Distributed Energy

Powering sustainability

October 2018

centrica
Business Solutions

Contents

Foreword

“I'm excited about the role that distributed energy solutions has to play in meeting our national climate change targets.”

The summer of 2018 was one of the hottest on record for the UK, bringing home to many what the future could look like for our homes and businesses if global temperatures were to continue to rise.

As a country, we've made a big contribution to the fight against global warming and have so far been successful in meeting the carbon reduction targets set out by the UK government. Much of this is down to the strides made by the power generation industry in moving away from fossil fuels, in particular coal, to cleaner forms of electricity production.

But from here on, things get much more difficult as we strive to hit our ultimate goal of an 80 per cent reduction in UK carbon emissions by 2050. And the onus to achieve this now falls squarely on business, industry and the public sector.

I believe that distributed energy solutions have a central role to play in meeting our national climate change targets. The range of tools on offer that allows businesses to generate, store, and optimise their own energy will enable our businesses and public sector organisations to deliver a cleaner energy future for the UK.

This is not just about hitting targets or obeying rules set down by the government and regulators. We know from talking to our customers there is a growing customer preference for climate-friendly products, services and providers, which means that there is a commercial imperative too.

It needn't be expensive. The cost of distributed energy technologies is falling, they have the potential to create new revenue streams and can be financed in a way that does not detract from other vital investments .

At Centrica we are investing hundreds of millions of pounds over the next few years in distributed energy solutions. We're doing this because we believe that it will deliver competitive advantage for our customers and for us as the UK's leading energy supplier. But fundamentally, it will also help the planet, and we think that's good for everybody.

Jorge Pikunic, Managing Director,
Centrica Business Solutions

October 2018

Executive summary

The UK is a global leader in the fight against climate change, and has already cut emissions by 43 per cent since 1990[1]. The legally-binding Carbon Budgets set out an ambitious path to a 57 per cent cut in emissions by 2030, and ultimately at least an 80 per cent reduction in emissions by 2050[2]. This report focusses on the emergence of new distributed energy technologies which can help public bodies, businesses and heavy industry play their part in the UK's low carbon future.

Our analysis reviews the emissions-saving opportunity offered if just 50 per cent of organisations in the health, industry and hospitality & leisure sectors adopted distributed energy solutions. Overall, we project that these three sectors alone could deliver savings of 137 $MtCO_2e$ between 2017 and 2030, or deliver more than 9 $MtCO_2e$ annually. This equates to an annual saving of 11 per cent of the three sectors' current carbon footprint. Fast forward to 2030 and that's a three per cent reduction of the UK's entire Carbon Budget.

137 $MtCO_2e$

Potential emissions savings between 2017 and 2030

9 $MtCO_2e$

More than 9 $MtCO_2e$ potential annual emissions savings

To put this into context, the total saving (between 2017 to 2030) is more than the direct carbon emissions of the entire UK industrial sector in 2017 (105 $MtCO_2e$)[3], more than the carbon emissions of all UK transport in 2017[4], or more than one quarter of the UK's 2017 greenhouse gas (GHG) emissions . It is also equivalent to eradicating the carbon emissions associated with the energy use of the UK's 27m homes for nearly 20 months[5].

This highlights that the potential for emissions reductions through distributed energy solutions is significant. But all sectors of business and the public sector must continue to innovate if the UK is to meet the 2050 target of at least an 80 per cent reduction in overall carbon emissions.

In this report, we define the opportunities available to each sector, and provide an example of an organisation in the UK that is already achieving carbon savings from adopting new energy technology.

We also profile a range of distributed energy and power technologies available today, which together provide a toolkit for businesses and public sector organisations to take control of their energy use, upgrade their energy resilience and reduce emissions. We argue that falling upfront costs, new financing options including zero-capital investment plans, and the ability to create revenue from generation assets are all driving the uptake of this new energy technology.

Ultimately, we see the energy transformation taking place through a future energy market where deployment of distributed energy technology is the norm for businesses and large organisations.

This is likely to include emerging technologies which we believe can help build this future, such as smart grids and green gas.

Finally, as the move to renewable power generation has demonstrated, having the right political, fiscal and regulatory frameworks in place is critical to fostering innovation and bringing new technologies to maturity. As part of this report, we have identified three policy measures that we believe can help the UK realise its distributed energy potential:

1. The Department for Business, Energy & Industrial Strategy (BEIS) should commit to assessing the role distributed energy solutions could play in delivering long-term carbon emissions reductions for the UK and promote these solutions across government and public bodies, working with the devolved administrations as required.
2. The Committee on Climate Change should assess the impact of new energy solutions for larger energy users in achieving lower cost routes to decarbonisation.
3. Reform carbon accounting rules.

1 Committee on Climate Change, "Progress Report to Parliament", 2018
2 Committee on Climate Change, "Fifth Carbon Budget", 2015
3 Committee on Climate Change, "Progress Report to Parliament", 2018
4 Department for Business, Energy & Industrial Strategy, "2017 UK Greenhouse gas emissions, provisional figures", 2017
5 Department for Business, Energy & Industrial Strategy, "Government emission conversion factors for greenhouse gas company reporting 2018"; and Ofgem, "Typical Domestic Consumption Values", August 2017
6 Total cumulative emissions savings from a 2017 base year

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Our findings

We find that by 2030 if 50 per cent of organisations within these sectors embrace distributed energy they could achieve:

Health

- Annual emissions savings = **483 $ktCO_2e$** (equivalent to 16 per cent of sector's current carbon footprint)
- Total cumulative emissions saving to 2030[6] = **8.8 $MtCO_2e$**

Industry

- Annual emissions savings = **7.2 $MtCO_2e$** (equivalent to 11 per cent of sector's current carbon footprint)
- Total cumulative emissions saving to 2030 = **106 $MtCO_2e$**

Hospitality and leisure

- Annual emissions savings = **1.3 $MtCO_2e$** (equivalent to 14 per cent of sector's current carbon footprint)
- Total cumulative emissions saving to 2030 = **23 $MtCO_2e$**

> “The summer of 2018 was one of the hottest on record for the UK, bringing home to many what the future could look like for our homes and businesses if global temperatures were to continue to rise.”
>
> **Jorge Pikunic**

Introduction

The heatwave that hit the UK and continental Europe in the summer of 2018 brought home to many the potential scale of the effects of climate change. Ten years on from the UK’s landmark 2008 Climate Change Act, this has reinforced the importance of the UK government meeting its targets to cut emissions.

