slovenia	50,0
Economic information	smartENERGY, Bessere Energie, Iberdrola Clientes, CUREnergia, MojE.On, mHepi, Muj CEZ, ENGIE, Total Energies, GAZ, EDF, Protergia APP, EAC**, EDP Solar	Austria, Spain, Croatia, Czech Republic, France, Belgium, Greece, Cyprus, Portugal	64,3
Comparison among similar dwellings	ENGIE, PPC app/MyEnergy Coach	France, Belgium, Greece	21,4
Help and assistance	ENGIE, Total Energies, Protergia APP	France, Belgium, Greece	25,0
Customized notifications and incidents	Iberdrola Clientes, CUREnergia, mHepi, Total Energies, Protergia APP, Heron app/Eco-advisor, PPC app/MyEnergy Coach, ELPEDISON app/MyElpedison, Muj CEZ, EAC**, EDP Solar, Elektro Ljublja d.d. web site	Spain, Croatia, France, Greece, Czech Republic, Cyprus, Portugal, Slovenia	53,6

Consumption alerts	EDF, ELPEDISON app/MyElpedison, EDP Solar	France, Greece, Portugal	10,7
Suggestions for efficiency improvements	EDF, Protergia APP, PPC app/MyEnergy Coach	France, Greece	25,0
Claims	Iberdrola Clientes, CUREnergia, Muj CEZ	Spain, Czech Republic	10,7
Integration with another devices	EDF, Heron app/Eco-advisor	France, Greece	7,1
Submit reading	MojE.On, mHepi, EDF, Muj CEZ, EAC**,	Croatia, France, Czech Republic, Cyprus, Slovenia	21,4
Contract new services (digital home, smart home assistant, home electrical protection, ...)	Iberdrola Clientes, CUREnergia, ELPEDISON app/MyElpedison,	Spain, Greece, Slovenia	10,7
Consumption forecasting	Muj CEZ, ENGIE	Czech Republic, France, Belgium	7,1
E-mobility	smartENERGY, Bessere Energie, Protergia APP, EAC**, Gremo na elektriko**	Austria, Greece, Cyprus, Slovenia	14,3

* Slovenian hub MOJ ELEKTRO is a hub of DSOs // ** EAC is a regulated market application.

** Slovenia, Elektro Ljubljana d.d. as a DSO is also in the role of CPO and eMSP. These market based activities are completely separated from the regulated (electricity distribution) activities.

2.1.2. APPLICATIONS FROM DSO AND TSO

2.1.2.1. FUNCTIONALITY DESCRIPTIONS

The most developed functionalities in the application ecosystem of distribution and transmission companies are the following:

1. Historical consumption: the user can consult the active power consumption (kWh) over various periods (monthly/daily/hourly), as shown in Figure 9.

Figure 9. i-DE (Spain) – Historical consumption during the day (peak, plain, valley).

2. On-line access to the meter: it allows online access to remotely manage the measurement equipment at the client's request, which facilitates the analysis of the results of the measures adopted in the process of improving efficiency.

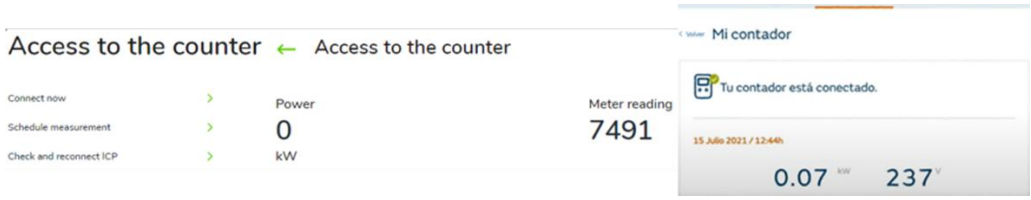

Figure 10. i-DE Access on-line to the counter i-DE – Spain (left) and UFD – Spain (right).

3. Customized notifications and incidents: it consists of sending messages adapted to the needs and particularities of the customer. For example, receive notifications during electrical supply interruptions in the customer´s area.

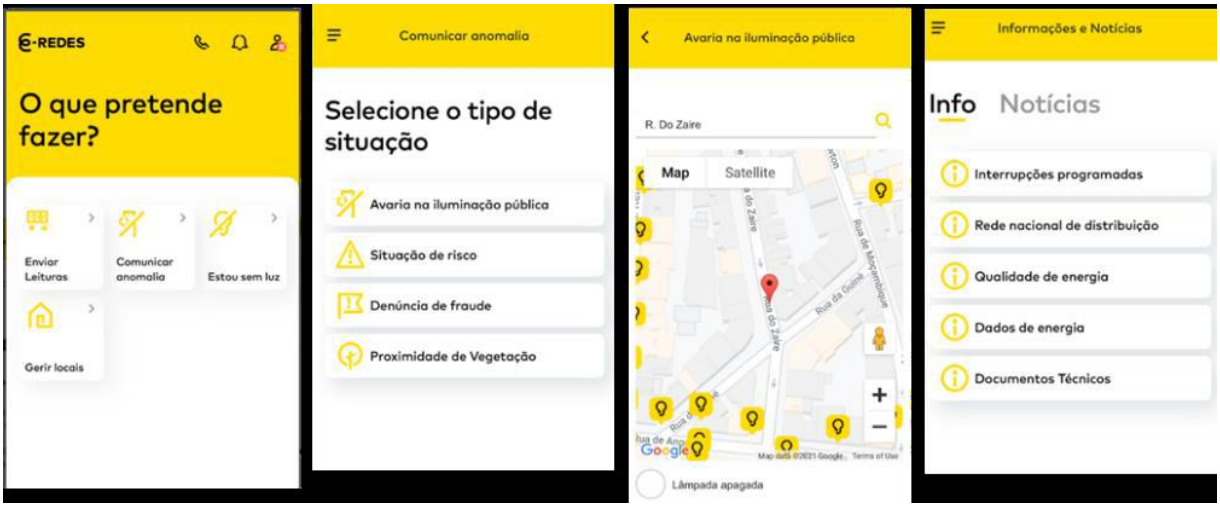

Figure 11. E-REDES (Portugal) – Incidents: scheduled maintenance, communication, and localization.

4. New connection requests allow the user to register a new supply point and send/receive related documentation.

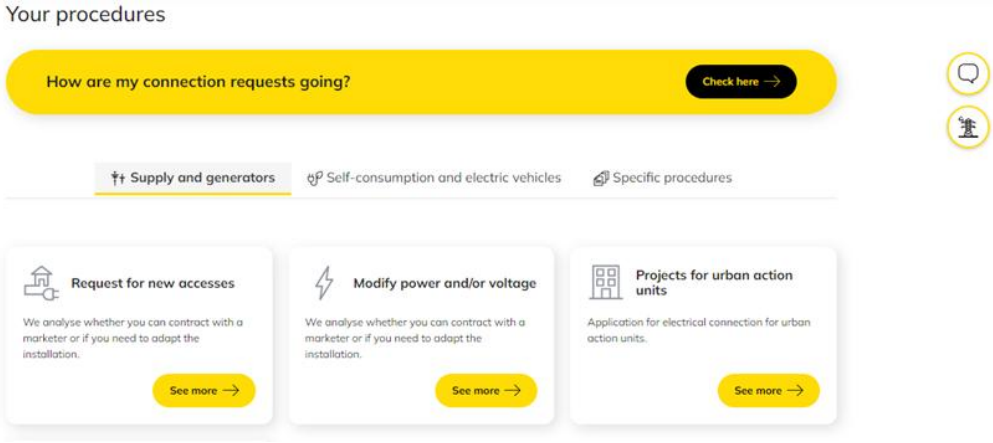

Figure 12. EDP (Spain) – Requests for new accesses, modification of power, urban actions.

5. Energy usage monitorization: this functionality allows the user to have a dashboard where, at a glance, can see the energy flows for both consumption and generation (if installed) which can be monitored at home, both in consumption and generation (if there exists).
6. Access and manage contractual data: customers can consult and make changes on contracts signed with the DSO.
7. Follow-up procedures & documentation: pursue a procedure opened by the user and send or receive online documentation.
8. Other functionalities:

- Manage energy sharing and selling: monitor the energy that the supply is sharing or selling with other supplies.
- Peak and off-peak comparison: compare consumption among the different periods that the analysis has been divided into. The objective is to move consumption as much as possible from peak to off-peak periods.
- Economic information: show the data that will serve as the basis for the retailer's billing to the end customer.
- Generation metering data: obtain generation data (usually PV) obtained by the metering unit.
- Comparation with similar dwellings: compare consumption with other customers, usually in the same area/location, with the same tariff rates and among similar homes. Data is anonymized (usually averages).
- Compare contracted power (vs demanded power): compare the maximum power demanded in the different periods and the contracted power. The objective is to adapt the contracted power to the real needs.
- Massive data consumption discharge: downloading data for long time periods.
- Capacity map for new generators: map showing the current capacity for connecting new generation units.
- Help and assistance: request for help by phone, Q&A, chatbot...
- Claims and compensation for low supply quality: register a claim and follow-up.
- Certificates of consumption: request a consumption certificate from the company (usually necessary due to administration requirements).
- Submit Readings: the client can submit readings taken from the meter if remote reading is not available. The objective is to avoid accumulations of consumption (and €) on the next bill.

- Modify power and or voltage: it allows modification of certain data of the contract.
- Notify a fraud: notify a situation of fraud or illegal connection.
- Others: meter room modification, deviation alerts of lines, consult projects for urban action, energy tips, mix generation available, …

Nevertheless, there are specific functionalities for the TSOs applications, which are specified below:

- Status of the energy demand: throughout colours it is shown the generation vs demand consumption. In the case of the "Energetyczny Kompas" APP from Poland, the dark green colour is for hours when it is advisable to increase electricity consumption. During these times, more energy is generated than consumers need. The green colour indicates that it is an off-peak hour. This is the recommended time to use equipment that consumes more energy. The colour yellow, means that saving is recommended. During these hours, it is advisable to reduce electricity consumption. Finally, with the red colour it is shown the required limitations. These are the hours when the power reserve needed to keep the system running safely is missing. In the case of "écoWatt", from France, the app uses a traffic light code to show the best times to consume and incitate consumers to modify their consumption

- Frontier exchanges: the app can display real-time data on energy flow between different regions. This includes interactive graphs and maps that allow users to see the amount of energy imported and exported, as well as transmission routes.

- Energy mix prices: the application can show the current prices of different energy sources, such as electricity, natural gas, solar energy, wind energy, etc. This allows users to see how prices vary based on supply and demand.

- CO_2 emissions linked to the production: the app can display real-time CO_2 emissions generated by different energy sources during production. This allows users to see the immediate environmental impact of their energy consumption. Also, users can set alerts to be notified when CO_2 emissions exceed certain levels, allowing a quick response to mitigate the impact.

- Solar PV power and wind forecasts: the application can provide accurate predictions of the amount of energy that will be generated from solar and wind installations at different time intervals, from hours to days.

Figure 13. Left. RTE-eCO2mix (France) – Electricity generation mix throughout the day. Right. Elia (Belgium) – Solar PV and wind forecasting, filtered by region and timestamp.

Figure 14. EcóWatt (France) – Customer tips based on electrical system state. The user can see the prevision of grid state during the following days, and its evolution during the day.

Figure 15. Left. RTE-écomix (France) – Home tips for energy efficiency. Right. ELIA (Belgium) – On-time electricity generation mix.

2.1.2.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES OF DSOs AND TSOs APPS

The following table shows the functionalities found in the different DSO & TSO Apps, the country to which they belong and the percentage (vs total) of them that have the function. Those functionalities that exceed a 25% (for DSOs) implementation have been highlighted in blue. Additionally, there are functionalities with less level of implementation that have been highlighted in green because of the useful additional value that its implementation in a common CERF could entail. Furthermore, for the TSOs case the functionalities that exceed a 50% have been also highlighted. This percentage has been calculated just for the total number of TSO applications.

Table 2. Summary of the typical functionalities of DSO and TSO Apps

Functionality	Apps with functionality	Countries	Apps with functionality / Total Apps [%]
On-line access to the meter	Sibelga, EMORES, MyORES, i-DE, E-redes, e-distribucion, UFD, VIESGO, eLicznik, Mój Licznik	Belgium, Spain, Poland	41,7
Energy usage monitorization	i-DE, E-redes, e-distribucion, UFD, VIESGO, RTE-éCO2mix, Proud	Spain, France, Czech Republic	29,2
New connection requests	Fluvius, MyRESA, i-DE, E-redes, e-distribucion, UFD, VIESGO	Belgium, Spain	29,2
Manage energy sharing and selling	Fluvius, Sibelga	Belgium	8,3
Historical consumption	Fluvius, Sibelga, EMORES, MyORES, MyRESA, i-DE, E-redes, e-distribucion, UFD, VIESGO, Ecowatt, eLicznik, Mój Licznik, Proud, App MOJ ELEKTRO	Belgium, Spain, France, Poland, Czech Republic, Slovenia	58,3
Peak and off-peak comparison	EMORES, MyORES, eLicznik, Proud	Belgium, Poland, Czech Republic	12,5

Economic information	Fluvius, MyORES, MyRESA	Belgium	12,5
Generation metering data	Fluvius, Sibelga, EMORES, MyRESA, Mój Licznik, MOJ ELEKTRO	Belgium, Poland, Slovenia	20,8
Follow-up procedures & documentation	Fluvius, MyRESA, i-DE, E-redes, e-distribucion, UFD, VIESGO	Belgium, Spain	29,2
Comparation with similar dwellings	Sibelga, MyORES, eLicznik	Belgium, Poland	12,5
Access and management of contractual data	MyORES, i-DE, E-redes, e-distribucion, UFD, VIESGO, Mój eLicznik	Belgium, Spain, Poland	29,2
Compare contracted power (vs demanded power)	i-DE, E-redes, e-distribucion, UFD, VIESGO, Fluvius, eLicznik	Spain, Belgium, Poland	25,0
Massive data consumption discharge	i-DE, E-redes	Spain	8,3
Capacity map for new generators	i-DE, E-redes, UFD, VIESGO	Spain	12,5
Help and assistance	i-DE, E-redes, UFD, VIESGO, Proud, App, MOJ ELEKTRO	Spain, Czech Republic, Slovenia	20,8

Claims and compensation for low supply quality	i-DE, E-redes, UFD, VIESGO, Proud	Spain, Czech Republic	20,8
Certificates of consumption	i-DE, e-distribucion, UFD, VIESGO	Spain	16,7
Submit readings	i-DE, e-distribucion, UFD, Proud	Spain, Czech Republic	16,7
Modify power and / or voltage	E-redes, e-distribucion, UFD, VIESGO	Spain	16,7
Notify a fraud	i-DE, E-redes, e-distribucion, UFD, VIESGO	Spain	20,8
Others: Meter room modif, deviation of lines, Projects for urban action, ...	E-redes, e-distribucion, UFD, VIESGO	Spain	16,7
Customized notifications and incidents	i-DE, e-distribucion, UFD, VIESGO, Ecowatt, Proud, MyORES, MyRESA	Spain, France, Czech Republic, Belgium	33,3
Status of the energy demand	Energetyczny Kompas, écoWatt, redOS	Poland, France, Spain	60%
Frontier exchanges	RTE-éCO2mix, Energetyczny Kompas, redOS	France, Poland, Spain	60%
Energy mix power and prices	RTE-éCO2mix, Energetyczny Kompas, ELIA, redOS	France, Poland, Belgium, Spain	80%

CO_2 emissions linked to the production	RTE-éCO2mix, redOS	France, Spain	40%
Solar PV and wind forecasts	ELIA	Belgium	20%

2.1.3. APPLICATIONS FROM AGGREGATORS AND ENERGY EFFICIENCY APPS

2.1.3.1. FUNCTIONALITY DESCRIPTIONS

The most developed functionalities in the application ecosystem are:

1. Integration with another devices: it is common to integrate Apps with the electrical appliances from home if they include IOT technology. Heating or air conditioning are very typical. Optimal, current and target temperatures are usually displayed.

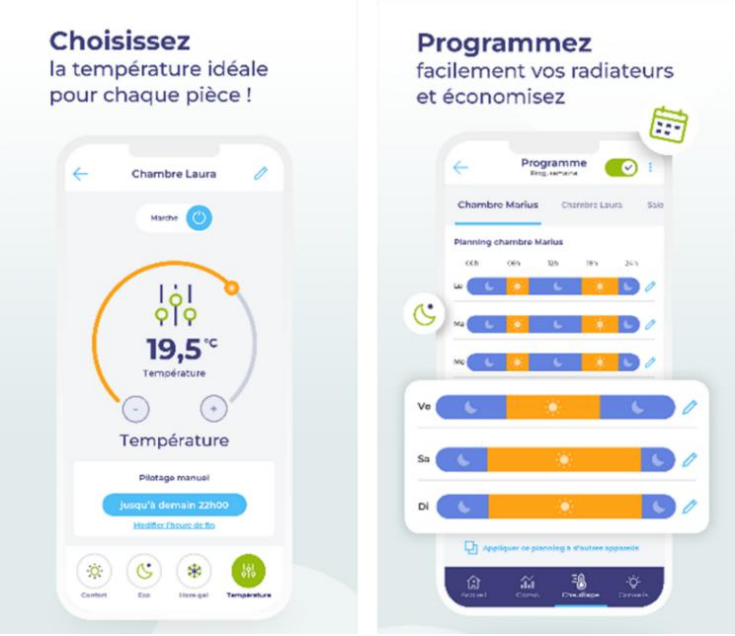

Figure 16. myVoltalis (France) – Manual and programmed home temperature adjustments.

2. Energy use monitorization: real-time monitoring of home consumption and generation is commonly widespread, indicating the percentage of energy independence from the grid. If the user has batteries, they can also be monitored, resulting in a graphic that shows energy exported or net consumption of the supply.

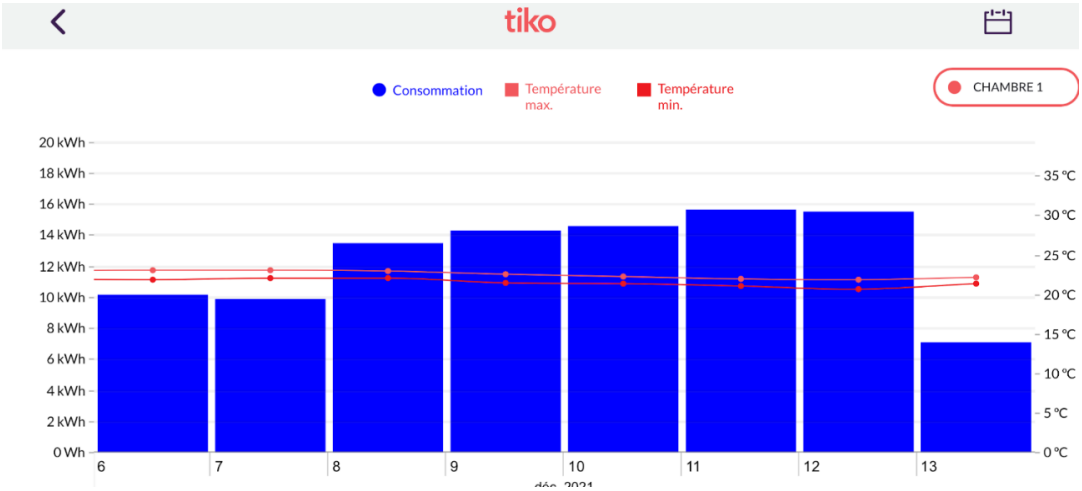

Figure 17. Tiko (France) – Daily consumption evolution vs indoor temperature. The changes in consumption are related with the outdoor temperature.

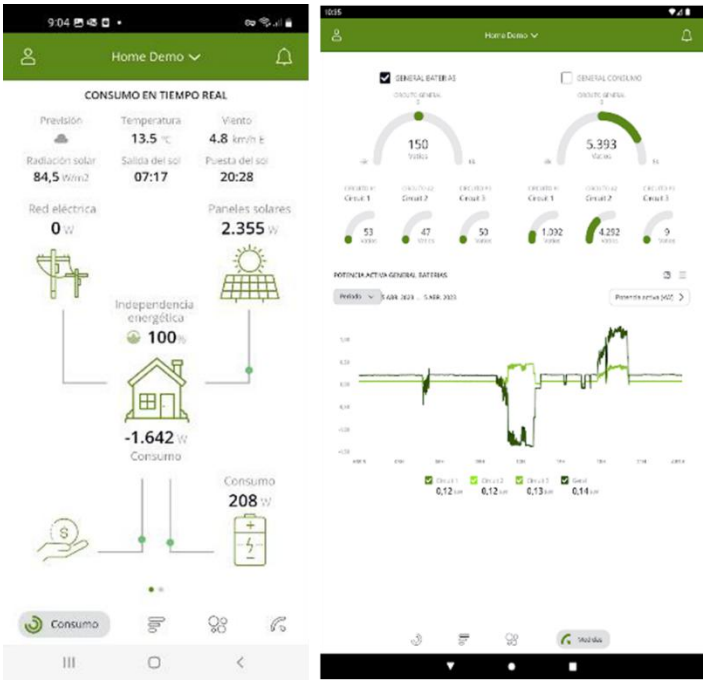

Figure 18. Monitor Smart (Spain) – Real-time measurements from home devices and historical curves.

3. Suggestions for efficiency improvements: both generic advice (control the room temperature) or specific ones for each user based on consumption history. The applications make proposals to reduce the consumption.
4. Cost and CO_2 Savings Tracking: for the demand curve it is widespread to differentiate between peak and off-peak hours (subsidized or not) as a way to promote hours where energy is cheaper and with a lower carbon footprint. Comparison with similar clients (anonymized) also allows to evaluate the home´s energy efficiency.

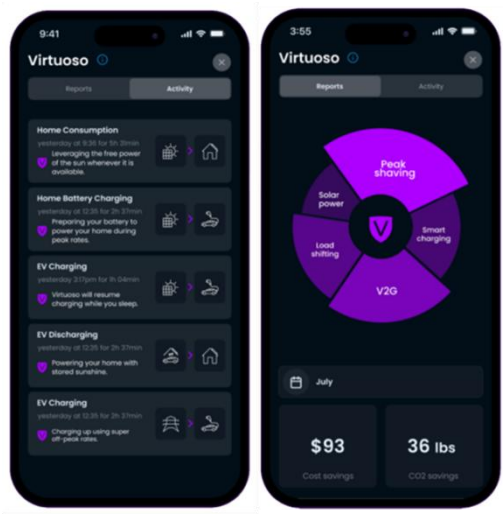

Figure 19. Virtuoso (France) – Historical EV Charging or consumption programs, cost savings, CO_2 savings.

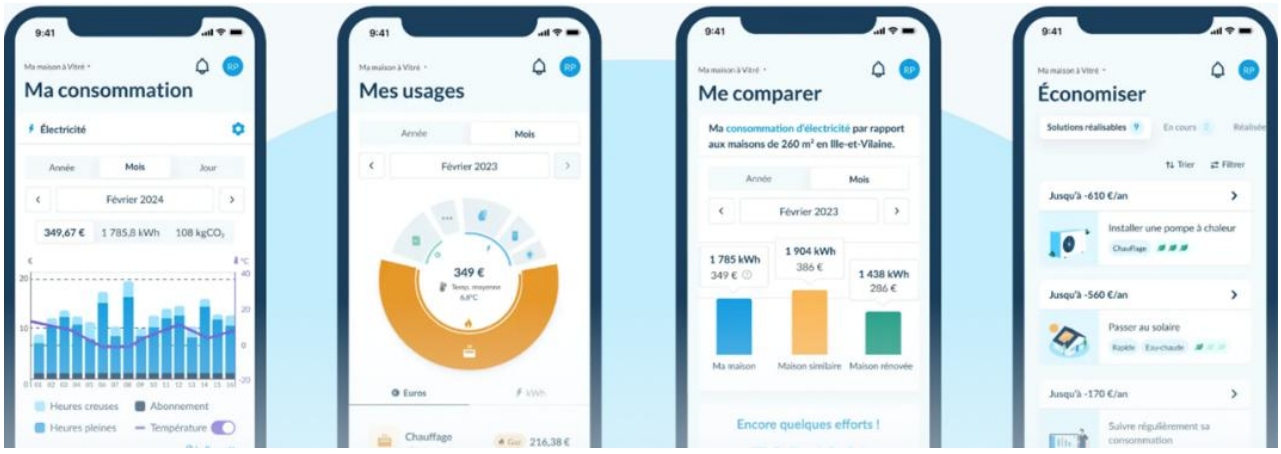

Figure 20. HelloWatt (France) – Historical costs, consumption comparison between dwellings and tips.

5. Other functionalities:

- On-line access to the meter: direct access to the meter to check the consumption during different periods.

- Net Zero Metrics (consumption, solar energy monitoring and energy storage): estimation of how far the house is from self-consumption supply by adapting its consumption to the available local generation.
- Consumption alerts and integration with another Apps: alerts of high consumption and integration with other applications from the same developer.
- Access and manage contractual data: manage contract data.
- Consumption forecasting: estimation of the consumption in the next periods based on the client´s historical readings.

2.1.3.2. SUMMARY OF THE TYPICAL FUNCTIONALITIES FROM AGGREGATORS AND ENERGY EFFICIENCY APPS

The following table shows the functionalities found on the different analyzed Apps, the country to which they belong and the percentage of them that have the development. Those functionalities that exceed a 30% implementation have been highlighted in blue. Additionally, there are functionalities with lower level of implementation that have been highlighted in orange because of the useful additional value that its implementation in a common CERF could entail.

Table 3. Summary of the typical functionalities from aggregators and energy efficiency Apps

Functionality	Apps with functionality	Countries	Apps with functionality / Total Apps [%]
Energy usage monitorization	Enpulse, Hello Watt, Netatmo Energy, Ekwateur, Ecobee, Heatmiser Neo, MYTILINEOS smart cities, Eco-Bot, OneMeter, MyVoltalis, Currently	Croatia, France, Denmark, Finland, Greece, Poland, Sweden	38,5

On-line access to the metering device	Dcbel Chorus, MyVoltalis, Sowee, Somfy, MYTILINEOS smart cities, Eco-Bot, IAMMETER	France, Greece, Poland	26,9
Cost and CO_2 Savings Tracking	Dcbel Chorus, Ekwateur, MyVoltalis, Wiser by Schneider electric, MYTILINEOS smart cities, IAMMETER	France, Belgium, Greece, Poland	26,9
Net Zero Metrics (consumption, solar energy monitoring and energy storage)	Dcbel Chorus, MYTILINEOS smart cities, OneMeter, Hello Watt	France, Greece, Poland, Spain	15,4
Integration with another devices	Dcbel Chorus, Hello Watt, Netatmo Energy, Ekwateur, MyVoltalis, Sowee, Somfy, Tiko, Wiser by Schneider electric, Mon pilotage by ENGIE, Ecobee, Heatmiser Neo, Tado°, Fever	France, Poland, Denmark, Belgium, Finland, Sweden	53,8
Consumption alerts	Mon pilotage by ENGIE, Hello Watt, MYTILINEOS smart cities, IAMMETER	France, Belgium, Greece, Poland	15,4
Access and management of contractual data	Ekwateur, OneMeter, Poupa Energia	France, Poland	11,5
Consumption forecasting	IAMMETER, Fever	Poland, Sweden, Spain	7,7

Suggestions for efficiency improvement	Enpulse, Dcbel Chorus, Hello Watt, Ekwateur, MyVoltalis, MYTILINEOS smart cities, Eco-Bot, Wibeee, Poupa Energia	Croatia, France, Greece, Poland, Spain	34,6

2.2. LESS FREQUENT FUNCTIONALITIES

This chapter details the functionalities that appear in specific Apps that can be interesting for future implementations in the rest of applications. Some screenshots are shown as examples.

2.2.1. FROM RETAILER

Below, a series of functionalities are listed among retail Apps that improve the user experience when using the applications. Among the most interesting is the one that allows to calculate the energy consumption of individual home appliances. It is also possible to register new devices.

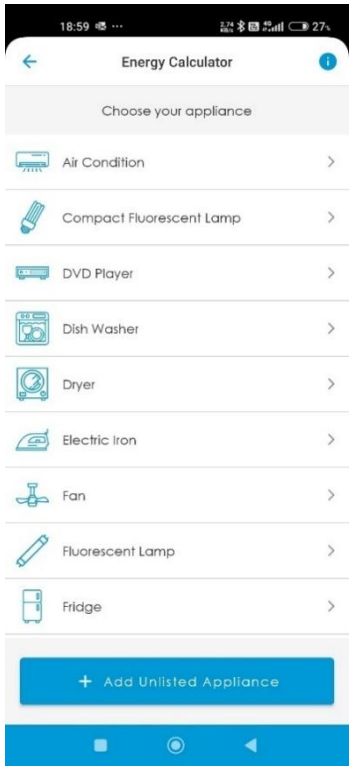

Figure 21. EAC (Cyprus) - Energy calculation for appliances

As a summary of the characteristics of these applications there exist:

- Loyalty programs: allows users to collect virtual points, which can be redeemed for rewards and discounts.
- Demand response through EV chargers: flexibility provided by electric vehicle charging at home.
- Customized challenges. proposals adapted to the consumer profile.
- Show consumption due to appliances on stand-by. The customer can check the consumption during the hours when the home is empty compared to total consumption.

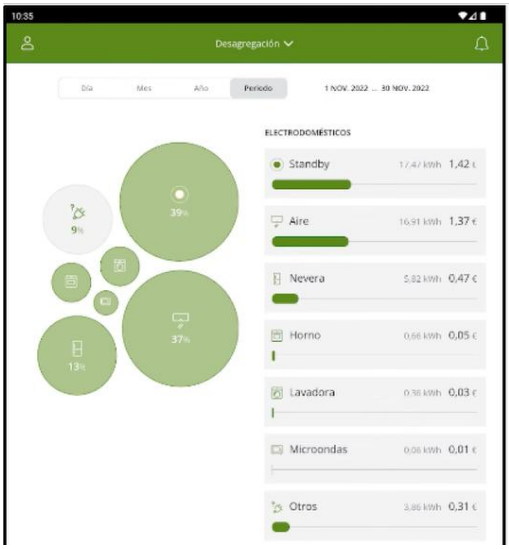

Figure 22. "Monitor Smart" from Iberdrola. Consumption by devides on stand-by

Table 4. Summary of less frequent functionalities from retailers Apps

App	Description
EAC	Calculate the indicative cost of use of any domestic appliance.
MojE.On	Unique loyalty program which encourages active engagement by allowing users to collect points. Can be redeemed for rewards and discounts. This feature is intended to promote the ongoing use and engagement with energy data.

Tibber	Demand response through EV chargers.
EDF	Customized challenges.
ENGIE	Get insights on how reduce their consumption. a visit by ENGIE technician that produces a detailed report and advice on how to reduce energy consumption.

2.2.2. FROM DSO AND TSO

In this chapter there are detailed interesting functionalities that, although they are not widely implemented among DSO & TSO Apps, they could serve to complete or improve the information provided to the user.

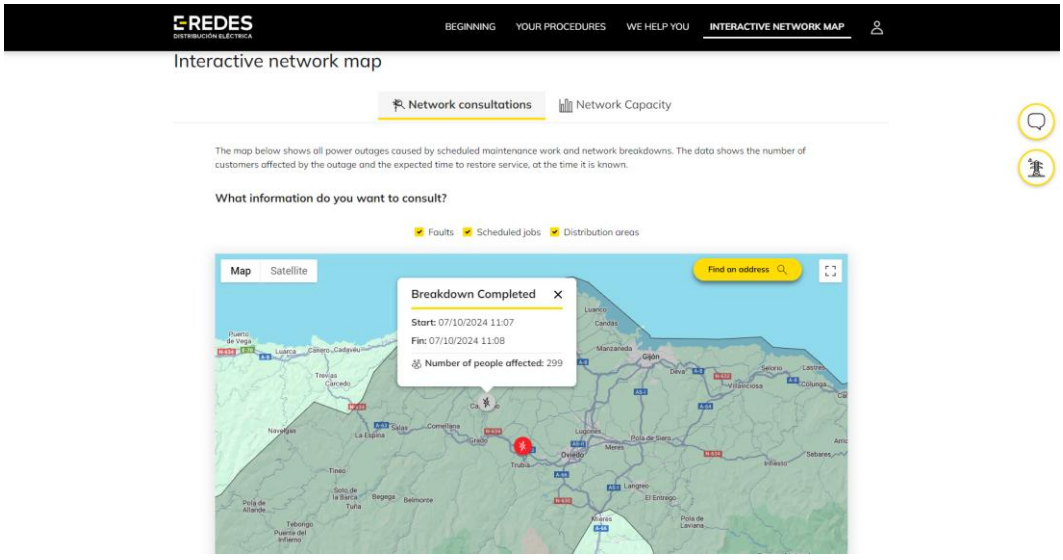

Figure 23. E-redes Interactive map showing problems in the grid.

Another interesting functionality is the consumption forecasting which allows, through a series of algorithms, the estimation of a consumption forecast for a certain future period of time.

