Energising Britain

Progress, impacts and outlook for transforming Britain's energy system

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Preface

This report was commissioned by Drax Group and delivered independently by academics from Imperial College London (facilitated by the College's consultancy company, Imperial Consultants), and consultants from E4tech.

Drax Group commissioned the authors to conduct new research into how transformations in Britain's energy system are likely to impact the country's economic, societal and environmental outcomes.

The aim of this research is to provide insight into the changes that are occurring and those that are needed to ensure that energy system transformation unlocks opportunities for businesses, government and households in a just and equitable way.

This report is the independent opinion of the authors. It focuses on Great Britain rather than the United Kingdom as lack of data prevented Northern Ireland from being included.

Drax Group

Drax Group plc plays a vital role in helping change the way energy is generated, supplied and used for a better future. Its 2,300-strong staff operate across three principal areas of activity – electricity generation, electricity sales to business customers and compressed wood pellet production.

Imperial Consultants

Imperial Consultants provide access to over 4,000 research-active expert academics and Imperial College London's state of the art facilities to deliver innovative solutions to meet the business needs of industry, government and the third sector.

E4tech

E4tech is an international strategic consultancy focused on sustainable energy. E4tech helps clarify and simplify complex and uncertain situations, to achieve solutions that are technologically, economically and environmentally sound

Cover illustration: viewcreative.co.uk

Foreword

Our world is changing fast.

New technologies are transforming the way we live and work. They are changing businesses and communities and creating huge opportunities to improve our quality of life, and Britain's ability to compete in a global economy.

This shift is being enabled by a revolution taking place across our energy system – ultimately to a zero carbon, low cost system where technology and data will enable businesses and homeowners to create energy as well as use it, and give them more control over the energy they use.

These changes are creating significant benefits. But as in every transition there is a risk that those most able to take advantage of new technologies will enjoy their benefits first while others get left behind.

A failure to ensure the transition is enjoyed across Britain will also undermine much needed progress to decarbonise our economy and tackle climate change.

Drax, is at the heart of the energy transition. We see these changes taking place every day – across our businesses, and among the customers and communities we serve. What's less clear is how Britain is faring through this change.

Now, for the first time, this report gives us some answers. Researchers from Imperial College London and E4tech have looked right across our economy. Using 20 different metrics they have assessed progress in critical sectors including power, transport and industry. Crucially they've also broken down their findings to a regional level.

The results make stark reading. While real progress has been made in some sectors to decarbonise, others lag behind.

While most nations and regions have taken steps to create the future energy system we need, the picture is not uniform. Most worrying is clear evidence that once again a divide is opening between those parts of the country where people are better placed to take advantage of new technologies – and those who are not.

The conclusion is clear: Failure to address these energy divides will leave some communities falling behind. It will restrict our businesses ability to compete in a fierce global economy. And our efforts to tackle climate change will be hindered.

To respond energy companies, businesses, communities and governments must work together. Drax is committed to play our part.

I'm proud of the contribution we have already made. We have transformed the UK's largest coal-fired power station to become the biggest decarbonisation project in Europe and the country's biggest renewable power generator. Today, we maintain significant generation capacity aim to bolster our ability to provide flexible, low-carbon generation further – supporting the increase in solar and wind power across Britain's energy system. We're trialling innovative Bioenergy Carbon Capture Use and Storage technology, which is the first of its kind in Europe and has the potential to deliver negative emissions. And through our retail businesses we are helping thousands of business switch to use 100% renewable energy, and use it more efficiently.

But, this report shows us there is much more to do.

We will continue to invest in and develop the new technologies which will finish the job of taking Drax off coal, ensure we become zero carbon and play a bigger part in decarbonising the wider economy.

And, we will continue to help our customers reduce their own carbon emissions, save money and create new revenues from energy production which will boost their ability to compete in their own markets.

Our role is clear. Drax is enabling a zero carbon, lower cost future for all.

This report reinforces the challenges ahead, but also the opportunities to meet them. I commit Drax to playing our part to do so.