The Climate Change Act sets a 2050 target of at least an 80 per cent reduction in emissions compared to 1990 levels. The UK met the first and second carbon budgets, and is on track to meet the third. However, the Committee on Climate Change (CCC) projects a shortfall of 3.3 percentage points against the target of the fourth budget (2023-27) and 6.7 percentage points against the fifth budget (2028-32)[7].

The decarbonisation challenge for the UK is getting tougher as the rate required accelerates. Business, industry and the public sector accounted for 27 per cent of the UK’s emissions in 2015[8]. Whilst the decarbonisation of power has gone a long way, there is more to do and distributed technology could help to close this gap.

The October 2017 Clean Growth Strategy challenged businesses to improve their energy productivity by at least 20 per cent by 2030[9]. Centrica is supportive of this action and can help both industry and government reach their goals through the use of innovative technology. As the CCC outlined in its most recent report to Parliament, the decarbonisation of electricity generation is a clear achievement of the last decade, but to achieve the UK’s fourth and fifth carbon budgets, more decisive action is needed in other areas including industry and buildings[10].

With the government’s commitment to help reduce costs for businesses, distributed energy technology can play a significant role in helping to meet binding carbon targets.

But it is not only policy and regulation driving companies to pay more attention to their environmental impact. More than three quarters of the population agree that they are concerned about climate change[11]. This is feeding into consumer behaviour, as consumers show increasing preferences for green businesses. In a recent Centrica Business Solutions survey, 85 per cent of UK businesses said demonstrating green credentials will be essential to their brand identity by 2025[12]. Indeed, the UK’s ethical products and services market has doubled in value since 2008 to £81.3bn[13].

Against this backdrop, more and more businesses are pushing themselves to improve their environmental performance by engaging with initiatives rating companies’ sustainability performance, such as CDP (formerly the Carbon Disclosure Project). Centrica is a long-standing leader in this regard, with CDP awarding it an A- for action and disclosure on climate change in 2017[14]. Centrica is also a longstanding constituent of the FTSE4Good index, demonstrating strong environmental, social and governance practices.

7 Department for Business, Energy & Industrial Strategy, “Updated Energy and Emissions Projections 2017”, January 2018
8 Department for Business, Energy & Industrial Strategy, “The Clean Growth Strategy”, October 2017
9 Department for Business, Energy & Industrial Strategy, “The Clean Growth Strategy”, October 2017
10 Committee on Climate Change, “Progress Report to Parliament”, 2018
11 Department for Business, Energy and Industrial Strategy, “Energy and climate change public attitude tracker Wave 25”, April 2018
12 Centrica Business Solutions, Energy Advantage research, August 2018
13 Hancock, Alice. “Younger consumers drive shift to ethical products”. Financial Times, 23 December 2017
14 Centrica, “CDP recognises Centrica as a global leader for environmental action”, October 2017

The distributed energy offer

The shift away from large centralised power plants to distributed energy technologies is one of the defining features of the emerging new energy sector. Consequently, these new technologies are providing public bodies, businesses and heavy industry with a toolkit to take control of their energy use, improve their productivity, and lower emissions. These include:

Energy Efficiency

Support and technology to reduce costs and emissions by upgrading or improving a range of energy consuming processes, including lighting, building management systems, insulation, and heating and cooling systems.

Demand Side Response (DSR)

Assisting energy users to shift, reduce, or even increase their energy consumption during a given time period enables the grid to be more flexible and allows a greater role for renewables in power generation. It can also create revenue streams for businesses.

Energy Insight

Advancements in connected and sensor technology to allow energy users to accurately monitor their energy use across all equipment and devices by transmitting real-time data from equipment to an analytics programme. This enables businesses to respond to issues, undertake predictive maintenance and identify opportunities for cost reductions.

On-site Power Generation

A range of small-scale power generating technologies, including gas generators, can provide on-site generation, a source of backup power for sites as well as the ability to sell excess energy back to the grid at peak times.

Battery Storage

Battery storage systems are becoming more viable as a standalone asset or as an addition to on-site generation. Battery storage facilities are increasingly being combined with large scale industrial load to deliver flexible services to the grid from a single virtual power plant. This balancing service enables a greater amount of renewables to enter the system.

Combined Heat and Power (CHP)

CHP plants work by converting gas into both electricity and heat in a single process. It is one of the most efficient sources of energy and allows organisations to produce a significant amount of their energy and heat needs on-site, improving the resilience of supply, reducing costs and helping to reduce carbon emissions.

Solar

Solar power is a renewable source of generation that works by absorbing sunlight and converting it into electricity. Solar panels are mounted on the roof of a building, on a carport, or on the ground (such as in a field). The power generated can be used directly on-site, stored for later use or even fed back into the grid to create an additional revenue stream.

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Why more companies are taking control of their energy

UK businesses operate in a competitive domestic and global marketplace, requiring constant scrutiny of the bottom line. But more and more businesses are concluding that cutting emissions is not only aligned with their business models, but can boost their competitiveness for the future.