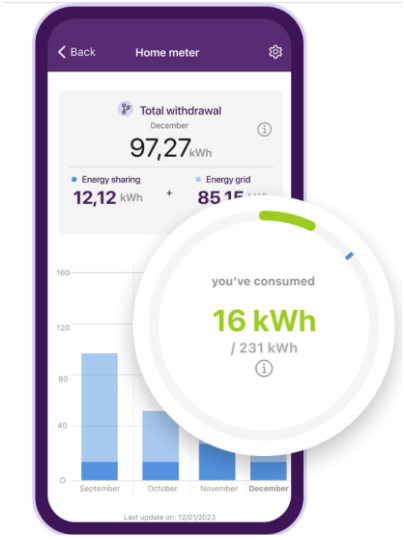

Figure 24. Electricity consumption estimations and monthly benchmarking

Other options found in the analysis of the Apps are the following:

- Download multi-contract: it allows downloading information from all the contracts of the same client without having to go one by one.
- An interactive map to check if there is a problem in the grid: it allows to check if there is a problem in the network that prevents the normal operation of the energy supply.
- Electric vehicle: information about the procedure of installation of a charging point at home.
- Reconnect Power Control Switch: functionality that allows the reconnection of the device in case of tripping due to power excess.
- Individual or collective actions to promote national energy stability: consists on a series of general suggestions to improve the quality of supply.
- Frontier energy exchanges: energy exchange across electrical borders (usually between countries).
- Energy prices: hourly energy prices on the energy pool.
- Setting targets and e-mail notifications: enter or update the owner's contact information in order to receive notifications.
- Access to metering data between energy communities: once an energy community is created, members can access this functionality to track the energy flow recorded by the billing meter.

- Evolution of the country's energy demand and consumption engagement to the consumer: users can consult the energy demanded by the country over different periods of time.
- Real time engagement & consumption recommendations: general tips for reducing consumption.
- Asset registration and information change: customer can register devices whose consumption wants to monitor.
- Check about risks of failure of customer´s PV inverters due to congestion in their area: when there are restrictions in the area due to congestion, the customer is aware of the risk and photovoltaic panels will stop providing energy into the grid.

Table 5. Summary of less frequent functionalities from DSOs and TSOs Apps

App	Description
i-DE	Download multi-contract
E-redes	An interactive map to check if there is a problem in the grid
E-redes	Electric vehicle: Information about the installation of a charging point at home
VIESGO	Interactive map of the network
E-distribucion	Reconnect Power Control Switch
Ecowatt	Individual or collective actions to promote national energy stability
RTE-éCO2mix	Frontier energy exchanges
RTE-éCO2mix	Energy prices
eLicznik	Setting targets of daily, monthly or annual energy consumption and e-mail notifications of exceeding them
eLicznik	Access to metering data between among energy communities

Energetyczny Kompas	Evolution of the energy country demand and consumption engagement to consumer
Ecowatt	Real time engagement & Consumption recommendations
Fluvius	Asset registration and information change
Fluvius	Check about risks of failure of customer´s PV inverters due to congestion in their area

2.2.3. FROM AGGREGATORS AND ENERGY EFFICIENCY

Below, a series of functionalities are listed among the aggregator or energy efficiency Apps that improve the user experience using the applications.

The functionality of the Tado° App is interesting, so it allows the automatic adjustment of the home air conditioning depending on which room is being occupied. Also notable is the possibility of detecting open windows.

Figure 25. Tado (France) - Geolocation: the system automatically adjusts the heating or cooling settings based on your location

Other useful features are the following:

- External Air Quality tracking (by city or district): shows information about the air quality in the location using information available on internet.
- Real time weather data: climate data to better manage home air conditioning.
- Reactive energy consumption tax: information of the reactive energy consumed in order to reduce losses in the supply grid.
- Revenues from flexibility services: benefits for participating in flexibility programs.
- Aggregator platform for participation in the balancing market: information of participation in the balancing markets in which the customer is registered.
- Demand response through heat regulation: thanks to air conditioning management, flexibility requirements can be met through demand management.
- Flexibility from EV charging and battery storage: the aggregator can jointly manage the storage or charging capacity of electric vehicles of several clients and participate in flexibility markets. The owner can see their participation in the process.
- Participation in energy programs: allows the customers to check their participation in the energy programs in which they are enrolled.
- Pool price: allows to track the price of the energy in the markets.
- EV charging control: allows the management of electric vehicle charging at home.

Table 6. Summary of less frequent functionalities from aggregators and energy efficiency Apps

App	Description
Sowee	External Air Quality tracking (by city or district)
Netatmo energy	Real time weather data
Tado°	Heating and cooling settings based on allocation
Tado°	Open window detection for heating and cooling operation
OneMeter	Reactive energy consumption tax

Currently	Revenues from flexibility services
Fever	Aggregator platform for participation in the balancing market
Ngenic	Demand response through heat regulation
Varberg Energi	Flexibility from EV charging and battery storage
Dcbel Chorus	Participation in Energy Programs
OneMeter	Pool price
Dcbel Chorus	EV charging control

2.3. PENETRATION LEVEL OF SOLUTIONS

Below is the number of downloads registered on each of the Apps (ordered by countries) as of the date of preparation of the report. The source is the Play Store application, so the real number of downloads could be higher. There exists a wide range of downloads (from a few hundred to a few million) depending on, among other factors: market size, App launch date or user acceptance.

Table 7. Number of downloads registered on each of the Apps

COUNTRY	App	DOWNLOADS [x1000]
Austria	smartENERGY (Retailer)	+1
Austria	Bessere Energie (Retailer)	+0,1
Belgium	My Fluvius (DSO)	+50
Belgium	My Sibelga (DSO)	+0,5
Belgium	EMORES (DSO)	Unavailable data
Belgium	myOres (DSO)	Unavailable data
Belgium	myRESA (DSO)	Unavailable data
Belgium	Elia (TSO)	+0,1

Belgium	Epic (TSO)	Unavailable data
Cyprus	EAC Mobile App (DSO)	+5
Croatia	MojE.ON (Retailer)	+10
Croatia	mHepi (Retailer)	+10
Croatia	Sunči (Retailer)	Testing phase
Croatia	Enpulse (Energy efficiency)	Unavailable data
Slovenia	MOJ ELEKTRO (Energy efficiency)	+10
Spain	i-DE (DSO)	+100
Spain	E-redes (DSO)	+500
Spain	e-distribucion (DSO)	+50
Spain	UFD (DSO)	+10
Spain	VIESGO (DSO)	+1
Spain	RedOS (TSO)	+100
Spain	IBERDROLA CLIENTES (Retailer)	+1000
Spain	CURENERGIA (Retailer)	+500
Spain	RECARGA PÚBLICA (Retailer)	+100
Spain	SMART MOBILITY (Retailer)	+10
Spain	MONITOR SMART (Retailer)	+10
Spain	Eligenio (Aggregator)	Unavailable data
Spain	Energia XXI (Aggregator)	+1000
Spain	AleaSoft (Aggregator)	Unavailable data

Spain	Green Eagle Solutions (Aggregator)	Unavailable data
Spain	Asoconelec (Aggregator)	Unavailable data
France	Dcbel Chorus (Energy efficiency)	Only a few (App recently released (November-2024))
France	Hello Watt (Energy efficiency)	+700
France	TotalEnergies (Retailer)	+1000
France	Ekwateur (Energy efficiency)	+100
France	EDF et moi (Retailer)	+10000
France	Ecowatt (TSO)	+1000
France	RTE-éCO2mix (TSO)	+100
France	MyVoltalis (Energy efficiency)	+100
France	Sowee (Energy efficiency)	+100
France	SOMFY (Energy efficiency)	+500
France	TIKO (Energy efficiency)	+10
Belgium and France	Wiser by Schneider electric (Energy efficiency)	+50
Belgium and France	Mon pilotage Elec by Engie (Energy efficiency)	+10
Belgium and France	Engie Electricité et Gaz (Retailer)	+100
France, Denmark and all European Union	Netatmo Energy (Energy efficiency)	+1000

France, Belgium, Denmark, Estonia	Tado (Energy efficiency)	+1000
Denmark	Ecobee (Energy efficiency)	Unavailable data
Finland	Heatmiser Neo (Energy efficiency)	+50
Greece	Protergia App (Retailer)	+50
Greece	MYTILINEOS smart cities (Energy efficiency)	Under development
Greece	Heron App/Eco-advisor (Retailer)	+100
Greece	PPC App/MyEnergy Coach (Retailer)	+500
Greece	ELPEDISON App/MyElpedison (Retailer)	+100
Poland	eLicznik (DSO)	+100
Poland	Mój Licznik (DSO)	+100
Poland	Energetyczny Kompas (TSO)	+10
Poland	Eco-Bot (Energy efficiency)	Unavailable data
Poland	OneMeter (Energy efficiency)	+5
Poland	Wibeee (Energy efficiency)	+5
Poland	IAMMETER (Energy efficiency)	+5
Portugal	EDP Solar (Retailer)	+100
Portugal	Poupa Energia (Energy efficiency)	+7
Portugal	E-REDES (DSO)	+100

Czech Republic	Proud (DSO)	+100
Czech Republic	Muj CEZ (Retailer)	+100
Sweden	Currently (Aggregator)	Unavailable data
Sweden	FlowerHub (Retailer)	Unavailable data
Sweden	Fever (Aggregator)	Unavailable data
Sweden	Ngenic (Aggregator)	Unavailable data
Sweden	Tibber (Retailer)	Unavailable data
Sweden	Emaldo (Aggregator)	Unavailable data
Sweden	Varberg Energi (Retailer)	Unavailable data

2.4. FUNCTIONALITIES OF THE APPS IN RELATION WITH HLUCS

This chapter analyzes how the High-Level Use Cases (HLUC) specified in the ECLIPSE project are fulfilled from the different functionalities that are been analyzed in this report. ECLIPSE identified 5 HLUCs.

HLUC1. Personalised messages for consumer flexibility based on economic benefits

Retailer´s applications deal with the economic aspect from a point of view of accumulated consumption and in some cases give the possibility of sending consumption alerts in case of a certain threshold of historical consumption is exceeded.

There are price signals as there are different time periods (peak and off-peak hours or non-subsidized hours in the contract).

The flexibility aspect is practically not addressed in any of them and therefore there are no signs of modification in the consumption pattern based on this aspect.

The exception, however, is the Swedish market which has a more advanced flexibility market, and which allows customers to participate in the regulation of frequency markets (Currently App). Participation through Battery Energy Storage Systems (BESS) is also possible with clients and photovoltaic installations, which allows them to receive compensation for participating in flexibility services. Other applications such as Varberg Energi allow energy management of EV during battery charging. Tibber also provides flexibility while charging the electric vehicle at home.

Thus, the conclusion is that HLUC1 is not sufficiently covered in the Apps analysed.

HLUC2. Personalised messages for consumer flexibility based on non-economic incentives

Non-economic benefits are not sufficiently addressed. As an exception, we can point out the Virtuoso and MyVoltalis applications from France which provide the historical EV charging or consumption programs, cost and CO_2 savings.

MojE.oN. application has a unique loyalty program that encourages active engagement by allowing users to collect virtual points, which can be redeemed for rewards and discounts.

HLUC3. Personalised messages to consumers about energy efficiency potential

In general, the level of message personalization is not very high. We have only seen customized messages about black-outs (duration and end time). There are only a few Apps that allow sending personalized messages or show consumption graphs for energy savings after its analysis. Examples of this are the following Apps:

- My Voltalis (France) allows manual and programmed home temperature adjustments.
- Tiko (France) compares daily consumption evolution versus indoor temperature, which suggest that changes in consumption are related with the outdoor temperature.
- In general, the Swedish market allows battery management and EV charging.

HLUC4. General messages/alerts about extreme grid situations

This HLUC should be fulfilled especially from the DSO & TSO Apps but neither here nor the retailers or aggregators show notices of network restrictions. Messages only arrive

when the lack of supply has already occurred, indicating the expected duration and the approximate time of replacement. Some Apps also show scheduled jobs that involve a black-out (App from E-REDES).

The exception is the App from Fluvius (Belgium) that shows the risks of failure of customer´s PV inverters due to congestion in the area.

HLUC5. General tips and guidance for energy efficiency

General advice for energy saving is not treated enough in the Apps. In some of them, it is proposed adjusting the room temperature, covering the pots during cooking, etc. but there is nothing, for example, regarding an efficient driving behavior, for reducing EV consumption.

APPLICATIONS FROM RETAILERS:

The following functionalities are the more common ones and allow the user to know current consumption/generation data at home (disaggregated by devices, in some cases) and search information about consumption in the past (It is also possible to filter the data by periods).

- Energy usage monitorization: HLUC 1, 2, 3 and 5.
- Historical consumption: HLUC 1, 2, 3 and 5.

APPLICATIONS FROM DSO/TSO:

Similar functionalities to the previous case but with direct access to the meter used for supply billing. They allow responding to the first two HLUCs.

- Historical consumption: HLUC 1 and 2.
- On-line access to the meter: HLUC 1 and 2.

APPLICATIONS FROM AGGREGATORS / ENERGY EFFICIENCY APPS:

The monitoring of consumption, its economic cost and CO_2 emissions respond to HLUC 1 and HLUC 2. They are one of the more common functionalities among the Apps analyzed.

- Energy use monitorization: HLUC 1 and HLUC 2.
- Cost and CO_2 Savings Tracking: HLUC 1 and HLUC 2.

2.5. RECOMMENDATIONS & CONCLUSIONS

In summary, it can be concluded that HLUCs are not sufficiently covered by the Apps. There are some exceptions (specially in Sweden) but in general they are far from becoming a useful tool to encourage customers to adopt flexibility patterns. The output of this section will be used for WP2 and WP4 deliverables.

Only a few functionalities are useful and could be adopted by other Apps (reward points, room temperature or general tips). We suggest the inclusion of the following proposals that have not been observed in any of the Apps analyzed:

- There is not an overlap between the consumption or generation graphs of the supply point with the energy prices (both in the pool market and the different hourly prices that the retailer could offer to the customer). The customer could be encouraged to focus their consumption on hours of lower prices and therefore lower CO_2 emissions.
- The energy saving recommendations are only for homes. No suggestions have been found for other uses such as small businesses or industries. The reason why these other supplies do not receive attention from developers is unknown, although it could be due to the lower volume of customers compared to homes (meaning lower number of downloads) that does not compensate for the developer's effort. It is proposed to disseminate and publicize the use of these Apps as well as in the industrial or commercial activities. Maybe a consumption certificate could be given and encourage customers to buy in the lowest consumption business segment (for example, restaurants).
- For “Retailers” applications and consumption history, the following proposals are detailed:
    - Show consumption due to appliances on “stand-by” mode. It can be easily shown the consumption in the hours when the home is empty compared to total consumption. Showing this percentage and its cost can raise awareness of the importance of reducing them.
    - In the OneMeter App or other similar applications, it may be interesting to show the solar irradiation curve for that latitude and the expected production contrasted with the installation's production. This would serve to check the correct operation of the photovoltaic panels (for example, the existence of

shadows, incorrect orientation, or inverters that do not work, or PV panels need cleaning due to dust or snow).
    - The App could simulate photovoltaic production for different orientations. If the aim is to achieve the greatest possible independence from the network, the southern orientation of the panels may not be optimal since, although production is lower with a different orientation (e.g. east or west), this may coincide with the main consumption.
    - If the client does not have PV, the application could show on the consumption monitor an estimation of the production, encouraging the owner to consider the installation.
- There is no information of energy communities around the supply (location, number of customers, amount of energy…). If the App could show which energy communities exist within a radius of "X" km, it could be interesting. This would awaken the owner's curiosity about them, promoting their participation and, indirectly, the proliferation of a greater number of energy communities.
- The comparison with other dwellings could be completed with the following information:
    - Comparison of the consumption of devices on stand-by between the owner and other dwellings.
    - Improved energy efficiency from a certain date compared to other dwellings.
    - Taking as a reference the number of people who live in each home, an estimation "consumption per capita" in comparison with other dwellings.
- The App should show an estimation of the client's bill if customer signs contracts other plans and/or modify their contracted power.
- In the App, the user should be able to set the percentage from which the high consumption alerts are received and not being a fixed value.

It has not been found that the aggregator or energy efficiency Apps take advantage of network maintenance incidents to adapt energy efficiency suggestions for that day. For example, proposing to carry out a specific action at home (turn up the heating a little earlier or charge the battery).

3. ENERGY DATA PLATFORMS

In this section, the analysis carried out regarding energy data platforms is being presented. With the term energy data platforms, we are referring to platforms that showcase raw energy consumption data, at a national level, in most cases coming from the DSOs' smart meters. In some cases, e.g., EDDIE platform and Mytilineos Smart Cities platform, these platforms are not used in a national level, however, can facilitate the exchange of data between different entities in a regional level. These platforms make raw metering data available for the end user, which can be accessed by manually downloading data files or automating the process via API.

In total 14 platforms were reviewed, namely: CEEPS, DATADIS, EDA, EDC, EDDIE, EDSN Energie Data Services, ELHUB, Enedis DataHub, ENERGINET Datahub, ESTFEED, Fingrid Datahub, MYTILINEOS Smart Cities platform, REN Datahub, SIORD. An overview of the platforms is presented in the table below:

Table 8. Energy data platforms

Platform name	Developer/ provider name	Country of operation	Website link
CEEPS, Moj elektro	Informatika d.o.o.	Slovenia	https://ceeps.informatika.si/login
DATADIS	It is developed by several partners grouped in a consortium formed by ASEME, CIDE, e-distribución, E-REDES, I-DE, UFD and Viesgo	Spain	https://datadis.es/home
EDA	It is owned by a group of 15 Austrian DSOs, TSOs and utility companies	Austria	https://www.eda.at/

Electricity Data Center (EDC)	EDC shares are owned equally by the operator of the transmission system CEPS and distribution system operators CEZ Distribuce, EG.D and PREdistribuce. The system itself is currently developed internally.	Czech Republic	https://www.edc-cr.cz/
EDDIE	Developed in the context of the EDDIE research project	Europe	https://data.entarc.eu
EDSN Energie Data Services	Owned by the Dutch TSO and all DSOs	Netherlands	https://www.edsn.nl/
ELHUB	Elhub AS c/o Statnett SF	Norway	https://elhub.no/
Enedis Datahub	Enedis	France	https://datahub-enedis.fr/en/
ENERGINET Datahub	Energinet	Denmark	https://en.energinet.dk/energy-data/datahub/
ESTFEED	Elering	Estonia	https://estfeed.elering.ee/metering-points
Fingrid Datahub	Fingrid	Finland	https://palvelut.datahub.fi/en/
MYTILINEOS Smart Cities platform	MYTILINEOS	Aspra spitia village (Greece)	https://aspraspitiacp.mytilineos.com

REN Datahub	REN	Portugal	https://datahub.ren.pt/
SIORD	It is developed by several partners grouped in a consortium formed by AELEC, ASEME, CIDE, e-distribución, E-REDES, I-DE, UFD and Viesgo	Spain	https://aelec.es/consulta/

In the sections below, we present more details regarding the functionalities of these platforms, as well as the value proposition and benefits that they offer for their end-users. Our analysis is structured on three pillars: (i) Technical information (such as data types, technical requirements for accessing the platform, user interface); (ii) Impact (such as value proposition, number of end users, integrated functionalities for promoting active consumer participation); and (ii) Insights towards ECLIPSE, highlighting which features or best practices can be utilized in the context of ECLIPSE project.

3.1. CEEPS

In May 2020, an online portal for B2B data exchange called the Central Electricity Exchange Portal of Slovenia (CEEPS) was launched, which provides data services in the domain of imbalance settlement (at intervals of one hour and 15 minutes) for suppliers and the electricity market operator, and SODO has also formally joined the project. By the end of 2020, the CEEPS portal had developed many new features based on consumer needs, including the exchange of RES metering data with the TSO in near real-time (15-minute or 1-minute intervals).

Therefore, technical changes or upgrades were made at all five distribution companies, including the implementation of more advanced metering data collection and the new set-up or replacement of metering equipment at metering points for the real-time exchange of metering data from production facilities using RES.

CEEPS was implemented following the Slovenian Government Decree on measures and procedures for the introduction and interoperability of advanced electric power metering systems and the Plan for the introduction of an advanced metering system

in the Slovenian electricity distribution system define, among other things, the advanced metering system architecture, roles and responsibilities, its minimum functionalities, and some aspects of the implementation of data exchange based on relevant standards (CIM, etc.) The Decree required also the DSO to establish a single access point for accessing data in the advanced metering system.

In this context, CEEPs system for accessing metering data (national data warehouse), which is managed by the DSO and provides data exchange services among business entities and network users in the B2B and B2C domains, with a plan to further extend the area of exchange to the B2G segment. The development was carried out within an initiative by distribution companies, united under the Electricity Distribution Economic Interest Grouping, with the participation of the DSO. The single-entry point of the national data hub (EVT/Portal CEEPS) is a hub ensuring the exchange of data among distributors and suppliers of electricity, final consumers and their authorised representatives (e.g. aggregators, ancillary services providers) and at the same time the central data hub for the exchange of data in the electricity market.

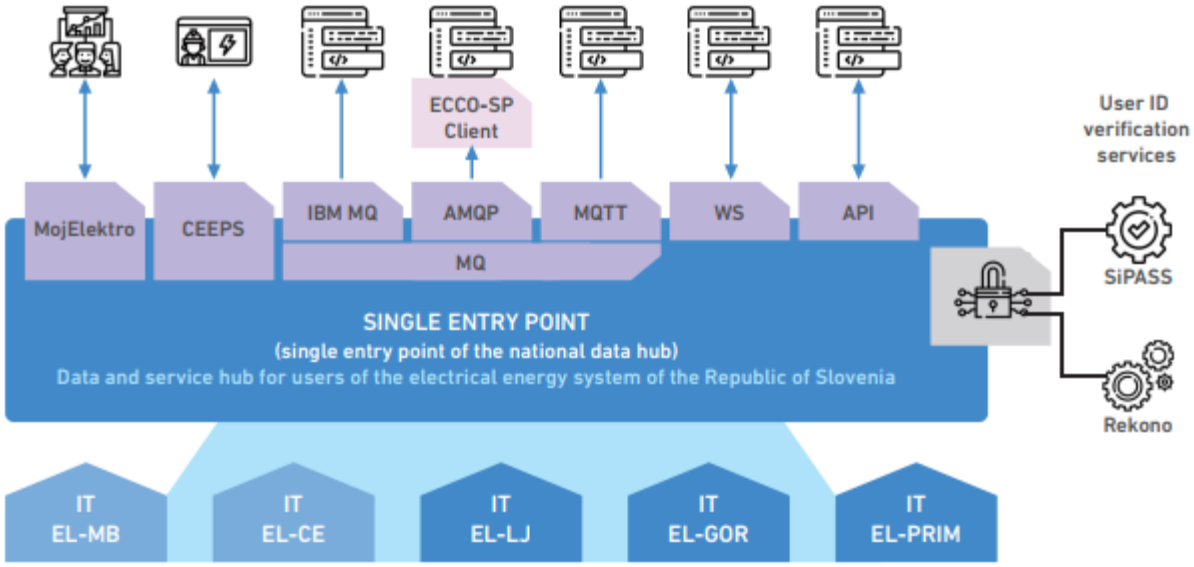

Figure 26. CEEPS overall concept

3.1.1. TECHNICAL INFORMATION

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

- **The MojElektro Portal** – the online user portal intended for all end consumers and their authorised representatives who can access all the metering points and metering and accounting data that they are entitled to, regardless of their supplier or distribution area. It enables an overview and export of all available 15-minute data by metering points (received and delivered active/reactive power, possibility of aggregation by hour, day, month, etc.), monitoring consumption and production above the self-supply metering points, submission of a new tax ID number for a metering point, the submission and entry of the meter reading at a metering point.

- **CEEPS Portal** – for users eligible to access data. All electricity suppliers, Borzen, the Centre for RES/CHP support, the closed distribution systems and the distribution network operators are registered on the portal. It enables centralised imbalance settlement, access to and export of 15-minute data based on balance sheet eligibility, the submission and entry of meter readings on behalf of the final consumers, carrying out the supplier switching process in line with the SONDSEE (System operating instructions for the electricity distribution system) requirements, access to accounting data (the so-called Annex A), management of all the changes on the metering points, etc.

- **Massive data exchange** - B2B MQ services, continuous daily massive data exchange for the individual eligible user, daily transmission of the available 15-minute metering data for the previous day, the addition of new measuring points to the daily transmission and specific inquiries for the available 15-minute metering data.

The types of data shown in the platform are:

Table 9. CEEPS platform type of data

Type of data	Unit	Granularity
Load profile of the distribution power network users, which is not measured by smart meters- for each local DSO, a difference between electricity taken-over from the TSO and the electricity measured by all smart meters (energy kWh, power in kW)	kWh, kW	15 min

Energy and power of the consumption and production: separate lines for metered and unmetered data, sum of the data.	kWh, kW	15 min
Balancing data, shares, data exchange	NA	NA

The single-entry point of the national data hub (EVT/Portal CEEPS) is a hub ensuring the exchange of data among distributors and suppliers of electricity, final consumers and their authorised representatives (e.g. aggregators, ancillary services providers) and at the same time the central data hub for the exchange of data in the electricity market.

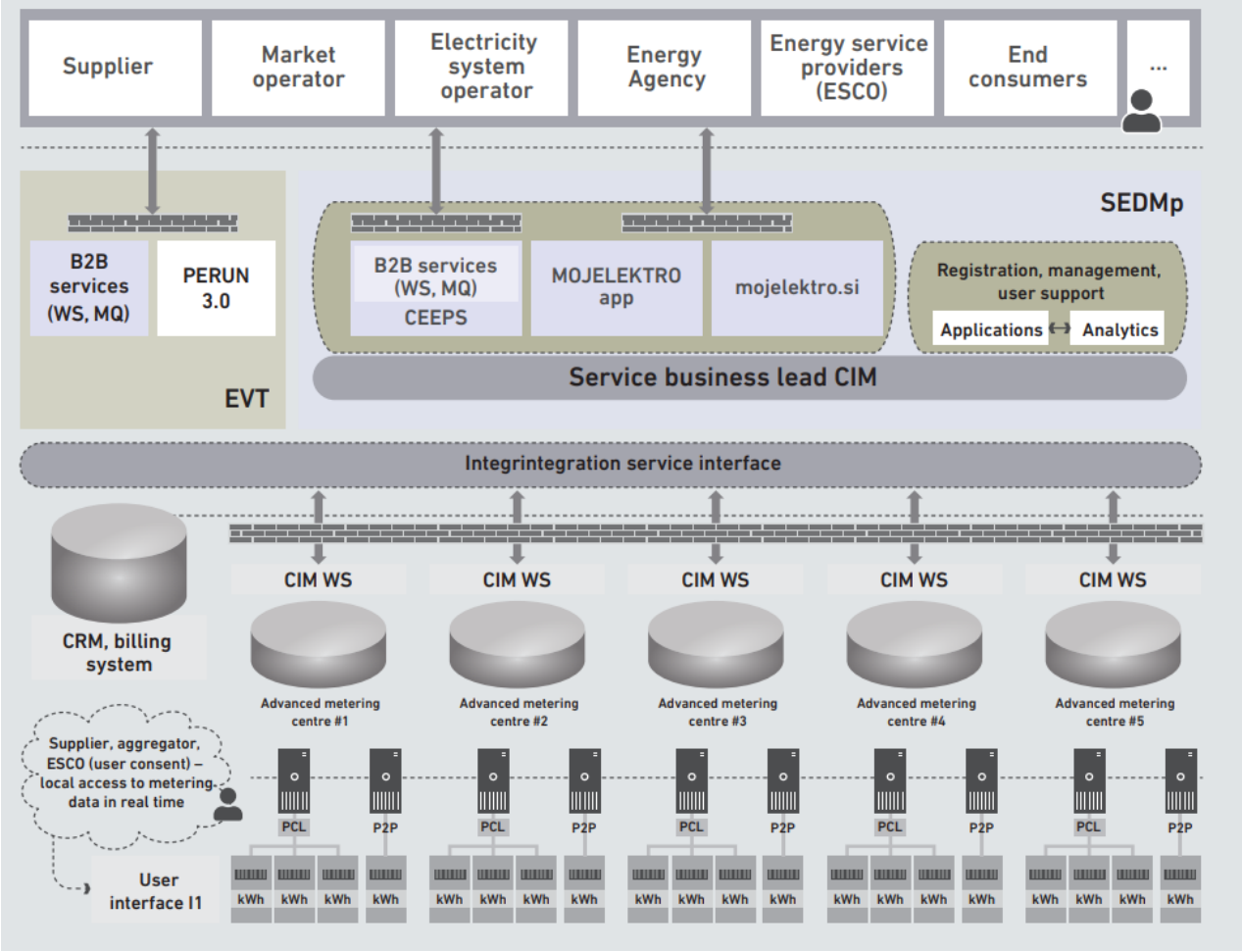

Figure 27. The EVT/CEEPS multi-level architecture functioning as a national data hub

In addition, a UI for end users has been developed. To access the platform, first, the potential user must sign in Rekono system (security reasons) [1]. Legal entity representative must create a Rekono account, namely this way is defined the account keeper. Each new participant (only legal entities) must inform via e-mail the users' accounts administrator about his/hers desire to become the CEEPS user. This administrator makes then the final sign-in of a legal entity.

The Government Decree on measures and procedures for the introduction and interoperability of advanced electric power metering systems requires the DSO to establish a single access point for accessing data in the advanced metering system.

3.1.2. IMPACT

The main value proposition for the end-users is gaining access to the data and enabling the exchange of data between them. Regarding the number of end users (either consumers or DSOs) are using and/or accessing the platform, this information is not publicly available.

Using B2B CEEPS services, metering data from more than 210,000 metering points is exchanged daily, i.e. more than a quarter of all end-consumer metering points in Slovenia, covering approximately more than 85% of the energy portfolio in terms of consumption on a daily basis.

No special functionalities for the consumers are in place for promoting active consumer participation and the adoption of changes in their energy behaviour.

[1] Rekono d.o.o., is a Slovenian company that provides a service management system supporting the provision of electronic identification, authentication and trust services in accordance with the service catalogue for all external clients.

3.2. DATADIS

DATADIS is a free and simple platform that includes information of the energy consumption from most of the Spanish DSOs. DATADIS groups the information of almost all the Spanish electricity distribution companies so that facilitates users to consult the data of the electricity contract and the details of the electricity consumption.

3.2.1. TECHNICAL INFORMATION

The platform allows electricity consumers to consult, in an integrated manner and through a single window, the disaggregated information, current and historical, of all their supply contracts. Moreover, it is possible to authorize third parties (e.g., marketers with whom the supply has not been contracted) access to said information. In addition, the platform allows users to access aggregate information regarding energy consumed and the number of supply contracts associated with such consumption.

The types of data shown in the platform are:

Table 10. DATADIS type of data

Type of data	Unit	Granularity
Consumption	kWh	Hourly
Peak power	kW	

Every type of electricity consumers are the end users of the platform, but it is also possible to authorize third parties (e.g., marketers with whom the supply has not been contracted) access to said information. The UI through which they can access their data can be seen below:

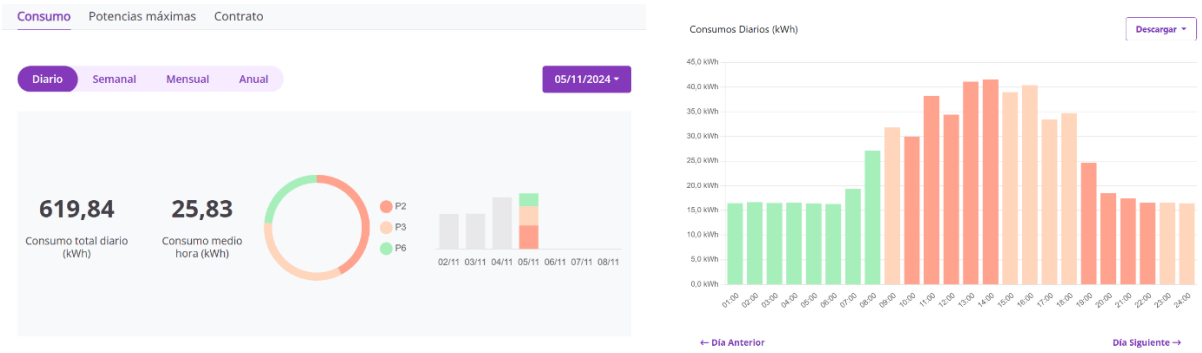

Figure 28. DATADIS UI view

On the technical side, the usability requirements are limited to having access to the platform via web and downloading files in CSV, XML and JSON formats.

For the collection and access to data, the consumers need to register to the platform with their NIF/CIF[2] and provide an identification document. All data, both individual and aggregated, can be viewed on the platform or downloaded via API.

Consumers can access all the relevant information in their contract, as well as information on electricity consumption over different time periods, with a breakdown that can be up to hours and a quarter of an hour. It also offers the maximum power demanded, which is extremely important information for adapting our contracts.

Likewise, access can be allowed to those agents that the client considers of interest, and to those who give express consent to access this information, such as other marketers or companies that offer energy saving and efficiency services that can make personalized offers.

[2] The NIF serves as a tax identification number for both individuals and legal entities in Spain. For individuals, the NIF usually coincides with the DNI for Spanish nationals, while for companies and other entities, it's unique and specific to tax, commercial, and contractual purposes. The NIF may include letters that designate the type of entity it identifies. The CIF was previously the tax ID number specific to companies and legal entities in Spain. However, following Royal Decree 1065/2007, the CIF was replaced by the NIF in 2008. Companies now use a NIF, which includes a specific initial letter to indicate the type of entity, followed by a unique set of numbers.

3.2.2. IMPACT

DATADIS is a free, simple and fast platform that includes most Spanish distributors and allows consumers to access the data of all their supplies independently of the distributor. It even allows consumers to give temporary permission to third parties to access certain data. This may be of interest if the consumers want to carry out a billing study or an optimization of a self-consumption installation. This platform does not store data from the suppliers, but rather it launches queries to the corresponding distributor's website and displays the results in an understandable way.

