NETWORKS

Data Platforms and Dashboards

NATIONAL NETWORK, LOCAL CONNECTIONS PROGRAMME

DOC-230921-GYS

OPENING STATEMENT

The decarbonisation of Irish society relies on fundamental changes to how energy is generated and consumed. To enable these changes at the right pace and the right price, we will rely on the electricity network, and we need to make the connection between how renewable energy is generated, and how we use or store it. Every Irish home, farm, community, and business is being called on to play a part. The National Network, Local Connections Programme has been established to work with, and for, customers to make this possible.

We are entering a period of rapid change and uncertainty. Over the coming years, technologies will change as will the energy needs of Irish homes, farms and communities. We will need to be able to adapt to meet changing needs and emerging challenges. In this document we have sought to develop a proposed plan that accounts for uncertainty and delivers that adaptability.

For example:

1. **Iterative piloting and development of processes so that we can learn what delivers the response we need to ensure we maintain a reliable network for our customers and what needs to be done differently as we prepare for a national rollout.**
2. **Extensive commitment of resources to communications and collaboration, working with partners and customers to understand their needs and how and why they change, so we can better respond and adapt to these needs.**

Over the life of this programme we will face uncertainties and risks. If we proceed too quickly, we increase the risk that customers will not be ready, or technologies will not be as mature. But if we do not proceed quickly enough, there is a risk that the solutions will not be in place when then need to be. Without taking the initial steps now, there is a risk that we and our partners could not replicate solutions that we pilot or commence a national rollout until later in the decade.

We will need to commit people and capital to deliver this programme, and we are reaching a critical decision point regarding the level of resources to commit. ESB Networks serves, and is funded by, all electricity customers. All our customers will share in the benefit, but they will also share in the costs and the risk if we act too slowly or too soon. As such, we want to give all customers an opportunity to consult.

1. **Do you think we should take a more measured pace and begin to scale closer to 2030, or commit resources needed to begin build towards a national rollout commencing in 2024 / 2025?**
2. **There are trade offs between different developments in this plan that we could prioritise. What do you think we should prioritise, and how will this affect your business.**

We need your input to determine the path forward. So please have your say!

CONTENTS

1 NATIONAL NETWORK, LOCAL CONNECTIONS – HAVE YOUR SAY!

This document is the 2030 Power System Requirements proposal. In this document we set out:

1. **The key information and views that could be provided on a local and regional basis.**
2. **The potential services and interaction that will need to be supported on future platforms.**
3. **International comparisons and examples which we are using to inform our proposals.**

It is critical that we implement solutions that optimally meet the wishes and needs of the people of Ireland. In developing these proposals, we have taken time to seek and utilise stakeholder input from round tables and focus groups, as well as to research and utilise exemplar international experiences. This has enabled us to develop the proposed approaches within this document. While we have confidence that these can meet the overall programme objectives, we are open to change and, as a result, we have prioritised this transparent and consultative approach. There were several key dimensions on which we based this document and it is important to us that we develop an understanding of your perspectives, objectives and concerns across each of those.

It may be useful to consider the below questions while reading this document. Please note when responding to this document, it is not necessary to respond to each of the below questions; responding to a specific question or a general response is welcomed and appreciated.

PRIORITIES
We set out the priority we are proposing for different platform / dashboard functionalities. Have you other priorities for the functionality which could be provided?

INTERNATIONAL STATE OF THE ART
We have set out some of the best examples we have found. Are there other international examples you think we should learn from? Or requirements not deployed elsewhere that we should investigate as they would be valuable here?

EMPOWERING CUSTOMERS
How can we make local, regional and national renewable energy dashboards accessible and engaging for customers?

EMPOWERING COMMUNITIES
We want to empower people to make a local impact; individually, or in communities. Are there others we should be seeking to serve and empower?

TECHNOLOGY
Are there particular technologies, or technological approaches, you think we should leverage in rolling out data platforms and dashboards?

PILOTING
Do you think we should focus the development of platforms and dashboards to support piloting activities initially?

1 NATIONAL NETWORK, LOCAL CONNECTIONS – HAVE YOUR SAY!

It is also important to us that we maximise the overall value of the programme across our stakeholders. As such, we are inviting perspectives on additional considerations that we could fold into our approach:

LEARNING OBJECTIVES
Are there customer, DSO or market learning objectives which we could progress through the introduction of new data platforms and dashboards?

CUSTOMER & POLICY OBJECTIVES
Are there other upcoming policy developments or customer needs we could reflect in new data platforms and dashboards?

CUSTOMER EDUCATION AND AWARENESS
How best can new data platforms or dashboards be used to help drive customer education and awareness?

SUPPLY CHAIN
How best can new platforms or dashboards be used to help support other parts of the supply chain?

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Glossary

2 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 Platforms & Dashboards deliverable will provide a proposed roadmap for the delivery of beta and production data exchange platforms for the purposes of enabling customers and industry engage with system operation, challenges and solutions, as active customers and communities, and participants in system services.

The blueprinting of this will be delivered in 2021, involving engagement with customers and industry to identify needs and opportunities for local and regional dashboards, and platforms supporting market participants and customers participate in system services. It will involve investigation of technological alternatives, to make better use of the tools, technologies, and data available to ESB Networks and share these with the wider community.

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4.1 DESCRIPTION

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4.2 CURRENT DASHBOARD & PLATFORMS - STATE OF THE ART

This document is presented as part of the study being undertaken for designing the energy dashboard and platforms for ESB Networks. The report includes various features and the functionalities utilised by system operators for representing data related to DER energy resources.

This report aims to provide a comprehensive analysis on the energy dashboard and platforms of five different organisations across the world, from which ESB Networks could benefit in gaining insights and inputs for designing the energy dashboard and platforms.

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)**

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.

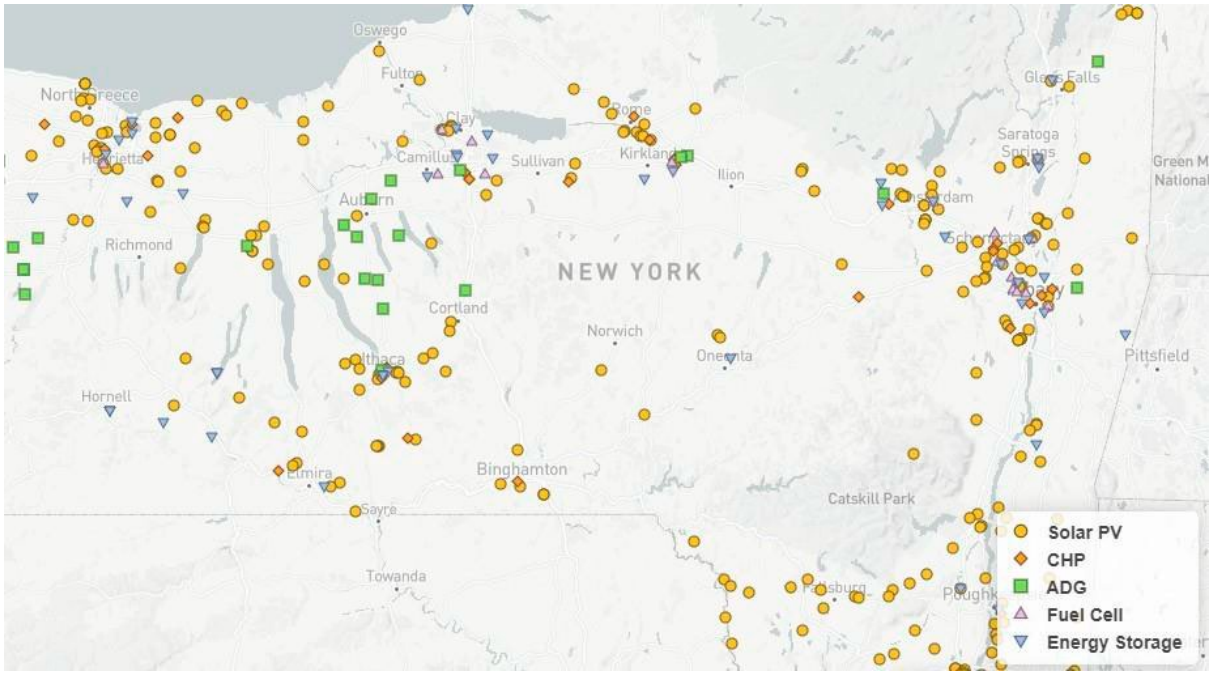
4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Map

The map below identifies the locations of DER projects at facilities across New York State. The user can sort by DER 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 DER 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:

- **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.**
- **Solar: Completed and operational projects funded by NY-Sun's Commercial & Industrial incentive program.**
- **Combined Heat and Power, Anaerobic Digester, and Fuel Cell.**

4 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:

- **Viewing a map of DERs across New York (NYSERDA DER Integrated Data System) or**
- **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.