We believe there are three reasons why:

First, costs for technologies that can reduce emissions are falling rapidly. Battery prices are down 79 per cent since 2010 and are expected to fall further still to around $70/kWh by 2030 – a further 67 per cent drop on today's prices[15]. Distributed energy costs will continue to come down as technology advances, supply chains become more efficient and manufacturers achieve economies of scale.

Second, companies recognise that these technologies offer new revenue streams. Organisations with on-site power generation can buy and sell electricity live in the market or access funding through the Capacity Market.

> "With costs falling, revenue streams available to offset costs and different financing solutions on offer, distributed energy solutions are now more accessible than ever before."

Third, new financing options are available to companies for the deployment of these technologies. Banks are now alive to the opportunities of the low carbon transition, and a growing number are offering 'green loans' to businesses. Energy companies are also offering finance packages. Centrica, for example, offers zero upfront costs for some customers.

With costs falling, revenue streams available to offset costs and different financing solutions on offer, distributed energy solutions are now more accessible than ever before.

15 Bloomberg, "2018 New Energy Outlook", 2018

The distributed energy opportunity

Health

Our estimates suggest that if by 2030, 50 per cent of the NHS took up a suite of decentralised energy solutions the UK could:

- Achieve annual savings of **483 $ktCO_2e$**, the equivalent of 16 per cent of sector's current carbon footprint;
- Achieve total emissions savings of **8.8 $MtCO_2e$**

483 $ktCO_2e$
Potential annual emissions savings

8.8 $MtCO_2e$
Potential total emissions savings

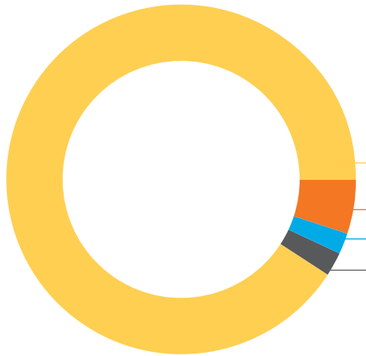
Context

With an annual carbon footprint of 2.9 $MtCO_2e$, the NHS's energy use accounts for five per cent of the UK's total annual greenhouse gas emissions[16]. Initially published in 2009, and updated in 2010, the NHS's Carbon Reduction Strategy has driven an 11 per cent reduction in emissions between 2007 and 2015.

The NHS is targeting a 64 per cent reduction in emissions from 1990 levels by 2030, and an 80 per cent reduction by 2050[17]. This will require an acceleration in abatement activities.

Distributed energy technology may offer a solution. Available finance options mean that technology can often be installed at no upfront cost, with guaranteed energy costs savings as well as carbon emissions reductions. Our 2017 Report, 'Distributed Energy: Powering Britain's Economic Future', identified that NHS England could save £130m a year on its energy bills if 50 per cent of the organisation adopted distributed energy solutions.

The equivalent saving for NHS Scotland would be £19m, while NHS Wales would see savings of £9m.



Assumed technology split to achieve cumulative savings from 2017 to 2030

- Energy efficiency incl. CHP 91%
- Energy insights and analytics 5%
- Solar PV 2%
- LED lighting 2%

Technology used by a typical customer

Hospitals with ageing energy infrastructure and inefficient gas-fired generation equipment can benefit from a range of technology:

- Energy efficiency:
  The industry benefits from efficiencies including CHP, lighting systems, building management system (BMS) upgrades and optimisation, insulation, macerators and PC shutdown. Transformative solutions to replace or update existing infrastructure in a cost-effective manner can achieve significant savings in carbon emissions and improve site resilience.
- LED lighting:
  Healthcare facilities require significant lighting installations, many in critical areas such as operating theatres. They can utilise long lasting LED systems to achieve energy savings and improve the wellbeing of staff and patients.
- Energy insights and analytics:
  Create an additional tool for ensuring patient safety with device and equipment level energy insight, as well as identify faulty equipment and action repairs before it breaks. Hospitals can also highlight energy waste and identify areas where efficiencies can be gained.
- Solar PV:
  Hospital and carpark roof space can be used to effectively generate on-site electricity for free with no carbon emissions.

16 Combined annual carbon footprint figure taken from: NHS Digital, Estates Return Information Collection 2016/17, England September 2017, State of NHS Scotland assets and facilities report 2016 and NHS Wales 2016/17 estate and facilities performance management system data. Energy use converted to carbon emissions using BEIS factors. Department for Business, Energy & Industrial Strategy, "2017 UK Greenhouse gas emissions, provisional figures", 2017

17 NHS Sustainable Development Unit, "Saving Carbon, Improving Health", January 2010

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"By saving £1m annually for the next 15 years, the contract will go a long way to help us maximise the resources we can put into patient care. It also massively cuts our carbon emissions and improves our overall sustainability."

Kevin Howell, Director of Estates and Facilities, St George's University Hospitals NHS Foundation Trust

CASE STUDY:

Energy savings for NHS hospital

Centrica Business Solutions develops energy strategy for St George's Hospital to deliver £1m annual savings and reduce environmental impact.

Replacing ageing energy infrastructure

St George's University Hospitals NHS Foundation Trust is the largest healthcare provider in South West London. A staff of 8,500 serve a local population of 1.3 million people. Around 800,000 patients are treated in the hospital each year, including more than 5,000 babies delivered.

The Tooting site also acts as a teaching hospital and advanced medical research centre.

The location had been served by a 40-year-old energy centre. This had grown increasingly inefficient, and incapable of meeting new environmental targets.

Energy efficiency to fuel improved patient care

In response, the Trust partnered with Centrica Business Solutions to create a new energy strategy for the hospital as part of a 15-year Energy Performance Contract (EPC).

The contract includes the installation of two Combined Heat and Power (CHP) units and four boilers, which form the energy centre. Centrica Business Solutions also introduced a number of schemes across the site, including lighting, a building management system, chiller replacement and split unit air conditioning optimisation.

