NETWORKS

Data Platforms and Dashboards

NATIONAL NETWORK, LOCAL CONNECTIONS PROGRAMME

DOC-230921-GYS

Updated following consultation in Q4 2021

CONTENTS

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Glossary

1 GLOSSARY

TERM	DEFINITION
ADMS	Advanced Distribution Management System
CHP	Combined Heat and Power
DER	Distributed Energy Resource
DERMs	Distributed Energy Resource Management
DMS	Distribution Management System
DSO	Distribution System Operator
EV	Electric Vehicle
LV	Low Voltage
MMS	Market Management System
MV	Medium Voltage
NES	Net Effort Score
NYSERDA	New York State Energy Research & Development Authority
SCADA	Supervisory Control And Data Acquisition
TSO	Transmission System Operator

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Overview

The core objective of the National Network, Local Connections Programme is to bring together changes in how we are generating electricity, and how we are using it, enabling all electricity customers and communities to play an active role in climate action, by using or storing renewable electricity when it is available to them locally. In this context, the Platforms & Dashboards Roadmap for the delivery of beta and production data exchange platforms is central to creating opportunities for customers and industry engage with their local energy system, and participate in local services.

Through customer and stakeholder engagement, a blueprint for this roadmap was developed based on identified needs and opportunities for local and regional dashboards and platforms. The process involved investigation of technological alternatives, and a focus on how to make better use of the tools, technologies, and data available to ESB Networks.

In Q4 2021, we consulted on the proposed Data, Platforms & Dashboards Roadmap as part of the wider consultation on the National Network, Local Connections Programme. Positive and constructive stakeholder feedback was received, with 34 individual items of feedback received on this document. This feedback provided a rich insight into the perspectives of our stakeholders on this area. All feedback was carefully reviewed and feedback which fell within its scope was considered in updating the proposed Data, Platforms & Dashboards document which has now formed this proposed Data, Platforms & Dashboards programme delivery plan.

2 OVERVIEW

2.1 PLATFORMS & DASHBOARDS - STAKEHOLDER FEEDBACK

1 Importance of Data Visualisation & Sharing

The availability, usage and sharing of data was a key area of focus for many stakeholders who responded to the National Network, Local Connections programme consultation in Q4 2021. Stakeholders commented on the significance of customer awareness and education to enhance customer participation and engagement, and the role of local and regional dashboards in supporting this.

2 Platforms & Dashboards in Piloting

Stakeholders emphasized the importance of Platforms and Dashboards to support the piloting activities, and the role of piloting in building an understanding of the value that data platforms and dashboards can bring. There was also an emphasis on the use of piloting opportunities to validate development assumptions and identify unexpected requirements for future development.

3 Simplicity & Transparency

A theme that came up repeatedly in stakeholder feedback was the importance of simplicity and transparency. One stakeholder highlighted that in the context of increasingly complex market signals, it is important that signals provided when rolling out a customer market are made simple and understandable. Stakeholders commented on the value of working with community groups, and had a range of specific suggestions for how platforms and dashboards could be made user friendly and useful. Ultimately, stakeholders emphasized the importance of helping customers and system users get a full picture of the distribution system.

2 OVERVIEW

2.2 PLATFORMS & DASHBOARDS - ACTIONS

Based on the feedback received, a number of additions and adaptations have been made in the roadmap, as reflected in this updated paper. The first is the proposed introduction of Application Program Interfaces (APIs) as a user-friendly data resource for customers to encourage wider market participation and customer buy-in. The functional requirements for data integration will depend on the technology solution adopted, however this inclusion at the concept stage can help support informed decision making in that regard.

We can confirm our intention that the Platforms and Dashboards would support pilot activities throughout the life of the National Network, Local Connections Programme, and based on the feedback received propose to define an additional Agile Customer/Community Pilot. It is proposed that the definition of this pilot would focus on the agile development and validation of customer/community dashboards, testing design assumptions, identify in-demand functionality, and testing how people engage with different stimuli provided through the dashboards.

For more information on the full body of stakeholder feedback received and how this feedback has been incorporated into the National Network, Local Connections Programme delivery plans, please refer to the Consultation Response Paper available on the National Network, Local Connections Programme website.

3

Data Visualisation for Platforms & Dashboards

3.1 DESCRIPTION

As the uptake of low carbon technologies on local electricity networks grows, local electricity dashboards, and platforms for interacting with local markets can play an important role in making this real for customers and communities, and enabling easy to access interaction with flexibility markets.

The combination of historical, real time and forecast local electricity information and analytics can help make our changing energy system more tangible and real. However, this level of data complexity necessitates well-designed visual graphics that focus on the most relevant information.

Data visualisation will be important for community energy initiatives, microgrids, as well as market participants and those seeking to innovate and develop new customer offerings. These users need a model and visualisation capabilities that are clear and transparent.

Data visualisation provides the opportunity for the consumer to see and understand what they are consuming, and in many cases, what they are providing to the local network.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3.2 CURRENT DASHBOARD & PLATFORMS - STATE OF THE ART

A comprehensive review of state of the art developments internationally was undertaken as part of the high level design process. This section shares some of the highlights from this review, setting out various features and the functionalities which other system operators have used to represent electricity system data related to distributed renewable energy resources.

This section shares our analysis on the energy dashboard and platforms produced by five different organisations across the world, which have provided insights and inputs for our design of equivalent solutions in Ireland.

The 5 use cases covered in the report are from the following organisations:

1. **NYSERDA (New York State Energy Research and Development Authority)**
2. **Alliander (DSO - Netherlands)**
3. **E-Redes (DSO - Portugal)**
4. **Enedis (DSO - France)**
5. **EirGrid (TSO - Ireland)**

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

1 NYSERDA (New York State Energy Research and Development Authority):

The New York State Energy Research and Development Authority, known as NYSERDA, promotes energy efficiency and the use of renewable energy sources. NYSERDA offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. A public benefit corporation, NYSERDA has been advancing energy solutions and working to protect the environment since 1975 (NYSERDA DER Integrated Data System, 2021).

NYSERDA works with stakeholders throughout New York including residents, business owners, developers, community leaders, local government officials, university researchers, utility representatives, investors, and entrepreneurs. NYSERDA partners with them to develop, invest, and foster the conditions that:

- **Attract the private sector capital investment needed to expand New York's clean energy economy.**
- **Overcome barriers to using clean energy at a large-scale in New York.**
- **Enable New York's communities and residents to benefit from energy efficiency and renewable energy (NYSERDA DER Integrated Data System, 2021).**

The NYSERDA dashboard and platforms for Distributed Energy Resources (DERs) capture all the details pertaining to the DER type, location, capacity, and the projects.

The website provides a comprehensive data analysis and representation on each of the following sections:

- **Map**
- **Performance Data**
- **Characteristic Data**
- **Search DER Facilities**
- **Portfolio Manager**

The following section will briefly cover the contents and the data represented in them.

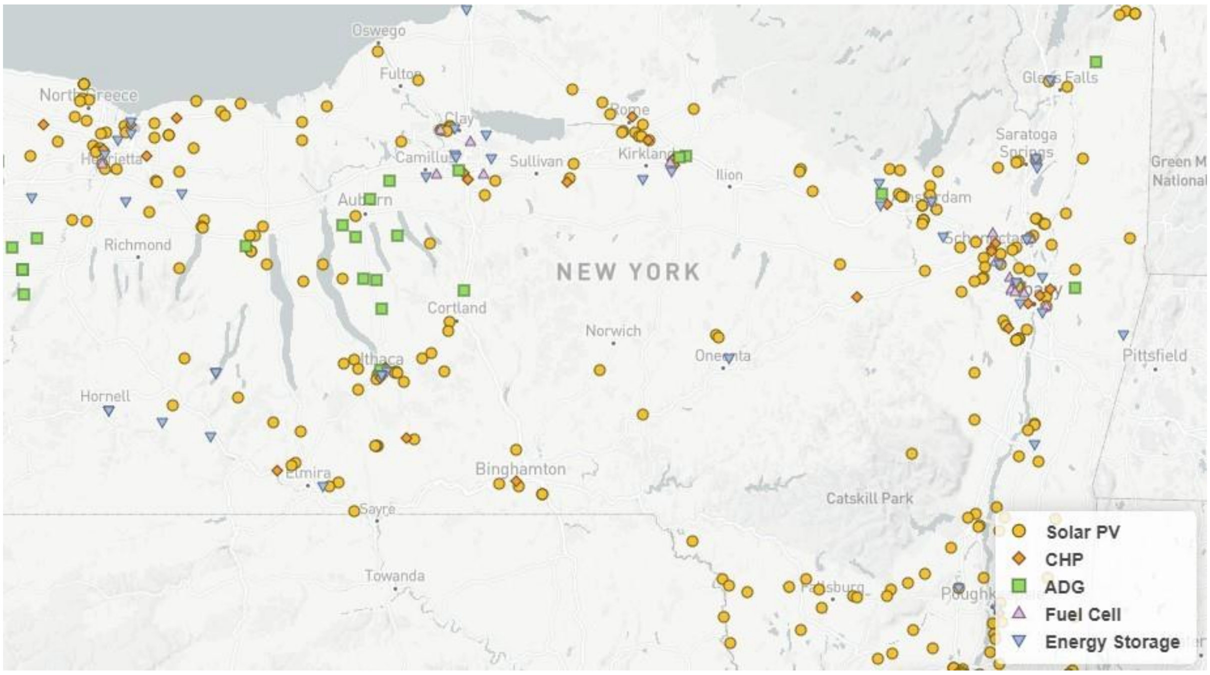
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Map

The map below identifies the locations of renewable generation projects at facilities across New York State. The user can sort by renewable energy technology type by clicking within the legend in the bottom-right of the map. By clicking on the individual pin, the user can identify the facility name and access a link to the detailed performance data of renewable energy projects at that facility.

A graphic representation of this is shown in Figure 1 below:

FIGURE 1
LOCATIONS OF DER PROJECTS AT FACILITIES ACROSS NEW YORK STATE



The data available on this map includes:

1. **Energy Storage: All operational energy storage projects in New York State. It includes projects funded by NYSERDA, publicly available information from interconnection queues, as well as information voluntarily shared with NYSERDA.**
2. **Solar: Completed and operational projects funded by NY-Sun's Commercial & Industrial incentive program.**
3. **Combined heat and power, anaerobic digester, and fuel cell.**

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Performance Data:

This tab includes real-world data from over 1,200 live DER projects in NY State either by:

1. **Viewing a map of DERs across New York (NYSERDA DER Integrated Data System) or**
2. **By searching for projects through criteria one selects.**

Performance data for all projects is updated daily. Current and past data on electricity generation and storage can be viewed with actual performance.

