Project Call for 2022 ERBE Cohort

MaREI Supervisor	Dr. Ciara Ahern; School of Mechanical and Design Engineering and Dublin Energy Lab, TU Dublin and Director of EnergyCloud
Institution	TU Dublin in partnership with 
Co-Supervisor & Institution (if known – please note this is not a requirement at application stage):	A further supervisor from a University College London or Loughborough University will be identified if application is successful
PhD Proposal Title:	**Assessment of how smart hot water controls responding to excess wind, could provide free hot water to fuel-poor households to create a flexible citizen-owned, just energy system asset**.

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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)	As shown in Fig.1, this research is at the nexus of all 3 ERBE themes. This project will assess how smart hot water controls responding to excess wind, could provide free hot water to fuel-poor households thereby creating a shared flexible citizen-owned and just energy system asset.

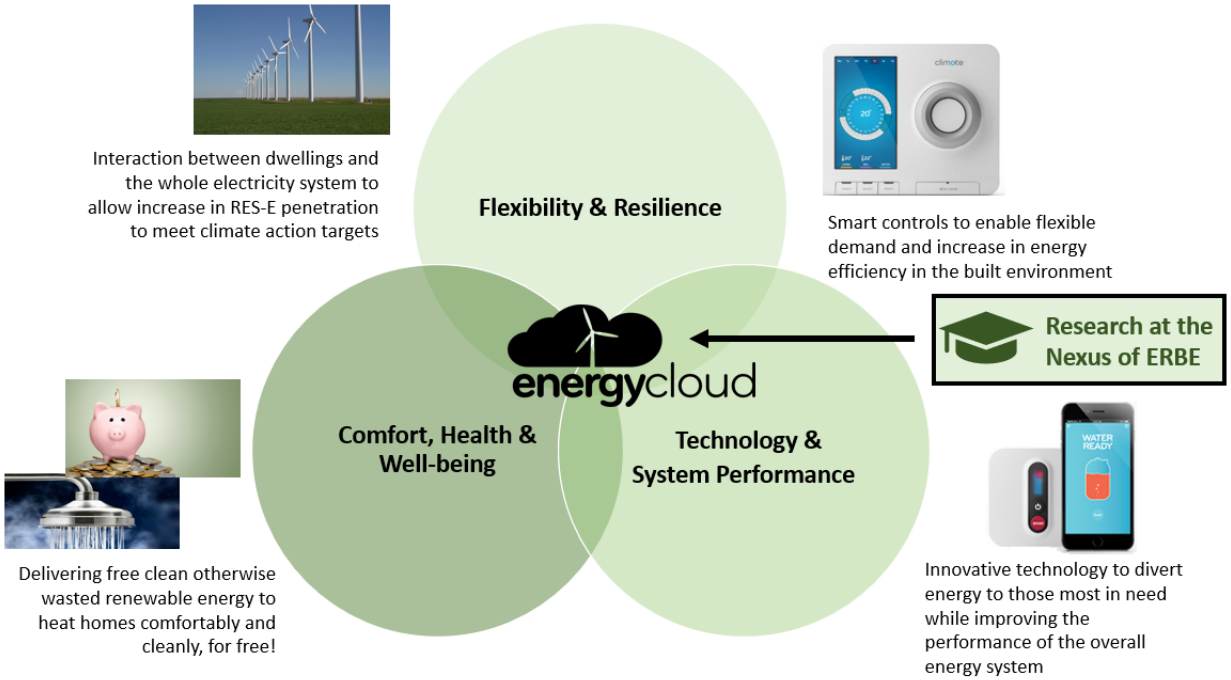

Fig.1 Alignment of research with ERBE themes

The social housing sectors in Ireland/Northern Ireland house citizens who, because they are not homeowners are at risk of being left behind in the transition to new markets for flexibility. c80% of these homes are fitted with domestic hot-water storage tanks and electric immersion heaters representing an unharnessed citizen-owned flexibility asset.