During the work on the energy centre, it was crucial that the boiler house remained operational as the steam generated by the boilers is used to generate heat and hot water for the rest of the hospital. Centrica Business Solutions managed the installation without any impact on the hospital and its patients.

The results

The Trust is guaranteed to save more than £1m a year during the 15-year contract with Centrica Business Solutions. It will also save 6,000 tonnes of carbon a year, the equivalent of the emissions from 3,000 cars. The savings allow the Trust to invest more in patient care and teaching medical staff. The environmental savings help the Trust meet regulatory compliance, and act as a benchmark to other healthcare providers.

£1m savings
Guaranteed savings per annum over 15-year contract

6,000 tonnes
Annual carbon savings

15 year
Energy Performance contract

Industry

Our estimates suggest that if by 2030, 50 per cent of organisations in this sector took up a suite of decentralised energy solutions, the UK could:

- Achieve annual savings of **7.2 $MtCO_2e$**, the equivalent of 11 per cent of the sector's current carbon footprint
- Achieve total emissions savings of **106 $MtCO_2e$**

7.2 $MtCO_2e$

Potential annual emissions savings

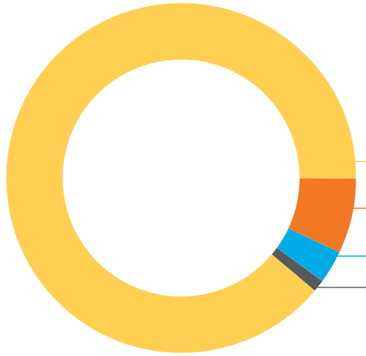
106 $MtCO_2e$

Potential total emissions savings

Context

As a sector responsible for around a quarter of UK emissions, the industrial sector has a key role to play in meeting the UK's climate change target. Taking no action on industrial emissions would see them increase to more than half of the UK's allowed emissions budget under the 2050 target[18].

Industry is aware of the challenge. More than a quarter of businesses see environmental and sustainability targets as one of the biggest challenges for the UK manufacturing sector[19]. Some of this is driven by fears that installing lower carbon solutions will increase energy costs and reduce the competitiveness of the sector globally. Policymakers too have been alive to the threat of 'carbon leakage' i.e. driving carbon intensive production out of the UK overseas to jurisdictions with less stringent carbon measures, with no reduction in global emissions.[20]. Distributed technology may offer the solution here. Now more affordable, and often with little upfront investment, it can help customers achieve significant energy savings and provide new revenue streams.



Assumed technology split to achieve cumulative savings from 2017 to 2030

Energy efficiency incl.CHP 89%

Energy insights and analytics 7%

Solar PV 3%

LED lighting 1%

Technology used by a typical customer

With high demands for heat, a typical customer in the industrial sector would benefit from the below technology:

- Combined Heat & Power (CHP):
  This technology supports secure 24/7 operations with efficient on-site generation, vital for the sector. The recovery of heat for operational processes or environmental systems immediately reduces energy costs.
- Energy insights and analytics:
  Equipment-level energy data and analytics tools identify energy waste and enable preventative action to repair malfunctioning equipment before it goes offline.
- Solar PV:
  A business can utilise its often large roof space to effectively generate on-site electricity for free with no carbon emissions. Combined with a battery, it offers enhanced flexibility.
- LED lighting:
  Achieve immediate, significant savings by replacing what are typically large lighting installations with more efficient solutions and improve the wellbeing of employees.

18 Department of Energy and Climate Change, "The Carbon Plan: Delivering Our Low Carbon Future", 2011

19 Centrica Business Solutions, Energy Advantage research, August 2018

20 Department for Business, Energy and Industrial Strategy, "Building our Industrial Strategy Green Paper: Response from the Energy Intensive Users Group", April 2017

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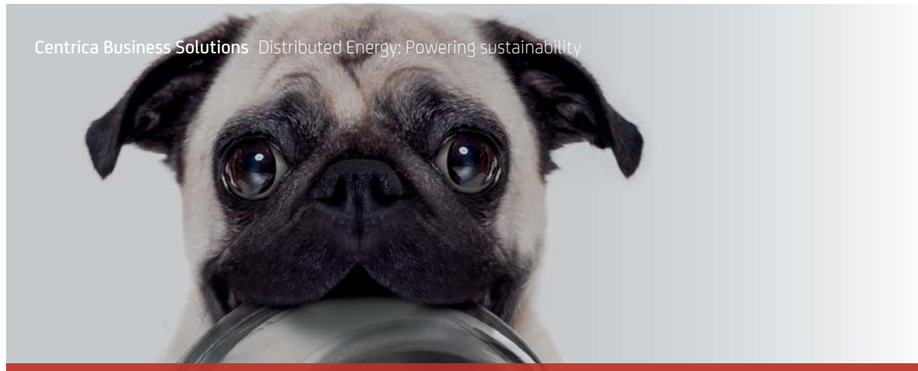


"We do everything we can to reduce energy consumption and prevent waste. Our Combined Heat and Power Plant (CHP) generates electricity from natural gas and also produces heat and steam for use in our production processes."

Company spokesperson

CASE STUDY:

Becoming a sustainable energy producer

A UK producer of dried pet food cuts carbon footprint and attains sustainable Bronze standard after installing Centrica Business Solutions' CHP unit.

Obligation to sustainable production

To become a sustainable energy producer, this UK pet food manufacturer sought to reduce its carbon footprint and make a positive impact in the local community.

CHP and beyond

A holistic approach to reduce energy costs in a sustainable manner needs an expert, multi-faceted strategy.

To aid the company's commitment to greener production, Centrica Business Solutions installed a Combined Heat and Power Plant (CHP).

The organisation also examined its approach to procuring resources. The business sourced materials such as meat and cereal from local farmers, which significantly reduced transportation costs and supported local businesses.

