NETWORKS

INNOVATION STRATEGY CLOSE-OUT REPORT

PROJECT TITLE	Real Value – Balancing Heat & Electricity Demand
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BRIEF OVERVIEW OF PROJECT & EXPECTED BENEFITS

Real Value was a Horizon 2020 European funded project, it was a 3 year project which closed out in September 2018. The project investigated the impact of controllable electric heating to provide a more flexible network and provide a solution to Demand-Side Management (DSM) at Low Voltage (LV) level and allow energy users of all kinds to act as “virtual power plants”. The project was completed in collaboration with Glen Dimplex, EirGrid, Intel, SSE, UCD and Oxford University and included physical demonstration in Ireland, Germany and Latvia where the Smart Electric Thermal Storage (SETS) units were installed into 1,250 homes. The project had several objectives, to assess the participants overall comfort, assess the difference in the older storage heaters against the new SETS and monitor the impact of controllable electrical load on the electrical grid.

- Glen Dimplex manufactured heaters, the SETS were installed into properties that had existing storage heaters. The SETS are low cost and energy efficient storage heaters, the difference in the SETS to the conventional storage heaters is that they can be controlled via a gateway.
- Intel supply a gateway which they had developed to communicate to the heaters, the heaters could be remotely switched on and off by Intel. This provided controllable load with the potential to be used for ancillary services. Controlling the heating load at mass gives the potential for it to be sold as an ancillary service in the market.
- ESB Networks (ESBN) role was to control and monitor the project objectives, this was achieved by upgrading the electrical meters in each property participating in the project to enable 24hour switching of the storage heating circuits and monitor switching trials with the aid of monitoring devices at the LV feeders. Meter exchanges were completed in over 11 town and villages throughout Ireland.

The function of the new meters was to provide ESBN the ability to remotely control the contact on the meter to initiate switching trials remotely with the aggregator, the existing analogue meters were programmed to switch the storage heating circuit on between 11pm-8am (winter) and 12am-9am (summer) and could not be remotely controlled. All trial participants had existing storage heaters installed, during the project the heaters were upgraded to the Dimplex Quantum storage heaters. The Quantum heaters are more efficient when compared to existing storage heaters, they can also be controlled via an aggregator.

The project looked at 3 main areas

- Managing load requirements with increasing load on the system,
- How to offset the peak demand
- How to give more flexibility to the grid

RESULTS

As part of the project ESBN completed 342 meter upgrades which were capable of providing additional instrumentational data locally which was compared to the data from the monitoring devices in the local substation (see figure 2). To ensure the local LV network was capable of withstanding the thermal load shifting event, the LV network was mapped (figure 1) and modelled to simulate the load shifting event.

