CBI

STEPPING UP TO THE CHALLENGE

CREATING A GLOBALLY COMPETITIVE LOW-CARBON ECONOMY IN 2030

FEBRUARY 2017

CONTENTS

FOREWORD

We live in a rapidly changing world. Innovation and technology are developing faster than ever, with implications for the way we live and work. The sharing economy, Internet of Things and 3D printing mean that every home can be a business, while the new industrial revolution of data, digitisation and communications mean that we can engage with the world around us in new ways. These changes are profound and will reach into every aspect of our lives and communities in the coming years.

We are also faced with political and economic change. Brexit means that we must redefine our relationship with Europe and the rest of the world. Meanwhile, a renewed focus on a modern industrial strategy will set a new economic direction for the country, as well as a new partnership between government and business to spread prosperity more evenly and build on the UK's economic strengths in a competitive global marketplace.

Our low-carbon transition, which is already well on its way, must be at the heart of this change. The UK's long-term carbon targets, combined with new technological advancement mean that the road to 2030 offers huge opportunity. Our energy system will become more dynamic, where people and businesses can all generate, store and share power. Companies and communities – no longer content to be passive consumers – are taking greater ownership of their energy future: adapting, innovating and thriving. Our homes and businesses should be more efficient and could be heated in new ways. And by 2030 the majority of new cars could be ultra-low emission; car ownership could even be a thing of the past.

Business will be at the heart of delivering this change, and is up to the challenge; whether it's developing the steel to go in our wind turbines or creating the smart appliances for our connected homes. But to do this, the right plan must be in place which recognises the interconnectivity and complexity of the world we live in. With this in mind, business will be looking to the forthcoming Emissions Reduction Plan to provide a clear and long-term framework so they can invest and innovate for the future.

But the plan should do more than what it says on the tin. A key measure of success will be to ensure a smart approach, which keeps the lights on and costs manageable for hard pressed businesses and families. But with the right mind-set, business and government can aim higher. By embedding the low-carbon transition within the government's industrial

strategy, embracing it across government – from Whitehall to town halls – and educating and empowering consumers, the UK can harness innovation in new technologies, exploit new markets and boost prosperity right across the country.

While 2030 might seem some way off, for many of the businesses that will drive the low-carbon transition, it is just two investment cycles away. And with our global competitors forging ahead, we cannot afford to lose pace. The vision for the future is exciting, but turning opportunity into action requires strong leadership and deep collaboration. We must start this new phase now.

Josh Hardie
Deputy director-general, CBI

EXECUTIVE SUMMARY

1 *Setting the stage for long-term, low-carbon growth*

Business has, to date, embraced the low-carbon transition, however the stakes have been raised. In the 8 years since the adoption of the UK Climate Change Act, business has been at the forefront of change, becoming more efficient and investing for the future. As a result, we have seen carbon cuts across the UK of almost 40%[1], with the low-carbon economy adding £29bn to the economy[2]. However, with the 5th Carbon Budget setting a tough new target to reduce emissions by 57% by 2030, and business confidence hit by policy uncertainty, the UK must up its game if it is to keep pace with global competitors.

In a changing environment – technologically, politically and economically – we need a fresh approach to meet this challenge. Ensuring a low-carbon transition which is affordable and keeps the lights on must be the foundation. However, if the right approach is taken, we can achieve more than this, aiming to build a more resilient economy for the future, where we continue to grow our advantage in new low-carbon technologies and markets - whether offshore wind or low-carbon vehicles - underpinned by a strong and competitive industrial base. This will support greater prosperity, growth and wellbeing right across the country.

2 *A refreshed plan: a 'future fit' policy framework for the whole economy*

Business will be at the heart of delivering our low-carbon vision, and needs a clear and credible plan against which to innovate and invest. Following a turbulent 18 months in energy and climate change policy, the government's Emission Reduction Plan will be key in building business confidence by providing a long-term framework which goes with the grain of the market and is 'future fit'.

In an increasingly interconnected world – where we might see cars connected to the electricity grid and homes and businesses generating as well as consuming energy – taking a 'whole system' approach to the transition will be crucial. We must ensure that interdependencies across the economy are understood, synergies exploited and innovative cross-cutting technologies developed. In parallel, more targeted policy actions and options will be needed to remove barriers and unlock investment and innovation across our homes, transport, power systems and businesses.

3 *The right mind-set: delivering and communicating the value of the low-carbon transition*

To fully maximise the opportunities of the low-carbon transition, we need not just a shift in policy, but a shift in mind-set – among government, business and consumers.

The low-carbon transition must not be considered in isolation, but should be a core thread running through government, with buy-in and ownership across departments and regional and local authorities. In particular, embedding the government's plan for a low-carbon transition within the long-term industrial strategy will be key to successfully translating business investment into sustained growth and competitive advantage for the UK.

A successful low-carbon transition also requires us all to play our part, and to work together in different ways. This firstly means a new relationship for government and business, with a new and long-lasting partnership to evaluate progress and assess options. But it also requires engaging consumers: both government and business have a shared responsibility to take the public with us on the low-carbon journey. While business must build consumer confidence and excitement in low-carbon products – whether low-carbon vehicles or smart technologies in our homes – government must continue to make the public case for the low-carbon shift through an honest conversation which is clear on both the costs and benefits.

Ultimately, government, business and the public must all drive and benefit from this change, creating a more competitive and prosperous Britain.

> *Business will be at the heart of delivering our low-carbon vision, and needs a clear and credible plan against which to innovate and invest.*

Recommendations

To support and accelerate investment and innovation, business will look to the Emission Reduction Plan to set out a credible, long-term plan, which works for all parts of the economy. This should be coupled with the right mind-set among government, business and consumers.

A refreshed plan: a 'future fit' policy framework for the whole economy*

	Homes	Transport	Power	Industry
Building on progress	Develop a refreshed strategy for household energy efficiency, focused on a clear outcome, lowest-cost pathways and innovative solutions	Continue to communicate and deliver incentives for Ultra Low Emissions Vehicles, ensuring regulation doesn't act as an unintended barrier to take-up	Set a clear long-term policy outlook for low-carbon power generation which ensures transparency and value for money for energy consumers	Improve existing policies to support industrial competitiveness and encourage positive investment decisions, particularly in energy efficiency
Accelerating change	Prepare pathways for decarbonising homes that account for the heterogeneity of the UK's housing stock, and include energy efficiency requirements, low-carbon heating, and the role of smart technology	Provide clarity on the long term ambition for Ultra Low Emissions Vehicles, considering the need for investment in skills, technology and infrastructure in order for business to confidently invest	Review and develop regulation that allows a range of low-carbon technologies and business models, such as storage and demand response, to thrive in a smart and more flexible system	Forge a long-term path for innovative solutions in industrial and commercial properties
Take a 'whole system' approach, with a focus on identifying and developing innovation around cross-cutting technologies and infrastructure, such as energy storage and a strategy for the deployment of carbon capture and storage/utilisation.				
Ensure the plan is underpinned by a set of smart principles which support a competitive low-carbon economy.				

* Detailed recommendations can be found within the sector specific chapters

The right mind-set: delivering and communicating the value of the low-carbon transition

- Ensure the plan is owned by all government departments and embraced by local government, as well as embedded into the government's wider programme of work, particularly its industrial strategy
- Foster a meaningful and long-lasting partnership between government and business to deliver the plan, potentially in the form of a Steering Board
- Develop a more honest dialogue between government, business and consumers, with clear communication about the costs of the low-carbon transition – through the publication of an annual report – as well as the benefits, at both an economy-wide and individual level.

A successful transition must recognise the interconnectivity and complexity of the world we live in, allowing innovative cross-cutting technologies to develop.