The results

Today, zero waste from the company reaches landfill, and any non-recyclable waste goes to waste transfer stations. The numbers associated with the new CHP unit demonstrate the manufacturer's commitment to sustainable energy production. In 2014, the business cut carbon output by 1,726 tonnes of CO_2.

Environmental governing bodies took notice. One prominent sustainable business monitoring firm honoured the company's commitment to sustainable business practices with their Bronze standard.

"It's great to see a business proudly setting the standard for the environment and making such a positive impact," says a spokesman for the sustainable practices firm. "Within their environmental commitments, the company introduced a robust waste management system, with good segregation of waste helping them achieve zero waste to landfill."

certified

Bronze standard for Green Business

0 waste

Zero waste goes to landfill

1,726 tonnes

Annual carbon savings

Hospitality and leisure

Our estimates suggest that if by 2030, 50 per cent of organisations in this sector took up a suite of distributed energy solutions the UK could:

- Achieve annual savings of **1.3 $MtCO_2e$** the equivalent of 14 per cent of the sector's current carbon footprint
- Achieve total emissions savings of **23 $MtCO_2e$**

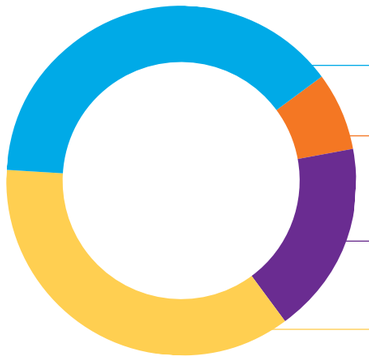
1.3 $MtCO_2e$

Potential annual emissions savings

23 $MtCO_2e$

Potential total emissions savings

Assumed technology split to achieve cumulative savings from 2017 to 2030



Solar PV 39%

Energy insights and analytics 7%

Battery storage 18%

Energy efficiency incl. CHP 36%

Context

The hospitality and leisure sector faces complex challenges due to the varied sources of CO_2 emissions in the sector. The regulation and policy framework for the sector is equally varied, ranging from building energy efficiency standards to transport and aviation emission standards.

Businesses recognise the need to improve the sector's sustainability and emissions performance, with a quarter of hospitality and leisure businesses responding in a recent survey that ensuring environmental and sustainability targets are met is one of the biggest challenges for their company[21].

21 Centrica Business Solutions, Energy Advantage research, August 2018

Technology used by a typical customer

The hospitality sector, with typical needs for heating and lighting large spaces would benefit from the following technology:

- Combined Heat & Power (CHP):
  CHP units would allow for efficient on-site generation of electricity, and the recovery and utilisation of heat for swimming pools and other facilities. The technology can also help avoid the need to enhance grid connections if expanding a business.
- Solar PV:
  Businesses such as hotels and leisure centres can utilise roof space to generate on-site electricity with no carbon emissions. It also supports the brand by demonstrating green credentials to guests. It can be combined with batteries to enhance flexibility.
- Battery storage:
  Store power on-site, such as that generated by solar PV to use during periods of peak prices to lower costs, such as early evening when facilities are busy. Batteries can be discharged at times when renewable generation isn't operational to further reduce carbon emissions and avoid using grid supply.
- Energy insights and analytics:
  Capture insights into your operations and identify ways to reduce energy waste and improve energy efficiency.

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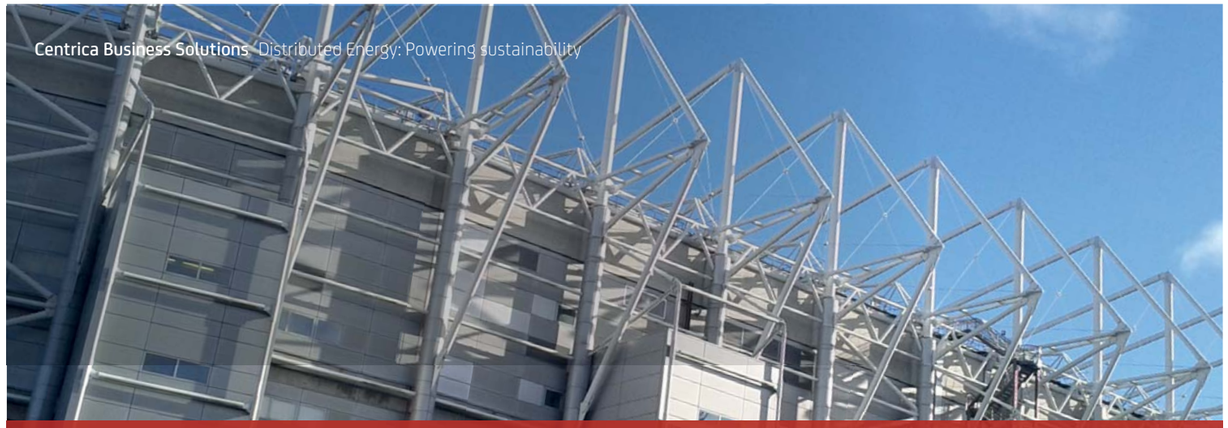

"Our partnership introducing a high efficiency CHP system is another major step in our mission to achieve outstanding green performance."

Eddie Rutherford
Facilities Manager at Newcastle United

CASE STUDY:

A great result for United

We're helping Newcastle United save 390 tonnes a year in CO_2 emissions – with no upfront costs.

They were looking to improve results

The club were already offsetting more carbon than they emitted through boiler optimisation, burner management, lighting upgrades, smart building and energy monitoring. But to take their carbon saving to the next level, they needed a permanent, cost-effective solution onsite.

Our solution was the perfect match

The ENER-G Combined Heat and Power (CHP) units were the perfect choice for Newcastle United. They don't just generate electricity, they actually recover the majority of the heat created in the process. This is then used to supply heating and hot water for the building.