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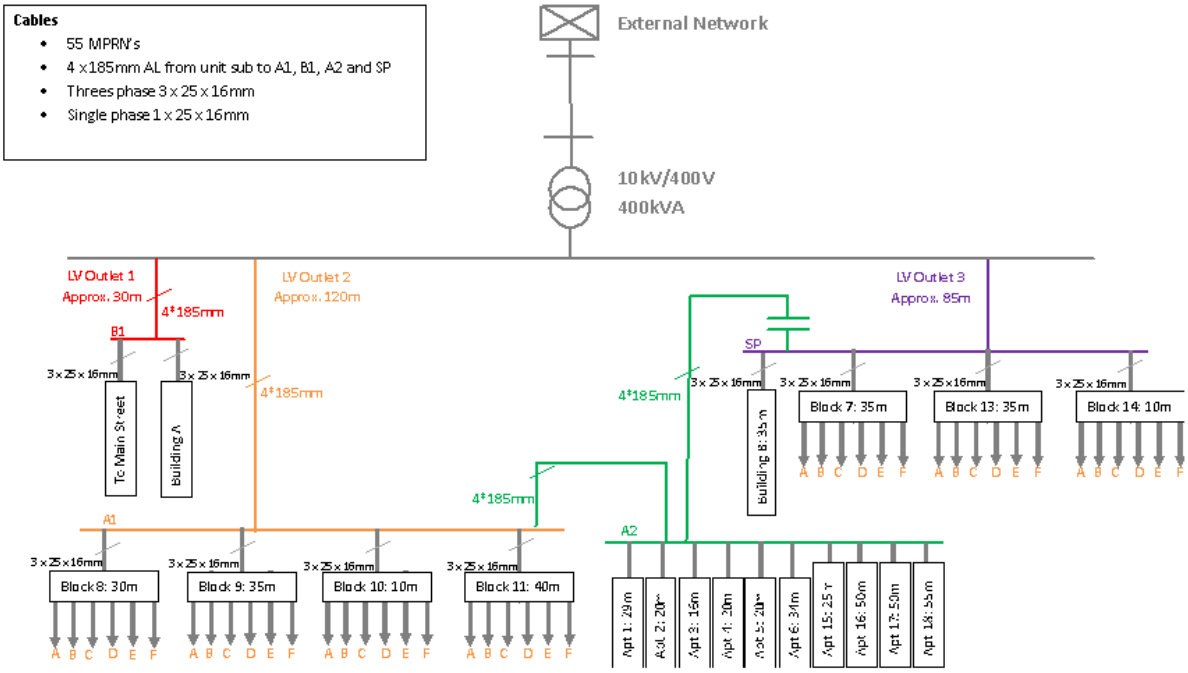

Figure 1 - LV Network Mapped

To trial the aggregator service and SETS in a controlled environment switching trials where required. ESBN identified where there was a cluster of participants on the LV network and installed monitoring devices onto the Medium Voltage/Low Voltage (MV/LV) substation to monitor the impact of the switching trial while being able to compare the data to the previous days data. The switching trials where a controlled load shifting event, typically done during the daytime to investigate the impact of the aggregator switching on all thermal load at an agreed time. The monitoring devices installed were able to provide information such as, power factor, harmonics, active power, reactive power, current and voltage. This additional data is beneficial to ESBN to understand what happens to the LV feeders if 24hour switching was a customer proposition in the future. The data from the switching trials indicated that the substations had the capacity during the day to complete the day time switching of the SETS. Figure 2 shows a substation with a monitoring device installed, the results of the switching trial on the substation are shown in figure 3 & 4.

Figure 2 - MV/LV substation with monitoring device installed

The graphs in figure 3 indicate that the current does not exceed the rated 400A per phase for any of the three outlets at any point in time. Figure 4 shows the voltage levels over the 2 week period. The voltage levels did not fluctuate beyond a value of 230V +/- 10% during the switching trial, which indicates that the switching trial did not impact the voltage supply to the area, while there was an increase in load on the circuits. This analysis and switching trials should be replicated for 24hr switching to ensure the storing of energy during the day does not cause the voltage to fluctuate beyond a critical level, particularly at peak periods for example between the hours of 5pm and 8pm when people return home from work.