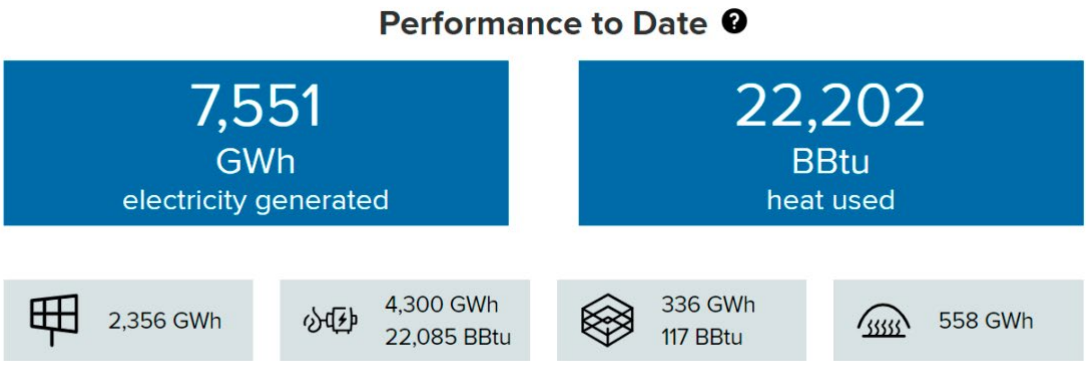
Another key feature is that the user can analyse the abundance of data present within individual facility data pages by:

- **Viewing data by a selected time range, by month, or by day.**
- **Getting a snapshot of performance capacity ratings and efficiency.**
- **Plotting electricity generation against ambient temperatures.**
- **Comparing DER facilities with peers by clicking on the benchmark tab.**
- **Analysing DERs or aggregate data from multiple DERs 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 DERs 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



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

Characteristic Data:

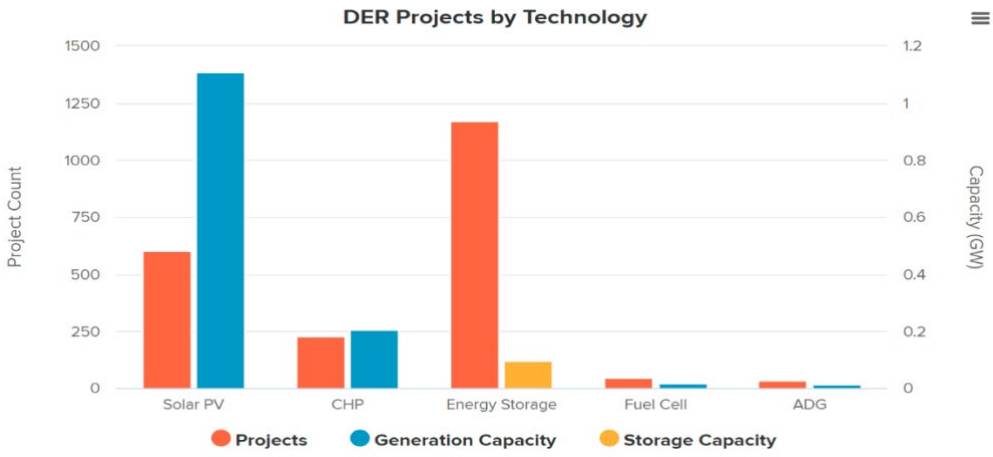
Characteristic data outlines the "what" and "where" of DER projects in New York State. By accessing the data file linked to the right, users can view the characteristics of individual DER projects at over 1,200 facilities, including facility names, locations, facility types, DER technologies used, electric 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 DER 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 DER 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 highlights the number of DER projects by facility category and also the capacity of DER projects by each of the facility categories (e.g. for facility categories listed include manufacturing, healthcare, education, residential, agriculture, etc.).

4 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 DER 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 DER 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.**

Portfolio Manager:

The Portfolio Manager tool enables users to compare or aggregate performance and characteristic data across multiple DER 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 DER 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

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

4 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). A strong suit of this DSO is creating intelligent and efficient solutions for street lighting and traffic lights. Alliander seek 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).

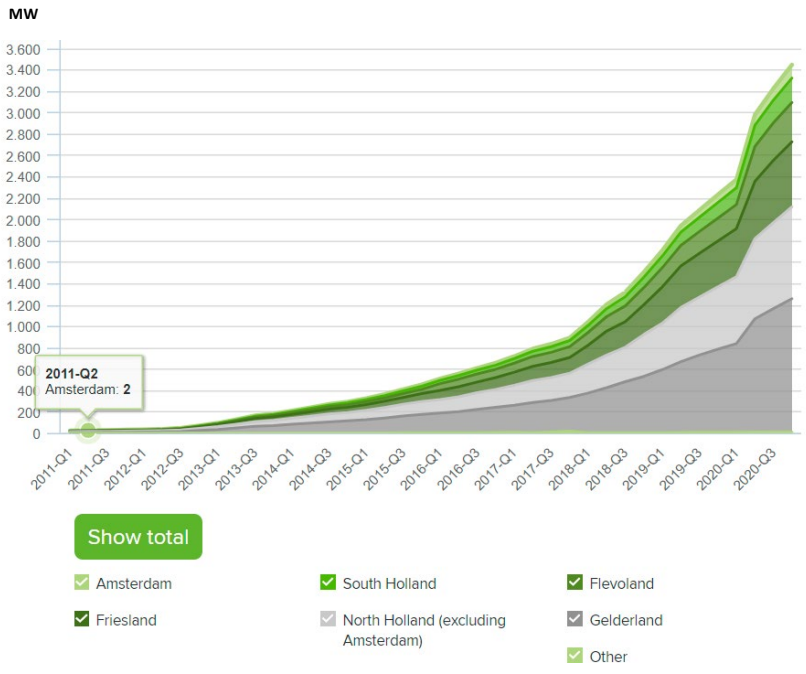
Alliander publishes its figures on solar and wind energy, electric vehicles, and green gas each quarter. A prominent feature in the dashboard and platforms portal for Alliander are two dedicated tabs for the energy transition and the system performance.

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.

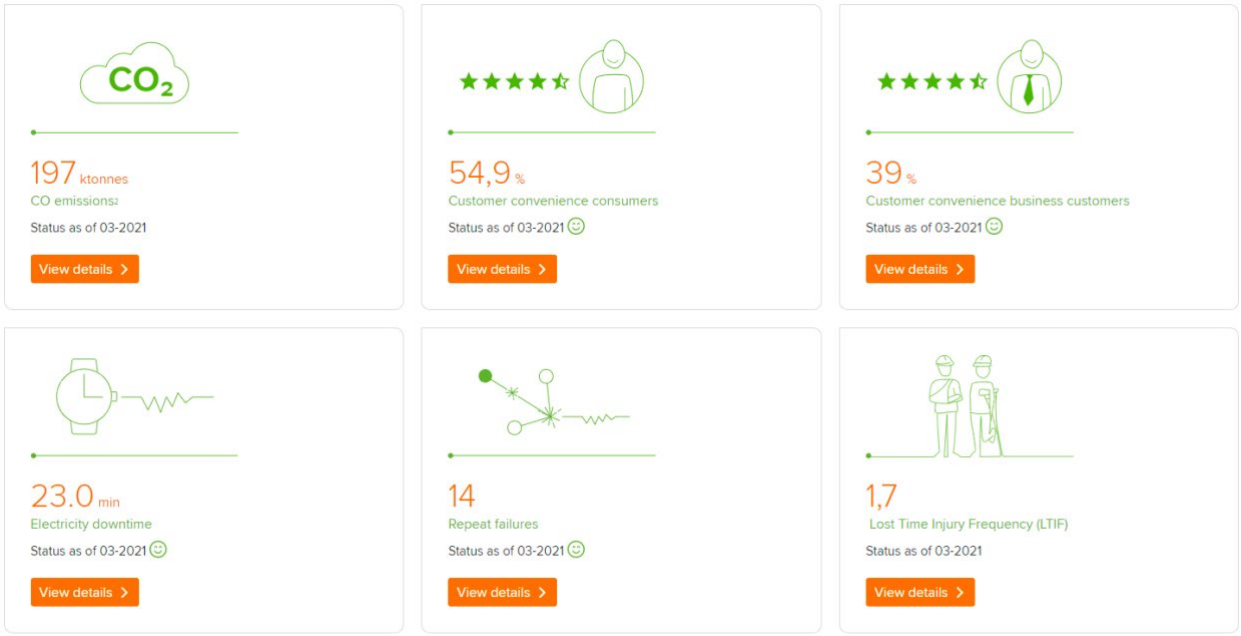


4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

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

The Performance tab provides data pertaining to CO2 emissions, expressed in kilotons, caused by grid losses are is captured here. In addition, it also covers CO2 emissions when carrying out daily activities.

