INNOVATION STRATEGY PROGRESS REPORT

PROJECT TITLE	Intelligent Secondary Substation Transformer (Winter Peak)
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OVERVIEW OF PROJECT & EXPECTED BENEFITS

Decarbonisation of Heat and Transport can be achieved by electrification of the sector and will prove one of the most economic and practical ways to meet Irish decarbonisation targets.

Decarbonisation of the electrical network will see a significant impact on the Low Voltage (LV) network with the increasing integration of Low Carbon Technologies (LCTs) such as heat pumps, solar Photovoltaic (PV), Electric Vehicle (EV) charging points and Smart Electric Thermal Storage Systems (SETS).

The effect on the LV network as a consequence of the integration of these new technologies is not yet fully understood. To gain valuable knowledge of these technologies, ESB Networks propose to trial a number of different monitoring devices to fully understand what is required to effectively monitor the LV network.

PROJECT SCOPE

With the installation of heat pumps and solar PVs increasing rapidly in new dwellings and retrofitted into older dwellings, it is anticipated that the effect on the LV distribution network will be significant.

The project team will seek both new and old housing developments (roughly twenty houses or more supplied on a single outlet) where heat pumps or solar PVs are installed (or a combination of both) and will seek to install monitoring devices in the substation that supplies these developments.

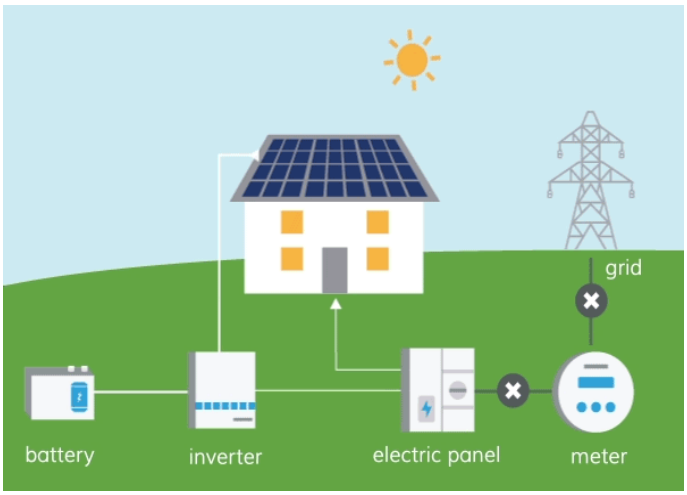

FIGURE 1: LOW CARBON TECHNOLOGIES

The project aims to standardise MV/LV monitoring devices so they can be easily installed and operated by ESB Networks personnel.

The project scope is also concerned with identifying method(s) of efficiently storing the significant quantities of data that will likely result from widespread deployment of these devices.

Some degree of flexibility in the device is also sought in respect of communications technologies used and in relation to data and data storage.

MILESTONES ACHIEVED TO DATE

There are 24 monitoring devices installed to date with a further 26 planned from Q1 2020. The monitoring devices will be installed in different substation types, where there has been an installation of some LCTs and where there is a mixture of these LCTs installed. The trial locations will focus on Co. Kerry, Co. Dublin and Co. Galway.

Significant work was undertaken to develop and approve (in October 2019) a procedure document that described how devices are to be installed safely and consistently.

Key milestones achieved to date are outlined below:

Q2 2017: Assessment of devices.

Q3 2017 – Q2 2019: Device installations in substations.

Q3 2018 – Q4 2019: Device installations on pole mounted transformers.

Q2-Q3 2019: Installation, Commissioning and Decommissioning Procedure document issued for review.

Q4 2019 – Q1 2020: Specification to be written as an open draft. Discussion needed internally with other departments. The tender process may not be required at this stage after the discussions.

PROJECT TIMELINES

Q2 2017 - Q1 2020

PROJECT BUDGET

Time and expenses for ESB Networks staff. The project capex costs to date are c. €70k.

RESULTS TO DATE

There are approximately 20,000 MV/LV ground mounted substations. Since Q3 2017, 24 LV monitoring devices were installed in these ground mounted substations on networks with LCTs integrated at LV level. The data from these monitoring devices provided ESB Networks with load, voltage, active and reactive power information. This critical information enabled ESB Networks to build a profile of the impact of LCT's on LV networks.

There are approximately 230,000 Pole Mounted Transformers connected to the network. The project team identified the requirement to access this information for pole mounted transformers. In Q2 2018 a bespoke solution for ESB Networks LV pole mounted transformers was designed and developed in-house. In August 2018 the project team installed the first prototype of this monitoring device suitable

for pole mounted transformers. A design for a three phase monitoring device was then pursued for monitoring three phase pole mount transformers.