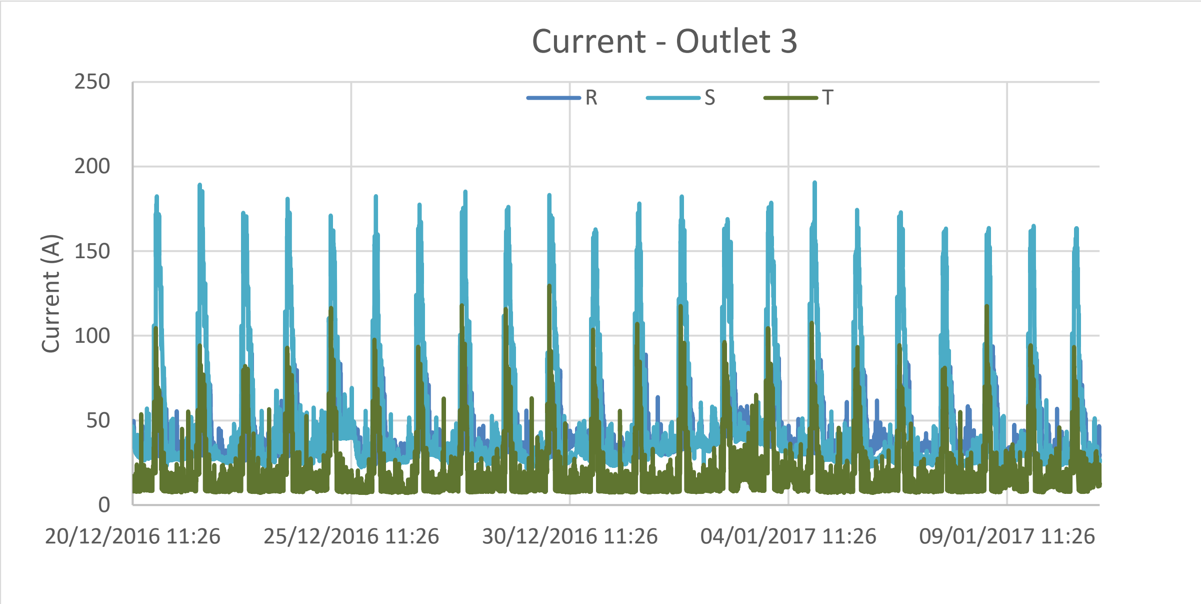

Figure 3 - Current Levels for all 3 phases of Feeder 3 (feeder 1 and 2 similar results)

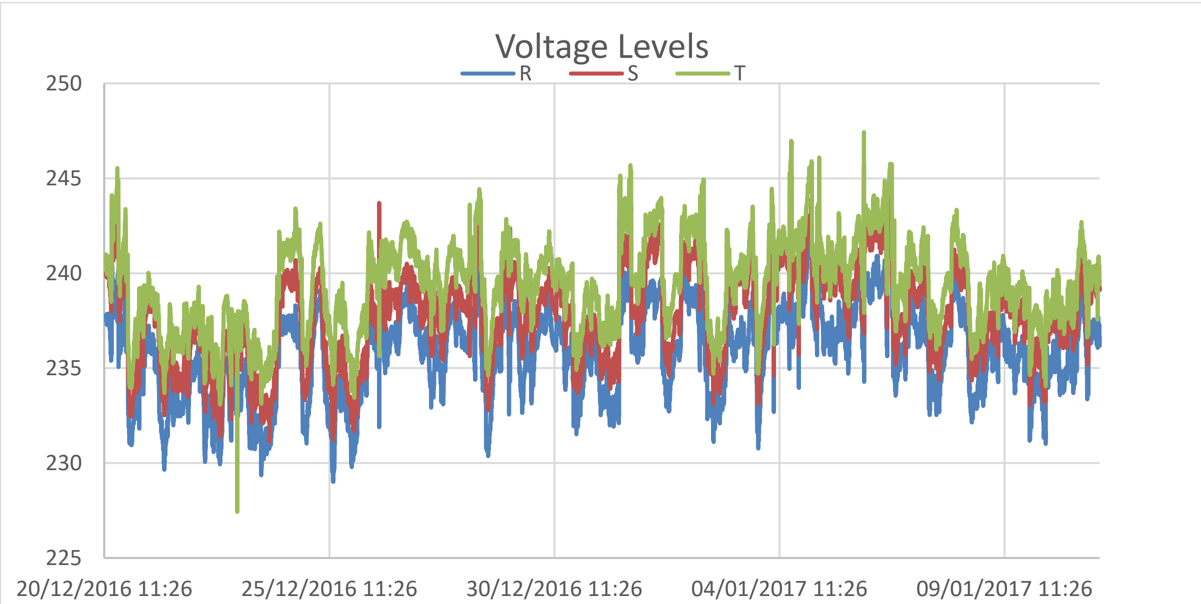

Figure 4 - Voltage levels for the Substation

LEARNINGS

ESBN has gained experience to appreciate an architecture to allow the optimal amount of customer flexibility and aggregated services on the distribution system in a fair, open and safe way. It has been instrumental to the development and appreciation of future technologies and services required by a DSO. The project highlighted a number of concerns if this type of project was rolled out nationwide. An aggregator service would have to request permission to switch load on/off due to network conditions or constraints at the time, this could be achieved by using a SERVO-type platform. The reliability of the software used to perform the commands and the ICT that are supporting these devices is extremely important to ensure the service operates without impacting the customer's needs.

