Editorial

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Cities and the resources they consume are of paramount importance given that rapid urbanisation is taking place across the globe. Energy is one of those key resources receiving enormous attention. As a contribution towards the ongoing efforts to identify long-term solutions for the energy demands of cities, this themed issue of *Energy*, on urban transitions to fossil-fuel-free futures, brings together a diverse range of papers that share experiences about how transitions can take place from a multidimensional perspective underpinned by sound technical knowledge of integrating variable energy flow from renewable energy sources while minimising energy losses and maintaining grid stability.

The first of these contributions is the paper by Dyer and Ógmundardóttir (2018). The authors share unique experiences about the transition of two medium-sized Scandinavian cities, Sønderborg and Växjö, to becoming almost completely powered by renewable energy, leaving aside transportation. In both these cases, the driving force was not technology but instead community-inspired narratives, stretching back to the 1970s in the case of Växjö. From a series of ethnographic studies, the paper describes the main features of the different and distinct narratives developed by the people and communities of Sønderborg and Växjö from a social, political and cultural perspective. As a guide for planning and implementing future renewable urban energy initiatives, the paper sets out a framework for energy transition comprising local identity, political consensus, external partnerships, inclusive communication, local leadership and champions.

In comparison, the paper by Barragán-Escandón *et al.* (2018) presents a mathematical-based approach for selecting the most appropriate combination of renewable energy sources for cities. Using the Promethee (preference ranking organisation method for enrichment evaluation) method, the authors adapted a multiple-criteria decision analysis (MCDA) methodology that

had previously been used at a regional or national scale. The methodology compared the suitability of different renewable energy sources based on technical, economic, environmental and social criteria. The energy sources themselves comprised biomass, biogas, incineration, tidal, wind, photovoltaic (PV) and hydro. The MCAD tool was used to develop a renewable energy strategy for the South American city of Cuenca in Ecuador with the aim of reducing energy imports. In the case of Cuenca, the optimum energy solution based on high solar radiation, presence of river crossings and good waste management practices was a combination of PV, mini hydroelectric and landfill biogas.

A similar and complementary multidimensional approach is presented by Ziebell and Singh (2018). Adapting the concept of urban metabolism (UM), the authors have developed a similar large-scale approach for energy use in cities termed urban energy metabolism (UEM). The approach examines energy flows in relation to the physical infrastructures of urban systems as energy sinks as a tool for urban planners.

In comparison with the large-scale models proposed by Ziebell and Singh (2018) and Barragán-Escandón *et al.* (2018), the paper by Lühn and Geldermann (2018) focuses on the technical difficulties of integrating PVs into the energy distribution grid in Germany. The authors propose grid optimisation using battery storage systems in private households to reduce active peak power at the grid connection points. The approach is underpinned by a fuzzy control system for grid-optimisation that uses solar surplus and battery charge levels as input parameters. These parameters are standardised to allow adjustment to different plant size and storage capacity. To reduce energy losses significantly, the study showed that the ratio of the peak power of the PV plant compared to the storage capacity of the battery system must be lower than 3 kW/kWh.

Lastly, the importance of converting to renewable energy sources from oil is well illustrated in the paper by Umar (2018). The study addresses the opportunity for the Gulf state of Oman to exploit geothermal energy sources for electricity generation. The study showed that the cost of electricity generated from binary-cycle geothermal plants is comparatively low compared with other renewable energy sources. The analysis was based on data from 53 boreholes in Oman with a maximum temperature of 173°C at the petroleum development well called ‘Makarem-1’ located in northern Oman.

In summary, this themed issue highlights the need for a diverse range of perspectives to make the transition towards a low-carbon dioxide society. This involves recognising the motivational power of community narratives helped by the dual approach of large-scale energy mapping in cities coupled with technical capability to integrate variable energy flows from renewables into the energy grid.

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