Position Statement

Climate Change

Summary

The Royal Society of Chemistry (RSC) calls on Governments to show strong leadership to achieve the goals of the Paris Agreement through domestic frameworks that make the most of their scientific and industrial capability. The RSC is committed to supporting the chemical sciences community in their efforts to understand and address climate change. We have adopted a goal of net zero greenhouse gas emissions from our organisation by 2040 and are taking urgent action as part of a commitment to play our full part in this transformation.

Climate science; observations, causes and consequences

The scientific community can say with high confidence that human activities have caused the Earth's surface to warm by approximately 1°C since the pre-industrial era. This warming is due to the accumulation of greenhouse gases in the atmosphere, with carbon dioxide from fossil fuel combustion being the leading cause. The chemical sciences have been at the forefront of understanding the origin and fate of greenhouse gases and their biological, geological and oceanographical interactions. If we continue emitting at the current rate, global warming is likely to reach 1.5°C between 2030 and 2050 and could go much further with very harmful consequences. Until anthropogenic emissions of carbon dioxide and other long-lived greenhouse gases reach a balance of sources and sinks, "net zero", the global temperature rise will continue. Net zero identifies the date at which we stop directly adding to further warming, but it is the cumulative emissions of carbon dioxide, and other long lived greenhouse gases, that largely determines the extent of warming and this emphasises the urgent need for near term emissions cuts. Nature and societies around the world will struggle to adapt to extreme weather, sea level rise and ocean acidification if we do not change course now.

Policy Position

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The extent to which the world will cut emissions in the next two decades will determine the level of additional climate risk that people and the natural world are exposed to in the future. The decisions we make today will have far-reaching consequences for generations to come. 40% of the carbon dioxide we release may still be in the atmosphere 1000 years from now, depending upon a number of factors not least the chemistry of the world's oceans.[1] It is incumbent upon the UK government, as co-host of COP26, to deliver its highest possible ambition in line with the Paris agreement and continue to reduce emissions to limit future climate risks. Getting to net zero by the middle of the century is important, but it must be backed up by policies and actions to cut emissions in the short term and to initiate a green revolution in

[1] WG1AR5_Chapter06_FINAL.pdf (ipcc.ch) Box 6.1 p472

the way we use energy and materials. The chemical sciences recognise that many of the innovations, processes and products that they have brought to market have an impact on the climate. Achieving net zero will require fundamental changes in society and the economy, and just as scientists and engineers drove the first industrial revolution, they will play a central role in the low carbon revolution. Responsibilty for the causes of climate change and for resolving the problem lies throughout our economy with government, business and citizens all having a role to play. We set out the contribution of the chemical science community in an accompanying manifesto of actions.

We welcome the UK Government's commitment to bring all greenhouse gas emissions to net zero by 2050. To achieve this ambitious but necessary target, we recommend the Government to:

1. **Ensure scientific evidence sits at the heart of strategies to address climate change**

   Governments, businesses and large organisations need to develop mitigation and adaptation strategies to address the challenges that climate change poses using sound scientific understanding. As these strategies will include developing and deploying low carbon technologies, improving energy and resource efficiency, and changing behaviours and choices, multidisciplinary approaches are required. As we shift to sustainable development, that meets the needs of the present without compromising the ability of future generations to meet their own needs, we must also understand the limits to our knowledge of complex systems. For instance, in recognising that while geoengineering and greenhouse gas removal technologies may in the future be part of a solution, the prospect of them cannot be a substitute for present day actions to reduce emissions.

2. **Support science, from discovery to applications, to effectively tackle climate change**

   Scientific innovation is crucial to understanding, mitigating and adapting to the effects of climate change. Whilst many low carbon energy technologies are available, and some such as photovoltaic cells are mature and cost competitive, energy storage in various forms will be essential to managing the interface of variable renewable power with society's energy demands and there remain sectors where we do not have substitutes for our existing fossil fuel using infrastructure. Likewise, though we understand a great deal about biogeochemical cycles, further research will help us to better manage agriculture, forestry and increasingly threatened water resources in a changing climate. Government must deliver on its commitment to invest 2.4% of GDP in R&D by 2027, in part to advance understanding in how to mitigate and adapt to climate change. As science is a collaborative endeavour this should include support for international activity such as through Horizon Europe.

3. **Establish coordinated policy and incentives to deliver net-zero greenhouse gas emissions alongside other environmental targets**

   Net zero targets and urgent reductions are justified by our understanding of the carbon cycle. We must defossilise the economy, recognising the great value that carbon containing molecules bring to society but also the great harm in moving carbon from below ground into the atmosphere. Other greenhouse gases, such as nitrous oxide, methane, and fluorinated gases, emitted from diverse sources must also be addressed to restore the Earth's energy balance. Fundamental scientific discoveries and the broad application of low carbon technology will assist but while the atmosphere remains freely accessible to polluters, proactive policy and incentives are required to drive this process. There are risks of creating additional environmental harms through particular technological or economic choices. The chemical sciences can make a substantial contribution to identifying and mitigating these impacts too, especially where new low carbon technologies are still in development. Government should draw on research findings and tools, such as life cycle analysis, to better understand the consequences of different choices and establish coordinated policy and incentives to move towards a sustainable circular economy.

4. **Ensure the chemistry curriculum lays the foundations for future citizens to fully participate in efforts to tackle climate change.**

Everybody is entitled to an excellent chemistry education, whether they go on to pursue a career in the chemical sciences or take their place in society as scientifically literate citizens. Climate change impacts, and the actions to avoid them, will occur substantially in the lifetime of children at school today. The chemistry curriculum should therefore equip learners with the core ideas in chemistry needed to understand climate change, and the scientific and technological developments that impact society. The knowledge and skills gained through chemistry education should support progression into green jobs and further study in the chemical sciences.

RSC Policy and Perspectives Focus

The chemical sciences contribute to understanding and tackling climate change in a great many ways, revealing the flow of carbon and nitrogen through different geological, atmospheric and biological pools, elucidating the interactions of greenhouse gases and aerosols, and providing fundamental insights essential to developing new low impact technologies. It is in this latter activity that the RSC will establish a programme of thought leadership catalysing progress on energy storage and sustainable materials.

With economies-of-scale being realised by widespread deployment, renewable power is now globally competitive with thermal generation. However, the problems of intermittency and the limited ability to despatch renewable power to meet instantaneous demand remain. Energy storage is therefore a vital component of a net zero society, and we must seek affordable substitutes for stockpiles of fossil fuels. This will likely come in many forms to serve the differing needs of industry, heating and cooling in buildings, or mobility on land, water and in the air. We will showcase the fundamental chemical science research that is developing diverse storage solutions from improving the longevity of existing battery formulations, using computational methods to discover new electroactive compounds for redox flow batteries, to elucidating the fundamental processes in catalysis for low cost hydrogen production.

In sectors where battery technology is mature there may be other environmental and social problems caused by scaling up. Globally electric vehicle sales could reach 44 million per year by 2030 facilitated by the refinement and mass production of lithium ion cells, however, this may place unsustainable demands on critical raw materials (CRMs) such as nickel, cobalt and graphite. We will continue our work on the Precious Elements campaign on e-waste to encompass the growing demands of low carbon technologies.

The transition to a circular economy, where end of life products become inputs to new processes to prevent waste flowing to the environment, must occur for the broad range of materials that modern society depends upon. As well as CRMs, we will particularly focus on plastics and their fate in the environment and work within our community to maintain the benefits of this vital group of materials but minimise their harms. This will also include the use of waste CO_2 through carbon dioxide utilisation technologies to defossilise the feedstocks to industrial production.