More than 29 million consumers in Spain can access data on their electricity consumption through DATADIS platform, a common interface of all energy distributors and in addition to those currently offered by these companies. It includes information from more than 350 Spanish DSOs.

Thanks to DATADIS is possible for consumers to access information easily and free of charge, through a single platform, regardless of who the distributor is. It is a solution for multi-point or multi-distributor users who want to view consumption data from all supply points in Spain on a single platform, improving their energy management, be able to make savings decisions on the bill and facilitate the application of energy efficiency measures.

3.3. EDA

The EDA platform facilitates the exchange of energy-related data between Austrian market participants in the gas and electricity sectors. It supports reliable and secure communication for processes such as supplier switching, meter data exchange, and customer data management.

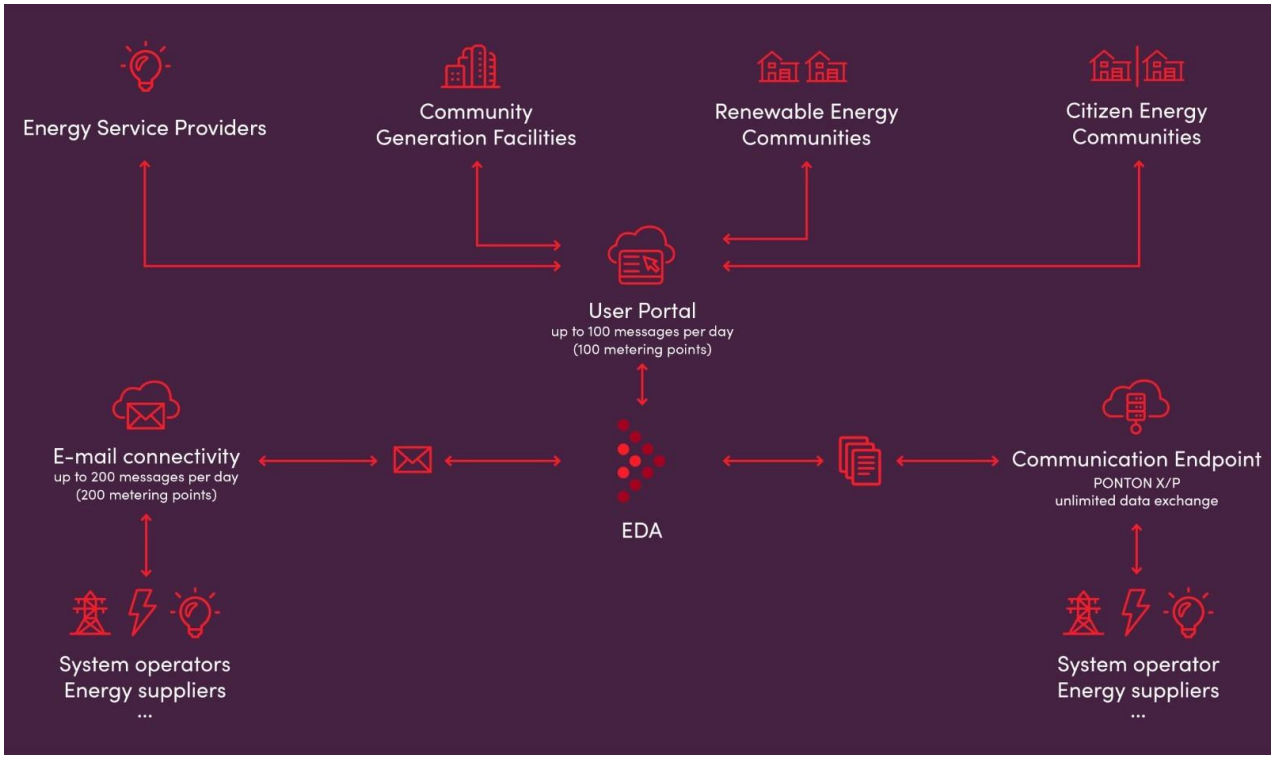

Figure 29. EDA platform overall concept

3.3.1. TECHNICAL INFORMATION

EDA is a secure, future-oriented, stable and cost-effective data exchange method that plays a pioneering role in the European energy market. Specifically, EDA supports three aspects of the information chain:

- despatch,
- distribution and
- reception of a message

in encrypted form in each case, and independent of the data format of the market message itself.

A uniform infrastructure is available to all companies from the Austrian energy sector, through which data or electronic documents can be exchanged in a uniform format and using a uniform communication protocol. This helps to avoid costs arising from individual agreements in the B2B integration of individual communication partners.

The data is encrypted end-to-end, such that only the actual addressee of the message can read its content. With the help of a public-key infrastructure (PKI), each participant has a private key that is stored locally and known only by the participant. This enables electronic signatures to be created and encrypted messages to be made readable.

Physically, data is forwarded to the recipient via a distributor, the Single Internet Access (SIA). The SIA is maintained and physically operated within Austria. The contents of the messages are not visible to the infrastructure operator.

The type of data shown in the platform are:

Table 11. EDA type of data

Type of data	Unit
Generation according to metering	KWh
Generation according to the participation factor	KWh
Surplus generation at energy community	KWh
Consumption based on metering	KWh
Consumption according to the participation factor	KWh
Share of joint generation	KWh
Own coverage of joint generation	KWh
Own coverage from renewable energy	KWh
Information on the contracts of the participants as well as the generation facilities	N/A

The primary users of the platform are energy market participants such as system operators, energy suppliers/energy service providers, and energy communities (operators of community generation facilities, Renewable Energy Communities, Citizen Energy Communities). End customers can also participate, especially in energy

communities where they can share and manage their energy production and consumption.

In addition, there is a user interface for end users. The EDA platform provides an online portal where users can manage their data exchange processes. The User Portal is free-of-charge to authorised market participants (operators of community generation facilities, Renewable Energy Communities, Citizen Energy Communities and Energy Service Providers).

Accessing the EDA platform typically requires an internet connection and a compatible web browser. For more advanced functionalities, users might need specific software applications that support data exchange protocols like ebXML.

There are three connection types for accessing data:

- **User portal** - The User Portal is a web platform for handling processes for Energy Service Companies and energy communities. It provides low-threshold access to energy data exchange with an integrated process environment. This means that certain messages can be sent, received and processed directly in the User Portal. Participation for Energy Service Companies and energy communities on the User Portal is free-of-charge.

- **E-mail connectivity** - E-mail connectivity is the connection type for market participants who exchange data on a low to medium-frequency basis and have their own software application for message processing and creation. In these cases, the participant connects to the mailbox provided via IMAP and SMTP. Use of the e-mail connectivity is only possible for up to about 200 messages per day (200 metering points), depending on message volume. The market participant receives messages as .xml (extensible mark-up language) files attached to an e-mail and can process them individually in the market participant's own software applications.

- **Communication endpoint** - The "PONTON X/P" standard CEP is the connection type for market participants with very high data exchange volumes who have their own IT infrastructure or IT service provider and their own software application for message processing and creation.

The EDA platform employs governance schemes that ensure transparency, security, and efficiency in data handling. This includes standardized protocols, access controls,

and compliance with legal and regulatory frameworks to protect data integrity and privacy.

Focusing on two of the available connection types:

- **E-mail connectivity** - The mailbox provided can only be used for purposes of energy data exchange. No e-mails can be sent to e-mail addresses outside the energy data exchange. Authentication is done by means of a username and password.
- **Communication endpoint** - Access to the CEP is restricted by means of authentication using a username and password. Additional users may be created for administration via the CEP user administration. A web interface for monitoring message transmissions and for configuring the CEP is included in the installation. Standardised services (file structure, REST, etc.) may be used to transmit messages between the CEP and the user's own software application for message processing.

3.3.2. IMPACT

The secure, standardised and simple energy data exchange is based on the following principles:

- Standardised communication protocols
- Standardised data formats
- Standardised business processes

The use of standardised protocols within the EDA infrastructure ensures that market participants do not incur additional expense for maintaining different interfaces. Data is exchanged in a standardised format, which means that data processing remains uniform for all participants. The processes for processing and responding to messages are also standardised. The processing of the data is also standardised to a certain extent, such that the effort required to process messages is minimised.

In terms of end users' outreach, so far 140 network operators, 305 energy suppliers, 204 energy service providers and 6.375 energy communities have used EDA platform. In the following figure the growth of the users and activated counting points between November 2023-October 2024 is being illustrated:

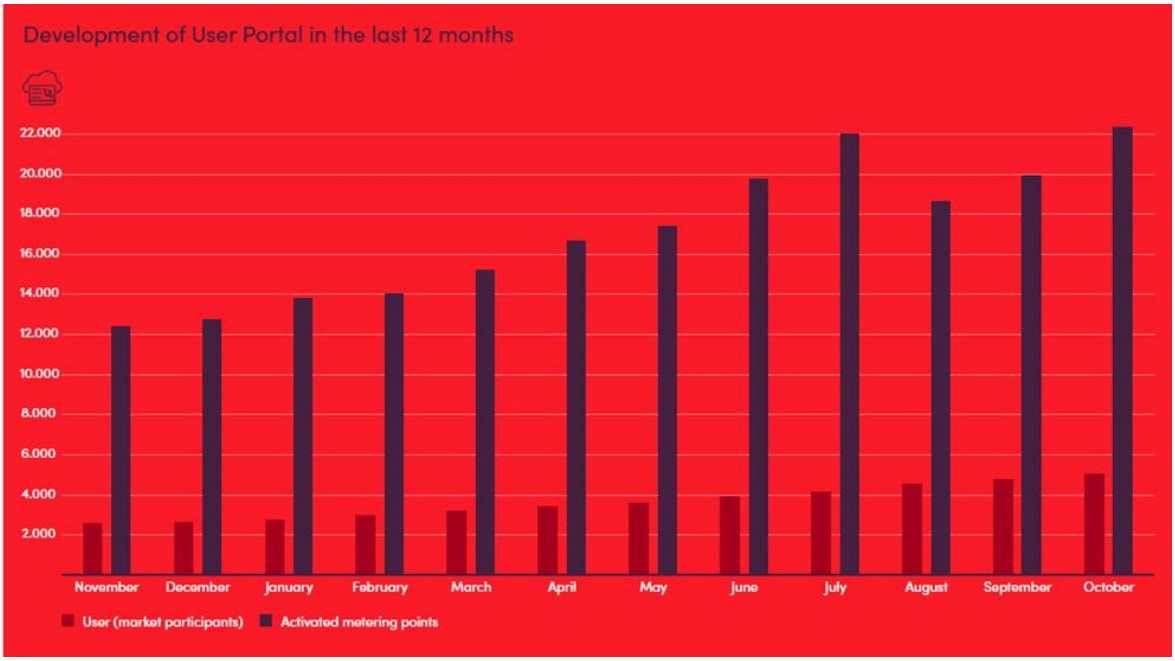

Figure 30. User EDA portal growth from November 2023 to October 2024

3.4. EDC

The Electricity Data Center (EDC) was created as a digital technical solution to enable energy transition of the Czech Republic. EDC serves as the main hub for overseeing data related to electricity sharing. It gathers and analyses data regarding electricity usage and generation. It assesses whether sharing has taken place by using information from electricity meters. In addition, It provides households and entrepreneurs with information about their consumption every 15 minutes, broken down by time, tariff, and in some cases in the future, by the type of appliance. EDC also mediates this data to electricity providers, distribution and transmission system operators, and will ensure the data flows on electricity sharing.

Every consumption and delivery location participating in electricity sharing is required to have a smart meter installed. These meters assess both electricity consumption and production at 15-minute intervals. The local distributor installs these meters at no cost, with a deadline of three months for installation.

3.4.1. TECHNICAL INFORMATION

Electricity Data Center (EDC) has been providing services supporting electricity sharing in communities since August 1, 2024. It allows the registration of market participants, data collection and processing, evaluation of electricity sharing, and handling of complaints. From the second half of 2026, EDC will expand its services to include data management for energy storage, flexibility services, and aggregation according to the amendment to the Energy Act[3].

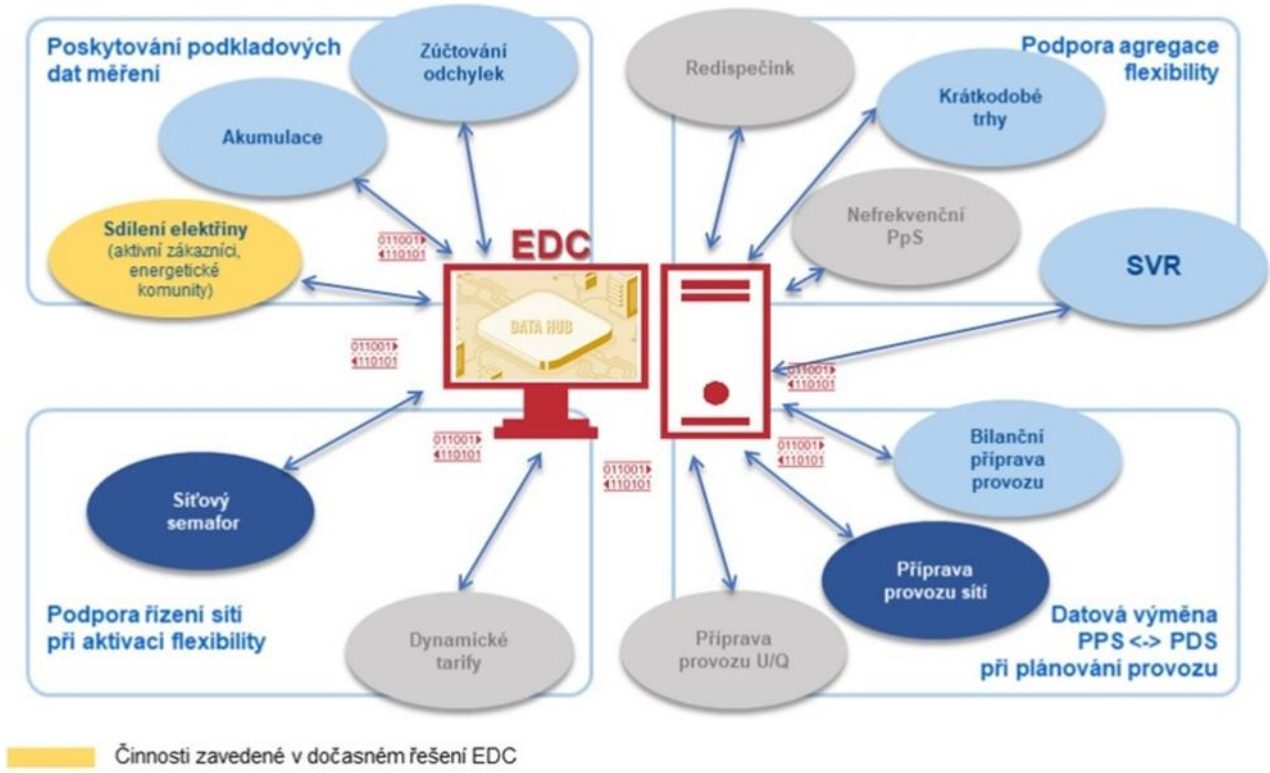

Figure 31. Functionalities in future versions of the EDC. Currently only Energy Sharing (yellow circle) is in place.

[3] https://www.roedl.com/insights/renewable-energy/2023/february/czech-republic-amendment-energy-and-building-act-accelerates-ee

The EDC collects and manages information related to electricity consumption, production, and trading in the energy-sharing framework. Data is transmitted to the EDC on a daily basis. The EDC analyses this data and distributes it to other stakeholders in the market. It enables rapid communication among electricity distributors, producers, market operators, suppliers, and future flexibility aggregators. However, it is critical to note that such data is not shared with the ECs. It processes large volumes of standardized data in a few minutes, however; yet is still unable to provide them in real-time.

The type of data shown in the platform are:

Table 12. EDC type of data

Type of data	Unit	Granularity
Basic data of external participants and (contact details, names, addresses, etc.) and identifiers such as EAN	-	-
Measured consumption data in fifteen-minute intervals	kWh	15 min.
Measured production data in fifteen-minute intervals	kWh	15 min.
Evaluated data after sharing calculation	kWh	15 min.

The end customers of the platform include energy producers, electricity providers, distribution system operators, market operator and energy communities.

A UI for end users has been developed, along with video tutorials and manuals to guide the end users.

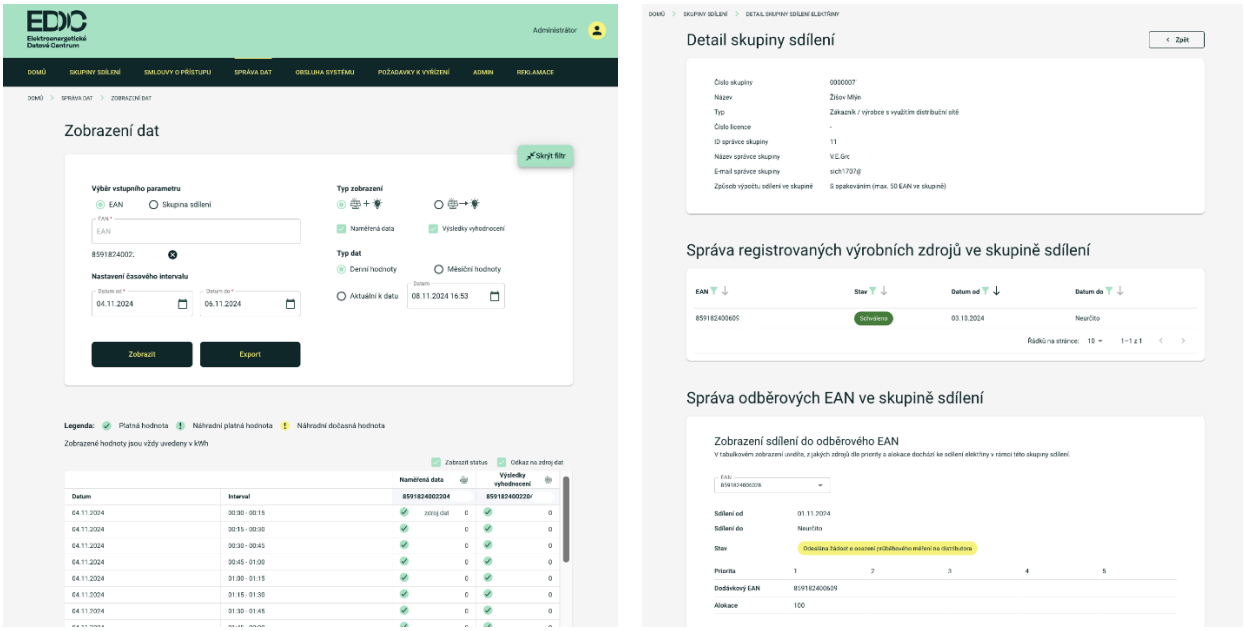

Figure 32.: EDC UI view

Regarding the technical requirements for accessing the platform, access to the web portal is a requirement for end users. For selected market participants, it is automatic communication in the CIM format.

In terms of governance schemes that are in place, in accordance with Section 27d of the Energy Act, EDC concludes so-called "access contracts". If accepted, data from the contract and the technical data that are necessary for sharing are stored for a period of up to 10 years. These are the following categories of personal data:

- data necessary for the fulfilment of EDC's legal obligations, in particular data on the consumption, sharing, consumption and accumulation of electricity;
- data necessary for concluding, fulfilling and amending contracts for access to the data center;
- data necessary for ensuring access to the data center information system and its operation;
- data necessary for handling complaints and claims; and
- employee data, including an extract from the criminal record.

3.4.2. IMPACT

The main advantage of the EDC platform is the subtraction of the produced electricity from the electricity consumed at various collection points. Customer can provide (share) the electricity produced at the same moment (15-minute block) to another supply point at another address (anywhere in the Czech Republic).

More than 12,000 end users and 15,000 supply points have accessed the platform in the 3 months since its launch.

There is ongoing campaign in media mainly driven by electricity providers and/or PV or battery storage installation firms for promoting active consumer participation and encouraging consumers to change their behaviour.

3.5. EDSN ENERGIE DATA SERVICES

As a collaboration platform for grid operators, Energie Data Services Nederland (EDSN) facilitates the free energy market in transition with knowledge and expertise. We do this by ensuring robust, transparent market processes and making all relevant energy data securely available. In this way, we give the energy transition and sustainability of the Netherlands ample scope.

3.5.1. TECHNICAL INFORMATION

The EDSN platform facilitates the exchange of energy data between market participants in the Dutch energy sector. It supports processes such as meter data collection, supplier switching, and customer data management. The platform ensures reliable and secure communication to enhance the efficiency and transparency of the energy market.

EDSN processes data relating to energy connections and related data. This includes the address of the connection, data about the energy contract and data about the consumption of the connection. This data is being processed on behalf of the grid operators.

The primary users of the EDSN platform are energy suppliers, DSOs, and other market participants. End consumers can also access their own consumption data through the platform. A UI for end users is also available. The EDSN platform provides an online portal where users can manage their data exchange processes.

Accessing the EDSN platform typically requires an internet connection and a compatible web browser. Users need to log in through the customer portal, which ensures secure access to their data.

In terms of governance schemes, EDSN may only provide data to third parties on behalf of the grid operators or on behalf of the energy supplier with the consent of the end customer. This is always done according to the rules within the energy and privacy legislation.

3.5.2. IMPACT

The EDSN platform offers several benefits for end-users, including centralized access to energy data, enhanced transparency, and improved efficiency in energy management. It supports the development of new applications for energy savings and provides tools for monitoring and managing energy consumption more effectively.

According to the EDSN website, 2,270,105 people switched energy suppliers through EDSN in 2023, 3,320,550,358 return data was exchanged and 310 market parties used the portal in 2023.

The platform includes functionalities that promote active consumer participation, such as providing detailed consumption data and supporting the use of smart meters. These features help consumers understand their energy usage and adopt more efficient energy behaviours.

3.6. ELHUB

Elhub is the Norwegian power industry's common data hub, where all data from electricity meters across the country is collected in a common system. The aim of Elhub is to make it easier for customers, grid companies and power suppliers to report electricity consumption and detect problems in the distribution grid.

3.6.1. TECHNICAL INFORMATION

Elhub supports the distribution and aggregation of meter readings for all consumption and production in Norway. The grid companies are tasked with submitting all hourly readings to Elhub, and Elhub then passes on the readings to the relevant power suppliers, third parties and end users.

Elhub also calculates the basis for the balance settlement, which is the financial settlement in the regulating power market, and then reports the resulting settlement to eSett.

The type of data shown in the platform are:

Table 13. ELHUB type of data

Type of data	Unit	Granularity
Energy production	W	Hourly
Energy consumption	W	Hourly

The end users of the platform are power suppliers, third parties and end users. No UI has been developed for the end-users.

The process for accessing the platform is as follows: All production and consumption at all measuring points in Norway are stored in Elhub. As an end user, they can log into Elhub via their power supplier's website. They can then see, control and grant access to their own data stored in Elhub. This solution is called Elhub Min Side.

Elhub is a neutral data hub which handles all meter data and market processes in the Norwegian power market. Through standardised messaging interfaces, all market participants relate to a single party, Elhub accepts and processes incoming messages, and then generates messages which are then distributed to the submitter and relevant parties. In accordance with specific validation rules, market participants thus receive information about supplier switches, changes to master data, and meter readings concerning electricity production and consumption in Norway.

Elhub is developing APIs to support their vision of sharing more data with the public and end users.

3.6.2. IMPACT

Elhub is a common portal for network operators and energy suppliers in Norway, which simplifies the energy market for electricity customers and makes it more efficient. All production and consumption at every measurement point in Norway is stored in Elhub. End users can log in to Elhub via the website of their electric utility company. They can then view, control and access their energy data stored in Elhub.

The Norwegian data hub (Elhub) has 3 million consumers who can even use the platform to change vendors automatically without having to follow the traditional route, in which a customer is responsible for communicating with his current vendor for terminating the existing contract and then communicating with his new vendor and providing him the necessary data for signing the new contract.

Although ElHub does not offer any sort of recommendation or analytics, third party applications use their data to provide these services or just raw data that can be downloaded.

3.7. ENEDIS DATAHUB

The Enedis Data Hub is a centralized platform developed by Enedis, the French electricity distribution network operator, to manage and facilitate the exchange of energy data. The platform is designed to streamline the collection, management, and sharing of electricity consumption and production data. It supports various stakeholders in the energy market, including DSOs, energy suppliers, local authorities, and end consumers.

3.7.1. TECHNICAL INFORMATION

The Enedis Data Hub facilitates the exchange and management of energy data for the electricity distribution network in France. It supports various processes such as meter data collection, energy consumption monitoring, and data sharing with market participants to enhance energy efficiency and support the energy transition.

The platform handles various types of data, including electricity consumption data, production data from renewable sources, and grid operation data. This data is crucial for monitoring energy usage, managing the grid, and supporting energy transition initiatives.

The primary users of the Enedis Data Hub are DSOs, energy suppliers, local authorities, and other stakeholders involved in the energy market. End consumers can also access their own consumption data through the platform. In addition, there is a user interface for end users. The Enedis Data Hub provides an online portal where users can access and manage their energy data.

Accessing the Enedis Data Hub typically requires an internet connection and a compatible web browser. Users need to log in through the customer portal, which ensures secure access to their data.

The Enedis Data Hub employs strict governance schemes to ensure data security and privacy. This includes standardized protocols for data exchange, access controls, and compliance with legal and regulatory requirements. The platform ensures that data is anonymized and shared in a way that protects personal and commercially sensitive information.

3.7.2. IMPACT

The Enedis Data Hub offers several benefits for end-users, including centralized access to energy data, enhanced transparency, and improved efficiency in energy management. It supports the development of new applications for energy savings and provides tools for monitoring and managing energy consumption more effectively.

The Enedis Data Hub serves approximately 35 million customers in France. The platform includes functionalities that promote active consumer participation, such as providing detailed consumption data and supporting the use of smart meters. These features help consumers understand their energy usage and adopt more efficient energy behaviours.

3.8. ENERGINET DATAHUB

Energinet DataHub is a central storehouse with massive volumes of data about Denmark energy consumers (including consumer contracts, grid fee billing and balance settlement), their consumption patterns, and prices from approximately 3.3 million metering points. All market parties could contribute to DataHub, and access it at any point in time, for any information they needed.

The Energinet Datahub is the first forerunner in Europe that has made its technical know-how public so that other countries could create their own Data Hub similar with the Danish system.

3.8.1. TECHNICAL INFORMATION

Energinet DataHub primarily serves market players in the Danish electricity market, who use Energinet DataHub to communicate with each other about the electricity consumption of Danish consumers and to make sure that they have all the information necessary to bill their customers.

The types of data shown in the platform are:

Table 14. Energinet DataHub type of data

Type of data	Unit	Granularity
Energy production	W	Hourly
Energy consumption	W	Hourly
Analysed and processed data by third parties	N/A	N/A

Energinet DataHub has an API available to private individuals, businesses, and third parties. To retrieve actual data the third party must be authorized by customers to access data for specific metering points for specified periods of time. The third party must request access from the customer by a separate process which is not part of the API.

On the technical side, the usability requirements are limited to having access to the platform via web and downloading files or through an API-based access.

Every piece of information about the electricity consumption of Danish consumers is stored in DataHub, which also handles business processes, such as change of address, change of supplier etc. When grid operators submit readings for a metering point to DataHub, it transfers the information to the applicable electricity supplier, who is then able to bill the consumer.

Energinet upgraded DataHub to include the so-called Supplier-centric Model, which changed the rules and the roles of market players in the Danish electricity market. Consequently, it is now the electricity supplier who is responsible for all customer communication – including billing – which ensures that the electricity customer only receives one single invoice.

Customers authorise parties to use their information for specific purposes. For example – if a particular service needs access to a customer's consumption data, this must be authorised by the customer. Customers can see which companies have access to their information and the time periods that these permissions are in place for. They can revoke the authorisation at any time.

3.8.2. IMPACT

DataHub has the capacity to process metered data and business processes for all 3.3 million Danish electricity consumers. Based on the information obtained directly from official sources, during the last six months of 2022 there has been a 500% increase in the number of queries on electricity consumption data within the quota of users who interact with the application. And specifically, approximately 5 out of 6 users who have an access ID to the application consult information on their electricity consumption in the indicated period.

Energinet does not offer any sort of recommendation or analytics. Recommendation (or statistics) are shown via third-party applications implementation.

3.9. ESTFEED

ESTFEED is a highly secure and transparent data sharing platform developed by the Estonian transmission system operator, ELERING. It aims to connect smart meter data from various hubs and sources across Europe with energy services in order to integrate retail markets, offer new smart services and lower costs. End-consumers can keep track of their own energy consumption and use it with comparison tools to receive personalized offers.

3.9.1. TECHNICAL INFORMATION

ESTFEED is a highly secure and transparent data transport layer with a consent management system that enables the consumer to be in control of his or her energy data and to choose with whom to share data with and also have an overview who has accessed the data.

The high-level functionalities (business processes) handled by Estfeed include:

- Handling of and access to metering data – enabling easy, transparent and equal access to metering data by all stakeholders (including consumers, suppliers, BRPs, aggregators and any other interested parties). Features data collection, transfer to central databases, data storage, data verification, data sharing and management of authorisations;
- Supplier switching;
- Managing open supply chain (including change of BRP; balance responsibility is ensured through a continuously open supply chain);
- Balance scheduling;
- Balance settlement;
- Calculation of RES production and subsidies along with calculation of residual mix;
- Register for Guarantees of Origin;
- Joint invoicing with network invoice forwarding;
- Comparison tool; and
- Single point of access to different types of data (electricity, gas, heat, prices, weather, etc

The types of data shown in the platform are:

Table 15. ESTFEED type of data

Type of data	Unit	Granularity
Energy prices	€/kWh	Hourly
Metering data (grid injected)	W	Hourly

Overall, ESTFEED is a data sharing platform that allows network companies, energy producers, and consumers to interact more efficiently and make the data collected during energy consumption understandable and usable for end users. It enables the consumer to be in control of his or her energy data and to choose with whom to share data with and also have an overview who has accessed the data. The final users of the platform are the data providers. It is not a tool for energy consumers. The service works on a B2B basis. The platform can interface with various data sources and these data can be used in the applications desired.

ESTFEED brings together data sources and applications. Data sources range from electricity, gas, and district heating smart meter readings to weather forecasts and energy day-ahead prices. It can also be consumption information from individual devices in industry, offices, and households.

ESTFEED is a portal that gives developers a chance to access this information flow. By interpreting and combining data, they can create useful applications for themselves or their customers (end consumers). The aim of the applications is to improve efficiency, either for cost optimisation or for other end consumers purposes.

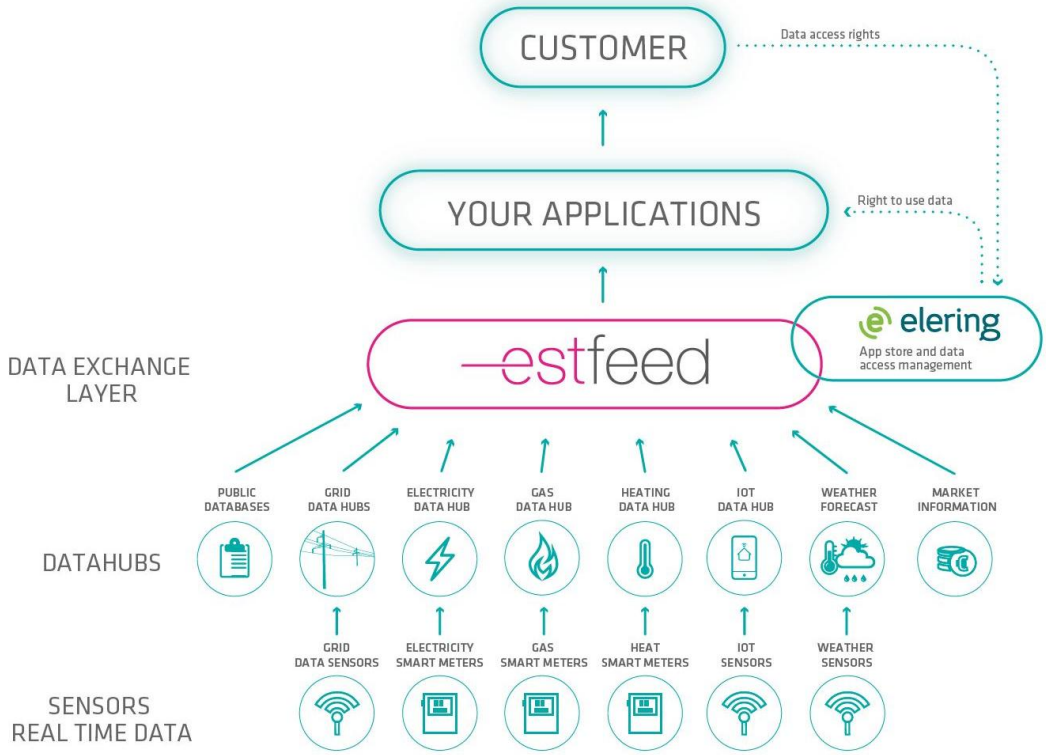

Figure 33.: Data flows and access management scheme of ESTFEED

3.9.2. IMPACT

ESTFEED is not aimed at providing a service to end-users. They can only be data providers for third parties to use their data and offer them their services via a set up Data Hub.

The objective of the ESTFEED project is to create a smart grid that allows market players to obtain energy consumption information securely and transparently, to understand the needs related to the metering point, and to change their behaviour accordingly. The ESTFEED platform and applications turn the data into valuable information for consumers, energy producers, network companies, and other participants in the energy market.