Setting the stage for long-term, low-carbon growth

The UK is turning 'green growth' from an idea into reality...

Business has embraced the low-carbon transition, becoming more efficient, productive, and innovative and investing in new low-carbon technologies and processes. As a result, the value of the UK's low-carbon industry stands at £29bn (Box 1) – more than that of the food and drink sector – and we have become world leaders in new and growing markets, such as offshore wind. This, supported by our first-of-a-kind Climate Change Act and Carbon Budgets (see Box 2) has led to carbon cuts of almost 40% since 1990, while our economy grew at the same time.

Box 1 - Green growth to date

- UK has cut emissions by 38% since 1990, while GDP has grown by 60%[3]
- Environmental goods and services contributed £29bn to the UK economy in 2014[4]
- Employment in low-carbon sectors increased by almost 11% between 2010 and 2014[5]
- The value added from the production of renewable energy activities doubled between 2010 and 2014, from £2.2bn to £4.5bn[6].

Box 2 - The Climate Change Act and Carbon Budgets

The Climate Change Act 2008 established a target for the UK to reduce its emissions by at least 80% from 1990 levels by 2050, in line with limiting global temperature rises to 2°C. The Act also established a system of five-yearly Carbon Budgets to manage the process, set out 12 years ahead of time to give business and society time to prepare.

In June 2016 the government legislated for the 5th Carbon Budget (2028-32) which will require that emissions be reduced by 57% on 1990 levels in 2030. Once the Budget has been set, the government is required to set out a plan to ensure the country meets the target[7].

...But the stakes have been raised, and we must up our game

While progress in decarbonising our economy has been strong to date, our high ambitions mean that there is much further to go. The Paris Agreement set the bar for global climate action, while domestically, the now legislated 5th Carbon Budget requires emissions cuts of 57% on 1990 levels by 2030 – equivalent to cutting all carbon from the transport and agriculture sectors combined.

Yet despite these commitments, a series of policy changes and lack of long-term certainty has undermined confidence – and indeed momentum – in the low-carbon transition at a time when global competition is strong (Exhibit A). The UK ranked 14th in its attractiveness to renewables investors in 2016, down six places in just 2 years. With our international competitors, particularly those in emerging markets like China and India, forging ahead to grow their share of the global low-carbon market, it is crucial that the UK raises its game in order to keep pace.

Exhibit A - Scale of the challenge

High UK ambitions

- Paris Agreement in force setting aim to limit temperature rises to 2°C , which the UK has ratified
- UK 5th Carbon Budget set a target to reduce emissions by 57% by 2030.

Declining investor confidence

- The UK has fallen from 8th in 2014, to 14th in 2016 in EY's renewable energy country attractiveness index[8]
- Almost 60% of energy infrastructure providers are dissatisfied with government's current energy policy framework to boost investment[9].

Strong global competition

- By 2025, Norway aims to have 100% electric vehicle sales[10]
- India plans 100 GW of solar power, and 60GW of wind capacity by 2022[11]
- China plans for 5m sales of electric vehicles by 2020 and currently produces two thirds of global wind capacity[12].

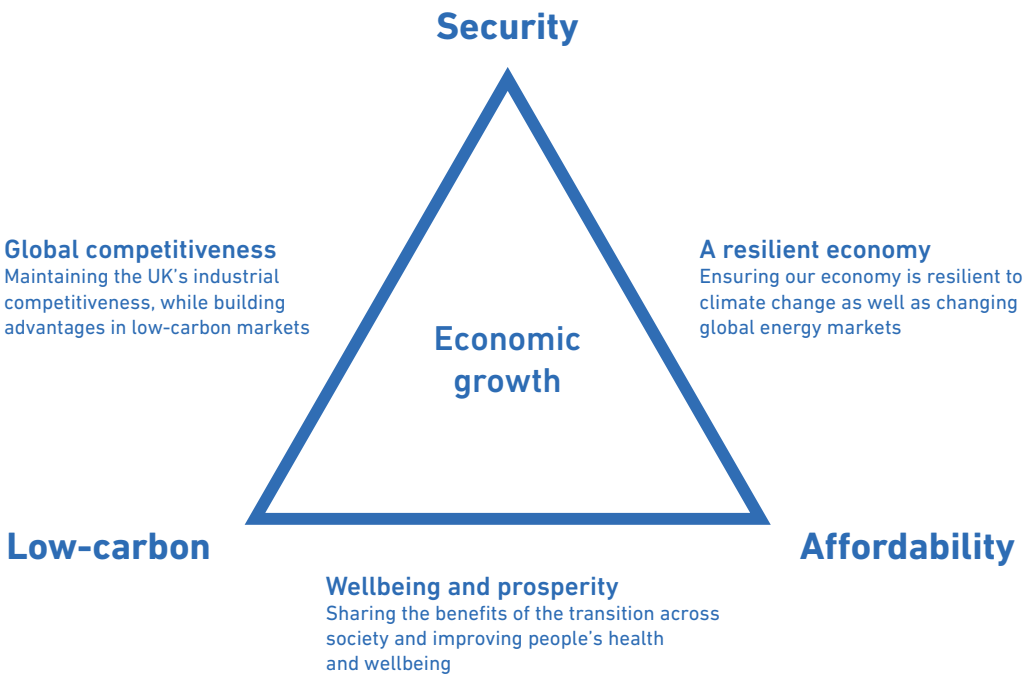
We must meet these new challenges in a time of significant change...

The government will, in the coming months, set out a plan to demonstrate how the UK will meet its long-term carbon challenges; and it must do so in recognition of a rapidly changing environment. We are in the midst of a revolution in technological and consumer trends, from the 'sharing economy' to the Internet of Things. At the same time, we have seen tectonic shifts in our political landscape following Brexit, with the UK now looking to redefine its relationship with Europe and the rest of the world. Furthermore, a renewed focus on industrial strategy and regional growth will set a new economic direction for the country, with the aim of delivering a system which works for all. Our approach to the low-carbon transition must reflect, and go with the grain of, this wider societal transformation.

...Which requires a refreshed approach to deliver a successful low-carbon transition for the UK

Addressing the energy 'trilemma' must remain a fundamental objective; but with a smart approach, we can achieve more (see Exhibit B). In moving to a low-carbon economy, it is essential that our energy supplies are secure, and with many households and businesses struggling with rising energy bills, we must keep the transition affordable for all. But with a credible plan and the right mind-set, we can go beyond this: building a more resilient economy for the future; driving our global competitiveness; improving people's wellbeing; and creating growth and prosperity across the country. These are bold ambitions, and will require clear leadership, as well as strong collaboration, as set out in the following sections of this report.

Exhibit B - Energy trilemma



We are in the midst of a revolution of technological and consumer trends; our low-carbon transition must reflect and go with the grain of this wider societal transformation.

A refreshed plan: a 'future fit' policy framework for the whole economy

Business will be at the heart of delivering our low-carbon vision, and therefore needs a clear and credible plan against which to innovate and invest. With the 5th Carbon Budget now providing a long-term direction of travel, industry will be looking to the forthcoming Emission Reduction Plan to set out a clear framework for how this will be achieved, enabling them to plan for the future.

