

REPORT

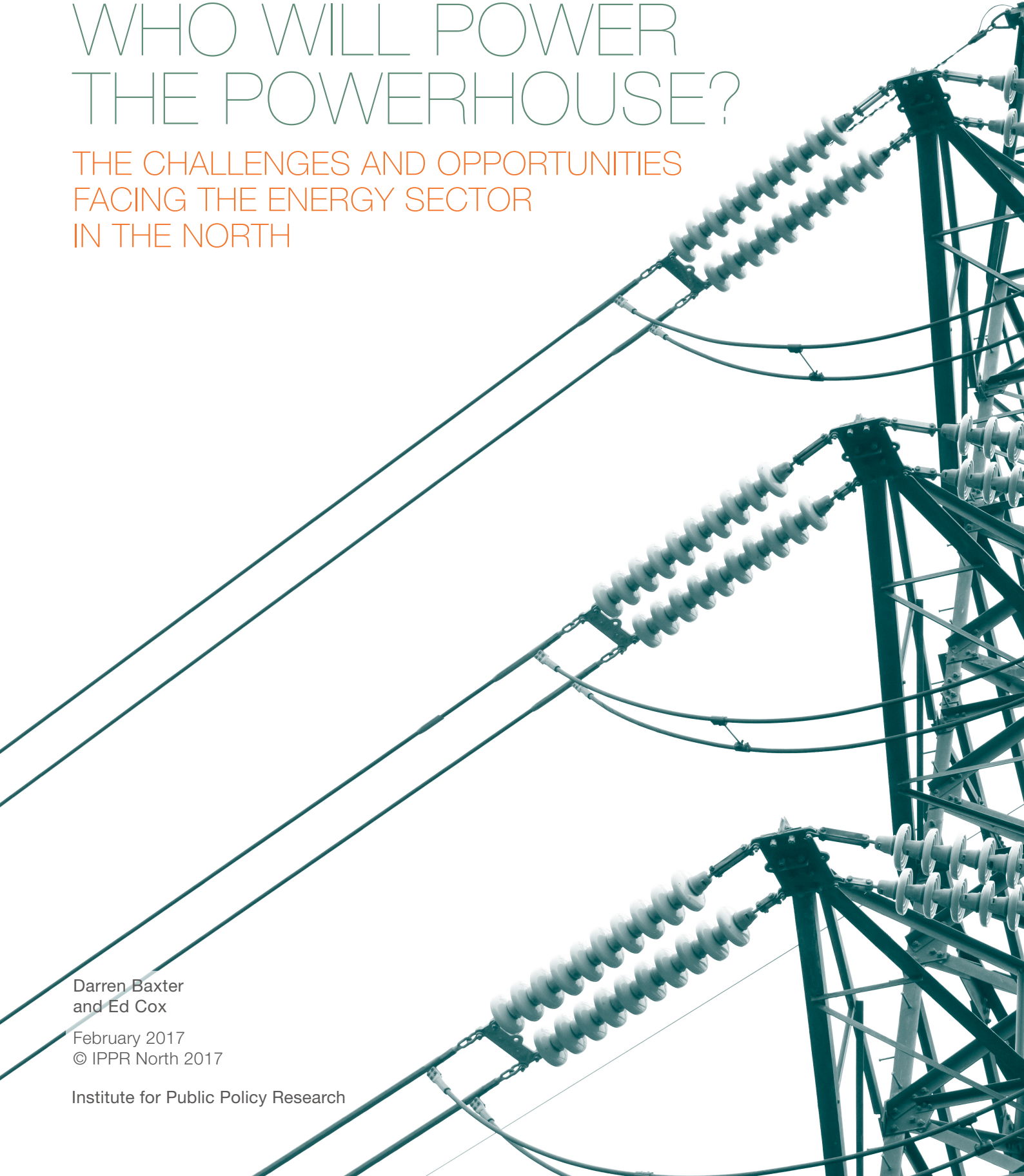
# WHO WILL POWER THE POWERHOUSE?

