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Necessary inventions

ECONOMIC POLICIES TO INCREASE LOW-CARBON INNOVATION

The UK Government has set a target to reduce carbon emissions by 80 per cent between 1990 and 2050. The scale of the challenge is such that it could never be met by the efforts of individuals and businesses to reduce their energy consumption. Energy generation and transport would need to be almost wholly decarbonised and this would require massive technological innovation. Whilst economists can't do the innovating, they can design policies to stimulate the necessary invention.

The challenge of reducing carbon is huge and international. Most businesses and individuals now accept the importance of tackling climate change and are starting to change their behaviour, by offering carbon offset schemes, using low-energy light bulbs, restricting air travel and so forth. These actions will all contribute to reducing emissions. However, there is a limit to what can be achieved by changes in behaviour alone. Technological change must be a part of the solution.

The chart below shows the scale of the challenge. The electricity and transport sectors would need to be almost entirely decarbonised. Transport and residential

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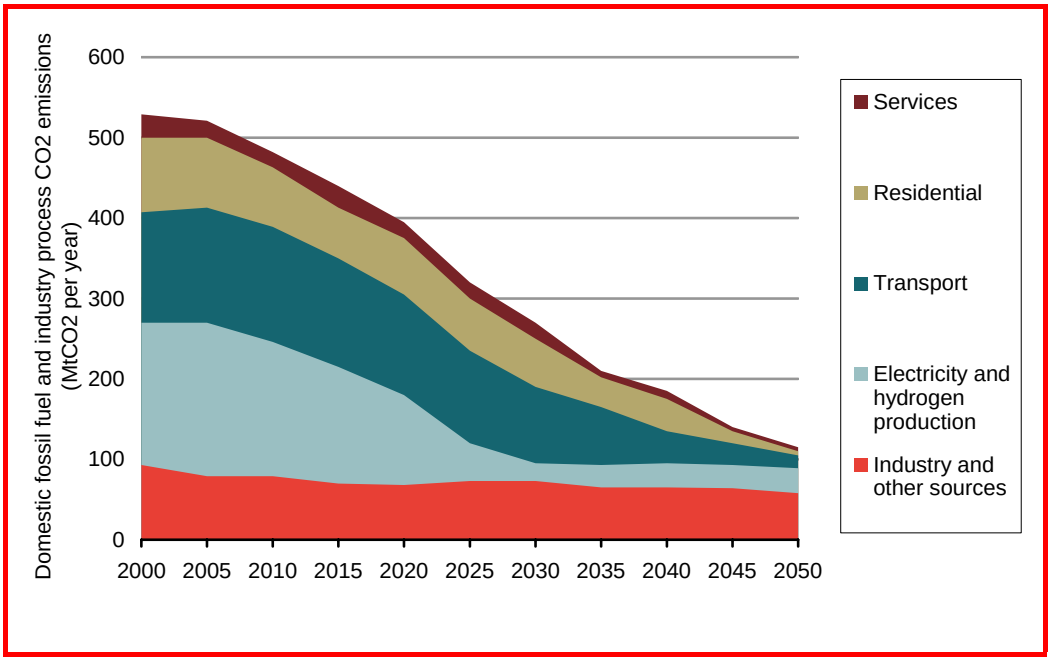
heating would need to use electricity as fossil fuels are withdrawn, which means much will depend on generating high volumes of low-carbon power. Innovation will take place globally, so what can the UK do to help stimulate change here?



UK sectoral CO2 emissions to 2050 on an 80 per cent reduction path

Source: Climate Change Committee, "Building a low carbon economy"

Many of the technologies needed are already under development.

- In the UK and other coastal countries, offshore wind is becoming an important source of electricity generation, but innovation is required to reduce the cost and extend the sea depth at which wind turbines can be used. Developing technology to store the electricity for when there is no wind would also remove the need for back-up fossil-fuel generation.
- Carbon capture and storage (CCS), which removes the emissions of fossil fuel generation and is critical to meeting climate change goals, has yet to be deployed for a large-scale power plant in the UK.
- Electric cars are being driven in UK cities, but still appeal mainly to "green consumers". Developing battery technology to achieve high performance and refuelling convenience is required to allow such vehicles to supersede those powered by the combustion engine in general use.