Following a turbulent 18 months in energy and climate change policy, which saw a series of unexpected changes, such as the early closure of the Renewables Obligation to onshore wind and solar and the cancellation of the carbon capture and storage programme, a clear plan will be important. While it is not expected to provide all the answers, particularly given the rapid pace at which technology is evolving, business will expect the plan to be 'future fit' and underpinned by a set of smart principles (see Exhibit C), ensuring a low-carbon transition which works for all parts of the economy and supports a more competitive and prosperous Britain. Importantly, it must demonstrate:

A 'whole system' approach

In our digitally connected and increasingly smart world, the plan must recognise that no part of the economy operates in isolation. From homes and businesses producing as well as consuming energy, to factories providing waste heat to nearby communities, the linkages across the system are complex and wide-ranging. A smart system needs a smart approach, therefore it is crucial that these interdependencies (as set out in the diagram overleaf) are identified, and synergies exploited in order to keep costs down, supplies secure and to maximise opportunities. This should be underpinned by a focus on innovation around cross-cutting technologies and infrastructure, such as energy storage and carbon capture and storage/utilisation.

Targeted policy actions and options across the economy

While a holistic approach will be critical to the low-carbon transition, targeted action will, of course, be needed to drive investment in different parts of the economy. The government's plan presents an opportunity to assess where we can build upon progress already made and identify where more heavy lifting is needed. Importantly though, as we cannot necessarily know now exactly which technologies will provide the most cost-effective paths to decarbonisation in each sector, the plan must set the conditions for the market to innovate,

thus indicating a clear set of options and choices. As such, the Emissions Reduction Plan should focus on:

- Prioritising energy efficiency, and rethinking how we heat our homes
- Creating a significant gear shift in low-carbon transport
- Continuing progress in a low-carbon, secure and smart power system
- Driving further efficiency, innovation and competitiveness among industry

Recommendation:

Take a 'whole system' approach, with a focus on identifying and developing innovation around cross-cutting technologies and infrastructure, such as energy storage and a strategy for the deployment of carbon capture and storage/utilisation.

Recommendation:

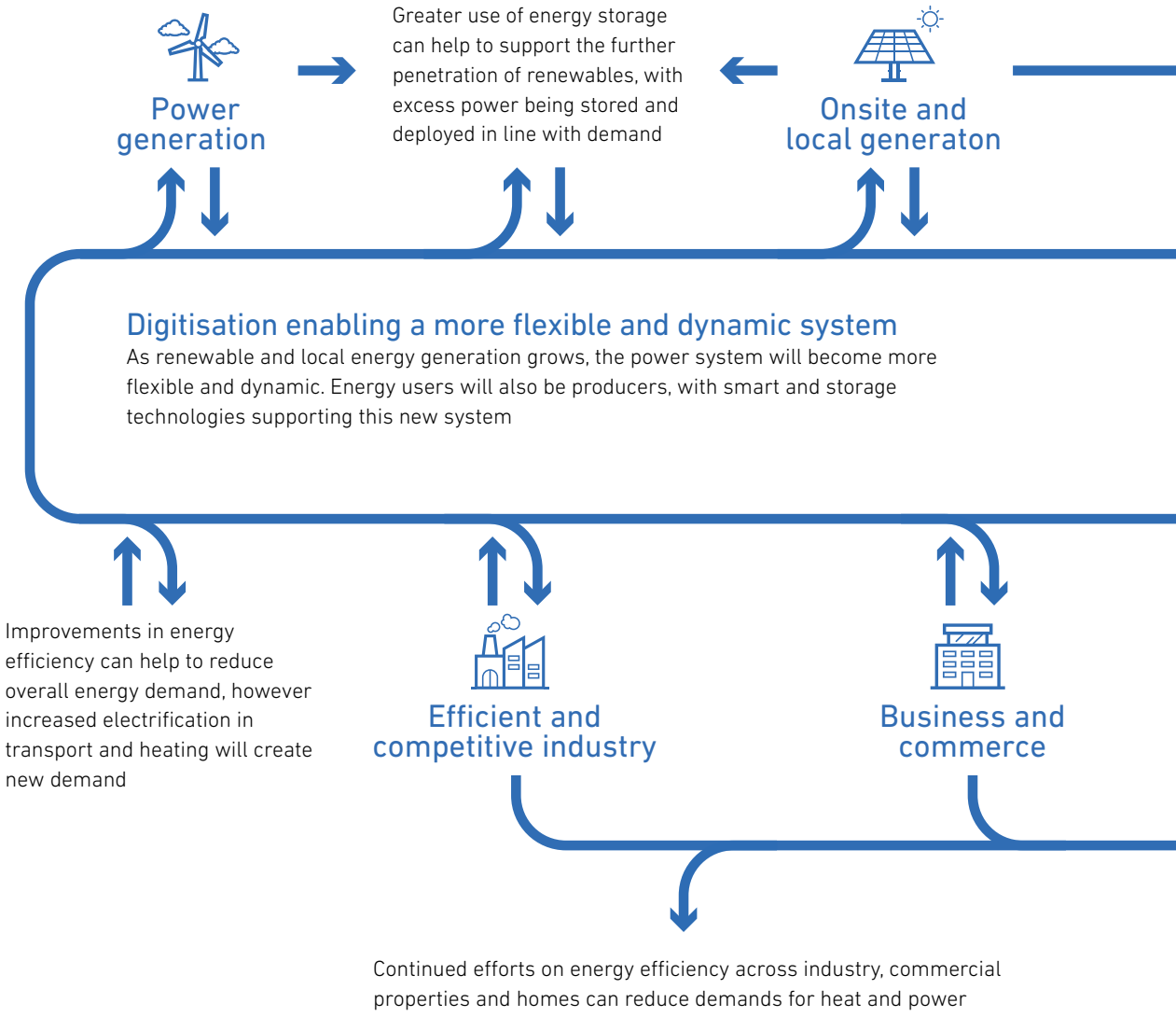
Ensure the plan is underpinned by a set of smart principles which support a competitive, low-carbon economy.

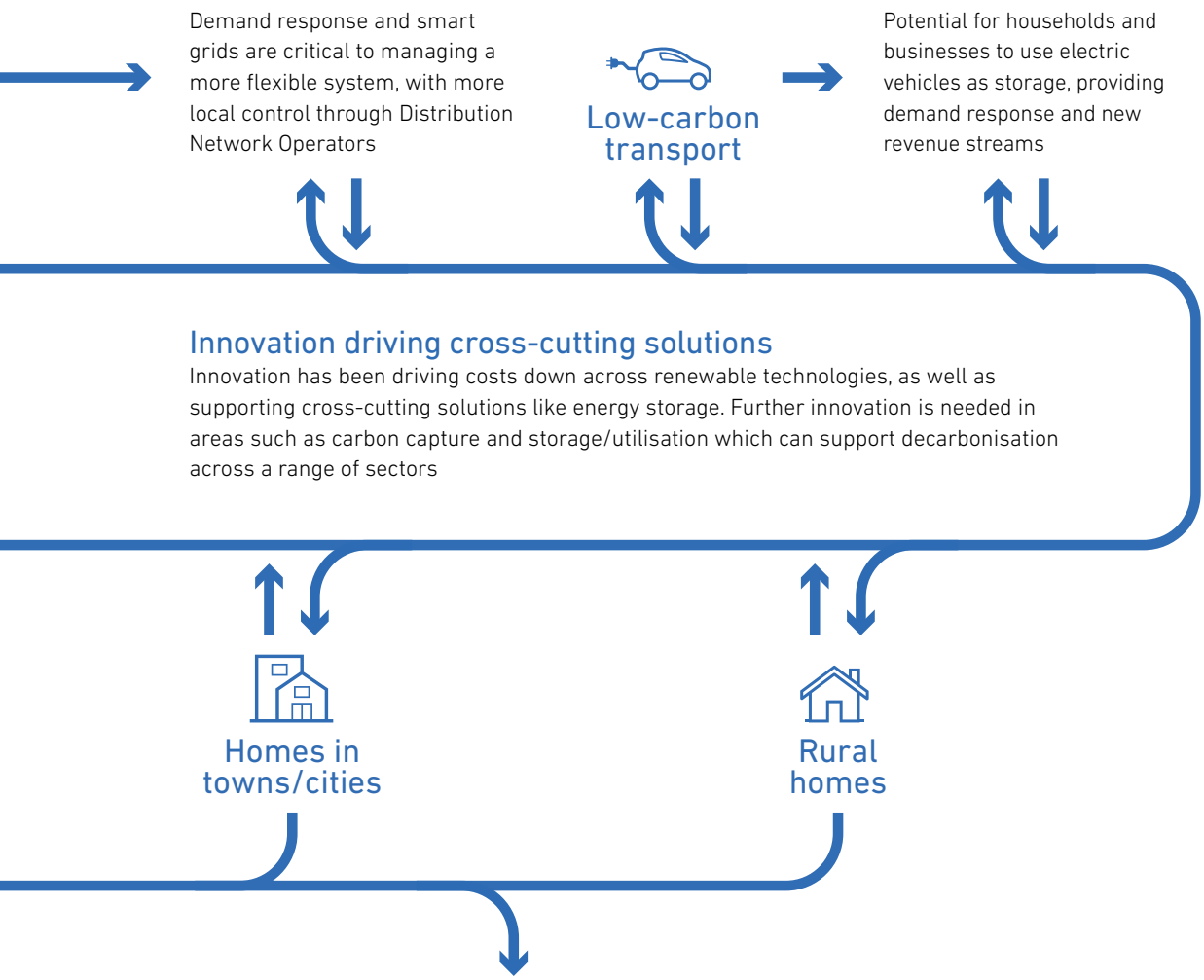
Exhibit C - Principles for a smart low-carbon policy framework