What ESTFEED does:

- Connects data sources, applications and market participants
- Provides secure access and management of consumption data and related rights

- 12 ESTFEED services for applications, such as consumption aggregators, virtual power plant, one stop shop for renewable producer, heat monitor, office building manager, central heating operator plant monitor, price package comparison, etc.
- Electricity Data Hub, Gas Data Hub, Central Commercial Register, Electricity price (Nord Pool), weather forecast (Foreca)
- Promotes applications that increase energy production, transport and consumption efficiency

ESTFEED went Live in September 2017 and every month there are about one thousand new end consumers who sign-in to ESTFEED customer portal to study their electricity and gas metering data and give about 500 to 1000 consents in one month to energy suppliers or other energy services to access their data.

ESTFEED is a data sharing platform in the energy sector that enables Data Providers (e.g., Data Hubs) to share data with Data Users (e.g., applications of energy services).

Besides the highly secure architecture, the value of ESTFEED lies in the consent management system that is built on top of the data exchange platform. This makes it possible for the Data Owner (end-users and businesses) to give permissions (consents) to different energy service providers to use their private metering data.

3.10. FINGRID DATAHUB

Fingrid Datahub is a centralised information exchange system for the electricity retail market, storing data from 3.8 million electricity accounting points in Finland. The data stored in Datahub will be used by approximately 80 electricity suppliers and 80 distribution system operators serving their customers: electricity consumers. The shared system will improve and speed up the service received by electricity consumers, with the parties to the information exchange (electricity suppliers, distribution system operators) operating in the same system. The system contains information on electricity accounting points, electricity consumption, and electricity contracts.

Datahub is administered by Fingrid Datahub Oy, which is a subsidiary of Fingrid Oyj, the Finnish transmission system operator.

3.10.1. TECHNICAL INFORMATION

The Datahub handles various types of data, including customer information, metering data, and accounting point information. This data is essential for processes such as billing, supplier switching, and energy consumption monitoring.

Datahub processes information related to electricity accounting points. Datahub stores data on the accounting point's owner as well as the accounting point's consumption data and other related data. For instance, when a person moving to a new apartment sign an electricity agreement with an electricity supplier and a network company, the customer's information is updated in Datahub by the electricity supplier. Both the supplier's and the network company's data for the accounting point is always transferred from their own systems to Datahub. This means that all information related to an electricity accounting point, in this case the apartment, is found in the same system.

Personal data stored in Datahub includes:

Name

- Personal identity code or date of birth
- Address
- Phone number
- Email address
- Information on the electricity agreement (e.g., validity period)
- Electricity accounting point ID
- Electricity accounting point address
- Additional information on the electricity accounting point (e.g., fuse rating, connection status)
- Network service product (e.g., general transmission)
- Authorisations
- Information on invoicing
- Consumption information

In case the customer contacts Fingrid Datahub, the following information may be stored:

- Information related to the issue

3.10.2. IMPACT

The Fingrid Datahub offers several key benefits for end-users:

- **Centralized Data Access**: End-users can access all their electricity usage data in one place through the Datahub customer portal. This centralized access simplifies the management of electricity consumption and billing information.
- **Enhanced Transparency**: The platform provides transparent and up-to-date information on electricity usage, helping users understand their consumption patterns and make informed decisions about their energy use.
- **Improved Efficiency**: By streamlining data exchange processes, the Datahub reduces errors and speeds up transactions such as supplier switching and billing. This efficiency benefits end-users by ensuring more accurate and timely services.
- **Support for Smart Grids and Meters**: The Datahub promotes the full utilization of smart grids and meters, enabling the development of new applications for electricity consumers. These applications can help users save energy and monitor their consumption more effectively.
- **Enhanced Security and Privacy**: The platform employs robust security measures to protect user data, ensuring that only authorized parties have access. This enhances the privacy and security of personal and consumption data.

Overall, the Fingrid Datahub provides a more efficient, transparent, and secure way for end-users to manage their electricity data, ultimately leading to better energy management and cost savings.

As stated, the Fingrid Datahub is used by approximately 80 electricity suppliers and over 80 distribution system operators (DSOs). The platform manages data for around 3.8 million electricity points of use in Finland.

The Datahub provides a customer portal where consumers can access detailed information about their electricity usage. This transparency helps consumers understand their consumption patterns and identify opportunities to save energy. Also, the Datahub facilitates the development of new types of applications for electricity

consumers. These applications can include tools for saving electricity, monitoring consumption, and managing energy more efficiently.

3.11. REN DATAHUB

The REN Data Hub is an open-data platform developed by REN – Redes Energéticas Nacionais, Portugal's energy transmission system operator. Launched in June 2021, this platform aggregates and provides up-to-date and historical data on Portugal's energy sector, including electricity and natural gas. It offers insights into energy consumption, production, and forecasts, supporting transparency and research in the energy domain.

The Data Hub platform aggregates and makes available, in an up-to-date manner, quantitative data on the national energy sector (15 minutes electricity data and hourly natural gas data) ensuring users have access to the latest information. It has been recognized internationally, winning the Gold Stevie Award in the Website category for Energy at the 19th International Business Awards and receiving honours at the Vega Digital Awards 2022 for Best Data Visualization. It offers insights into energy consumption, production, and forecasts, supporting transparency and research in the energy domain.

By providing open access to comprehensive energy data, the REN Data Hub aims to foster knowledge sharing and support the transition towards a more sustainable and decarbonized energy system.

3.11.1. TECHNICAL INFORMATION

The REN Data Hub is a comprehensive platform that provides regularly updated information on Portugal's energy sector. Its main functionalities include:

- **Continuous Monitoring**: Users can access up-to-date information on electricity and natural gas metrics, with electricity data updated every 15 minutes and natural gas data hourly.
- **Data Visualization**: The platform offers interactive charts and graphs, allowing users to visualize energy production, consumption, and transmission data effectively.

- **Forecasting**: It provides forecasts for electricity consumption and renewable energy generation, aiding in planning and decision-making processes.
- **Open Data Access**: All information is available in an open data format, facilitating easy sharing and use by researchers, professionals, and the general public.

The types of data shown in the platform are:

Table 16. REN Data Hub type of data

Type of data	Unit	Granularity
Electricity Production	Megawatt-hours (MWh)	Updated every 15 minutes; detailed by primary sources such as coal, natural gas, hydro, wind, solar, biomass, and others.
Electricity Consumption	Megawatt-hours (MWh)	Updated every 15 minutes; includes total consumption and losses in transmission and distribution networks.
Electricity Imports/Exports	Megawatt-hours (MWh)	Updated every 15 minutes; indicates the balance between production and consumption.
Renewable Generation Share	Percentage (%)	Updated every 15 minutes; represents the proportion of electricity generated from renewable sources.
Electricity Market Prices	Euros per Megawatt-hour (€/MWh)	Daily average prices; sourced from the Iberian Electricity Market Operator (OMIE).
Natural Gas Transmission Inputs	Megawatt-hours (MWh)	Updated hourly; details the origin of natural gas entering the National Gas Transmission Network (NGTN), including interconnections with Spain and LNG imports via the Sines terminal.

Natural Gas Transmission Outputs	Megawatt-hours (MWh)	Updated hourly; categorized by destinations such as interconnections, underground storage, and supply for consumption.
Natural Gas Demand Forecast	Megawatt-hours (MWh)	Updated hourly; provides forecasts of total hourly natural gas consumption in mainland Portugal, distinguishing between conventional consumption and consumption for electricity generation.

The REN Data Hub with all information in an open data format, is designed for a diverse audience, namely academics, researchers or professionals of the sector will have easy and intuitive access to the most relevant data on energy production and consumption in Portugal. The site also allows access to larger segmentation of data, such as production's breakdown by primary sources.

- **Academics and Researchers**: To facilitate studies and analyses related to the energy sector.
- **Energy Professionals**: For industry insights and operational planning.
- **Policy Makers**: To inform energy policies and regulatory decisions.
- **General Public**: To promote transparency and public awareness of energy data.

REN Data Hub provides a user-friendly web-based interface accessible at https://datahub.ren.pt/. The platform offers interactive visualizations and dashboards for data exploration.

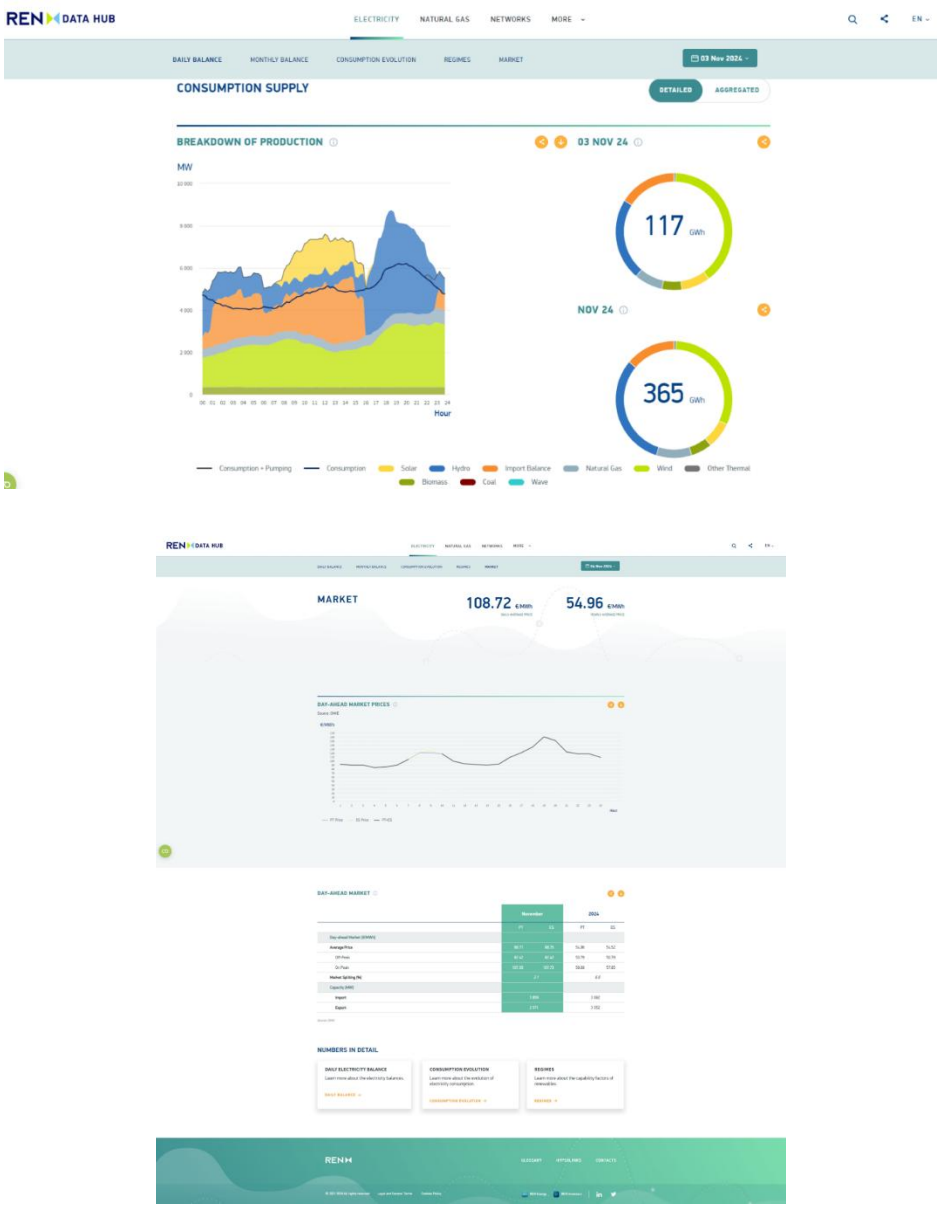

Figure 34.: REN Datahub UI view

The technical requirements for accessing the platform:

- **Internet Connection**: A stable internet connection to load data and visualizations.
- **Web Browser**: A modern web browser (e.g., Chrome, Firefox, Safari) with JavaScript enabled.
- **Device Compatibility**: The platform is optimized for desktops and may have limited functionality on mobile devices.

The REN Data Hub adheres to stringent data governance practices to ensure the accuracy, security, and compliance of its data. Data is collected from REN's operational systems, providing accuracy and reliability. Regular audits and validation processes are conducted to maintain data integrity. The platform offers open access to data, promoting transparency and supporting research and innovation in the energy sector. By implementing these governance schemes, REN ensures that the data provided through the Data Hub is both reliable and accessible to all stakeholders.

3.11.2. IMPACT

The benefits for the end-users are:

- **Comprehensive Energy Data Access**: Users can access up-to-date quantitative data on Portugal's energy sector, including detailed information on energy production, consumption, and transmission.
- **Support for Research and Innovation**: By providing open data, the platform facilitates academic research, policy analysis, and innovation within the energy sector.
- **Enhanced Transparency**: The platform promotes transparency by documenting the transformation of the energy sector towards decarbonization, allowing stakeholders to monitor progress and developments.

Specific data on the number of end-users, including consumers and DSOs, accessing the platform is not publicly disclosed.

The REN Data Hub primarily serves as an information repository and does not include interactive features designed to promote active consumer participation or influence changes in individual energy consumption behaviours.

3.12. SIORD

The digitalization and monitoring of the distribution network becomes a priority for the hereinafter, DSOs, to operate their network, guarantee and improve the quality and reliability of the supply. In this scenario, the current information exchange model (in real time) between the agents connected to the distribution network and the DSOs must evolve to consider the implementation of new flexibility systems in the network.

This includes the flexible access connection to the network and possible flexibility services, as stated in the proposal for the new Flexibility Network Code (Network Code on Demand Response). For its implementation, SIORD plays a key role.

SIORD does not store data but receives it in real time from significant users (USR) of more than 1MW connected to the grid (mainly active and reactive power and the status of the switches) through Generation and Demand Control Centres (GD-CCs). This information is forwarded to the DSO to which it is connected and vice versa. Thus, the system (operational since 2023) is like a centralized SCADA that allows you to monitor, manage and maintain the system: new connections, check communications, KPIs etc.

SIORD, as a platform that integrates the DSOs of the national territory, represents the most efficient solution from a technical-economic point of view to develop the necessary functionalities as a flexibility operator. The design of the SIORD platform, based on open protocols and the highest security standards, guarantees high availability, possibility of scaling and functional evolution capabilities, while maintaining low operation and maintenance costs.

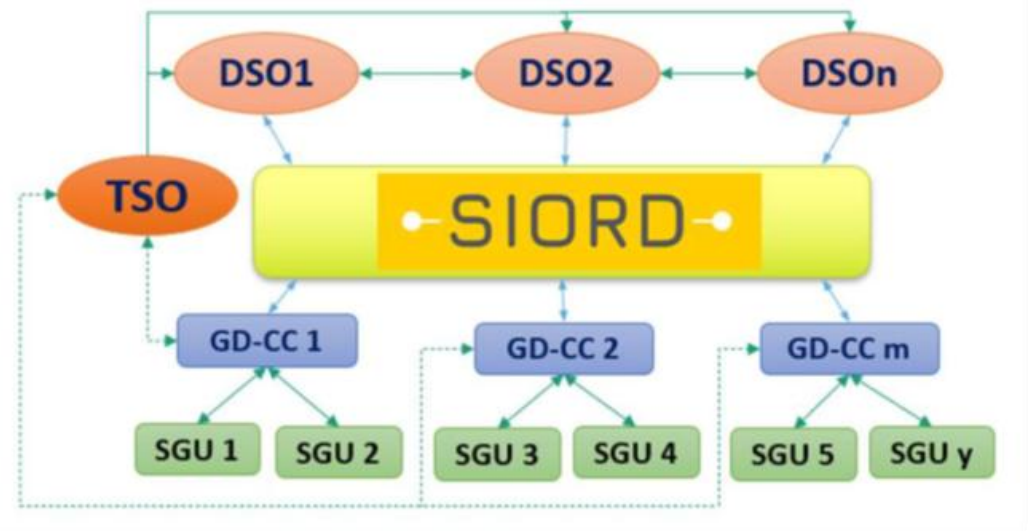

Figure 35.: SIORD overall concept

3.12.1. TECHNICAL INFORMATION

SIORD is initially developed as a single platform to facilitate the exchange of USR and DSO information. The main functionalities and current features of SIORD “v1” already implemented and in use are the following:

- SIORD is prepared to admit different communications protocols and is open to linking with all GD-CCs.
- It guarantees the confidentiality of the USR information, since only the DSO to which it is connected can access it.
- It does not store or process information, being only a means of data exchange and communication.
- Improves the reliability of the exchange of information between the agents of the electrical system, decentralizing the current information flows between TSO, DSO, GD-CC and USR.
- Low operating costs, which makes it easier to reduce the minimum power threshold for sending information in real time.

The data shown in the platform are:

Table 17. SIORD type of data

Type of data	Unit	Description	Granularity
Connection state	N/A	Connection state of the installation to the transmission or distribution network.	Real-time
Active Power produced	MW	Active power produced by the installation, except the own consumptions of the generation units.	Real-time
Reactive Power Produced	MVAr	Reactive power produced by the installation, except the own consumptions of the generation units.	Real-time
Voltage in busbars	kV	Voltage measured in power plant busbars.	Real-time
Max. Power Produced	MW	Maximum power produced in the current conditions.	Real-time

Hourly production	MWh	Expected hourly production in hour h+1 with hourly update.	Real-time
Active power consumed	MW	Active power consumed by the installation, except for consumption associated exclusively with the generation units.	Real-time
Reactive power consumed	MVAr	Reactive power consumed by the installation, except for consumption associated exclusively with the generation units.	Real-time

The principal end users of the platform are the GD-CCs, SIORD operators (OPS) and Information Platforms with Distributed Energy Resources (PIRED). Also, the DSO is an end user, so SIORD facilitates the exchange of signals from its observable network between distributors.

As for the existence of a user interface, it is already developed a signal concentrator for the exchange of information in real time, but it does not have an interface as such. In any case, there is a development in progress on a management portal that will have its own interface.

The technical requirements in charge of the entity that aims to access the platform are the following:

- Establish the communications link.
- Identify the electrical resources to integrate, as well as their Unified Supply Point Code (CUPS), which in any case will not be from physical people.
- Identify the communication channel data for the new communications link between SIORD and the entity´s platform (PIRED, such as an electric vehicle charging point management or self-consumption monitoring platforms) to ensure the sending and reception of data with the SIORD platform through said link.

- Guarantee the validity of information and verification of data exchanged in real time with SIORD.

Additional technical requirements that need to be determined with SIORD are the following:

- Agree on the content and format of the real-time resources information to be exchanged.
- Provide the data to register the new communication channel between the entity´s platform and SIORD.

To date, the platform does not store or process the information, so no governance scheme is being used.

3.12.2. IMPACT

The DSOs are developing new solutions to improve real-time information exchange processes with the energy resources connected to their network. Real-time information allows for efficient and safe operation of the distribution network. The national DSOs have developed a Distribution Network Operator Information System (SIORD) to unify the communication channel between the distributed energy generation and those agents who have the obligation to send information in real time according to current legislation (significant network users or USR).

To date, around 5 to 10 GD-CCs, OPS or PIREDs are connected. And a similar number of distribution companies are already connected. With the launch of the regulatory sandboxes and the regulatory evolution, we expect the number of connections to multiply.

As to the special functionalities that promote active consumer participation, SIORD enables the information exchange from installations and consumers with the DSOs throughout GD-CCs, OPS or PIREDs, who act as interlocutors. SIORD was created to facilitate the integration of new services into the network, thus allowing not only the monitoring of these resources in real time, but also the sending of instructions. Therefore, it is developed to facilitate the active participation of these clients in new markets and flexibility mechanisms managed by distributors based on the needs of their network.

3.13. MYTILINEOS SMART CITIES PLATFORM

The MYTILINEOS Smart Cities platform envisions an energetic community with digital innovations aimed at improving quality of life, enhancing performance, optimizing resources and engaging citizens actively and efficiently.

3.13.1. TECHNICAL INFORMATION

The main functionalities of the platform are:

- Smart Energy Management
- Smart Infrastructure and Mobility
- Urban Data Analytics
- Sustainability and Environmental Monitoring
- Citizen Engagement and Services
- Integrated Building Solutions
- Cybersecurity and Data Protection
- Smart Healthcare and Emergency Services
- Smart Water and Wastewater Management

The types of data shown in the platform are:

Table 18. MYTILINEOS Smart Cities platform type of data

Type of data	Unit	Granularity
Energy Consumption	kWh	Annual/monthly/weekly/daily
Grid to Build Power	kWh	Annual/monthly/weekly/daily
PV to Build Power	kWh	Annual/monthly/weekly/daily
Battery to Build Power	kWh	Annual/monthly/weekly/daily
Grid Withdraw Power	kW	Annual/monthly/weekly/daily (*)
PV Power Production	kW	Annual/monthly/weekly/daily (*)

Home Consumption	kW	Annual/monthly/weekly/daily (*)
Battery	kW	Annual/monthly/weekly/daily (*)
EV	kW	Annual/monthly/weekly/daily (*)
Available Battery Capacity	Percentage (%)	Real-Time
Total Stored Energy	kWh	Real-Time
Device State	On/Off	Real-Time
Battery Health	Descriptive	Real-Time
State of charge	Percentage (%)	Real-Time
Battery stored energy	kWh	Real-Time
Total Charge Cycles	Total cycles	Real-Time
Total battery usage	Operation time (hours)	Real-Time
Date for check	Current Date	Real-Time
CO_2 Emission Saved	Tons CO_2	Annual/monthly/weekly/daily
Annual Energy Production	kWh	Annual/monthly/weekly/daily
Building Energy Consumption	kWh	Annual/monthly/weekly/daily
Net Zero	Percentage (%)	Annual/monthly/weekly/daily
Battery Autonomy	Battery level percentage (%)	Real-Time
Green Energy Consumption	kWh	Real-Time

Smart Battery Health - Expected Life Cycle Improvement	Percentage (%)	Real-Time
Weather	1. Feel Like Temperature 2. Dew Point 3. Barometer 4. Humidity 5. Wind Direction 6. Wind Speed 7. Solar Radiation 8. Sunrise 9. Sunset	Real-Time

(*) It is presented the average power over the selected time interval

The developed UI is not public available yet, it is used by the company only.

Figure 36. A screenshot of Mytilineos smart home dashboard

Regarding the governance schemes that are being used for the collection and access to data, the users of the houses have signed concession form for the provision of data from the houses.

3.13.2. IMPACT

The MYTILINEOS SMART CITIES platform creates an ecosystem that enables residents, businesses, and authorities to collaborate in building a smarter, more efficient, and sustainable urban environment. The platform's ability to aggregate, analyse, and visualize data leads to improved decision-making, cost savings, enhanced services, and a better overall quality of life for everyone involved. It is used only by Mytilineos company.

3.14. EDDIE

The project EDDIE is thoroughly analysed in Section 4.6 of this deliverable, so the respective EDDIE platform functionalities and impact is described in the respective section.

3.15. INSIGHTS TOWARDS ECLIPSE

The review of the energy platforms provided a set of best practices that can be also considered within the ECLIPSE solutions:

- **Open Data Format**: In some platforms, the information is provided in an open data format, allowing for easy sharing and use at any time. This promotes transparency and facilitates research and innovation within the energy sector. A short list of such data formats and protocols to manipulate data organised in these formats will be also useful, for allowing less effort for developing new applications.

- **Data governance and security**: Energinet DataHub has an API available to private individuals, businesses, and third parties. To retrieve actual data the third party must be authorized by customers to access data for specific metering points for specified periods of time. The third party must request access from the customer by a separate process which is not part of the API. Moreover, the value of ESTFEED lies in the consent management system that is built on top of the data exchange platform. This makes it possible for the data owner (end-users and businesses) to give permissions (consents) to different energy service providers to use their private metering data. It should be noted that all platforms

have well defined data governance schemes defined allowing consumers to control the share of their data. This is something that should be considered within the ECLIPSE architecture design. Moreover, the conditions of the data governance for using the private metering data should also consider a) which metering data is needed for the specific service (meaning that not all metering data of a certain user should be shared externally, but only the ones which are needed for a certain energy service), b) which time granularity is allowed to be shared with the external actor (it is a great difference between giving hourly mean data and giving minute-based or seconds-based data) and c) the time window for sharing the data. All these are suggested to be "a mirror" of the service contract annexes which describe such conditions. As an example, an extension of GDPR in the framework of energy service contracts - and labelled as C-DPR (Contractual DPR), is addressed in [1].

- **User-Friendly Interfaces**: Some of the platform feature intuitive and interactive user interfaces, enabling users to easily navigate, visualize, and interpret data. This enhances user experience and accessibility. These UI''s should be available for both mobile terminals (e.g. smart phones - for accessing the data anytime, as well as for stationary computers and laptops - where the higher resolution screen allows a more complex representation of the needed information.

- **Regular Data Updates**: Most of the platforms provide regular data updates, with electricity data updated up to every 15 minutes or up to hourly data. This ensures users have access to the most current information available. However, for specific energy services, a higher update (refresh) rate may be needed, e.g. each 1 minute or below. These requirements may be specifically needed when the feedback with such data need end-user reaction within a commercial time frame of e.g. 15 minutes, thus requiring eventually several corrections of the production / consumption / storage behaviour in due time, before the commercial interval ends.

- **IoT data integration**: The use of IoT devices for data-set production and the calculation of KPIs is being utilized in Mytilineos Smart Cities platform. This could be a feature that can be also part of the ECLIPSE solution to promote active customer participation in new markets and flexibility mechanisms.

- Information should contain both **historical and real-time data**, the latest being especially useful if actions are needed as well in real-time, e.g. within a commercial time period of 15 minutes or one hour.

4. BEST PRACTICES FROM OTHER PROJECTS AND INITIATIVES

An analysis of the most relevant European projects and initiatives related to energy ECLIPSE project, has been conducted.

The analysis includes the summary of the projects objectives and results, including main demo sites activities, and also the most relevant actions related to ECLIPSE project.

4.1. OPENTUNITY – OPENING THE ELECTRICITY ECOSYSTEM TO MULTIPLE ACTORS IN ORDER TO HAVE A REAL DECARBONIZATION OPPORTUNITY

Programme: Horizon Europe

From: 1 January 2023 to 31 December 2026.

Total cost: € 10 802 543,75

Webpage: https://opentunityproject.eu/

Coordinator: ETRA I+D

Partners who are also part of ECLIPSE consortium: HEDNO.

4.1.1. PROJECT DESCRIPTION AND OBJECTIVES.

OPENTUNITY's ecosystem reduces interoperability barriers and favour the use of standards in order to decarbonize EU grids and put the end-user in the spotlight. Grid

operators, prosumers, market actors etc. are supported by OPENTUNITY via innovative methodologies backed by advanced, interoperable software modules, in order to provide them with new features and services related to: 1) Technologies to for active consumers (or prosumers); 2) Technologies for DSOs and TSOs to better manage its infrastructure.

OPENTUNITY also evolves, adapts and integrates an energy-specialized blockchain as a distributed, fast and reliable energy dataspace in which actors from different fields share services and find synergies among them to create a reliable energy system.

4.1.2. PROJECT DEMO SITES.

The OPENTUNITY project showcases its innovations through four large-scale complementary demonstrators located in Greece, Slovenia, Spain, and Switzerland. These demonstrators involve a diverse range of energy sources, networks, systems, and assets, and are implemented across heterogeneous climatic, geographic, and socio-economic conditions and sizes. This diversity facilitates replicability, scale-up, and eventual market launch after the end of the project.

The consortium comprises various demonstration partners who provide access to critical infrastructures necessary for the project's implementation. Almost all of the innovations are tested at the four demo sites, ensuring coherent demonstrations and future replicability.

4.1.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

In Opentunity it will be developed the tool OPENFLEX (Flexibility in Prosumer's environment) to enable flexible delivery and valorisation of energy assets within buildings, including stationary storage and electric vehicle chargers. This includes the Non-intrusive load monitoring (NILM), which is a technology that estimates energy consumption of individual appliances, which can be implemented in real-time and can provide controllable feedback in terms of energy behavior and personalized recommendations to consumers. In ECLIPSE project, this technology will be implemented as part of CERF energy services.

4.2. INTERCONNECT - INTEROPERABLE SOLUTIONS CONNECTING SMART HOMES, BUILDINGS AND GRIDS

Programme: Horizon 2020

From: 1 October 2019 to 31 March 2024 (concluded)

Total cost: € 36 014 241,31

Webpage: https://interconnectproject.eu/

Coordinator: INESC TEC

Partners who are also part of the ECLIPSE consortium: E-REDES, Elektro Ljubljana, TRIALOG, E.DSO.

4.2.1. PROJECT DESCRIPTION AND OBJECTIVES.

The InterConnect project brought together the whole energy system value chain (R&D institutions, manufacturers, DSOs, retailers, IT providers, and energy users) to address the challenge of interoperability to interconnect and integrate digital homes, buildings, and electricity grids. The project aimed to develop and test an open ecosystem to unlock demand-side flexibility from smart homes, buildings, and communities contributing to the successful democratisation of energy management.

In late 2022, following the publication of the Digitalising the Energy System Action Plan by the European Commission, InterConnect further took on the challenge of creating the first blueprint for the creation of a Common European Reference Framework for Energy (CERF) for energy-saving applications with the ambition of reducing energy bills, stimulating energy efficient behaviour and contributing to the stability of the power system by enabling information exchange with consumers.

4.2.2. PROJECT DEMO SITES.

The InterConnect solutions were extensively tested in pilots located in Belgium, France, Germany, Greece, Italy, the Netherlands, and Portugal. Further to this, the validation of the first blueprint of the CERF took place in an additional number of pilots selected

through an Open Call launched in 2023. The Open Call pilots were located in Croatia, Lithuania, Latvia, Estonia, Germany, Denmark, France, Slovenia, and Spain.

4.2.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ECLIPSE solutions will build on several of the results achieved by InterConnect, in particular:

- The technical, regulatory, economic and social recommendations produced from the project experience.
- The requirements identified for the development of the CERF architecture, communication protocols, interfaces and data models.
- The Semantic Interoperability Framework (SIF), which deployed the concept of semantic interoperability into practice on a large scale to guarantee interoperability across appliances and services.
- The DSO interface (DSOi), which leverages the SIF to enable the communication between DSOs and household devices and allow data transactions between DSOs and service providers.
- The Interoperable Recommender (IR), which bridges the domains of the SIF and the DSOi to provide energy recommendations based on predicted scenarios and real-time grid measurements.
-

4.3. ODEON - FEDERATED DATA AND INTELLIGENCE ORCHESTRATION & SHARING FOR THE DIGITAL ENERGY TRANSITION

Programme: Horizon Europe

From January 2024 to June 2027.

Total cost: € 22 564 718,75

Webpage: https://odeonproject.eu/

Coordinator: ETRA I+D

Partners who are also part of ECLIPSE consortium: ETRA I+D, UBITECH.

4.3.1. PROJECT DESCRIPTION AND OBJECTIVES.

The ODEON project aims to realize the Digital and Green Transition by creating an inclusive ecosystem of stakeholders focused on integrating data, intelligence, services, and market flows. This approach enables the resilient operation of the energy system amidst increased renewable energy sources (RES) integration and effective utilization of flexibility offered by distributed energy assets.

ODEON introduces a Federated Energy Data Spaces implementation to integrate energy data across the value chain, fostering secure and trustful data sharing among stakeholders. This initiative removes barriers and enables stakeholders to tackle the complexity of decentralized energy systems through collective intelligence frameworks and data-driven intelligence.

4.3.2. PROJECT DEMO SITES.

Extensive validation will occur in 5 large-scale demonstration sites in Greece, Spain, France, Denmark, involving all relevant stakeholders and assets, to ensure effectiveness in different contexts.

4.3.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ODEON provides a user-friendly technological framework for managing data and intelligence to support innovative energy services and enhance grid resilience which is aligned with ECLIPSE objectives, to reduce energy consumption and emissions.

Moreover, ODEON facilitates seamless data exchange and integration across the energy value chain, fostering collaboration among energy stakeholders to establish a decentralized environment for flexible grid management, as in the case of ECLIPSE solution.

4.4. SYNERGIES - SHAPING CONSUMER-INCLUSIVE DATA PATHWAYS TOWARDS THE ENERGY TRANSITION, THROUGH A REFERENCE ENERGY DATA SPACE IMPLEMENTATION

Programme: Horizon Europe

From: 1 September 2022 to 28 February 2026.

Total cost: € 10 180 687,50

Webpage: https://synergies-project.eu/

Coordinator: TXT E-TECH SRL.

Partners who are also part of ECLIPSE consortium: ETRA I+D.

4.4.1. PROJECT DESCRIPTION AND OBJECTIVES.

SYNERGIES brings forward a reference Energy Data Space Implementation that unleashes data-driven innovation and promotes the creation of an inclusive ecosystem of stakeholders across the energy data value chain by leveraging on an intelligence-enabled digital solution.

The main objective consists in promoting an innovative solution based on knowledge sharing and data intelligence integration that includes all energy actors of a complex value chain, considering diverse data sources, heterogeneous energy systems and spanning different socio-economic characteristics.

4.4.2. PROJECT DEMO SITES.

SYNERGIES is extensively validated in 3 large-scale demonstration sites in Greece, Spain and Denmark involving complete value chains, diverse data sources, heterogeneous energy systems/assets and spanning different socio-economic characteristics.

4.4.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The SYNERGIES solution will value the flexibility capacity of consumers in optimizing energy networks' operation, maximizing RES integration and self-consumption at different levels of the system, which is aligned with ECLIPSE objectives, to reduce energy consumption and emissions.

