

TRENDS

Rethinking Current Practices to Enable a Sustainable Future

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Mary is the Co-Director of the Hitachi and Imperial Centre for Decarbonisation and Natural Climate Solutions. At Imperial, she is Professor of Materials Science and Nanotechnology and leads a large interdisciplinary group focused on understanding nanoscale materials, and nanoscale interfaces in and between materials and their environments. She has a particular interest in the development of operando approaches and has pioneered nanoscale methods in synchrotron science. She was elected Fellow of the Royal Academy of Engineering in 2015 and is a Fellow IoM3 and of the Institute of Corrosion. She is also Armourers and Brasiers' Chair for Materials Science and holds a CBE for her career-long contributions in this field.

The UK's Action on Decarbonization

Many countries and regions have declared their intention to reach zero carbon or carbon neutrality by 2050 or 2060. Meanwhile, environmental problems have been a longstanding concern for the nations of Europe, with specific policies and schemes for investment in carbon neutrality making the region a leader in global decarbonization. What are the key considerations when it comes to achieving carbon neutrality? Also, as an island nation in Europe, can you talk about what the UK, in particular, is doing?

The European nations are indeed taking practical action on carbon neutrality, having adopted a variety of policies and regulations aimed at achieving this ambitious goal. Unfortunately, the path to carbon neutrality by 2050 is complex and there is no “one size fits all.” Different countries are pursuing drastically different strategies. Germany, for example, has put a lot of effort into solar power whereas in France there is a longstanding commitment to nuclear power. As an island nation, the UK is making use of offshore wind power generation. Offshore wind has expanded considerably over the past decade, to the extent that it often now accounts for as much as 50% of the total electric

power supplied to the UK grid. While this represents major progress, it is still not enough to get us to carbon neutrality. More action is needed.

While nuclear energy currently supplies approximately 15% of the electric power to the UK grid, our existing nuclear plants are reaching the end of life and it remains a subject of much debate whether the construction of new plants is needed to maintain the security of energy supplies. Another key issue is that major upgrades to the electricity distribution (grid) infrastructure will be needed if we are to transition to 100% renewable energy. Imperial College London is working as part of the Global Power Systems Transformation Consortium* on this.

MISSION ZERO—Independent Review of Net Zero was published in January 2023 by Chris Skidmore, the former Minister for Energy and Clean Growth. It highlights a variety of technological issues specific to the UK that will need to be addressed in the future, also laying out policy measures for making the transition to carbon neutrality. In business, for example, it asks what planning will be needed from the private sector as it factors regulatory considerations into the research and development of technology. As well as addressing policies and frameworks for supporting the transition that relate to the general public, such as what standards to set for the construction of new homes and how existing homes can be improved, the review also touches on critical technical questions regarding the use of solar power for electrification, the use of carbon capture and storage (CCS), and natural sources of energy. On the supply side, issues such as the full electrification of transportation and the supply of industrial and domestic heat are also covered, along with the question of how to shift to a hydrogen-based economy. On the demand side, a key issue is how the system can be made more efficient in response to demand.

While these many and varied opportunities exist for decarbonizing society, it also seems likely that the final stages of decarbonization will require CCS in some form, meaning that progress is needed on the associated technologies. We need to accelerate technology development and innovation to make the transition to a carbon-neutral society while also proceeding in a way that all regions

* A consortium that brings together the knowledge of system operators, manufacturers, electric utilities, standardization organizations, research institutes, etc., with the goal of operating the world's power grids on 100% renewable energy.

onboard. Achieving this will require appropriate global investments and incentives.

Decarbonization policy in the UK has prioritized industrial heat and domestic heating demand. What specific actions are you taking in this area?

