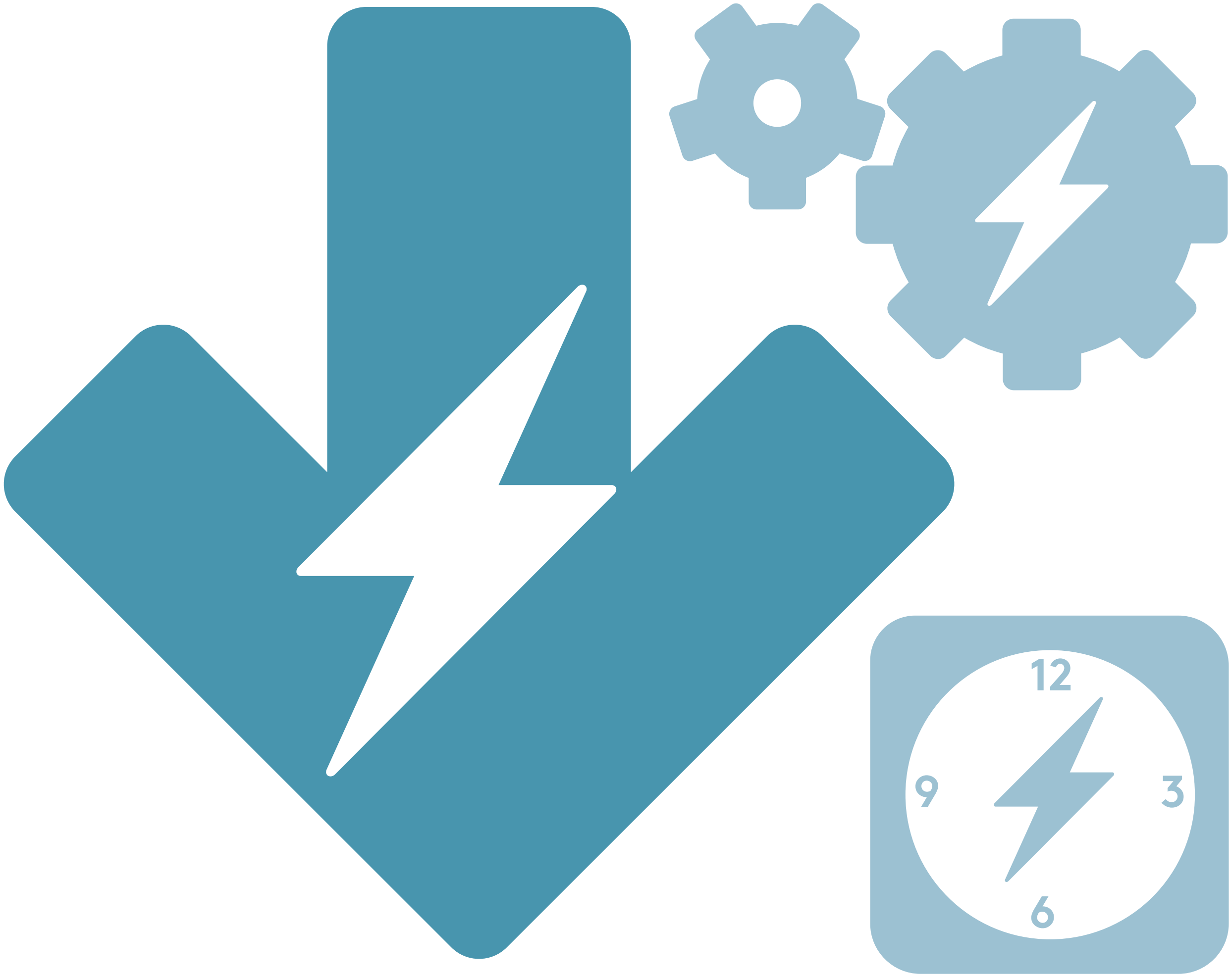
Balancing the energy equation

Three steps to cutting UK demand



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CREDS

CENTRE FOR RESEARCH INTO ENERGY DEMAND SOLUTIONS

Summary

The international community is waking up to the urgency of the climate and environmental crisis. The UK has shown leadership by legislating to reach net zero emissions by 2050. But, as the host of the UN summit in Glasgow in November 2020, where all countries will need to put their pledges on the table, the UK now needs to show how it can be done.