THE CHALLENGES AND OPPORTUNITIES  
FACING THE ENERGY SECTOR  
IN THE NORTH

Darren Baxter  
and Ed Cox

February 2017  
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Institute for Public Policy Research





## ABOUT THE NORTHERN ENERGY TASKFORCE

The Northern Energy Taskforce has been established to oversee an ambitious programme of work over the next 18 months that will develop an energy strategy for the northern powerhouse. The Taskforce is chaired by Sir John Harman, who will be supported by a number of high-profile figures with expertise across infrastructure, engineering, finance, academia and local government. It is supported by IPPR staff in a research and secretariat capacity.

The taskforce has three central objectives.

- Develop a plan for the northern energy system to 2030, addressing the key needs and challenges facing energy consumers and businesses in the North.
- Create an economic vision for the northern energy sector in 2030 and a practical roadmap for how to get there, addressing the opportunities for businesses, higher education institutions and the public sector in the energy sector.
- Set out a plan for 'energy devolution' that will consider whether and how various powers and responsibilities for energy issues should be devolved to different pan-northern, sub-regional and local levels.

## ABOUT IPPR NORTH

IPPR North is IPPR's dedicated thinktank for the North of England. With its head office in Manchester and representatives in Newcastle, IPPR North's research, together with our stimulating and varied events programme, seeks to produce innovative policy ideas for fair, democratic and sustainable communities across the North of England.

IPPR's purpose is to conduct and promote research into, and the education of the public in, the economic, social and political sciences, science and technology, the voluntary sector and social enterprise, public services, and industry and commerce.

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# SUMMARY

## 60-SECOND SUMMARY

The energy sector in the North is facing a series of challenges, but it is well positioned to take advantage of the opportunities presented by the UK's changing energy needs, and has the potential to reassert the North's role as the 'powerhouse' of the nation. This report analyses the current landscape in the North, examining the challenges and opportunities facing the sector, and highlighting key questions for further analysis.

As the UK plots its path towards a low-carbon economy, energy policy has reached something of a crossroads. The choices that government, business and ordinary citizens take about the generation, supply and use of power and heat will determine whether we can fulfil the commitments made in the Paris agreement on climate change, and whether our energy system becomes a challenge we struggle to cope with or an opportunity we are ready to seize.

Nowhere is this more true than in the north of England, where historically the energy sector has not only supplied the whole nation with significant quantities of heat and light, but has also been a major contributor to the labour market and the health of the wider economy. By virtue of its historical natural abundance of coal, the North became home to major centres of power and heat generation, and a wide range of energy-intensive industries that have clustered around them. But its future role in 'keeping the lights on and our homes warm' is now open for question.

## ANALYSIS

### Challenges

The northern energy sector faces three significant challenges.

1. **A decline in the traditional energy economy:** Traditional power generation is already in decline, with coal-fired power stations due to be phased out by 2025 and many combined cycle gas turbines reaching the end of their working lives. In economic terms, the North's share of energy GVA has fallen from a third to less than a quarter since 1997.
2. **High energy demand:** Energy demand is disproportionately high in the North due to the presence of several energy-intensive commercial and industrial sectors. This means that energy supply is critical to the wider health of the economy, but also that demand projections show little scope for significant reductions in the demand for gas or power between now and 2030.
3. **A reliance on national policy:** The North's ability to exploit the potential sites for power generation is potentially vulnerable given its reliance on a national energy policy and direction of travel, which may obscure regional opportunities and key strengths.

## Opportunities

The fact that the north of England is facing such major challenges makes very little sense because – while it is vulnerable, given its legacy of coal generation – it is not without a range of other geographical, geological and historical advantages that make it well positioned to reassert its role as the powerhouse of the nation. There are two primary opportunities for the energy sector in the North.