Will Gardiner

Will Gardiner
Chief Executive, Drax Group

Executive Summary

Why this report matters

Major pressures are shifting the UK's patterns of employment, leisure, travel and industry, with consequences for our energy needs. At the same time, the UK has made strong commitments to reduce greenhouse gas emissions related to energy. Many towns and cities struggle with chronic air pollution from cars, vans and lorries. Businesses and households face rising energy bills, putting a squeeze on both economic competitiveness and quality of life.

Electrification is essential, touching all elements of Britain's changing economy and energy system. Renewable electricity has radically transformed the power sector, and electric vehicles are poised to revolutionise transport. Electricity could lower the cost and pollution from home heating and the daily commute, as well as the way in which large buildings and factories operate. Alongside electricity, other ingredients of the future energy system will include a growing role for data, minimising energy use when power is in short supply and maximising use when and where it is plentiful, making intelligent use of low carbon fuels and heat, and potentially capturing greenhouse gases. Together these changes are known as the 'energy revolution'. There is strong global evidence of the imperative for this significant and – increasingly – urgent change.

Work towards the energy revolution is underway in UK, but so far much of the action has been behind the scenes. The sweeping changes to how we generate electricity have not changed what happens when you turn on the lights at home, but the next steps will impact on everyday life for many. The emergence of electric vehicles, intelligent home energy management and zero-carbon buildings are all necessary to stay competitive and honour our climate change and related policy targets. These will have profound implications on the cost of energy and how people receive energy services, so it is imperative to outline these changes for stakeholders of all types.

The UK's energy transition is well described by national and international expert bodies, but mainly looking at individual components of the system in terms of technologies, costs and benefits. These studies treat countries and continents as a whole, potentially missing the important socio-economic and environmental differences that exist within countries.

This assessment is the first to examine Britain's energy transition at the regional level, showing where each aspect of the energy system currently stands and where it must go to avoid being left behind.

This assessment is the first to examine Britain's energy transition at the regional level,[a] showing where each aspect of the energy system currently stands and where it must go to avoid being left behind. It looks more broadly than raw emissions reductions to consider the many infrastructural enablers for revolutionising the energy system. Crucially, it explores what these changes will mean for individual households, businesses and society as a whole, and exposes the important regional differences that are developing within Britain. Without awareness of these regional disparities and their potential impacts, Britain risks creating a two-tier energy system, where some get ahead with the fuels and technologies of the future, while others are left behind with the higher costs, environmental and health problems that come from burning legacy fossil fuels - **leaving millions of families and businesses less equipped to enjoy cheaper bills and better outcomes.**

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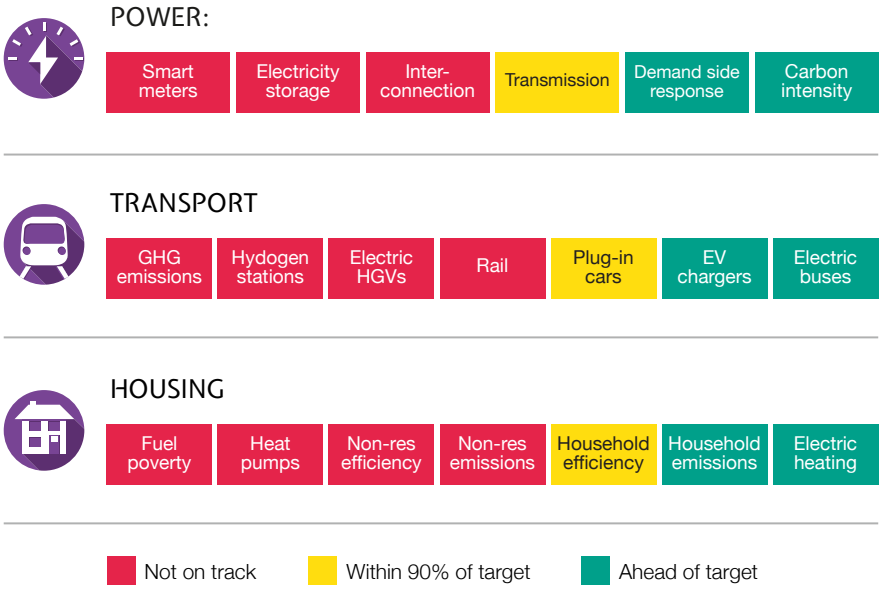
[a] Northern Ireland's electricity system is largely separate from that of Great Britain, so this study focuses on GB rather than the UK