Building the solution on-site

One of the main obstacles we overcame was the actual space constraints within the stadium. To get the equipment to where it was needed meant delivering it in three sections then rebuilding onsite.

With the system safely in its new surroundings, we de-rated the 230kWh CHP engine to 185kWh capacity in order to achieve a 200kVa load threshold. This was due to the electrical grid network constraints.

The results

The CHP unit is now helping the club reduce their CO_2 emissions by an additional 390 tonnes per year.

Thanks to the on-board computer, which provides a two-way communication channel between the unit and the ENER-G service centre, we can monitor the energy levels in real-time to optimise performance.

As the technology we supplied was on a pay-as-you-save basis via the Discount Energy Purchase scheme, there was no capital outlay for the equipment or installation either.

390 tonnes

of CO_2 emissions reduced annually

320 acres

or 320 acres of forest being planted

Future technologies

We have set out how UK public sector organisations and businesses are already using distributed energy technology to reduce emissions. But to meet the UK's 2050 commitment to reduce emissions by at least 80 per cent compared to 1990 levels, a more radical transformation will be required.

Innovation will be at the heart of this transformation. As the grid decarbonises, newer forms of technology will become available to support those in use today. Centrica and its partners are already working on this next generation of distributed energy and power technologies.

Ultimately, we see a future energy market where deployment of distributed energy technology is the norm for businesses, delivering dramatic carbon savings. Smart grids, both at the local and national level, will determine how energy is managed, responding efficiently to demand and supply patterns based on real-time data. Businesses will minimise costs and maximise commercial opportunities, using automation and AI systems either to go off-grid, or engage in local markets using their own small-scale generation and battery storage technologies. This real-time understanding of energy use can deliver greater flexibility for the grid.

We profile five technologies that we think will play a particularly important role in the future energy system:

Smart grids

Centrica's Distributed Energy and Power business is working on a pioneering £19m Local Energy Market trial in Cornwall that aims to help relieve grid constraints and support the further deployment of renewables in the region. The trial is testing the use of flexible demand, small-scale generation and storage across both the domestic and business markets. We are also developing a virtual marketplace that will provide participants with a platform to buy and sell energy and flexibility both to the grid and the wholesale energy market.

The government and National Grid recognise the key role flexible, smart energy will play in supporting a secure, affordable and lower carbon system for the UK. The National Infrastructure Commission has also suggested that smart power in the form of demand management, battery storage and other technologies could save the UK £8bn in the journey to meeting our decarbonisation targets and securing energy supplies[22].

Green gas

Green gas is a virtually carbon neutral gas created from biodegradable material. It is produced through anaerobic digestion of biodegradable feedstock, creating biogas and natural fertiliser as a by-product. The biogas can then be purified into high quality biomethane, which can be injected into the national gas grid alongside traditional fossil fuel gas.

In 2018, Centrica acquired a 50 per cent stake in Barrow Green Gas (BGG) the UK's largest biomethane supplier. BGG ships almost half of the green gas used by British homes and businesses. This new partnership will enable Centrica to offer customers a wider choice of renewable energy products.

Biogas CHP

While most CHPs currently run on natural gas, biogas CHP can combine the efficiency benefits of CHP with a carbon neutral fuel source. Biogas CHP should be of particular interest to food and drink manufacturers and agribusinesses with access to organic food waste as a potential input. While they can use the heat and power provided by the CHP themselves, some producers may choose to export excess power to provide back-up to the grid, or sell the heat on to other large users such as schools, hospitals or residential areas.

Linear generation

Linear generation is a technology that uses a low-temperature reaction of air and fuel to drive magnets through copper coils to produce electricity. The high efficiency of this technology provides substantial CO_2 savings compared to other technologies. Crucially the low temperature combustion produces less waste heat than conventional generators. Linear generation also produces near-zero levels of pollutants making it significantly better for air quality than other internal combustion generators. In our report, we have assumed a 50 per cent take-up of distributed technology, as for example, some customers may not have enough heat use to justify the use of a CHP. Linear generation, with its low temperatures could be implemented by a far bigger customer base.

Centrica invested in a California-based start-up called EtaGen in 2018. It is developing a linear generator which offers businesses affordable and flexible on-site power that's also reliable and clean. Based on research pioneered by its founders at Stanford University, the company has developed a highly efficient gas generator that has a lower emissions profile than conventional power generation. It also has greater flexibility and is more cost effective than competing clean technologies. We believe this could offer an important alternative to traditional CHP within the next three to five years. Heat pumps

Heat pumps

Heat pumps absorb heat from a variety of sources, including the ground, the air and water, and transfer it into a building. They supply more heat energy than the electricity they need to operate, giving them efficiencies (or coefficients of performance) above 100 per cent.

Heat pumps have not yet taken off as a heating technology in the UK, although they are used widely in many other countries including Sweden and France. In the non-domestic sector, heat pumps are relatively cost-effective. The Committee on Climate Change has estimated that heat pumps for businesses can run at a little over half the cost of conventional electric heating and will be cost competitive with gas heating for commercial buildings by around 2030.[23].

22 National Infrastructure Commission, Smart Power, March 2016

23 Committee on Climate Change, 'Sectoral scenarios for the Fifth Carbon Budget', November 2015

Policy recommendations

Distributed energy is a developing market and one which is growing rapidly. But to achieve the carbon savings described in this report the potential of distributed energy needs to be better understood and recognised.

We believe that the following recommendations would help to unlock the potential of distributed energy and deliver significant carbon savings.

1. The Department for Business, Energy & Industrial Strategy (BEIS) should commit to assessing the role distributed energy solutions could play in delivering long-term carbon emissions reductions for the UK and promoting these solutions across government and public bodies.

