

IOP Institute of Physics

Physics and climate change

Physics has played a key role in investigating the impacts of climate change and predicting environmental outcomes, as well as providing responses and solutions to the challenges ahead.

The IOP at a glance

The Institute of Physics is the professional body and learned society for physics in the UK and Ireland, inspiring people to develop their knowledge, understanding and enjoyment of physics. Working with members and partners, we encourage innovation, growth and productivity in business including addressing significant skills shortages; and we provide evidence-based advice and support to governments across the UK and in Ireland.

Our offer: The IOP offers evidence and briefings on both the future impact and mitigation of climate change, and the work done by the physics sector, to support any climate change activities. Physicists and the wider physics community have already contributed to determining our climate change responsibilities and, with the IOP, will continue to help to achieve both a better understanding of the challenges we all face, and the pioneering solutions required to address them.

Identifying the extent and monitoring climate change

UK-based physicists work with international teams to collect, analyse, model and interpret data on local environments and the wider climate. Teams work to capture the state of our planet as it changes, to measure the speed and threat of climate change.

Using sensors, satellite imagery and tracking devices, scientists such as those in London's [National Physical Laboratory](#) and Southampton's [National Oceanography Centre](#) have built a picture of the climate spanning decades, from weather patterns to changes to land mass, sea levels and vegetation, and greenhouse gas and pollution levels.

Responding to climate change

The UK has committed to reduce its net emissions of greenhouse gases by 100% relative to 1990 levels by 2050, making it a 'net zero' emitter. This move is essential to avoid the worst-case scenarios of climate impact on the environment and society. To do so, the UK must transform economies to avoid further climate change and adapt to the impacts caused by global warming.

The necessary changes are underpinned by physics-based innovation and technology. Physics has played, and continues to play, a crucial role in creating solutions to combat the impacts of climate change.

Solutions from the physics sector include:

Defence against, and adaptation to, climate change

Physics modelling and technologies are fundamental to predicting where our environment will be impacted by a changing climate, and defending habitats against/adapting environments to this change. This ranges from the development of flood risk plans and river and coastal management, protecting at risk regions such as the North East of England and Southern Scotland, to supporting farmers and food manufacturers across the UK with innovative technology to minimise waste and their environmental impact.

Sourcing and developing clean energy

Physics research is being converted into tangible solutions to mitigate and minimise the impact of the climate crisis, and these solutions are manufactured and rolled out at scale. In the transport sector, physics research has been used in the technology and manufacturing of hydrogen fuel cell vehicle and battery-powered electric vehicles, technology which is being adopted by UK manufacturers Rolls-Royce, Jaguar and Land Rover, and research continues to improve vehicle manufacturing and power, battery life-span, and to reduce the sector's carbon footprint. The transport sector accounted for 34% of the UK's CO₂ emissions in 2019, the largest total sectoral contribution, making these vehicle alternatives a crucial solution to achieving carbon neutrality.

Physics innovation has led to the development of carbon reduction technologies such as carbon capture, utilisation and storage (CCUS), and the research, development, manufacture, and roll out of fossil fuel-based energy alternatives, such as popular renewables, which produce around 40% of the UK's electricity. These alternatives have started the move away from fossil fuels. Looking to the future, research and development into nuclear fusion has the potential to create cheap, safe and plentiful energy. The UK hopes to deliver the world's first [prototype fusion power plant](#) by 2040.

Transitioning to new energy systems

Physics skills, from data analysis to mechanics, are crucial to transitioning from our current infrastructure to one fit for the future. In the coming years, data analysts, engineers and manufacturers will be mapping and re-modelling the UK's infrastructure, to build the energy systems needed to support tomorrow, create a digitally connected network of charging points on roads and in houses, and transform the electricity and heat systems in our homes and buildings. This will enable a transition to a clean and connected ecosystem.

Hydrogen technology has been researched and developed for many years by physicists and has the potential to provide a gas alternative not just to long-distance freight, but also to heat. With heating accounting for 37% of the UK's carbon emissions, of which around 14% is from domestic settings, transitioning to hydrogen for heat could be a key step to achieving the net zero target.

Improving the efficiency of energy and infrastructures

Physicists construct and optimise design and materials for improved efficiency, such as material composition and weight. This has led to next generation materials used in aeroplane manufacture, reducing net weight, allowing planes to go further on less fuel, reducing emissions. In the energy sector, [physicists across Scotland](#) are working to improve the capacity of solar cell technology, creating next generation converters to optimise the energy created by solar power.

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