Smart meters may have to be installed in all homes with storage heating to allow control over the storage heaters, the home owners comfort should never be affected due to switching load to suit network conditions. Real Value provided evidence that SETS could provide a Demand Response (DR) solution if associated with an aggregator service. Real Value had a total installed load of 4MW throughout Ireland, although widely disbursed. If a similar project proposal was offered in the future it is recommended that customers selection should be concentrated where there is a cluster of participants on the same LV network i.e. towns and cities, this would make the DR potential of such a project more attractive to the TSO and DSO.

BENEFITS REALISED/VALIDATED

Real Value has the potential to provide Flexibility to the network and increase usage of Renewable energy during low load demand.

In the UK there is a customer proposition for a project similar to Real Value, however at this stage there is no mention of controlling the heating system as a service via an aggregator.

Within Real Value the trial participants were scattered throughout Ireland, load shifting on these properties would not provide the ideal results i.e. only one house supplied from a substation. For a project similar to Real Value to be successful the proposed trial participants should be selected by area and substation they are fed from.

ESBN gathered data from the trial sites with interval meters and monitoring devices. With the information form the monitoring devices ESBN can assess the substation loading, if there is room for more connections/capacity on the transformer and whether the transformer is running efficiently.

Customer Empowerment

It gives control to the customer to monitor their heating, see their consumption and switch on their heating at specific times of the day. They can set the temperature to what they want and gives the homeowner full control of their in-home heating system.

DER & Renewables

Real Value aimed to demonstrate that DSM is a valuable opportunity in the electricity industry in enabling distribution grids to facilitate increased integration of variable renewable energy generation, whilst maintaining grid security and stability. During the project ESBN had the opportunity to have interactions with the DSM/Aggregator actors whilst safeguarding the distribution network, giving good foresight for future interactions of this type. Using the energy produced by wind turbines during times of low electrical demand to charge heaters and water cylinders, it was shown that it may be possible to reduce wind curtailment and increase the use of renewable energy on the network.

Flexibility

The inclusion of DSM has the potential for security and stability providing grid flexibility for the integration of renewables. Whilst technically possible, there remains commercial and contractual issues to be resolved before DSM can be fully implemented. For example, the DSM may require an aggregator to control customer heating systems, customers may require an incentive to sign up for such a project, market rules need to be established in agreement with the DSO/TSO.

E-Heat

The demonstrations addressed the synergies between two different energy vectors, heat and electricity, as the technology (smart electric thermal storage (SETS)) is electric heating with thermal energy storage capability.

NEXT STEPS – BAU, TRANSFER OF OWNERSHIP

Glen Dimplex have an offer in place with an energy supplier in the UK, OVO energy, where OVO customers can upgrade their heating system to the Quantum heaters at a discounted rate. ESBN will continue to explore how new flexibility market services might develop to ensure the network can support these new services.

FINAL TIMELINES (REASONS FOR ANY DELAYS IF THEY OCCURRED)

October 2016 - Project started
December 2016 - Initial installation of interval meters (phase 1)
January 2017 - Installation of monitoring devices
March 2017 - Switching trials in Limerick
November 2017 - Installation of monitoring devices
December 2017 - Switching trials in Birr
Febuary 2018 - Switching trials in Limerick
April 2018 - Switching trials in Ennis
May 2018 - Meter installation finished of interval meters (phase 2)
September 2018 - Project completed

FINAL COSTS

The overall project was valued at €12M. ESBN was granted a max of €1,715,881.25 to spend on their scope. The total expenditure came to €1,095,069 with ESBN funding €561,209, the remainder being funded by the H2020 Project.