Editorial

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This is the first issue of 2020 in which the Institution of Civil Engineers is introducing a minor rebranding of all its journals. At the same time, the Editorial Advisory Panel for the *Energy* journal has decided to introduce a new ‘strapline’ for the journal: ‘Transitions in the era of climate change’. This reflects the emphasis on climate change mitigation or adaptation to which I referred to in my inaugural editorial last year (Hammond, 2019). There I also stressed the so-called energy policy ‘trilemma’: reconciling the requirements for energy services that are low carbon, secure and affordable. A subsequent editorial in the August issue reflected on many of the activities and events that have taken place in the UK during 2019 (Baird, 2019). In November 2019, the World Meteorological Organisation (WMO) summarised the state of the global climate in an important publication (WMO, 2019). It observed that 2018 was the fourth warmest year on record, and that 2015–2018 were the four warmest years on record as part of a continuing long-term warming trend. Average global temperature reached approximately 1°C above pre-industrial levels. It noted that measurements of the atmospheric content of radiocarbon confirm the dominant role of fossil fuel combustion in increasing levels of atmospheric carbon dioxide (CO₂; the dominant ‘greenhouse gas’ (GHG)). Ocean heat content is currently at a record high, and extreme weather events are having significant impacts on human lives on every continent and are limiting the search for sustainable development (WMO, 2019). Global mean sea levels are continuing to rise with the extent of Arctic and Antarctic sea-ice well below average. The WMO (2019) contends that humanity is not on track to meet climate change targets, and thereby restrict atmospheric temperature increases to 1.5–2°C as agreed in the 2015 Paris Agreement (Ares and Hirst, 2015; IPCC, 2018; UN, 2015).

In the light of the climate challenge, this journal therefore encourages contributions that address energy production, storage and use in the context of a pathway towards net-zero GHG emissions in line with the 2015 Paris Agreement (Ares and Hirst, 2015; UN, 2015). The UK introduced a legally binding target for achieving net-zero (or ‘carbon neutrality’) by 2050 in June 2019, whilst a few other countries in Europe have adopted even more stringent targets of 2030 (Norway), 2035 (Finland), 2040 (Iceland) and 2045 (Sweden). However, these Nordic nations are relatively well placed in terms of

low-carbon energy resources (various combinations of biomass, hydroelectric and geothermal schemes, as well as nuclear power plants in the cases of Finland and Sweden) that make rapidly securing a net-zero target rather easier than in other countries within northern, central and southern (Mediterranean) Europe. The larger European nations, such as France, Germany, Italy, Spain and the Netherlands, have recently followed the UK example of setting a 2050 target date or supporting its introduction across the European Union. So the need to combat the ‘climate emergency’ is clear. Consequently, this journal seeks submissions that address the implications of global warming or heating resulting from the international energy sector. It will prioritise ground-breaking original journal papers, critical reviews and short briefing papers that address innovation in all aspects of energy in the context of whole-life carbon and cost reduction. Topics might include, but are not restricted to: transition pathways to a low-emissions future; sustainable energy technologies and sources; energy systems integration; energy policy; fossil fuel prospects; carbon capture, utilisation and storage (CCUS) facilities; nuclear power (including modular nuclear reactors); electricity generation and transmission; smart grids; energy storage for heat and electricity; bioenergy; offshore wind turbines and foundations; energy demand reduction, conservation, efficiency and productivity in homes, businesses, industry, transport and the electricity sector.

The present issue reflects both energy supply-side and demand-side contributions. The first paper, which focuses on the supply side, is by Xiao *et al.* (2020) based in China. It provides an analysis of the supercritical organic Rankine cycle (ORC) employed for low-grade waste heat recovery for a system using four working fluids: the refrigerants R134a (tetrafluoroethane or norflurane (CH₂FCF₃) – a hydrofluorocarbon (HFC) and haloalkane; typically used in automotive air conditioning as a replacement for the traditional ozone-depleting chlorofluorocarbons (CFCs) R12 and R22), R152a (difluoroethane (C₂H₄F₂) – commonly used in gas dusters and in many consumer aerosol products), R227ea (heptafluoropropane (C₃HF₇) – classified as an HFC aerosol propellant, but used to replace R114) and R290 (refrigerant-grade propane (C₃H₈) – used as an alternative to R404A and R407 series refrigerants). ORC systems are well suited for heat conversion technologies supplied by renewable energy resources

(Chen *et al.*, 2016; Lecompte *et al.*, 2015; Macchi and Astolfi, 2017; Quoilin *et al.*, 2013; Sun and Li, 2011; Wei *et al.*, 2007). Xiao *et al.* (2020) have evaluated the thermo-economic characteristic of a supercritical ORC for use with a power plant fuelled by low-temperature waste. They have determined the optimal combination of working fluids and process conditions, as well as the savings in petroleum and reductions in carbon dioxide emissions (found to be proportional to the temperature). Chen *et al.* (2016), in a separate study related to UK industrial applications, observed that the thermodynamic potential cannot be reached in practice, and the technical potential for energy savings is defined by the performance of available technology. Only applications of the technology that are considered economic will usually be considered for real-world installation. However, this economic potential will not be fully realised, as the actual savings that can be achieved are limited by further socio-economic barriers.

The second article in this issue is related to a demand-side issue: the determination of the optimal location of cooling and heating appliances, by Pezeshki *et al.* (2020) from Iran. They have used the Taguchi method (see Taguchi and Yokoyama, 1993) originally developed by Genichi Taguchi (a Japanese engineer and statistician (1924–2012)) to improve the quality of manufactured goods, and more recently also applied to engineering, biotechnology, marketing and advertising. It provides an extension of the technique for laying out the conditions for experiments involving multiple factors that was first proposed by an English statistician and geneticist, Sir Ronald A. Fisher (1890–1962). The method is popularly known, for example in undergraduate classes, as the ‘factorial design of experiments’. The Taguchi approach employs a special set of arrays called ‘orthogonal arrays’. The primary goal is to keep the variance in the output very low even in the presence of significant noise in the inputs. Thus, it is used to find the minimum number of experiments to be performed within the permissible limit of factors and levels to secure this goal. It has been employed in a number of building energy–environmental simulations and related applications internationally (see, for example, Bilen *et al.* (2001), Esen and Turgut (2015), Joybari *et al.* (2013), Verma and Murugesan (2014)). Pezeshki *et al.* (2020) have adapted the Taguchi method for the purposes of building energy modelling (EM) and optimisation to predict the best location for heating and cooling appliances in one of the units of the Toos Arman Star Apartment Hotel located in Mashhad, Iran. The building coordinates (X, Y, and Z) and other major factors give rise to an ‘orthogonal array’ in the Taguchi experiments. The authors have tried to maximise the satisfaction of building residents by defining a fitness function approaching the thermal comfort condition of 25°C. Thus, the experimental results identified the successful location for cooling and heating appliances compared to the initial design of the targeted room.

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