- 1. The North has the geological, geographic and historical assets to power and heat the nation.** The North is leading the way in the transition to a renewable power supply, with nearly half of all renewable power generated in the north of England and extensive scope to scale-up offshore wind and develop tidal schemes. The North is also home to an extensive nuclear capability, and biomass energy generation represents another short- to mid-term option for cleaner generation. As regards heat, the North has the attributes and natural advantages to lead in the take-up of new approaches, infrastructure and resources that will underpin a sustainable, low-carbon pattern of heat supply for the nation. There exists the potential to convert significant parts of the gas network to run on hydrogen, which can be stored in the North's extensive system of salt caverns. There is scope for harnessing waste heat from significant industrial clusters in sophisticated district heating systems and, although controversial, there are significant amounts of shale gas across the Bowland-Hodder Basin which could be exploited through fracking.
- 2. The North has the low-carbon economy and assets needed to deliver new sources of generation.** The North has the ability to lead the way with its burgeoning low-carbon goods and services sector, in which levels of employment are well above national averages. In part this is due to the significance of important local assets, unique to each local enterprise partnership area, but it is also a result of significant investment in new energy technologies and their development. Alongside its world-renowned expertise in the renewable industry, the North has pockets of innovation in critical areas such as energy storage and demand management. With many of these specialisms linked to other 'prime economic capabilities' in which the North has world-leading strengths, such as in advanced manufacturing and data processing, there is no good reason why the northern energy sector shouldn't become a key plank of a place-based industrial strategy.

So the country sits at an energy intersection, where the North is exposed to the risk of being held back by the lack of strategic thinking at an appropriate spatial scale to mitigate the challenges ahead and to maximise the clear opportunities and a reliance on national policy. The failure to exploit these assets would not just be of detriment to the North but also the nation. It could represent a major missed opportunity to develop secure, low-carbon and abundant power and heat. The North has the potential to help the UK meet its greenhouse gas emission reduction targets and position itself as a leader in the innovation and technologies that are necessary to deliver generation in a low-carbon energy system.

### **Key questions for further analysis**

The energy system, like many aspects of transport infrastructure, is one area in which a pan-northern approach is likely to yield significant advantages. To this end, the northern energy taskforce, whose remit is to explore and develop a high-level Northern Energy Strategy, will build upon this initial landscape analysis by exploring a series of further questions.

- How far do current demand projections reflect the level of ambition required both to provide energy security at a reasonable cost to the North's businesses and consumers while at the same time putting the nation on track to meet its climate change commitments?
- How much can each of the significant opportunities in the North – both in terms of power and heat – contribute towards the nation's transition to a low-carbon economy and reduce its dependency on energy imports?
- How can we make sure that place-based industrial strategy maximises opportunities for the north of England to continue to drive the energy sector in the UK and build on its comparative advantages in order to maximise its leading role in energy systems innovation on a global stage?
- What aspects of energy policy are best addressed by national government, and by local players such as local enterprise partnerships? To what extent is there value and scope in devolving certain powers and strategic responsibilities to a pan-northern level of co-ordination?

# 1. CHALLENGES FACING THE ENERGY SECTOR IN THE NORTH

In order to meet carbon reduction targets, every nation will need to adopt new methods of powering and heating homes and businesses, and adopt new technologies to manage this changing energy supply. In the context of this transition the north of England finds itself faced with three particular and interrelated challenges.

1. The declining size of the traditional energy economy.
2. The high demand for energy in the North.
3. The reliance on national energy policy to drive decarbonisation.

