

WORLD ENGINEERING DAY 2021:

DEVELOPING ENGINEERING FOR SUSTAINABLE DEVELOPMENT AND A LOW-CARBON ECONOMY

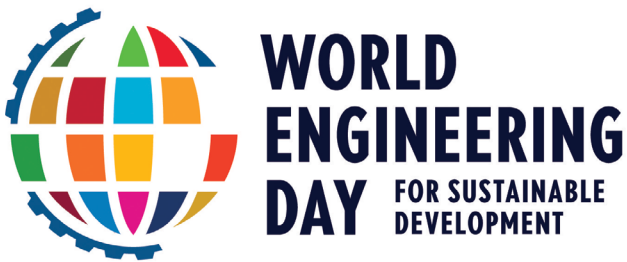
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Some of the strategies formulated to address climate change are presented against a background of the urgent need to take action.

Introduction



WED Logo. The occasion was formally proclaimed by the UNESCO General Conference at its 40th session in November 2019.

The World Engineering Day for Sustainable Development is celebrated worldwide on 4 March every year. As an Engineering Professor and Chair of Sustainable Manufacturing TC at The Institution of Engineers, Singapore (IES), it is my privilege and honour to pen my thoughts on further development of the engineering field for sustainable development as well as for transitioning of the world's linear economies into circular economies or low-carbon economies (Lerwen and Seeram Ramakrishna, 2021).

This is in line with the chosen theme of World Engineering Day 2021 (WED2021) - 'Engineering for A Healthy Planet', which recognises the efforts of engineers and the necessity of diverting such efforts towards sustainable development.

Recent surveys elicit perceptions such as green washing by businesses, companies and governments; embellishment by companies and organisations of environmental, social and governance (ESG) reports; Exclusion of sustainability considerations by engineers, designers and innovators while generating solutions, services and products for the market; sinister business practices known as designed and predetermined

