Project Call for 2021 ERBE Cohort

MaREI Supervisor	Dr. Ciara Ahern Dr. Ronan Oliver
Institution	TU Dublin
Co-Supervisor & Institution (if known – please note this is not a requirement at application stage):	TBC
PhD Proposal Title:	energycloud Diverting free clean otherwise wasted renewable energy to households who need it most through innovation, research and social inclusion

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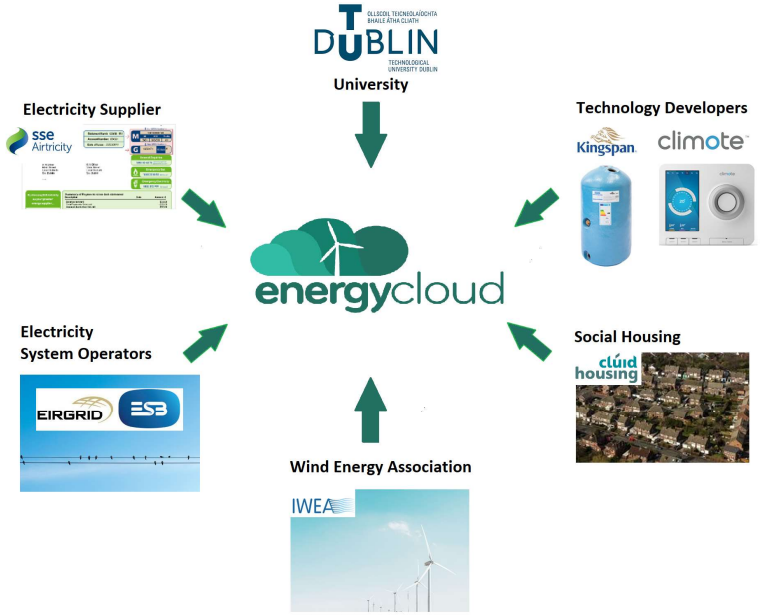
Alignment with ERBE Themes: (200 words max – please specify if the project aligns with 1 or more of the ERBE Themes)	Increased wind and solar penetration levels are resulting in electrical power systems encountering operational constraints forcing operators to accept less renewable energy than is available. In 2019 more than 710,000 MWh of clean energy was lost in Ireland - enough to power the city of Galway for a year. When wind farms are dispatched down they are replaced by fossil fuel generators and CO_2 emissions rise.  **Figure 1 Project Stakeholders** In parallel a 'silent crisis' is occurring in Ireland wherein 1 in 4 households are classified as fuel poor. A survey carried out in 2020 found that people are sacrificing food and clothing to pay for heat. Respondents reported living in one room, children and parents sleeping in the living room, continuously wrapping up in quilts during the day or staying in bed all day.

In partnership with stakeholders shown in Figure 1, this research will employ emerging smart technology (see explanatory video here) and machine learning to create a rule set for a new electricity distribution model that will enable currently wasted clean energy to be redeployed to deliver free heat to as many fuel poor homes as possible. As shown in Figure 2, this research is thus at the nexus of all 3 ERBE themes.

Interaction between dwellings and the whole electricity system to allow increase in RES-E penetration to meet climate action targets

Smart controls to enable flexible demand and increase in energy efficiency in the built environment

Delivering free clean otherwise wasted renewable energy to heat homes comfortably and cleanly, for free!

Innovative technology to divert energy to those most in need while improving the performance of the overall energy system

