Building resilience towards a range of alternative earth futures

The devastating impacts of increasingly frequent and wide-ranging climatic events from tornadoes to hurricanes, wild floods to extreme droughts, freezing cold to extreme heat periods, melting ice and sea level rises to wildfires and deforestation have rapidly evolved the global mindset from climate change to climate crisis, and public demands for climate emergency declarations. The unprecedented level of global ‘eco-enthusiasm’, in particular among younger generations whose quality of life is most likely to be deeply affected, appear to have finally gained the desired traction among key decision makers and stakeholders.

The COP26 conference in Glasgow was the largest gathering of governments, industrial leaders and community representatives who appeared to compete in shining the light on their sustainability aspirations and firm commitments to reduce negative impacts on the environment. There was a clear and unstoppable excitement prior to this gathering, seeing this as a critical moment in history with potential to make notable changes towards a sustainable future. Undoubtedly, the long-term successes or failures of COP26 will be scrutinised and assessed in the coming weeks and months, however, a common observation among activists is that the agreements on improvement and reduction targets are not ambitious enough to address the urgent needs and investment commitments are not proportional to size of the challenges ahead. For example, the United Nations Emissions Gap Report (2021) stated that the planet was on course for a dangerous 2.7°C of global warming just before COP26. Based on new announcements made during the Conference, it is estimated that we are now on a path to between 1.8°C and 2.4°C of warming, with further agreement among signatories to revisit their commitments by the end of 2022 to ‘keep the 1.5°C ambition under the Paris Agreement alive’ (COP26 2021).

The paramount importance of the role of engineering research and innovation to achieve short-term targets (now until 2030) to build a sustainable future, encapsulated by the United Nations Sustainable Development Goals (UN-SDGS 2015), is now very well defined and understood. But, perhaps the most significant lesson from COP26 is the recognition and final acceptance of paralysing complexities in generating global, coherent and transitional strategies and plans to avoid irreversible changes in our eco-system. This highlights the importance of long-term targets (2030–2050) to become resilient towards a set of alternative ‘earth futures’ that are emerging due to the common reality of the current climate crisis. In this context the key research questions, therefore, are ‘how do we identify and define these alternative earth futures?’ and ‘what are the long-term engineering challenges in building resilience towards these futures?’.

Among the many roadmaps and scenarios that have been published, one approach is the utilisation of a two axes scenario planning methodology. This has been used for many years to improve the quality of strategic planning in various applications, and in particular to identify the critical factors that will shape our eco-system futures. Readers are referred to Rahimifard et al. (2013) for further details. The proposed critical factors in this study are firstly the severity of our negative impacts on the environment that were extensively discussed at COP26 and secondly the rapid depletion of resources which perhaps has not been deliberated to the same extent but would undeniably have immeasurable economic and socio-political consequences in the way that the global population will maintain lifestyles. Using these factors, Figure 1 depicts four possible scenarios (or futures) for the eco-system in our planet, labelled as follows:

(i) **Sustainable Planet**: in this scenario, low consumerism and significant advances in sustainable technologies have created a planet where human life can thrive under sensible climatic conditions. A circular approach to use of resources has been realised by a societal shift towards responsible and equitable consumption behaviours.

(ii) **Unsustainable Planet**: in this scenario, high consumerism and lack of investment in environmental technologies has led to difficult and complex climatic conditions in which stringent environmental regulations have created very restrictive lifestyles and a high-cost business operating environment in which access to all resources is severely limited.

(iii) **Technologically Sustained Planet**: in this scenario, our eco-system is sustained by vast technological growth and advancements, and climatic conditions are controlled by advanced but resource intensive technical solutions. Consumerism remains high, however, technological and product developments must centre on combating the effects of the climate crisis, such as the impacts of flooding, droughts, extreme heat and sea level rises.

(iv) **Socio-economically Sustained Planet**: in this scenario, lack of investment in sustainable technologies has led to the creation of localised insular communities, formed to protect their own resources and to sustain a lifestyle in which continuous financial crisis has significantly driven down consumption patterns. As consumers are more economically aware, companies require significantly more competitive products that address specific needs and enable efficient, recoverable use of resources.
The consideration of these alternative earth futures highlights a set of significantly more challenging demands for the sustainable engineering community to improve our resilience to climatic conditions that are currently not foreseen, envisaged nor could be visualised. These include designing totally novel ‘innovative products’ that meet our basic needs for food, shelter, clothing, transportation, healthcare, etc.; establishing ‘perpetual sources’ of energy and freshwater; moving away from consuming resources to ‘borrowing resources’ to satisfy our needs based on a circular approach; developing ‘foraging factories’ that are flexible to use varying waste (used resources) to make new products; implementing connected ‘resource-constrained’ supply chains that continuously adapt to market conditions and consumer needs; creating solutions to drive ‘behaviour change’ towards equitable consumption; developing tools and techniques for ‘lifelong learning and reskilling’ to react to business and societal trends and needs; and redefining engineering ethics to commit to the vision of establishing ‘one common sustainable future for all’.

The growing climate anxiety among all age groups combined with disappointment and frustration due to limited and slow progress by policy makers and industrial leaders may lead to a pessimistic daunting view that these challenges are simply insurmountable. However, the aspirational visions of ‘no one is safe until everyone is safe’ and ‘global citizenship’ which have emerged and consolidated during the pandemic as well as mobilisation of the international research and development community through seamless sharing of data and knowledge have proven the potential for incredible achievements within an astonishingly short timeframe and must renew hope in our ability to address these ‘grand challenges’.

**Operational changes for the international journal of sustainable engineering (IJSE)**

It is in this context of the urgency for immediate and wide-scale dissemination of research results that the IJSE publisher and editors have decided to adopt an ‘Open Access’ (OA) model (https://authorservices.taylorandfrancis.com/publishing-open-access/), which is increasingly demanded by funding bodies as a condition of support and by academic organisations through seamless inclusion of their staff publications within institutional repositories. The many advantages of OA include wider access to most recent research results without the need for a subscription, the dissemination of new knowledge rapidly and widely which could in turn result in more real-life impacts, trigger new research directions, and be used as an ‘open educational resource’. It could also contribute to a knowledge economy and provide a much-needed economic boost within both developed as well as developing countries.

IJSE’s publisher and editors have taken every step to ensure that Author Processing Charges (APC) do not become a prohibiting factor for publication of high-quality papers through the introduction of a very competitive pricing scheme as well as setting up an APC discount or waiver initiative (https://authorservices.taylorandfrancis.com/publishing-open-access/requesting-an-apc-waiver/). It must be noted that every IJSE submission will continue to be subject to the usual rigorous reviewing process.

**The final printed issue of IJSE**

It is with a mixed sense of nostalgia and great excitement that we publish our very last printed version of IJSE and are looking forward to the future of the Journal under the OA model. This
This sixth issue of volume 14 contains 60 papers, focusing on the impact of emerging digital technologies and Industry 4.0 standards, in particular intelligent decision support algorithms and models, to support very complex assessment and selection procedures within sustainability applications. It also includes papers on the rapidly growing area of the circular economy, in particular challenges in the management of reverse logistics, remanufacturing of products, and use of alternative sources of recycled materials in construction industry. Furthermore, several papers in this issue focus on decarbonisation of energy and water sources as well as practical implications of wide scale adoption of electrical vehicles and use of biofuels from renewable sources to improve long-term sustainability of transportation.

**Disclosure statement**

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