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ICE PROJECT OUTPUTS DESCRIPTION

OUTPUT 3.3: ENHANCED LOW CARBON SERVICE PRODUCED

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BRETAGNE DÉVELOPPEMENT INNOVATION · SDEF · TECHNOPOLE BREST-IROISE · Technopole Quimper-Cornouaille · PÔLE MER BRETAGNE ATLANTIQUE · UNIVERSITY OF EXETER · PLYMOUTH UNIVERSITY · UEA University of East Anglia · marine

ICE report OUTPUT 3.3:
Enhanced low carbon service produced

Optimising performance of existing low carbon technologies

In 2021, the University of East Anglia announced that it will reach net zero carbon emissions by 2045. As an integral part of its existing low carbon development strategies, the University has adopted a series of low carbon technologies in its energy supply, including the installation of solar PV system, the upgrade of combined heat and power (CHP) plants, the replacement of old inefficient boilers, the adoption of a thermal heat storage system, and other smart and low carbon technologies such as the use of TermoDeck technology in buildings, and the installation of a district cooling system.

The integration of top-down and bottom-up approaches enable optimising the performance of the low carbon technologies at UEA campus. For instance, excessive heat production from the CHP plants is stored in the thermal storage system and is released when heat demand grows; the upgraded gas boilers are running at their optimal energy performance levels (60% of rated output) that relies on thermal storage system to fulfil changes in heat demand. Heat production is distributed through the heating distribution network that allows for maximum energy efficiency of both the CHP and the gas boilers. It can also be converted to cooling services with the installation of air chiller equipment. In addition, the UEA has also adopted other technologies/measures as well as engaged with staff and students in achieving its climate targets.

Enhanced low carbon service - demonstration of a smart heating system

Despite effort to upgrade its low carbon technologies with better energy efficiency and lower environmental impacts, there is still room to further improve the energy consumption performance from the demand side. The ICE project provides a demonstration of a smart heating system with aims to increase energy users' awareness of their energy consumption, change consumption behaviour through better management of heating use, maximize user comfort, improve overall energy efficiency for heating, and potentially provide a decarbonised source of flexibility in the future. The smart heating system includes specific key components, including a zoning control system, programmable thermostatic radiator valves (PTRVs), a central controller, sensors, actuators, and a wireless user interface. Detailed description of the key components can be found in Output 3.1.

The implementation of the smart heating system led to savings in gas consumption over a period of 26 weeks (see Figure 1). Better communication strategy, more intuitive settings can facilitate the higher level of participation in the future.