Getting to net zero will require action beyond just switching to renewables in the power sector. This will remain important, but the focus will need to shift to reducing energy demand right across the economy.

Working with academics from the Centre for Research into Energy Demand Solutions (CREDS), we have identified three important steps the government must take in a new policy approach to energy demand reduction.

1. Reduce energy demand
Avoiding energy use in the first place is the easiest way to minimise its environmental impacts.

2. Improve technical energy efficiency
Eliminating energy waste and loss through technical improvements means less energy is needed.

3. Flex energy demand
Aligning demand to energy supply is vital to get the best out of intermittent sources of renewable energy.

We examine how these three steps could apply to high emitting sectors: transport, buildings and industry.

In the transport sector, the top priority should be to reduce the need to own and drive cars, by facilitating shared mobility, walking and cycling, and by improving public transport. Transport and planning objectives should also be aligned to avoid the need to make so many journeys.

The poor energy efficiency of much of the UK's existing building stock, both housing and commercial, needs urgent attention. It requires real world performance data to inform decisions, and can be done through a £1 billion per year upgrade programme to 2035. This should target low income households and be combined with new incentives for those who are able to pay.

In industry, resource efficiency is the next frontier for action, with great untapped potential to cut energy use by making longer lasting, repairable items, bringing down the demand for products and promoting resource efficient industrial processes.

Action to reduce energy demand is not only necessary to meet decarbonisation targets, but also highly desirable. As we show, these developments have other, far reaching positive impacts, including cleaner air, healthier homes and a more productive economy.

Introduction

In June 2019, the UK became the world's first major economy to legislate to reduce greenhouse gas emissions to net zero by 2050.[1] This amended the previous target of 80 per cent reduction on 1990 levels, which was set out in the equally historic Climate Change Act of 2008. Both were passed by large cross party majorities.

But government policy is failing to match these world leading ambitions. In fact, the House of Lords appended a 'regret motion' to the net zero legislation, expressing concern that the government had provided "little detail on how the emissions target will be met".[2]

Even before the new target was adopted, the UK was not on course to hit its lower target. That is in spite of proposals in *The clean growth strategy*, which was meant to show how the UK government would meet its legally binding fourth and fifth carbon budgets. In the light of the net zero commitment, this strategy is due to be reviewed and bold new policies have been promised.[3]

Balancing the energy equation

Most approaches to reduce emissions have relied on decarbonising energy supply: phasing out coal and drastically reducing the price of renewable energy. However, this ignores the potential contribution and benefits of the other side of the energy equation: demand reduction.

Even without much government intervention, demand reduction has a proven and profitable track record. Energy efficiency has been directly responsible for 25 per cent of the UK's economic growth since 1971.[4] And, globally, 90 per cent of the decoupling of emissions and economic growth has come from reducing the energy intensity of the economy, rather than reducing the carbon intensity of energy generation.[5]

Lower energy demand has other benefits

Reducing demand is also the easiest way to support the three pillars of UK energy policy: security, affordability and sustainability.[6] If the country uses less energy, it will be easier to maintain supply, which will cut costs for users and meet energy needs with low or no carbon sources.

Best of all, addressing energy demand has other, considerable benefits, including cleaner air, improved comfort in homes and public spaces, better health and new employment opportunities.

Capitalising on the potential

We outline a new, three step approach to reducing energy demand that will capitalise on this potential and get the country on track to net zero. This is based on research by the Centre for Research into Energy Demand Solutions (CREDS).