- **Market-led:** Policies should go with the grain of the market, avoiding distortions and enabling business and investors to respond to clear, long-term regulatory and price signals.
- **Technology-enabling:** The Plan should allow for a range of low-carbon technologies and fuels to come forward, ensuring flexibility for constant innovation, disruption and cost-reduction.
- **Long-term and stable:** To support positive investment decisions and drive business confidence, policies should be long-term in design and provide stability in implementation, with any changes pre-defined.
- **Cost-effective:** We should continue to follow a 'least cost' path towards a low-carbon economy, taking account of the cost burden for businesses and households, and supporting those that are vulnerable.
- **Inclusive:** As well as managing costs effectively, we should ensure that all parts of society are enabled and empowered to be both agents and beneficiaries of the transition. As such, policies should be simple in design in order to facilitate engagement.
- **Global outlook:** As the UK leaves the EU, it is important that we continue to maintain global efforts towards tackling climate change, maintaining our commitment to the Paris Agreement and progress efforts towards joined up carbon pricing schemes.

A whole-system approach to delivering a successful low-carbon shift

The various sectors in our economy do not operate in isolation. The policy framework must move with the fast pace of technological development – recognising these interdependencies, and exploiting synergies.




Demand response and smart grids are critical to managing a more flexible system, with more local control through Distribution Network Operators
Low-carbon transport
Potential for households and businesses to use electric vehicles as storage, providing demand response and new revenue streams
Innovation driving cross-cutting solutions
Innovation has been driving costs down across renewable technologies, as well as supporting cross-cutting solutions like energy storage. Further innovation is needed in areas such as carbon capture and storage/utilisation which can support decarbonisation across a range of sectors
Homes in towns/cities
Rural homes
Multiple solutions to low-carbon heat, such as heat networks, waste heat, alternative fuels and electrification. Success of deployment will depend on user and location

HOMES

Prioritising energy efficiency, and rethinking how we heat our homes

The success of the 5th Carbon Budget relies heavily on decarbonising the UK's housing stock. With some of the draughtiest homes in Europe, major improvements will be needed in energy efficiency along with a move towards low-carbon heating solutions and smart new technologies which have the potential to revolutionise how we power and use our homes. This can yield benefits far beyond reaching our carbon targets, supporting families in managing rising energy bills, as well as improving living standards and wellbeing. Achieving this goal requires a clear strategy that recognises the diversity of our homes and engages and empowers consumers to take control of their energy future.

State of play – slowing action on efficiency and little progress on low-carbon heating

- **Slowing progress on efficiency:** Despite a range of policy initiatives over the years to improve the efficiency of our housing stock, the UK still has some of the draughtiest homes in Europe. And, as government schemes are scaled back, and growth in the able-to-pay market remains slow, we've seen a fall in the total number of energy efficiency measures installed, down 87% on 2012 levels[13]. At the same time, households are paying on average around £1,200[14] each year for their energy, with bills having doubled over the past ten years.
- **The heating challenge:** Heating and hot water accounts for 40% of the UK's total energy consumption, and 20% of the UK's GHG emissions[15], with two thirds of those emissions coming from domestic buildings. Gas remains the dominant fuel used by the majority of households. There has been little progress in decarbonising our heat – in 2014 only 2.5% of total heating came from low-carbon sources[16].

Long-term goal – smarter, more efficient homes with consumers in control

- **Efficient and smart homes:** There is significant potential to continue to improve the efficiency of our existing homes through further insulation of lofts, cavities and some solid walls, while we could also see greater demand management and whole house refurbishment, including options around the better use of energy storage. Rigorous, practical standards for new builds could also prevent costly retrofit in the future, and technology such as smart meters and smart-enabled appliances will help to engage and empower consumers, and could play a role in supporting a flexible power grid.

- **Low-carbon heating:** With such a heterogeneous housing stock, a range of solutions to decarbonise heating must be considered. This includes electrification through the deployment of heat pumps, low-carbon heat networks and the use of bioenergy, such as biomass boilers or by injecting biomethane into the gas grid. Additionally innovations in green gas, and green hydrogen could provide low, or zero-carbon solutions, especially for rural/off-grid homes.

Key benefits – manageable bills, with improved wellbeing

- **Manageable bills:** It is estimated that a full house retrofit could result in up to a 59% reduction in bills[17], with studies showing savings to the tune of £8.61bn per year as a result of improving energy efficiency across the UK housing stock[18].
- **Improved wellbeing:** Additionally, energy efficiency in homes can deliver improved wellbeing for consumers. It's estimated that cold homes cost the NHS in England £1.36bn per year[19].
- **Jobs and growth:** According to a recent report, bringing all homes up to an EPC C standard could see a 0.6% relative GDP improvement by 2030, as well as increased employment by up to 108,000 net jobs per year between 2020 and 2030, spread across the whole UK[20].

Ambition in action

Green Energy Options – developing a 'hybrid home'

Green Energy Options have developed the 'hybrid home' allowing consumers to benefit from smart technology, focusing on making homes affordable to run, and allowing consumers to have more control over their energy usage.

Germany – taking action on energy efficiency

Following the launch of the EU's energy efficiency directive in 2012/27, Germany launched a comprehensive strategy – the National Action Plan on Energy Efficiency (NAPE). The plan focuses on three key elements: the role of energy efficiency in reducing emissions; driving energy efficiency services, technologies, and competitiveness; and embedding the ethos that energy efficiency is an individual responsibility. All of this seeks to create the environment in which businesses can make long-term investment decisions. Whilst the UK was subject to the same efficiency directive, the lack of consistency in policy set by the UK significantly undermined confidence.