FIGURE 7
OVERVIEW OF THE PERFORMANCE INDICATORS FOR THE ALLIANDER NETWORK



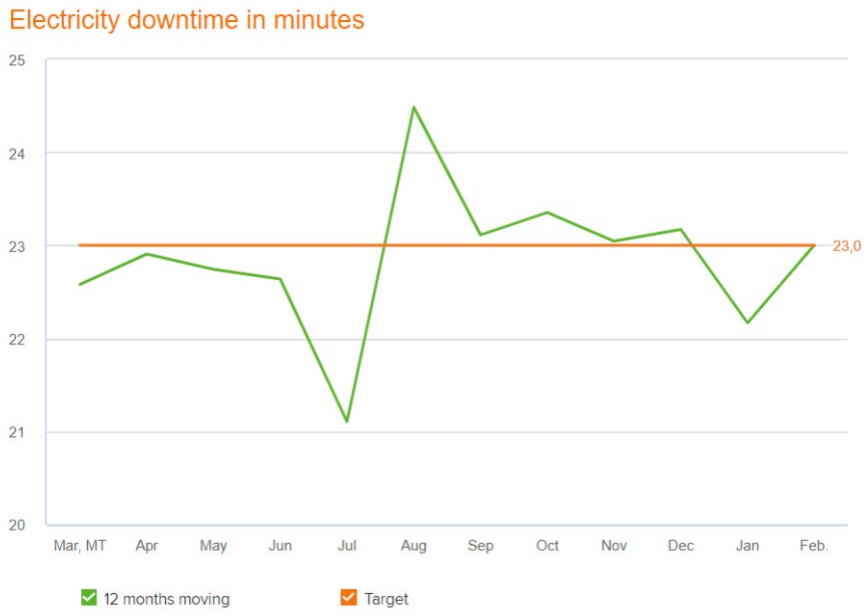
Customer convenience is measured from post service customer feedback, collected immediately after completion of work. These are easily fed back to link to the different processes within the organisation for measurements. The Net Effort Score (NES) immediately shows the level of convenience (in %) a customer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

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

4 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, is aimed to prevent repeated power outages by monitoring connections (cables) on a 24/7 basis. If connections 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 the staff safety in the number of accidents involving absenteeism per one million hours worked.

More details on Alliander dashboard are available on the following link:
Prestaties Alliander - Alliander verslagen

3 E-REDES (DSO - Portugal)

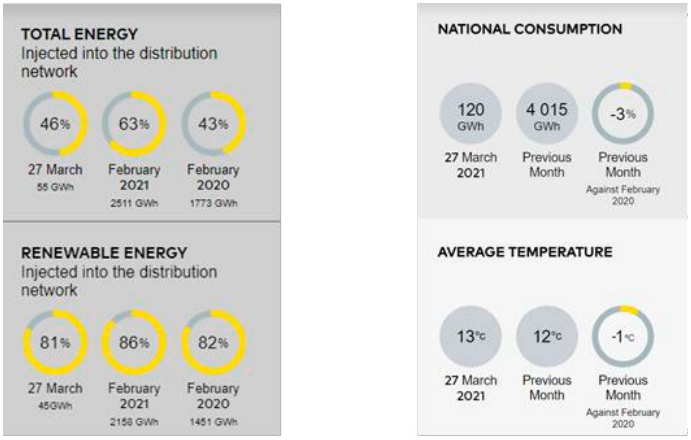
E-Redes is responsible for the management of high and medium voltage networks (state granted), and low voltage (through municipal concessions). E-Redes operates 228,000 km of distribution network in Portugal. E-Redes operates the network that transport energy between substations and households or companies (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)

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

In the main dashboard and platforms portal (as seen in the screenshots captured 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



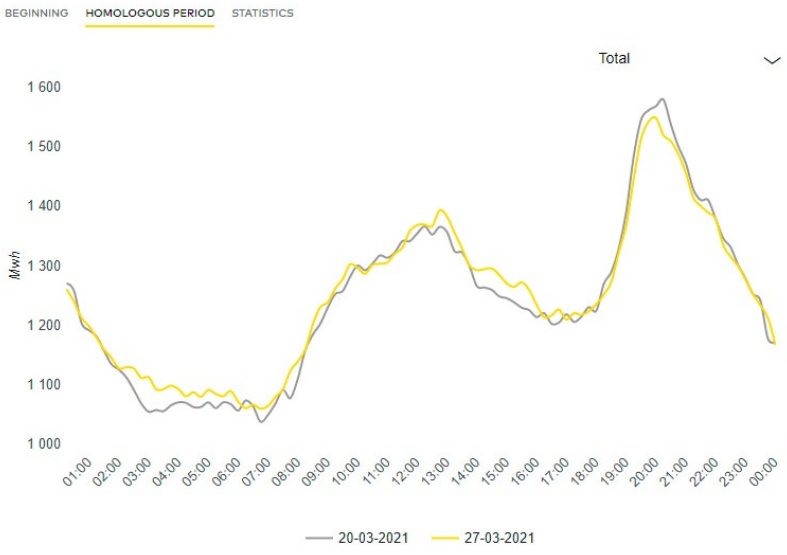
E-Redes Data in the Dashboard and Platforms:

E-Redes trend national consumption by 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.

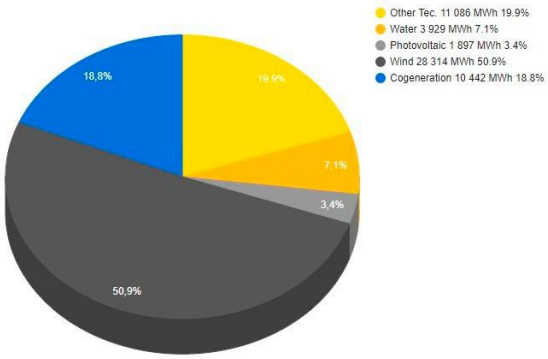
FIGURE 10
STATISTICS FOR THE TOTAL ENERGY PRODUCED ON 27TH MARCH 2021 COMPARED AGAINST THE ENERGY PRODUCED ON THE 20TH MARCH 2021.



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

The graphical representation of energy produced by various technology types, such as water, photovoltaic, wind, cogeneration (CHP) and other sources, is provided in the below pie chart. 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



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

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

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

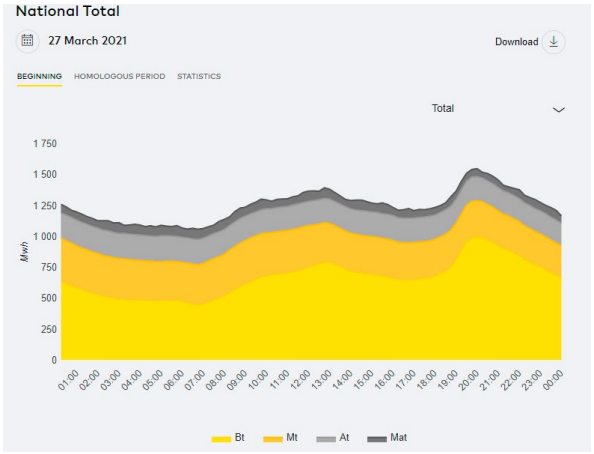
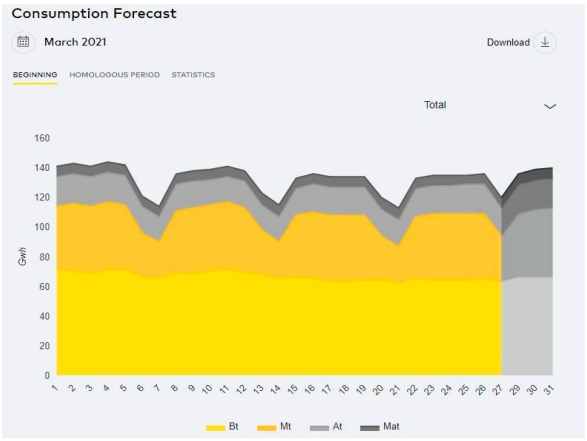


FIGURE 13
CONSUMPTION FORECAST FOR LAST THREE DAYS OF THE MONTH



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)

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4 ENEDIS (DSO- France)

