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Innovation policy  
for net zero



THE BARTLETT

# Innovation policy for net zero

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## Overview

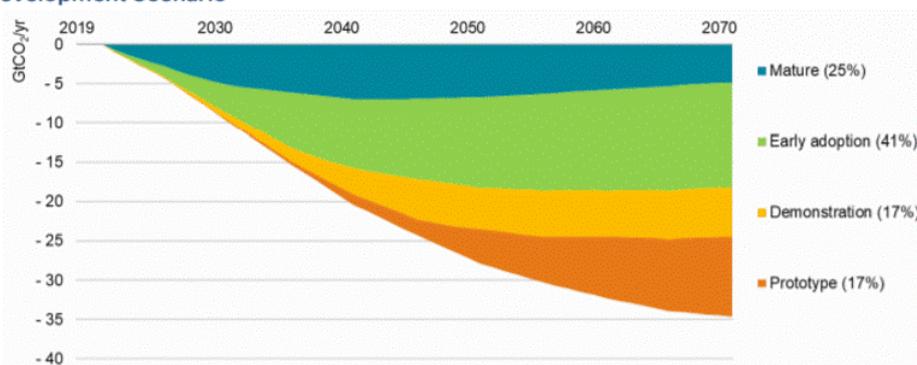
- Low-carbon innovation must be accelerated, and broadened beyond renewable energy, hydrogen and electric vehicles, to support the UK's climate ambitions
- Innovation policy for net zero requires much more than R&D investments in exciting new technologies that have good long-term potential.
- Innovation policy needs also to include strategic investment and early market support for key priority technologies; incentives for zero-carbon solutions across the economy; and support for businesses developing emerging zero-carbon goods and services.
- The costs and benefits of zero-carbon innovation must be distributed across income groups and regions in a way that is fair, to support a 'just transition'.
- Government should introduce a net zero innovation strategy by November 2021, to follow-up the Prime Minister's "10-point plan for a Green Industrial Revolution", which was launched in November 2020.

## The urgency of innovation for net zero

In the past few months a flurry of new climate targets have been announced, including in the UK, suggesting a step-change in global political willingness to take action to reduce emissions. Innovation –the creation and adoption of new technologies, processes and business models— will play a central role in reaching those targets. Analysis from the International Energy Agency, shown below, suggests that many of the technologies likely to be necessary for achieving

deep decarbonisation are still very far from mature. Technologies currently in the early phases of adoption, such as offshore wind, solar photovoltaics and electric cars can do much of the heavy lifting to reduce emissions, but they are not enough. The challenge is that innovation needs to be both *accelerated*—with more rapid deployment and cost reduction for key technologies like offshore wind; and *broadened* - to develop technologies and new business models to drive emissions reductions across the economy.

**CO<sub>2</sub> emissions reductions by technology readiness category in the Sustainable Development Scenario**



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Notes: Percentages refer to cumulative emissions reductions by 2070 between the Sustainable Development Scenario and baseline trends enabled by technologies at a given level of maturity today.

**Technologies that are at the prototype or demonstration stage today contribute more than one-third of the cumulative emissions reductions in the IEA Sustainable Development Scenario.**

The IEA's analysis also highlights that much of the innovation required needs to be focused on technologies that are already diffusing in markets—those in an 'early adoption' phase—or those which are already being demonstrated at scale. Innovation policy for net zero is as much about improving existing technologies and systems as it is supporting the creation of new ones.

## Why is innovation for net zero such a challenging policy goal?

The dizzying pace of technological change in recent years can sometimes give the impression that technological innovation can offer a quick response to the climate emergency. But the recent progress in renewables and battery costs have come about only after decades of investment and government support. Innovation in the energy system takes time, and for net zero, time is in very short supply.

Innovation for net zero is slowed by three core factors.

First, innovation for net zero is beset by uncertainty about future demand for low-carbon goods and services, which often depends in part on government action on climate. Few investors are willing to take decisions in the absence of clear action from governments to back them up. In [our work at UCL with companies](#), we have heard repeatedly that managers struggle to win investment to develop a clean product when consumers can access cheaper (though more polluting) alternatives. The reductions in carbon emissions from clean technologies are not valued in the marketplace unless government policies are in place, and too often they are not.