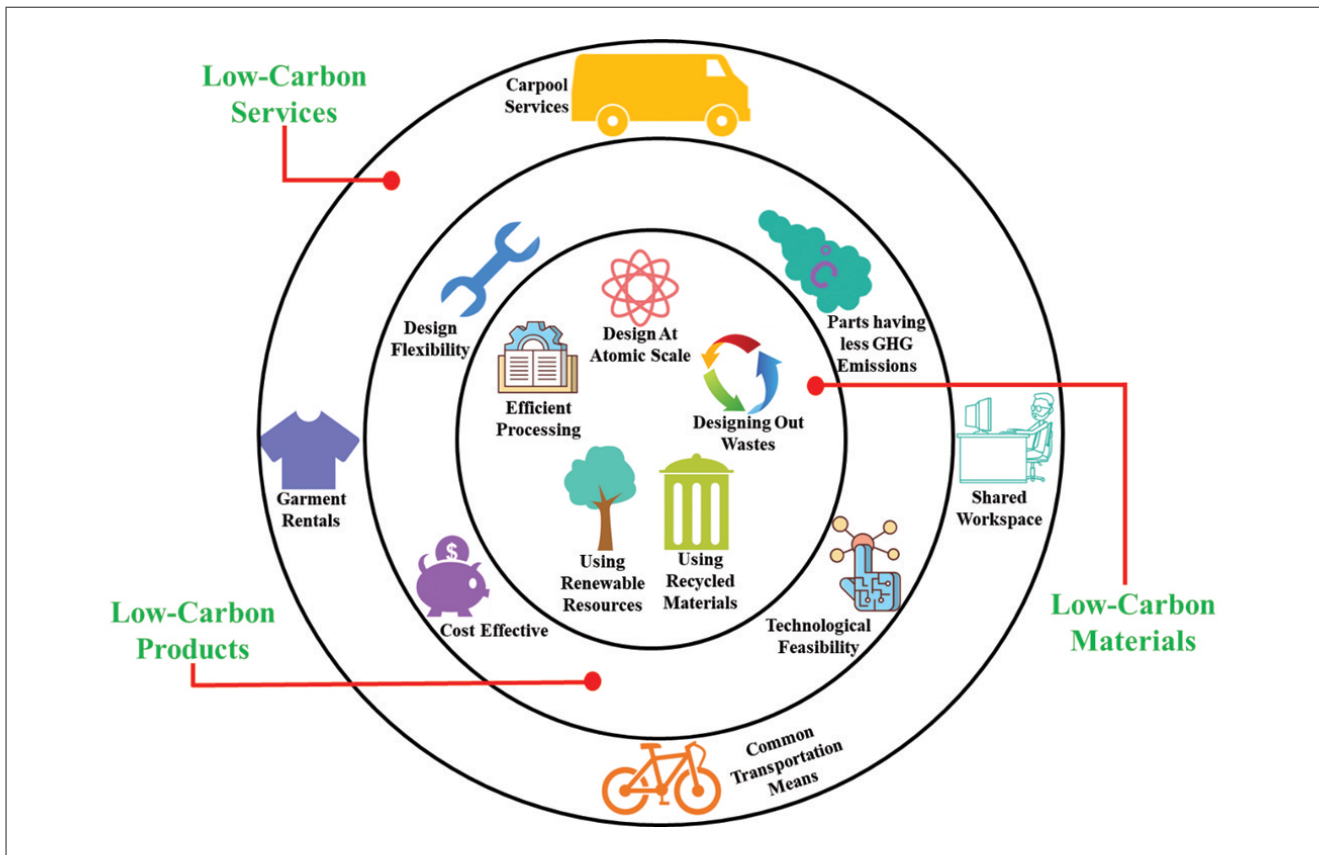


Human activities have caused undue stress on the environment. Image: PIXNIO.

obsolescence; the perception that sustainability considerations lead to increased business costs; and prioritising by human beings of convenience and consumerism over sustainability, thus leading to resources depletion and adversely impacting the environment.

For example, according to an estimate, the global human-made mass now exceeds the total biomass on Planet Earth (Ihacham et al, 2020). In other words, excessive human activities have caused undue stress on the Earth's environment and ecosystem. They underscore the importance of reimagining all human actions with responsibility to the Earth and all its beings. This includes reimagining all products and services through the lens of sustainability.

Recognising that human behaviour can be tuned, by inculcating values and habits in human beings at a younger age, more than 7,000 higher and further education institutions from around the world declared a



Sustainable practices cut across all sectors of society and the development of solutions involves integrating knowledge and systems from multiple disciplines. Image: Professor Seeram Ramakrishna.

climate emergency in 2019, and pledged to implement the following three-point plan (UN Environment, 2021):

- Firstly, committing to going carbon-neutral by 2030, or 2050 at the very latest.
- Secondly, mobilising more resources for action-oriented climate change research and skills creation.
- Thirdly, increasing the delivery of environmental and sustainability education across curricula as well as campus and community outreach programmes.

It is to be noted that innovative engineering and technology solutions are just as important, as changing human behaviour, in ensuring a healthy planet.

Hence, the estimated more than 25 million engineers around the world are critical for achieving the UN Sustainable Development Goals (SDGs). Moreover, they need to embrace the culture and mind-set of developing and implementing sustainability solutions ubiquitously so as to mitigate and adapt to climate change and its outcomes of extreme weather events such as floods, forest fires, drought, rising temperatures, rising sea levels and erratic seasons.

In addition, engineers should team up with other stakeholders to make low-carbon products and services, as the 'new normal'.

Sustainability cuts across all sectors of society. Scientific research and adequate prior preparations

have shown how the detrimental consequences of extreme weather and climate change can be avoided. It is to be recognised that generating sustainability solutions requires interdisciplinary, transdisciplinary, multidisciplinary, cross-disciplinary and co-production approaches, instead of the current practice of mono-disciplinary pursuits (Elena Rodriguez-Falcon, 2021; Jose and Ramakrishna, 2021; Norström et al, 2021). In addition, engineering education should provide deeper hands-on experience in doing the actual projects with sustainability considerations as opposed to students merely listening to lectures and reading text books. It is also important to infuse ethics and humanities into the engineering projects and education.

UN Sustainable Development Goal, SDG 11, is about sustainable cities and communities. About half of the world's population now lives in cities, and by 2050, nearly two-thirds of all humans are projected to live in cities. Cities contribute about 80% of the global GDP. They are responsible for 70% of global carbon emissions and energy consumption. Hence sustainable development cannot be realised without paying significant attention to urban communities (UNDP, 2021).

Comprehensive actions by all the stakeholders in cities are necessary for transitioning to sustainable cities and communities. Examples are helpful to convince the climate-risk sceptics who are reluctant to make difficult ecological choices.

Hence, let us take the example of Singapore, which is an island city-state with minimal agriculture and home to more than 5.7 million residents (Ghomi et al, 2021).

Singapore

Singapore is among the world's leading places in terms of the healthy life-span, per capita income, PISA (Program for International Student Assessment) Score coordinated by OECD (Organization for Economic Cooperation and Development), location of world-class universities, number of researchers per million population, internet speed, economic competitiveness, innovation index, entrepreneurial index, employment rate (low unemployment), density of greenery, modern sanitation (covers 100% of the population), and collection & treatment of waste water (100%).

As a signatory of the Paris Agreement, Singapore has adopted a range of strategies to reduce carbon emissions across all sectors of the economy, which include the following:

- Improving energy efficiency.
- Reducing carbon emissions from power generation.
- Developing and deploying cutting-edge low-carbon technologies.
- Collective action by government agencies, individuals, businesses and the community.