Moreover, SYNERGIES will also support network operators in optimally monitoring, operating, maintaining and planning their assets and coordinating between each other for enhancing system resilience, creating an inclusive pathway towards the energy transition, through consumer empowerment, awareness and informed involvement, delivering personalized and automated features to increase prosumer acceptance, similarly to ECLIPSE CERF.

4.5. STREAM - STREAMING FLEXIBILITY TO THE POWER SYSTEM.

Programme: Horizon Europe

From: 1 October 2022 to 30 September 2026.

Total cost: € 10 370 000

Webpage: https://stream-he-project.eu/

Coordinator: University of Ljubljana – Faculty of Electrical Engineering

Partners who are also part of ECLIPSE consortium: ETRA I+D.

4.5.1. PROJECT DESCRIPTION AND OBJECTIVES.

Empowering data

The aim is to increase and facilitate collection, integration, analysis and utilization of data, both legacy and where available, open data to enable innovative energy and non-energy data-driven services, by leveraging on, and evolving standardizable capabilities

and technological tools to facilitate secure data sharing and exchange as the baseline building blocks of the STREAM Ecosystem framework.

Tailor-made services for end users

A service offering will be developed via the STREAM Ecosystem platform, which will allow the digitalization and addition of a wide array of technologies for offering flexibility services on local energy markets via a scalable and easy-to-implement user service framework. This service design will need to be carefully considered based on the specific consumer's desired level of involvement and the platform would focus on increasing the ease of participation and tailoring the amount of data reaching the consumer.

Utilization of local flexibility

The main aim is to develop a local market design on the LV grid that will enable the cross-integration of key stakeholders and facilitate cost-effective rendering of flexibility services via aggregation from consumers to flexibility & market operators and finally DSOs and TSOs. The key component of this objective is the establishment of a standard Device Register, which will be used to integrate consumer flexibility capacity, enable flexibility capacity and flexibility utilization.

Inform decision-making of policy makers and regulators

The introduction of a robust flexibility market via sMART and the unlocking of new, untapped business models for flexibility services will equip network operators and NRAs with new information and valuable insight to inform their decision-making processes for any planned grid upgrade and regulatory/policy changes that impact the structure and operation of local, national and international power markets.

4.5.2. PROJECT DEMO SITES.

The STREAM pilot sites were chosen carefully to present the diversity in geographical, economic, size and type of the consumers.

All the pilots focus on a specific part of STREAM Ecosystem but complement each other to form a comprehensive testing ground of all the elements of STREAM Ecosystem.

The demonstration sites were in Italy, Spain, Finland and Slovenia.

4.5.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ECLIPSE project builds directly on the STREAM project. The STREAM project's primary focus was calculating clients' flexibility and activating it, providing insights into how clients can adjust their energy usage in response to grid demands. These insights are crucial for the ECLIPSE project as it aims to take the next step by effectively communicating these flexibility needs to clients.

One of the key contributions of the STREAM project was its data collection and analysis.

The STREAM project's success in activating client flexibility laid the groundwork for ECLIPSE to focus on communication. STREAM demonstrated that clients could and would adjust their energy usage when informed of the need. ECLIPSE takes this a step further by ensuring that this information is communicated effectively and efficiently, enabling clients to take appropriate actions swiftly.

In essence, the ECLIPSE project is designed to complement and enhance the STREAM project's achievements. While STREAM was about understanding and activating flexibility, ECLIPSE is about ensuring that this flexibility is communicated clearly and promptly, thus creating a more dynamic and responsive energy management system.

4.6. EDDIE - EUROPEAN DISTRIBUTED DATA INFRASTRUCTURE FOR ENERGY

Programme: Horizon Europe

From: 1st January 2023 to 31 December 2025.

Total cost: € 8 800 168,77

Webpage: https://eddie.energy/

Coordinator: FHOOE

Partners who are also part of ECLIPSE consortium: D4G, FHOOE

4.6.1. PROJECT DESCRIPTION AND OBJECTIVES

EDDIE (European Distributed Data Infrastructure for Energy) aims to establish a comprehensive framework for energy data management and sharing across Europe. The project focuses on developing and implementing solutions that enable efficient data exchange, promote sustainability, and empower energy consumers through improved data accessibility and utilization.

The main objective is to create an integrated data infrastructure that facilitates cross-sectoral collaboration, supports energy transition initiatives, and enables data-driven innovation in the energy sector through various demonstrators and prototypes.

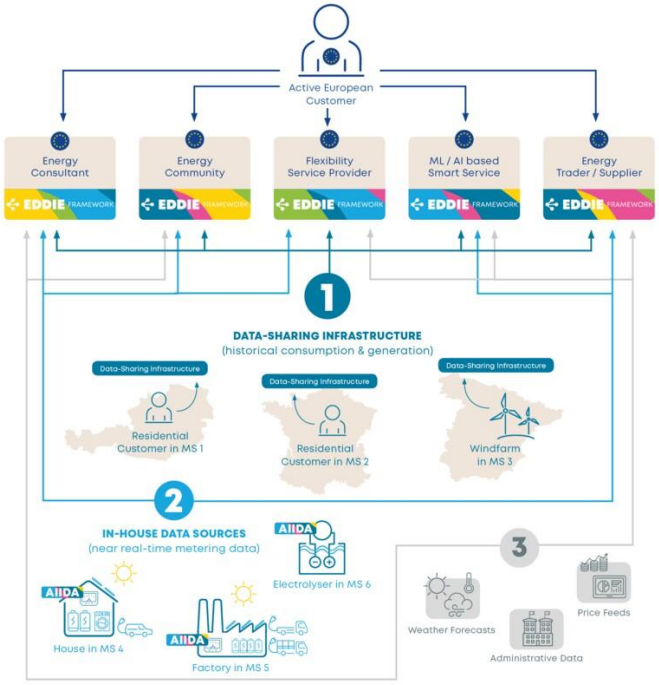

Figure 37. EDDIE architecture

4.6.2. PROJECT DEMO SITES

EDDIE validates its framework through multiple demonstrators, each focusing on different aspects of energy data management and utilization:

1. FlexiDAO Demonstrator
2. ÖTZI Strom Demonstrator

3. German Demonstrator
4. Flexible Grid Connections Agreements Demonstrator
5. Residential Prosumer Flexibility Prototype

4.6.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE

EDDIE's solutions align with ECLIPSE's goal of implementing energy consumer applications and data sharing frameworks. The project's focus on data infrastructure and consumer engagement complements ECLIPSE's mission of enabling voluntary energy consumption reductions. Through its various demonstrators and prototypes, EDDIE develops solutions for secure data exchange and consumer empowerment that can support and enhance ECLIPSE's objectives. The standardization efforts and interoperability frameworks developed within EDDIE contribute to the broader ecosystem of energy data applications that ECLIPSE aims to establish. Both projects share common goals in promoting consumer awareness, data security, and efficient energy management, creating potential synergies for future energy transition initiatives. EDDIE can support the demonstrators of ECLIPSE to fetch energy data and operate on EDDIE framework.

4.7. BEFLEXIBLE - BOOSTING ENGAGEMENT TO INCREASE FLEXIBILITY

Programme: Horizon Europe

From: 1 September 2022 to 31 August 2026

Total cost: € 10 383 163,75

Webpage: https://beflexible.eu/

Coordinator: I-DE REDES ELECTRICAS INTELIGENTES SA

Partners who are also part of the ECLIPSE consortium: I-DE, E.DSO

4.7.1. PROJECT DESCRIPTION AND OBJECTIVES.

The project aims to boost consumer engagement in network management, by increasing energy system flexibility, enhancing cooperation among DSOs and TSOs and easing participation of all energy-related actors in electricity markets.

The project further develops already demonstrated solutions (e.g., from the previous Horizon 2020 CoordiNet project) to design new cross-sectorial business models to increase flexibility in power systems and analyses existing regulatory frameworks to ensure alignment with emerging energy customer- and grid-centric energy services. BeFlexible further fosters the emergence and adoption of local flexibility platforms in the market domain and their integration in DSO-TSO coordination platforms while increasing consumer engagement and acceptance of the proposed technologies.

4.7.2. PROJECT DEMO SITES.

The BeFlexible solutions are extensively validated in 3 large-scale demos (South-mid EU, North EU and South-west EU). Each of these demos is further articulated in pilots, totalling a number of eleven pilot sites spread across four countries (Italy, Sweden, Spain, France).

The pilots are testing several types of services, including customer-centric services (e.g., individual and collective energy optimisation, flexibility optimisation for grid services, cross-sectoral flexibility services, and energy traceability), grid-operator-centric services (e.g., congestion management, balancing and grid observability).

4.7.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

Customer engagement plays a central role in the BeFlexible project. Engagement of residential and small/medium-scale commercial customers in the provision of flexibility services represents one of the main challenges taken over by the project. The findings from BeFlexible in this field, which will include identified drivers and barriers, developed strategies and tools and final learnings will provide valuable insights to the ECLIPSE project and the development of a CERF. In particular, the recommendations formulated by BeFlexible will support the integration of energy services that bring value to the customer and the grid into the CERF-based applications and support the design of applications that are capable of keeping users engaged over time.

The following table provides an overview of the most relevant services (with respect to ECLIPSE) to be developed and tested by BeFlexible.

4.8. REEFLEX - REPLICABLE, INTEROPERABLE, CROSS-SECTOR SOLUTIONS AND ENERGY SERVICES FOR DEMAND SIDE FLEXIBILITY MARKETS

Programme: Horizon Europe

From: January 2023 to December 2026.

Total cost: € 9 972 247,92

Webpage: https://reeflexhe.eu/

Coordinator: FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS - CIRCE

Partners who are also part of ECLIPSE consortium: UBITECH.

4.8.1. PROJECT DESCRIPTION AND OBJECTIVES.

The success of energy-saving and emission-reduction technologies hinges on cross-sector partnerships. The EU-funded REEFLEX project will create opportunities for SMEs and start-ups to enter the demand-side flexibility markets. Specifically, the project will develop a central interoperability platform and a catalogue of services with the capability of maximising the flexibility of distributed energy resources while respecting the different end-user profiles. The creation of a common operation market model together with AI services and automation systems (through distributed ledger technologies) will reduce market entry barriers and costs. It is also expected to increase energy consumer participation.

4.8.2. PROJECT DEMO SITES.

REEFLEX solutions will be showcased and cross-tested in 4 key demonstrators across Europe, including Spain, Greece, Switzerland, and Bulgaria. Each of these

demonstrations will incorporate different characteristics and scenarios to evaluate their impact across various sectors, such as residential buildings, mobility, commercial establishments, industrial sites, and data centres.

4.8.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

REEFLEX offers several solutions relevant to ECLIPSE, particularly its interoperability platform and service catalogue, which link cross-sector stakeholders and boost demand-side flexibility while providing accessible infrastructure. The use of AI-driven services and distributed ledger technology aligns with ECLIPSE's goals by enabling personalized, transparent, and secure energy solutions. Additionally, REEFLEX's emphasis on cross-sector partnerships and opportunities for SMEs and start-ups enhances market entry and engagement, fostering a collaborative ecosystem that can drive energy savings and emissions reduction across the industry.

4.9. OMEGA-X - ORCHESTRATING AN INTEROPERABLE SOVEREIGN FEDERATED MULTI-VECTOR ENERGY DATA SPACE BUILT ON OPEN STANDARDS AND READY FOR GAIA-X

Programme: Horizon Europe

From: 1st May 2022 to 30 April 2025.

Total cost: € 10 223 435,00

Webpage: https://omega-x.eu/

Coordinator: ATOS IT

4.9.1. PROJECT DESCRIPTION AND OBJECTIVES

The aim of OMEGA-X is to implement a data space (based on European common

standards), including federated infrastructure, data marketplace and service marketplace, involving data sharing between different stakeholders and demonstrating its value for real and concrete Energy use cases and needs, while guaranteeing scalability and interoperability with other data space initiatives, not just for energy but also cross-sector.

The proposed concept and architecture heavily rely on the approaches adopted by IDSA, GAIA-X, FIWARE, BDVA/DAIRO and SGAM as major EU references regarding data spaces. It will pursue the GAIA-X label, which ensures highest standards on protection, security, transparency, openness and trust, avoids vendor lock-in and restricted to EU countries.

4.9.2. PROJECT DEMO SITES

The OMEGA-X project includes setting up 4 use cases families that will showcase the value of having a common data space for a particular problem identified by energy stakeholders:

RENEWABLES: Having renewable plant owners and service providers to optimize operation and maintenance to increase renewable energy sources (RES) availability and reducing CO_2 footprint. This OMEGA-X use case family consists of 3 pilots in Spain (Caravaca/Valles Oriental, La Carlota/Cordoba) and France (Narbonne).

LOCAL ENERGY COMMUNITIES: Exploiting data from different energy vectors to optimize the overall performance of a local community, instead of optimizing each vector individually. This OMEGA-X use case family consists of 4 pilots in Spain (Granollers), Italy (Osimo), Serbia (Belgrade) and Portugal (Municipality of Maia).

ELECTROMOBILITY: Demonstrating how data sharing can ease and scale up services such as booking and building innovative services such as cross-border self-consumption of renewable energy. It will involve the electricity system from charging points to transmission system operators (TSOs), crossborder. This OMEGA-X use case family consists of 1 pilot in France/Belgium

FLEXIBILITY: Aiming to demonstrate the performance upgrade that can be achieved for the flexibility identification and provision at local/municipality level when service providers can have access to extended data sets from multiple origins. This OMEGA-X use case family consists of 1 pilot in Portugal (Municipality of Maia).

4.9.1. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

Similarly to ECLIPSE, in OMEGA-X there will be deployment a smart set of services and solutions to serve as baseline for the demonstration of how a Data Space can be relevant for all energy actors in concrete case studies. Moreover, OMEGA-X is focused on the interoperability of the Data Space to be replicable. The availability of data will empower new participants and market roles such as aggregators and local energy community managers. This will facilitate the large-scale penetration of renewables in the local grid without significant investments in grid infrastructure and will also create an opportunity for new business models to emerge.

4.10. BUNGEES - BUILDING UP NEXT-GENERATION SMART ENERGY SERVICES OFFER AND MARKET UP-TAKE VALORISING ENERGY EFFICIENCY AND FLEXIBILITY AT DEMAND-SIDE

Programme: EU LIFE Programme – Clean Energy Transition Sub-programme

From: 1 October 2022 to 1 October 2025 (36 month)

Total cost: 2 104 525 €

Webpage: https://bungees.eu/

Coordinator: Frantisek Doktor ViaEuropa Competence Centre s.r.o, Slovakia

Partners who are also part of ECLIPSE consortium: Voltalis

4.10.1. PROJECT DESCRIPTION AND OBJECTIVES.

The overall objective of the project is to develop an **integrated package** (a one-stop-shop package) of **novel** smart energy efficiency services (**EES**) integrating **energy efficiency and distributed generation, demand response, e-mobility, energy storage/hybrid energy systems and integrating different energy sectors** (e.g., electricity with heating and cooling), and to develop innovative financing and rewarding solutions. In addition, the integration of **non-energy benefits** and **non-energy services** will be investigated. Focus will be on identifying **market, regulatory and other barriers** for integrated energy efficiency. Innovative legal, financial, and regulatory solutions to overcome these barriers and enablers of EES market will be recommended.

4.10.2. PROJECT DEMO SITES.

The BungEES is actually having as one of their focus point: **Analytics, integration and efficiency.**

The BungEES project is actively developing and testing its smart energy services on several pilot sites across Europe, primarily in countries such as Slovakia, France, Czech Republic, Germany, Spain, Portugal, Italy, and Belgium. One notable demonstration site is the University of Coimbra in Portugal, where advanced technologies, including demand-response and distributed generation systems, are being implemented to monitor and optimize energy use within university facilities. This site serves as a hands-on example of how BungEES' energy efficiency services integrate renewable energy, storage solutions, and IoT capabilities to enhance energy performance in large buildings.

4.10.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The BungEES is broader in scope as ECLIPSE as they focus on **energy efficiency and distributed generation, demand response, e-mobility, energy storage/hybrid energy systems and integration with different energy sectors** (e.g., electricity with heating and cooling). It is less 'consumer centric' than ECLIPSE is.

What could be of interest is that BungEES launched the Platform for Smart Energy Services (PSES) to facilitate collaboration among stakeholders, offering a testing ground for legislative and regulatory frameworks and an educational hub for smart energy solutions. This platform connects pilot sites with key energy market players, enabling them to explore new business models and regulatory standards within real-world settings.

4.11. DR-RISE - DEMAND RESPONSE – RESIDENTIAL INNOVATION FOR A SUSTAINABLE ENERGY SYSTEM

Programme: Horizon Europe

From: June 2023 to June 2027

Total cost: € 7 045 815,00

Webpage: https://dr-rise.eu/partners/

Coordinator: IDENER

Partners who are also part of ECLIPSE consortium: Voltalis

4.11.1. PROJECT DESCRIPTION AND OBJECTIVES.

DR-RISE's main objective is to demonstrate the benefits of Demand response in the residential sector, not only for the **end-consumers** but for the **overall energy system** and the actors involved and promote it. Accordingly, DR-RISE will further develop a holistic **set of tools and services** with a twofold objective: **increasing energy efficiency via optimal management and demonstrating DR schemes' benefits**.

DR-RISE's approach is based on the idea of a complete set of tools and services that will assist the end-consumers in their journey to become active users in the energy market. The end-consumers will be able to make their **own-educated decisions** thanks to the

provided information and to select their preferred comfort level, risk level, and operating actions.

In a nutshell 3 main objectives:

- Develop residential DR digital tools
- Demonstrate the benefits
- Raise awareness and exploit the results

For social, environmental and economic benefits.

4.11.2. PROJECT DEMO SITES.

3 use cases in Europe in Spain, Germany and Greece.

1) **Location: Peón, Villaviciosa, Asturias – Spain Partners: CTIC**
2) The rural energy community is composed of 5 residential houses, 1 school and 1 office. This pilot's concept is the implementation of DR programs and energy sharing among households. **Location: Athens, Minoan and Samos – Greece Partners: ELE**
3) ELE is leading the implementation of energy communities in several locations in Greece, Athens, Minoan and Samos. **Location: Borkum – Germany Partners: IDE** Borkum is a German island located in the North Sea that presents a tertiary-oriented demand profile without industry, and a significant green electricity uptake amongst the citizens.

4.11.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The 3 developed use cases are very much resonating with the work done in ECLIPSE as they focus on consumer centric vision especially UC 1 and 3, less 2 which is more Energy community focused. Yet they do not mention how the information and data will be shared with the customer whereas in ECLIPSE we want to make usage of the existing and future standard to achieve this and really focus on which information will the end consumer have at hand. Yet UC developed here could resonate with ours.

4.12. ACCEPT – ACTIVE COMMUNITIES & ENERGY PROSUMERS FOR THE ENERGY TRANSITION

Programme: Horizon 2020

From: 1 January 2021 to 31 August 2025.

Total cost: € 7 571 716,25

Webpage: https://www.accept-project.eu/

Coordinator: Hypertech

Partners who are also part of ECLIPSE consortium: METLEN

4.12.1. PROJECT DESCRIPTION AND OBJECTIVES.

The Core of the ACCEPT project is the concept of "energy communities" with the collective approach to bring citizens, local businesses and organizations together, to produce and consume locally generated, renewable energy. The EU-funded project intends to develop and deliver a digital toolbox, that allows such energy communities to offer innovative digital services to reduce the dependency on fossil fuels, save energy in the users' households and thus be able to reduce their electricity bill without compromising the quality of living, but ideally increasing the comfort in their homes through smart devices. In ACCEPT, these developed tools will be demonstrated and validated in four pilot sites in Greece, the Netherlands, Spain and Switzerland involving more than 3.000 people and 750 residences.

The main objectives are:

- To deliver an integrated ACCEPT tool-chain to bootstrap the transition of energy communities to full players of the energy & flexibility markets and offering value-adding services to customers.
- To develop the Consumer Digital Twin model that streamlines the information exchange between building-level tools and market actors enabling insights on consumer behaviour and improved demand forecasting.

- To deliver a secure and interoperable digital toolbox compatible with the majority of residential building systems used across the EU as a fundamental enabler of ACCEPT solution replication.
- To understand incentives and drivers of citizens and energy communities and deliver a citizen engagement methodology that stimulates citizen participation in the energy system and community flourishing.
- To design compound (energy & non-energy) service offerings and business models that enable the participation of the residential sector in demand response markets/services.
- To validate the expected impact of the ACCEPT solution in real-life conditions (citizens, communities) in four Member States and maximise replication potential.

4.12.2. PROJECT DEMO SITES.

ACCEPT is demonstrated within four "living labs", volunteer households provided with energy services that are equipped with smart devices. The "living labs" are located in Culemborg, Netherlands, Capriasca, Switzerland, Murcia, Spain and Aspra Spitia, Greece.

The partners in the pilot regions constantly gain & provide knowledge on the concept of demand response and perform surveys to gather feedback and further improve the energy profile of the households.

4.12.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ACCEPT solution will deliver technologies and ICT tools to increase the share of energy or power that can be mobilised to provide flexibility to the grid and increase the hosting capacity for RES, which is aligned with ECLIPSE objectives, to reduce energy consumption and emissions.

Moreover, ACCEPT will also try to understand incentives and drivers of citizens and energy communities and deliver a citizen engagement methodology that stimulates citizen participation in the energy system similarly, to ECLIPSE CERF.

4.13. ENERSHARE - EUROPEAN COMMON ENERGY DATASPACE FRAMEWORK ENABLING DATA SHARING-DRIVEN ACROSS- AND BEYOND- ENERGY SERVICES

Programme: Horizon Europe

From: 1 July 2022 to 30 June 2025.

Total cost: € 9 593 822,50

Webpage: https://enershare.eu/

Coordinator: ENGINEERING - INGEGNERIA INFORMATICA SPA.

Partners who are also part of ECLIPSE consortium: R&D Nester, Elektro Ljubljana.

4.13.1. PROJECT DESCRIPTION AND OBJECTIVES.

The ENERSHARE project, titled "European commoN EneRgy dataSpace framework enabling data sHaring-driven Across- and beyond- eneRgy sErvices," is an EU-funded initiative under the Horizon Europe programme. Launched in July 2022, the project spans three years and involves a consortium of 31 partners from 12 European countries. ENERSHARE aims to develop and demonstrate a European Common Energy Data Space that facilitates secure and sovereign data sharing among energy and non-energy stakeholders. The primary objectives include creating a data-driven reference architecture tailored for the energy sector, compliant with established frameworks like FIWARE, IDSA, and GAIA-X, while extending interoperability across various energy commodities such as electricity, heat, and natural gas, as well as beyond the energy domain. This framework will focus on building trust and ensuring data sovereignty by incorporating privacy, confidentiality, and cybersecurity measures that allow data owners full control over their information. Additionally, ENERSHARE seeks to establish a blockchain-enhanced data marketplace with smart contracts, facilitating the exchange and coordination of data for energy assets and services, including compensation mechanisms that go beyond financial transactions. The project will

validate this framework through real-world use cases across seven countries, demonstrating its applicability across diverse regulatory and socio-economic settings to foster the adoption of open data-driven services in the European energy landscape.

4.13.2. PROJECT DEMO SITES.

ENERSHARE's framework is applied, implemented, demonstrated, and validated through seven real-life pilots across seven countries:

- Spain: Demonstrating intra-electricity data sharing and services.
- Portugal: Utilizing the "Living Lab" from the Smart Energy Lab to showcase data-sharing aligned with the vision of Transmission System Operators.
- Italy: Focusing on cross-sector data exchange and services.
- Finland: Implementing data-driven services within the energy sector.
- Slovenia: Exploring data sharing across energy and non-energy sectors.
- Greece: Demonstrating data exchange mechanisms within the energy domain.
- Norway: Validating cross-sector data-driven services.

These pilots aim to support large-scale EU-wide replicability and market adoption of energy data-sharing technological solutions and data-driven services in different socio-economic contexts.

4.13.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ENERSHARE project focuses on developing a European Common Energy Data Space to facilitate secure and sovereign data sharing among energy and non-energy stakeholders. Several solutions from ENERSHARE are particularly relevant to ECLIPSE:

- Data-Driven Reference Architecture: ENERSHARE has developed a reference architecture for the energy domain that is compliant with frameworks like FIWARE, IDSA, and GAIA-X. This architecture can serve as a foundational model for ECLIPSE in creating its open-source reference framework for energy-saving applications.
- Interoperability Across Sectors: By extending interoperability across various energy commodities and beyond, ENERSHARE ensures seamless data exchange among different systems. ECLIPSE can leverage these interoperability standards to integrate diverse energy consumer applications effectively.

- Trust and Data Sovereignty Mechanisms: ENERSHARE implements trust-related connectors to maintain privacy, confidentiality, and cybersecurity, allowing data owners full control over their data. ECLIPSE can adopt these mechanisms to build user trust in its energy consumption reduction applications.

4.14. HEDGE-IOT - HOLISTIC APPROACH TOWARDS EMPOWERMENT OF THE DIGITALIZATION OF THE ENERGY ECOSYSTEM THROUGH ADOPTION OF IOT SOLUTIONS

Programme: Horizon Europe

From: 1 January 2024 to 30 June 2027.

Total cost: € 21 952 255,00

Webpage: https://hedgeiot.eu/

Coordinator: EUROPEAN DYNAMICS LUXEMBOURG SA.

Partners who are also part of ECLIPSE consortium: R&D Nester, TRIALOG.

4.14.1. PROJECT DESCRIPTION AND OBJECTIVES.

The HEDGE-IoT project, titled "Holistic Approach towards Empowerment of the DiGitalization of the Energy Ecosystem through adoption of IoT solutions," is an EU-funded initiative under the Horizon Europe programme. Launched in January 2024, the project spans 42 months and involves a consortium of 42 partners from 13 European countries. HEDGE-IoT aims to revolutionize the digitalization of European energy systems by deploying Internet of Things (IoT) assets across various levels—from behind-the-meter installations to Transmission System Operator (TSO) infrastructures. The project focuses on enhancing intelligence within edge and cloud layers through advanced Artificial Intelligence (AI) and Machine Learning (ML) tools. A key objective is to bridge the cloud-edge continuum by introducing federated applications governed by sophisticated computational orchestration solutions. The focus is on increasing the

European energy system's capacity to integrate renewable energy sources (RES) by harnessing advanced IoT solutions, which will unlock new levels of flexibility within the grid and improve operational efficiency. This project aims to strengthen the grid's resilience by advancing digitalization and establishing robust IoT standards. Additionally, it emphasizes promoting interoperability and standardization, ensuring seamless communication and data exchange among various platforms, systems, and stakeholders using widely adopted standards like SAREF. Through these efforts, HEDGE-IoT fosters a comprehensive digital energy ecosystem that enhances resilience, inclusivity, and trustworthiness, paving the way for a more connected and sustainable future in energy.

4.14.2. PROJECT DEMO SITES.

The HEDGE-IoT project is implementing and validating its innovative digital framework through six large-scale field demonstrators across Europe, each situated in a unique geographic and regulatory context.

1. **Finland**: In Finland, the demonstration focuses on electricity distribution grid congestion management and digital solutions enabling large-scale utilization of such services deep in the distribution grids. This involves developing an integrated congestion management solution based on both technical and commercial flexibility services combined with cloud-edge computing systems. The developed solution will be tested in the Järvi-Suomen Energia Oy network, in collaboration with other pilot partners.
2. **Greece:** The Greek demonstration aims to create an innovative system grounded in reinforcement learning environments and algorithms. This system leverages existing commercial platforms to extend their capabilities, providing prosumers with the opportunity to actively participate in the flexibility market—a prospect that has not been realized thus far in Greece. The demonstration involves collaboration with HEDNO (DSO) and PPC (TSO).
3. **Portugal**: In Portugal, the demonstration is a collaborative effort involving CEVE (DSO), R&D Nester and REN (TSO), INESC TEC, SONAE group, and Elergone. The focus is on implementing and demonstrating a "Living lab for Interoperable AI-based Energy Services," aiming to enhance the integration of renewable energy sources and improve grid resilience.
4. **Netherlands**: The Dutch demonstration is implemented at the Arnhems Buiten Electricity Innovation Park. The focus is on upgrading and transforming

buildings and energy infrastructure to facilitate sustainable growth. This involves integrating IoT solutions to enhance energy efficiency and grid flexibility.

5. **Slovenia:** In Slovenia, the demonstration involves the development and testing of a Dynamic Thermal Rating (DTR) system at the transformer station level. This system aims to increase the loading capabilities of power lines and transformers, enhancing the transmission and distribution networks' capacity to meet the growing power demand. The demonstration is led by Operato, a subsidiary of ELES, the Slovenian TSO.
6. **Croatia:** The Croatian demonstration focuses on developing AI/ML solutions to improve the accuracy of the transformer's dynamic thermal rating forecast and increase the flexibility potential of distribution networks for mitigating planning and operational problems. The University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER) team contributes to this demonstration.

These diverse demonstrators are integral to HEDGE-IoT's mission to revolutionize energy systems by deploying IoT assets across different levels and infusing intelligence into the edge and cloud layers using advanced AI/ML tools.

4.14.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

Given the objectives of HEDGE-IoT, several solutions and approaches could be relevant to ECLIPSE:

- **Edge and Cloud Intelligence:** The integration of AI and ML tools in HEDGE-IoT to enhance decision-making and operational efficiency can be leveraged by ECLIPSE to develop intelligent energy management systems.
- **Federated Applications and Computational Orchestration:** HEDGE-IoT's approach to bridging the cloud-edge continuum with federated applications can provide a framework for ECLIPSE to ensure seamless data flow and processing across distributed energy systems.
- **Interoperability and Standardization:** HEDGE-IoT's commitment to interoperability and standardization, particularly through the use of widely adopted standards like SAREF, can guide ECLIPSE in developing solutions that are compatible with existing systems and facilitate widespread adoption. The

HEDGE-IoT project introduces IoT assets across energy systems, providing detailed data that enhances ECLIPSE's ability to offer accurate energy-saving recommendations.

- **Advanced AI and machine learning tools**: HEDGE-IoT advanced AI and machine learning tools enable smart, predictive decision-making that aligns well with ECLIPSE's goals of consumer-driven load management.
- **Resilient energy infrastructure:** HEDGE-IoT's focus on a resilient energy infrastructure reinforces ECLIPSE's mission of fostering sustainable consumer behaviours. Together, these projects create a cohesive ecosystem that supports both grid flexibility and energy efficiency.

4.15. ENFLATE - ENABLING FLEXIBILITY PROVISION BY ALL ACTORS AND SECTORS THROUGH MARKETS AND DIGITAL TECHNOLOGIES

Programme: Horizon Europe

From: 1 September 2022 to 31 August 2026

Total cost: € 9 313 018,75

Webpage: https://enflate.eu/

Coordinator: NOVA TELECOMMUNICATIONS

Partners who are also part of ECLIPSE consortium: ESO (BG), UBITECH (BE)

4.15.1. PROJECT DESCRIPTION AND OBJECTIVES.

The EU-funded ENFLATE project will build upon existing solutions on data-driven energy services and non-energy services, and replicate them in different geographies, climates and consumer needs. It will propose applicable consumer-centred flexibility platforms and test them in Bulgaria, Greece, Spain, Sweden and Switzerland, engaging local consumers, as well as authorities, service providers, manufacturers and academia.

Efficient business models will be developed and tested, combining energy services with health and mobility services.

ENFLATE projects' main objective is to build upon existing solutions on data drive energy services and non-energy services, and replicate them in different geographies, climate and consumer needs. It will propose applicable consumer-centered flexibility platforms and test them in Bulgaria, Greece, Spain, Sweden and Switzerland engaging local consumers, TSOs, DSOs, market operators, regulatory authorities, service providers, manufacturers, academia. It will provide smart grid innovative technologies, peer-to-peer market platforms for consumers, smart building and local community cross vector flexibility services, integration of consumer centered flexibility with pan European spot markets. Efficient business models will be developed and tested, combing energy services with health and mobility services. The developed ENFLATE project will be interoperable with existing data platforms in Horizon 2020, like ONENET, CoordiNET, SmartNet and INTERRFACE, leveraging the benefits of data exchange and adaptive middleware architectures. ENFLATE will evaluate the impact of the proposed multi-vector flexibility services to local, regional and pan European level.

4.15.2. PROJECT DEMO SITES.

ENFLATE will carry out pilots in demo sites in five dispersed European countries adapting to the local energy requirements (Bulgaria, Greece, Spain, Sweden and Switzerland) demonstrating (i) consumer-centric flexibility market designs; (ii) TSO-DSO-consumer coordination for cross-sector flexibility provision; and (iii) non-energy services for healthcare and mobility.

4.15.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The ENFLATE solutions aims to:

- enhance system flexibility by promoting the synergy among various energy vectors and additional cross-industry services
- accelerate decarbonization strategies, through local energy management and promotion of local DERs
- the participation of consumers/ prosumers in cost-effective power trading

- improve assets energy usage levels and cost-efficiency

All those goals are aligned with ECLIPSE objectives.

4.16. SENDER - REVOLUTIONIZING THE ENERGY GRID FOR A GREENER TOMORROW

Programme: Horizon Europe

From: 1 October 2020 to 30 September 2024.

Total cost: € 6 630 000

Webpage: https://www.sender-h2020.eu/sender-project/

Coordinator: SMART INNOVATION NORWAY

Partners who are also part of ECLIPSE consortium: TRIALOG

4.16.1. PROJECT DESCRIPTION AND OBJECTIVES.

SENDER takes into account that consumers/prosumers are at the heart of the energy market by engaging them directly in a co-creation process with other actors from the energy domain during the design, development and utilization of pro-active demand response mechanisms. These mechanisms will be paired with cross-sectoral and value-adding services that will be defined according to consumer/prosumer preferences.

