Technological innovations 1

Chair

Mark de Bruijne

Presentation 1

The value(S) of thermal storage IN urban energy systems

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Decentralised heat storage infrastructure has a vital role to play in the transition to a sustainable, secure and cost-effective energy system (Lund *et al.* 2014) but deployment in UK cities has been slow to date and little is known about how systems are being used as part the transition to a sustainable energy system. Decisions made on the basis of traditional marginal economic gains over wider social and environmental values lack recognition of the complex nature of urban infrastructure systems and benefits that extend beyond climate change mitigation.

This paper applies the 'extended infrastructure business model canvas' (Foxon *et al.* 2015) to thermal storage projects in United Kingdom cities. This includes analysis of the types of business models and extent to which social, ecological, economic development, and fiscal value streams are sought. An extensive dataset on projects has been analysed through a thematic analysis of non-traditional value streams. Classification through a range of attributes, types of local actor involved, and interactions with other urban systems is used to investigate the role of thermal storage in energy system transition.

The research finds that thermal storage can support the urban energy system when combined with business models which value flexibility. The results show an important role for municipal authorities in driving innovative schemes which seek to capture the widest range of values. There is evidence that the ongoing devolution of powers from central to local government is playing an increasingly important role in the delivery of sustainable urban infrastructure. Ownership model has an impact on the range of benefits sought and whether local projects support national infrastructure priorities.

The paper makes policy recommendations that thermal energy storage is appreciated as an asset which supports the urban energy system and highlights that it can also deliver a range of social, environmental and economic benefits that should be recognised in appraising future schemes.

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Presentation 2

Looking at energy security through community lens, new perspective

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Energy Communities are key elements of the energy transition on the local level. We define a community as group of stakeholders and its associated technical energy system on the local level , that share common interest(s) or problem(s). One of the main interests that needs to be addressed in the energy related context is energy security.

The goal of this research is to understand and conceptualize energy community formation and survival. lthough there are different energy security concepts at national level for fossil fuel based, centralized energy systems, there is no specific conceptualization and definition of energy security at a community level for decentralized energy systems. Therefore, the paper focuses on the confluence of two main concepts: energy community and energy security.

Energy security is a complex concept with several dimensions and indicators. Apart from several frequent indicators such as availability and affordability which are usually present in the definitions, there is no widely accepted definition of energy security. Furthermore, as it mentioned definitions and indicators do not focus specifically on energy communities. In order to address this gap, this paper addresses the definition and different indicators of energy security at the community level.

An in-depth literature review and desk research have identified energy security indicators at the community level. Data was collected through literature review and interviews in order to understand the relation and importance of these energy security indicators. Afterwards, the definition of energy security at the community level will be developed and presented. Key words: energy security, energy community, energy transition, renewable energy technologies, decentralized energy systems

Presentation 3

PLANHEAT: mapping LowEx heating and cooling sources

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Keywords: LowEx, heating and cooling, energy potential mapping

A large share of the CO_2 exhaust in the European Union is directly related to heat and cold demand in the urban environment. The EC is therefore requiring its member states to update its energy efficiency plans every five years, the next deadline coming up in 2020. Therefore, the goal of the Horizon 2020 funded PLANHEAT project (2016-2019) is to support decarbonisation of urban heating and cooling systems by providing an open source mapping, planning and simulation toolkit for public authorities. Within this project, the authors are responsible for developing calculation algorithms to spatially quantify the heating and cooling potential of various LowEx sources (point, line or raster), using public data sources as much as possible. These sources are low temperature and sometimes fluctuating throughout the year. To this end, a generic method was developed and applied to four different categories of residual and ambient thermal sources: heat from ambient and exhaust air, residual heat from cooling processes, heat from sewage systems and heat and cold from sewage water bodies. These algorithms will be integrated into the PLANHEAT mapping module, which will be publicly available soon.

Presentation 4

A District Scheme for GHG Reductions in Urban Energy Systems: the Case for Cooling

Keywords: decarbonisation, CHP, district heating and cooling

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One of the emerging challenges for future urban energy systems in European cities is the decarbonisation of heating and cooling. Existing urban heating systems are primarily based on the direct use of fossil fuels (i.e. natural gas) accounting for 50% of total energy consumption in cities. Global decarbonisation efforts are currently following an ‘electricity first’ trajectory, concentrating on renewable energy generation. The logic underlying this approach is that once the electricity grid is decarbonised, low carbon electricity can be used to substitute for fossil fuels in other sectors, including heating and cooling.

This model, however, is challenged in several cities around the world where cooling, rather than heating, is the primary consumer of energy. Sine cooling services are primarily delivered using air conditioners and electric chillers this sector is already electrified. The growing demand for cooling, expected to overtake heating by the middle of this century, therefore, challenges the

‘electricity first’ approach due to the increasing strain on power grids during peak demand hours. How then can significant reductions in GHG be achieved in the urban cooling sector?

Our study explores an innovative scheme for sustainable energy provision in cities, based on CHP and district cooling. Using an integrated methodology based on hourly demand energy system modelling, techno-economic analysis, and a study of local energy governance and institutional frameworks, we explore a case study of two new developments currently under planning in Tel-Aviv, Israel. Our proposed scheme for these developments is based on renewable power generation from rooftop PV installations, alongside high-efficiency natural-gas powered tri-generation systems. Recycling the thermodynamic heat losses in electricity generation through absorption chillers helps meet peak thermal demand for cooling while reducing overall electricity consumption. Our results demonstrate significant reductions in GHG emissions and energy costs compared to alternative grid-based schemes.