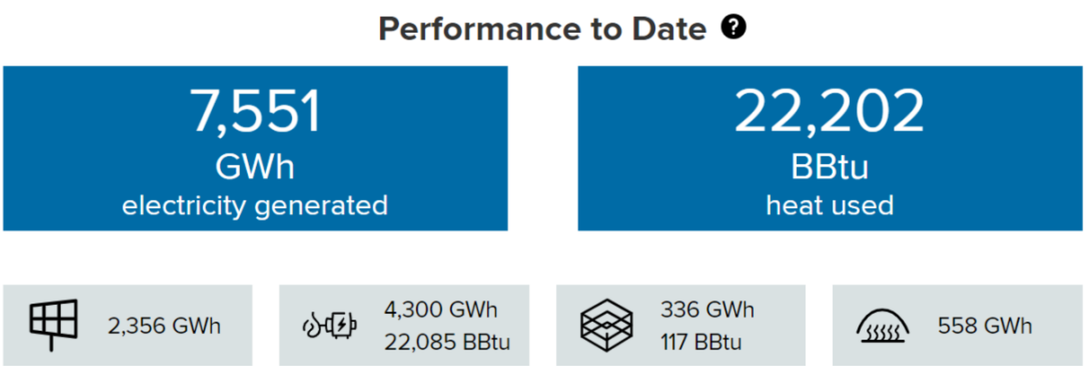
Another key feature is that the user can analyse the abundance of data present within individual facility data pages by:

1. **Viewing data by a selected time range, by month, or by day.**
2. **Getting a snapshot of performance capacity ratings and efficiency.**
3. **Plotting electricity generation against ambient temperatures.**
4. **Comparing renewable energy facilities with peers by clicking on the benchmark tab.**
5. **Analysing renewable energy resources or aggregate data from multiple renewable energy resources by using the Portfolio Manager tool.**

All data is available for download as a .csv file.

The data below in Figure 2 includes a summary of distributed energy resources across New York State, i.e. the total amount of electricity generated, and the total amount of heat generated and used on site at DER locations..

FIGURE 2
SUMMARY OF DERS ACROSS NEW YORK STATE



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

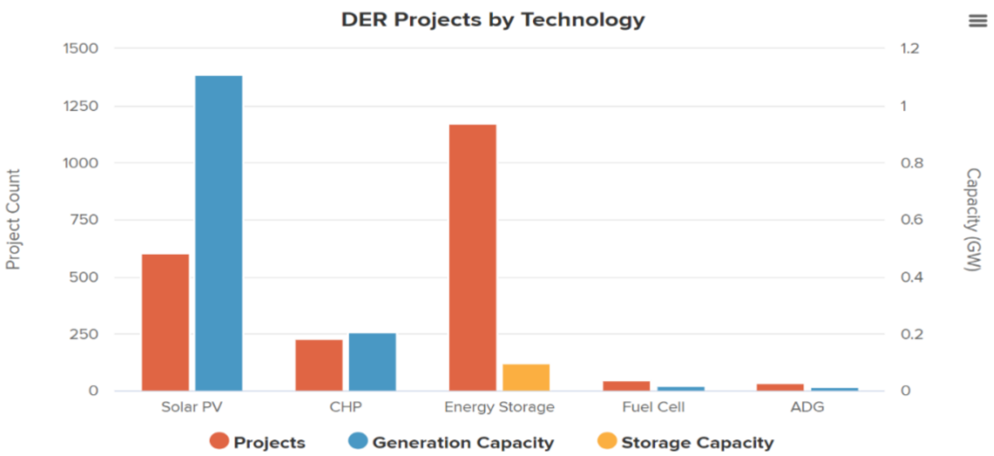
Characteristic Data:

Characteristic data outlines the "what" and "where" of distributed renewable energy projects in New York State. By accessing the data file linked to the right, users can view the characteristics of individual distributed renewable energy projects at over 1,200 facilities, including facility names, locations, facility types, renewable energy technologies used, electric generation or electric storage capacity, and more.

These projects have either received NYSERDA funding or are energy storage projects that voluntarily provided information to NYSERDA.

As distributed renewable energy projects continue to grow throughout New York State, this data is updated as new projects are brought online. The charts below provide an overview of the number and scale of distributed renewable energy projects across New York State.

FIGURE 3
OVERVIEW OF THE NUMBER AND SCALE OF DER PROJECTS ACROSS NEW YORK STATE



There are also separate charts that highlight the number of distributed renewable energy projects by facility category and also the capacity of distributed renewable energy projects by each of the facility categories (e.g. for facility categories listed include manufacturing, healthcare, education, residential, agriculture, etc.).

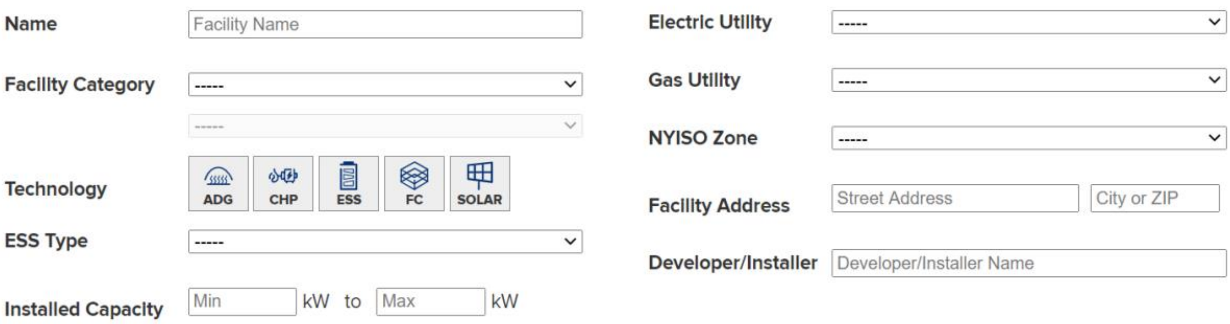
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Search DER Facilities:

This tool allows users to filter through the complete database of performance data available for New York State distributed renewable energy projects, which have either received NYSERDA incentives or are energy storage projects that voluntarily shared characteristic data with NYSERDA.

The user can utilise this tool (shown below in Figure 4) to access individual project performance data, find individual projects by type or in a geographic area or utility zone, or determine the number of distributed renewable energy projects within a given set of search criteria.

FIGURE 4 **THE SEARCH TOOL TO FILTER THROUGH THE DATABASE OF PERFORMANCE DATA AVAILABLE FOR NEW YORK STATE DER PROJECTS.**



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Portfolio Manager:

The Portfolio Manager tool enables users to compare or aggregate performance and characteristic data across multiple distributed renewable energy projects located in New York State, customised to users' selections.

The filters (shown above) could be used to search for projects that fulfil search criteria. By clicking the checkbox to the left of the project name, users can easily add to the specific portfolio or remove from it. The portfolio list will automatically update.

Once selections are finalised, clicking "View Portfolio" will display or download an aggregate view of the characteristics and performance of multiple distributed renewable energy projects. The user can also copy the custom URL to share the portfolio selections with colleagues.

FIGURE 5

THE PORTFOLIO MANAGER FILTER TOOL TO SEARCH FOR PROJECTS THAT FULFIL THE SEARCH CRITERIA

2099 projects. 12 per page   1 2 3 ... 175

Project Name	Facility Name	Tech
110 E 59th Street	110 E 59th Street	
Durst Organization	1155 Avenue of the Americas	
1211 Avenue of the Americas	1211 Avenue of the Americas	
1249 Park Ave	1249 Park Ave	
132 Pattersonville Rynex Corners Rd - 91062	132 Pattersonville Rynex Corners Rd	
141 Verbeck Ave - 90995	141 Verbeck Ave	
16 Rewe St LLC - Marjam	16 Rewe St LLC - Marjam	
180 West End	180 West End	
1948 Troutman St.	1948 Troutman St.	
2 Tudor City	2 Tudor City Place	
200 East 57th	200 East 57th	
20598 Old Rome Road - 90998	20598 Old Rome Road	

More details on NYSERDA dashboard are available on NYSERDA DER Integrated Data System.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

2 ALLIANDER (DSO - Netherlands)

Alliander is the distribution system operator for roughly one third of the Netherlands. Alliander N.V. owns and manages low and medium voltage electricity and gas distribution networks in the Dutch provinces of Gelderland, Noord-Holland, Flevoland, and large parts of Friesland and Zuid-Holland. The company is the largest electricity and gas network operator in the Netherlands with approximately 3.2 million electricity and 2.5 million gas connections, covering some 35% of the Netherlands. The vast majority of Alliander's revenues come from its regulated activities (Liander network activities) (Ontwikkeling energietransitie - Alliander verslagen, 2021).

Alliander provide products and solutions for smart grid, smart home and smart city as well as charging stations for electric vehicles (EVs). One of this DSO's strengths is creating intelligent and efficient solutions for street lighting and traffic lights. Alliander seeks partnerships with local communities and initiatives to successfully complete the energy transition with the support of residents and to make it affordable (Alliander - uw browser, 2021).

Alliander publishes its figures on solar and wind energy, electric vehicles, and green gas each quarter. A prominent feature in the dashboard and platforms portal for Alliander are two dedicated tabs for the energy transition and the system performance. The dashboard also has drill-down capabilities depending on the type of DER and the geography.

In the energy transition tab, the data captured includes the summary of energy generated from solar energy, green gas, wind energy and the number of EV charging stations. Under each tab, a detailed information tab is available to portray the rapidly changing trends in contracted power for energy type per region. This data also gives the maximum power that the green energy producers expect to return at a specific time in a year, which aids forecasting and analysis.

Figure 6 shows the development of solar energy from the period Q1-2011 to Q3-2020, for different regions.