Enedis manage 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**

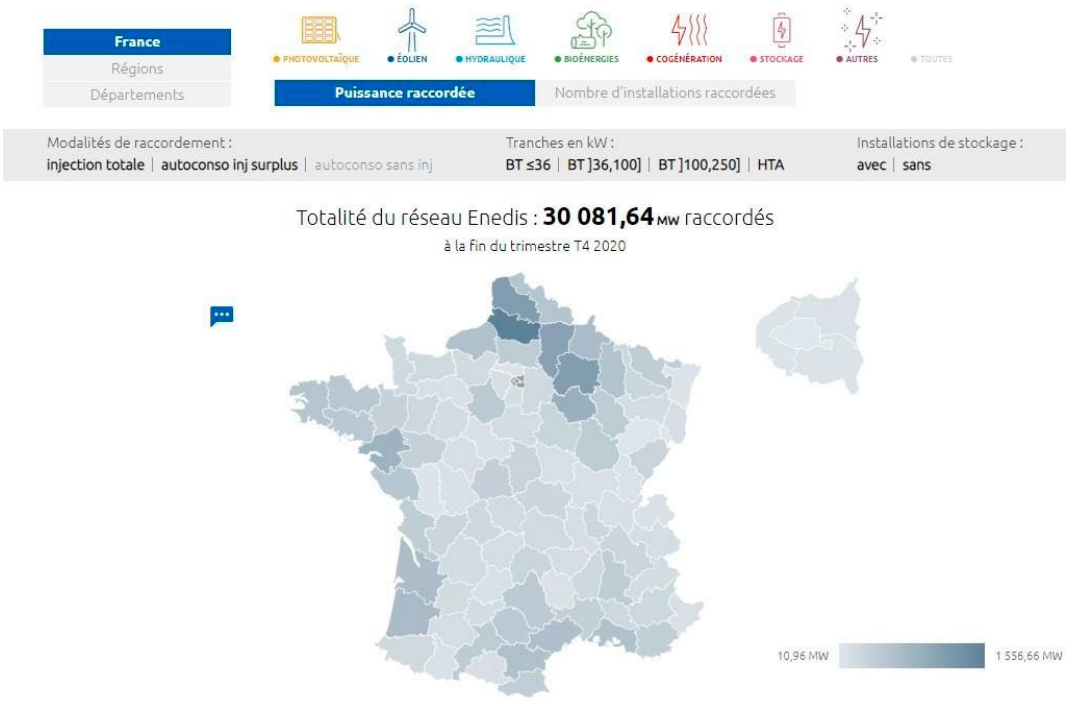
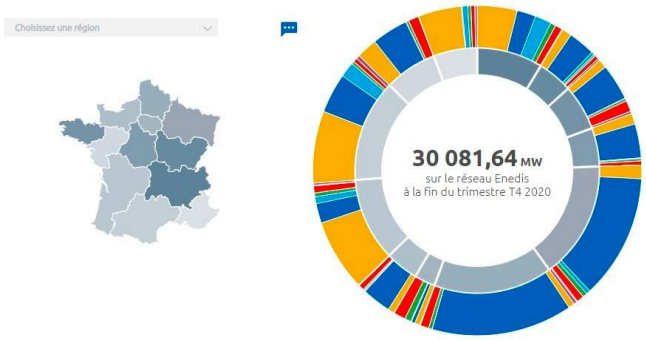


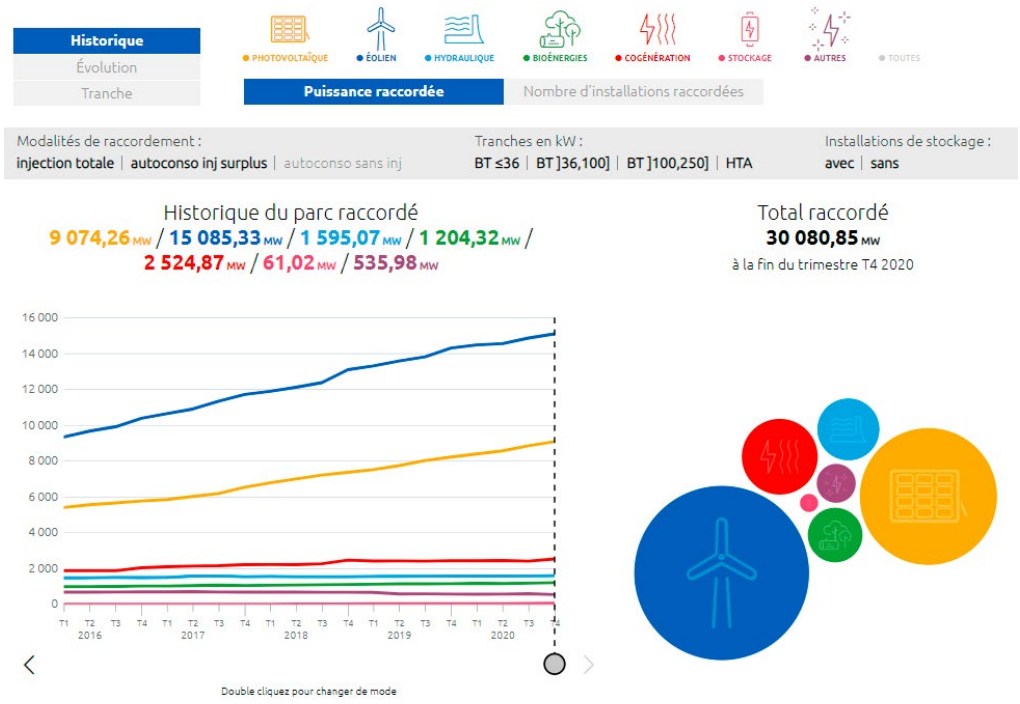
FIGURE 15
REGION WISE SPLIT OF THE VARIOUS DER ENERGY SOURCES AND THE TOTAL POWER GENERATED (IN MW)



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

The historical data and trends can be accessed for each type of DER. The graph in Figure 16 displays the DER connection uptake from 2016 to 2020. The amount of energy generated is also captured to identify the DER injected 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.

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4 EIRGRID (TSO)

Ireland's Transmission System Operator, EirGrid, uses a web-based Smart Grid dashboard and platform application which enables users to view and compare some of the key 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 the user with a real-time view of some of the most popular energy data.

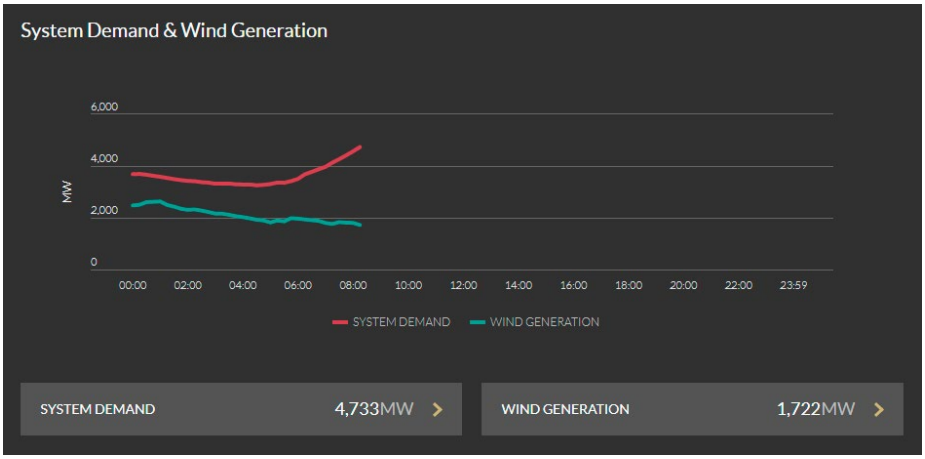
The dashboard is an interactive application including:

- **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 & CO2 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**
  Represents the predicted electricity production required to meet national consumption. Actual and forecast system demand are shown in 15-minute intervals.
- **System Generation**
  Represents 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



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

- **Average Fuel Mix**
  Represents 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 50Hz. Frequency is shown at five second intervals.