Each monitoring device measures a multitude of network parameters and these measurements are transmitted at set intervals to the vendors own cloud platform over a cellular communications network. Each vendor has their own bespoke web application to visualize the recorded data from each measurement device installed in the field. Analysis of the data informs the planning and operations departments on any current or potential issues at the monitoring device location.

More recently, ESB Networks has deployed an IoT gateway and backend database in its cloud environment. One vendor has successfully tested the transmission of measurements from its monitoring device and storage in the ESB Networks cloud. Upcoming works will include migration of existing field devices from the vendors cloud platform into the ESB Networks cloud and develop appropriate dashboards for visualization and analytics.

FIGURE 2 - POLE MOUNTED DEVICE

LEARNINGS/BENEFITS REALISED TO DATE

There are many lessons learnt that arise from a project of this scale, these lessons will facilitate ESB Networks in understanding the future needs and requirements of the LV network.

1. The capabilities of network monitoring devices and systems are understood.
2. The cost of equipment and their value has been assessed.
3. In the future domestic properties can play a part in Demand Side Management (DSM) which will affect the LV network, having data available at the LV level will assist in DSM activities.
4. The challenges associated with the erection of the devices have been understood and a method for their erection has been issued.
5. The Power Quality of EV fast charging stations has been shown to vary with some stations causing harmonics detectible by the monitoring devices.

Sample data available from the LV network where monitoring devices have been installed.

FIGURE 3 - AVAILABLE SUBSTATION DATA

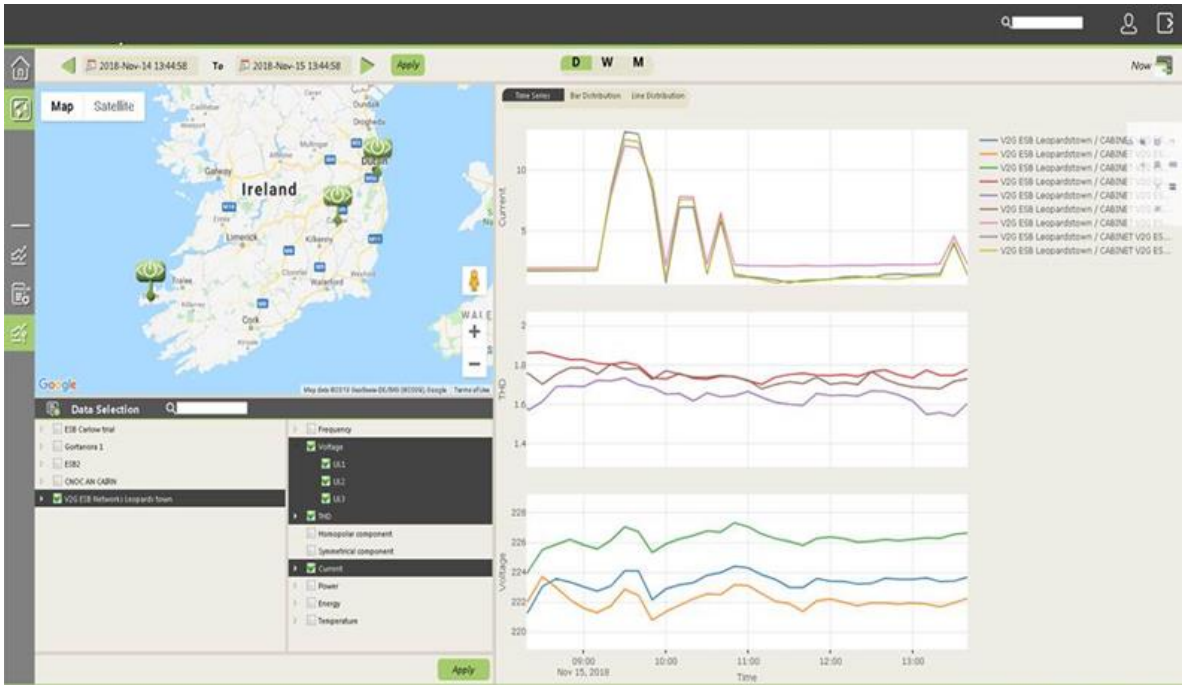

FIGURE 4 - AVAILABLE SUBSTATION DATA

NEXT STEPS

1. Provide a specification for an LV monitoring device.
2. Smart meters will assist LV customers in providing Demand Response (DR) providing a more flexible network.