

Guest Editorial

Innovation in the Manufacturing Sector: The Catalyst for a Decarbonised Future

NON-PEER REVIEWED FEATURE

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The imperative and urgency of the message is clear. We need to act now to avert the worst effects of the very real climate crisis tragedy looming on the horizon. The effects of climate change are becoming more ubiquitous, with heatwaves, wildfires, droughts and floods becoming more frequent. Even during the unprecedented COVID-19 pandemic, the climate crisis did not stop. In October 2020, the International Monetary Fund (IMF) stated a clear message: even in the midst of the COVID-19 crisis, we should mobilise to prevent the climate crisis. The negative impacts caused by climate change could be the equivalent of a pandemic crisis every year from the middle of the 21st century.

We have known about global warming since Fourier's work in the 1820s establishing that the Earth's temperature was much higher than if warmed by only incoming solar radiation. And yet we have failed to manage the climate crisis this far. The message started to reach the status of a major public issue in 1988, when *Newsweek* magazine made 'The Greenhouse Effect' its cover story. Later on that year, the United Nations General Assembly endorsed the Intergovernmental Panel on Climate Change (IPCC) to provide scientific evidence of climate change. But it was not until the Paris Agreement in 2015 that a legally binding international treaty on climate change was put in place.

The Transition to Net Zero

In 2019, the UK became the first major economy to pass net zero emissions legislation and we now have more than 70 countries, including the biggest emitters (China, the USA and the European Union countries) that have set a net

zero target, covering around 80% of global emissions. Moreover, to keep global warming below 1.5°C, as set out in the Paris Agreement, we need to reduce emissions globally by 45% by 2030. With less than 90 months left to meet this world target, we are currently not on the path to delivering our net zero ambition. To achieve a timely and just energy transition, we need to step up the pace and scale of decarbonisation. The 2020s are a critical decade of action for developing and deploying decarbonisation solutions. The 2020s are also a decade to untap the opportunities of the energy transition. For example, decarbonising power, road transport, steel, hydrogen and agriculture would increase world gross domestic product (GDP) by 4% in 2030 compared to inaction (1).

Inevitably, the transition to net zero is particularly challenging for energy-intensive and hard-to-decarbonise sectors. Industry plays an essential role in society with the chemical sector alone consuming globally 28% of industrial energy (fossil fuels providing 58% of carbon feedstock and 42% to generate process energy), and by 2030 it could become the single largest driver of global oil consumption (2). The transition of this sector is therefore crucial to achieving net zero targets. However, decarbonising industry is not only complicated by the long lifespans of industrial sites infrastructure, but also requires a two-fold transition away from fossil fuels to low-carbon energy sources (for example, renewables, hydrogen or bioenergy) as well as from carbon feedstocks. Moreover, the chemical sector plays an important role in delivering net zero, for example manufacturing catalysts for hydrogen production or coatings for solar panels. For every tonne of CO₂ equivalent (CO₂e) emitted from chemical production in 2005, the sector's products saved 2 tonnes of CO₂e (3). Therefore, innovation in the chemical sector will be a key enabler to accelerate the pace of the transition.

The UK was the first country to publish an Industrial Decarbonisation Strategy in 2021, with industrial emitters responsible for about 16% of the UK's CO₂ emissions, but also contributing to ~9% of GDP and providing 2.6 million direct jobs. The first steps of this strategy are focused on the decarbonisation of industrial clusters. Over 50% of UK industrial emissions come from regions where energy-intensive industries such as chemicals manufacturing, oil refining and cement and steel production are co-located, providing 1.5 million jobs and export goods and services worth £320 billion, but also presenting opportunities for developing a wide range of decarbonisation solutions. The UK Industrial Decarbonisation Research and Innovation Centre (IDRIC) (4), funded by UK Research and Innovation (UKRI), supports this strategy to transform the UK's major industrial clusters (Grangemouth, Teesside, Humberside, Southampton, South Wales, North West England and Black Country) into world-leading, low-carbon manufacturing hubs, including the world's first net zero carbon industrial cluster by 2040. Green skills are essential to make this transition a reality and by attracting inward investment, these clusters will protect and create new jobs, with estimates of around 2 million green jobs by 2030.

Critical Role of Innovation

Innovation was key in emerging from the COVID-19 crisis, including novel vaccines as well as innovative technologies that enabled new ways of working and doing business. Innovation is also our best weapon to fight the climate crisis. In these unprecedented and rapidly changing times, the global impact of our research and innovation is needed more than ever. Indeed, half of the global emissions cuts needed to meet our climate targets will require technologies that are still at the demonstration or prototype phase or not yet fully commercially available (5).

Addressing urgent innovation needs is IDRIC's main mission. Our joint industry, government and academic-led research and innovation programme not only includes technology development projects aiming to reduce the costs, risks and timelines of technologies like carbon capture, utilisation and storage (CCUS) and hydrogen, but also design tools and digital models which help industry clusters make the right decisions, including open source techno-economic and environmental assessment tools. Beyond technological innovation, many of our projects focus on unlocking social barriers, developing financial models and bridging skills gaps.

The centre has established close collaborations between academia, industry and government to create opportunities for collaboration, sharing of best practice and knowledge exchange which are key for unlocking the wider economic and social benefits of industrial decarbonisation.

Finally, decarbonisation solutions also require supportive policy and regulatory frameworks (6), so it is vital that we continue the dialogue not just across the industrial decarbonisation community, but also keep abreast of policy developments, and conversely, inform policymaking using evidence.

Decarbonising industry is a global effort, and we all have a part to play. Research, innovation and industrial communities need to work together to implement world-leading innovation which will catalyse the competitiveness of our manufacturing sector and meet our decarbonisation goals for a sustainable future.

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M. MAROTO-VALER

Director and Champion, UK Industrial Decarbonisation Research and Innovation Centre (IDRIC), Heriot-Watt University, Edinburgh, EH14 4AS, UK

Email: M.Maroto-Valer@hw.ac.uk