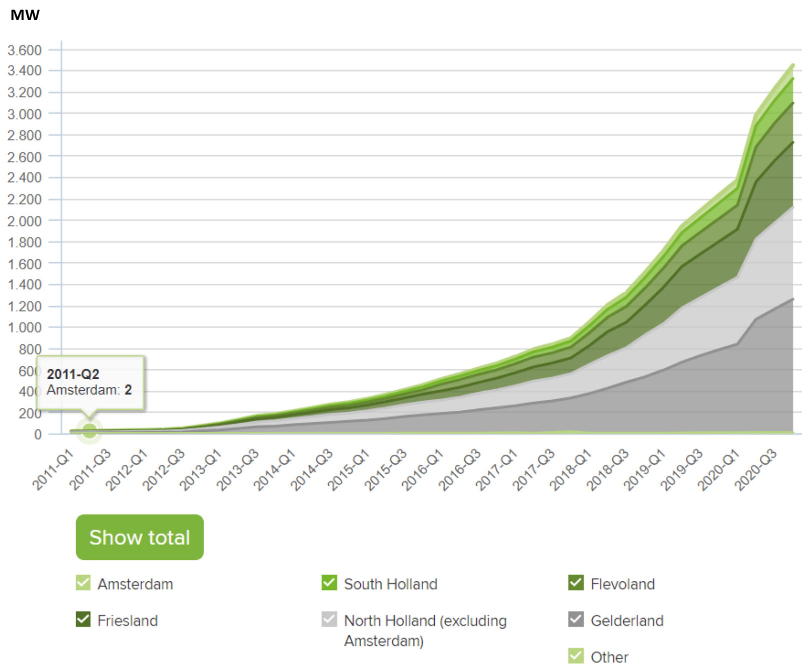


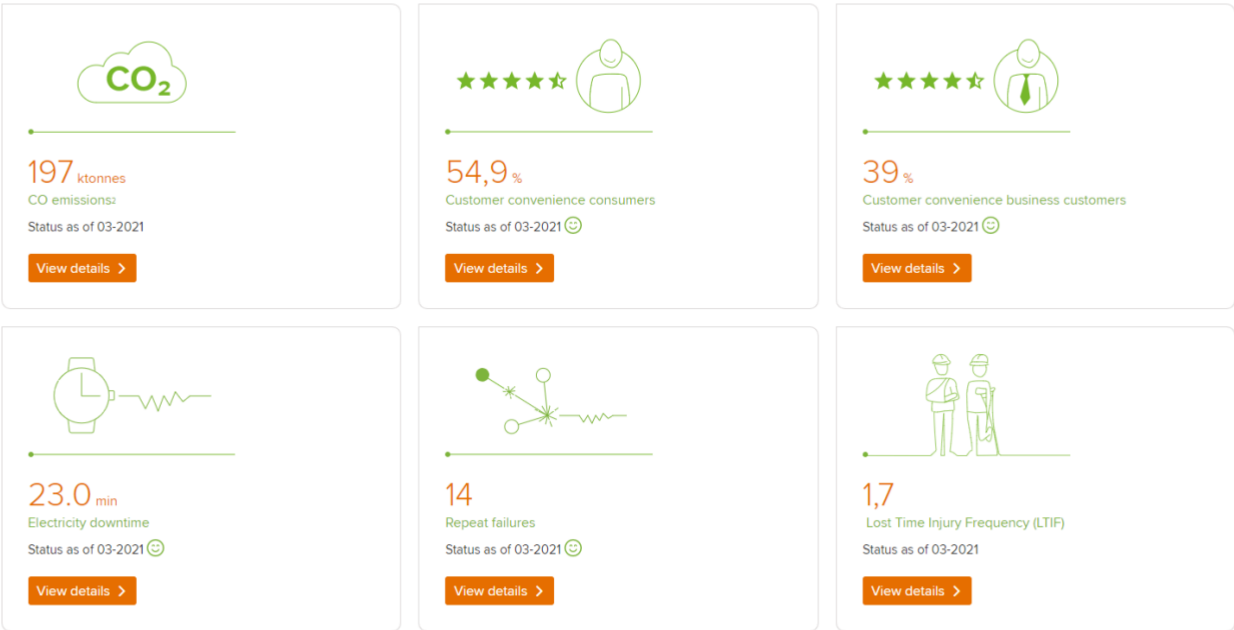
FIGURE 6
DEVELOPMENT OF SOLAR ENERGY FROM THE PERIOD Q1-2011 TO Q3-2020, FOR DIFFERENT REGIONS.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Similarly, there is a drop-down capability for each type of distributed energy resource: wind energy, EVs and green gas. Please refer to the link here for additional information.

The Performance tab provides data pertaining to CO_2 emissions, expressed in kilotons, caused by grid losses is captured here. In addition, it also covers CO_2 emissions when carrying out daily activities.

FIGURE 7
OVERVIEW OF THE PERFORMANCE INDICATORS FOR THE ALLIANDER NETWORK



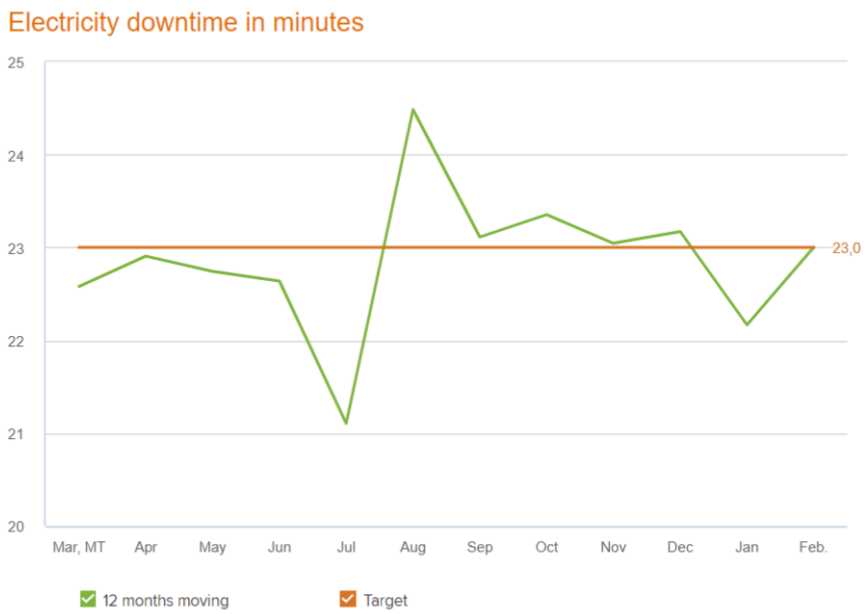
Customer convenience is measured from post-service customer feedback, collected immediately after completion of work. These are easily fed back to link to the different processes within the organisation for measurements. The Net Effort Score (NES) immediately shows the level of convenience (in % that a customer experiences in Alliander's services.

Customer convenience business customers is a similar parameter used for focusing on feedback from the business customers.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Electricity downtime in minutes indicates the average downtime per customer in minutes per year. This uses advancing annual languages to make more trend development visible.

FIGURE 8 **AVERAGE DOWNTIME IN MINUTES FOR THE LAST 12 MONTHS (MAR 2020- FEB 2021)**



Repeat failures, as the name suggests, aims to prevent repeated power outages by monitoring connections (cables) on a 24/7 basis. If disconnections in certain locations are more frequent, a root cause analysis is conducted to identify suitable solutions to improve security of supply at these locations.

Lost Time Injury Frequency (LTIF) is a measure of the safety performance which indicates staff safety in the number of accidents involving absenteeism per one million hours worked.

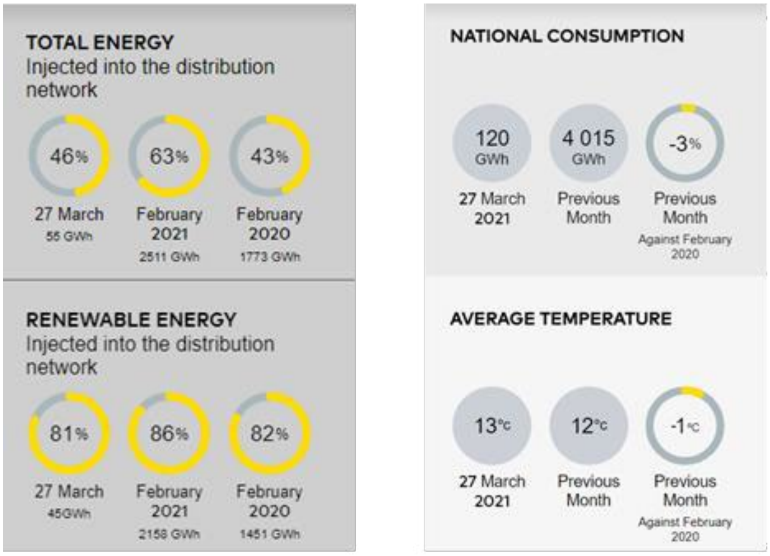
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3 E-REDES (DSO - Portugal)

E-Redes is responsible for the management of high and medium voltage networks (state granted), and low voltage (through municipal concessions) in Portugal. E-Redes operates 228,000 km of distribution network in Portugal, operating the network that transports energy between substations and households or companies (E-Redes - Dados de Energia, 2021). E-Redes is responsible for 34 million meter readings annually, 56% in person; 1.5 million service orders, 70,000 network connection requests, and 4.9 million commercial interactions. (E-REDES, 2021)

In E-Redes' main dashboard and platforms portal (illustrated in Figure 9), the left-hand side of the page gives a synopsis of the total energy produced: the total energy injected into the distribution network and the share of renewable energy injected into the distribution network.

FIGURE 9
SUMMARY OF THE TOTAL ENERGY INJECTED INTO THE NETWORK, RENEWABLE SHARE AND THE TRENDS PERTAINING TO NATIONAL CONSUMPTION AND AVERAGE TEMPERATURE



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

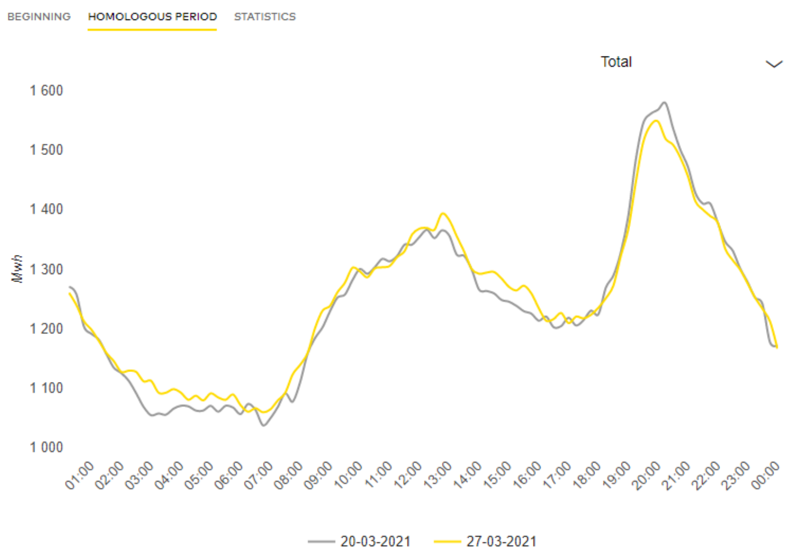
E-Redes Data in the Dashboard and Platforms:

E-Redes trends national consumption, showing total consumption for a specific date and month. The average temperature also is mentioned in the separate section, as seen in the below graphic. Among the data incorporated in the forecasting model is the history of daily consumption since 2012, macroeconomic projections made by various public sources, temperature and calendar effects, consumption inertia (behavioural and thermal), and energy efficiency measures.

Data for the previous day is updated daily on the dashboard. Monthly data for the previous month, past three months and for the past nine months are included. These successive updates result from updated consumption values from meter readings.

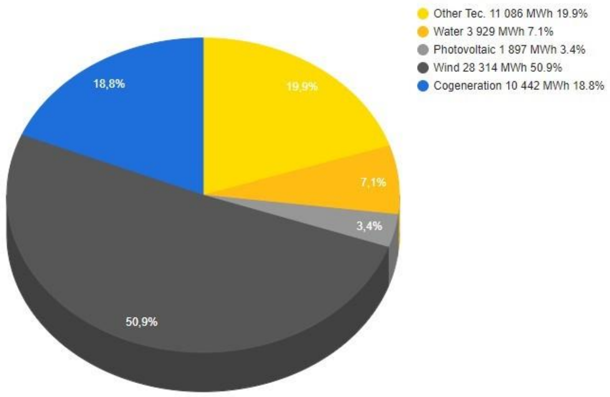
The summary of the national total energy produced for each day is captured in the graph, divided into Market (DGM) and the Special Regime (PRE). There is also a separate tab for the data during the homologous period for comparison of energy data with the same day/month of the previous week/year.

FIGURE 10
STATISTICS FOR THE TOTAL ENERGY PRODUCED ON 27TH MARCH 2021 COMPARED AGAINST THE ENERGY PRODUCED ON THE 20TH MARCH 2021.



The graphical representation of energy produced by various technology types, such as water, photovoltaic, wind, cogeneration (CHP) and other sources, is provided in the pie chart here. There is also an option to download the data for a day, to allow easy interpretation of the data offline.