EnergyCloud[1] (see Fig.2), a non-for-profit enterprise, established in 2019 to innovate solutions to divert otherwise wasted renewable energy to Irish homes in fuel poverty has pilot studies underway. Through the lens of a just-transition, this research will leverage these studies and a developed wind energy allocation model to evaluate the value proposition of a citizen-owned wind-powered flexible electrical water heating aggregation scheme to the grid, state and to climate change objectives balanced against the benefit to the citizen/fuel-poor householder. This research aligns with climate change policy, just-transition objectives and the United Nation Sustainable Development Goals 1-11,13,14 and 17.

Figure 2 Project Stakeholders

[1] https://www.energycloud.org/

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PhD Proposal Abstract: (500 words max)	Ireland is the leader in Europe for electricity demand met by onshore wind[2], however, in 2020, c12% wind energy was rejected because there was no demand when it was available[3]. 1 in 4[4] households in Ireland went without heating at some point, with the worst affected being routinely exposed to cold, damp conditions and poor health. Investor-owned storage technologies are often cited as the solution to wind energy curtailment[5], however, citizens already share a massive unharnessed storage resource which could simultaneously make use of wind energy currently wasted and address the fuel-poverty crisis. The social housing sector houses citizens who, because they are not homeowners, and many of whom have limited access to capital, are at risk of being left behind in the transition to new markets for flexibility. c80% of homes are fitted with hot-water storage tanks and electric immersions. Our overarching objective is to **assess how smart hot water controls responding to excess wind, could provide impactful levels of 'free' hot-water to fuel-poor households to create a citizen-owned flexible energy asset.** **Objective 1** The monetary savings from wind-generated 'free' hot-water are not significant[3]. Notwithstanding, those in fuel-poverty are known to limit use of hot-water, therefore the receipt of a 'free' tank of hot-water may be a significant boon. Lone parents overwhelmingly women, and their children, are at a higher risk of fuel-poverty that all other cohorts[6,7]. It is hypothesised that the receipt of a weekly tank of hot-water could become 'bath night' for these households. Pilot studies through EnergyCloud are ongoing, householders will be interviewed to understand impactful levels of provision. The best methods of communicating (visual/SMS messages etc.)the provision will be tested.

[2] https://windenergyireland.com/latest-news/4126-ireland-now-number-one-in-the-world-for-onshore-wind-energy
[3] http://www.eirgridgroup.com/site-files/library/EirGrid/Annual-Renewable-Constraint-and-Curtailment-Report-2020.pdf
[4] R. Nestor, Social Impact Assessment - SEAI Programmes Targeting Energy Povery, in: Department of Public Expenditure and Reform, Irish Government Economic and Evaluation Service, Dublin Ireland, 2020.
[5] **Oliver and Ahern, 2022**, Utilising curtailed wind power for smart domestic hot water generation at scale – a feasibility study in Ireland, focusing on households at risk of fuel poverty, under review
[6] Saint Vincent de Paul, Growing up in the cold, a policy briefing on the nature and extent of energy poverty in households with children, in, Dublin, Ireland, 2019
[7] https://onefamily.ie/media-policy/facts-figures/

Objective 2

Through engagement with Irelands TSO, optimum levels (balanced with Objectives 1, 3 and 4) of EWH[8] aggregation to the grid will be established.

Objective 3

Creating new markets for VRE[9] facilitates greater penetration of renewables, balanced against objectives 1, 2 and 4, the CO_2 benefit of EWH aggregation will be assessed.

Objective 4

Balanced against objectives 1, 2 and 3, the value proposition of an EWH aggregation scheme to the state in meeting climate policies will be evaluated.

Objective 5

TU Dublin has developed a wind energy allocation model in excel, using data returned from pilot studies and learnings gained from realising Objectives 1-4, this model will be refined to inform the scalability of the aggregation scheme.