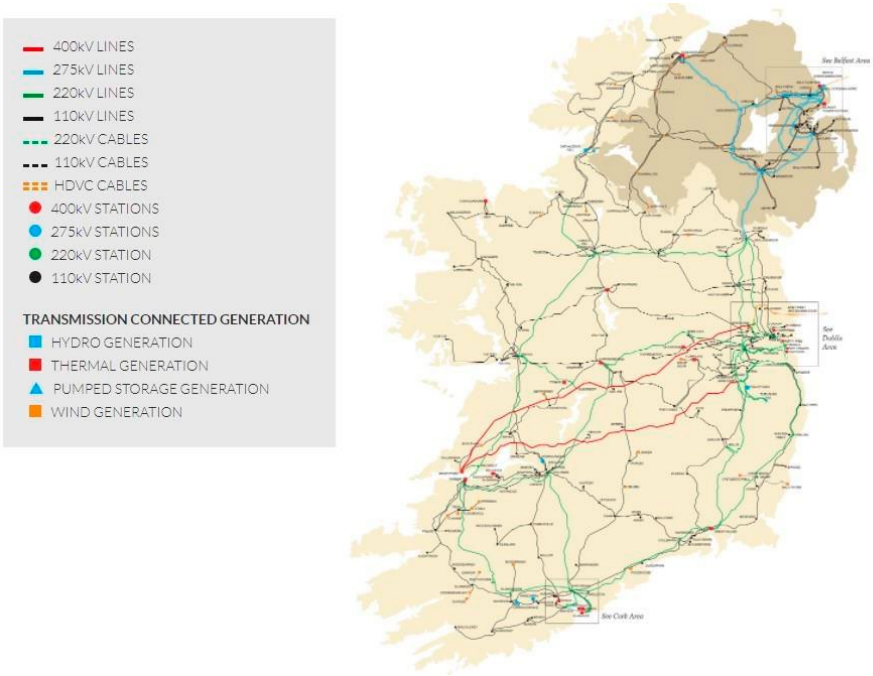
FIGURE 18
THE 24-HOUR AVERAGE OF THE FUEL MIX FOR SYSTEM GENERATION AND THE FREQUENCY OVER TIME

- **Wind Generation**
  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**
  Represents 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.
- **CO2**
  CO2 intensity is the average CO2 emissions per unit of electricity generation output. CO2 intensity is shown at 15-minute intervals. CO2 intensity is measured by grams of CO2 (emissions) per kilowatt hour (kWh) of generation.

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

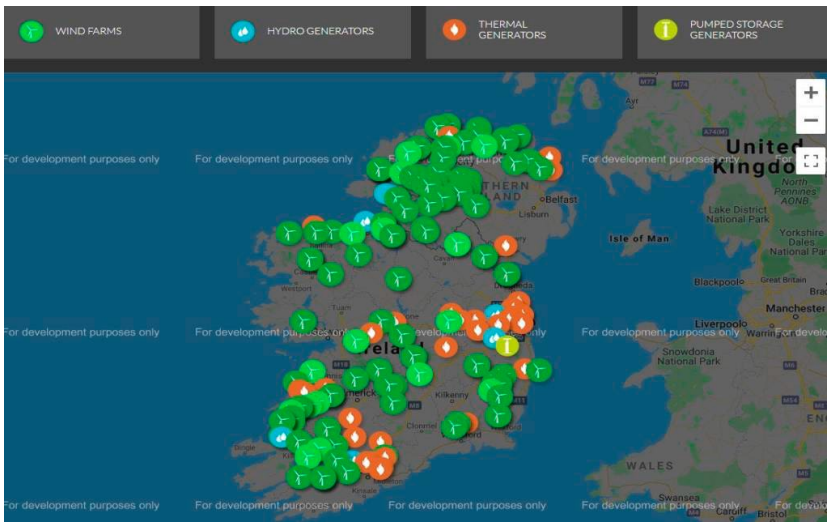
EirGrid also has a tab for the transmission map for the entire Ireland, which is further categorised into different key areas (Dublin, Cork and Belfast areas).

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 the Republic 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.



More details on EirGrid dashboard and available in EirGrid Group plc - Smart Grid Dashboard

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4.3 FUNCTIONALITY REQUIREMENTS FOR DATA PLATFORMS AND DASHBOARDS

Table 1 provides a comprehensive list of all the functionalities that may be considered for ESB Network's Energy Dashboard and Platforms. This will provide a high-level overview of the different functionalities that are important for acquiring the required data and information needed as part of designing the dashboard and platforms.

Various functionalities, along with their description, are introduced here, which are captured from the state-of-the-art review earlier.

The functionalities are divided into three different categories: High, medium, and low, depending on their significance from ESB Networks standpoint.

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	Wind energy and EVs could be important considerations for ESB Networks.
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 DER projects in different facilities across the state, with an option to retrieve details of each of the facilities and DER type. • Both map of currently installed DER and the on-going projects.	High	Weekly	NYSERDA	Geographic representation of different DER 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 DER projects, including facility type, DER technology used, locations, storage capacity, etc.	Medium	Weekly	NYSERDA	

4 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 DER 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 DER 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	

4 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.

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

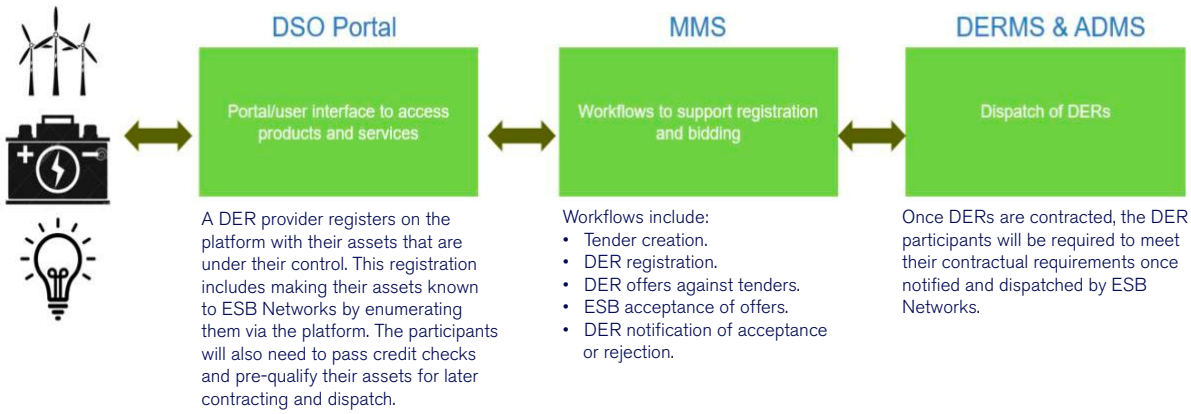
DSO Portal and Market Platforms:

An illustration of how a Market Management System (MMS) works alongside a DSO Portal and DERMS/ADMS is shown below in Figure 21.

The DSO portal/user interface created to access products and services where the DER provider will register their assets. Registration would include declaring their assets known to ESB Networks by enumerating them via the platform.

Key functionalities of an MMS platform are defined on the below diagram as tender creation, DER registration, DER offers, acceptance of offers and issuing notification followed by settlement.

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



There are a number of key stages which are defined below for the procurement of flexibility services in a region. This means that the DSO Portal, the MMS Platform as well as the DERMS/ ADMS need to work together 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

4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

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. The organisation is independent and is supported by government funded projects, that 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.

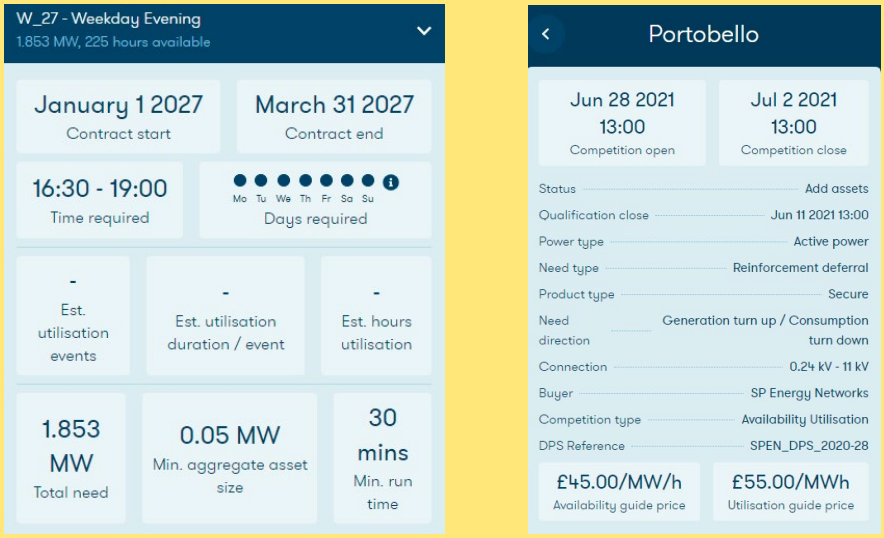
Piclo, as an example of an MSS platform provider, has an online electricity portfolio which gives companies full control and traceability of every kWh and can help with their sustainability reporting. The service collects meter readings every half an hour for each business, giving granular data from 48 daily meter readings (Flexibility Hub - UKPN Smart Grid, 2021).