The government has set UK businesses a challenge: to improve energy productivity by 20 per cent by 2030. The government has also agreed to set tighter targets for emissions reductions in central government, and a voluntary public sector target of a 30 per cent reduction in emissions by 2020-2021.

As the UK public sector looks to do more with less, distributed energy technology can help improve the efficiency levels and emissions performance of public service provision. Reducing the emissions profile across the public sector estate should therefore be a central challenge as part of the Clean Growth Strategy.

We believe that BEIS should build on the initial analysis of this report to produce an authoritative assessment of the carbon reduction opportunities and economic benefits of distributed energy to the UK. This should also be extended to review how public sector procurement can be simplified to support the rollout of technology that saves both carbon and costs.

This would provide a powerful tool to promote improved decision-making in business and in the public sector. It would stimulate innovation and growth in distributed energy technologies by highlighting the potential emissions reductions. And it would provide an important signal to public services providers about the potential of these technologies.

In Scotland and Wales, the devolved administrations should carry out similar assessments as part of their strategies for decarbonising the public sector.

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2. The Committee on Climate Change to assess the impact of new energy solutions for larger energy users in achieving lower cost routes to decarbonisation.

Based on the initial research in this report, we believe that the potential impact of distributed energy solutions is yet to be fully incorporated into policymaking. Working with companies who are developing these technologies, the Committee on Climate Change should now take the lead in producing a definitive assessment of the cross-economy potential for distributed energy to cut carbon emissions. This should also include the scope for distributed energy technology in delivering future carbon budgets, assessing the impact of emission reduction plans across multiple sectors.

3. Reform carbon accounting rules

Companies listed in the UK are required to disclose the carbon emissions from the energy they use, incentivising companies to invest in measures to reduce their carbon footprint. However, the current rules mean that in some cases companies are unable to account clearly for the genuine carbon benefits of projects they undertake, deterring them from these investments.

As an illustration, consider a company that installs a battery storage unit. The company charges the battery at times of low electricity demand, and discharges it at times of peak demand. This delivers a carbon saving for the UK, by storing electricity with a lower than average carbon intensity (as primarily renewables and nuclear power come onto the grid first) and releasing that electricity back to the grid during periods of higher than average carbon intensity (when more fossil fuel plants come online to meet rising demand).

Current UK accounting rules require that the company reports its emissions from electricity use using only grid-average carbon intensities. This effectively masks the carbon benefits that are being delivered by the battery unit.

We propose a reform to accounting rules that, along with the growth of smart grids, would allow companies to report more clearly in their accounts the genuine carbon benefit of such projects.

Smart grids and easier access to energy data are now enabling the measurement of real-time carbon intensity data. This allows the grid to see the emissions of the actual power plants running at any given time. By allowing companies to calculate or compare the emissions of their on-site storage or generation to the power plants running during the specific time period, we can ensure that companies are properly incentivised to invest in emissions-reducing distributed energy measures.

Appendix 1 : Methodology

Stage 1 – Identifying typical users

- Centrica Business Solutions (CBS) took the energy usage profiles of typical, representative distributed energy customers in three sectors that play a key role in the UK economy:
  1. industrial,
  2. healthcare, and
  3. leisure / hotel / hospitality.
- The range of economically viable products which CBS offers were then theoretically deployed at a scale appropriate to each representative customer's usage profile.

Stage 2 – Determining carbon savings

- To calculate the carbon savings from the deployed products the change (in kWh) of grid electricity and gas usage for each representative customer was modelled. This resulted in an increase in gas use, due to CHP installation, and a decrease in electricity usage, with efficiency measures reducing overall consumption and the installation of a CHP and/or solar PV reducing requirements from the electricity grid.
- The changes in electricity and gas demand were assigned an appropriate carbon intensity (which varies for each year of analysis) and summed to determine the overall impact on the carbon footprint annually and cumulatively.

Stage 3 – Determining multipliers to scale savings across the sectors

- These scaling multipliers were formulated by comparing the energy use of the representative customers, prior to the deployment of CBS goods and services, to the total energy use (within the UK) of the three respective sectors.

Stage 4 – Calculating total figures

- The carbon savings for each representative customer were multiplied by the relevant scaling multiplier to provide potential carbon savings across their respective sectors. This total was then halved, assuming only a 50 per cent take-up scenario.

Inputs

- Centrica (to identify typical users in each sector, an accurate characterisation of representative products, and the changes in energy usage these deliver)
- NHS England, Scotland and Wales (for energy consumption figures)
- UK Government Department for Business, Energy & Industrial Strategy (for energy market data, emission factors, and consumption figures);
- National Grid (2018 Future Energy Scenarios provided carbon intensity figures for the evolution of the UK electricity grid out to 2030).
- 2017 was used as the baseline and start of this analysis. Where 2017 data was not available for a component of sector analysis, the most recent alternative was used.

Assumptions

Carbon intensity analysis and evolution

- The carbon emission factor for gas was kept constant at current levels throughout the analysis.
- There were two separate electricity carbon intensities used for this analysis:
  - The average grid intensity; for this the latest BEIS figures were used for 2017 and 2018, and then the mean of the National Grid's four 2018 Future Energy Scenarios (FES) was used to approximate decarbonisation out to 2030. CBS estimated the 2019 intensity figure to be halfway between the BEIS 2018 figure and the National Grid 2020 figure. FES figures were subject to a two-year lag, as per DEFRA calculating practices.
  - The marginal unit of electricity; effectively the carbon intensity of which generation sources react to changes in grid demand. This was applied where appropriate, in line with the GHG Project Protocol (https://ghgprotocol.org/standards/project-protocol), to 'load-following' localised generation. For simplicity and transparency this was assumed to be at the level of a Combined-Cycle Gas Turbine (CCGT) operating at 0.411 kgCO_2e/kWh for all years[24].
- A marginal intensity was used for CHP electricity generation in the hospitality and industrial sectors, and for battery discharge (following charging from solar PV units) in the hospitality sector. The marginal intensity was not used for any components in the healthcare sector as their CHP generation profiles are typically characterised as 'baseload'.