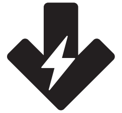
We suggest how this approach could be applied to important sectors: transport, buildings and industry.

As the government reviews *The clean growth strategy* to meet net zero, we propose these steps to bring the greatest benefit while cutting the most costs in the long run.

Three steps to energy demand reduction

For all areas of the economy, the government should plan to cut energy use to complement supply side measures. This approach should have three overarching elements:

Reduce demand

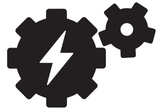


Just as ‘reduction’ is the first of the 3Rs (reduce, reuse, recycle) in sustainable resource use, eliminating the need for energy in the first place is the easiest way to minimise the impacts associated with its generation and use.

This is achieved by avoiding unnecessary consumption, including undue dependence on cars, over heating or over cooling buildings, and avoiding the use of virgin materials when lower energy input recycled resources are available instead.

New infrastructure or business models that reduce the need for materials and products – and, therefore, the energy to make them – will also help. This includes emerging trends towards paying for services, instead of owning products like cars or appliances.

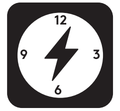
Improve technical efficiency



Energy efficiency means eliminating energy waste and loss. It is achieved by introducing measures that reduce the energy needed to achieve a given benefit, such as heating or lighting a room.

Technical improvements to increase efficiency include appliances that require less energy to run, more insulated buildings that need less heating or cooling and industrial processes that use less energy and fewer resources to make the same products.

Flex energy demand



Aligning demand to supply will become more important for two main reasons. First, intermittent sources of renewable energy – like wind and solar – will become the low cost backbone of the electricity system. Second, more efficient technologies reliant on electricity, like electric vehicles and heat pumps, will increasingly be used.

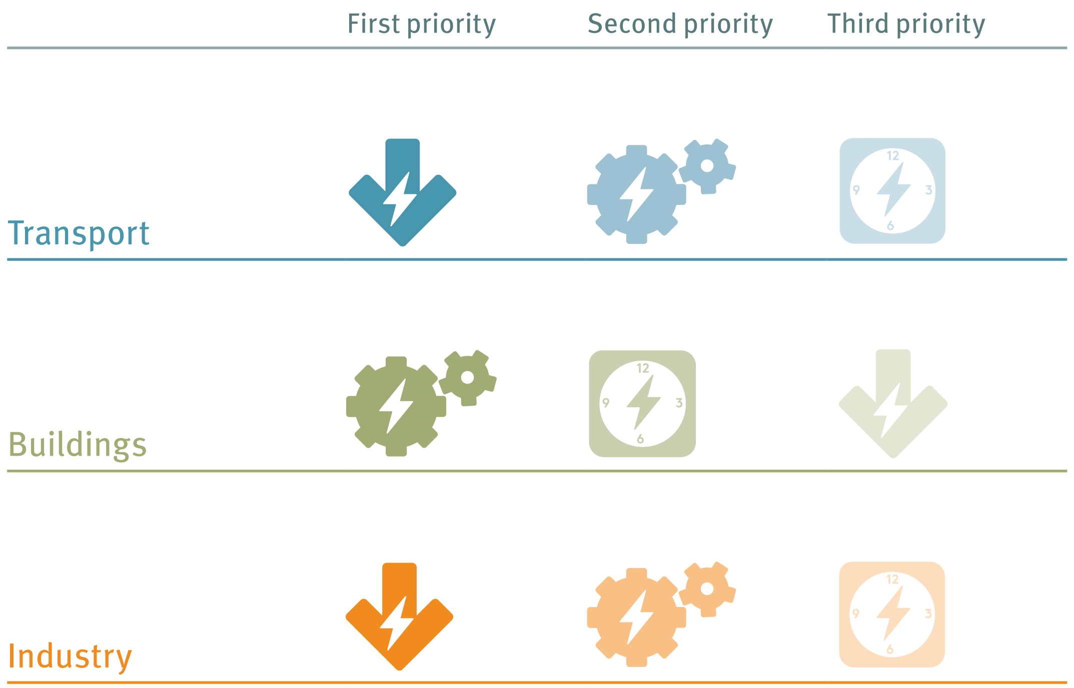
This can be supported by energy storage, but also by flexing demand over time, to use more energy when renewable sources are plentiful and less when they are not. ‘Time of use’ tariffs for both households and businesses can encourage them to reduce consumption at peak times.