Key challenges – lack of consumer engagement and policy certainty

- **Lack of consumer understanding and engagement:** The current lack of information on alternative heating sources, as well as what it means for both convenience, cost of installations and impact on bills is a barrier to uptake. Additionally, consumers still do not see the value of energy efficiency, and are often put off by the perceived 'hassle factor'.
- **A policy gap for energy efficiency:** While a policy framework to drive the provision of energy efficiency measures to the fuel poor will continue with the Energy Companies Obligation, the end of the previous government's underperforming Green Deal policy, along with the Green Deal Home Improvement Fund, has left an incentives gap in the so-called 'able-to-pay' market, where take-up of measures remains low. This has also impacted the ability of landlords to meet minimum energy efficiency standards by 2018, which will become harder to achieve in the absence of support for up-front financing.
- **A lack of direction for low-carbon heat:** Whilst the government has attempted to drive the uptake of low-carbon heating technologies – largely through Renewable Heat Incentives, and a £320m capital investment for heat networks – a lack of clarity on the overall aim or intended outcome has meant limited progress. Limited information has been provided to consumers about low-carbon heating options, and with high up-front costs, and relatively low levels of government support, uptake has been low.

Brexit impact

As we leave the EU, the UK must consider its role within the EU Energy Efficiency Directive, which sets binding measures to help the EU reach a 27% energy efficiency target by 2030. In addition, many product standards are harmonised through the EU, as such the UK will need to consider whether it will maintain those product standards, particularly if it looks to export new, low-carbon heat and building efficiency technologies.

Supporting investment and innovation – recommendations to government

Building on progress

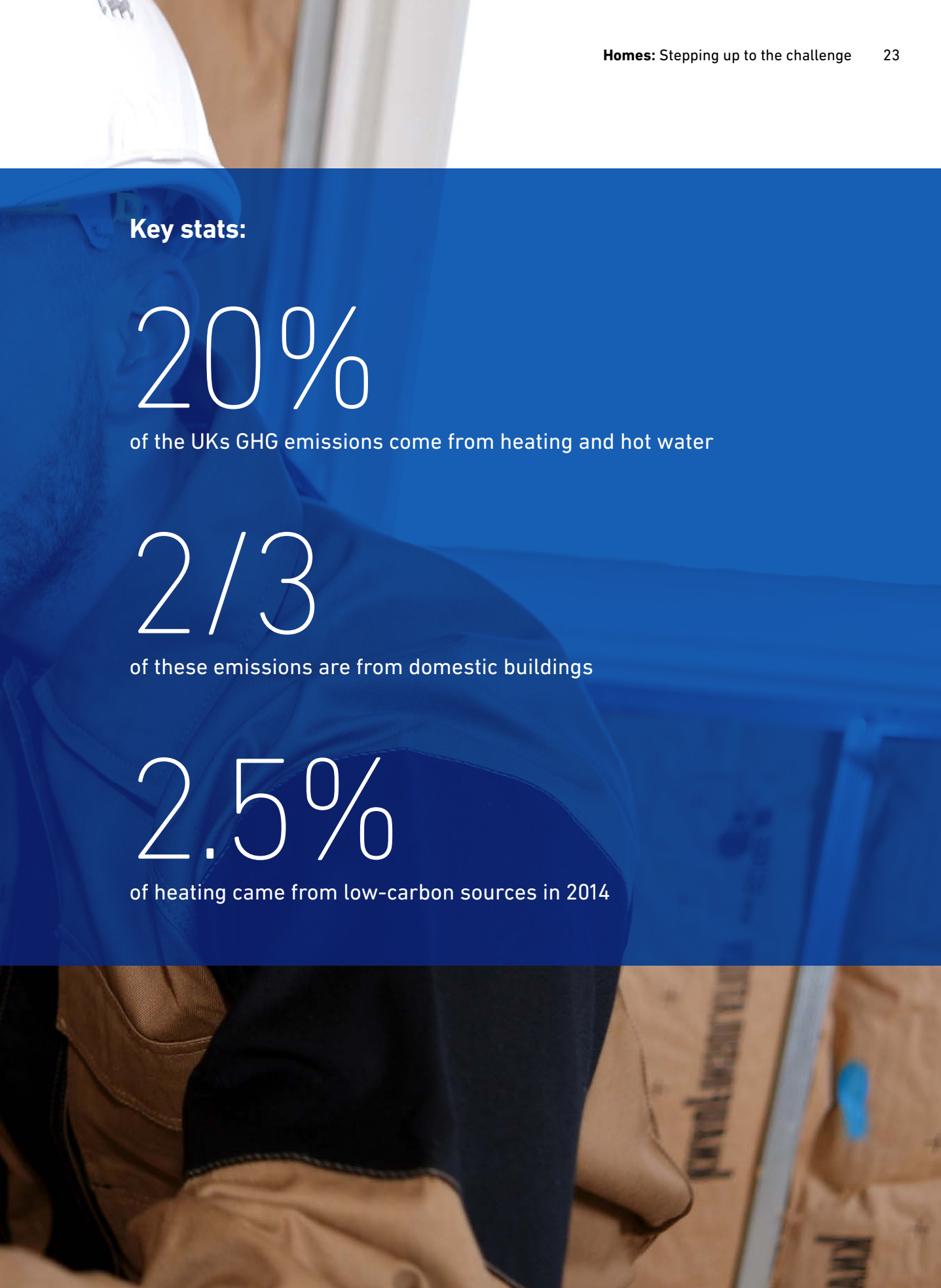
Develop a refreshed strategy for household energy efficiency, focused on a clear outcome, lowest cost pathways and innovative solutions. This should include:

- Incentivising those in the able-to-pay market utilising the findings of the Bonfield Review, and providing consumer information at key trigger points (e.g. house-buying, mortgages and stamp duty)
- Supporting the roll-out of smart meters by improving awareness and understanding among households, including their opportunities for installation and the benefits.

Accelerating change

Prepare pathways for decarbonising domestic buildings that account for the heterogeneity of the UK's housing stock, and include appropriate energy efficiency requirements, low-carbon heating and the role of smart technology.
This should include:

- Trialling a range of low-carbon heating options (e.g. through match-funded pilot programmes), working with industry and Local Authorities where appropriate to suit local needs
- Laying the groundwork to make new build homes 'low-carbon ready' through the installation of smart enabled (or smart optional) appliances and networks.



Key stats:

20%

of the UKs GHG emissions come from heating and hot water

2/3

of these emissions are from domestic buildings

2.5%

of heating came from low-carbon sources in 2014

TRANSPORT

Creating a significant gear shift in low-carbon transport

The way we travel and the types of vehicles we use in 2030 could look very different to today. New low-carbon fuels and technologies, autonomous vehicles, as well as changing business models and consumer behaviour could facilitate and drive this transition. Alongside reducing emissions, this shift will improve our air quality and enable the UK to build on existing strengths in car manufacturing to drive growth in new markets. Realising this potential will require a strong communication plan to engage business and consumers in the take-up of low-carbon vehicles, as well as addressing the policy and infrastructure gaps that could act as a drag on progress.

State of play – a range of actions and incentives, with low-carbon vehicles starting to take off

- **Improved efficiency, but growing emissions:** Average car emissions have fallen by 18% since 2007[21], but with 36.7m vehicles registered on UK roads[22], domestic transport now makes up 21%[23] of our total emissions. 2015 saw a 1.4%[24] rise in emissions as demand for vehicles outpaced efficiency improvements.
- **ULEVs taking off:** With subsidies, tax breaks and access to free/discounted charging for electric vehicles (EVs) we have seen the number of ULEVs (Ultra Low Emissions Vehicles) on the road grow by 508%[25] in the last two years, to a total of 85,000 vehicles[26]. Additionally we have seen a rise in public charge points for EVs to over 11,000[27], as well as a growing number of hydrogen refuelling stations. In contrast to passenger vehicles, limited progress has been made on Heavy Goods Vehicles (HGVs), which remain unregulated at EU level.

