Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally.

1. Paper / Proposal Title: What are Smart Grid Optimised Buildings?

2. Format:

Written paper with presentation.

3. Author(s) Name:

Andreas D. Georgakarakos [1], Martin Mayfield [2], Alex H. Buckman [3], Stephen A. Jubb [4], Craig Wootton [5]

4. University or Company Affiliation:

[1] EPSRC CDT in Energy Storage & Its Applications, University of Sheffield

[2] Department of Civil & Structural Engineering, University of Sheffield

[3] Energy Technologies Institute

[4] Department of Chemical & Biological Engineering, University of Sheffield

[5] Estates and Facilities Management, University of Sheffield

5. Abstract (300 words):

Smart Grid Optimised Building (SGOB) can be thought of as meeting its service obligations to its occupants and minimising its operational cost and footprint to its owner while actively engaging with the electricity provider, enabling in this way the best use of the available resources. SGOBs differ from Smart Buildings, regarding their aim and objectives, as their design and energy systems are optimised for the needs of the Smart Grid. Conceptually, they must have an active interaction with the energy network through responses to dynamic electricity prices and carbon emissions, similarly to Active Buildings [1]. Instead of being considered as a passive element of the energy equation like conventional buildings, SGOBs follow an original and innovative approach and have the capacity to transform to prosumers, with the deployment of on-site renewable energy sources and by participating in a 2-direction power exchange with the Network Operator.

The current literature and research have followed an ad-hoc approach by focusing on conventional strategies on existing buildings, such as increasing the building energy efficiency or reducing the current energy loads. On the other hand, SGOBs are expected to consist of several optimised design elements, including thermal mass, shape, orientation, insulation and glazing. Furthermore, SGOBs can meet their energy loads with electricity, either directly from the grid or using their incorporated energy storage systems e.g. batteries. Electricity can be stored at times of low demand when the electricity tariffs are cheaper, and used on the following day to cover part of the peak load. Another possibility includes the load-levelling service, where the building is notified by the Network Operator to maintain its consumption below a power limit for a specific time period. This paper is the first to present the concept and the philosophy on which SGOBs are based, along with initial results, demonstrating how a building can adjust its loads to reduce stress on the grid.

[1] M. B. Bulut, M. Odlare, P. Stigson, F. Wallin, and I. Vassileva, "Active buildings in smart grids - Exploring the views of the Swedish energy and buildings sectors," *Energy Build.*, vol. 117, pp. 185–198, 2016.

6. Author(s) Biography (200 words each):

Andreas D. Georgakarakos is a PhD Researcher at the University of Sheffield, currently investigating the utilisation of energy storage systems in Smart Grid Optimised Buildings. He is a member of the EPSRC-funded Energy Storage CDT and based in the Department of Civil & Structural Engineering, He received an MEng in Mechanical Engineering and one year later he graduated from Newcastle University with an MSc in Environmental Engineering (Distinction). Having acquired a broad introduction to energy issues from his previous degrees, he is extremely interested in Renewable and Sustainable Energy Technologies, as a way to promote and achieve a carbon free economy. He is an associate member of the Institution of Mechanical Engineers and a graduate member of the Energy Institute. He has been elected as Committee member and Treasurer of the

Energy Institute YPN for the Yorkshire & Humberside area, a position that holds since January 2016.

Professor Martin Mayfield is a Chartered Engineer and a member of the Institution of Mechanical Engineers. He holds the Chair of Engineering Design at the University of Sheffield after 25 years in practice. As a Director of Ove Arup and Partners Ltd, he held a portfolio including Sustainable Building Leader for the UK, Middle East and Africa, Education Leader for the UK, Middle East and Africa and Leader of the Arup office in Sheffield, leading a team of professional Engineers, working on a diverse array of projects in the UK and overseas. Within this team, he led a Built Environment Research Group, providing thought leadership to the wider group and Arup on the future of sustainable design, identifying and driving the research strategy, horizon scanning and leading the technical progression of sustainable building design and research. He has led and supported many applied research projects for major industrial clients in the field of sustainable infrastructure including projects such as the definition of a route to zero carbon for the Further Education sector, defining Scope 3 carbon footprinting for the Higher Education Sector and the design of the UK's only Hydrogen powered zero carbon building.

Dr. Alex Buckman completed his PhD in Mechanical Engineering in the area of information utilisation within Smart Buildings. He now works as a Strategy Analyst for the Energy Technologies Institute in the area of Energy Storage and Distribution. His interests are based within the area of system integration and urbanisation.

Stephen A. Jubb received the BEng (Hons) degree in electrical and electronic engineering (telecommunications) from Queen Mary College, University of London in 1987 and the MSc (Eng) degree in environmental and energy engineering from the University of Sheffield in 2013. Between these periods of study, he worked in the telecommunications industry, first for British Telecom in the UK and U.S., then Concert (an AT&T/BT global venture) and AT&T in California. His career spanned roles in operational and project management but centered on technical service support of networks provided to the organisations' largest, global customers. Since 2013, he has been pursuing a PhD in the area of Energy Storage integration in future Smart Grids also contributing to work on building and infrastructure considerations in Smart Cities and the formation of Urban Laboratories. He is a member of the Institution of Engineering and Technology, Energy Institute and Institute of Electrical and Electronic Engineers, previously sitting on the UK and Ireland regional committee of the IEEE Society for Social Implications of Technology.

Craig Wootton has a background in construction and early interest in architecture. He formally joined the industry as a consulting engineer in 1995. Collecting initial experience from design assignments across the UK, then around the world as a team leader within Ove Arup & Partners, Craig has developed a reputation for getting amongst the

technology, people and processes that make up the built environment. Recognising an opportunity to collaboratively improve and innovate, Craig currently has a strategic role at The University of Sheffield with a focus on collection, organisation, analysis and insight from the data that buildings continually collect.