INNOVATION STRATEGY CLOSE-OUT REPORT

PROJECT TITLE	Superhomes 2.0
PROJECT OWNER	Ronan Murphy, Electrification & Innovation Delivery, Network Assets
CONTRIBUTOR(S)	Cristian Coleman-Kenny, Tom Clancy, Jonathan Sandham
INTERNAL DOCUMENT NO	DOC-201219-FMX
VERSION	1.0
DATE OF THIS REPORT	02/12/2019
DATE PROJECT COMPLETED:	30/06/2019

BRIEF OVERVIEW OF PROJECT & EXPECTED BENEFITS

The mass adoption of eHeat is a key pillar of Ireland's national decarbonisation strategy. The installation of Air Source Heat Pump (ASHP) based technologies has traditionally been very limited in Ireland with negligible impact on the electricity networks. Understanding and predicting the impact of ASHPs on the electrical distribution network is key to enabling ESB Networks to understand and design a network capable of efficiently hosting the mass deployment of such technology.

ESB Networks engaged in the "International Energy Research Centre (IERC) Co-ordinated Superhomes 2.0 Project" with four Irish based consortium partners in order to develop an understanding of the impact on the distribution network and electrical demand in general of ASHPs in newly retrofitted residential dwellings. The project partners included the IERC, Tipperary Energy Agency (TEA), Limerick Institute of Technology (LIT) and Electric Ireland. The project installed Advanced Metering Infrastructure at 20 diverse premises located throughout the country and leveraged this technology to gain an in-depth understanding of the seasonal and climate factors that impacted these premises' energy requirements. Working with our consortium partners we combined this data with ASHP performance metrics in order to inform an understanding of the relationship between ASHP energy requirements and latent electricity demand.

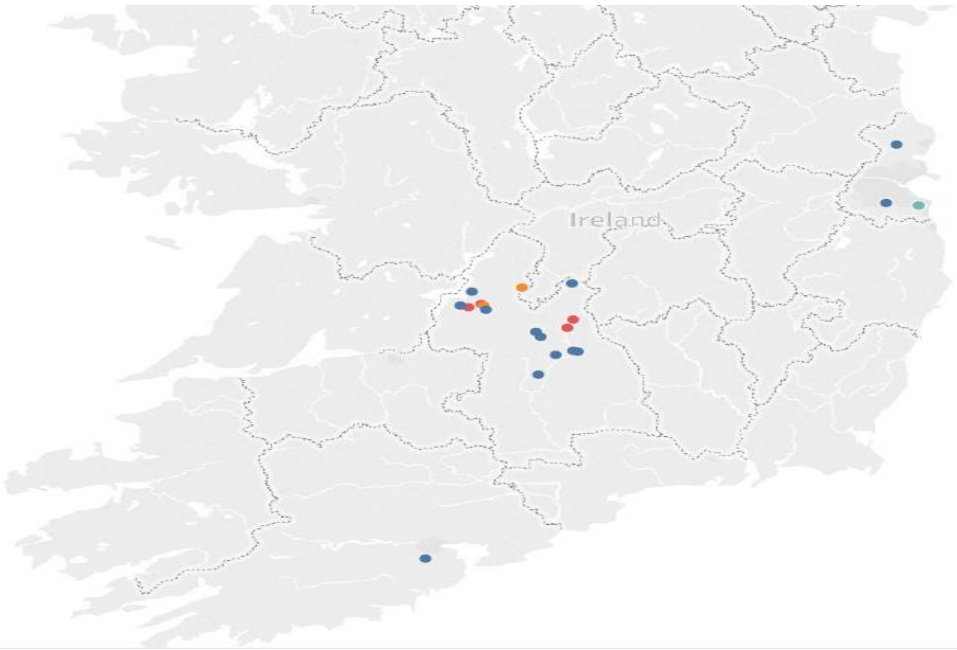

FIGURE 1:LOCATIONS OF DWELLINGS INCLUDED IN THE SUPERHOMES 2.0 PROJECT

RESULTS

The Superhomes project successfully delivered deep retrofit upgrades to the building fabric and heating systems of an array of dwellings located across the country. In monitroing the performance of these dwellings we obtained two valuable data sets;

- Energy Consumption records for each dwelling for a greater than12 month period recorded with 15 minute granularity.
- Air Source Heat Pump performance data for each installation for a greater than 12 month period with 1 minute granularity.