ECONOMIC INCENTIVES ARE THE MOTHER OF INVENTION

The development of these necessary technologies will rely on scientists and engineers. But without the right economic incentives, the investment required for research and development (R&D) will not be forthcoming. The UK Department of Energy and Climate Change asked Frontier to consider the design of policies to support low-carbon R&D in the UK.[1]

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There are two fundamental requirements for successful low carbon innovation.

- First, a "carbon price" which gives an economic value to savings in carbon emissions. This helps to differentiate between fossil fuels according to their different emission levels; allows low-carbon technologies to compete with their cheaper fossil-fuelled equivalents; and permits researchers and their investors to earn an economic return on innovation.
- Second, policy must be consistent and credible, so that researchers and their investors can be confident that policies put in place today will still be in place when new technologies hit the market tomorrow.

The UK does relatively well on both of these scores. The EU Emissions Trading Scheme, UK Renewables Obligation and high levels of road fuel duty all provide a carbon price that significantly increases the competitiveness of low-carbon technologies. The introduction of a legally-binding carbon reduction target and an independent Committee on Climate Change provide a high degree of credibility for researchers. However, too many government initiatives have not stood the test of time, and the EU ETS price is discouragingly volatile.

A further requirement is that the cost of intervention should be as cheap as possible. In his report for the government in 2006**,** Lord Stern projected the cost of tackling climate change to be one per cent of national income. But this assumed the introduction of economically efficient mitigation policies. If the design and targeting of policies is poor, the cost will be correspondingly greater. Frontier's work looked at the relative effectiveness of different policies for generating additional R&D.

PULL AND PUSH

There are two broad approaches to encouraging innovators: demand-pull and supply-push.

- Demand-pull policies aim to increase demand for low-carbon technology through, for example, subsidies, regulation or carbon pricing. The UK Renewables Obligation for electricity generators is an example of a substantial demand-pull policy.
- Supply-push policies, such as grants, tax credits, prizes and matched equity funding, reduce the cost of the innovation itself, and/or provide immediate reward. This can both provide an economic return and offset some of the market failures that slow innovation.

Demand-pull policies are absolutely necessary, both to create the climate for innovation and to pay for deploying technologies, such as the capital investment required for windfarms. Providing the carbon price is one of the building blocks for successful low carbon innovation. But much of the economic cost of these policies goes on deployment rather than innovation, and the UK government is already spending very substantial sums on deployment support. Hence the returns, in terms of additional R&D, to additional demand-pull policies may be modest relative to the economic costs.

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Supply-push policies cannot work on their own. But pound for pound they may, given current demand-pull, generate more additional R&D, because the money is not diverted to deployment costs. However, there is a major risk with such policies, which is that they finance fruitless research, or alternatively research that would have gone ahead without any government support. The selection of research to support is therefore critical to the effectiveness of supply-push.

AND THE PRIZE GOES TO…

In the UK, nearly all support from supply-push policies is given through grants. This necessarily involves "picking winners", who then enjoy a financial advantage over their competitors. Such policies therefore encourage researchers to direct resources towards winning grant applications rather than towards winning in the laboratory. This distortion may significantly increase the economic cost of innovation support. To solve this problem, policymakers need to innovate as well, in order to maximise the impact on R&D of a given level of funding. Prizes offer one possible route to greater cost-effectiveness, largely untested in the UK.

In most sectors, it would be a mistake for government to try to pre-select the kind of technologies that should win prizes. But there are some specific technology gaps on the climate change agenda – such as batteries with shorter recharge times, or more efficient tidal generation – at which prizes could perhaps be usefully targeted.

There are two sources of additional R&D from prizes. First, the prospect of a prize causes firms to raise the amount of R&D to try and win. Second, the firm that is awarded the money will be research-intensive, and so is likely to spend some of the money on further R&D. The combination of these effects may be greater than is provided by grants.

There are downsides to prizes as well, such as the need to raise finance to compete for the prize, and the risk of research duplication by competing firms. But these can be minimised by – for example – using prizes only in well- funded sectors, or by designing multi-staged competitions, through which only the leading participants progress to the final round.

CONCLUSION

Demand-pull policies are essential to the creation of a dynamic market approach to energy innovation. But there is a place for supply-push policies to stimulate research, if they are designed in a way that maximises their cost-effectiveness and minimises the risk of subsidisation of inappropriate technologies. Developing such policies requires policy-makers to be as innovative in incentive design as scientists need to be in responding to the challenge of low emissions targets.

NOTES

1 *"Alternative policies for promoting low carbon innovation: A report for the Department of Energy and Climate Change", Frontier Economics (July 2009)*

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