Project Call for 2022 ERBE Cohort

MaREI Supervisor	Dr. Dominic O' Sullivan, ERBE (MaREI) Vice Director, Director of IERG, School of Engineering
Institution	University College Cork
Co-Supervisor & Institution (if known – please note this is not a requirement at application stage):	TBC
PhD Proposal Title:	Advancing Measurement and Verification techniques (M&V 2.0) to nurture energy saving projects and ensure benefits.
Alignment with ERBE Themes: (200 words max – please specify if the project aligns with 1 or more of the ERBE Themes)	This project aligns with the ERBE theme (2) **Technology and system performance**. It will require development of the M&V 2.0 concepts which differ from traditional M&V. M&V 2.0 uses large data sets and automated advanced analytics to streamline and scale the process of measurement and verification. Such developments will require an appreciation of energy saving projects, advanced data analytics, machine learning, digital twins and intelligent efficiency. Much expertise in these areas exists within the IERG group. Through these developments in M&V practices, M&V will progress from a static, retrospective process to a more dynamic state in which energy performance can be optimised using cyber physical systems developed in the first instance for M&V activities.

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PhD Proposal Abstract: (500 words max)	As the mix of fuels satisfying the ever-growing worldwide energy demand changes, end-use energy systems are also undergoing a transition. This presents a number of challenges, which the advent of digitalisation and Industry 4.0 practices can offer solutions to. International and national energy policies demonstrate a global commitment to addressing the negative impact humans have on the environment. On the demand-side, the threat of rising energy prices, the cost benefits arising from lower consumption and public financing are driving investment in energy efficiency improvements. However, there exists a number of barriers that are preventing investments in cost-effective measures. This has resulted in an energy efficiency gap being established. Risk, uncertainty and hidden costs all contribute to this difference between the optimal and actual levels of investment in energy efficiency. With global efforts focused on closing this gap and the increased reliance on energy efficiency as a resource, the accounting system used for measuring and verifying energy savings has been brought into question. Measurement and verification (M&V) is this accounting system and it exists as a sub-sector of the energy industry. In developing solutions to close the energy efficiency gap, M&V plays a central role in overcoming the barriers to investment that exist. The advent of advanced metering infrastructure has led to vast quantities of energy data becoming available. Despite this, the typical methods employed for the performance verification of energy efficiency improvements have not progressed, as they continue to rely on expert knowledge and simplistic statistical modelling techniques. This leads to uncertainty in the quantity of savings arrived at, with this uncertainty acting as a barrier to investment in energy efficiency. In response to this, the industry is evolving towards more advanced and automated methods known as M&V 2.0. This however presents the challenge of keeping the resources required to perform M&V at a minimum level, while also improving the accuracy, reliability and trust in the process.

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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)	In 2015, industry accounted for 25.3% of total final energy consumption in the European Union (EU) [1]. The European Parliament have issued the Energy Efficiency Directive in an attempt to maximise the efficiency with which energy is consumed in industry [2]. The success of energy conservation measures (ECMs) implemented to achieve this target can only be measured using M&V. Thus, accurate M&V is a necessity for ECMs to be confidently relied upon when assessing progress towards EU targets. There are many widely recognised and well-established methodologies for the measurement and verification (M&V) of energy savings. These include the International Performance Measurement and Verification Protocol (IPMVP) [3], the American Society of Heating, Refrigerating and Air- Conditioning Engineers' (ASHRAE) Guideline 14 [4] and ISO 50015-2014 [5]. These methodologies provide guidance but lack a rigid calculation process which has been highlighted as a significant shortcoming [6]. In recent years, M&V 2.0 represents an area of significant interest and it is being used to further develop the commonly used practices. M&V 2.0 differs from traditional M&V as it uses large data sets and automated advanced analytics to streamline and scale the process [7]. This enables M&V to progress from a static, retrospective process to a more dynamic state in which savings can be maximised. **This project will exploit the potential of machine learning, data analytics and digital twins to advance and automate the M&V processes related to industrial energy saving projects.** This project will be supervised by Dr. Dominic O' Sullivan and Dr. Ken Bruton of the Intelligent Efficiency Research Group in UCC. UK co-supervisors will be appointed on success. The project will lean on existing industrial site's and established contacts for trials and demonstrations. It will benefit from the expertise within the IERG group around data analytics, machine learning, digital twins and energy efficiency.

References

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2. European Parliament and Council, Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (2012). doi:10.3000/19770677.L_2012.315.eng.
3. Efficiency Valuation Organization, Core Concepts, Tech. Rep. October, Efficiency Valuation Organization (2016). doi:10.1073/pnas.1317033110.
4. American Society of Heating Refrigerating and Air-Conditioning Engineers, Guideline 14 - Measurement of Energy, Demand, and Water Savings (2014).
5. I. O. for Standardization, ISO 50015:2014
6. S. Ginestet, D. Marchio, Retro and on-going commissioning tool applied to an existing building: Operability and results of IPMVP, Energy 35 (4) (2010) 1717–1723. doi:10.1016/j.energy.2009.12.024. URL http://www.sciencedirect.com/science/article/pii/S0360544209005441
7. J. Granderson, S. Touzani, S. Fernandes, C. Taylor, Application of automated measurement and verification to utility energy efficiency program data, Energy and Buildings 142 (2017) 191–199. doi:10.1016/j.enbuild.2017.02.040. URL http://www.sciencedirect.com/science/article/pii/S0378778817300294