Piclo could also help companies make the business and regulatory case for reducing, or avoiding, transmission and distribution use-of-service charges when the energy is generated and used locally.

The below graphics in Figure 22 display the 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



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4.4 HIGH LEVEL CAPTURE OF THE DASHBOARD & PLATFORM REQUIREMENTS

This section focuses on the high-level graphical representation of DER dashboards and platforms for ESB Networks. 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**

1 GEOGRAPHICAL OVERVIEW OF THE EXISTING DER FACILITIES IN IRELAND

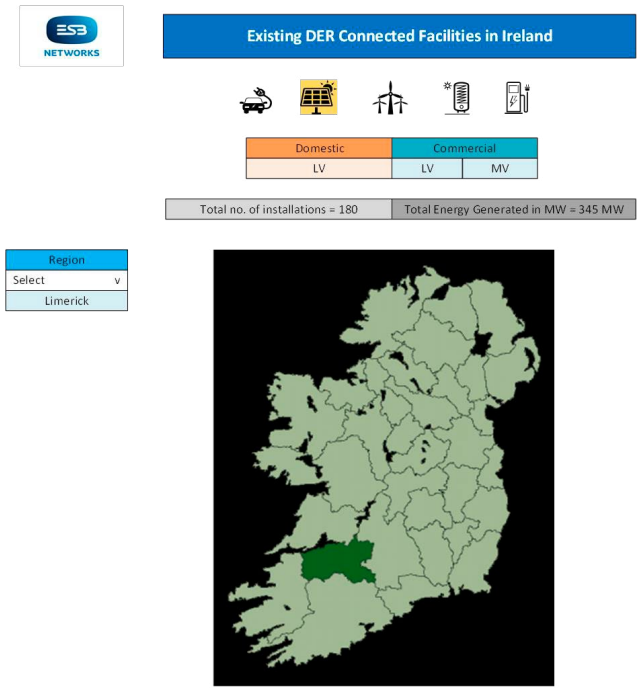
This section represents the geographic overview of the existing DER facilities across the Republic of Ireland with capabilities to segment the DER energy sources and power generated based on specific location. The five energy sources namely EV, solar, wind, heat pumps and charging stations are captured, as seen in the below figure.

There is also an option to select the domestic and the commercial customers separately to view the details pertaining to the LV/ MV network, e.g. the total no. of EV installations within the domestic LV network, total charging stations in the commercial MV network and so on.

The region drill-down capability enables the user to select any county from the drop-down menu to understand the DER 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 & MV) network.

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

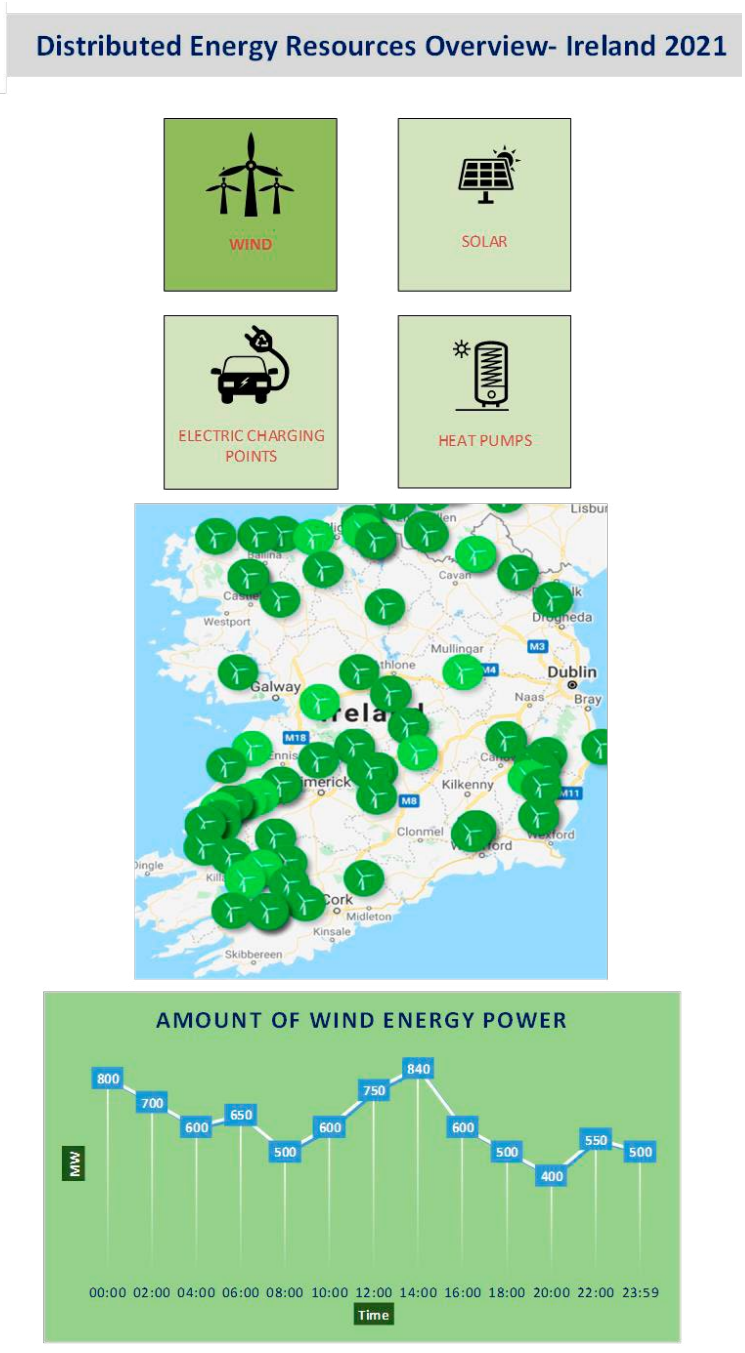


4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

2 DETAILED OVERVIEW OF EACH OF THE DER TYPES

The DER sources are detailed separately in this section, where the user would be able to select any energy source to get further insights about the renewable energy generated at any particular time of the day. The figure below 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



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

3 TOTAL AND RENEWABLE ENERGY INJECTED INTO NETWORK

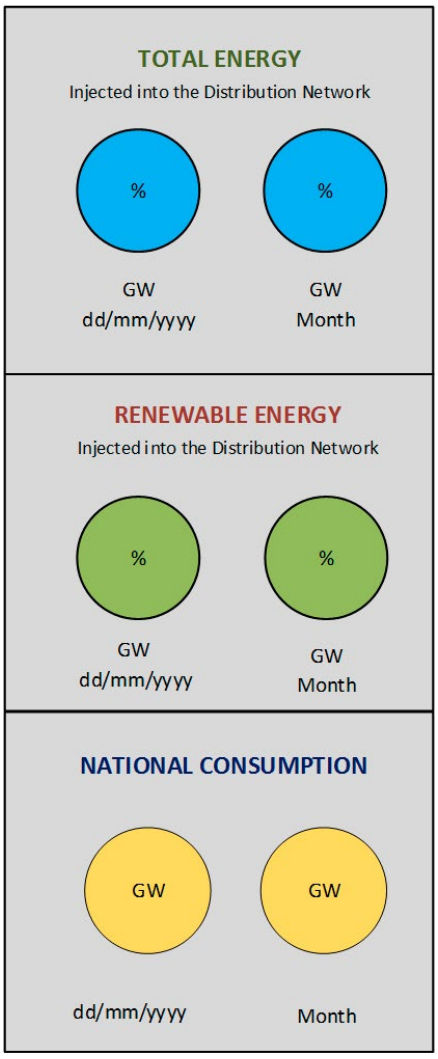
Figure 25 shows the total energy, and the share of renewable energy, injected into the distribution network.

The first section denotes the total energy injected (in percentage) into the distribution network on the specific day, with the total percentage of energy injected for the month shown separately in the right blue circle.