Britain's energy transition progress

This report analyses Britain's complex and highly interdependent energy system by considering power generation and then energy use in transport, buildings and industry.

Within these four sectors, 20 measures have been devised to represent Britain's progress towards having an energy system that's fit for the future, and can serve households and businesses with clean, secure and low-cost energy. Aggregate progress is summarised below with a 'barometer' for three of the four sectors:[b]



Britain's greenhouse gas (GHG) emissions have fallen since 1990, but the decline is not evenly distributed across energy sectors. The outstanding success has been in the power sector, chiefly through closing coal-fired generation and the rise of renewables, also benefiting air quality. Further progress is expected, raising the importance of a smart and flexible power system that features demand side response, storage, interconnections and smart meters. Most of these areas are behind target, requiring immediate efforts to bring them in step with growing renewables.

The rapid clean-up of the power sector has fed through into electricity-consuming areas such as industry, where economic growth has decoupled from GHG emissions. Britain's industry is currently on track to reach climate targets. Absolute electricity use in industry has stayed constant while fossil fuel combustion has declined, as processes have been electrified and efficiency increases have been made. Further electrification will be harder, so GHG reductions may need to come through technologies such as hydrogen and carbon capture use and storage (CCUS).

All of this is made harder still by the need for most industries to remain internationally competitive whilst avoiding the 'offshoring' of emissions and jobs to other countries.

In contrast with the power sector, the limited pace of transformation in transport and domestic heating means that there is much more to do. Of particular concern is air quality in Britain's cities and the slow progress being made on diesel pollution, but CO_2 emissions from transport are also on the rise, especially from goods vehicles. The stage is set for a radical shift in transportation thanks to recharging infrastructure growth and EV sales picking up; over a quarter of new vehicle sales are expected to be 'plug-ins' by 2030 and forecasts are frequently being revised upwards. Electric buses are finding a place in cities where pollution is a pressing problem, but electric goods vehicles are some way behind. Hydrogen vehicles and infrastructure remain in their infancy in UK, though these provide a zero emission option for goods vehicles, where batteries appear less suitable. Furthermore, hydrogen may offer a means to electrify railway lines where the cost of overhead power lines is prohibitive.

The efficiency of Britain's building stock is a critical issue, with 13% of homes suffering from fuel poverty, and non-domestic buildings generally worse than households. UK buildings remain largely heated by fossil fuels, so only a few parts of the UK are well-placed to benefit from the decarbonisation of power through electric heating. The outlook for heating is unclear, with heat pumps, electric heating and hydrogen each having their proponents, but no overall direction. Regardless of the pathway choice (which is needed urgently) building efficiency will be a core feature. Thankfully, appliances and lighting in buildings have seen improved efficiency and thus reducing pressure on energy bills and indirect GHG emissions from the power sector.

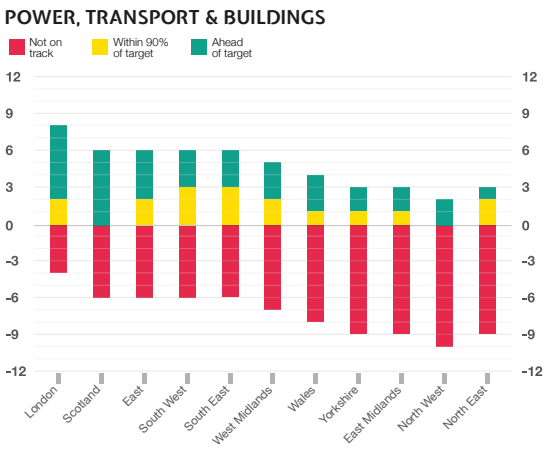
[b] Note that data are too scarce to support an equivalent summary for industry

Regional disparities

Progress in transforming Britain's energy system is uneven and this report reveals marked differences between the regions.