One of the most important objectives is approved by the 3 demonstration sites: 400 households based in Spain, Austria and Finland.

The consumer segmentations identified during the first steps of WP5 & WP6 will need to be digitally reproduced to help predict the energy demand from the selected consumers. The digital representations of the consumer segmentations are called digital twins. The data of these digital twins can be aggregated to create a complete view of the different consumers' interaction with the network. Based on this data aggregation (WP5), energy services actors (e.g. grid operators, aggregators, energy cooperatives, energy communities) will be able to better identify, exploit and commercialise the flexibility potential of consumers' behaviours. This will lead to an

optimised grid management, a higher degree of RES integration and reduced downward regulation of RES sources. Objective's indicators: Increase in controlled flexible power demand (in % of installed flexible demand), amount of flexibility provided per household and year (in kWh)

Second objective to be exposed is: Innovative strategies to co-create demand response mechanisms with consumers. 10 types of stakeholders implicated in the co-construction activities through co-created strategies for consumers' proactive demand response mechanisms. In recent years, limited progress has been made to include consumers in demand response solutions development, In particular for individual households' demand response. The main reason for this is the rigid structure of current price-based and incentive-based demand response mechanisms. Very few flexibilities is allowed on the grids and consumers are not engaged to participate in the development of the solutions. That is why, consumer engagement is one of the main issues of demand response in Europe and why SENDER makes it a priority.

In SENDER, consumer engagement is at different stages:

- During the project: consumers are placed at the heart of the specifications, design and development (WP2-4) through co-creation activities, and the specifically developed energy services will include economic and non-financial incentives.
- After the end of the project, in the long term: a "package" of services will provide additional value for the consumers in the fields of home convenience, assisted living and home security.

In SENDER, the co-creation mechanisms aim also to bridge the gap between technology providers and consumers and thus the co-creation activities involve a wide variety of actors. The steering groups and workshops will be composed of professionals of the energy field (DSOs, suppliers, aggregators, energy cooperatives, etc.) but also local and individual actors (consumer associations, end-users, etc.). Objective's indicators: Number of stakeholders involved in each co-construction workshop, Percentage of contacted consumers that finally participate in the pilot.

4.16.2. PROJECT DEMO SITES

The Spanish demonstration site will be based in Alginet, a village located 25 km from

Valencia, in the east of Spain, with 13 000 inhabitants. The distribution network in Alginet has a special particularity: it is owned by the end users through a cooperative. Currently, the Cooperative supplies 46 GWh per year by means of 40 centres of transformation, with an installed power of 18,000 kW and almost 6.000 users get benefit from the smart meters deployed by the electric cooperative, as well as other services and actions that the cooperative initiate to benefit its end users. Apart from the main basic activities of commercialization and distribution of electric energy, the cooperative group also plays a major social role in the town by investing and redistributing their benefits among the end users.

The W.E.I.Z. demonstration site is located in the eastern part of Styria, about 30km from the provincial capital Graz. The pilot area includes the municipality of Weiz (11.700 inhabitants), as well as the six neighbouring municipalities and a total of 26.000 inhabitants. In this context, the municipality of Weiz is seen as a centre that provides numerous important functions (schools, shopping, authorities, entertainment, hospitals, etc.) for the households of the neighbouring municipalities. Currently connected to the grid but the potential for photovoltaic systems is very high relative to the number of citizens due to the space requirements in the neighbouring municipalities.

Pilot sites in Finland are located in Tampere, western Finland, and in Espoo, southern Finland, near the capital Helsinki. Tampere has about 245,000 inhabitants and Espoo about 300,000. Both are among the largest cities in Finland. They are also important working municipalities to work in from nearby municipalities. Around 3 500 people live in the area, but more importantly, about 15 000 people come here daily for working. The area is composed of university buildings, VTT offices as well as several companies. Services such as shopping centres and restaurants are found in the area. In both Tampere and Espoo, 50 households will be invited to participate in the demand response experiment. In Finland, the price of electricity has increased significantly recently, and numerous households have entered into an electricity contract with hourly market price to save on energy costs. Electric residential space heating is more common in Finland than in most European countries. Demand flexibility on electricity is needed more than ever before.

4.16.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

SENDER Powering Smart Living: A New Dawn in Energy Efficiency; by optimizing usage and distributing it over time, SENDER not only enhances efficiency but also mitigates demand peaks, reducing reliance on fossil fuels.

SENDER smart box: A Raspberry Pi reads data and sends information about the energy usage at home.

SENDER App: capable of switching appliances on and off according to the user's needs, energy prices and photovoltaic production (if applicable).

SENDER sensors and actuators: keep track of the temperature, humidity, light level and occupancy of the rooms, and turn on and off the devices.

SENDER shared cloud: collects and stores water consumption data for analysis and modeling, to improve energy use.

SENDER smart boilers: provide wireless information on remaining hot water and potential energy production to adjust the most efficient times for heating water.

4.17. OPENCONTINUUM - AN OPEN ECOSYSTEM FOR EUROPEAN STRATEGIC AUTONOMY AND INTEROPERABILITY ACROSS THE COMPUTING CONTINUUM INDUSTRY

Programme: Horizon Europe

From: 1 September 2022 to 31 August 2024.

Total cost: 1,5 M€

Webpage: https://eucloudedgeiot.eu/open-continuum/

Coordinator: SMART INNOVATION NORWAY

Partners who are also part of ECLIPSE consortium: TRIALOG.

4.17.1. PROJECT DESCRIPTION AND OBJECTIVES.

OpenContinuum has set the following main objectives:

Objective 1: Promote the establishment of a European industrial Open Ecosystem based on Open Source and Open Standards

Objective 2: Map and analyse the supply-side landscape of the European emerging Computing Continuum

Objective 3: Engage the EU industrial and research actors to create a supply-side community that spans the whole Computing Continuum

Objective 4: Coordinate the relevant EU project portfolio towards an open European ecosystem for the cloud-edge-IoT continuum.

4.17.2. PROJECT DEMO SITES

The European Cloud, Edge and IoT Continuum Initiative

The EUCloudEdgeIoT.eu initiative aims to realise a pathway for the understanding and development of the Cloud, Edge and IoT (CEI) Continuum by promoting cooperation between a wide range of research projects, developers and suppliers, business users and potential adopters of this new technological paradigm.

4.17.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

Cloud: Cloud computing is a key technology enabler in increasing Europe's data sovereignty and achieving the sustainability goals of the European Green Deal. The European Cloud-Edge-IoT Continuum initiatives aim at developing new technologies and business models to create a computing continuum from the IoT devices to the cloud, encompassing the edge and HPCs to achieve high-standard requirements and support EU values with regard to data protection, performance, resilience and energy efficiency.

Edge: Edge and cloud computing are both essential in a computing continuum to ensure data is managed most efficiently closer to the originating source rather than transmitting raw data to data centres for processing. This will lead to energy-efficient and trustworthy infrastructure, solving climate challenges and driving new business opportunities. By 2025, 80% of all data in Europe is expected to be processed in smart devices closer to the user, meeting the future digitisation needs of industry and the public sector.

IoT: Today, the IoT merges both the physical and virtual worlds, creating innovative solutions and smart environments through domains like AI, 5G, Edge and Cloud computing, blockchain, and micro-to-nano systems. With processing moving closer to the edge, advancing on the IoT can reduce communication and storage costs and energy consumption, and by applying machine learning and AI, the internet infrastructure can safely identify data patterns that bring positive impact and benefit citizens and businesses.

4.18. PARMENIDES - PLUG&PLAY ENERGY MANAGEMENT FOR HYBRID ENERGY STORAGE

Programme: Horizon Europe

From: 1 January 2023 to 31 December 2025.

Total cost: € 3 633 065

Webpage: https://parmenides-project.eu/

Coordinator: AIT-Austrian Institute of Technology GmbH.

Partners who are also part of ECLIPSE consortium: Trialog.

4.18.1. PROJECT DESCRIPTION AND OBJECTIVES.

PARMENIDES aims to develop a new ontology with a focus on the electricity and heating domain for buildings and customers in energy communities. Additionally, it aims to support a number of use cases, a new generation of innovative Energy

Management Systems (EMS) will be developed. As a framework for the integration of the EMS, PARMENIDES will define an information and communication architecture, enabling an interoperable, reliable, and secure exchange of data and instructions.

4.18.2. PROJECT DEMO SITES.

PARMENIDES is extensively validated in 2 large-scale demonstration campaigns in

(i) Austria, involving the Demo AT-1: Municipality of Gasen (Gasen, Austria, population: ~900) and the Demo AT-2: Municipality of Heimschuh (Heimschuh, Austria, population: ~2.000)

(ii) Sweden: it will leverage the capabilities of the KTH Live-in-Lab and the laboratory at the KTH Department of Energy Technology (EGI).

The demonstration campaigns are involving complete value chains, diverse data sources, heterogeneous energy systems/assets and spanning different socio-economic characteristics.

4.18.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The PARMENIDES project solution will value the flexibility capacity of Hybrid Energy Storage Systems (HESS). This system will be capable of using ontology as a knowledge base. This will enable a very generic software design and ensures the scalability and replicability of the solution.

Besides the representation of storage technologies, information about energy community customers, their behaviors, and components including their relation will be part of the PARMENIDES ontology, providing a standardized vocabulary of the domain of energy communities.

These PARMENIDES technologies mobilize consumers to valorize their cross-sector flexibility (hybrid storage systems) to achieve energy efficiency and decarbonization. Additionally, the storage systems ensure the resilience of the community energy systems.

4.19. RESONANCE - FACILITATING DEMAND-SIDE FLEXIBILITY MANAGEMENT AT A LARGE SCALE

Programme: Horizon Europe

From: 1 January 2023 to 31 December 2025.

Total cost: € 10 230 321,50

Webpage: https://www.resonance-project.eu/

Coordinator: VTT Technical Research Centre of Finland Ltd.

Partners who are also part of ECLIPSE consortium: Trialog, CheckWatt.

4.19.1. PROJECT DESCRIPTION AND OBJECTIVES.

The RESONANCE project is creating a software framework for plug-and-play development of standard-compliant Customer Energy Manager solutions for demand-side flexibility management of distributed and small-scale assets.

The RESONANCE Framework constitutes three catalogues of software libraries as well as marketplace services and tools that provide means for rapid, cost-efficient development & customisation of standard-compliant Resource Manager and Customer Energy Manager solutions as well as their aggregation services across sectors.

4.19.2. PROJECT DEMO SITES.

Each pilot site of the RESONANCE project is acting as a primary development & testing venue for one to several types of services. The results are populated to the Framework and used to replicate the services in other pilot settings with different stakeholders and constraints. The countries hosting the pilots are France, Germany, Slovenia, Greece, Sweden, Finland.

4.19.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The RESONANCE project aims to make it as easy as possible to tailor Customer Energy Manager (CEM) solutions for consumer and prosumer customers in different sectors. The Customer Energy Manager is the central concept, being the software agent that manages flexible assets in homes and buildings and provides flexibility to the power grid.

By making consumers and prosumers active participants in the energy system, the concept has the potential to revolutionize demand-side flexibility management and enable new consumer-oriented services. In that sense the RESONANCE project is relevant to ECLIPSE, since it mobilizes the consumers to become active participants in the energy system decision making and provide their flexibility to the grid.

The CEM introduced in RESONANCE project is envisioned to provide a more deterministic response, unlocking market participation while maximising the benefits for the customers who deliver the flexibility. To achieve this, there is a need for accurate models of the smart appliances and model predictive control techniques to automate the decision-making within the customer premises.

4.20. INSTAR - INTERNATIONAL COOPERATION FOR DIGITAL STANDARDISATION

Programme: Horizon Europe

From: 1 January 2024 to 30 June 2026.

Total cost: € 1 498 596,67

Webpage: www.instarstandards.org

Coordinator: BlueSpecs

Partners who are also part of ECLIPSE consortium: Trialog.

4.20.1. PROJECT DESCRIPTION AND OBJECTIVES.

The INSTAR project positions Europe as a leader in setting global standards for advanced ICT technologies, including AI, 5G/6G, IoT, cybersecurity, and quantum technologies, through strategic partnerships. Over 30 months, INSTAR will shape standards adoption in target regions, conduct studies on ICT standards, and track international standards in trade agreements. A team of ICT standardization experts manages workstreams to develop high-level frameworks, create a Standards Dashboard, and form task forces that provide input on evolving standards. Monthly and bi-annual reports outline agreements on standards and roadmaps, while a monitoring process ensures standards implementation in trade partnerships.

4.20.2. PROJECT DEMO SITES.

Due to the standards-development-focused nature of the project, INSTAR does not include traditional demonstrators.

4.20.3. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

INSTAR's focus on advancing ICT standards is directly relevant to the ECLIPSE project, as it provides a standardized framework for technologies critical to energy applications, such as IoT, cybersecurity, and data protocols. By shaping global standards, INSTAR ensures that ECLIPSE's consumer applications can operate seamlessly across different systems and international markets, supporting interoperability. The Standards Dashboard developed by INSTAR offers ECLIPSE a resource to track relevant standards and incorporate updates, ensuring compliance and future-proofing the project's tools. INSTAR's international partnerships and agreements on common standards reduce technical and regulatory barriers, facilitating ECLIPSE's scalability across the EU and beyond.

4.21. SMART GRIDS TASK FORCE

4.21.1. DESCRIPTION AND OBJECTIVES.

The SGTF advises the Commission on policy and regulatory frameworks at European level to co-ordinate the first steps towards the implementation of Smart Grids under the provision of the Third Energy Package. The Task Force shall serve primarily as an advisory forum to the European Commission on policy and regulatory measures to coordinate at European level the implementation of Smart Grids under the provisions of the Directive 2009/72/EC, Directive 2009/73/EC and Directive 2012/27/EU. The activities of the Task Force may encompass all issues relating to the roll-out of smart metering systems and the deployment of Smart Grids.

The Task Force shall discuss, assist and provide recommendations at the Commission's request in particular on the following issues: identifying priorities for preparation of guidance documents, recommendations and best practices relevant to the effective deployment of Smart Grids; identifying market dysfunctions that may hinder the implementation of Smart Grids; identifying issues that could potentially or actually do prevent consumers, industry or utilities from taking advantage of the full potential of Smart Grids; collecting, or initiating and overseeing the preparation of, guidelines on the industry best practices; proposing incentives and any regulatory activities that may improve the effective implementation of Smart Grids and Smart Metering systems; exchanging information regarding the application of national and Union legislation and policies relevant the implementation of Smart Grids. Smart Grids will play a key role in achieving the EU's 2020 strategy to reduce greenhouse gas emissions and use more renewable energy.

4.21.2. TASKS

- Assist the Commission in relation to the implementation of existing Union legislation, programs and policies.
- Assist the Commission in the preparation of legislative proposals and policy initiatives.
- Provides expertise to the Commission when preparing implementing measures, i.e. before the Commission submits these draft measures to a comitology committee.

4.21.3. SOLUTIONS RELEVANT TO ECLIPSE.

The Smart Grids Task Force (SGTF) offers valuable solutions relevant to ECLIPSE, especially in regulatory alignment and best practices for Smart Grid deployment. By utilizing SGTF's guidance on grid implementation, addressing market barriers, and leveraging proposed incentives for Smart Metering, ECLIPSE can enhance adoption and stakeholder engagement. Additionally, SGTF's emphasis on information exchange regarding EU legislation supports ECLIPSE in aligning its solutions with current policies, ensuring compliance and effective integration across regions.

4.22. BRIDGE INITIATIVE

Programme: European Commission Initiative

From: 2016 – now

Total cost: NA

Webpage: https://bridge-smart-grid-storage-systems-digital-projects.ec.europa.eu/

Organizational Support: secretariat@horizon-bridge.eu

Communications: communication@horizon-bridge.eu

Partners who are also part of ECLIPSE consortium: ETRA, FHOOE, Trialog, UBITECH.

4.22.1. PROJECT DESCRIPTION AND OBJECTIVES.

BRIDGE is an initiative by the European Commission, uniting Horizon 2020 and Horizon Europe projects in the areas of Smart Grids, Energy Storage, Islands, and Digitalisation. Its goal is to provide a structured approach to cross-cutting issues faced by demonstration projects, facilitating knowledge-sharing and recommendations to advance Europe's energy transition. BRIDGE focuses on overcoming barriers to innovation by addressing issues in data management, regulation, consumer engagement, and business models.

BRIDGE Working Groups (WGs):

- Data Management: Covers data exchange, processing, security, and responsibilities. Key projects include establishing a data exchange reference architecture and interoperability among home appliances.
- Regulation: Explores regulatory barriers to market access and sector integration, supporting system operators and fostering peer-to-peer energy sharing models.
- Consumer and Citizen Engagement: Focuses on engagement strategies to maximize consumer involvement in the energy transition through accessible and automated digital tools.
- Business Models: Develops frameworks for evaluating and standardizing business models, emphasizing data value chain integration and monetization.

BRIDGE Tools and Support:

- Use-Case Repository: Offers standardized definitions for project use cases, simplifying cross-project comparisons.
- Standards Liaison: Connects BRIDGE outcomes with European standards organizations to support interoperability and data exchange.
- Reports and Best Practices: Includes publications like the European Data Exchange Reference Architecture (DERA) and the Business Model Working Group's findings.

4.22.2. PROJECT SOLUTIONS RELEVANT TO ECLIPSE.

The BRIDGE initiative offers several solutions relevant to ECLIPSE, particularly in advancing data management, consumer engagement, regulatory adaptation, and business model innovation. In data management, BRIDGE's development of the Data Exchange Reference Architecture (DERA) and cybersecurity protocols supports secure, interoperable data exchange across energy systems, aligning with ECLIPSE's emphasis on protecting consumer data and enabling flexible energy usage. The Consumer and Citizen Engagement Working Group's focus on automated tools and accessible engagement strategies helps consumers make informed decisions, empowering them to participate actively in the energy transition—a priority shared by ECLIPSE as it seeks

to reduce energy consumption and emissions through consumer involvement. Furthermore, BRIDGE's regulatory solutions explore flexibility markets and peer-to-peer energy sharing, which facilitate collective energy management and help break down barriers to consumer participation, echoing ECLIPSE's vision of enhanced network operations and renewable integration. Lastly, BRIDGE's work on data-driven business models, including methods to assess and monetize the social value of energy data, aligns with ECLIPSE's goals by offering frameworks that enhance value for both energy providers and consumers. These collaborative solutions between BRIDGE and ECLIPSE ultimately support a more resilient, consumer-centered path toward energy sustainability.

4.23. LESSONS LEARNED AND CONCLUSIONS

The ECLIPSE project builds on existing innovations to create an ecosystem that integrates energy systems, empowers consumers, and supports sustainable energy transitions.

This section includes analyses and references to related projects, initiatives, and best practices that contribute to the ECLIPSE project's objectives. By leveraging lessons from related projects, ECLIPSE aims to establish a replicable and interoperable framework that aligns with EU energy policies and enhances market adoption.

From the analysis of the related projects described, we can extract some lessons related to several aspects:

Regarding **consumer engagement**, it has been identified that effective communication of energy needs and tailored tools (e.g., STREAM and BeFlexible projects) are critical for empowering users to participate actively in energy management. User-friendly interfaces and actionable insights are required to ensure engagement over time.

Moreover, in the context of **interoperability**, projects like InterConnect, ODEON and ENERSHARE emphasize the need for standardized frameworks and seamless data sharing to enable cross-sector collaboration.

Regarding **data security**, projects such as EDDIE and ENERSHARE stress the importance of privacy, cybersecurity, and data sovereignty to build trust among stakeholders.

Finally, it is demonstrated that the initiatives such as Smart Grids Task Force and BRIDGE highlight the role of **policy frameworks in overcoming market barriers** and aligning solutions with EU energy goals. In this sense, demonstration pilots across diverse geographies and socio-economic contexts (e.g., HEDGE-IoT and RESONANCE) provide templates for scaling solutions EU-wide.

5. LEGAL FRAMEWORK AND POLICIES

The regulatory landscape governing energy data-driven services in the European Union is both robust and dynamic, reflecting the critical role of these services in shaping a sustainable and innovative energy ecosystem. As illustrated in the initial overview diagram below, the interplay of various regulations underpins the secure, efficient, and fair utilization of energy data. This is essential for enabling technologies like smart grids, renewable energy integration, and real-time energy demand management, all of which are vital for the EU's energy transition goals.

Compliance with the EU regulatory framework is paramount for several reasons. Regulations such as the General Data Protection Regulation (GDPR) ensure that personal data is protected, fostering trust among users and stakeholders. Similarly, sector-specific instruments like the Digitalisation of the Energy Sector Action Plan and the Electricity Market Regulation (2024) are designed to harmonize market practices and promote interoperability across the EU energy sector.

The Data Governance Act (DGA) and the Data Act establish fair and transparent mechanisms for data access and sharing, enabling innovative solutions while ensuring data sovereignty. Furthermore, the Network & Information Security Directive (NIS2) and the Network Code on Cybersecurity safeguard critical infrastructure against cyber threats, underscoring the importance of resilient energy systems.

By adhering to these regulations, energy service providers can mitigate compliance risks, enhance operational trust, and unlock cross-border opportunities for collaboration. The synergy between regulatory adherence and innovation forms the backbone of a competitive and forward-looking energy market. This document provides a comprehensive analysis of the regulatory framework, highlighting its implications for stakeholders and offering actionable insights to navigate this complex but essential environment. It is highly important for the design of the CERF to commemorate the findings and recommendations of regulatory analysis to avoid problems in its deployment.

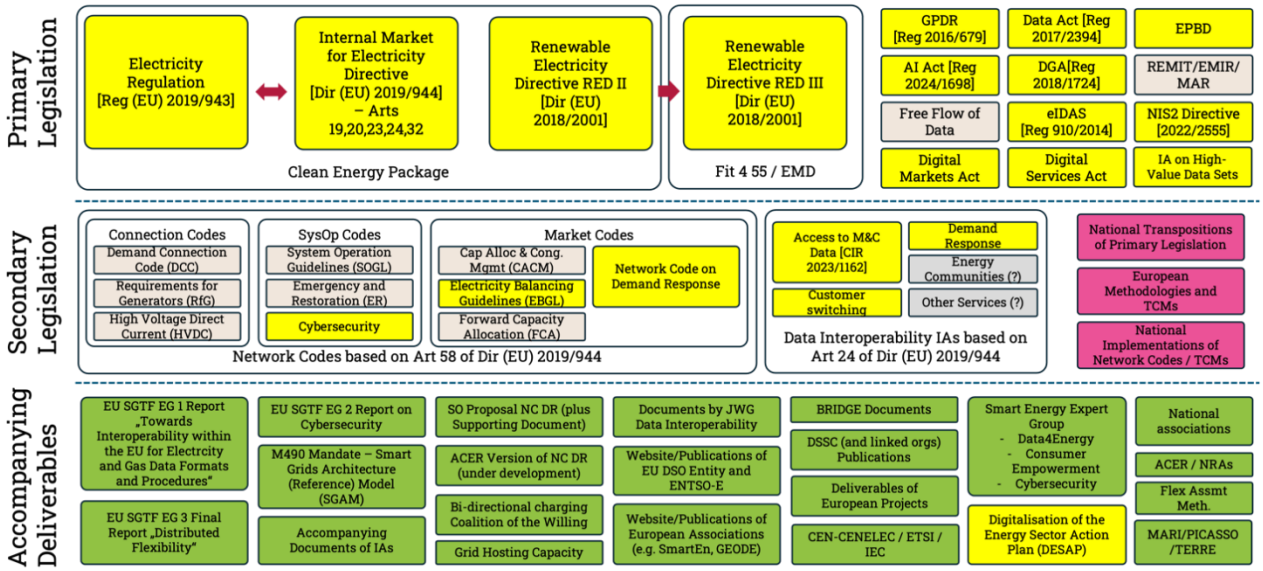

Figure 38.: EU regulatory framework summary

The team has primarily – but not exclusively – analysed the initiatives and regulations marked in yellow above. In order to provide reliable references, the following tables provides detailed information on the official names and links to the original documents to allow for an in-depth dive-in during architectural and product design activities.

Table 19. Initiatives and regulations summary

Index	Name	Type	Official legal identifier	Status	Level	First version	Latest amendment
1	Digitalisation of the Energy Sector Action Plan	Communication	COM/2022/552 final	In force	EU	Oct 18th 2022	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560						
2	Electricity Market Regulation (2024)	Primary legislation	REGULATION (EU) 2024/1747	In force	EU	June 2019	13th June 2024
Link:	https://data.consilium.europa.eu/doc/document/PE-1-2024-INIT/en/pdf						

3	Electricity Market Directive (2024)	Primary legislation	PE-2-2024-INIT	In force	EU	21st December 2018	7th May 2024
Link:	https://data.consilium.europa.eu/doc/document/PE-2-2024-INIT/en/pdf						
4	Harmonised rules on fair access to and use of data (Data Act)	Primary legislation	Regulation (EU) 2023/2854	In force	EU	2017	11th January 2024
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R2854&qid=1734093786647						
5	Network & Information Security Directive	Primary legislation	Directive (EU) 2022/2555	In force	EU	16th January 2023 (18 months transposition)	-
Link:	https://eur-lex.europa.eu/eli/dir/2022/2555						
6	Data Governance Act	Primary legislation	Regulation (EU) 2022/868	In force	EU	23rd June 2022	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0868						
7	General Data Protection Regulation (GDPR)	Primary legislation	Regulation (EU) 2016/679	In force	EU	27th April 2016	25th May 2018
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R0679						
8	Artificial Intelligence Act	Primary legislation	Regulation (EU) 2024/1689	In force	EU	13th June 2024	-
Link:	https://eur-lex.europa.eu/eli/reg/2024/1689						

9	Digital Services Act (DSA)	Primary legislation	Regulation (EU) 2022/2065	In force	EU	16th November 2022	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R2065						
10	Digital Markets Act (DMA)	Primary legislation	Regulation (EU) 2022/1925	In force	EU	1st November 2022	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R1925						
11	European Digital Identity Framework	Communication	COM(2021) 281 final (manifested in 2024 amendment of EIDAS Reg)	In force	EU	3rd June 2021	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0281						
12	Implementing Act on High-Value Data Sets	Secondary legislation	Commission Implementing Regulation (EU) 2023/138	In force	EU	9th February 2023	-
Link:	https://eur-lex.europa.eu/eli/reg_impl/2023/138/oj						
13	EIDAS Regulation	Primary legislation	Regulation (EU) 2024/1183 of the European Parliament and of the Council of 11 April 2024 amending Regulation (EU) No 910/2014	In force	EU	23rd July 2024	23rd April 2024
Link:	https://digital-strategy.ec.europa.eu/en/policies/eidas-regulation						

	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0073.01.ENG https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1183						
14	Network Code on Demand Response	Secondary legislation	Not yet available	In progress	EU	9th May 2024	5th September 2024
Link:	https://www.acer.europa.eu/documents/public-consultations/pc2024e07-public-consultation-draft-network-code-demand-response						
15	Implementing Acts as mandated by Article 24 of Directive (EU) 2019/944	Secondary legislation	Commission Implementing Regulation (EU) 2023/3477 (ff.)	In force, in progress	EU	6th June 2023	
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=pi_com:C%282023%293477						
16	Revised Renewable Electricity Directive	Primary legislation	Directive (EU) 2023/2413	In force	EU	11th December 2018	18th October 2023
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023L2413&qid=1699364355105						
17	Energy Performance of Buildings Directive (EPBD)	Primary legislation	Directive (EU) 2018/844	In force	EU	30th May 2018	-
Link:	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0844						
18	Network Code on Cybersecurity	Secondary legislation	Commission Delegated Regulation (EU) 2024/1366	In force	EU	13th June 2024	-
Link:	https://eur-lex.europa.eu/eli/reg_del/2024/1366						

19	Electricity Balancing Guidelines	Secondary legislation	Regulation (EU) 2017/2195	In force	EU	23rd November 2017	-
Link:	https://eur-lex.europa.eu/eli/reg/2017/2195/oj						
20	"Towards a common European data space" / European Data Spaces Initiative	Communication	COM/2018/232 final	In force	EU	25th April 2018	-
Link:	https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2018:0232:FIN						

5.1. TOWARDS A COMMON EUROPEAN DATA SPACE

The "Towards a Common European Data Space" initiative, introduced by the European Commission, aims to establish a unified framework for secure and seamless data sharing across sectors and borders within the EU. Recognizing data as a key driver of the digital economy, the initiative seeks to address challenges such as fragmented markets, legal uncertainties, and a lack of trust that hinder the free flow and effective use of data. Its overarching goals include creating a single market for data, ensuring data sovereignty, and fostering innovation to drive economic growth and societal progress.

Central to the initiative is the concept of European data spaces—sector-specific ecosystems that facilitate secure and interoperable data sharing. These spaces are designed to unlock data's full potential in areas such as health, energy, transport, and manufacturing, enabling new applications like smart grids, personalized healthcare, and real-time logistics management. By making high-value datasets, particularly those held by the public sector, widely available for reuse, the initiative promotes transparency and innovation. For instance, open access to energy data can help optimize renewable integration and enhance grid management.

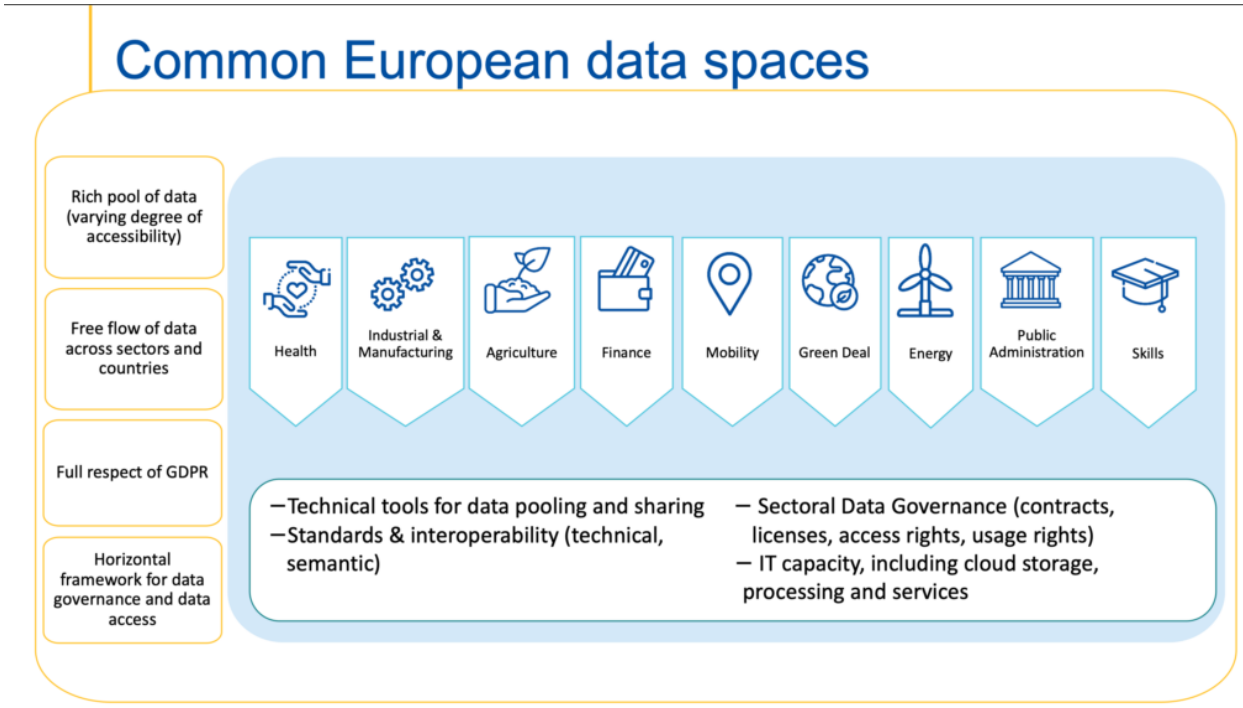

Figure 39.: Common EU data spaces summary. Source: https://ec.europa.eu/digital-single-market/en/policies/building-european-data-economy

To build trust and ensure compliance, the initiative aligns with existing EU regulations such as the General Data Protection Regulation (GDPR) and the Data Governance Act (DGA), emphasizing user control over personal data and fostering secure data-sharing mechanisms. Investments in infrastructure and technology, such as cloud computing and artificial intelligence, are also prioritized to support advanced data processing capabilities.

Ultimately, the initiative aims to empower consumers, enhance Europe's digital competitiveness, and contribute to sustainability by leveraging data-driven insights for smarter resource management. By fostering collaboration among businesses, governments, and researchers, the initiative represents a significant step toward building a robust, fair, and innovative data economy in Europe.

5.2. DIGITALISATION OF THE ENERGY SECTOR ACTION PLAN (DESAP)

With this Action Plan, the Commission set out actions to realise the dual green and digital transformation of the European energy system necessary for the achievement of the European Green Deal and the REPowerEU Plan. In particular, the proposed

actions aimed to boost data sharing and promote investments in digital electricity infrastructure and new technological solutions while ensuring benefits for consumers and strengthening cybersecurity.

5.3. COMMON EUROPEAN REFERENCE FRAMEWORK FOR CONSUMER APPLICATIONS

The Action Plan introduced for the first time the concept of a common reference framework for the implementation of consumer applications.