## 1.1 CHALLENGE ONE: THE DECLINING SIZE OF THE TRADITIONAL ENERGY ECONOMY

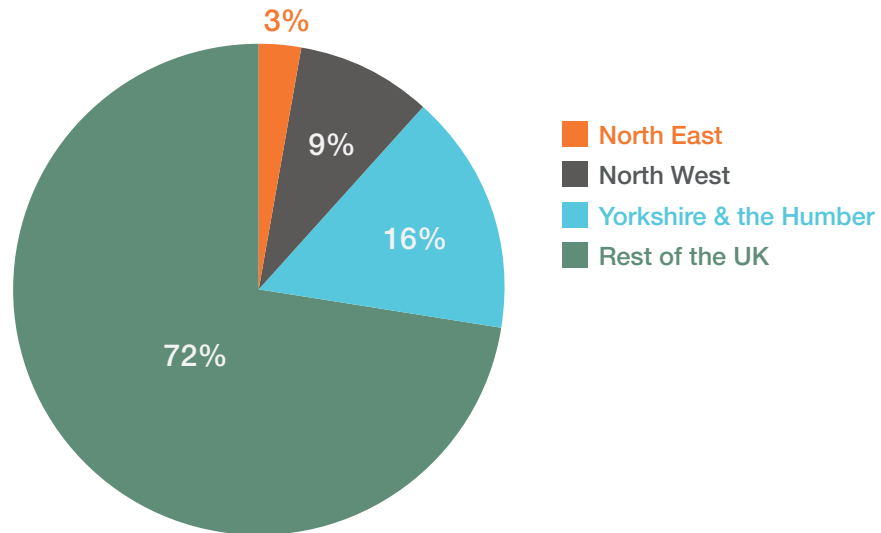
Historically, the north of England has powered the nation with fossil-fuelled power stations. As we transition to new forms of power and heat and reduce our reliance on fossil fuels, this is hitting the northern energy sector hard.

Currently more than a quarter (27 per cent) of the UK's installed electricity capacity is in the North, over half of which (58 per cent) is located in Yorkshire and the Humber. That region, given its coal deposits, has a long association with power generation and alone accounts for 16 per cent of total UK electricity capacity (see figure 1.1). The North West accounts for a further 9 per cent, followed by just under 4 per cent by the North East (BEIS 2016a).

However, capacity in the North remains dominated by conventional thermal power stations using coal and gas (see figure 1.2). Much of this is due to close in the next few years as ageing power stations reach the end of their useful lives and regulation on carbon emissions and air pollution bites harder.

**FIGURE 1.1**

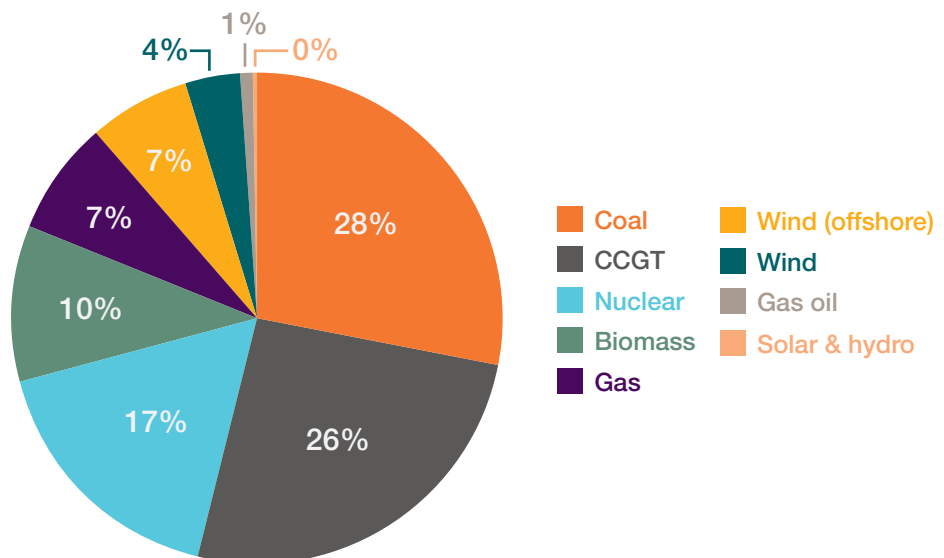
More than a quarter of the UK's installed electricity capacity is in the North, over half of which is located in Yorkshire and the Humber  
*Percentage of UK's installed electricity capacity in the North*