FIGURE 11
ENERGY SHARE OF DIFFERENT ENERGY SOURCES



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

The national consumption total figures are displayed in the other half of the dashboard, for each of the voltage levels:

- **BT - Low Voltage**
- **MT - Medium Voltage**
- **AT - High Voltage**
- **MAT - Very High Voltage**

FIGURE 12
THE TOTAL CONSUMPTION FIGURES (IN MV) FOR THE DIFFERENT NETWORKS (LV, MV, HV) FOR PORTUGAL

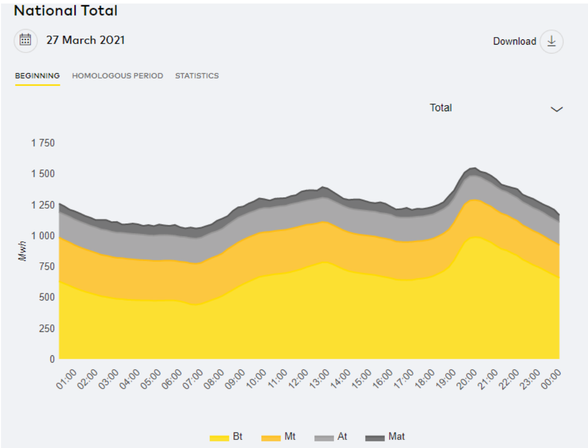
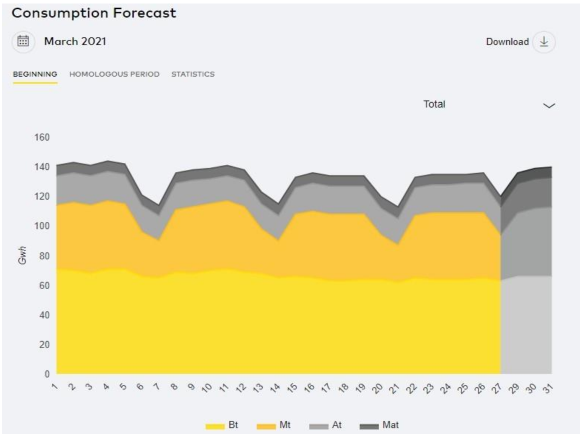


FIGURE 13
CONSUMPTION FORECAST FOR LAST THREE DAYS OF THE MONTH



E-Redes also captures the data for forecasting the consumption based on the historic trends. The consumption forecast for the remainder of March 2021 can be seen in the above graphic, in Figure 13 above (displayed in grey, towards the right).

One key consideration for ESB Networks, in this context, is the drop-down options available for analysing high-level data at a more granular level, depending on the requirement of the user.

More details on the E-Redes dashboard are available on E-Redes - Dados de Energia (wntech.com)

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4 ENEDIS (DSO- France)

Enedis manages the electricity distribution network in France (Enedis (ex-ErDF) dans votre région: raccordement, contacts, 2021). The company has a strong customer base of over 36 million, covering 95% of the metropolitan area of France (Enedis: Le Mix par Enedis, 2021).

Enedis's energy dashboard and platform offer a drop-down approach through the major figures and parameters on renewable generation. The dashboard map is dynamic with the capability for the user to track the total energy generated from each of the renewable sources listed in different colours, see Figure 14. The left-hand side contains a tab for all of France, which can also be filtered further by choosing the specific region.

Another interesting feature in the Enedis dashboard and platforms package is the new connection requests per quarter, per area/region. This provides a complete view of the trends and demand in each region, with the view on the number of on-going projects.

FIGURE 14 **OVERVIEW OF THE DER POWER GENERATION TRENDS ACROSS FRANCE**

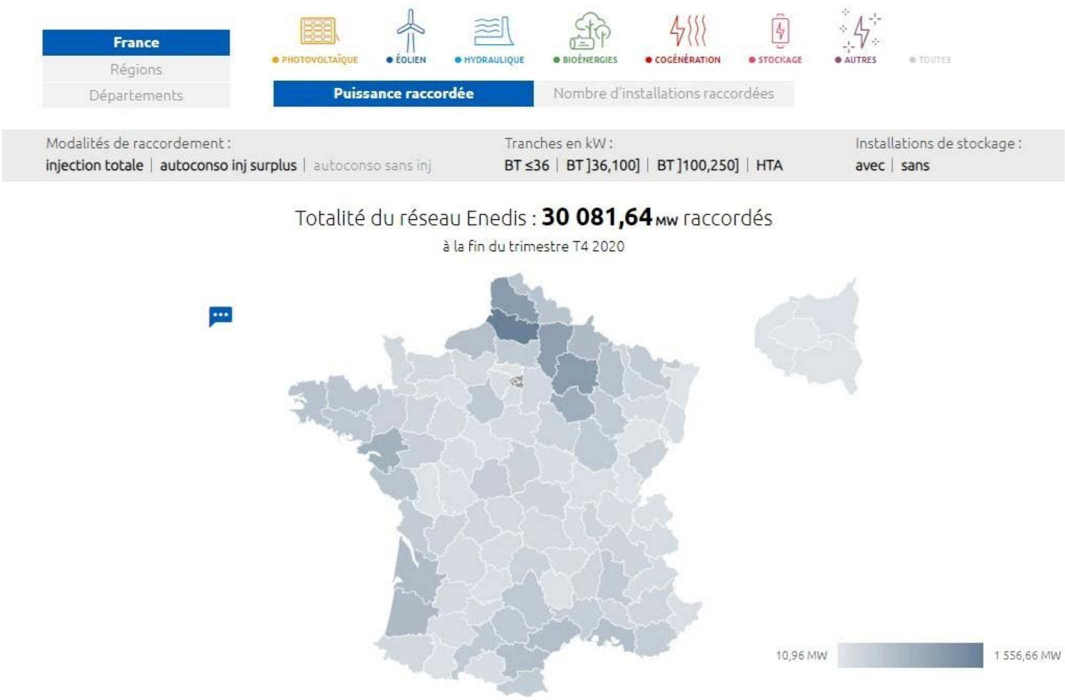
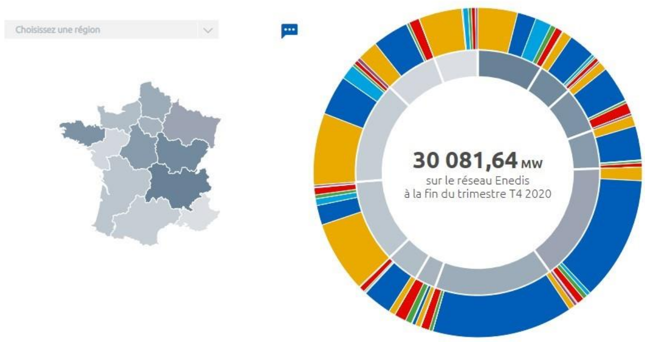


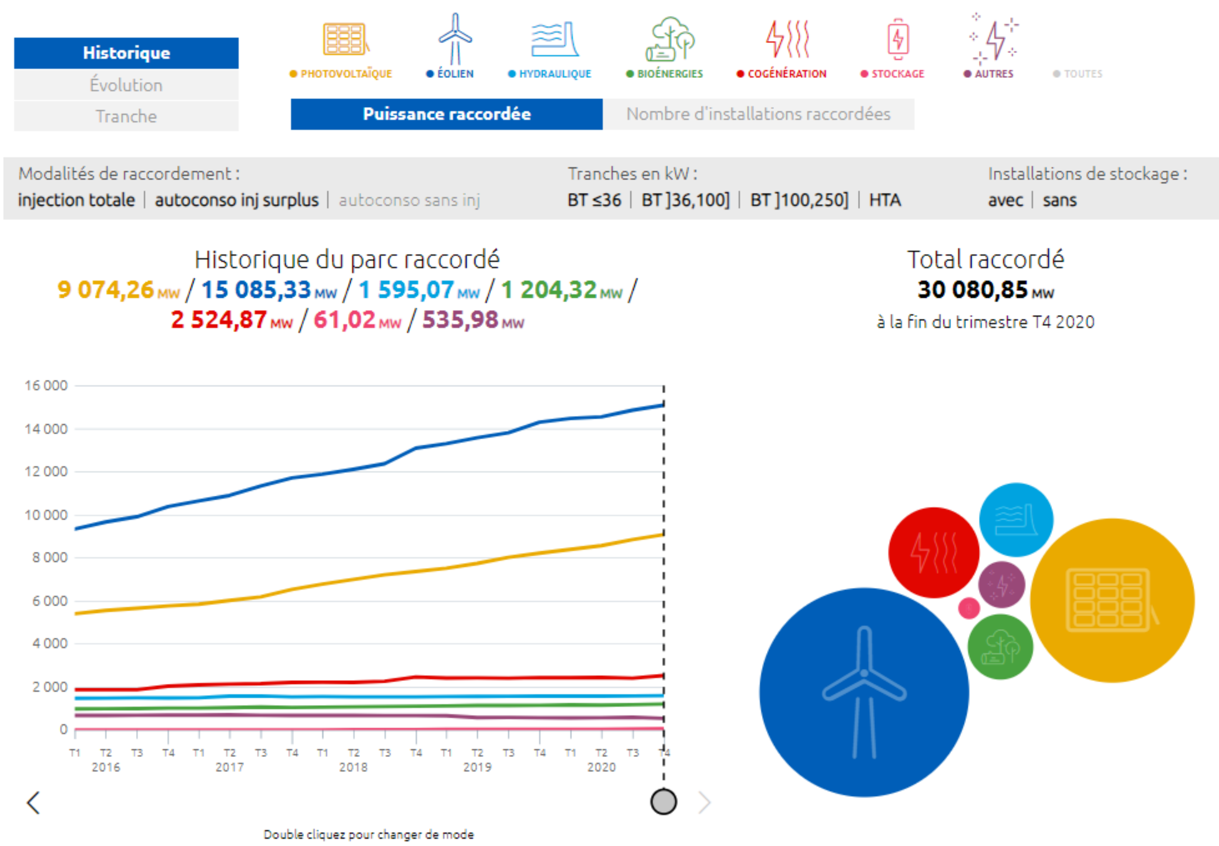
FIGURE 15
REGION WISE SPLIT OF THE VARIOUS DER ENERGY SOURCES AND THE TOTAL POWER GENERATED (IN MW)



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

The historical data and trends can be accessed for each type of distributed energy resource. The graph in Figure 16 displays distributed energy resource uptake from 2016 to 2020. The amount of energy generated is also captured to identify the distributed energy resources' contribution into the distribution network.

FIGURE 16 **HISTORICAL DER CONNECTION TRENDS FROM THE PERIOD 2016-2020**



More details on Enedis' dashboard are available on Le Mix par Enedis | Enedis.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

5 EIRGRID (TSO)

Given its familiarity in an Irish context, the final example we include is EirGrid's Smart Grid Dashboard. Ireland's Transmission System Operator, EirGrid, provides a web-based smart grid dashboard application which enables users to view and compare some power system statistics across the Island of Ireland (Explore the Smart Grid Dashboard, 2021). From system demand to imbalance price/volume, the Smart Grid Dashboard provides a real-time view of some of the most popular energy data.

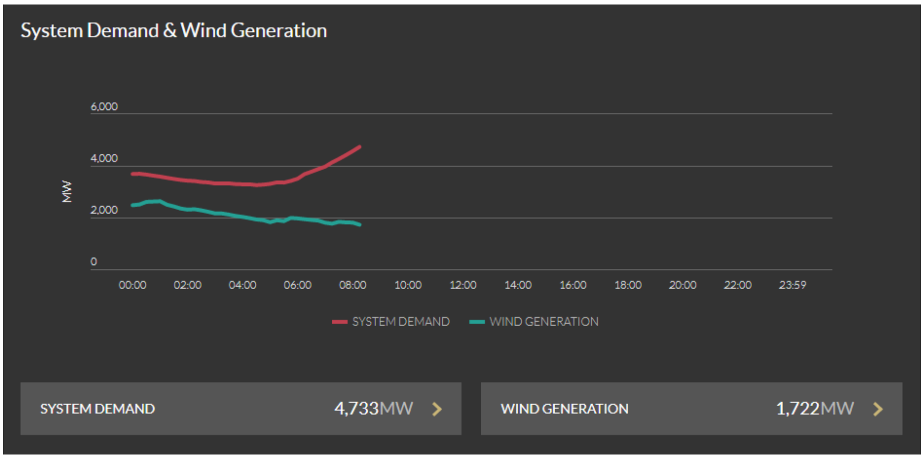
The dashboard is an interactive application including:

- **A jurisdiction toggle to switch between All Island, Ireland, and Northern Ireland data.**
- **Data displayed across 7 key categories: system demand, system generation, wind energy, interconnection, frequency, imbalance price/volume & CO_2 emissions.**
- **Graphs which are customisable by date.**
- **Data comparison and download to .csv options on graphs.**
- **Ability to switch visual display between a dark and light background.**

The key categories displayed are explained in the below section.