Demand reduction in key sectors

These three steps to demand reduction should be embedded across the economy, but, in specific sectors, certain steps may require more policy attention and have greater potential to cut carbon.

In the next section, we examine how this new approach to demand reduction would work for the transport, buildings and industry sectors. Our analysis, focusing on the top policy priority for each, draws on the substantial body of evidence gathered by researchers at CREDS, a team of over 100 academics at 15 institutions across the UK.

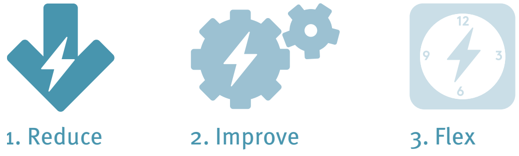
Sector priorities for reducing energy demand



Transport
The largest emitting sector in the UK

Transport policy is not on track to deliver emissions savings compatible with net zero by 2050. By the end of the fifth carbon budget period, in 2032, the sector needs to reduce its annual emissions by around 70MtCO_2. Current policy will only cut 6MtCO_2 a year by then.[6]

Energy demand reduction priorities



Emissions are not coming down

Although the wider UK economy has seen carbon emissions fall by 43 per cent, there was no reduction at all in the emissions from road transport between 1990 and 2017, and there has actually been a rise of three per cent in the past five years.[7] Transport is now responsible for a third of the UK's carbon impact, with road transport alone contributing 23 per cent of total greenhouse gases in 2018.[8,9]

Emissions are not coming down, in large part due to increases in the weight of cars. These have gone up by 15 per cent since 2001. SUVs account for a quarter of all new car sales, including for electric vehicles. The Mitsubishi Outlander, a plug-in hybrid SUV, is one of the most polluting cars on the road when not running on its electric battery.[10]

Government transport policies, including those in *The clean growth strategy* and *The road to zero*, have focused on technological solutions, specifically "to put the UK at the forefront of the design and manufacturing of zero emission vehicles, and for all new cars and vans to be effectively zero emission by 2040".[11]

This focus on improving technology is important, and should be accelerated by bringing the ban on sales of petrol and diesel cars forward to 2030, and including hybrids in the ban. But new policy should prioritise helping people to get out of their cars and use other means of travel.

Reducing the need to drive

Traffic demand does not have to rise inexorably. Already, successive cohorts of young people have shown less and less interest in driving: between 2004 and 2014 the average number of miles driven by 17-34 year olds fell by 20 per cent, and 35-59 year olds drove ten per cent less. Only those over 60 drove more.[12]

Capitalising on this trend by encouraging car clubs and shared travel offers considerable potential. A single car club vehicle can replace 10.5 privately owned vehicles, and lift sharing is largely an untapped option.[13] The UK company Liftshare estimates that over 20 per cent, and perhaps as many as 40 per cent, of employees of large organisations could share their commutes.[14]

There is also a lot of scope to increase walking and cycling with the right infrastructure in place. Over half of car journeys made (58 per cent) are less than five miles. It is estimated that half of these trips could easily be substituted with walking and cycling.[15,16]

The Committee on Climate Change has noted that promoting active travel, as well as buses, trams and light rail, could reduce car miles driven by ten per cent in the near future.[17]

What are the other benefits of cutting energy demand for transport?

The potential to curb energy demand from transport could be much greater if medium length journeys were also targeted for switching to public transit, alongside approaches to reduce the need to travel at all.