The Plan recognised the potential of digital tools and technologies to boost the engagement of consumers in the energy transition and facilitate their participation in the energy market and flexibility provision. Building on the insights gathered by the Smart Grids Task Force, the European Commission committed to the delivery, by mid-2023, of a common reference framework for consumer applications and to supporting R&I projects in the field through the Digital Europe programme. The framework was foreseen to, on one hand, empower consumers to make voluntary reductions in their energy consumption and, on the other, support communication with energy providers active in the market. The Plan provides some additional indications on the expected scope of the applications developed according to the CERF:

- Integration of energy consumption and weather data.
- Provision of energy-saving tips and advice.
- Provision of information to navigate energy crises.
- Integration with smart systems (e.g., smart meters, smart appliances, sensors, etc.).

5.3.1. COMMON EUROPEAN ENERGY DATA SPACE

The Action Plan further announced the deployment of a European energy data space starting in 2024 with the aim of enabling data access, secure sharing and interoperability. The establishment of the data space and the assurance of EU data governance would manifest as a harmonized European framework for the sharing and utilization of energy data. A new working group Data for Energy (D4E) is set to established under a newly formed strategic body (Smart Energy Expert Group (SEEG), follow-up of EU Smart Grids Task Force) by the Commission for the coordination of the development of the energy data-sharing framework and the building blocks of the

data space. The Commission committed to supporting the achievement by making funding available under the Digital Europe Programme.

Of particular relevance for the CERF are sections 2.1 – Strategic EU coordination and 2.2 – Immediate results and building blocks to support the process on the European Energy Data Space, as well as section 4.2 - Digital tools designed for and with consumers on the establishment of an open-source and common reference framework for consumer applications.

DESAP has a big impact on the enabling environment for consumer applications and has triggered and framed a lot of important actions. However, as it is an Action Plan it is by itself not legally binding.

5.4. PRIMARY LEGISLATION

It is important to get an in-depth view on roles, definitions and timelines for the relevant pieces to develop a credible compliance strategy for the CERF.

5.4.1. ENERGY-RELATED PRIMARY LEGISLATION

With regards to primary legislation, the following legal acts need to be taken into account.

5.4.1.1. DIRECTIVE (EU) 2018/2001AMENDED BY DIRECTIVE (EU) 2023/2413 ON THE PROMOTION OF THE USE OF ENERGY FROM RENEWABLE SOURCES (RENEWABLE ENERGY DIRECTIVE)

This directive sets targets for the share of renewables in the EU's energy mix and outlines mechanisms for achieving them. Its implications for data-driven energy services are significant:

- Integration of Renewables: Facilitates the integration of renewable energy sources into the grid through advanced data analytics and forecasting tools.

- Guarantees of Origin (GoO): Ensures transparency in renewable energy claims by requiring robust data management systems for GoO certification.
- Decentralized Renewable Systems: Supports the development of localized renewable energy communities, relying on data for coordination and optimization.

The Directive embodies a first step also towards Collective Self-Consumption, defining jointly acting self-consumers as "a group of at least two jointly acting renewables self-consumers who are located in the same building or multi-apartment block. Furthermore, Renewable Energy Communities with renewable generation in locational proximity of self-consumers.

Directive (EU) 2023/2413 aims to strengthen the resilience and sustainability of the EU's energy system by providing a clear framework for integrating renewable energy sources, improving energy efficiency, and enhancing cross-border cooperation among Member States.

The Directive introduces measures to streamline permitting processes for renewable energy projects, promote energy storage solutions, and establish minimum requirements for demand-side flexibility. Additionally, it sets ambitious targets for renewable energy deployment and energy savings, ensuring alignment with the European Green Deal and the Fit for 55 package.

A key feature of the Directive is its focus on consumer empowerment and engagement, enabling households and businesses to actively participate in the energy transition through initiatives such as energy communities, peer-to-peer trading, and better access to green financing. The Directive also emphasizes the importance of ensuring a just transition by addressing social and economic disparities arising from the energy transformation.

The Directive underscores the role of digitalisation and data-driven solutions in achieving its objectives. It encourages the use of real-time data platforms to enhance transparency, optimize grid operations, and support renewable energy integration. Specific provisions include:

- Development of standardized data exchange protocols to ensure interoperability across Member States.

- Implementation of advanced metering infrastructure to facilitate demand-side management and consumer participation.
- Promotion of digital tools for energy forecasting, consumption tracking, and market participation.

By leveraging energy data, stakeholders can optimize resource allocation, improve decision-making processes, and create innovative services that support the EU's climate goals. Of particular importance for the CERF are Article 4.1 on renewable energy deployment targets, Article 6.2 on streamlined permitting processes and Article 10.3 on consumer participation and energy communities.

5.4.1.2. REGULATION (EU) 2019/943 ON THE INTERNAL MARKET FOR ELECTRICITY

This regulation establishes the rules for the functioning of the internal electricity market, emphasizing the importance of competition, transparency, and efficiency. Its relevance for energy data-driven services includes:

- Market Transparency and Fair Competition: The regulation promotes fair access to market data, which is essential for enabling competitive electricity markets and fostering innovation in energy data-driven services.
- Efficient Grid Operations: It supports the use of data for demand-response mechanisms, grid optimization, and better integration of renewable energy sources.
- Consumer Empowerment: By facilitating access to market information, it empowers consumers to make informed decisions and participate in new market models, such as prosumer-based systems and energy communities.

Of particular relevance for the CERF in this Regulation are Article 3.2 on long-term contracts and PPAs, Article 5.4 on demand-side flexibility and consumer participation and Article 7.1 on market data transparency and sharing.

5.4.1.3. DIRECTIVE (EU) 2019/944 ON COMMON RULES FOR THE INTERNAL MARKET FOR ELECTRICITY

This directive complements Regulation (EU) 2019/943 by focusing on consumer rights, market access, and the role of data in modern electricity markets. Key aspects for energy data-driven services include:

- Smart Metering and Data Access: The directive mandates the deployment of smart meters and ensures consumers have access to their consumption data. This enables innovative services, such as personalized energy management tools and dynamic pricing.
- Consumer-Centric Markets: It establishes rules for active consumer participation, enabling services like peer-to-peer energy trading and aggregators to use consumer data for optimizing energy use.
- Interoperability and Standardization: Ensures the seamless flow of data between stakeholders by promoting interoperability standards, critical for scaling energy data-driven innovations across the EU.

The Directive defines – in addition to the self-consumption structures defined in Directive (EU) 2018/2001 – so-called Citizen Energy Communities without the obligation for locational proximity, no binding to renewable generation and a slight option to self-operate grids.

Very importantly the Directive defines in Articles 19 – 23 provisions for making data available directly to final customers and – with their permission – to eligible parties to provide services related to “metering and consumption, billing, demand response and other services”. Furthermore, it regulates that for all smart meters deployed systematically after July 5th 2019 a standardized or remote interface for non-validated near real-time data must be available, all very relevant data sources for energy efficiency and consumer applications. The CERF must capitalize on the established capabilities and utilize the provision of Article 24 implying that the European Commission shall facilitate the full interoperability of energy services across all Member States via the means of Implementing Acts. The first – Commission Implementing Regulation (EU) 2023/3477 defines reference models for this data access and is the basis

for Project EDDIE – European Distributed Data Infrastructure for Energy, which builds a European Data Space for a participate and digital energy system based on it.

5.4.1.4. REVISED RENEWABLE ELECTRICITY DIRECTIVE (2024)

The revised directive updates and strengthens the EU's commitment to renewables and further emphasizes the role of digitalization and data-driven services:

- Streamlined Permitting and Digital Tools: Promotes the use of digital platforms for permitting renewable energy projects, reducing delays and enhancing transparency.
- Energy Storage and Flexibility Services: Encourages the deployment of energy storage and flexibility services, relying on real-time data to balance supply and demand.
- Sector Coupling: Supports cross-sectoral integration (e.g., electricity, heating, and transport) enabled by data exchange, critical for achieving climate neutrality.

In addition to the abovementioned topics, the Directive puts a push for Energy Sharing and clarifies to conditions for the use of Dedicated Measurement Devices (DMDs).

The Directive amending Directives (EU) 2018/2001 and (EU) 2019/944 introduces several key changes aimed at improving the Union's electricity market design and fostering the integration of renewable energy sources. Article 1 - Direct Price Support for Renewable Electricity focuses on financial aid schemes for electricity produced from renewable sources. It establishes support in the form of market premiums, which can be fixed or variable. This measure is designed to incentivize renewable electricity production by providing stable and predictable financial support, thereby encouraging further investment in clean energy technologies.

Article 2 - Amendments to Directive (EU) 2019/944 introduces significant updates to enhance consumer rights, energy sharing, and market flexibility. Under the amendment to Article 2 - Definitions and Rights of Active Customers, the directive defines terms such as "active customer," "energy sharing," and "fixed-price and fixed-term electricity supply contracts." These provisions empower active customers to share renewable energy, either directly or through legal entities, while ensuring access to

contracts that offer stable and predictable conditions. Additionally, the introduction of flexible connection agreements provides a solution for connecting to the grid in areas with limited capacity, addressing infrastructure constraints. Of particular relevance are:

The amendment to Article 4: Freedom to Choose Electricity Suppliers strengthens consumer choice by guaranteeing the right to select electricity suppliers. It allows consumers to hold multiple electricity supply contracts or energy-sharing agreements simultaneously, supported by separate metering and billing points. This flexibility empowers consumers to optimize their energy use and costs while benefiting from diverse market opportunities.

Article 6: Flexible Connection Agreements establishes a framework for integrating new renewable energy installations into the grid. By allowing partial or temporary connections in areas with limited capacity until grid reinforcements are completed, this provision facilitates the deployment of renewable energy sources and supports grid resilience.

Article 11: Consumer Rights to Fixed-Price and Dynamic Contracts focuses on ensuring the availability of fixed-term, fixed-price, and dynamic pricing electricity supply contracts. Fixed-price contracts protect consumers from energy price fluctuations, while dynamic pricing shifts cost risks to consumers, enabling them to engage in demand response (DR) or Demand Side Response (DSR) and energy-sharing programs. Importantly, the directive ensures that consumers participating in fixed-term and fixed-price contracts are not excluded from demand response opportunities. It mandates equitable access to the demand response market for consumers and operators, allowing them to compete with producers and contribute to the flexibility needs of the electricity grid.

These amendments collectively aim to create a more consumer-centric, flexible, and renewable-friendly electricity market. By addressing key challenges such as grid capacity, consumer empowerment, and renewable integration, the directive supports the EU's energy transition and sustainability goals.

5.4.2. ENVIRONMENTAL PRIMARY LEGISLATION

In addition to regulation focused on Energy there is a growing number of legal sources that need to be taken into account when designing a CERF, categorized into areas of relevance:

5.4.2.1. GENERAL DATA PROTECTION REGULATION (GDPR)

The GDPR (Regulation (EU) 2016/679) ensures the secure and transparent handling of personal data, forming the cornerstone of trust in energy data-driven services. One of the GDPR's standout features is its focus on "privacy by design and by default," requiring privacy measures to be embedded into systems and processes from their inception. Additionally, it demands robust security protocols and rapid reporting to authorities in the event of data breaches. With respect to this, a CERF must comply with the following principles of GDPR:

- Lawfulness, Fairness, and Transparency
    - Lawfulness: Data must be processed based on a lawful basis, such as consent, contract necessity, or legitimate interest.
    - Fairness: Data processing must be conducted in a way that is fair and not misleading to individuals.
    - Transparency: Individuals must be informed about how their data is collected, used, and shared, typically through clear privacy notices.
- Purpose Limitation - personal data must be collected for specified, explicit, and legitimate purposes and not processed further in a way incompatible with those purposes.
- Data Minimization
- Data collected must be adequate, relevant, and limited to what is necessary for the purposes for which it is processed.
- Accuracy - personal data must be accurate and kept up to date. Inaccurate data should be corrected or deleted without delay.

- Storage Limitation - personal data must not be kept for longer than necessary for the purposes for which it was collected. Organizations should implement policies for data retention and secure disposal.
- Integrity and Confidentiality - data must be processed in a manner that ensures its security, including protection against unauthorized or unlawful processing, accidental loss, destruction, or damage. This requires implementing appropriate technical and organizational measures.

Additionally, the GDPR includes the accountability principle, which requires organizations to demonstrate compliance with these six principles through documentation, policies, and practices.

5.4.2.2. DATA GOVERNANCE ACT (DGA)

The European Data Governance Act (Regulation (EU) 2022/868) is a key component of the EU's digital strategy, aimed at strengthening the European data economy and promoting the responsible use of data across the Union. Adopted on May 30, 2022, and entering into force on June 23, 2022, this regulation facilitates the secure sharing of data while ensuring fundamental rights such as privacy are respected.

At its core, the initiative seeks to create common European data spaces in sectors like energy, health, mobility, and environmental protection, among others. These data spaces are intended to foster data sharing and interoperability across borders, while maintaining control over how data is used, regardless of where it is stored. The goal is to break down silos between industries and promote innovation through the exchange of both personal and non-personal data.

One of the main innovations of the Data Governance Act is the establishment of data altruism, allowing individuals and organizations to voluntarily share data for the common good, such as in healthcare or environmental protection, under a regulated framework. This provides a legal structure that supports the pooling of data for beneficial purposes while safeguarding privacy and avoiding misuse.

Another important aspect is the regulation's aim to reduce market concentration by ensuring that large tech companies do not monopolize access to critical data. By promoting data portability and interoperability, the Act facilitates a more equitable

data economy, allowing small businesses and start-ups to benefit from the data-driven innovations emerging across Europe.

Additionally, the regulation also amends Regulation (EU) 2018/1724 concerning the European Data Portal, which aids the discovery and sharing of public sector information. By improving the governance of data and enhancing trust, the initiative lays the groundwork for the broader EU Digital Strategy, which includes fostering advancements in technologies like artificial intelligence.

In summary, the European Data Governance Act is a pivotal legal framework in the EU's push towards a more data-driven economy, enabling secure data sharing across member states, boosting innovation, and ensuring that data governance practices are ethically aligned with European values.

The European Data Governance Act (Regulation (EU) 2022/868) is highly relevant to energy-data-driven services because it establishes a legal framework that promotes the sharing and governance of data across the European Union, including critical data for the energy sector. The Act is designed to facilitate data sharing in various domains, including energy, climate, and environmental data, which are crucial for developing data-driven solutions in these areas. Also, it is central to unlocking the potential of energy data-driven services, as it facilitates secure and efficient data sharing, encourages innovation in energy technologies, and enhances cross-border collaboration in the EU energy market. This is particularly relevant for advancing green energy transition and energy efficiency initiatives across Europe.

Of particular relevance are Article 1 - Subject Matter and Scope, Article 2 – Definitions, Article 3 - Categories of Data, Article 5 - Conditions for Re-use, and Article 31 - International Access and Transfer.

These provisions within the regulation aim to support energy innovation by ensuring that data is accessible, reusable, and interoperable, helping to develop data-driven solutions for the energy sector. The focus on data altruism also allows for collaborative energy data sharing, which can be particularly beneficial for large-scale sustainability and climate initiatives.

5.4.2.3. DATA ACT

Connected products (i.e., items generating or collecting data about their use and environment and capable of communicating this data) and related products (i.e., digital services connected and providing functionalities to the product) shall be designed to make the generated or collected data available to the user free of charge and in an easy and secure way. The manufacturer or service provider shall provide the user with clear information on the generated data and how the user can access it. If the data cannot be made directly accessible to the user, it is the responsibility of the data holder to make it available to them. Moreover, under the request of the data user, the data holder shall make this data available to third parties. The data holder shall not use the abovementioned data in a way that could undermine the commercial position of the user or the third party in the market under consideration. On their side, data use by third parties shall be limited to the purposes agreed with the user.

When a public sector body, the Commission, the European Central Bank or a Union body demonstrates an exceptional need to use specific data for the public interest (as defined in national or Union law) or its inability to acquire this data by other means (e.g., purchase of non-personal data on the market), the data holder shall make such data available taking into account necessary technical, organisational and legal measures. The public body shall, on its end, demonstrate the conditions for the exceptional data need and forward a specific request. If personal data is requested, the data holder shall ensure that the necessary anonymisation (or pseudonymisation) measures are taken. The use of the obtained data by the public body shall be limited to the purpose of the request and shall not be aimed at developing a product/service that competes with the one of the data holders. Data confidentiality, integrity and security of the data shall also be guaranteed. Fair compensation of the data holder also applies.

Providers of data processing services (i.e., services such as collection, recording, organisation, structuring, storage, adaptation, retrieval, consultation, use, disclosure, and dissemination of data) shall take the necessary measures to allow customers to switch providers upon request and ensure a high level of security throughout the transfer process.

Participants in data spaces shall facilitate by providing a public description of the datasets and adopted methodologies for collection, storage and access. Moreover,

vendors of applications using smart contracts (i.e., a computer program used for the automated execution of an agreement) for data sharing shall ensure their robustness and security. The Commission is empowered to adopt delegated acts to further specify essential requirements of data spaces and implementing acts to adopt common interoperability specifications.

Additional provisions of the Regulation address the transfer of data to countries outside of the European Union.

Of particular relevance are Article 3-6 - Data availability to product/service users and third parties, Article 15-20 - Data availability to public bodies, Article 23 - Switching of data processing service provider, and Article 33-36 - Interoperability, data spaces and smart contracts.

5.4.2.4. DIGITAL MARKETS ACT (DMA)

The Digital Markets Act (DMA) aims to ensure fair and contestable digital markets by regulating large online platforms that act as "gatekeepers." The DMA introduces specific obligations to prevent anti-competitive behaviour, foster innovation, and protect users in digital markets. It focuses on issues like data-sharing, transparency, and interoperability, giving the EU the power to enforce compliance through fines and sanctions. It is designed to create a more equitable digital environment, particularly benefiting smaller players in the online economy.

The DMA ensures fair access to digital platforms and data-sharing, which is vital for energy-data-driven services like smart grid systems, energy platforms, and digital energy services. It creates a level playing field for smaller companies, allowing them to innovate and access necessary digital infrastructure and data.

Of particular relevance for the CERF are Article 3 - Designation of gatekeepers, Article 5 – Obligations for gatekeepers, Article 6: Obligations for gatekeepers susceptible of being further specified under Article 8, and Article 11 - Reporting.

5.4.2.5. DIGITAL SERVICES ACT (DSA)

The Digital Services Act (DSA) is a comprehensive piece of primary EU legislation that regulates digital platforms, including online marketplaces, search engines, and social media platforms. It aims to create a safer digital space by tackling illegal content,

improving transparency on advertising, and ensuring platforms are accountable for systemic risks. A key focus is addressing the misuse of algorithms, enhancing user rights, and improving oversight for very large online platforms (VLOPs). By harmonizing regulations across the EU, the DSA supports user trust, innovation, and the integrity of the digital market.

The DSA indirectly impacts energy-data-driven services, particularly those relying on online platforms or digital tools for data exchange and analytics. Platforms hosting energy-related services or managing consumer data must comply with transparency requirements for content moderation, personalized recommendations, and targeted advertising. Additionally, it ensures robust data-sharing frameworks, contributing to trust and legal clarity for energy-data service providers.

For the design of the CERF, particularly Article 8: Obligations for intermediary services to address illegal content Article 9 – Due diligence requirements and Article 10 - Content removal processes, Article 39 - Transparency on algorithmic systems used by platforms, and Article 41- Independent audits for very large online platforms (VLOPs) are of interest.

5.4.2.6. ARTIFICIAL INTELLIGENCE ACT

The AI Act is a European regulation on artificial intelligence (AI) – the first comprehensive regulation on AI by a major regulator anywhere.

The AI Act classifies AI according to its risk:

- Unacceptable risk is prohibited (e.g. social scoring systems and manipulative AI).
- Most of the text addresses high-risk AI systems, which are regulated.
- A smaller section handles limited risk AI systems, subject to lighter transparency obligations: developers and deployers must ensure that end-users are aware that they are interacting with AI (chatbots and deepfakes).
- Minimal risk is unregulated (including the majority of AI applications currently available on the EU single market, such as AI enabled video games and spam filters – at least in 2021; this is changing with generative AI).

The majority of obligations fall on providers (developers) of high-risk AI systems.

- Those that intend to place on the market or put into service high-risk AI systems in the EU, regardless of whether they are based in the EU or a third country.
- And also, third country providers where the high-risk AI system's output is used in the EU.

The EU AI Act enforces rigorous data quality and governance standards. Any AI system classified as high-risk must use datasets that are relevant, complete, and free from bias. In the context of energy services, this ensures that predictive models or load-balancing algorithms are trained on accurate and representative data. This could potentially prevent issues like unequal energy distribution, system inefficiencies, or failures caused by data biases, which could disrupt energy supply. Other relevant issues considered in the Act is for example transparency requirements and cybersecurity.

One of the most important risks associated with automated decision-making in energy infrastructure, the Act emphasizes the need of human oversight. This ensures that human operators can intervene when AI system malfunction or produce unexpected results. This human-in-the-loop approach helps avoid catastrophic failures by allowing timely corrections during critical situations.

With regards to the Artificial Intelligence Act, CERF-based solutions need to take into account particularly Article 6 – Risk classification, Article 10 and 11 – Data Quality and Governance, Article 14 – Human Oversight, Article 15 – Cybersecurity Requirements, and Article 52 – Transparency Requirements.

5.4.2.7. IMPLEMENTING ACT ON HIGH-VALUE DATA SETS

The High-Value Datasets Initiative, formalized under Commission Implementing Regulation (EU) 2023/138, focuses on ensuring the availability and re-use of public sector datasets with significant socio-economic potential across the European Union. Adopted on December 21, 2022, the initiative stems from Directive (EU) 2019/1024, which aims to harmonize open data policies in EU Member States. By designating specific high-value datasets, this initiative seeks to foster innovation, enhance cross-border data-driven services, and generate societal and economic benefits.

High-value datasets are grouped into six thematic categories: geospatial, earth observation and environment, meteorological, statistics, companies and company

ownership, and mobility. These datasets are chosen for their potential to drive innovation and improve transparency. To ensure accessibility, they must be made available in machine-readable formats, through Application Programming Interfaces (APIs), and, where applicable, as bulk downloads.

The initiative promotes adherence to the FAIR principles—findability, accessibility, interoperability, and reusability. It mandates that datasets be provided free of charge, under open licensing conditions such as Creative Commons BY 4.0 or equivalent. Public sector bodies are also required to publish metadata and offer detailed documentation about the data structure and semantics.

A key feature of the initiative is its focus on minimizing barriers to data re-use. This includes ensuring legal compliance, such as adhering to the GDPR when processing personal data and encouraging Member States to complement high-value datasets with additional relevant public sector information. The initiative also sets out specific technical and licensing arrangements to avoid distortions in competition, especially for data held by public undertakings.

Member States are tasked with reporting their progress to the European Commission, ensuring transparency and accountability. Reports must include details of available datasets, licensing conditions, API access points, and data protection measures. By facilitating standardized access to critical datasets, the initiative aims to empower businesses, researchers, and policymakers, fostering innovation and cross-border collaboration.

Ultimately, the High-Value Datasets Initiative represents a significant step towards a unified European data space, enabling smarter governance, sustainable development, and technological growth.

The regulation categorizes high-value datasets under six themes, including earth observation and environment and statistics, both of which may encompass data crucial for energy-related services. Examples include:

- Environmental data such as land cover, geology, and biogeographical regions that can inform renewable energy site planning.
- Climate and emissions data essential for energy efficiency initiatives, carbon tracking, and regulatory compliance.

The regulation mandates that all high-value datasets be:

- Machine-readable and accessible via APIs for seamless integration into energy applications.
- Provided in publicly documented formats that facilitate cross-border interoperability, enabling energy service providers to scale their solutions across EU Member States.

Datasets must be made available under open licenses, such as Creative Commons BY 4.0, allowing unrestricted re-use. This facilitates innovation in energy services, such as:

- Predictive modeling for energy demand and supply.
- Monitoring of renewable energy outputs (e.g., solar or wind) based on meteorological and environmental data.

By aligning with the FAIR principles (Findability, Accessibility, Interoperability, and Reusability), the regulation ensures data consistency and reliability, essential for energy services relying on accurate analytics.

The regulation encourages Member States to complement the listed high-value datasets with additional energy-related public sector information, such as energy production statistics, grid data, or emissions data. This fosters a richer data ecosystem for energy innovations.

By enabling easy access to data that underpins energy efficiency, renewable energy planning, and emissions monitoring, the regulation aligns with the EU's goals for a green and digital transition, supporting sustainable energy services and smart grid technologies.

In summary, the regulation provides a framework that enhances the availability, accessibility, and utility of data crucial for energy-data-driven services, enabling innovation, transparency, and cross-border scalability within the energy sector.

Of particular importance for the CERF are Article 1 – Subject Matter and Scope, Article 3 - Arrangements for Publication Applicable to All Categories of High-Value Datasets, Article 4 - Arrangements for Re-use Applicable to All Categories of High-Value Datasets, Article 5 – Reporting, and the Annex (detailing specific data sets under categories like environmental data, climate data, emissions, ad transport networks, etc.). The CERF

may also lead to a master data model making it easier for applications to link and build upon high-value data sets.

5.4.2.8. SECURITY AND RESILIENCE OF ENERGY SYSTEMS

The NIS2 Directive (Directive (EU) 2022/2555) enhances cybersecurity in critical sectors, including energy:

- Infrastructure Resilience - protects energy systems from cyberattacks to ensure uninterrupted services.
- Incident Reporting - requires timely disclosure of cyber incidents to prevent broader disruptions.
- Supply Chain Security - mandates cybersecurity measures for third-party energy service providers.

With regards to security and resilience, the Network Code on Cybersecurity orientates strongly towards NIS2 and details requirements for critical infrastructure.

5.4.2.9. ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE (EPBD)

The EPBD (Directive (EU) 2018/844) focuses on improving energy efficiency in buildings:

- Smart Building Systems - supports smart meters and IoT devices, enabling real-time energy monitoring and optimization.
- Energy Audits - relies on data to evaluate and enhance building energy efficiency.
- Consumer Awareness - provides consumers with actionable insights into energy savings opportunities.

As buildings are amongst the most important energy consumers, and – as a result – there is a growing class of energy-data driven solutions designed to integrate building considerations, especially Article 14 (reflecting data-sharing obligations that we also see in the Electricity sector) has a significant impact on the CERF.

5.4.2.10. EIDAS REGULATION AND ELECTRONIC IDS, AND THE EUROPEAN DIGITAL IDENTITY FRAMEWORK

The eIDAS Regulation (Regulation (EU) No 910/2014) establishes a framework for electronic identification, authentication, and trust services within the European Union. It aims to enhance trust in electronic transactions by providing a legal framework for secure and seamless electronic interactions between businesses, citizens, and public authorities. Key features include:

- Electronic Identification (eID) - allows mutual recognition of national electronic identification schemes across the EU, enabling citizens and businesses to access online services in other Member States using their national eID.
- Trust Services - defines legal standards for electronic signatures, seals, timestamps, registered delivery services, and website authentication, ensuring their validity and legal equivalence to traditional paper-based processes.
- Cross-Border Interoperability - promotes seamless electronic interactions across EU borders, fostering the digital single market.
- Legal Certainty - provides legal clarity and uniformity for electronic transactions, boosting confidence in digital services.

The eIDAS Regulation is a cornerstone of the EU's digital transformation strategy, fostering secure and efficient online services.

Especially eIDs are widely used in eGovernment and public services and – with recent enhancements – are now opened to more private and public-private use cases. EIDAS has established a European Network of Authentication Services that allow not just for simple authentication, but also for digital representations of juristic persons by natural persons or natural persons by natural persons. The system works cross-border and EU-wide adoption has come to a high degree (see https://eidas.ec.europa.eu/efda/browse/notification/eid-chapter-contacts).

With its 2024 amendments, eIDAS has been extended with the European Digital Identity Framework. All regulated EU – wide IAM strategies are set to leverage a lot of cost savings potential and obstacles across multiple value chains in our sector.

As more and more digital platforms and data spaces are interacting with each other, these platforms may not be forced to operate on a common data pool, but are acting in a federated manner, which brings a lot of advantages.

As of status quo, most digital energy platform operators are utilising proprietary means for identification and authentication, often storing credentials on their own. This leads to a lot of media breaks and the lack of a chain of trust. This lack of trust creates a lot of very expensive obstacles for data-driven solutions to go to market. As an example, and as proven impressively by Project EDDIE, in most MSs service providers need to found domestic companies, which creates a lot of liabilities, costs and unnecessarily slows down time-to-market. The acceptance of cross-border eIDs places an available, secure and easy-to-adopt solution to this big issue.

However, there is also a growing demand for sharing interoperable means for authentication of actors.

A CERF must leverage eIDAS in many levels, also e.g. for certification and electronic signatures.

5.4.3. SECONDARY LEGISLATION OF RELEVANCE

Accompanying primary legislation developments, there is a series of implementing and delegating acts under elaboration or already in place that complement the regulatory environment for consumer applications:

5.4.3.1. THE (UPCOMING) NETWORK CODE ON DEMAND RESPONSE [INDEX 14]

Following Regulation (EU) 2019/943 of the European parliament and of the Council of 5 June 2019 on the internal market for electricity, and in particular Article 59(1)(e), which says that regulatory authorities must ensure the integration of demand response in electricity markets. This includes providing methodologies and frameworks for the development and implementation of market-based mechanisms for flexibility services, ensuring coherence across different timeframes and wholesale markets, and maintaining transparency and non-discriminatory access for all stakeholders.

The Network Code on Demand Response establishes a regulatory framework for integrating demand response, energy storage, distributed generation, and demand curtailment into the European electricity market. Its primary goal is to ensure non-discriminatory access to markets while promoting efficient, transparent, and flexible energy systems aligned with the EU's decarbonization objectives.

Key Objectives are

- Market Integration - Enables the participation of demand-side resources in balancing, congestion management, and voltage control markets. Removes barriers for market access and sets clear rules for system operators, service providers, and stakeholders.
- Flexibility and Renewable Integration - Supports renewable energy growth by incentivizing flexible services to manage intermittent sources like wind and solar.
- Promote efficient grid operations to avoid costly expansions by using distributed energy resources.
- Regulatory Harmonization - Introduce EU-wide methodologies for demand response processes, including product prequalification, baseline calculations, and service procurement.
- Ensure streamlined coordination between transmission system operators (TSOs) and distribution system operators (DSOs).

In order to achieve this objective, the Network Coder foresees the following core provisions in line with the ACER Framework Guidelines for the Act:

- Simplified Market Access - establish clear qualification, prequalification, and verification processes for service providers, mandate user-friendly, interoperable digital systems for data exchange and flexibility management.
- Baseline and Measurement Standards - develop transparent methods for calculating baselines and validating service performance, accurate and secure measurement devices for injections and withdrawals.
- Local Markets and Cost Efficiency - encourage the use of local markets to address grid congestion and voltage issues cost-effectively and ensure system operators adopt market-based solutions for flexibility services before pursuing grid expansions.

- Consumer and Stakeholder Engagement - empower consumers, aggregators, and third parties to actively participate in demand response markets, emphasize stakeholder consultations and transparency in regulatory decisions.
- Coordination and Oversight - require TSOs and DSOs to coordinate their grid planning and operational processes and provide mechanisms for national regulatory authorities to oversee compliance and resolve disputes.
- Cost Recovery and Confidentiality - allow system operators to recover costs deemed reasonable by regulatory authorities and establish data confidentiality and limits the use of sensitive information to authorized purposes.

The regulation applies to TSOs, DSOs, market participants, and other relevant stakeholders within the EU. It aims to optimize the electricity market by fostering non-discriminatory, competitive, and innovative solutions while supporting the EU's transition to a sustainable energy future. Through market-based mechanisms, it facilitates grid stability, enhances renewable energy integration, and ensures cost-effective decarbonization.

The Network Code on Demand Response implies a high degree of standardisation for data exchange for local and balancing services and opens a big value chain for energy data-driven services. Energy efficiency applications and other services will need to consider that value chain as a main revenue and/or cost driver, and integrate with the flexible, digital, and participative infrastructure prescribed by the code.

All MSs will be obliged to establish a Flexibility Information System (FIS) managing data on Controllable Units (CU), Service Providers and their portfolios. FIS will look differently in many MS due to MS necessities and considerations, which demands a smart approach to data interoperability.

Market platforms for balancing and local services are being built, which CERF-based applications may interact with to leverage revenues and cost savings for their clients.

The code foresees interactions between system users and system operators for the implementation of so-called Flexible Connection Agreements (FCAs) and is set to regulate the role of behind-the-meter Dedicated Measurement Devices (DMD) and their integration into a flexibilised system.

Following official procedures, after the DSO/TSO proposal has been published May 8th, 2024, ACER have published a revised draft September 9th 2024 for public consultation. They will publish their full revision end of Q1 or Q2 2025. After that, the European Commission will take over and put their version into force at the beginning of 2026.

After its entry into force, there is a clear path towards stepwise implementation, leading to a transitional period in which the usability of the implied structures by the CERF is not clear yet. What is very clear though is that consumer applications will heavily utilise the participative nature the code brings to our electricity system.

In addition, the upcoming Network Code on Demand Response has a very central role in the overall Electricity regulatory landscape and is heavily inter-dependent with other initiatives as can be seen below.