- **System Demand**
  This shows the predicted electricity production required to meet national consumption. Actual and forecast system demand are shown in 15-minute intervals.
- **System Generation**
  This shows the total electricity production on the system, including system losses, but net of generators' requirements. System generation is shown in 15-minute intervals.

FIGURE 17
SYSTEM DEMAND AND WIND GENERATION TRENDS DURING DIFFERENT HOURS FOR A PARTICULAR DAY



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

- **Average Fuel Mix**
  This shows the system generation fuel mix and net imports across the power system. The day view below shows the average fuel mix for the last 24 hours.

- **Frequency Over Time**
  The nominal frequency on the island of Ireland is 50 Hz. When supply and demand are in balance, the frequency will be 50 Hz. Frequency is shown at five second intervals.

FIGURE 18
THE 24-HOUR AVERAGE OF THE FUEL MIX FOR SYSTEM GENERATION AND THE FREQUENCY OVER TIME

- **Wind Generation**
  This shows an estimate of the total electrical output of all wind farms on the system. Actual and forecasted wind generation are shown in 15-minute intervals.

- **Interconnection**
  This shows the flow of energy between Ireland and Wales (EWIC), and Northern Ireland and Scotland (Moyle). Flows from Great Britain to Ireland are shown as a positive MW transfer while those from Ireland to Great Britain are shown as a negative MW transfer. Interconnection imports and exports are shown in 15-minute intervals.

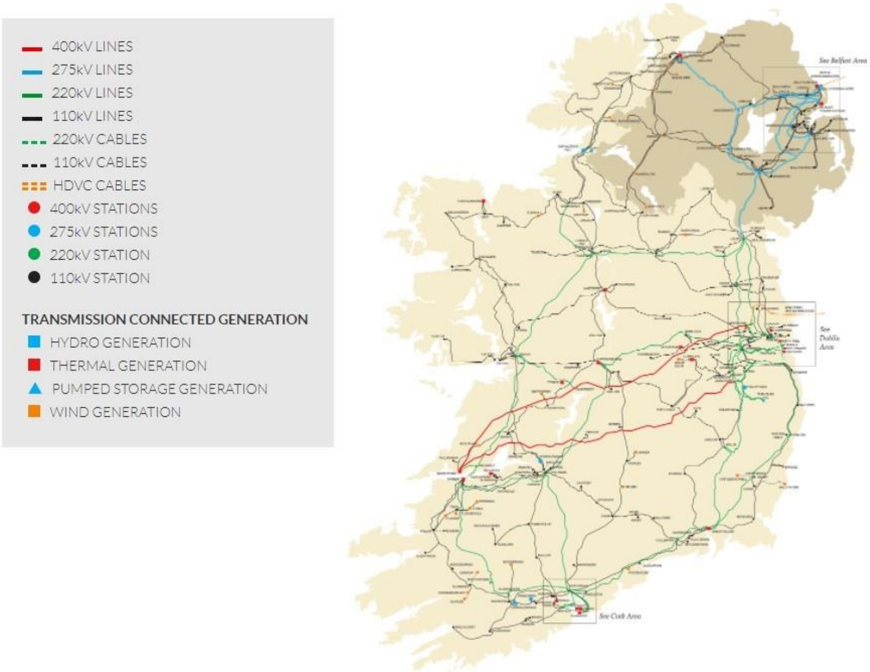
- **Imbalance Price/Volume**
  The imbalance settlement price contains the time weighted average imbalance price and net imbalance volume for each 30-minute trading period (imbalance settlement period). The imbalance price and net imbalance volume values are calculated by averaging each 5-minute period contained within that half hour settlement period.

- **CO_2**
  CO_2 intensity is the average CO_2 emissions per unit of electricity generation output. CO_2 intensity is shown at 15-minute intervals. CO_2 intensity is measured by grams of CO^2 (emissions) per kilowatt hour (kWh) of generation.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

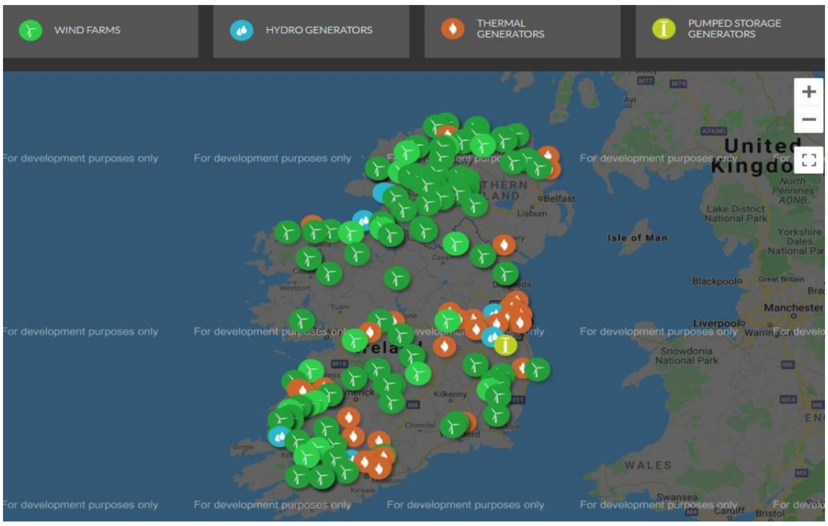
EirGrid also has a tab for the transmission map for the entire Ireland, which is further categorised into different key areas (Dublin, Cork and Belfast areas).

FIGURE 19
TRANSMISSION MAP FOR IRELAND, WITH ALL THE TRANSMISSION LINES, SUBSTATIONS AND THE DETAILS OF THE TRANSMISSION CONNECTED GENERATION



This provides a complete view of the overall transmission system in Ireland and Northern Ireland, where the generation tab displays the wind farms, hydro generators, thermal generators, and pumped storage generators.

FIGURE 20
GENERATION MAP WITH THE REPRESENTATION OF WIND FARMS, HYDRO, THERMAL AND PUMPED STORAGE GENERATORS IN IRELAND.



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3.3 FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS

Table 1 provides a comprehensive list of all the functionalities that may be considered by ESB Network's in the definition of dashboard and platforms. Various functionalities, along with their description, are introduced, accounting for what was identified in the state-of-the-art review summarised earlier in this document.

The functionalities are divided into three different categories: high, medium, and low, depending on their relevance to the delivery of the National Network, Local Connections Programme.

TABLE 1 **FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS**

FUNCTIONALITY	DESCRIPTION	IMPORTANCE (HIGH/MED/ LOW)	FREQUENCY OF UPDATE	REF	REMARKS
Energy Transition Overview	• Data includes the summary of energy generated by different regions from wind, solar, green gas, EV charging stations, etc. • Quarter-wise DER energy generated trends are captured in the graphics, to identify the increase/ decrease in generation for any given region in the country. • There is also a feature to forecast the max. green power produced at any specific month of year.	High	Monthly	Alliander	Important in the context of National Network, Local Connections
Total & Renewable Energy Injection into the Network	• A graphic summary depicting the total energy injected into the distribution network and the share of renewable energy injected into the distribution network.	High	Daily	E-Redes	Important for assessing the renewable energy share to the network, that helps for future state scenario planning.
Map	• The map identifies the locations of distributed energy resource projects in different facilities across the state, with an option to retrieve details of each of the facilities and DER type. • Both maps of currently installed distributed energy resource and the on- going projects.	High	Weekly	NYSERDA	Geographic representation of different distributed energy resource types, facilities would be useful to identify the energy usage and generation trends in HV, MV and LV networks across Ireland.
Characteristic Data	• Users can view the characteristics of individual distributed energy resource projects, including facility type, DER technology used, locations, storage capacity, etc.	Medium	Weekly	NYSERDA	

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

TABLE 1 **FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS**

FUNCTIONALITY	DESCRIPTION	IMPORTANCE (HIGH/MED/ LOW)	FREQUENCY OF UPDATE	REF	REMARKS
Region Wise Drill-Down	• The total no. of distributed energy resource facilities connected in each region could be retrieved using the filter, for a specific time frame. • Within the filter functionality, there is an option to further drill-down the energy share for each distributed energy resource energy source for any particular region.	High	Daily	Enedis	
Distribution System Consumption Forecast	• The energy consumption trend is captured based on the historic data and the average temperature for the period. • The temperature results from the average daily temperatures recorded for the corresponding region of the country. • All consumption data include energy consumed and energy related to technical losses.	High	Daily	Enedis	
Distribution System Demand Forecast	This represents the electricity production required to meet national consumption. Data from the previous day is published every day. Monthly data for the previous month, for the last three months and the last nine months are updated. These successive updates result from updating consumptions, productions, and readings.	Medium	Daily	EirGrid	

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

TABLE 1 **FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS**

FUNCTIONALITY	DESCRIPTION	IMPORTANCE (HIGH/MED/ LOW)	FREQUENCY OF UPDATE	REF	REMARKS
Flexibility Market Services	• A flexibility marketplace to help ESB Networks and support their flexibility needs for a more integrated and efficient grid of the future. • A marketplace which connects system operators and the flexibility providers where assets of any size and capacity are submitted for bidding as flexibility assets that would help balance the grid.	High	Quarterly	Piclo	
Distribution System Wind Generation (Actual vs Forecast)	• Actual wind generation is displayed, which is an estimate of total energy produced from all wind farms. • Actual and forecasted wind generations are shown in 15-minute intervals.	High	Hourly	EirGrid	This could be key from ESB Networks' standpoint, considering wind energy to be the main contributor for DER energy source in Ireland.
Distribution System CO_2 Intensity	• It is the measure of grams of CO_2 emissions per kilowatt (kWh) hour of generation. • Average CO_2 emissions per unit of electricity generation output. This is shown at 15-minute intervals.	High	Hourly	EirGrid	Advanced energy management system would improve the visibility of energy consumption trends and costs associated, thereby optimising the usage to balance the generation and consumption trends.
Heat Pumps and Demand Response	• Demand response (DR) schemes that adapt the normal pattern of end-user power consumption using an external signal. • Enabling DR for domestic consumers at large scale (e.g. heat pumps) will help to manage the grid by increasing the power reserve while providing monetary benefits to end-users.	High	Hourly	-	This will facilitate the heat pump operational flexibility that would also help to lower the carbon intensity of heating/ hot water usage.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

TABLE 1 **FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS**

FUNCTIONALITY	DESCRIPTION	IMPORTANCE (HIGH/MED/ LOW)	FREQUENCY OF UPDATE	REF	REMARKS
Application Programming Interface (API)	• The use of API in the energy dashboard application will assist in obtaining live and historic data pertaining to DERs. • APIs would be useful to link/ interface various functional requirements such as outage portals, metering portals, flex. Market portals, energy transition dashboard (this P&D document's prime focus). Integrating these would surely increase the UX/CSAT (customer satisfaction).	High	-	-	Customisable end-user dashboards will be essential in analysing and sharing the results of energy efficiency monitoring through reliable and fault tolerant data collection. Also, to note, functional reqs. specific to data integration depends on the technology solution offering (integrated ADMS/ stand-alone interface systems) Perhaps, it may be a possibility that data visualisation needed for operational purposes would be handled by ADMS and within ADMS, and not in external dashboards, which would be an added functionality of the ADMS solution.
Pilot Support	• The Platforms and Dashboards would be used to support the pilot activities from 2022 to 2025, using piloting as a mechanism to understand the value they bring and identify further functionalities for future development. • The geographic representation of the system demand functionality would be utilised for pilot activities to understand the network constraints, DER projections, demand and supply.	High	-	-	To validate a number of functionality design assumptions before rolling-out the final energy platform and dashboard.
Community Owned Renewable Energy Projects Portfolio	• The visualisation of community owned renewable generation projects would be beneficial in identifying the shift towards changing energy landscape in Ireland. • Details on onshore wind and solar projects with the offer quantity (MW), applicant details, tariff (€/MWh), region, county would be useful for educating and promoting renewable energy generation across homes, farms and businesses across Ireland.	High	-	-	Building a strong connection with regional customers across the country by providing them with local DER performance data.