Journeys of between five and 25 miles account for 43 per cent of car miles driven. These journeys could often be replaced by better public transport, particularly within and between cities.[18]

A number of trends, including changing working patterns and advances in virtual meeting technologies can also help to reduce demand.

Priority should be given to co-ordinating transport and planning objectives to reduce the need to travel. For instance, local authority housing targets should include the travel efficiency of new developments.

Better health

£2.5 billion
The value of annual health benefits from shifting just 1.7 per cent of car journeys to active travel, like walking and cycling.[19]

Better air quality

65,000
The number of early deaths caused by air pollution in the UK each year, which greener transport will help to prevent.[20]

Improved mobility for low income households

46%
Almost half of low income households are likely to benefit from better public transport, as they have no access to a vehicle.[21]

Higher public satisfaction

74%
The percentage of people who want to reduce motor vehicles in urban areas for public health reasons[22]

Better quality of life

2x
People who drive two hours a day are twice as likely to smoke than those who drive for less than half an hour.[23]

More information about each of these benefits can be found in the endnotes

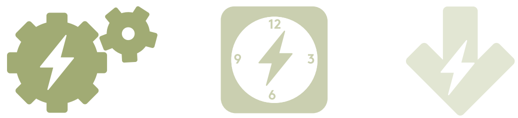
Buildings
Lack of effective policy is holding up progress

Buildings policy is not on track to deliver emissions savings compatible with net zero by 2050. By the end of the fifth carbon budget period, in 2032, the sector needs to reduce its annual emissions by around 35MtCO_2. Current policy will only result in a reduction of 5MtCO_2 a year by then.

Annual emission reduction needed by 2032

35MtCO_2

Energy demand reduction priorities



Progress has stalled

Together, the UK's 29 million buildings, including homes and commercial premises, are directly responsible for 17 per cent of the country's CO_2 emissions. And the indirect emissions arising from them contribute around ten per cent more.[24] Government buildings policy, combined with rising global temperatures, have seen direct emissions fall around 15 per cent since 1990, or about 0.5 per cent per year.[25] But, to be on track for net zero, emissions need to fall by 2.8 per cent per year.

The government has so far focused on new builds, for example in the Future Homes Standard. However, most of the country's 2050 building stock – including 80 per cent of homes – already exists now, and these properties have received relatively little attention.[26]

Since 2012, the situation has grown worse. Energy efficiency subsidies have been withdrawn, including £100 million a year for business and households through the Energy Saving Trust and the Carbon Trust. And the much publicised Green Deal scheme (2013-15) failed, disrupting the retrofit market to the extent that the loft insulation rate in 2018 was just 2.5 per cent of the rate in 2012.[27]

Policy for existing buildings is outdated and has neglected the harder to install measures: in 2018, only eight per cent of the Committee on Climate Change's targeted loft insulation installations were achieved, with solid wall insulation and cavity wall insulations not faring much better, at 20 and 41 per cent, respectively.[28]

Commercial buildings remain a policy blind spot, receiving just four paragraphs in *The clean growth strategy*, compared to 11 pages dedicated to households.

Making existing buildings more efficient

New government policy should focus on reducing energy demand by targeting and funding major improvements to buildings' energy efficiency, including the neglected harder to install measures. *The clean growth strategy*'s goal of ensuring all existing homes reach at least EPC band C by 2035 will be out of reach unless the government embarks on an ambitious new programme, requiring at least an additional £1 billion per year of public investment. This would attract considerably more in private finance.[29]

However, the EPC target is a blunt instrument and new policies should target cost effective long term improvements. Options include segmenting and providing incentives for the 'able to pay' market. This could be done through stamp duty reforms and zero interest loans, as identified by the government's Green Finance Taskforce.[30] And where hard to install measures, like solid wall insulation, are needed, aiming for EPC band A or B could be only marginally more expensive and avoid the need for future upgrades.[31]

