DC Number	DC8
Title of the PhD Project	Advanced Control for Highly Energy-Efficient Buildings and Neighbourhoods
Keywords	Learning-based and data-driven predictive control, distributed optimisation, multi-energy networks, intelligent buildings
Recruitment organisation	University of Manchester
Supervisors names and contacts	Alessandra Parisio (UMAN) – alessandra.parisio@manchester.ac.uk
Scientific context and objectives	Operating energy systems with increased penetration of variable renewable generation cost-effectively and securely will be increasingly challenging and, in this context, the role of buildings and neighbourhoods at the distribution level is crucial. There is a growing need of non-conventional technologies that can support flexible and efficient grid operation. System Operators worldwide are increasingly aware that the number of significant losses and their absolute size will increase over the years, hence building and demand-side participation is essential for addressing this issue and bridging the gap to net zero. It is timely and essential to provide a methodology to assess the technical capability of building- and neighbourhood- demand and storage technologies to address the challenges related to the safe aggregation of a large number of simultaneous device responses and to the close coordination of the requirements of both the transmission and distribution network operators. Building upon existing expertise (e.g., [1-3]), the focus of this project is to devise and demonstrate a highly scalable learning-based distributed control framework for transforming buildings into positive energy neighbourhoods through advanced automation, which procures flexibility to support more efficient grid operation. Physics informed data-driven approached will be adopted, with consideration of the building geographical location, of the network connections and of the associated sources of uncertainty in both network and building operation, such as renewable power generation, inflexible demand and consumers' patterns. The DC will join the Department of Electrical and Electronic Engineering and work in close collaboration with other doctoral students and colleagues working on relevant projects, such as the Supergen Energy Network Impact Hub.
Required skills	• A degree in the general areas of electrical and electronic engineering, computer science and engineering, with a focus on control and automation, energy and power systems. • Sound knowledge of dynamic modelling of power and energy systems, control or optimization methods. • Proven experience in modelling and optimisation studies within Matlab or Julia/Phyton. Experience with DigSILENT/PowerFactory environments would be desirable. • Ability to effectively liaise and collaborate with multinational and multidisciplinary teams. • Ability to work independently and write high quality technical reports. • Demonstrate a flexible approach to working, with the willingness to travel and participate to the project meetings and international events. • Ability to work to deadlines and deliver high quality results on time. • Proven, high proficiency in spoken and written English.
Language requirements	To study the University of Manchester students need to meet the requirements as indicated on https://www.manchester.ac.uk/study/international/admissions/language-requirements and in particular securing an IELTS score of at least 6.5 overall with a minimum of 6.0 in each component OR securing a TOEFL iBT score of 90 with no less than 20 in each component equivalent OR equivalent. Project supervisor teams may recommend a candidate who has excellent English language skills but otherwise has not formal certification of such. Please note that a timely demonstrable minimum English language level is a requirement of the UK home office for the issue of student visas to the UK. For some projects an ATAS certificate may also be required.

This project has received funding from the European Union's
Horizon Europe Framework Programme (HORIZON) under the GA n. 101120278 - DENSE

References	[1] M. Taylor, O. Marjanovic and A. Parisio, "Decentralized Supervisory Control of Networked Multi-energy Buildings," in IEEE Transactions on Control Systems Technology, 2024 [2] Y. Xu, A. Parisio, Z. Li, Z. Dong and Z. Ding, "Optimization-based Ramping Reserve Allocation of BESS for AGC Enhancement," in IEEE Transactions on Power Systems, 2023 [3] T. Zhao, A. Parisio, J. V. Milanovic, “Distributed Control of Battery Energy Storage Systems in Distribution Networks for Voltage Regulation at Transmission-Distribution Network Interconnection Points”, Control Engineering Practice, 2022

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