The renewable energy share is 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 are also 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



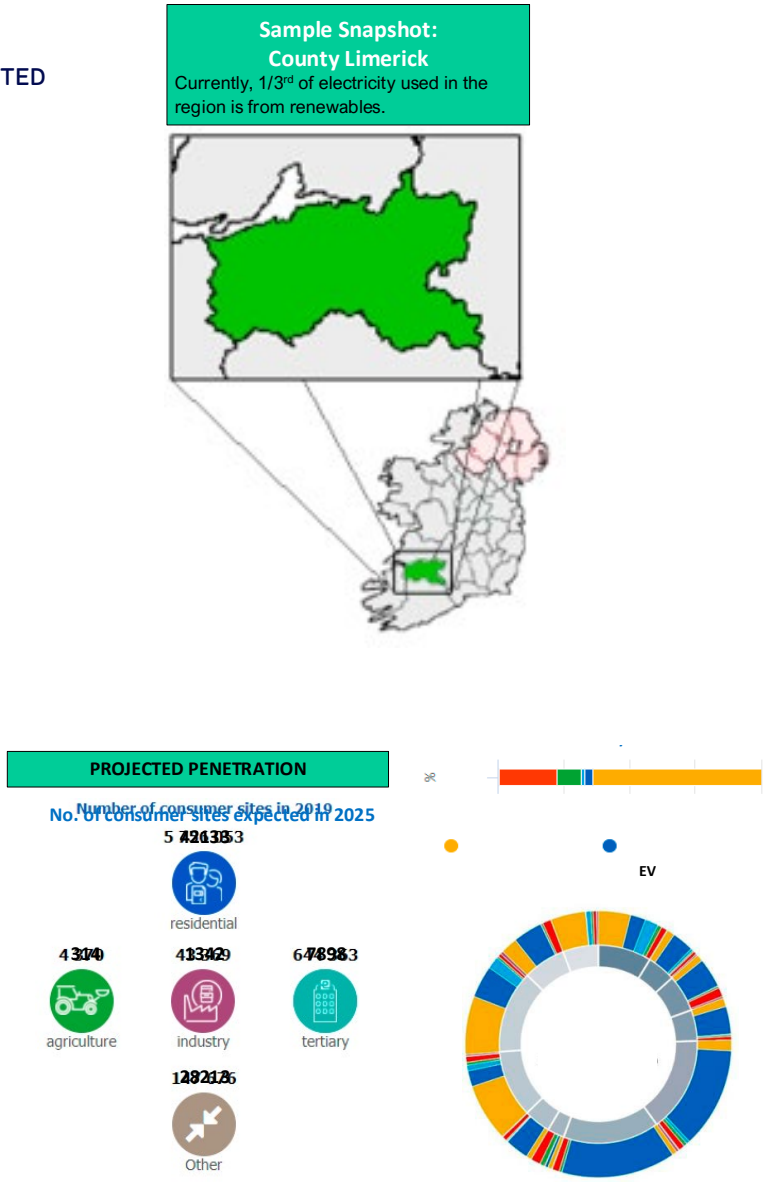
4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

4 DER PROJECTED GROWTH

The sample snapshot of projected DER growth for county Limerick in 2025 is shown in Figure 26 below, with the total no. of consumer sites expected, categorised based on consumer types.

The share of renewable energy on the ESB Networks distribution network is also displayed with the main contributors: 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.



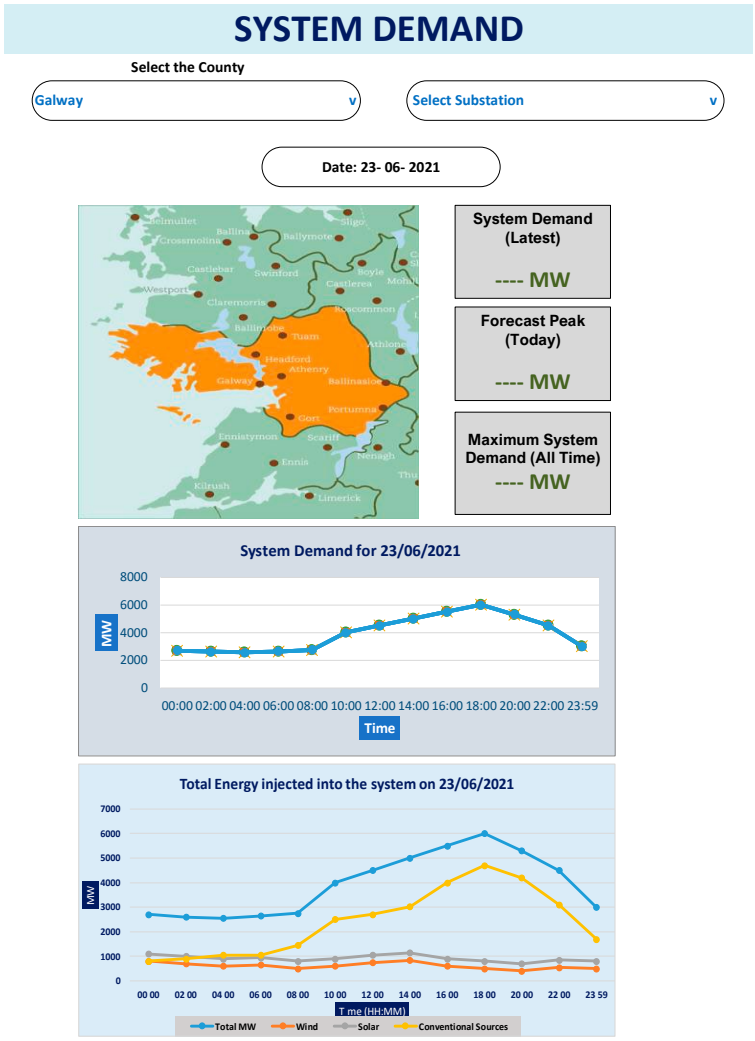
4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

5 SYSTEM DEMAND

The system demand displayed in Figure 27 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) is also 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



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

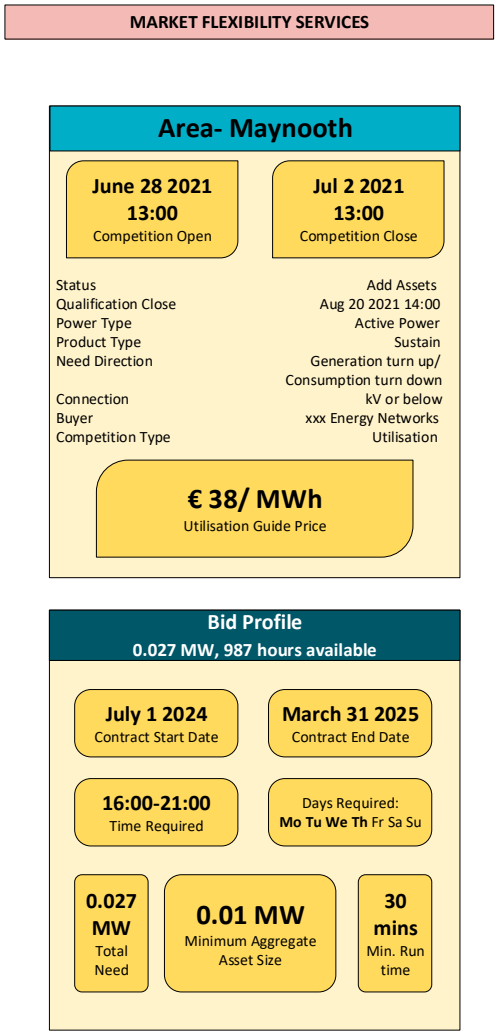
6 MARKET FLEXIBILITY SERVICES

The flexibility market platform illustrated in Figure 28 highlights the bidding profile and the details pertaining to the requirements for participation in the bidding process. The asset owners can choose the assets that they wish to bid, depending on the qualification criteria listed in the bidding profile.

The below graphic displays the 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 the participant/asset owner is successful in the bidding process and wins the final contract, they would 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 below.

FIGURE 28
REPRESENTATION OF BIDDING PROCESS FOR THE MARKET FLEXIBILITY SERVICES



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

7 SMART METERING DATA

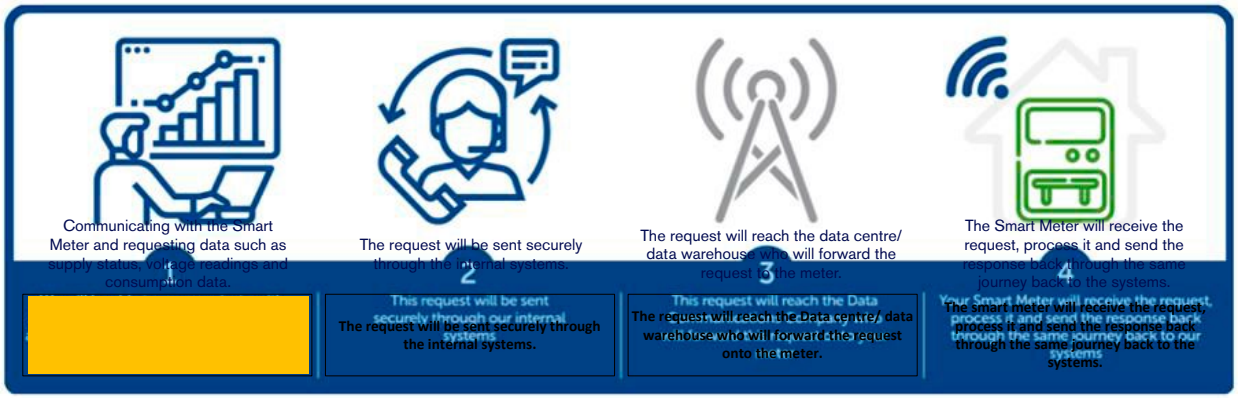
The features of smart metering applications include two-way communication between grid and smart meter, data recording capability at intervals of 10-60 min, daily data transmission to the monitoring centre, and secure data communication infrastructure (Ersan et.al, 2019).