Source: Department for Business, Energy and Industrial Strategy, 'Digest of UK Energy Statistics' (BEIS 2016a)

**FIGURE 1.2**

Energy capacity in the North is still dominated by conventional thermal power stations, many of which are due to close in the near future  
*Installed capacity of plant in the north of England by type of fuel, as a proportion (%) of total capacity, 2015*



Source: Department for Business, Energy and Industrial Strategy, 'Digest of UK Energy Statistics' (BEIS 2016a)

Coal-fired power stations are currently the largest single contributor to northern energy capacity (28 per cent); the region is home to 41 per cent of the total UK coal capacity. Any stations open beyond 2022 will need to cease normal operation, and will not be able to continue operating as unabated plants beyond 2025 following the UK government's commitment to a phase-out by that date.

The effects of these closures are already being seen in the region. Ferrybridge C power station in West Yorkshire closed in March 2016 after 50 years of service. This follows the closure in December of Kellingley colliery, the last deep coal mine in the UK. Fiddlers Ferry power station in Warrington and Eggborough power station in East Yorkshire were also expected to fully or partially close, but have both recently secured contracts with National Grid to continue operating in the short term. However, as soon as new capacity is brought online these stations will also close, ending the use of unabated coal-firing in the North.

Combined cycle gas turbines (CCGT) currently make up around a quarter (26 per cent) of the North's installed capacity (BEIS 2016a). Much of this capacity is also set to close as it reaches the end of its useful life, and the government is seeking to incentivise the construction of new CCGTs through the capacity market (BEIS 2016b). Although the scheme has been criticised for failing to deliver on this objective (see Orme 2016), it is widely expected that new CCGT will eventually be delivered and play a role in balancing the electricity network (NIC 2016), and in the most recent 2016 t-4 auction some CCGT capacity was successful (National Grid 2016a). Accordingly, it is likely that some of this decline in fossil fuel capacity will be offset by an increase in CCGT capacity in the North, with some plants already in the pipeline in the North West and Yorkshire.

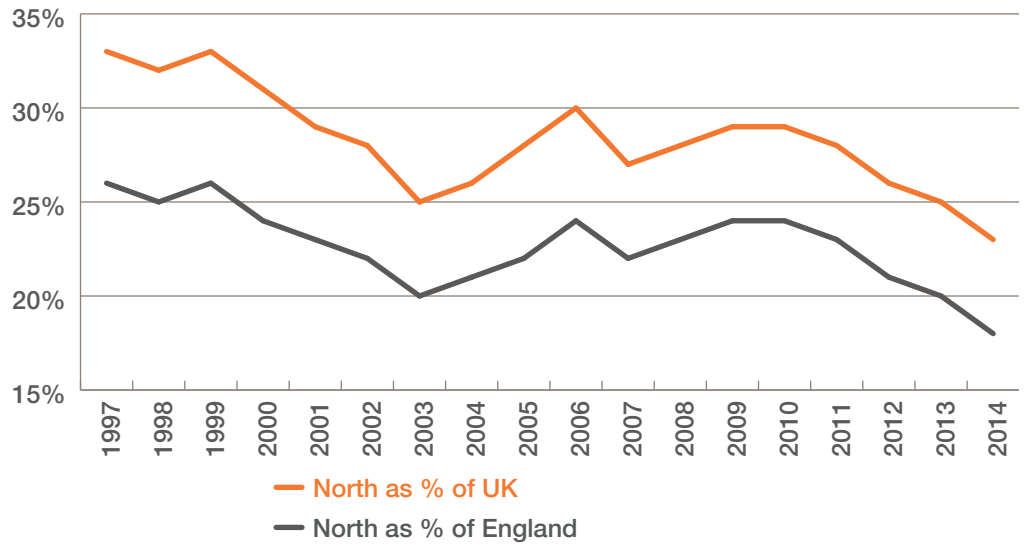
The transition away from traditional energy generation is having an impact on the contribution of the energy sector to the wider economy. Energy was identified by SQW in its Northern Powerhouse Independent Economic Review as one of the North's prime capabilities, and one that is particularly specialised in the region (SQW and CE 2016). In 2014 northern energy firms contributed £5.2 billion in GVA to the UK economy, making the energy sector the 18th largest in the northern economy, generating 1.5 per cent of the North's overall GVA and supporting 29,000 jobs (ONS 2016a, ONS 2016b).