With the dramatic increases in the price of natural gas in response to the war in Ukraine, large increases in the cost of domestic electricity have made this a very political issue and considerations around energy security and fuel poverty need to be factored into the “use of heat.” The UK has a large number of poorly insulated homes with low heat efficiency, the majority of them heated by gas boilers. This is one of the key challenges we need to prioritize on our way to achieving decarbonization. A variety of policies for improving home insulation have been introduced over the past decade, with limited success. Heat pumps represent one promising solution and switching from gas boilers to less energy-hungry heat pumps has the potential to improve both people’s lives and energy demand without compromising the living environment in their homes. While the UK government offers support to reduce the cost of installing heat pumps, two major obstacles to their wider adoption still remain. The first is that the cost to install remains higher in most cases than for a gas boiler. The second is a shortage of people with the requisite installation and maintenance skills. To address this, steps are being taken to drive the cost of heat pump installation down to the same level as gas boilers, with a lot of effort going into skills training at private-sector energy companies. In the future, I hope to see the shift to heat pumps being led by new-build homes, with regulations preventing the installation of gas boilers in new dwellings.

Rental housing is another focus of debate, key questions being who is responsible and who will bear the costs of change? As these are questions that span society, politics, and economics, everyone needs to be thinking about the respective roles that should be played by government, private companies, and individuals if we are to achieve an equitable transition to carbon neutrality. Meanwhile, although heating is probably not the best use for green hydrogen, this is a matter that will need to be addressed over the longer term given that, as yet, neither the technology nor the regulatory framework is adequately in place.

Similarly, technological innovation is also needed for industrial heating, including for the potential use of hydrogen, as will scale up of CCS to offset the carbon dioxide (CO₂) emissions from steelmaking and other heavy industry during the transition.

Rethinking Current Practices to Enable a Sustainable Future

It is recognized that the achievement of a sustainable society calls for action not only on reducing CO₂ emissions, but also on a range of other issues, including biodiversity, reducing food losses, and education. What do you see as the key points to consider when undertaking these actions?

Under the framework of the Imperial Zero Pollution Initiative, we are seeking to change how we do research and teaching at Imperial College London in order to address a wider range of environmental problems beyond focusing solely on carbon. Confronting the three great threats to the global environment of climate change, biodiversity loss, and chemical pollution calls for systems-level thinking, treating these issues in a holistic framework that looks at interdependencies. Part of this is the need always to be thinking about the choices we make and the consequences they bring.

If we replace petrol and diesel cars with electric vehicles (EVs), for example, what will happen to the pollution caused by mining the lithium and cobalt in different parts of the globe for batteries? What about the problems of road use and the particulates released by tires? What influence will this have on the health of people and the environment? A key point is to consider, as we transition to a net zero society, the potential for unintended consequences. The risk if we fail to consider the system as a whole and focus instead solely on reducing exhaust gas and CO₂ emissions is that we will end up damaging the environment in different ways.

Issues also arise regarding our ability to recycle the diverse resources needed for the deployment of new technologies. If we are to create a truly sustainable society, we need to be paying close attention to the use and reuse of finite resources. Understanding how we design for recycling, and change societal behaviour is critical to this.

Something we should never forget is that people lie at the heart of every system. It is vitally important when considering the adoption of a new technology that we ask whether or not it will be accepted by the public and how it will impact people individually and collectively. The participation of all sectors of the public is a prerequisite for achieving a society that is decarbonized, sustainable, and equitable. Achieving sustainable economic growth will require us to rethink the responsibilities of individuals, companies, and nations for environmental pollution as well as the nature of growth, driving a shift in both people and nations away from behaviors inspired by our existing consumer economy.

While our world confronts a diverse multitude of challenges, we can choose to view these challenges as a chance to build a different future. This involves rethinking everything in order to create clean and livable cities together with sustainable and secure energy systems. In effect, it means designing the future. While this process may well involve disruptive creation, I hope that it will also bring protection for the environment and a healthier and more prosperous life for people.

Rather than thinking only of the present, you are saying that we need to create a truly sustainable world by establishing a circular economy and recycling businesses that look to the future. Thank you for your time today.