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## **“Multi-Energy Systems: Modelling and assessing the Smart Grid beyond electricity”**

*Abstract.* While the Smart Grid is a key concept to move towards a sustainable power system, decarbonisation of the whole energy sector requires rethinking the role of electricity in a wider context. This refers in particular to the interaction with the heating, cooling and transport sectors (which contribute substantially to greenhouse gas emissions) on the end-use side, and with various types of fuels (and natural gas in particular) on the supply-side. In this respect, emerging concepts such as energy systems integration can increase the overall system’s economic and environmental performance from both operation and planning perspectives while maintaining the expected level of security of supply. More specifically, such a Smart Multi-Energy System thinking, which also entail Smart Buildings, Smart Communities and Smart Cities, has the potential to unlock value somehow hidden when considering only electricity and to access new forms of flexibility that may be essential in future networks. On the other hand, significant challenges also arise in terms of the complexity of modelling and then operating and planning such an integrated system.

The aim of this talk is to present some of the research activities that are going on for a few years at the University of Manchester on this topic, including: multi-energy load modelling and building energy management systems; integrated load flow analysis and multi-energy optimal power flow; flexibility assessment of integrated energy systems; operational optimization and flexible expansion planning of distributed multi-generation systems; business cases for distributed energy technologies (with focus on demand response and storage) and smart communities; city-level energy system modelling; integrated electricity and gas transmission operation; and risk and resilience assessment of future systems.

*Bio.* Pierluigi Mancarella is a Reader in Future Energy Networks in the School of Electrical and Electronic Engineering at the University of Manchester (UoM), UK.

He received his MSc and PhD degrees from the Politecnico di Torino, Italy, in 2002 and 2006, respectively, and was a Visiting Researcher at NTNU in Trondheim, Norway, in 2004, a Post-doc Research Fellow at the Politecnico di Torino in 2006 and 2007, and a research Associate at Imperial College London, UK, between 2008 and 2011. He then joined the Electrical Energy and Power Systems group at the UoM, where he has been teaching “Power System Operation and Economics” and “Smart Grids and Sustainable Electricity Systems”. After joining the UoM, Pierluigi has been a Visiting Professor at Ecole Centrale de Lille, France (June 2013, April 2014 and May 2016) and at the Universidad de Chile, Santiago (January 2015 and March 2016), and a Visiting Researcher at NREL, Colorado (August 2015). Since February 2016 he is also a Visiting Professor of Smart Energy Networks at the University of Melbourne, Australia.

Pierluigi’s areas of expertise and interests include techno-economic and environmental modelling of multi-energy systems; integration of low carbon technologies into power systems and distribution networks; planning of integrated energy infrastructure under uncertainty; business models for smart technologies; and risk and resilience assessment of future networks.

His current research team is composed of 13 PhD and post-doc researchers, working in several research projects mostly in the areas of sustainable development of smart energy systems and infrastructure planning under uncertainty, sponsored by the UK Research Councils, the European Commission, and various industrial companies.

Pierluigi is author of four books, various book chapters, and more than 200 research papers.

He is an Editor of the IEEE Transactions on Smart Grid, an Associate Editor of the International Journal of Electrical Power & Energy Systems, an Associate Editor of the IEEE Systems Journal, and the Chair of the Working Group on Energy of the IEEE European Public Policy Initiative.