Long-term goal – a rising uptake in ULEVs with shifting consumer behaviour driving change

- **Tipping point for ULEVs and alternative fuels:** With the right support, ULEVs will continue to reduce in cost and grow in the market. Alongside this, and particularly for HGVs, hydrogen fuel cells and sustainable biofuels could also play a key role over the longer-term.
- **Changing consumer behaviour:** Consumer attitudes towards vehicle ownership vs. usership may change, which may be driven by improvements in technology for autonomous vehicles. In addition, innovations in a smart, flexible power grid may see EVs allowing consumers to become 'prosumers', with EV batteries supporting demand side response, and even providing consumers with a source of revenue.

Key benefits – reducing dangerous pollutants, and driving growth across regional clusters

- **Improved wellbeing:** Based on government estimates, air pollution causes 50,000 early deaths[28], and as much as £20bn in costs every year[29]. A greater uptake of ULEVs, combined with a decarbonised power supply can reduce the level of pollutants which are currently having a negative impact upon consumer wellbeing.
- **Regional growth:** The UK has the opportunity to capitalise on its strong history in car manufacturing to lead in the production of ULEVs. For example, a Low-Carbon Vehicle Zone has been developed in Sunderland in the North East, bringing together universities with businesses and research centres to create a regional hub of expertise.

Ambition in action

Uber – changing how we travel

Uber has already delivered change to the way we travel through innovations such as UberPool, and now they are working hard to make ULEVs a viable alternative for drivers, as well as investing in autonomous vehicles, leading the way once again in innovations for the sector.

Norway – leading the way in the transition to zero emission EVs

In 2015, electric vehicles had a 22%[30] market share, something that can almost entirely be attributed to the substantial incentives that exist for consumers. These include: no purchase/import taxes; exemption from 25% VAT on purchase; low annual road tax; no charges on toll roads or ferries; free municipal parking; access to bus lanes; 50% reduced company car tax and exemption from the 25% VAT on leasing[31].

The low-carbon transition will be facilitated by new technologies and alternative fuels, as well as changing business models and consumer behaviour.

* ULEVs include vehicles with tailpipe CO2 emissions below 75g/km

Key challenges – lack of consumer engagement and policy certainty

- **Consumer awareness and perception:** The price of ULEVs are lowering and for now there are a range of incentives to bridge the cost gap, which must be communicated effectively to drive change. Furthermore, in the very recent past, owning a ULEV was seen as a significant lifestyle shift, however the ever-increasing range of these vehicles, alongside the growing infrastructure for re-fuelling means that public perception is not necessarily aligned with reality.
- **Policy gap for HGVs:** Alternative fuels will play a pivotal role in decarbonising HGVs, but currently the technology solutions are less advanced than for cars and light vehicles. Business needs support in order to find solutions and modernise fleets to meet future emissions targets.
- **Infrastructure gap:** With EVs expected to add pressure to the grid, demand side response, as well as investments in a flexible power system will be key to managing any fluctuations in demand. Consideration must also be made for charging and re-fuelling requirements for the range of vehicles we can expect by 2030, including charging in homes, both for those with and without off street parking.
- **Inconsistent regulation and policy:** Current policy can work against the deployment of ULEVs e.g. weight restrictions on roads restricting the use of EVs, potential inconsistencies of Ultra-Low Emissions Zones across cities and regions, as well as the unintended consequences of pedestrianisation and cycle lanes in cities on displacing traffic elsewhere.

Brexit impact

As current EU vehicle standards run through to 2020, it is important both from a manufacturing compliance perspective, and to support the UK's own emissions targets, that the UK considers its long term plans for vehicle emissions.

The UK has the opportunity to capitalise on its strong history in car manufacturing to lead in the production of ultra low emissions vehicles.

Supporting investment and innovation – recommendations to government

Building on progress

Continue to communicate and deliver incentives for ULEVs, ensuring regulation doesn't act as an unintended barrier to take up. This should include:

- Building on the Autumn Statement package in support of ULEVs, continuing to offer a range of incentives for consumers and SMEs whilst the cost gap for technology is bridged
- Ensuring policies and regulations are consistent with the continued uptake of ULEVs e.g. road weight restrictions that impact the use of EVs, particularly for light transit vehicles
- Engaging with Local Authorities to ensure the installation of ultra-low emission zones (ULEZs) are consistent across the UK and communicated in a timely manner to allow business to plan.

Accelerating change

Provide clarity on the long term ambition for ULEVs, considering the need for investment in skills, technology and infrastructure in order for business to confidently invest. This should include:

- Establishing clear milestones, particularly for emissions reductions in aviation and HGVs to allow businesses to confidently invest in innovation for alternative fuels
- Considering and planning for changing skills requirements with regard to the manufacture, maintenance and repair of ULEVs
- Considering how to ensure domestic and commercial buildings are future-proofed, with appropriate infrastructure available for charging and re-fuelling different vehicles.

Key stats:

18%

fall in average car emissions since 2007

1.4%

rise in emissions in 2015 due to increased demand

21%

of the UK's emissions now come from domestic transport

85,000

there are now over 85,000 registered ultra low emissions vehicles in the UK

Continuing progress in a low-carbon, secure and smart power system

The UK's energy market is in the midst of the most dramatic transformation since privatisation. Having already halved emissions since 1990, by 2030 we can expect to see around two thirds of our existing power stations shut down, including all coal power, with much of this capacity to be replaced by new nuclear, renewables and gas. We are also likely to see an increasing trend towards more local generation, where homes, businesses and communities move from passive energy consumers to more active 'prosumers'. A smarter and more flexible system, with innovative new technologies, can help manage this transition and ensure security of supply. But with technology moving at significant pace, it is crucial that policy keeps up.

State of play – significant emissions cuts, with coal declining and renewables growing

- **Falling emissions through increased low-carbon generation:** Power sector emissions are now 50% below 1990 levels, with generation from fossil fuels down from 74% to 54% between 2009 and 2015 and renewables up from 7% to 26%[32] over the same period, largely driven by policies such as the Renewables Obligation and more recently the Electricity Market Reform. In addition, the UK recently gave the green light to building the first new nuclear power station in a generation.
- **Tighter margins:** Capacity margins have tightened in recent years, made more challenging by less flexible renewables on the system. The Capacity Market has procured over 50GW from the 2016[33] auction for delivery in 2020/21, but no large scale gas power stations. Recently there have been more urgent interventions by the Systems Operator.
- **More local generation:** Decentralised generation – ranging from domestic rooftop solar panels to industrial-level Combined Heat and Power – now accounts for 14%[34] of the UK's energy needs.

Long-term goal – a more flexible and low-carbon system managing less predictable demand

- **New generation, with falling costs in low-carbon technologies:** Investment in new nuclear and renewables will continue as more plants come offline, supported by new build gas, and potentially carbon capture and storage. The cost of renewables continues to fall across the world – solar costs have more than halved since 2009[35] and offshore wind achieved record

lows in 2016. Energy storage costs have fallen 14% per year between 2007 and 2014, and are expected to fall a further 6% per year to 2020[36]. Maintaining a credible long-term delivery trajectory with competitive markets and appropriate support is key to maintaining this progress.

- **Peak demand becomes less predictable:** Trends in future electricity demand are very uncertain; with the potential rise in electrification of heating and transport, peak electricity demand could increase more quickly than total demand[37]. Smart technologies, as well as energy storage, should help manage supply and demand and store excess power.
- **Greater flexibility and local management:** With more variable renewables on the system, greater flexibility in demand from both homes and business, as well as a range of storage options, will be needed in order to better manage the grid. While Demand Side Response made up just 2.7% of the Capacity Market auction in 2016 it has the potential to make a significant contribution by the end of the decade. With decentralised energy expected to continue as a trend, local network operators may need to take on more of a role in balancing their systems.