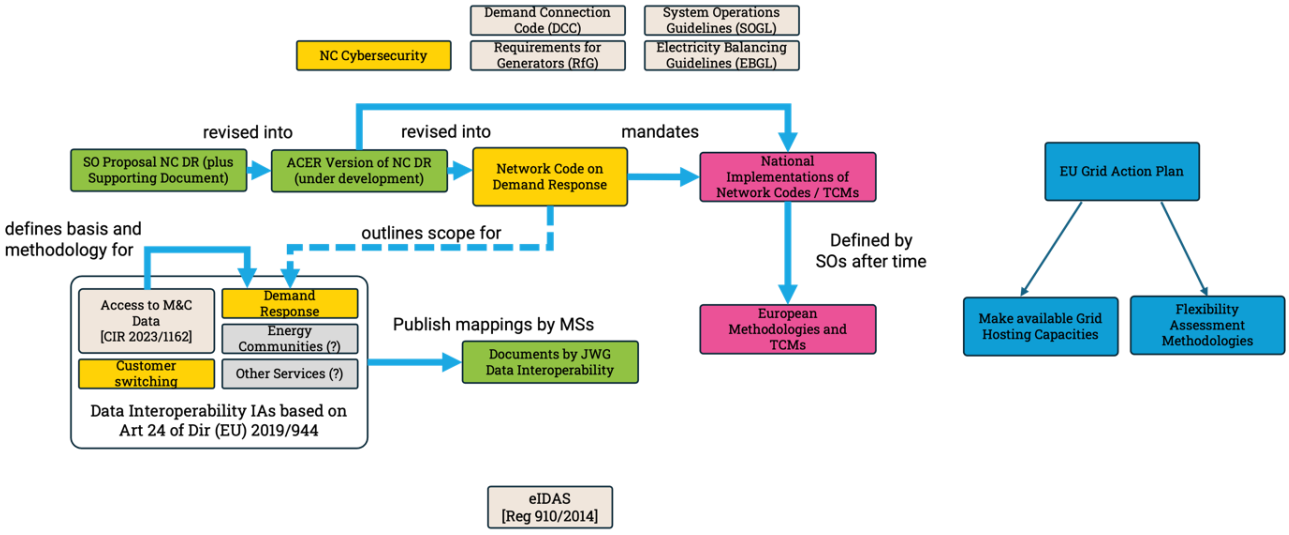

Figure 40.: Network code on demand response schema

It will furthermore lead to changes in the Electricity Balancing Guideline and lead to a common framework for local and balancing services, opening important revenue streams for consumer applications.

5.4.3.2. IMPLEMENTING ACTS AS MANDATED BY ARTICLE 24 OF DIRECTIVE (EU) 2019/944

Directive (EU) 2019/944 Article 24 states in Article 24 - Interoperability requirements and procedures for access to data:

1. In order to promote competition in the retail market and to avoid excessive administrative costs for the eligible parties, Member States shall facilitate the full interoperability of energy services within the Union.
2. The Commission shall adopt, by means of implementing acts, interoperability requirements and non-discriminatory and transparent procedures for access to data referred to in Article 23(1). Those implementing acts shall be adopted in accordance with the advisory procedure referred to in Article 68(2).
3. Member States shall ensure that electricity undertakings apply the interoperability requirements and procedures for access to data referred to in paragraph 2. Those requirements and procedures shall be based on existing national practices.

The first of these Implementing Acts/ Regulations has been released June 6th 2023 as Commission Implementing Regulation (EU) 2023/3477 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=pi_com:C%282023%293477), on interoperability requirements and non-discriminatory and transparent procedures for access to metering and consumption data.

New Implementing Regulations are proposed to the European Commission by a Joint Working Group between ENTSO-E and EU DSO Entity:

- Customer switching (accepted by both orgs, now under development by EC)
- Demand Response (under development, hopefully to be released together with NC Demand Response)
- Energy Communities (most probably to come after DR)
- Other services (open-ended formulation)

The Implementing Regulations on Demand Response are trying to cope with diversely set up national energy data management environments, by defining EU-wide reference models that MS have to use to document HOW they have fulfilled EU-level

requirements. It establishes interoperability requirements and transparent procedures for accessing electricity metering and consumption data within the EU.

This regulation aims to empower consumers by ensuring they can access their energy consumption data easily and securely, thereby promoting active participation in the energy transition.

Key aspects of the regulation include:

- Interoperability Framework - It introduces a reference model detailing roles, responsibilities, and procedures for data access, ensuring a shared understanding among market participants.
- Data Access for Consumers - Consumers are granted timely and straightforward access to both validated historical and near real-time metering data, facilitating informed energy usage decisions.
- Third-Party Access with Consent - With consumer authorization, suppliers and service providers can access metering data to offer tailored energy services, enhancing market competition and service quality.
- Access to Non-validated Near Real-Time data interfaces of smart meters. It features an implementation-neutral approach - the regulation remains neutral regarding specific technologies, allowing Member States to implement the reference model in line with national practices, particularly concerning communication protocols and hardware components.

In short, MSs are obliged to map their national environments towards the reference models and send it back to the EC. The EC will then – with the help of ENTSO-E and EU DSO Entity publish these mappings on a common place.

The Data Interoperability Implementing Regulations define 6 EU-wide procedures for access to data and data exchange that are needed by the CERF (see Annex / Reference Model Procedures):

- Access to validated historical metering and consumption data by the final customer
- Access to validated historical metering and consumption data by an eligible party
- Termination of service by an eligible party
- Revocation of an active permission by the final customer
- Activate near real-time data flow from smart meter or smart metering system

- Read near real-time data from smart meter or smart metering system

Furthermore, the Annex contains General Information on National Energy Market Communications environments that are highly needed by the CERF. For example, Project EDDIE already takes that information and synchronises it into a European Master Data Model.

Especially important are Article 19 – Smart Metering Systems, Article 20 – Functionalities of smart metering systems, Article 23 – Data management, and Article 24 – Interoperability requirements and procedures for access to data of Directive (EU) 2019/944. Of the CIR (EU) 2023/3477 all Articles in Document 1 (main part defining responsibilities of roles) and the Reference Model in Annex II are important.

5.5. CONCLUSIONS AND RECOMMENDATIONS

The regulatory landscape analyzed underscores the European Union's commitment to a sustainable, secure, and consumer-centric energy ecosystem, where data-driven solutions play a pivotal role. These regulations and directives collectively aim to balance innovation, competition, and consumer protection while advancing the EU's green and digital transitions.

One of the most significant observations is the emphasis on consumer empowerment. Regulations such as the Digital Markets Act, the Data Governance Act, and the revised Renewable Energy Directive place consumers at the core of the energy transition. By enabling provisions for energy sharing, flexible contracts, and access to real-time data, these frameworks empower individuals and businesses to actively participate in energy markets, optimizing their consumption and costs while contributing to broader sustainability goals. At the same time, the GDPR, the Data Act, and the implementing acts on data interoperability establish mechanisms to ensure responsible data handling and accessibility. These measures prioritize data sovereignty, enabling innovation while safeguarding privacy and security.

Another critical aspect is the focus on integrating renewable energy sources and enhancing grid flexibility. The Renewable Energy Directive and the Network Code on Demand Response demonstrate a strong commitment to decarbonization and grid resilience by supporting renewable energy deployment, demand-side response

mechanisms, and energy storage solutions. Additionally, trust and cybersecurity remain fundamental to the success of the digital energy ecosystem. The NIS2 Directive and the Network Code on Cybersecurity offer comprehensive measures to protect critical infrastructure, ensuring reliability and fostering consumer confidence in an increasingly digitalized energy market.

Despite these advancements, implementing the regulatory frameworks presents several challenges. The complexity of aligning diverse national approaches to data sharing and grid operations highlights the need for harmonization to achieve EU-wide interoperability. Effective collaboration among regulators, industry stakeholders, and technology providers is essential to streamline compliance and foster innovation. Moreover, the success of initiatives like the Common European Reference Framework (CERF) depends on addressing existing technology gaps, particularly in developing interoperable, scalable, and secure digital tools.

To support the successful implementation of the CERF, its design and operation must align closely with EU regulations, including the GDPR for data protection, the Data Governance Act for sharing frameworks, and the Renewable Energy Directive for integrating renewables. A strong focus on interoperability is essential, leveraging EU-wide reference models and standards defined in implementing regulations to facilitate seamless data exchange and cross-border collaboration. Equally important is a consumer-centric approach that prioritizes functionalities empowering consumers, such as personalized energy-saving advice, demand response participation, and energy-sharing options, while safeguarding their data rights. Robust cybersecurity measures, informed by the NIS2 Directive and Network Code on Cybersecurity, must also be embedded to ensure resilience and reliability in all data exchanges. Furthermore, the CERF should foster innovation by integrating advanced technologies, such as artificial intelligence, smart contracts, and digital identities, to enhance market efficiency and consumer engagement.

Looking ahead, the transition to a decarbonized and digitalized energy market will depend on the effective implementation of these regulations. The CERF, as a central framework, must harmonize technical, operational, and legal aspects to enable a participative, flexible, and innovative energy system. Strategic investments in digital infrastructure, cross-border cooperation, and consumer engagement will be key to achieving the EU's ambitious energy and climate goals. Moreover, an updated relevant

landscape will also be encapsulated in Deliverable D6.2 – Definition of replication and scaling-up guidelines and policy makers Recommendations.

6. DATA PROTECTION ACTIVITIES

The data protection best practices encountered by ECLIPSE partners on previous energy Apps have been analysed. Six main categories of best practices have been identified: Access control, data anonymisation, encryption, secure data collection and sharing, DataOps and GDPR compliance. They are detailed below, with the different best practices identified amongst the ECLIPSE partners.

6.1. ACCESS CONTROL

Granular Access Policies: Define access controls based on roles and attributes to secure sensitive data and align with compliance needs. Role-based and attribute-based policies enhance security by limiting access according to user roles and specific requirements. The following standards have been identified as relevant for managing granular access policies: RBAC (Role-Based Access Control), ABAC (Attribute-Based Access Control), OAuth2.0 and Keycloak.

Data Confidentiality Levels: Categorize data into confidentiality levels (confidential, private, open) to streamline access control and improve security. Classifying data by confidentiality level ensures that access rules are clear and consistently enforced, enhancing overall data protection. The ISO 27001 (Information Security Management) and NIST SP 800-53 (Data Classification Levels) standards can be used to implement them.

License Configuration and Management: Set up flexible access policies within licensing agreements to support dynamic needs without disrupting workflows. This flexibility in licensing and access control encourages collaboration while upholding security requirements. The Creative Commons Licensing (for data sharing), Data Use Ontology (DUO) can be used for licence configuration and management.

Federated Identity Management: Support federated identity solutions for consistent, multi-domain access control. Federated identity management enables secure cross-domain authentication, maintaining secure access across different systems and organizations. The SAML (Security Assertion Markup Language), OIDC (OpenID Connect), OAuth2.0 and Kerberos standards can be used for this.

6.2. DATA ANONYMISATION

Anonymization Protocols and Configurability: Use configurable techniques like pseudonymization and k-anonymity to protect personal and sensitive data while supporting privacy regulations. Customizable anonymization techniques allow organizations to secure data according to specific privacy needs, balancing privacy with data usability. The ISO/IEC 20889 (Privacy-enhancing data de-identification), GDPR Article 25 and NIST Privacy Framework can be used for this.

(Semi-)Automatic Anonymization Checks: Conduct pre-ingestion anonymization checks, ideally automated, to verify privacy compliance before data handling. This proactive approach identifies privacy risks early, adding a layer of security for sensitive information. The ISO/IEC 29100 (Privacy Framework) and IBM Data Privacy Passports are relevant for this.

Pre-Processing Anonymization: Apply anonymization during data preprocessing to protect privacy consistently across data stages. Early-stage anonymization ensures protection throughout the data lifecycle, reinforcing compliance and safeguarding individual privacy. HIPAA De-identification Protocols and Apache Parquet/ORC can be used for pre-processing anonymisation.

Granularity in Anonymization: Customize anonymization levels based on data attributes (e.g., identifying, quasi-identifying, sensitive) for more precise privacy control. Granular anonymization balances privacy requirements with data utility. The following methods can be used for this: K-anonymity, Differential Privacy, L-diversity.

6.3. ENCRYPTION

End-to-End Data Encryption: Implement encryption across all data states—on-premises, in transit, and in cloud—to ensure robust protection throughout the data lifecycle. End-to-end data encryption can use AES-256 (Advanced Encryption Standard), TLS 1.3 (Transport Layer Security), IPsec.

Key Exchange Protocols: Facilitate secure key exchanges to enable decryption access only for authorized users, ensuring controlled access across environments. Secure key management builds trust and strengthens security among stakeholders. Key exchange protocols include PKI (Public Key Infrastructure), Diffie-Hellman Key Exchange, RSA Cryptography.

Isolated Storage Options: Use isolated, secure data storage environments (centralized, private, or on-premises) with tailored encryption, ensuring that data storage meets specific privacy and security needs. FIPS 140-2 (Cryptographic Module Standards) and ISO 27001 can be used for this.

Multi-Level Encryption: Apply encryption across different stages (storage, transit) for added protection and compliance. Multi-level encryption safeguards data consistently, addressing both security and privacy regulations. NIST SP 800-57 (Key Management Guidelines), SSL/TLS for data in transit, BitLocker, VeraCrypt.

6.4. SECURE DATA COLLECTION AND SHARING

Controlled Data Sharing Mechanisms: Use standardized connectors (e.g., OCPP, Modbus, IoT) for structured and secure data sharing, which enhances interoperability and data integrity across platforms. The following protocols can be used for this: OCPP (Open Charge Point Protocol), Modbus (industrial protocol), IEEE 802.15.4.

Data Minimization: Collect only essential data points, minimizing exposure and simplifying compliance with privacy regulations. Limiting data collection reduces risks by excluding unnecessary data. The GDPR Article 5 (Data Minimization Principle) and ISO/IEC 29101 (Privacy Architecture) standard are relevant for this.

Risk Assessment and Monitoring: Provide regular cyber risk assessments and enable continuous monitoring to protect data confidentiality and identify potential vulnerabilities. The following frameworks can be used for this: NIST Cybersecurity Framework (CSF), ISO/IEC 27005 (Information Security Risk Management), Splunk, ELK Stack.

Secure Interoperability: Support secure data exchange across protocols to maintain data integrity and confidentiality in federated environments. The ISO/IEC 20248 (Data Carrier Interoperability) and ISA/IEC 62443 standards can be used for this.

6.5. DATAOPS

Automated Data Curation and Validation: Leverage machine learning to automate data validation and curation, reducing human error and ensuring data integrity during ingestion. MLFlow (ML model management), Apache Nifi (data flow automation), ISO/IEC 25012 (Data Quality) can be used for this.

Data Ingestion and Transformation Flexibility: Support diverse ingestion methods (e.g., batch, real-time) and data formats (e.g., JSON, CSV) to enhance compatibility and reduce integration challenges. The ETL Frameworks for real-time and batch ingestion Apache Kafka, Apache Flink and Apache Beam can be used for this.

Monitoring and Logging: Implement real-time monitoring and logging for visibility into data pipeline performance, enabling rapid response to issues and enhancing compliance. Prometheus, Grafana (monitoring), Datadog and ELK Stack can be used for this.

Efficient Resource Allocation: Optimize resource allocation across federated environments to maintain efficient workflows and reduce operational costs. Kubernetes (resource optimization), Apache Airflow (workflow scheduling) and Apache Spark can help the efficient resource allocation.

6.6. GLOBAL ANALYSES

Data management plan: A data management plan is a document that describes the data of the project or system, and makes recommendations on how to collect, store and handle them.

Privacy and security analyses: A privacy or security analysis gives a global view of the system at hand and goes through the different risks of the project and their impact. The objective is to define and prioritise controls to be put in place in order to suppress or reduce the risks. The following frameworks can be used for this: ISO/IEC 27570 Privacy Protection - Privacy Guidelines for Smart cities which provides an ecosystem point of view with many stakeholders of different sectors, as well as the Methodologies LINDDUN for privacy and STRIDE for security concerns.

Collecting end-customer consent: Consent collection on the collection and use of data is used to make an App compliant to the GDPR, article 7. This has been implemented in the GUI of the Trialog tool Troca.

6.7. EXAMPLES OF IMPLEMENTATION

The best practices mentioned above can be applied differently depending on the needs of the specific solution. A few examples are provided below.

The Trialog solution TROCA as EV charging solution coupled with Wirelane charging points for flexibility managing have executed a Privacy & Security analysis within the InterConnect project [1] in order to protect the end-customer leading to Anonymization of the PDL (Point De Livraison = point for energy delivery), Data minimization since EV charging profiles was considered as end-customer habits and consequently PII and Secure internal database storages.

The Voltalis App MyVoltalis [2] implements several best practices for data protection including encryption, VPN, Firewalls, the consumer right to be forgotten, the consumer right to access data and Secure storage.

The UK's IDSR programme in the THT Project [3] used secure storage area in a CEM using the cybersecurity - EN 303 645 with cryptographic keys using BS EN ISO/IEC 27000.

The Interoperability framework platform from Interconnect [1], implemented by Inesctec, included cybersecurity and data privacy protection capabilities of P2P marketplace enablers:

- The securisation of the framework in order to give privacy and security capabilities to the services and Apps that will use it. This is based on the Hyperledger fabric, and includes:
- Multi-channel design separates the information between different channels. Only organizations belonging to a certain channel can read and write information on that channel. This allows P2P marketplace integrators to fine tune access rights and information flow between participating parties.
- Private data collections (PDC) further refine privacy within a channel. In case of more organizations on one channel a PDC allows for a subset of them to share data privately. The organizations belonging to a PDC definition will be able to see the actual data, while others on the same channel will only see the hash of the data. It is algo possible to "purge" the data after a certain set number of blocks, leaving behind only hash of the data that serves as immutable evidence of the transaction.
- Controlled Chaincode access - users/Apps can only access the chaincode on the channels their organization is part of. Access in possible through a chosen SDK.
- Controlled Data Access - Within a chaincode, access to different functions (e.g. read, write, update) and parts of digital assets can be limited to allow only users/Apps from certain organization or with certain attributes to invoke them.

- Secure lifecycle for services: Capability to ensure that provided services comply to semantic interoperability protocol through automated testing.
- Secure access to services: Capability to ensure that access to services is controlled according to service provider's decisions/business logic and data protection rules.
- Integrity of interactions based on semantic interoperability framework: secure exchange of data and metadata through semantic interoperability layer.
- Protection against tampering of exchanged data and meta data.
- Performance logs to be analysed to identify usage and behaviour patterns with high risk of data misuse.
- Encryption in and out communications via TLS channels, modern cryptography algorithms up to date with latest standards.
- Minimal privileges concept, separation of roles (admin, non-admin), apply "four-eyed principle" (separate Administrator role for role assignment).
- Use "whitelisting" approach, generally don't trust any user input.
- Virus check for imported files.
- Consider keeping "sensitive information" out of the HTML/DOM, so it could not be modified or stolen (keeping integrity and confidentiality of data). Use secure flag when using cookies.
- Ensure application-level proxy with IDS capabilities is considered. Anti DoS (Denial of Service) proxy is set up, which not only filters incoming traffic by source IP, but also validates at the application level. Describe recovery plan.
- Data replication for backup purposes of the operational data for the service store.
- Privacy-by-design principles to apply in the developments.
- Periodic analysis of security and privacy risk, and review of vulnerabilities.
- Compliance to legal framework: GDPR, Cybersecurity Act, AI and Data Act.
- A Data Management Plan has been put in place, including: Lifecycle data definition (collect, store, use, deletion), Data access, data monitoring, Data Controllers identification, Data Processors identification, Data Contracts (if needed, e.g. JCA), data exchange (data flow) and Data Registry (Consents, Agreements, data sets).

The ODEON Federated Data Spaces [4] implemented several cybersecurity and privacy features:

- Data Confidentiality Levels
- License Configuration and Management
- Federated Identity Management

- Pre-Processing Anonymization
- Granularity in Anonymization
- Isolated Storage Options
- Controlled Data Sharing Mechanisms
- Risk Assessment and Monitoring
- Secure Interoperability
- Automated Data Curation and Validation
- Efficient Resource Allocation

The Ecoempower ICT platform [5] implemented granular access policies and controlled data sharing mechanisms.

The Evelixia Platform [6] implemented controlled data sharing mechanisms, data minimization, data ingestion and transformation flexibility, and efficient resource allocation.

The LeonR&Do application [1] in the Interconnect project used a HTTP Basic authentication for the user interface with SSH Keys authentication and a VPN.

The Gfi Semantic IoT Platform [1] in the Interconnect project used a HTTP Basic authentication for the user interface with OAuth token for the API.

The HomeGrid application [1] in the Interconnect project used Jason web tokens for authentication.

The ARTEMIS application [1] in the Interconnect project used OAuth for authentication.

The Ecko platform and ReFlex applications [1] from the Interconnect project used HTTP Basic authentications for the user interfaces.

The Cloud Forecasting App [1] in the Interconnect project used audits (traceability mechanisms implemented to trace back actions), 2Factor authentication, secure hash PDL (point for energy delivery) and the anonymization of personal details from metering databases.

The control of operational software from VITO [1] in the Interconnect project used code integrity, code repository restrictions and control version and automated testing.

6.8. RECOMMENDATIONs

As shown above, there are several possible ways to ensure the data protection of an ICT system, that can be used for different types of systems, and for different scenarios. Therefore, the first step in the development of cybersecurity and data protection features should be a thorough analysis of the system's use and need. The analyses described in the "Global analyses" section are performed for this purpose. They enable to identify gaps in the data protection of a system and select the best data protection features and practices to implement.

In ECLIPSE, an analysis of the cybersecurity and privacy of the different use-cases is planned as part of task T3.4. The solution providers will be guided through the analysis by cybersecurity and privacy experts. It will be based on the Data Management Plan, as well as the definition of the use-cases in T2.2 and of the data exchanges and architecture in WP3.

7. KPI IDENTIFICATION AND MONITORING PREPARATION

This section presents a set of preliminary Key Performance Indicators (KPIs) which will be used to assess the success of the project. KPIs are defined to ensure the objectives and the innovation challenges of the ECLIPSE project are fulfilled. The outcome of this section serves as a basis for elaborating the deliverable D6.1 "Economic and socioeconomic impact assessment (User satisfaction and innovative business models assessment)".

These KPIs were defined previously in the Grant Agreement and have been detailed by Trialog in collaboration with all involved partners in this section. The KPIs are detailed in the table below, including the calculation methods and data needed. Moreover, the related specific objectives (SO) and use-cases, that were defined in the Grant Agreement, are indicated for each KPI.

Table 20. KPI initial list

KPI ID	KPI Responsible	KPI type	KPI title	Description	Calculation method	Unit	Data needed	Baseline (M6)	Expected results (M24)	Related SOs	Related UCs	Related pilots
1	Pilot leaders	Deployment	States deployed	EU member states where the CERF for energy saving applications is broadly deployed	Number of countries where applications using the CERF have been deployed	Number of countries	Countries where the applications have been deployed	0	16	SO1	All	All pilots
2	Pilot leaders	Deployment	Downloads	Number of new downloads and active users of the CERF for energy saving applications in project pilot sites	Number of downloads and active users since the deployment of the project	Number of users	Number of downloads	0	> 40,000	SO1	All	All pilots
3	TRIALOG	Development	Stakeholders' development	Number of energy stakeholders collaborating on the development and deployment of the CERF (DSOs, TSOs, aggregators, user organizations, IT providers, etc.)	Number of stakeholders involved	Number of stakeholders	Number of stakeholders involved	0	> 23	All	All	All pilots
4	ETRA	Project	Milestones	Successful completion and achievement of all	Milestones completed	%	Milestones completed	0	100%	All	All	All pilots

				milestones of the ECLIPSE Project within the designated timeline and budget.								
5	FHOO	User satisfaction	Consumers satisfaction	User satisfaction (final consumers) with the CERF for energy saving applications, measured through surveys and feedback.	Average user satisfaction mark	Mark out of 10	Survey results	N/A	8 / 10	All	All	All pilots
6	FHOO	User satisfaction	Grid operators' satisfaction	User satisfaction (grid operators) with the CERF for energy saving applications, measured through surveys and feedback.	Average user satisfaction mark	Mark out of 11	Survey results	N/A	8 / 10	All	All	All pilots
7	FHOO	User satisfaction	Retailers & aggregators satisfaction	User satisfaction (retailers and aggregators) with the CERF for energy saving applications, measured through	Average user satisfaction mark	Mark out of 12	Survey results	N/A	8 / 10	All	All	All pilots

				surveys and feedback.								
8	ETRA/INN EUROPE	Dissemination	Stakeholders group	Number of members of stakeholders group involved at the end of the project	People outside of the project interested in the results	Number of people	Professional organisations, policymakers, contacts in the energy value chain, TSO, DSO, energy suppliers, aggregators, energy producers, consumers, prosumers, system integrators, digital developers and consumer service providers, domestic	8	15	SO4 and SO5	All	All

							consumers, industrial and commercial consumers & prosumers					
9	ETRA/INN EUROPE	Dissemination	Dissemination activities	Number of dissemination and awareness activities organized during the project for CERF widespread adoption	Number of events organised by the Eclipse project	Number of activities	Presentations, Videos, Meetings & workshops with end-users. Videos interviews. Publications. Social media.	2	20	SO1 and SO5	All	All
10	ETRA/INN EUROPE	Dissemination	States interested	Number of additional EU member states that showed interest to deploy the project solutions at the end of the project	Entities from EU member states not involved in the project who sign a letter of support	Number of letters of support	Letters of support and entities contacts	0	10	SO5	All	All

11	Pilot leaders	Impact	Bill	Energy bill reduction of final consumers	The calculation method will depend on the pilot. This information can be obtained: - By regularly collecting the bills through the application and calculating the average price/kWh or comparing different rates of the bill. - From the tariffs and the energy consumption reduction when the electricity prices are fixed	%	Energy bill of consumers; inputs from consumers through the application	0%	20%	SO1, SO2, SO3	All except PL	All
12	i-DE	Impact	Consumption	Energy consumption reduction of final consumers	The calculation method will depend on the pilot. This information can be obtained: - Through the collection of the information in the	%	Energy consumption of consumers; inputs from consumers through the	0%	10%	SO1, SO2, SO3	All	All

					application - The meter data can be compared on the activation dates versus non-activation dates (only for demand-side response)		application or meter data					
13	Pilot leaders	Impact	GHG	Reduction of GHG emissions	The GHG emissions will be calculated using the modification of the consumption correlated to the GHG emissions of the grid or the local system across time.	%	Grid GHG emissions across time, consumption across time, local system GHG emissions across time	0%	30%	SO1, SO2, SO3	FR, EE, FI, DK, BE, AT, ES, CY, PT, HR, CZ, PL	All
14	i-DE	Impact	RES share	Increase of Renewable electricity share	Calculated from the RES share of the grid in relation to the time of consumption	%	RES grid share across time, consumption across time	0%	30%	SO1, SO2, SO3	All	All
15	i-DE	Impact	Peak-load	Peak-load reduction through flexibility	Calculated/measured peak-load at pilot site/ per metering point (after summarizing them)	%	Peak loads at pilot site across the project time	0%	15%	SO1, SO2, SO3	All	All

					compared to historical peak load at pilot site/metering point.							
16	Pilot leaders	Impact	Short-term congestions	Reduction of short-term congestions (operation)	For pilots where the DSO is involved, on a local level and low voltage grids Historical congestion (kWh) compared to congestion after project implementation	%	Congestion at the pilot sites, across the project time	0%	6%	SO1, SO2, SO3	Pilots where DSOs are involved	All
17	Pilot leaders	Impact	Long-term congestions	Reduction of long-term congestions (planning)	For pilots where the DSO/TSO is involved, on a local level and low voltage grids . Historical congestion (kWh) compared to projected congestion 10 years after project implementation	%	Historical congestion, projected congestion	0%	5%	SO1, SO2, SO3	Pilots where DSO/TSOs are involved	All
18	Pilot leaders	Impact	Investments	Investments deferral in grid infrastructures	For pilots where the DSO/TSO is involved, on a local level. Investments (€)	%	Investments planned	0%	15%	SO1, SO2, SO3	Pilots where DSO/TSOs are involved	All

					planned without the project compared to investments planned after project implementation							
19	Pilot leaders	Impact	RES curtailment	Reduction of RES curtailment	For pilots where the DSO/TSO or electricity producer is involved, on a local level RES curtailment (kWh) before the project compared to after project implementation	%	RES curtailment	0%	8%	SO1, SO2, SO3	Pilots where DSO/TSOs or RES producers are involved	All

8. SUMMARY AND LESSONS LEARNT

This deliverable thoroughly analyzes and summarizes lessons learned from energy applications, platforms, related initiatives, and regulatory frameworks to design a sustainable, consumer-centric energy ecosystem. The findings and recommendations derived from this analysis provide a solid foundation for the development of the ECLIPSE Common European Reference Framework (CERF), which will be demonstrated and evaluated in the project's pilot sites.

On one hand, as part of this analysis it has been identified that new ways and functionalities to improve the existing energy monitoring Apps and platforms. Some examples are benchmarks for per capita consumption and energy efficiency improvements, billing simulations to provide cost estimates for various plans or power adjustments, customizable alerts for high consumption notifications, and maintenance adaptation tools that analyze network incidents and suggest tailored energy-saving actions. Developing intuitive designs is also identified as essential to improve navigation and facilitate data interpretation of the energy monitoring Apps.

On the other hand, as for this research, these platforms and applications should adopt open data formats to enhance transparency and foster innovation while implementing consent-based data access mechanisms and robust security protocols. In this context, real-time updates are necessary to deliver actionable insights, and IoT technologies should be leveraged for data collection and monitoring of Key Performance Indicators (KPIs).

Finally, in the context of policy and regulation framework, it has been defined that the CERF platform will be positioned and will continue to growth by means of dissemination and adoption campaign leading to widespread support, evolving with the energy efficiency stakeholders needs and considering the collaboration with other initiatives in line with the identified policies. In this analysis it has been identified that the EU regulations emphasize consumer empowerment through energy sharing, flexible contracts, and real-time data access. Directives such as the Renewable Energy Directive and the Network Code on Demand Response support decarbonization and grid resilience, while the NIS2 Directive ensures infrastructure protection and bolsters consumer confidence. However, harmonizing national approaches and addressing technological gaps remain critical challenges for achieving EU-wide interoperability.

In other words, the CERF must align with EU regulations, prioritize interoperability, and integrate advanced technologies such as AI and smart contracts. Investments in digital infrastructure, cross-border collaboration, and consumer engagement are vital to accelerating the transition to a decarbonized and digitalized energy market. By addressing existing gaps and leveraging best practices, the ECLIPSE project seeks to empower consumers, enhance energy efficiency, and contribute to the EU's energy and climate objectives.

9. ACRONYMS

Table 21. Acronyms

Acronym List	
API	Application Programming Interface
AI	Artificial Intelligence
App	Application
B2B	Business-to-business
B2C	Business-to-consumer
B2G	Business-to-government
BESS	Battery Energy Storage System
CEP	Communication End Point
CERF	Common European Reference Framework
CIM	Common Information Model
CSV	Coma Separated Values
DER	Distributed Energy Resources
DERA	Data Exchange Reference Architecture
DGA	Data Governance Act
DMA	Digital Markets Act
DR	Demand Response
DSA	Digital Services Act
DSOs	Distribution System Operators
DSR	Demand Side Response (another form of addressing DR)
EC	European Commission
EES	Energy Efficiency Services
eID	Electronic Identification
EMS	Energy Management System
EU	European Union
EV	Electric Vehicle
FAIR	Findable, Accessible, Interoperable and re-usable
GD-CCs	Generation and Demand Control Centres
GDPR	General Data Protection Regulation
GoO	Guarantees of Origin
HESS	Hybrid Energy Storage System
HLUC	High Level Use Case

HTTP	Hypertext Transfer Protocol
IoT	Internet of Things
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
KWh	Kilowatt hours
LV	Low Voltage
ML	Machine Learning
MQ	Message Queue
MS	Member States
NILM	Non-intrusive Load Monitoring
NIS2	Network & Information Security Directive
NGTN	National Gas Transmission Network
PKI	Public-Key Infrastructure
PV	Photovoltaics
RES	Renewable Energy Sources
SAML	Security Assertion Markup Language
SGAM	Smart Grid Architecture Model
SGTF	Smart Grids Task Force
SEEG	Smart Energy Expert Group
TSO	Transmission System Operators
UC	Use Case
UI	User Interface
XML	eXtended Markup Language

10. REFERENCES

[1] Interconnect European project, Grant agreement n° 857237, "Security, cybersecurity and privacy protection action plan and results," 2021.

[2] Voltalis, "MyVoltalis, l'application de suivi de conso électrique," 2025. [Online]. Available: https://www.voltalis.com/myvoltalis-lapplication-de-suivi-de-consommation-electrique. [Accessed 12 02 2025].

[3] gov.uk, "Interoperable Demand Side Response Programme: projects Streams 1-3," 2025. [Online]. Available: https://www.gov.uk/government/publications/interoperable-demand-side-response-programme-successful-projects/interoperable-demand-side-response-programme-successful-projects. [Accessed 12 02 2025].

[4] Odeon european project, Grant agreement N° 101136128, "ODEON PROJECT federated data and intelligence Orchestration & sharing for the Digital Energy transitiON.," [Online]. Available: https://odeonproject.eu/. [Accessed 12 02 2025].

[5] Ecoompower european project, Grant Agreement n°101120775, "Ecoempower," [Online]. Available: https://ecoempower.eu/. [Accessed 12 02 2025].

[6] EVELIXIA, "EVELIXIA BUILDINGS AS ACTIVE UTILITY NODES," [Online]. Available: https://www.evelixia-project.eu/. [Accessed 12 02 2025].

Thank You

If you have any questions, please get in touch with us.

eclipse

www.eclipse-digital.eu

info@eclipse-digital.eu

@eclipseproject

@Eclipse_Europe

@EclipseEUProject