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

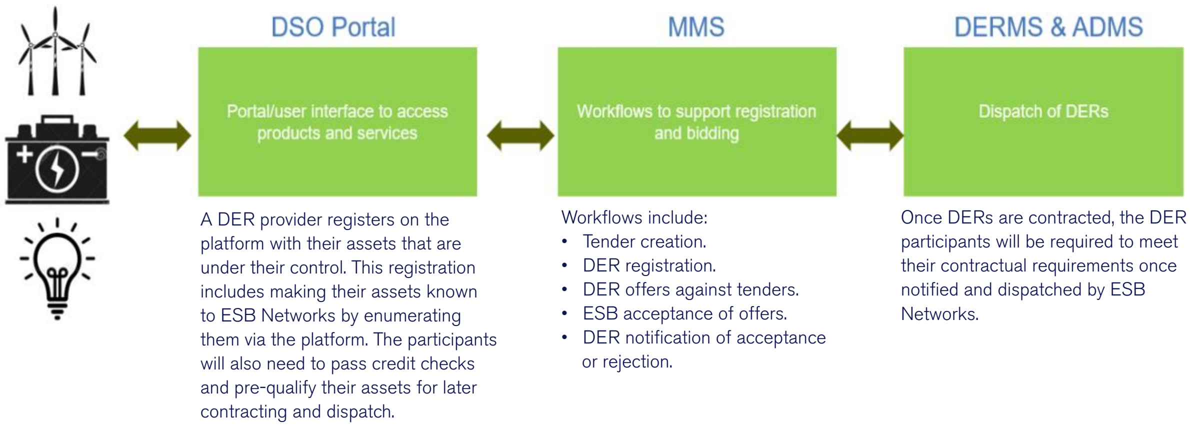
DSO Portal and Market Platforms:

In terms of the technical conceptual architecture to deliver a distribution flexibility market, an example Market Management System (MMS) working alongside a DSO Portal and Distributed Energy Resource Management System / Distribution Management System (DERMS/ADMS) is shown below in Figure 21.

The role of the DSO portal/user interface is to provide distributed energy resource owners and operators with access products and services being procured by the distribution system operator. The DSO portal is where the distributed energy resource owner / operator can register their assets.

The role of an MMS platform as indicated on the diagram below includes supporting tender creation, distributed energy resource registration, distributed energy resource offers, DSO acceptance of offers and issuing notification followed by settlement.

FIGURE 21
MARKET MANAGEMENT SYSTEM INTEGRATION WITH DSO PORTAL AND THE DERMS/ ADMS PLATFORMS



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

There are a number of key stages in the procurement of flexibility services in a region. The DSO Portal, the MMS Platform and the DERMS/ ADMS need to work together, operating in parallel whist exchanging data/information between them.

KEY STAGES	2025
Assess Network Needs	ADMS/Market Platform Enabled
Expression of Interest	Market Platform Enabled
Providers Registration	Market Platform Enabled
Invitation to Tender	Market Platform Enabled
Allocate Providers to Constraints	ADMS/Market Platform Enabled
Bidding/Procurement	Market Platform Enabled
Successful Bidders Notified	Market Platform Enabled
Awarding Contracts	Market Platform Enabled
Services Optimisation. / Setpoint Cal.	ADMS
Dispatch	ADMS/Market Platform Enabled
Settlement & Verification	Market Platform Enabled
Payment	Market Platform Enabled
Reporting	Market Platform Enabled

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

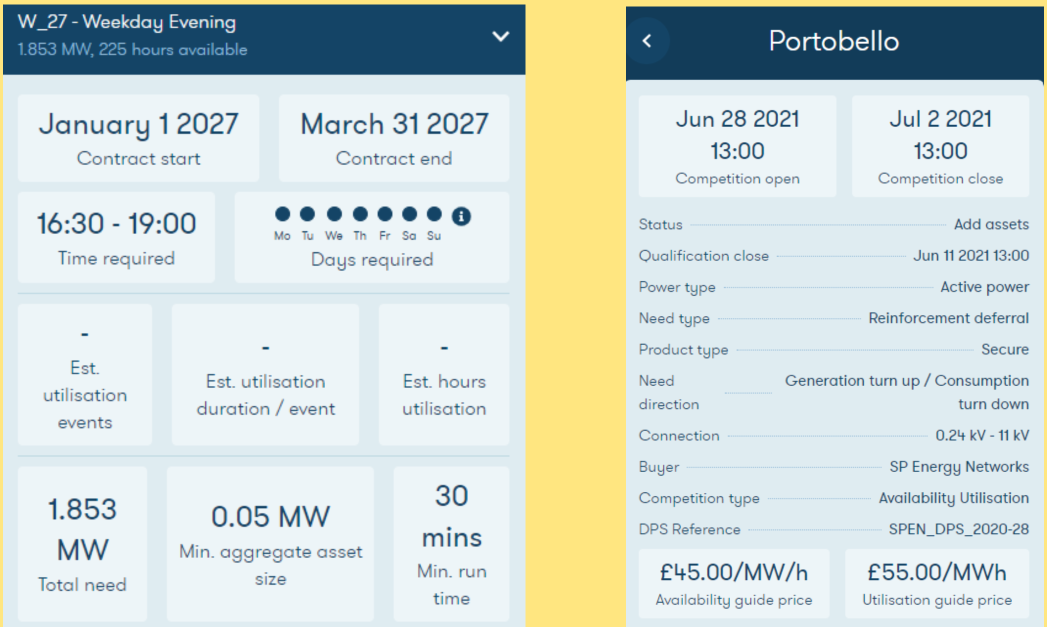
3.4 EXAMPLE: PICLO - MARKET FLEXIBILITY SERVICES

Piclo assists Distribution System Operators (DSOs) source demand-side flexibility to reduce network congestion and thereby making the grid more reliable and efficient. This aids the flexibility market services by linking with six different DNOs in the UK (Piclo Flex, 2021). Piclo operates across the procurement, bidding, selection, contracting and settlement services to both demand and generations customers wanting to participate in flexibility services.

Piclo Flexibility Marketplace is a marketplace with system operators on one side and the flexibility providers on the other. Any assets, irrespective of their capacity/size could be registered online, by simply creating an account in Piclo and then taking part in the bidding and the tender process. For certain grid services such as thermal or voltage management, a minimum provider size in kWs or kVAr may be required. Behind the meter resources can also participate in the market through aggregators. Once the technical assessments are done, the bids are closed after which the system will generate the report that would inform the participant/asset owner if they are successful in the bidding process, for finalising the contracts.

Piclo is an example of an MSS platform provider. Figure 22 displays a competition for the Portobello area, with details including the open and close date, the requirement type, the connection, the buyer and the price. The contract details are also displayed separately in a different tab, with the total power requirement mentioned (in MW) alongside the minimum run time and the minimum aggregate asset size.

FIGURE 22
THE BIDDING COMPETITION FOR THE PORTOBELLO AREA - UK, SEEKING THE FLEXIBILITY ASSETS FOR A SPECIFIC WINDOW



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3.5 ILLUSTRATIVE EXAMPLES OF PROPOSED FUNCTIONAL REQUIREMENTS

This section provides illustrate high-level graphical representation of the proposed functionality set out in the previous section. Several key functionalities discussed in the previous section are captured here as a visual front-end for demonstration and ease of understanding.

The end-user should be able to navigate through the different features with a user-friendly application where the data can be accessed from a central data-hub from which it receives the data via an ADMS (Advanced Distribution Management System) solution.

The functionalities that are highlighted in this section are as following:

1. **Geographical Overview of the Existing DER Facilities in Ireland**
2. **Detailed Overview of Each of the DER Types**
3. **Overall Summary for Total Energy Injections**
4. **DER Projected Growth**
5. **System Demand and Forecast**
6. **Market Flexibility Services**
7. **Smart Metering Data**

3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

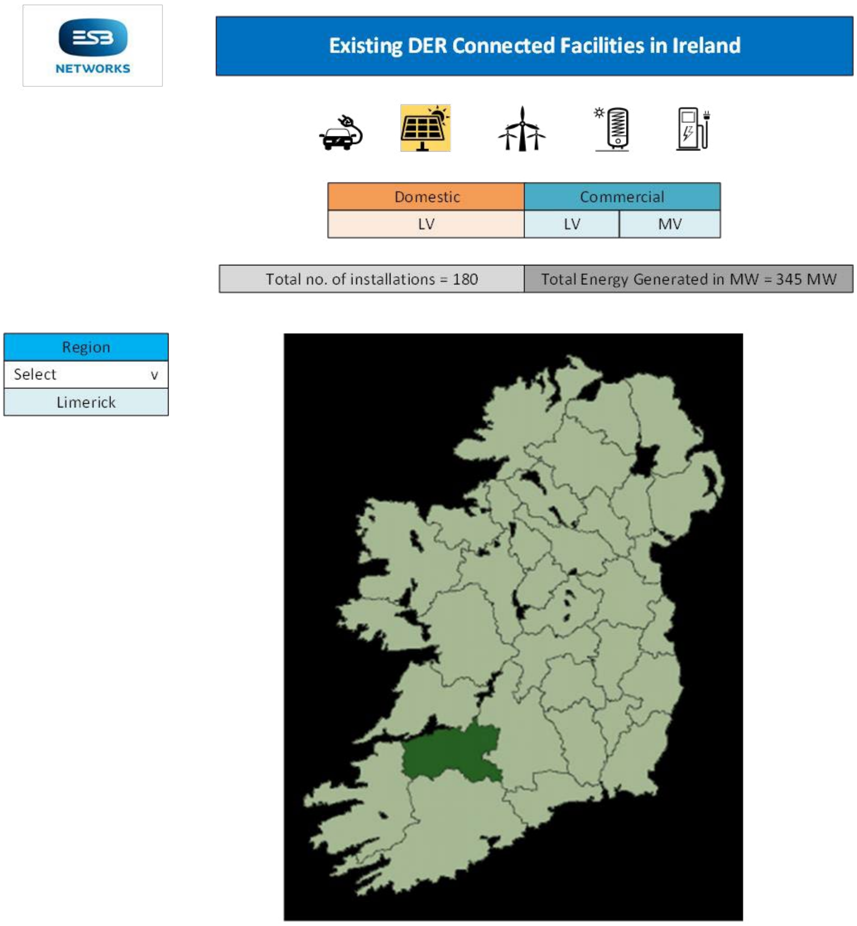
1 GEOGRAPHICAL OVERVIEW OF THE EXISTING DER FACILITIES IN IRELAND

This dashboard function would provide a geographic overview of the existing distributed energy resource facilities across Ireland, with capabilities to segment distributed energy resource' energy sources and power generated based on specific location. The five energy sources namely EV, solar, wind, heat pumps and charging stations are captured, as seen in the below figure.