Total energy usage

- The total energy use of the sectors did not include scope 3 emissions and was quantified using the most accurate and up to date information available.
- The healthcare sector only applies to public NHS energy usage, leaving out private hospitals. It also does not include Northern Ireland as public figures were not available.
- Industrial, hospitality and community, arts and leisure sectors were scaled using BEIS's 2018 updated energy consumption figures for 2017. The total carbon emissions were calculated assigning standard emissions factors to the fuels consumed.

50 per cent take-up scenario

- A 50 per cent take-up scenario was used to be conservative. This accommodates the fact that the calculation methodology does not involve a thorough analysis of where the CBS goods and services are not required or appropriate. This would include customers with atypical energy usage for their sectors (insignificant heat demand for instance) or those where equivalent technology has already been deployed.

Typical users Centrica identified are 'representative'

- The typical users identified and used for this analysis are representative of the potential users of CBS technology in the sectors to which they relate.

24 Department for Business Innovation and Skills. "Energy Intensive Industries in the UK- Maintaining International Competitiveness", October 2012

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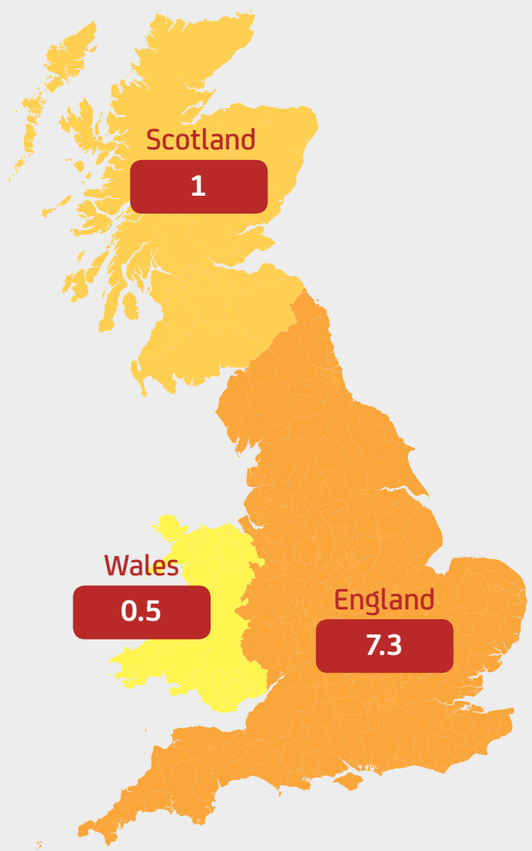
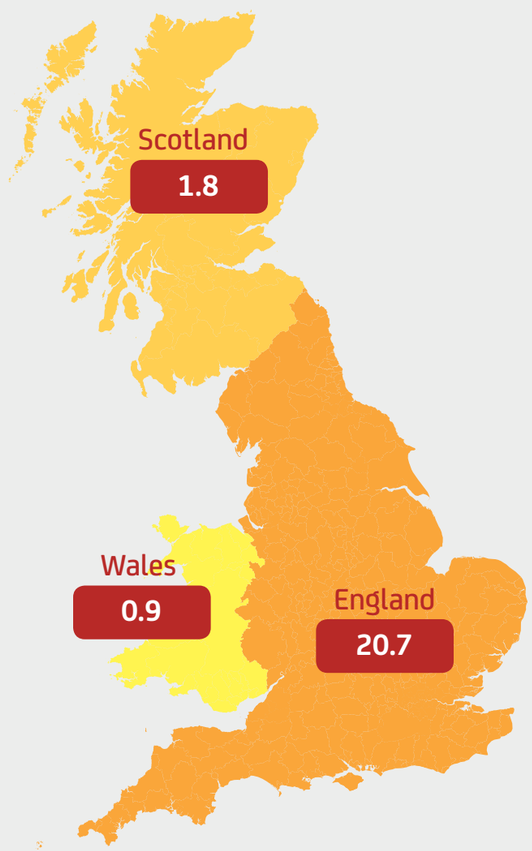
Appendix 2:
Breakdown by nation

Cumulative savings by 2030. All units in $MtCO_2e$.

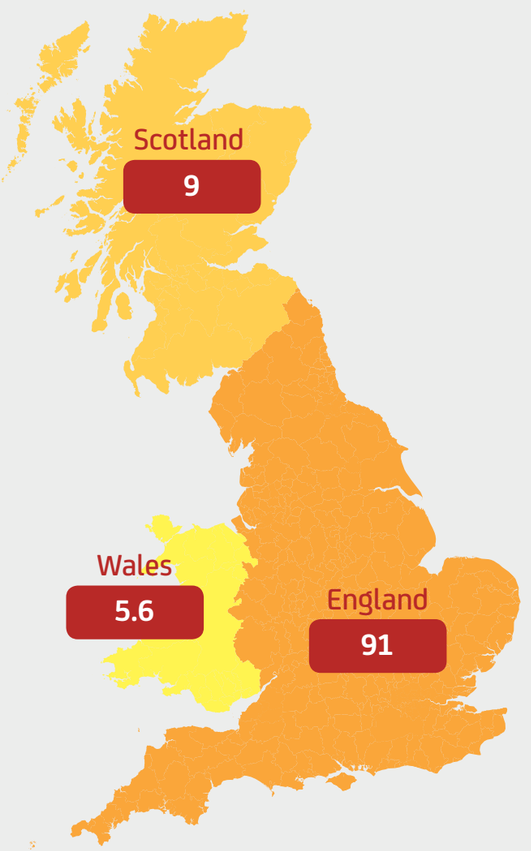
Healthcare



Hospitality and leisure



Industry



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