Second, competitors can copy inventions and thus capture value from a company's innovation investments. Knowledge is difficult to protect. Germany's industrial leadership in solar power, which was generated by substantial public support for the solar market in Germany, was lost to China, which was able to first absorb, then imitate and ultimately surpass German technological know-how in solar panel production. Such developments act as a brake on innovation investments.

Finally, despite all the talk of start-ups, it is large companies—with the deep pockets and expertise required for innovation—that account for most R&D spending. Many start-ups in the energy sector struggle to access finance or generate viable products within the timelines acceptable to venture capital investors. And yet for many large companies, truly radical innovation of the kind necessary to achieve net zero risks undercutting existing product lines. As a case in point, the oil majors dominate R&D spending in the energy supply industry, and while they have been hugely successful in generating innovation that keeps fossil fuels flowing, they have been slow to redirect innovation investments towards cleaner alternatives: [less than 5% of patents from fossil fuel extraction companies in the UK are dedicated to climate change mitigation](#).

## What needs to happen?

To accelerate and broaden innovation for net zero, government needs to take much more action. The basic policy recipe comprises three core ingredients: a 'vertical' element, consisting of targeted support for key technologies and systems; a 'horizontal' element, ensuring incentives to foster low-carbon innovation are present across the economy; and an 'underpinning' element, ensuring a vibrant innovation ecosystem—in part through effective support for R&D. These areas are already represented to some extent in the existing policy mix in the UK - the challenge is to ensure each element is working effectively. The following brief overview highlights what still needs to be done.

### **1. "Vertical": targeted support for key technologies, to accelerate early market development, bring down costs, encourage investment.**

The barriers that slow low-carbon innovation can be overcome in part through strategic investments that provide supportive infrastructure, or that support demand for the new technologies and systems. It is this kind of strategic investment that has catalysed the cost reductions seen in offshore wind and in solar PV.

This kind of targeted support is required in key priority technology areas, including hydrogen, technologies for road freight, and those related to heat decarbonisation. A ‘vertical’ approach combines market support—including through subsidies—with effective industrial strategy, just as we have seen for offshore wind.

This ‘vertical’ approach has real risks. It requires the government to make choices about promising areas of technology, something that governments have not always done well in the past. Such choices are vulnerable to lobbying and special interests, and they require strong governance arrangements to reduce the risks that decisions are taken for the wrong reasons. To help reduce these risks, government should avoid choosing specific designs or companies. Instead, support should be structured so that companies must compete, and so that government support is limited and declines as the technology matures, as has been the case with support for offshore wind. Similarly, experimentation is important, through pilots with real-time monitoring of policy impacts on innovation.

The government’s approach to selecting and supporting specific areas of low-carbon technology has not always been clear. The government has produced ‘Energy Innovation Needs Assessments’ (EINAs) for various energy technologies—these provide a good evidence base for informing such strategic decisions. But it is not clear how exactly they have informed government technology choices, such as those in the Prime Minister’s “10-point plan for a Green Industrial Revolution”. The processes for choosing key areas of strategic technology needs to be opened up to more transparent debate and scrutiny, involving both analytic inputs like the EINAs alongside expert advisory bodies, and clearer justification from ministers about the criteria used to inform technology decision-making.

## **2. “Horizontal”: cross-cutting framework conditions.**

Strategic ‘vertical’ choices are an essential part of the policy mix, but they impose a heavy burden on government to correctly identify and support the right technologies. Innovation

always generates surprises, and the structure of incentives and markets needs a ‘horizontal’ element to nurture the discovery of new ideas across the economy, including in areas where government has not thought to look.

Prices play a central role in shaping innovation incentives across the economy. Extensive evidence—including from [our work at UCL](#)—shows that prices induce and direct innovation. Yet in the UK, prices are often not aligned with net zero, and this is partly a reflection of policy choices. Fuel Duty has been falling, Air Passenger Duty is being cut, and policy costs inflate the price of domestic electricity but not gas—providing an incentive to households to continue using a fossil fuel. Government needs to ensure taxation and market structures create the price signals that drive innovation towards our long-term net-zero goals.