In the short term, it is expected that the use of smart meter (near) real-time consumption data would be beneficial for increased visibility of LV network, improved connections, and the analysis of losses. In addition, the use of smart meter hourly consumption data will assist the DSOs in their duty to develop and maintain efficient, co-ordinated, and economical systems for energy distribution (Smart Meter Data Privacy Plan, 2020).

Enhanced visibility would help DERMS for more accurate load flow, state estimation, optimisation, and increased convergence rate of contingency analysis, which would result in more accurate and reliable results to utilising distribution network capacity. This in-turn would result in efficiently identifying congestions on the LV network and utilise the best flexibility resources to manage congestions. This data can also be used for information provision to create heat maps and information for DER developers on where there is capacity, and lack of capacity, for future connections to help developers identify the best location to build their future projects.

The below image explains how ESB Networks can communicate with the smart meter and collect network data in order to fulfil the regulatory duties 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 a number of services provided to customers.

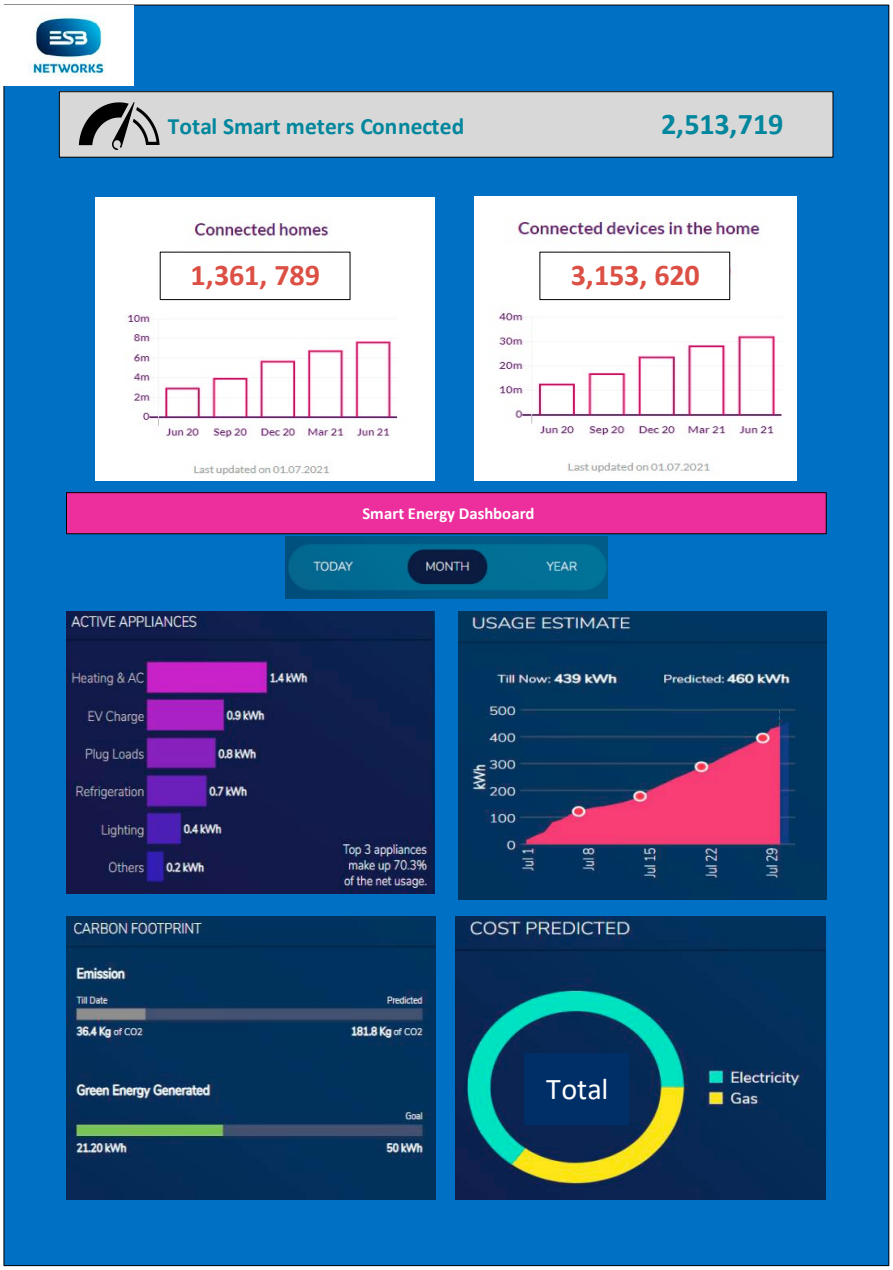
FIGURE 29
DEMONSTRATION OF THE COMMUNICATION PATH TO COLLECT NETWORK DATA FROM THE SMART METER



4 DATA VISUALISATION FOR PLATFORMS & DASHBOARDS

The smart energy dashboard provides improved visibility for energy consumption in the home and energy community. A sample smart energy dashboard is shown in Figure 30 for demonstration purposes. The active appliances and the power consumption associated with each appliance are captured, to give energy consumption profiles. The energy intensity with carbon footprint measures; including the emissions and the green energy generated, are also shown in the dashboard.

FIGURE 30
SMART METERING ENERGY DASHBOARD



5

Summary

5 SUMMARY

As part of the National Network, Local Connections Programme, ESB Networks will enable customers to visualise the growth and penetration of renewable energy on the distribution system. This document outlines the ESB Networks' strategy for data platforms and dashboards specific to the National Network, Local Connections Programme.

The various functionalities represented in the document in different sections (in the form of state of the art, functionality tables and the high-level graphic representations of the dashboard) will provide customers and communities with visibility of their local energy system. This will include consumption, demand, and the location specific or community specific views on the distribution network. ESB Networks dashboards and platforms also intends to have a view on the DER projected growth and penetration on the distribution network.

The key takeaways from the document include:

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 (F-MMS), and technological capabilities such as ADMS and DERMS are also illustrated in the document.**
3. **The dashboard provides 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.**

STAKEHOLDER SESSION WITH EIRGRID: 12/08/2021 – HOSTED BY RONAN MEERE (ESB NETWORKS)

Key discussion points:

1. **Aim is to look at the lowest level granular network (LV), at a lower level then the county level - i.e., the community level e.g. GAA, etc.**
2. **Dashboard and platforms will be accessible via a website initially and a mobile application.**
3. **A lot of data gathered from the smart meter would be anonymised (due to GDPR).**
4. **The MMS vendor would have the most state-of-the-art system that is easily accessible, and data will be easily available for analysis.**
5. **MMS to be re-named Flexibility MMS (FMMS), to differentiate from the wholesale market.**

5 SUMMARY

Remarks/ Comments from EirGrid:

1. **EirGrid would be interested to pull in most of the dashboard and platform's data into their systems.**
2. **EirGrid are interested in getting the data in API - high-level/summary.**
3. **Users/the public should be able to match both the DSO and TSO data - need to figure out strategies to ensure the alignment between TSO and DSO data.**
4. **Open Data License - to be discussed in detail with the wider ESB Networks group (to ensure data would be available with best endeavours).**

NEXT STEPS

The dashboards and platforms document will go out for public consultation and extensive stakeholder review in October 2021, to feedback all the comments and inputs into the document for the final submission in December 2021. A thorough market platform research would be also carried out in line with the National Network, Local Connections Programme objectives to design a future distribution electricity portal.

QUESTIONNAIRE

1. **Do you think this document clearly outlines the requirements needed to design and implement a platform and dashboard for DER integration in Ireland?**
2. **What additional details and information would you like to see in the ESB Networks Dashboard?**
3. **How would you like to see/experience the cost benefits and impacts on energy savings, based on the participation in the energy market (contributions to reducing grid costs)? i.e. based on my participation, what cost has been avoided?**
4. **What do you think are the key parameters for being an active energy citizen in the proposed new distribution energy market?**

6

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