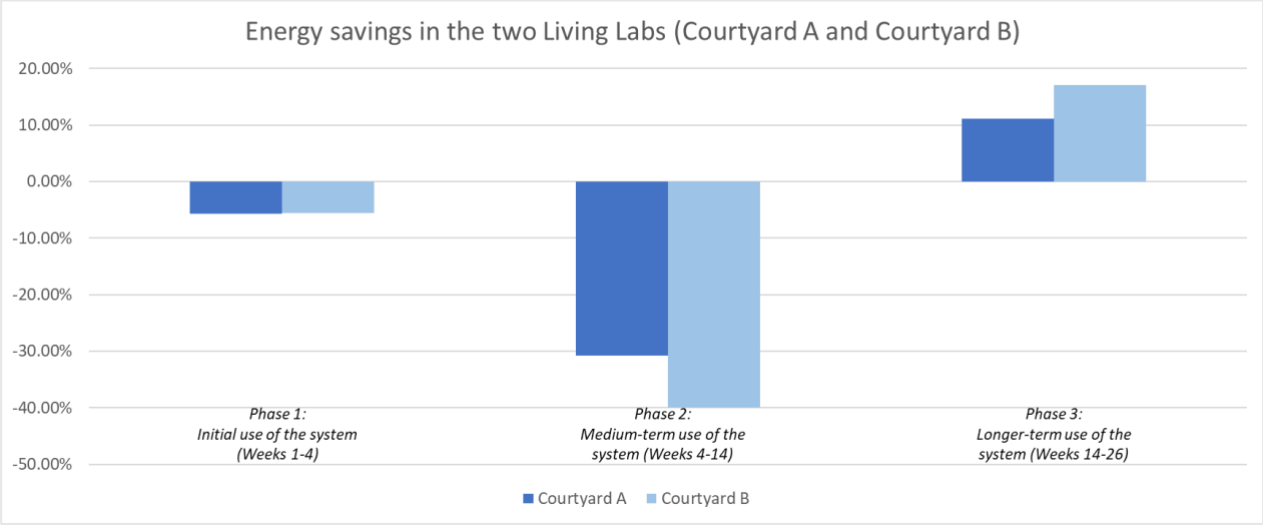

Figure 1: Energy savings in UEA's two Living Labs (compared against control flats in Courtyard A and Courtyard B respectively)

Benefits of the enhanced low carbon service

The installation and operation of the smart heating system can be an important element to the overall low carbon energy transition at UEA. There are multiple benefits that can be offered by extending the demonstration project to a large-scale deployment of the smart heating solution at UEA's residential buildings.

- **It can strengthen the user-oriented low carbon solutions at UEA.**

The installation and operation of the smart heating system can strengthen the existing user-oriented approach by extending the user group to students. Several engagement activities with students were implemented during the whole process, through focus groups, surveys and interviews. These activities are used for the evaluation of students' attitudes towards energy, the assessment of their consumption behaviour, the consultation on their opinions about the smart heating technologies, and the demonstration of the technologies. Students were well-informed about the adopted technology, their means to be involved, and possible outcomes from their participation.

- **It fits the existing low carbon energy systems and can contribute to the future low carbon development plan through flexible management of heating consumption at residential buildings.**

The University has plans to increase electricity use due to accelerated decarbonisation of power supply from the grid. Together with the proposed closure of CHP units, there are also plans to switch to heat pumps for heat supply on campus. The replacement in technology as well as the switch to electricity for heat supply will inevitably lead to higher electricity consumption from the grid. Electricity consumption in peak hours is considerably more costly than that of off-peak hours. That reflects the use of expensive fossil fuels to generate electricity when demand is very high. Typically, costs are lower when demand is covered by mostly low cost and low carbon energy technologies. If heat consumption could be better managed through the adoption of a scaled up smart heating system, it can be helpful to reduce electricity bills and most importantly consume energy when that is produced by low carbon energy technologies.

- **It provides new opportunities for energy efficiency improvement**

The smart heating system offers a novel approach to reduce emissions by improving energy efficiency through user engagement. The more granular control over heating at different time periods and with more precise temperature settings offer an effective means to increase savings in heat demand. One other important element from user participation is that it can improve the user awareness on issues related to climate change in general and transition in energy provision in particular. These are fundamental to the successful implementation of the Net Zero plan at UEA as well as the low carbon energy transition at national level.

- **It offers a cost-effective means to reduce energy consumption and emissions**

Potential scaling up of the smart heating system also offers a cost-effective way to reduce heating consumption at residential buildings. The smart heating system does not require significant spending on equipment and its operation and maintenance costs are negligible.

Future work

During the ICE project, the project team demonstrated a smart heating system at a small scale. Nevertheless, it presents a significant opportunity for a potential decarbonised demand-side solution if the technology can be deployed at large scale in many residential buildings at UEA campus. The aggregated load can be an important source of demand-side flexibility, which is necessary to both the power grid operator and the UEA energy system.

To enable the large-scale demand-side sources in the future, novel technical solutions are required. This is due to the fact that students do not pay for their energy bills therefore lacking motivation to participate in demand-side related programmes from an economic perspective. Improved automation within student-led parameters will be helpful in enabling participation and high standard of comfort without requiring consistent engagement with the technology.