To exploit these opportunities, more reliable, real world performance data is needed. Better data should be used to update the EPC rating system, in line with the need to decarbonise energy supply to meet the net zero challenge. Consequently, regulation should focus on actual rather than modelled heat loss, and assessments should be standardised and more rigorously enforced.[32]

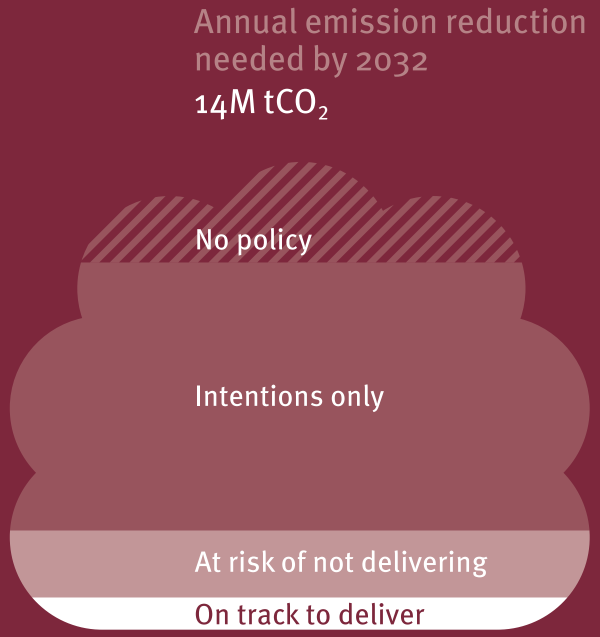
Likewise, for commercial buildings, evidence from other countries, including Australia, suggests that regulatory and market approaches based on in-use energy performance are much more effective at influencing emissions reductions throughout supply chains.[33]

What are the other benefits of cutting energy demand from buildings?

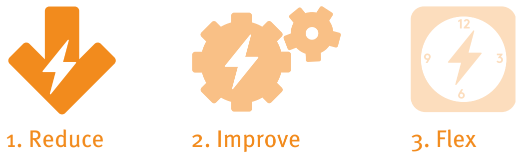
Industry

Resource efficiency potential is largely untapped

Government industrial policy is not on track to deliver emissions savings compatible with net zero by 2050. By the end of the fifth carbon budget period, in 2032, the sector needs to reduce its annual emissions by around $14MtCO_2$. Current policy will only cut $1MtCO_2$ a year by then.



Energy demand reduction priorities



Improvements in energy intensive industries are reaching their limit

In 2018, industry was responsible for 21 per cent of the UK's emissions, as well as using almost a third of grid electricity, causing another four per cent of indirect emissions.[40] Despite an increase in demand for goods and services, emissions have fallen to 52 per cent below 1990 levels. However, the rate of emissions reduction has been slowing, and the level only fell by one per cent in 2018.[41]

Reduction in demand for energy from industry has largely been achieved through energy efficiency measures and moving manufacturing abroad. Between 1997 and 2013, offshoring manufacturing to other countries accounted for nearly 40 per cent of reductions, which does not lower global emissions unless the producing country has lower carbon production. Energy efficiency improvements accounted for half of the savings made.[42]

These improvements mainly occurred in energy intensive sectors, such as iron, steel and cement manufacturing, and were driven by high energy prices. The rate of improvement has plateaued in recent years, and there is limited potential for further gains in some very energy intensive industrial processes, like blast furnace steel production.[43]

The non-energy intensive sectors have had little incentive so far to improve their energy efficiency, despite being responsible for around 35 per cent of total industrial energy demand.[44]

Scope to improve resource efficiency

The next frontier of cuts in energy use should come from bringing down the demand for new products and promoting resource efficient industrial processes. This would reduce the energy embodied in products from their production and consumption.