Key benefits – lower system costs alongside new business models and markets

- **Leaner system:** The need for large-scale generation and transmission could be reduced by a smart, more local, and flexible grid, with cheaper storage and energy use responding to supply and costs. The National Infrastructure Commission estimates this could give up to £8bn in savings[38], and keep energy requirements down.
- **New business models:** Data analytics are presenting more opportunities to understand and manage energy use. In a more dynamic system there are opportunities for new ways of managing energy, such as demand aggregators, that could allow for greater choice and lower costs.
- **Market growth:** The UK invested $22.2bn in renewables in 2015[39]. With investment in renewable energy on the rise globally, this presents a significant export opportunity for the UK.

A smarter and more flexible power system, with innovative new technologies can help manage our low-carbon transition and ensure security of supply.

Ambition in action

AES Energy Storage – developing low cost solutions to storage
AES are developing storage solutions to support more renewable and low-carbon generation on the grid. As well as providing a store for excess generation, and releasing it when needed, they are providing flexible and rapid services to the electricity grid.

Dong Energy - providing frequency response from wind energy
Dong Energy has successfully completed tests demonstrating the ability of wind generation to provide frequency response to support the National Grid network. This provides much needed flexibility to the grid to manage peaks and troughs in energy supply and demand.

Key challenges: we have the technology, but not the rules and infrastructure to deliver change

- **Policy uncertainty and lack of long-term outlook:** Investor confidence was hit by considerable uncertainty in the policy environment over the last 18 months. Furthermore, with the overall envelope for incentives to drive decarbonisation – the Levy Control Framework – only set out to 2020, there is a lack of confidence among the industry to invest for the long-term. This is exacerbated by the lack of clarity around the future of carbon pricing in the UK.
- **Regulatory lag:** With rapid technological shifts taking place in storage and renewables, regulations are often unable to keep up. Energy markets must enable all technologies, including storage and demand, to compete on a level playing field within existing market-based mechanisms. Furthermore, increasing decentralisation, onsite generation and battery storage will affect network use and could risk the poorest users paying relatively more to cover network costs.
- **Complex markets hold back innovation:** Multiple and complicated markets for demand response and "ancillary" services (such as frequency response) can make it difficult for companies to invest in new markets and business models. Furthermore, many generation or storage providers face challenges or uncertainties around "stacking" a number of revenue streams, which holds back innovation and investment.

Brexit impact

As the UK leaves the EU, its role in the EU Emissions Trading System (EU ETS) is increasingly uncertain, with potential implications for the UK's domestic carbon tax, the Carbon Price Support. The future of the UK's engagement with the Internal Energy Market, and how the flexible interconnection with the continent works will also have to be planned. Following Brexit the UK will probably not be subject to the EU's long-term goals for renewable energy and emissions.

Supporting investment and innovation – recommendations for government

Building on progress

Set a clear long-term policy outlook for low-carbon power generation which ensures transparency and value for money for energy consumers. This should include:

- Providing sufficient visibility of Contracts for Difference and Capacity Market auctions, ensuring the most cost-effective pathways, while controlling costs for consumers.
- Establishing a long-term carbon price trajectory, taking account of the lack of clarity around the UK's future participation in the EU Emissions Trading System.
- Working with National Grid and Ofgem to reform network and transmission charges, to reflect fair costs and usage.

Accelerating change

Review and develop regulation that allows a range of low-carbon technologies and business models, such as storage and demand response, to thrive in a smart and more flexible system. This should include:

- Reforming the capacity and demand response markets to enable all technologies, such as storage, to compete on a level playing field, where they meet technical requirements, and enabling renewables and storage to compete in day-and-week-ahead energy markets.
- Working with National Grid and Ofgem to simplify ancillary markets to widen participation as much as possible among industry and aggregators.

Key stats:

26%

of UK electricity from renewables in 2015

14%

annual fall in energy storage costs between 2007 and 2014

£8bn

possible savings from a smart energy system

$22.2bn

investment in UK renewables in 2015

Driving further efficiency, innovation and competitiveness among industry

Emissions from the private sector, primarily industrial processes and buildings currently account for almost half of emissions, with deep cuts needed[40]. By 2030 new buildings will have to not only be more efficient, but utilise smart energy management systems that respond to users and the environment. In manufacturing, progress must continue in energy efficiency, which can be greatly enhanced through digitisation – "Industry 4.0" – and demand response. However, large-scale reductions will only be achievable through a step change in innovative technologies. Industry can be the bedrock of the low-carbon transition – producing the steel for wind turbines, or the batteries for electric vehicles – but with increasing energy costs an on-going threat, a smart transition which maintains industrial competitiveness is critical.

State of play – steady, but slow progress

- **Falling emissions and improving efficiency:** Industrial emissions are 50% lower than in 1990, with emissions intensity having improved by 23% between 1990 and 2010[41] as a result of investment in energy efficiency and new industrial practices. Industrial low-carbon roadmaps have supported engagement between government and industry.
- **Increasing costs:** With energy costs for the largest users 70% above the EU median[42], UK energy intensive industries (EIIs) are currently at a competitive disadvantage with European and global competitors, as well as for investment within global companies, though this has been partially alleviated for many by government support schemes.
- **Slow progress in commercial sector:** While industry has made steady progress on energy efficiency, non-residential buildings' emissions have risen 6% since 2007, with just 2.5% of heat coming from low-carbon sources[43].

Long-term goal – new technologies driving change, but major innovations needed

- **Technology driving change:** Half of businesses see the main benefit of automation as raising productivity[44], with the digitisation of Industry 4.0, and the role of ICT in manufacturing potentially saving nearly 500mtCO2 in 2030 across the EU[45]. Steady progress on efficiency can continue to be made, but without major technological breakthroughs, such as in carbon capture and storage, meeting emissions goals will remain a challenge.

- **Tightening regulation:** Minimum energy efficiency standards (MEES) will come into force for commercial leases in 2018 which is driving investment in refurbishment and the energy efficiency market.

Key benefits – leaner, more productive firms, with improved competitiveness

- **Managing energy costs:** An increase in the energy efficiency of buildings will lower overall costs for businesses in the long-term, which can support investment elsewhere, including local supply chains. Industry and manufacturing will be able to find cost and emissions savings in a number of ways. Demand-response could save £600m by 2020 and £2.3bn by 2035[46].
- **Greater opportunities for industry:** Renewed investment in more energy efficient infrastructure, and renewables will need foundation industries, such as steel, cement and glass, to play a central role. Waste heat could provide 5TWh/y of heating to local heat networks[47]. Although small in the overall demand, this could be significant in areas where used.

Ambition in action

Tarmac - using demand response to help manage the electricity grid
Tarmac are working with demand response aggregators to respond to changes in energy demand, turning off systems when the National Grid needs more energy. This generates revenue for the company, helps keep the system in balance and reduces system costs.

Tata Chemicals - combined heat and power to cut costs and emissions
By generating energy onsite through combined heat and power plants, Tata Chemicals are making their facilities more energy independent, more efficient and lowering emissions. They are also able to provide energy to the Grid when needed.

A low-carbon future can provide a range of opportunities for industry - but a smart transition which maintains competitiveness is critical.