Generally, more affluent regions have made significantly greater progress. The north of England is falling well short, with only London and Scotland coming close to being on track to meet their overall targets. This first step towards exposing the differences between the regions paints an instructive picture of Britain's unequal progress, and it should be remembered that differences within individual regions will be similarly important.

Renewable power generation is distributed according to natural resources, so England has much less low-carbon power per person than Scotland and Wales. However, Scotland and Wales also have some of the lowest transmission capacities to neighbouring regions, holding back further development of renewables. In contrast with the general picture for most metrics, Wales and the North East have the highest penetration of smart meters in Britain, London the lowest.



In a fast-changing transport picture, the West Midlands and the East currently have the highest uptake of passenger electric vehicles, London has the most electric buses, while the South East, northern regions of England and Scotland have the highest share of ultra-low emission HGVs. On an absolute basis, however, the south of England is leading in the deployment of plug-in electric vehicles, which is correlated to higher household incomes in these regions.

Energy efficiency in buildings is neglected across Britain, and much lower than is justifiable. However, it is generally better in the south of England and Scotland and worse in the Midlands, northern England and Wales. The North East has done the most to fix low-efficiency houses, but still has high fuel poverty rates due to income levels and remaining poor quality buildings.

Implications for individuals, businesses and society

Cost reductions in key technologies such as renewable generators and batteries show that the costs of transforming the energy system could be modest. Ultimately, moving to modern clean energy could result in the lowest bills, although any increased capital costs to consumers and businesses should be considered in the context of affordability.

Homes and companies in London and the South East spend less on energy relative to income. Those in Wales and the North East spend the most, so any changes to energy costs will make the greatest difference to the welfare and profits of homes and businesses in these areas. In transport, the total cost of owning electric vehicles is on track to reach parity with conventional vehicles. However, the higher upfront purchase price of EVs poses a greater affordability barrier in less affluent regions. Scotland and Wales have lowest EV affordability, the West Midlands and London the highest. If marked differences in uptake arise from this, Britain's cities could see rising inequality due to the health effects of air pollution.

In industry, further electrification may be difficult without impacting on energy costs, unless measures are taken to level the playing field. The changing power mix is shifting employment patterns, with job losses in fossil fuels offset by gains in new industries, often in poorer remote areas. Electrification and automation often go hand in hand, and the South East, Midlands and north of England face the highest risk of job losses from automation.

Overall conclusions

In this first assessment of Britain's energy transition, there is much to be positive about, but the observation that "the future is already here – it's just not very evenly distributed" applies.

The rapid decarbonisation of electricity is a feather in the UK's cap, providing a means to transform electricity-intensive sectors. Buildings and to some extent industry are already benefiting, whilst transport is potentially well-positioned. There are tough challenges ahead though, since areas such as heavy industry, freight transport and some parts of heating do not immediately lend themselves to electrification, so other options need to be considered.

The uneven distribution of change also applies regionally and socially. A looming concern is the effect of disparities in the energy transition, with some at risk of being left behind economically due to unaffordable changes.

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As in other walks of life London stands apart, whilst less affluent regions in the north and elsewhere are falling behind on many measures. If the sole aim of the transition were to decarbonise energy, it might be rational to focus on wealthier metropolitan areas like London ahead of the rest of the country. However, if this begins to affect our way of life through the cost of energy, quality of services and air pollution then such a strategy risks creating a twotrack energy system that worsens regional inequality. To be effective, the UK's energy transformation needs be a force for good across society and across the UK, not just where it is most convenient.

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