Resource efficiency is an almost entirely unexploited tool in climate policy. Estimates suggest it could lead to carbon savings three to four times greater than those envisaged by the government for energy efficiency by 2050.[45]

In essence, resource efficiency means 'putting less in', by using and losing fewer resources in industrial processes, and 'getting more out' by ensuring longer, more intensive use of industrial outputs. The former can involve reducing waste in industry, lightweighting products and more modular design or remanufacturing. And the latter involves better quality products used for longer, including through repair and remanufacturing, and sharing items or using services instead of owning products.

Such strategies do not usually need any major breakthroughs in technology or much capital investment, but businesses often lack the strategic overview and foresight to make the change. This is compounded by poor price signals. And the economy wide target to double overall resource productivity by 2050 is not providing individual businesses and sectors with any incentive to change. The UK as a whole is already on course to easily surpass the government's unambitious target by tripling resource productivity by 2050. To make the most of resource efficiency's potential, far greater ambition from government is needed.[46]

A better approach would be to prioritise sectors offering the biggest energy saving potential, like construction, vehicles, electronics, food and textiles.[47] This could build on plans to create voluntary 'resource efficiency clusters'.[48] Germany's successful Resource Efficiency Programme (ProgRess) offers a template for increasing ambition and targeting specific sectors. It involves 31 'amplification networks' sharing best practice both across industries and within sectors.[49]

What are the other benefits of cutting energy demand in industry?

Lower business costs

£10 billion
Amount by which the manufacturing sector's profits could rise through better use of materials.[50]

International climate leadership

Greater resource efficiency will cut the carbon emissions the UK is responsible for abroad.[51]

Rebalanced economy

£1.13 billion
Potential growth in annual profits in Wales through greater resource efficiency, compared to £130 million in London. Wales is currently the least productive region in the UK, and London the most productive.[52]

Higher productivity

5x
The average UK manufacturer spends five times more on costs like energy and resources than on labour.[53]

Lower unemployment

102,000
The predicted net jobs the UK could gain from circular economy activities like recycling, repair, remanufacture and reuse.[54]

Higher public satisfaction

81%
Proportion of people who want businesses to offer repair, maintenance and disposal services for the products they make.[55]

More information about each of these benefits can be found in the endnotes.

We can’t ignore energy demand any more

The Committee on Climate Change, which advises the government on preparing for and preventing climate change, has made it clear that the UK will remain off track in meeting its emission reduction targets if it continues to ignore energy demand reduction. It says: “It will not be possible to get close to meeting a net zero target… by pursuing an approach that focuses only on supply side changes.”[56]

As we have outlined, there is considerable scope to cut energy use across the economy, not least in the priority areas of transport, buildings and industry. Compared to the power sector, these sectors are way behind in taking action and have significant unexploited potential.

Government departments which have not previously played a major role in climate policy, including the Treasury, must now also be central to the economy-wide push to address climate change.

The three steps we have outlined should guide government policy development, by reducing the need for energy, then improving energy efficiency and flexing demand to use low carbon energy. As we have shown, this will not only help to cut the UK’s contribution to climate change, but also lead to many other positive effects, on people’s health, inequality and business performance.

The best policies to achieve it will be built on the best scientific evidence. At CREDS, teams of researchers from leading UK universities are working to understand the changes in energy demand needed in different sectors to shift to a secure, affordable and low carbon energy future. Policy makers should make use of this expertise and the centre’s large body of work to assist them in plotting the path to zero emissions.

Endnotes

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2 House of Lords, 26 June 2019, ‘Climate Change Act 2008 (2050 Target Amendment) Order 2019’

3 Speaking in Parliament on 9 September 2019, Lord Duncan of Springbank, parliamentary under-secretary of state for climate change, said: “We will need to be bold about taking ourselves forward to net zero by 2050, because our present initiatives are not adequate to deliver that. There will need to be a significant refresh not just of the wider clean growth strategy but of all aspects of this covering all government departments.”