Working in co-operation with data science specialists, these data sets were cleansed, error checked and correlated with additional meteorological records in order to identify trends and dependencies with regard energy consumption by ASHPs. The output of this analysis is a deeper data driven understanding of the impact of eHeat installations on the distribution network, learnings which are now underpinning our plans to optimise the design and delivery of our networks to accommodate eHeat solutions.

The strong correlation between ASHP energy demand and external temperature was confirmed by the coincidence of extreme temperatures with the extremity of energy demand at the monitored dwellings (see Figure 2) and can be viewed as a trend throughout the 12-month period examined (see Figure 3).

	Coldest Day	Hottest Day
Date	1st March 2018	29th June 2018
Average Temperature (°C)	-3.34	21.77
Average Import (kW)	2.86	0.37
Average Consumption (kWh)	0.69	0.09

FIGURE 2: TEMPERATURE & ENERGY CONSUMPTION EXTREMES RECORDED DURING THE TRIAL

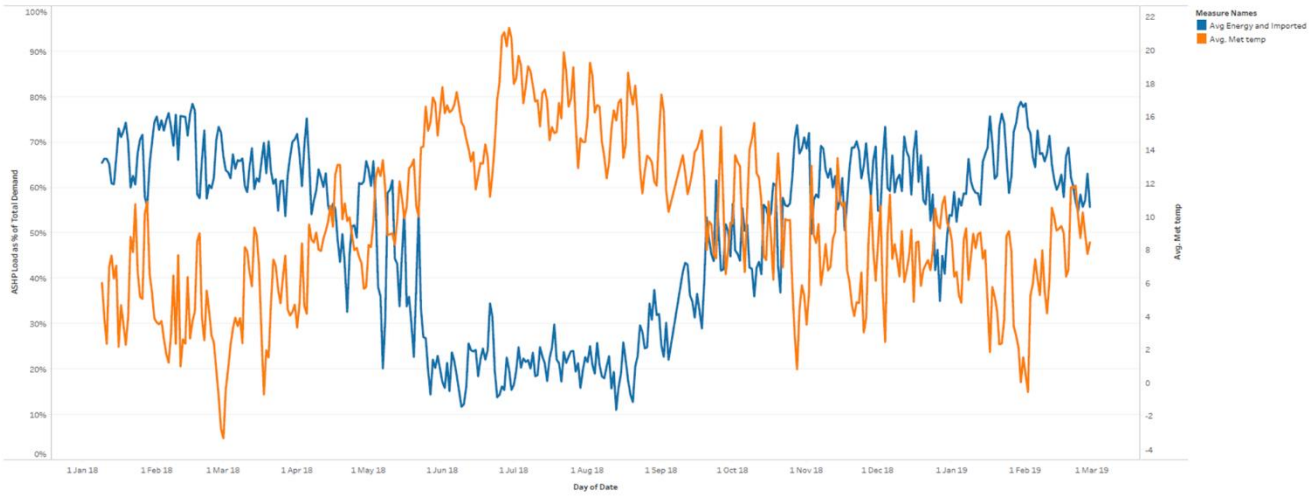

FIGURE 3: AVERAGE ELECTRICAL ENERGY IMPORTED (BLUE) VS AVERAGE METEOROLOGICAL TEMPERATURE (ORANGE) FOR THE FLEET OF SUPERHOMES OVER THE PERIOD JANUARY 2018 TO MARCH 2019.

The fact that ASHPs are the dominant source of electrical demand in dwellings equipped with ASHPs was confirmed by the seasonal variation in the percentage of electrical demand consumed by the ASHP in the monitored dwellings (see Figure 4).