Government must also ensure that infrastructure and regulatory choices are aligned with clean innovation. On infrastructure, there has been progress through the National Infrastructure Commission, which has highlighted the need for infrastructure consistent with the UK’s climate change ambitions, such as charging infrastructure for electric vehicles. But there are signs that infrastructure decisions are too often overlooking the urgency of climate change: the announcement in 2020 of £27bn to be spent on road-building, in contrast to much more meagre sums for buses, rail and cycling, highlights the problem. Regulatory choices also have the potential to steer innovation towards sustainability. While economists often view regulation as a barrier to innovation, the evidence suggests that well designed and flexible environmental regulations can stimulate innovation in cleaner technologies and business models.

## **3. “Underpinning”: support a strong research and innovation ecosystem.**

Policy supporting innovation for net zero is about much more than R&D, as the previous two elements have made clear. But there is strong evidence that sustained support for R&D and a strong innovation system helps to ensure that new technologies emerge, develop, and diffuse through markets. R&D is often seen as the route

to discovery of new technologies, but it plays an equally important role in driving cost reductions and technology enhancements in technologies that are already being widely adopted. The synergies between R&D and the learning-by-doing and economies of scale that come about through technology deployment enable an acceleration of cost reductions – generating further diffusion and investment.

The UK has been increasing public R&D spending on energy for a decade, following an extended period around 1990-2005 in which the UK spent very little in this area. The institutional landscape has matured too, with the establishment of innovation support bodies such as the energy system catapult, offshore renewable energy catapult, and advanced propulsion centre – all of which help build an effective innovation ecosystem that nurtures and connects emerging innovators and ideas.

This gradual expansion of support for low-carbon innovation must accelerate and continue – and it must move beyond a narrow focus on energy. Net zero means more than decarbonising the energy system. Take agriculture, for example: there is a need for R&D on soil carbon dynamics, feed supplements that reduce methane emissions from ruminants, and alternative plant-based proteins, which have all been overlooked by previous ‘low-carbon innovation’ strategies. It is time the UK developed an innovation strategy for net zero, not simply for energy innovation.

Beyond R&D, there is also an important role for wider support to the innovation system. This includes business advisory services for innovative SMEs, and support for networking and collaboration, business incubators, and skills development. Building on existing regional innovation strengths can help generate green innovation “clusters”, in which companies benefit from co-location through exchange of knowledge, human resources and shared infrastructure.

In climate policy debates, there is [a persistent](#) but very unhelpful idea that R&D spending can replace the need for the kind of ‘vertical’ or ‘horizontal’ market transformation policies outlined above. This rests on a basic misunderstanding of innovation processes.

R&D is not an alternative to such policies, but a complement: to bear fruit, R&D needs to be coupled with, and directed by, signals from the market. In the absence of market transformation policies, public money spent on energy R&D is unlikely to generate the innovation required to bring technologies to maturity in the time required.

## **Barriers to change – and necessary responses**

Accelerating innovation can generate huge benefits, but there will also be costs, and government must make choices about who bears those costs. In the past, government efforts to support the early market deployment of technologies have been regressive: for example, households that could afford solar roofs benefited from subsidies, paid for through levies on the electricity bills of all households, including the poorest. Loading such costs onto those least able to pay is neither fair nor—in the long term—a politically resilient strategy for achieving deep decarbonisation.

Regional impacts of innovation policies can also be significant. In recent years, the south and east of England have tended to benefit disproportionately from government R&D funding—and supporting innovation across the country will be important both for achieving green targets and for ‘levelling up’. Greening the economy will create new jobs in emerging fields, but will also eventually result in jobs being phased out in polluting activities and sectors. It will be important to ensure that regions that have high employment in high-carbon sectors—producing internal combustion engines, for example—do not suffer disproportionately. Support for regions to transition to low-carbon industries and service sectors will both help to reduce any negative welfare impacts, and help to ensure ongoing public support for decarbonisation.

## **Who needs to do what by when to get to net zero?**

A net zero innovation strategy requires cross-government collaboration. Broadening low-

carbon innovation beyond a narrow energy focus means that the Department for Business, Energy and Industrial Strategy (BEIS) must work more closely with others, particularly the Department for Transport (DfT), Ministry for Housing, Communities and Local Government (MHCLG) and the Department for Environment, Food and Rural Affairs (Defra).

Within the coming year, BEIS should work with these others—and the Treasury—to set out a net zero innovation strategy that incorporates all three elements described in this Policy Brief. For the strategy to have real impact, it is important that the Prime Minister launches it, as an explicit follow-up to his “10-point plan for a green industrial revolution” launched in November last year.