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16 A Neves and C Brand, May 2019, ‘Assessing the potential for carbon emissions savings from replacing short car trips with walking and cycling using a mixed GPS-travel diary approach’, in *Transportation research part A: policy and practice*, volume 123. The research found that 41 per cent of trips under three miles could be substituted by walking or cycling, and that if the threshold was set at five miles, 11.2 per cent more could be replaced by cycling.

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20 See: J Lelieveld et al, 12 March 2019, ‘Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions’ in *European heart journal*, volume 40, issue 20. The research suggested 98 early deaths in the UK per 100,000 population. As the UK’s 2018 population was 66,435,600 according to ONS figures, that suggests 65,107 people will have died early because of air pollution. Cutting vehicles, especially in urban areas, will be vital to cut these deaths. Vehicles emit nearly a third of nitrogen oxides (NOx), including 80 per cent of NO_2, and 11-12 per cent of particulate matter. See: Joanna H Barnes et al, August 2019, ‘Emissions vs exposure: increasing injustice from road traffic-related air pollution in the United Kingdom’ in *Transportation research part D: transport and environment*, volume 73; and Defra and DfT, July 2017, *UK plan for tackling roadside nitrogen dioxide concentrations*

21 DfT, 31 July 2019, *National travel survey,* statistical dataset table NTS0703: ‘Household car availability by household income quintile: England’

22 DfT, January 2020, *National travel attitudes study: wave 2*

23 D Ding et al, 2014, ‘Driving: a road to unhealthy lifestyles and poor health outcomes’, in *PLoS one*. Smoking is not the only lifestyle risk that increases with increased driving time. Large amounts of time driving also increases the odds of insufficient physical activity, sleep deprivation, poor physical and mental health and obesity.

24 CCC, July 2019, op cit

25 Ibid

26 The Institution of Engineering and Technology, 2018, *Scaling up retrofit 2050: why a nationwide programme to upgrade the existing housing stock is the only way for the UK to achieve its carbon saving goals*

27 CREDS, July 2019, op cit. According to CCC data, 1.61 million loft insulations took place in 2012, compared to 43,000 in 2018 (against a target of 545,000)

28 Calculated from figures in CCC, July 2019, op cit. In 2018, only 43,000 lofts were insulated against a target of 545,000 per year. For cavity walls, the number insulated was 82,000 against a target of 200,000, and for solid walls, 18,000 were insulated against a target of 90,000 a year.

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35 Ibid

36 BEIS, June 2019, *Annual fuel poverty statistics for England*, 2019 (2017 data)

37 Public Health England, 2014, *Fuel poverty and cold home-related health problems*

38 BEIS, July 2018, *Helping businesses to improve the way they use energy: a call for evidence*. As with households, the evidence suggests that the payback period for businesses making energy efficiency improvements can be very short. In this call for evidence, BEIS identified the potential to deliver 40TWh of savings from buildings. This, it said, would require a capital cost of up to £20 billion to 2030, but would deliver up to £5 billion of bill savings in that year alone.

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43 Centre for Industrial Energy, Materials and Products, 2016, *A whole system analysis of how industrial energy and material demand reduction can contribute to a low carbon future for the UK*

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45 Ibid

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47 Previous Green Alliance research with CIEMAP suggests resource efficiency in the construction, electronics and appliances, vehicles, food and textiles manufacturing sectors could save 200MtCO_2e by 2032. This dwarfs the savings expected to come from *The clean growth strategy*'s energy efficiency and carbon emissions reduction targets in the same timeframe: 61MtCO_2e. See: Green Alliance, 2018a, *Less in, more out: using resource efficiency to cut carbon and benefit the economy*

48 HM Government, 2018, *Our waste, our resources: a strategy for England*

49 Ellen MacArthur Foundation, 2017, 'Case study: German Resource Efficiency Programme (ProgRess II)'

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by Libby Peake

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