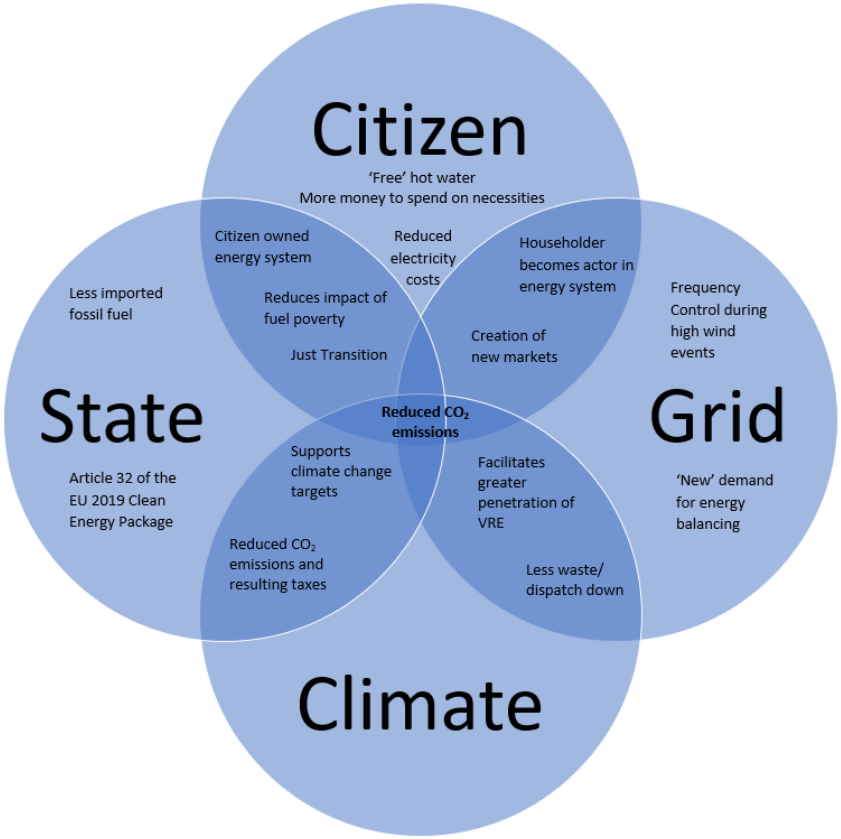

Fig. 3 Value nexus of a shared, low-cost, flexible system asset capable of eliminating wind wastage

[8] Electrical Water Heating
[9] Variable Renewable Energy

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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)	This research will evaluate the value proposition of a wind-powered electrical water heating aggregation scheme as a flexible system asset through; • refining and developing a real-time wind allocation model developed by TU Dublin using real water consumption data returned by EnergyCloud pilots, and hence • assess, through qualitative and quantitative means, the value proposition to the fuel-poor **citizen,** hence • balancing the benefit to the fuel-poor householder/citizen against the value to the: ○ **State**, in support of meeting requirements of article 32 of the EU Clean Energy Package[10] in enabling householders to become actors in the energy system, while creating a citizen owned energy system that reduces the impact of fuel poverty, enabling a just transition (making sure no one is left behind[11]) while reducing reliance on imported fossil fuel and carbon tax liabilities; ○ **Climate**, through facilitating greater penetration of variable renewable energy (through creation of new markets/demand), reducing waste and ultimately CO_2 levels; and to the ○ **Grid**, by offering grid balancing services during high wind conditions along with the creation of new markets for flexible assets. to inform climate policy decisions **Through completing this PhD, the student will gain expertise *inter alia* in, understanding and providing solutions for fuel-poverty, wind energy modelling, grid-balancing services, flexible energy markets and aggregation schemes and on evaluating competing value propositions informing climate policy decisions.** Dr. Ciara Ahern is a senior lecturer in TU Dublin, formerly Head of Building Engineering, is a member of the Dublin Energy Lab[12] and a Director of EnergyCloud. Ciara is a Funded Investigator with Science Foundation Ireland[13] and the MaREI Centre for Climate Energy & Marine. Dr Ahern is published widely[14] on building stock measures to reduce impact of climate change and is enthusiastic about applied research that can make a difference.