The function could provide an option to select domestic and the commercial energy resources separately, or to view details pertaining to the LV/MV network, for example the total number of EV installations within the domestic LV network, total charging stations in the commercial MV network and so on. Region drill-down capabilities would enable the user to select any county from the drop-down menu to understand the distributed energy resource trends and energy generation statistics for the selected county.

The example (Figure 23) shows the total energy generated from solar PV panels (highlighted in yellow), including the domestic (LV) and commercial (LV and MV) network.

FIGURE 23 **SOLAR PV CONNECTION TRENDS FOR THE LIMERICK REGION**



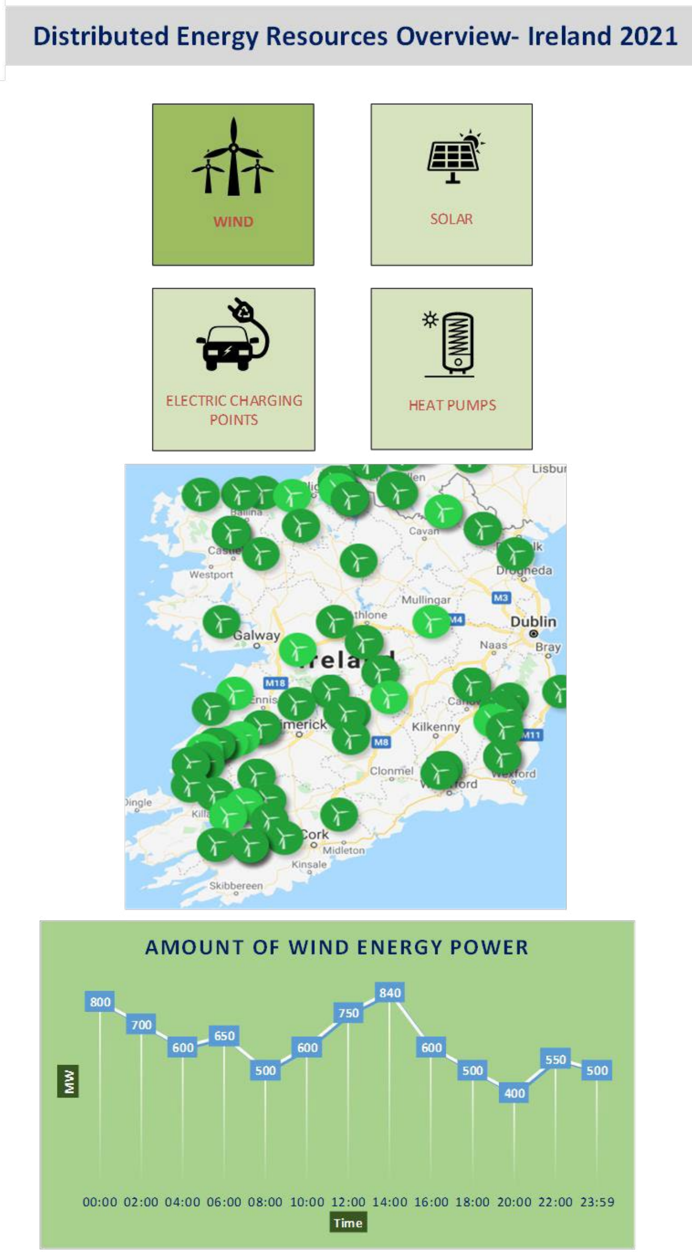
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

2 DETAILED OVERVIEW OF EACH OF THE DER TYPES

Distributed energy resource sources could be analysed separately with this functionality. The user could select any energy source to get further insights about the renewable energy generated at any particular time of the day.

Figure 24 shows the wind energy generated for the specific day (real-time), with the map of Ireland showing all the wind energy sources connected to the network. Similarly, the trends and patterns could be viewed for other DER sources shown in the figure.

FIGURE 24
OVERVIEW OF WIND ENERGY



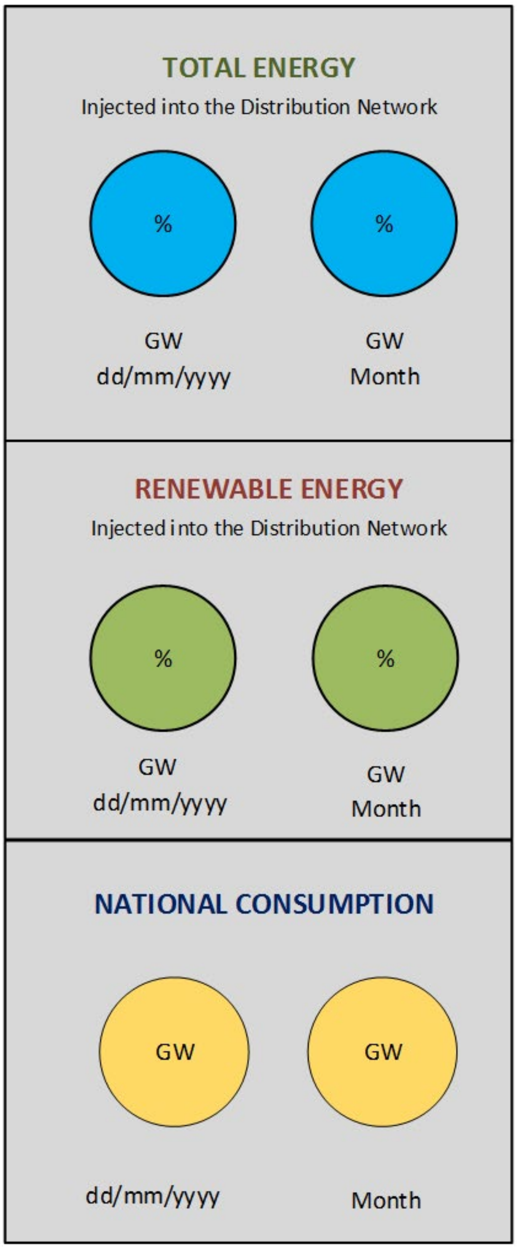
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3 TOTAL AND RENEWABLE ENERGY INJECTED INTO NETWORK

Figure 25 shows the total energy, and the share of renewable energy, injected into the distribution network. This functionality, as illustrated, could show the total energy injected (in percentage) into the distribution network on a specific day, illustrated here with the total percentage of energy injected or the month shown separately in the right blue circle.

The renewable energy share could be displayed indicating the percentage of renewable energy of the total energy injected into the network, both for the specific day and the month, as displayed in the green circles below. The national consumption trends could also be included in the section, based on the historic data and the average temperature for the period, highlighted in yellow.

FIGURE 25
SUMMARY OF THE TOTAL ENERGY INJECTION, RENEWABLE ENERGY SHARE AND THE NATIONAL CONSUMPTION TRENDS



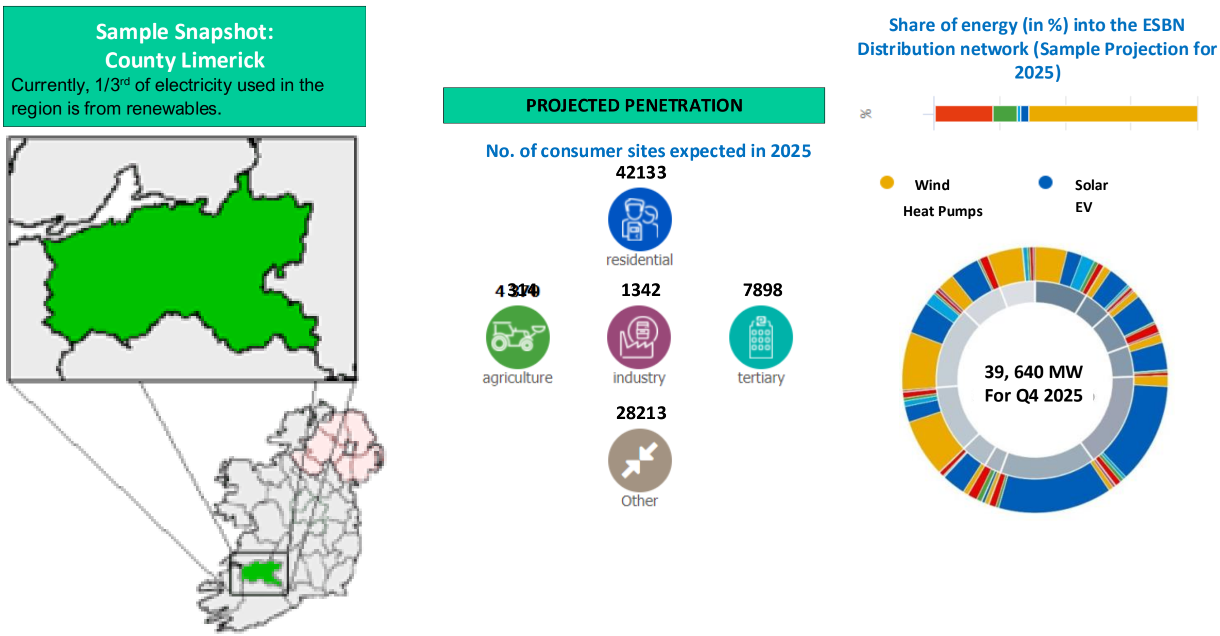
4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4 DER PROJECTED GROWTH

A sample snapshot of projected distributed energy resources' growth for county Limerick in 2025 is shown in Figure 26 below, with the total number of consumer sites expected, categorised based on consumer types.

The share of renewable energy on the Irish distribution network could also be displayed (as illustrated below) showing the relative contributions of wind, solar, heat pumps and EV. The total MW injected into the network for Q4 2025 is seen below, as a sample user selection for demonstration purpose.

FIGURE 26
SAMPLE SNAPSHOT OF PROJECTED DER PROJECTED GROWTH FOR COUNTY LIMERICK IN 2025.



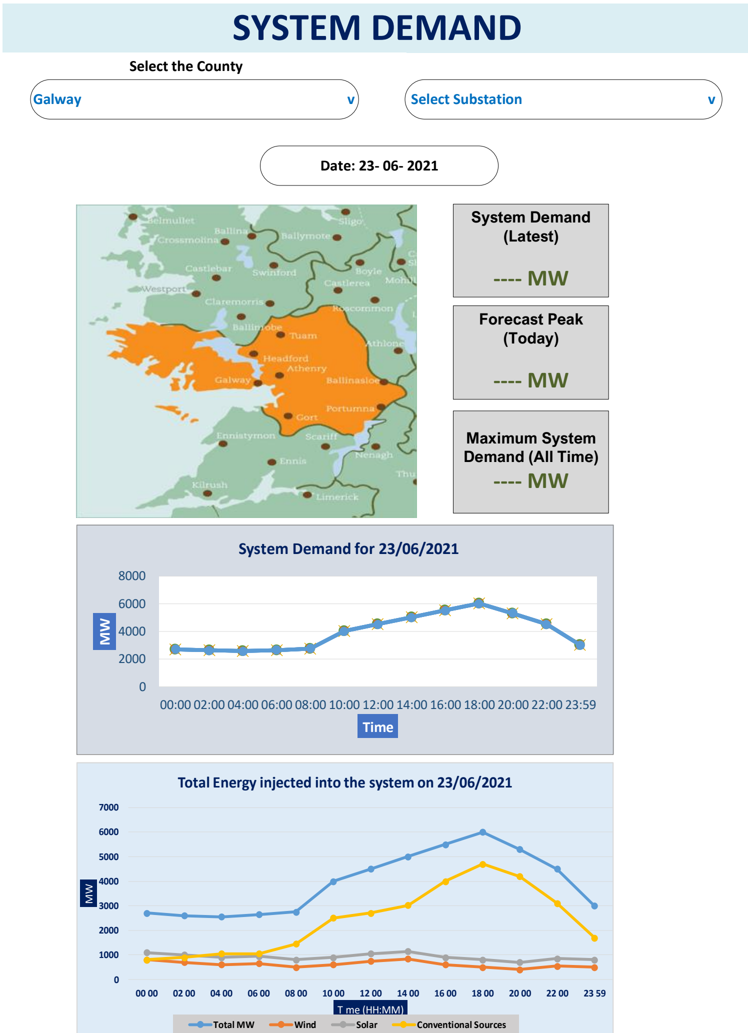
3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

5 SYSTEM DEMAND

The system demand could be included, as displayed in Figure 27 which represents the electricity production required to meet national electricity consumption (including system losses) for the selected substation of the county chosen. Maximum system demand (in MW) could also be captured in the dashboard alongside the forecast peak.