Key challenges: financing change and building infrastructure

- **Securing the right finance:** Energy efficiency measures for industry often cannot compete with other investments on payback periods or return on investment, and as a result are often at the end of the queue when it comes to board level decision making.
- **Maintaining competitiveness:** With relatively high energy costs for the largest users, global companies in particular will struggle to compete for markets and investment and may find UK manufacturing displaced overseas.
- **Lack of infrastructure:** Taking advantage of industrial and waste heat needs the right infrastructure. Many heat sources are located some distance from potential customers, and new heat networks are difficult to introduce in developed urban areas.
- **Policy changes and complexity:** The unexpected cancellation of the CCS programme in 2015 and review of the "embedded benefits" regime have undermined investor confidence. Furthermore, the business energy efficiency regime remains complex, and taxes such as Business Rates can act as a deterrent to investments that may increase the value of a property.

Brexit impact

As set out previously, the UK must consider its position within the Energy Efficiency Directive. Although the future role of EU Emissions Trading System is uncertain, current proposals for Phase IV of the scheme will need to be assessed in order to ensure that they are supporting competitiveness amongst the UK's energy intensive manufacturing sector.

Supporting investment and innovation – recommendations for government

Building on progress

Improve existing policies to support industrial competitiveness and encourage positive investment decisions, particularly in energy efficiency. This should include:

- Continuing to exempt energy-intensive industries from key pass-through costs such as Contracts for Difference, and establishing a long-term regime to support competitiveness into the 2020s
- Publishing proposals for a simplified energy efficiency reporting regime, and using the tax system to incentivise energy efficiency investments e.g. expanding the scope of Enhanced Capital Allowances, and exempting new plant and machinery from Business Rates
- Working with industry to develop innovative financial models to fund or aggregate energy efficiency project finance, in order to minimise and share risk of commercial energy efficiency projects, including the effective use of industrial waste heat in local heat networks.

Accelerating change

Forge a long-term path for innovative solutions in industrial and commercial properties. This should include:

- Taking forward the Minimum Energy Efficiency Standards to provide long-term trajectory, and strategy, for energy efficiency in buildings, with the public sector taking a lead to help develop the market, local supply chains and the sector's expertise
- Building on the industrial decarbonisation roadmaps, and linking them up with the government's work on industrial strategy (e.g. through the Industrial Strategy Challenge Fund) to support long-term decarbonisation, through new technologies, particularly industrial carbon capture and storage/utilisation.

Key stats:

23%

improvement in industrial emissions intensity between 1990 and 2010

500m

tonnes of CO2 – potentially saved every year from greater use of ICT in industry

£2.3bn

annual saving from demand response by 2055

The right mind-set: delivering and communicating the value of the low-carbon transition

Putting in place a smart, holistic and long-term policy plan will give businesses the confidence to invest in a low-carbon future. But if we are to capture the full benefits of the transition, and ensure that all parts of society are bought into the journey, we require not just a shift in policy, but a shift in mind-set – among government, business and the public.

The low-carbon transition must be embedded within wider government policy, including its industrial strategy, to effectively translate investment into growth across the UK

In our increasingly interconnected world, the low-carbon transition must not be considered in isolation, but should be a core thread running through the government's wider programme of work. This means the Emission Reduction Plan must have cross-departmental ownership, with its objectives and relevant policies integrated into departmental strategies. Furthermore, as many of our future low-carbon solutions, such as heat, will be place-specific, we must also achieve buy-in at a local government level. It is important, particularly in the context of devolution, that local and regional authorities are encouraged and empowered to incorporate the government's strategy into their local plans, creating partnerships across local boundaries in order to fully maximise regional opportunities.

More broadly, embedding the plan within the government's long-term industrial strategy will be key to successfully translating business investment into sustained growth and competitive advantage for the UK. To do this, low-carbon policies should align with, and build upon, existing strengths, where we have the greatest opportunity to create skills, jobs and wealth at both a national and regional level. The offshore wind industry is a good example where the UK is already a global leader. As illustrated with the collaboration between Siemens and AB Ports in the Humber (see Box 5), by joining the dots between national policies, regional ambition and industry expertise, we can build up core supply chain capabilities at home, with the opportunity to export to new markets abroad. Indeed, with a global green market of over £3 trillion[48], low-carbon products and services have the potential to be a core part of the UK's 'calling card' in an outward-looking, post Brexit world.

Box 5 - Ambition in action: Maximising UK strength in offshore wind

Hull and the Humber have become a global centre for offshore wind. Located on the North Sea coast, the area has the foundation for some of the best offshore resources in the world. Building on this natural strength, Siemens and Associated British Ports have worked with other businesses, national and local government – with over £1bn already invested – to create Green Port Hull which is dedicated to offshore wind engineering facilities. In collaboration with local universities, they are supporting the development of skills, and a strong supply chain is emerging. The local industry is not only supplying the UK's offshore wind industry with state of the art turbines, but also delivering to the rest of the world. At a national level, British companies have already won over 100 contracts to provide services for 50 projects abroad, and with around 250 offshore wind farms now in development globally, this represents a major opportunity for both the region and UK plc[49].

We must work towards a three-way partnership between government, business and consumers

A successful low-carbon transition cannot be driven top-down, and needs all participants to play their part. Ultimately, government, business and consumers must all drive, and benefit from, this change.

This firstly requires a shift in the way government and business work together. Business has welcomed the way in which the government has sought input into the development of its plan for a low-carbon transition, and it is important that this momentum is taken forward into a new and long-lasting partnership. To this end, business would welcome an ongoing dialogue, potentially in the form of a Steering Board, to evaluate and track progress, as well as provide advice as further policies are developed.

Beyond this, both government and business also have a shared responsibility to educate and inspire the public, and to ensure that the low-carbon transition works for everyone. In recent years, we have seen that while consumers believe that tackling climate change is important, they don't necessarily understand how this relates to the energy bills they pay, leading to misunderstanding and potentially mistrust[50]. Industry has an important role to play in building public confidence and engaging consumers in new and exciting low-carbon products, from low-carbon vehicles to smart appliances. For its part, government must be transparent about the cost impact of its policies on consumers, through the publication of an annual report, and show greater leadership in making the case for the low-carbon transition, at both an economy-wide and individual level. With low-carbon goods and services adding £29bn to the economy, the UK has a good story to tell, but such abstract figures are unlikely to resonate – to build sustained support, people need to understand what the low-carbon transition means for them, in their everyday lives.

Recommendations:

- Ensure the Plan is owned by all government departments and embraced by local government, as well as embedded into the government's wider programme of work, particularly its industrial strategy
- Foster a meaningful and long-lasting partnership between government and business to deliver the plan, potentially in the form of a Steering Board
- Develop a more open dialogue between government, business and consumers, with clear communication about the costs of the low-carbon transition – through the publication of an annual report – as well as the benefits, at both an economy-wide and individual level.

Embedding the low-carbon transition within the government's long-term industrial strategy will be key to creating a more prosperous and competitive low-carbon Britain.

Conclusion

When the government publishes its Emission Reduction Plan, it should go beyond its stated title. It must not only address the energy trilemma, of affordable, secure and low-carbon energy, but also set out how all of society can reap the benefits of a low-carbon transition, building a resilient, prosperous and competitive economy.

Business will be central to achieving this ambition, so the plan must work with the grain of industry: using markets and competition, embracing all technologies, and providing a stable platform for long-term investment and innovation. It must not just set out threads of how each sector could decarbonise, but also how these will be weaved together in a system-wide approach. And it should be coupled with the right mind-set, whereby all levels of government embrace and embed the transition in their long-term strategies; where government and business work in partnership to deliver change; and where consumers feel inspired and motivated to play their part.

This profound shift is already well on the way. But with 2030 now in the rear-view mirror, and key emerging economies already staking claims as global low-carbon leaders, we must keep up the pace. In doing so, we have a once in a lifetime opportunity to deliver growth, jobs and prosperity right across the country and create a sustainable future for the next generation.

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