In addition, the 'smart nation' programme is aimed at universal access to secure and high-speed information and communication technologies.

Not satisfied with its own progress and with deep understanding of diverse climate risks which include rising sea levels and temperatures, on 10 February 2021, Singapore responded with the Singapore Green Plan 2030, to recover from the fallout of COVID-19 and to chart an even more sustainable future.

Five key pillars of the proposed green plan are:

- City in Nature - Increase the nature parks' land area by over 50% from the 2020 baseline.
- Sustainable Living- Reduce waste sent to the landfill per capita per day by 30%, by 2030. At least one in five schools to be carbon-neutral by 2030, and the rest to follow thereafter. Infrastructure to facilitate less carbon-intensive mobility of people. In other words, developing sustainable, resilient and inclusive infrastructures.
- Energy Reset - Increase use of solar energy five-fold by 2030. Power all water treatment systems with solar energy, by 2021, while reducing the energy consumption of desalination. Diversify electricity supply with clean electricity imports. Green 80% of Singapore's buildings, by 2030. All new car registrations to be cleaner-energy models, by 2030, as determined by the life cycle sustainability analysis.
- Green Economy - Transform the petrochemical complex into a sustainable energy and chemicals park, by 2030, so as to align and upgrade the industrial value

chain and infrastructures for sustainability. Make industrial production processes and energy usage greener and improve energy & resources efficiency. In other words, promote sustainable and inclusive industrialisation. Singapore to be a carbon services hub and a leading centre for green finance and sustainability-themed securities in Asia, which increases availability and access to financial services and markets. This also facilitates sustainable infrastructure development for developing countries.

- Resilient Future - Complete formulation of engineering design and implementation plans for coastal adaptation to mitigate rising sea levels, by 2030. Mitigation targets against the urban heat island effect to be determined from studies. Meet 30% of Singapore food and nutritional needs through locally produced food. It is a sustainable solution to overcome broken supply chains caused by the COVID-19 measures of countries.

In other words, Singapore is seeking to harness sustainability and a low-carbon economy as a competitive advantage in the years ahead.

Green Singapore will lead the way for new life styles.

Future directions for the world

According to a survey, consumer attitudes are changing and more than 70% of global consumers say that they would definitely or probably change their habits to reduce their impact on the environment (Nielsen Report, 2020). ESG-rated companies recorded better performance than the average S&P 500 company.

Building on this backdrop, engineering research and innovation efforts are to be aimed at low-carbon alternatives so as to help companies to upgrade industrial technologies with better sustainability credentials and adopt sustainable practices. Such efforts will boost local technology expertise as well as industrial diversification.

This includes developing new sustainability solutions for packaging, low-carbon design of products & services, materials selection & substitution with renewables, waste management (reduction, refurbishment, reuse, recycling, upcycling, remanufacturing, recovery of resources & valorisation), urban farming, and conservation of resources.

New technologies, such as carbon capture, utilisation and storage as well as low-carbon hydrogen, are to be test bedded and scaled up. Many governments have taken a simplified approach of advocating electric vehicles (EVs) as an expedient green transport policy. It is important to conduct a systematic and transparent life cycle sustainability analysis so as to determine which transport vehicles are truly cleaner and greener models. Design thinking for sustainability should pervade all products, services and businesses.

In other words, design thinking should be embraced, with end-of-life management in mind and to ensure durability and ease of maintenance & repair.

Moreover, engineering solutions are essential to progress the UN SDGs with the aim of:

- Providing clean water, clean energy, clean air and nutritional food for all humans.
- Designing, developing and deploying resilient infrastructure to mitigate extreme weather events and climate change.
- Implementing sustainable economic development infrastructures such as transportation systems, dams, waste management, water supply and sanitation, power supply and digital networks, in all countries.

Epilogue

In a hard way, various governments around the world have realised that they cannot eradicate the COVID-19 pandemic by just eliminating it in their respective countries. Each and every country needs to work in concert with others to eradicate the disease. Likewise, climate change and environmental degradation are concerns for everyone, which need to be mitigated at the very source as well as globally.

COVID-19 is an acute problem. Human beings engineered vaccines within nine months, by employing science and technology advances. Climate change and environmental degradation are problems accumulated over years. Hence, much more sustained efforts have to be made by all nations while harnessing the science, engineering and technology.

The ongoing COVID-19 crisis reinforces the critical importance of adequate prior preparations for effectively dealing with the challenges. Among them is the impact of climate change on life on Planet Earth, and no country is capable of mitigating climate risks alone. Such aspects have been overlooked by all countries regardless of their stage of development. Henceforth, all countries have to sincerely embrace sustainability and a low-carbon economy or circular economy agenda, while cooperating with each other. All countries need to progress on the SDGs for a more prosperous, equitable and resilient future, for all, and to engineer a healthy planet.

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