The first graph shows the system demand for the day, with the varying view on demand for different times of the day. The total energy injected into the system on the same day is highlighted in the second graph, with the detailed statistics of total MW, the renewable energy and the conventional energy injected into the system.

FIGURE 27
SYSTEM DEMAND AND ENERGY INJECTION RATIO



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

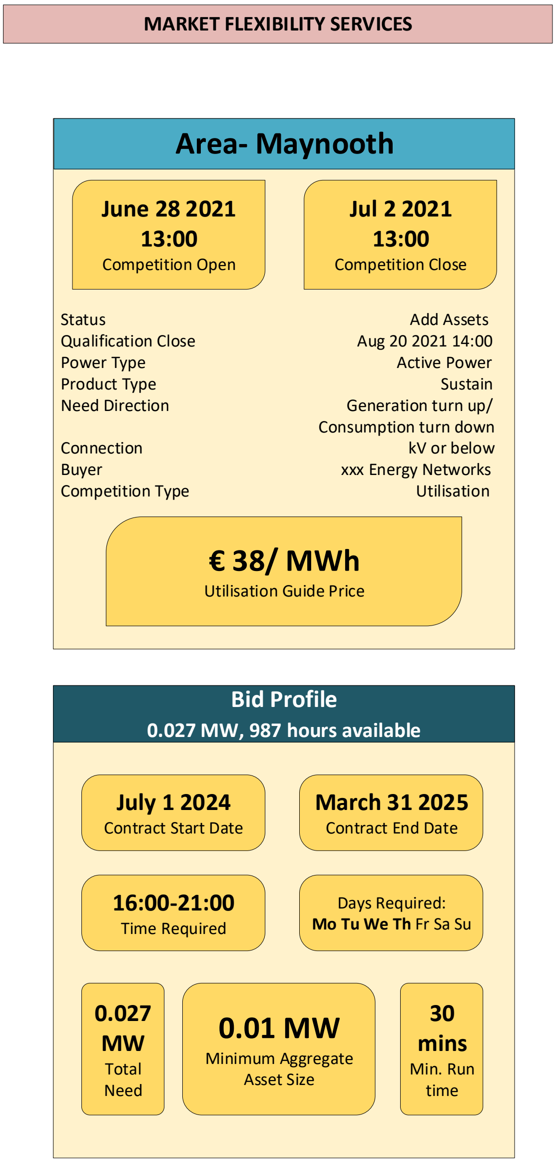
6 MARKET FLEXIBILITY SERVICES

The functional design could include a flexibility market platform as illustrated in Figure 28. As illustrated, this could highlight the bidding profile and the details pertaining to the requirements for participation in the bidding process. Asset owners seeking to participate could choose the assets that they wish to bid, depending on the qualification criteria listed in the bidding profile.

The graphic displays illustrate requirements for Maynooth region for a particular window (1st July 2024 to 31st March 2025), where the competition time is open from 28th June 2021 until 2nd July 2021. If a given participant/asset owner were successful in the bidding process and wins the final contract, they could be notified via the system by generating a report that would be sent to their online account registered for the flexibility services.

The pricing details (per MW); buyer, competition type, required power, product type, and minimum aggregate asset size are listed in the dashboard as seen in Figure 28.

FIGURE 28
REPRESENTATION OF BIDDING PROCESS FOR THE MARKET FLEXIBILITY SERVICES



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

7 SMART METERING DATA

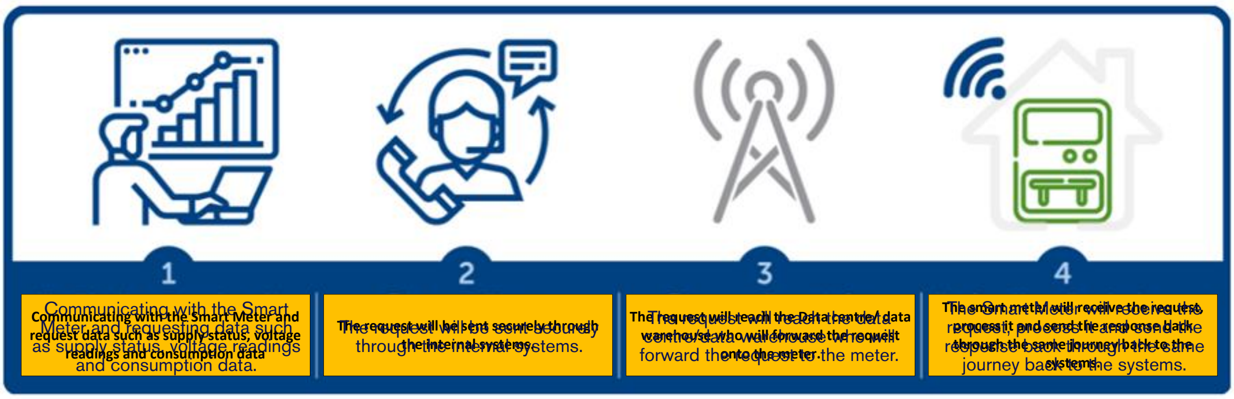
Smart metering data will be an important input to the systems developed, used, and shared in the National Network, Local Connections Programme. The features of smart metering applications include two-way communication between grid and smart meter, data recording capability at intervals of 10-60 min, daily data transmission to the monitoring centre, and secure data communication infrastructure (Ersan et.al, 2019).

In the short term, the use of smart meter (near) real-time consumption data will be beneficial in providing or supporting the development of increased visibility of the LV network and the analysis of losses. Smart meter consumption profile data will assist ESB Networks in meeting our responsibilities with regard to the development and maintenance of an efficient, coordinated, and economical system for energy distribution (Smart Meter Data Privacy Plan, 2020).

Enhanced visibility would help our distribution management system complete more accurate load flow, state estimation, optimisation, and increased convergence rate of contingency analysis. This will result in more accurate and reliable results to utilising distribution network capacity, identifying congestion and creating a role for flexibility resources to support our management of this congestion. This data can also be used to as an input as we create heat maps and other information for network users.

The figure below explains how we can communicate with the smart meter and collect network data to fulfil our regulated responsibilities and operate a smarter network. The data collected will be stored in a secure database and, where required, anonymised. The data will be used to improve several services provided to customers.

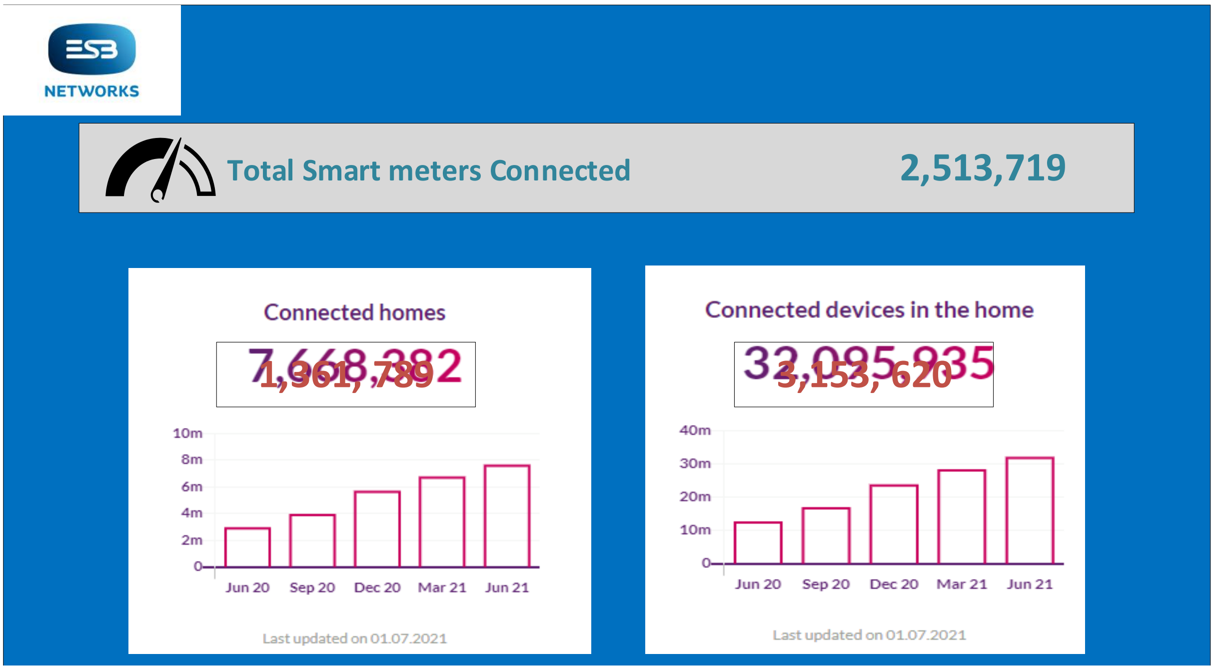
FIGURE 29
DEMONSTRATION OF THE COMMUNICATION PATH TO COLLECT NETWORK DATA FROM THE SMART METER



3 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

By including smart energy dashboard functionality, we can provide improved visibility of smart metering home installations and the number of smart devices connected on the network. A simple illustrated sample smart energy dashboard is shown below in Figure 30.

FIGURE 30
SMART METERING ENERGY DASHBOARD



4

Summary

4 SUMMARY

4.1 SUMMARY OVERVIEW

Through the National Network, Local Connections Programme, we plan to develop dashboards and platforms which will make local renewable energy and low carbon technologies more real and visible to customers, communities, and electricity market participants. This document outlines the proposed functionality to be developed and shares some of the research undertaken in developing these proposals. It has been updated in Q4 2021 to reflect stakeholder input regarding the role and desired functionality of dashboards and platforms.

The range of functionality is described in the form of:

1. **A state-of-the-art review.**
2. **Functionality tables.**
3. **Illustrative graphic representations of proposed functionality.**

The proposed functionality is designed to provide customers and communities with visibility of their local energy system, including consumption, demand, and the location specific or community specific views on the distribution network and local / regional renewable energy resources.

4.2 KEY TAKEAWAYS FROM THIS DOCUMENT

1. **The analysis and global benchmarking of the functionalities used by the distribution system operators in the US (New York), UK and major European countries such as France, Netherlands, and Portugal.**
2. **A fully digital process on integrating the DSO portal with the flexibility Market Management Services (MMS), and technological capabilities such as ADMS and DERMS are also illustrated in the document.**
3. **Dashboard would provide visibility of the local energy market by utilising distribution network SCADA data, new LV monitoring data, and the near real-time smart metering data in the future.**

5

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