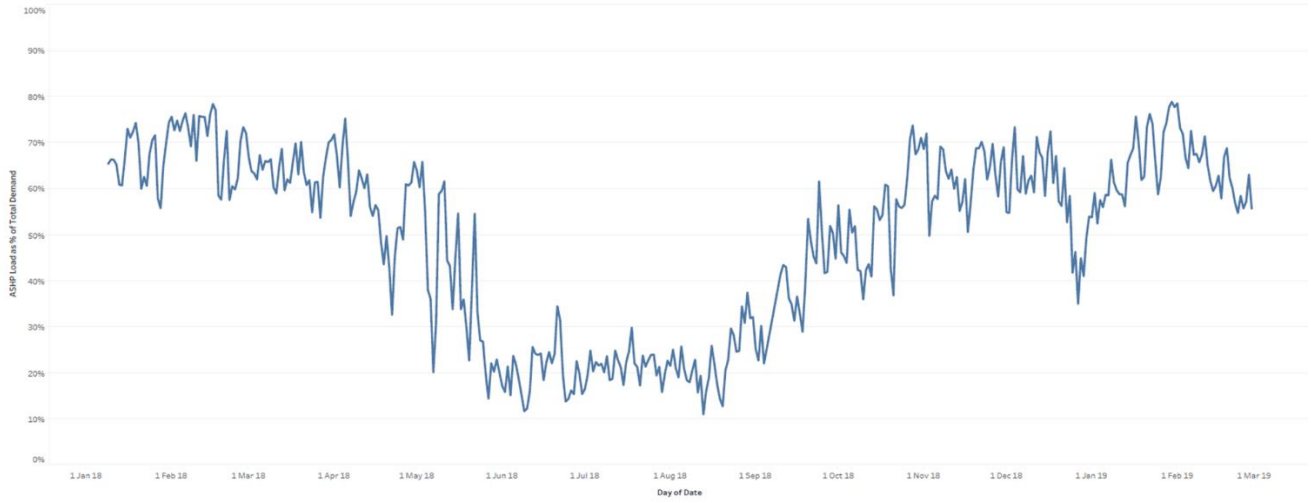

FIGURE 4: PERCENTAGE OF DOMESTIC ELECTRICAL DEMAND CONSUMED BY THE ASHP IN THE SUPERHOMES DWELLINGS IN THE PERIOD JANUARY 2018 TO MARCH 2019.

LEARNINGS

New skillsets in the fields of big data management and the use of data visualisation tools were developed within the innovation team.

In advance of the mass roll-out of Smart Metering solutions nationwide an interim technical solution for the remote data capture of metered data from AMIs had to be developed for this project. This required the manual dialling of each individual meter on a periodic basis. Such labour intensive data capture techniques will not be required in the future.

The non-universal availability of GSM based mobile data coverage resulted in data capture not being possible from one of the homes originally included in the project.

Key learnings with regard ASHP performance and it's impact on energy networks were captured in the course of the project. In addition, engagement with external project consortium partners identified opportunities for manufacturers and installers to optimise ASHP performance to reduce cycling with resultant positive implications for equipment reliability, energy consumption on distribution network performance.

The project also served to enhance relationships with external partners such as the Tipperary Energy Agency. This has resulted in additional engagement and benefit to the RESERVE project and offers to participate in further externally funded projects.

NEXT STEPS – BAU, TRANSFER OF OWNERSHIP

Sharing of the projects output with the Future Networks team in ESB Networks, assisted in informing the LV Design Standards review and contributed to the formulation of new design standards for increased After Diversity Maximum Demand (ADMD) suitable to cater for mass adoption of eHeat solutions in domestic dwellings.

The data-sets collected in this project are also informing the project 'Exploration of Air Source Heat Pumps for Ireland's Residential Heating Needs'. This project will leverage the data sets in order to develop generalisable models of ASHPs that can be used to inform future network planning and improve our understanding of the impact of large scale proliferation of ASHPs on the distribution network.

ESB Networks presented at the Superhomes 2.0 final conference in LIT Thurles in May 2019. The presentation was well received to the extent that the conference was repeated in Dublin in early June in order to engage with additional key stakeholders in the Department of Energy and SEAI.

FIGURE 5: ESB NETWORKS PRESENTED ON PROJECT LEARNINGS AT THE SUPERHOMES CONFERENCE IN LIT THURLES IN MAY 2019

FINAL TIMELINES

The project was completed in-line with its prescribed timeframe of April 2017 to May 2019.

FINAL COSTS

Cost contributions to the project were by means of Contributions-in-Kind (CIK). These equated to time and material expended on the project by ESB Networks in lieu of IERC membership fees or direct contributions towards the execution of the project. Total expended CIKs amounted to €90k.

This was higher than initially expected due to the time required by the team to establish the capability to undertake periodic manual downloads of metering data and to then perform these downloads.