Figure 2 Alignment of research with ERBE themes

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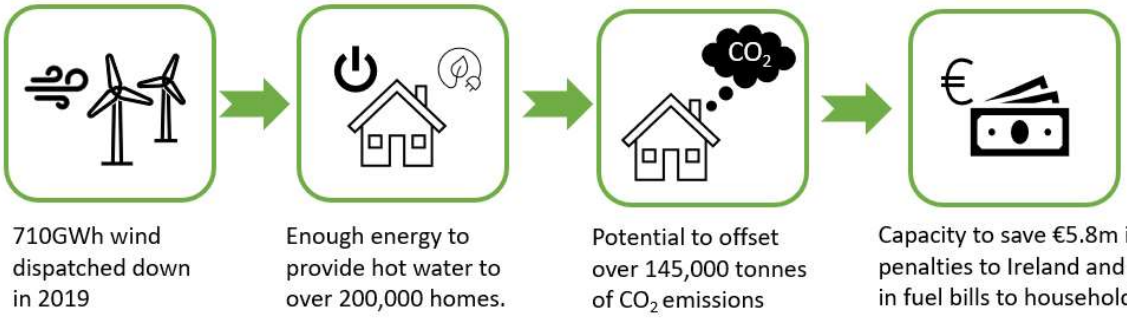
PhD Proposal Abstract: (500 words max)	~~In general, i~~Increased penetration of wind and solar energy into power systems is being sought to offset fossil fuels and decarbonise electricity generation. Ireland is a world leader in the generation of energy from onshore wind and our government has pledged to improve on this by generating 70% of electricity demand from renewable sources by 2030 (70% RES-E). As a nation we are already advancing on this target, since wind energy accounted for almost a third of Ireland's electricity in 2019 and most recent data shows that over the first five months of 2020 this rose to just over 40%. Consequently, Ireland is now the leader in Europe for the level of electricity demand met by onshore wind. However, such increases in wind and solar penetration levels is resulting in electrical power systems encountering transmission or operational constraints, forcing system operators to accept less wind or solar energy than is available. This research refers to this phenomenon as 'dispatch down' wherein renewable energy farms are instructed to reduce the amount of power they can generate – because the system is unable to cope with the large volumes of clean power available, at much cost, as illustrated in Figure 3.  **Figure 3 – Potential of Energy Cloud to offset CO_2 emissions and to fuel homes**

	Referring to Figure 3, in 2019 alone more than 710,000 MWh of clean energy was lost in Ireland - enough to power the city of Galway for a year. When wind farms are dispatched down they are replaced by fossil fuel generators and CO_2 emissions rise. In parallel a 'silent crisis' is occurring in Ireland wherein 1 in 4 households are classified as fuel poor. A survey carried out in 2020 found that people are sacrificing food and clothing to pay for heat. Respondents reported living in one room, children and parents sleeping in the living room, continuously wrapping up in quilts during the day or staying in bed all day. Energy Cloud exists first and foremost to reduce renewable energy wastage and instead divert it for social good to heat hot water *initially* in fuel poor homes. This project is partnered with ESB, EirGrid, Irish Wind Energy Association, Climote, Clúid Social Housing and Kingspan who will support this student to explore the feasibility (through modelling of ISEM with PLEXOS) of redistributing surplus renewable energy from wind and solar generators equitably to the fuel poor citizens of Ireland. The student will explore innovative and practical solutions that can be activated at a small scale in communities but scaled nationally and globally. As shown in Figure 3 – the amount of wind dispatched down in 2019 had the capacity to heat domestic hot water in 200,000 homes. Redeployment of this energy to heat hot water in homes could have displaced 145,337 tonnes of CO_2 in 2019 avoiding €5.8m in carbon penalties to Ireland and €45m in fuel bills to householders. A primary aim of this research is to establish how much of these benefits can be materialised year-on-year in the fight against climate change and fuel poverty.

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PhD Proposal Summary for inclusion in Student Call Document: (300 words max – please note the student will be indicating their order of preference for all submitted proposals; please ensure this summary includes a project overview & introduction to the supervisor & institution)	**Project Overview** Partnering with key stakeholders including: • EirGrid – electricity transmissions system operator (TSO) for Ireland, • ESB – electricity distribution system operator (DSO) for Ireland, • Irish Wind Energy Association, • Clúid Social Housing - largest housing body in Ireland, • Climote – smart heating controls developer; and • Kingspan – insulation and renewable technology manufacturer, and under the support and guidance of the centre for doctoral training in Energy Resilience and the Built Environment (ERBE), this student will lead innovation in grid flexibility and resilience through modelling the diversion of excess wind energy to heat hot water in vulnerable households employing emerging smart technology (see explanatory video here). The applicant would ideally have an electrical or building services engineering background and a familiarity with electricity marketing modelling software such as PLEXOS or similar. The research will establish a tool that would permit free electricity to be equitably distributed to fuel poor homes throughout Ireland **Supervisors** Dr. Ciara Ahern is Head of Building Engineering in TU Dublin. Dr. Ronan Oliver is a lecturer in TU Dublin, expert on heating systems fundamental to this research.

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	Technological University Dublin TU Dublin is a globally engaged, comprehensive, research-informed university. It hosts a thriving research community engaged in applying innovation and technology to solve the most pressing challenges facing business, industry and society in a dynamic environment. TU Dublin's vision is to be a leader in targeted research areas and make ground-breaking contributions to the ever-changing needs of the world's society and the economy. Our research is underpinned by an applied focus, which is enshrined in our mission as a Technological University, always keeping in mind the value and benefits of our outputs at regional, national and international levels. We continue to build on our research strengths in built environment research delivering quality research and graduating research students of the highest calibre.