However, the sector is undergoing a substantial change and the traditional energy economy is shrinking. The North's share of national energy GVA has declined since 1997, dropping from more than a quarter (26 per cent) in 1997 to 18 per cent in 2014 (see figure 1.3). This has occurred alongside a drop in the number of employees within the energy sector. Between 2009 and 2015 4,000 jobs have been lost from the sector, a 12 per cent drop, against an increase nationwide (see figure 1.4). The subsectors that have seen the greatest decline have been those associated with fossil fuels – mining and support services, the extraction of crude petroleum and natural gas, and the manufacture, distribution and trade of gas, steam and air-conditioning, matching the broader shift in the nature of energy generation within the North.

**FIGURE 1.3**

The North's share of national energy GVA has declined since 1997, falling from 27 per cent in 1997 to 18 per cent in 2014

*Share of national GVA held in the North from electricity, gas, steam and air-conditioning supply sector, 1997–2014*

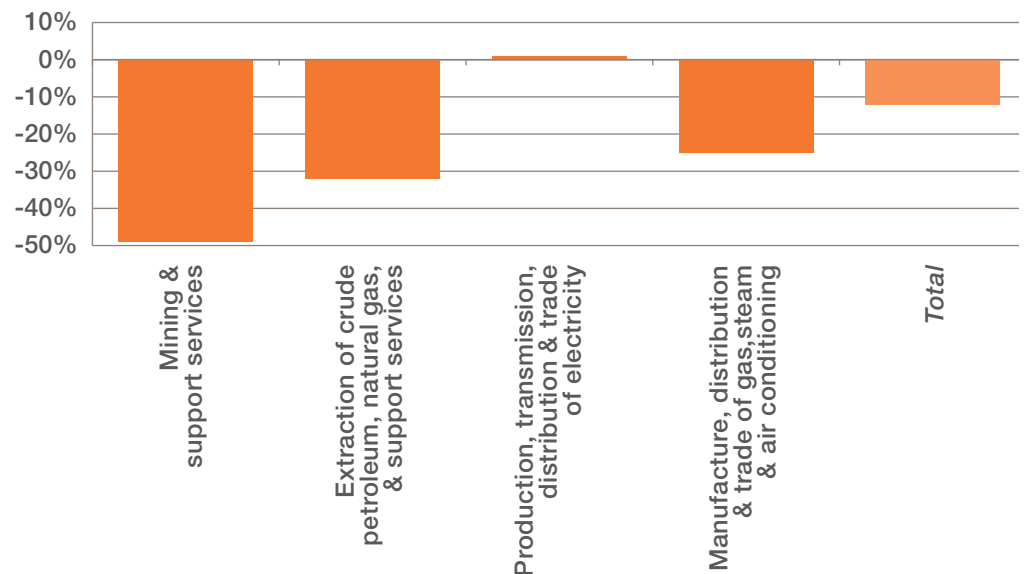


Source: ONS, 'Regional Gross Value Added by Component and Industry' (ONS 2016a)

**FIGURE 1.4**

Energy subsectors in the North associated with fossil fuels have experienced the greatest decline

*Percentage change in employment by energy subsector in the North between 2009–2015*



Source: analysis of ONS, 'Business register and employment survey' (ONS 2016b)



Overall, this suggests that the sector, and the jobs that rely on it, are at a turning point and could decline further as coal and other big plant is phased out.

## 1.2 CHALLENGE TWO: THE HIGH DEMAND FOR ENERGY IN THE NORTH

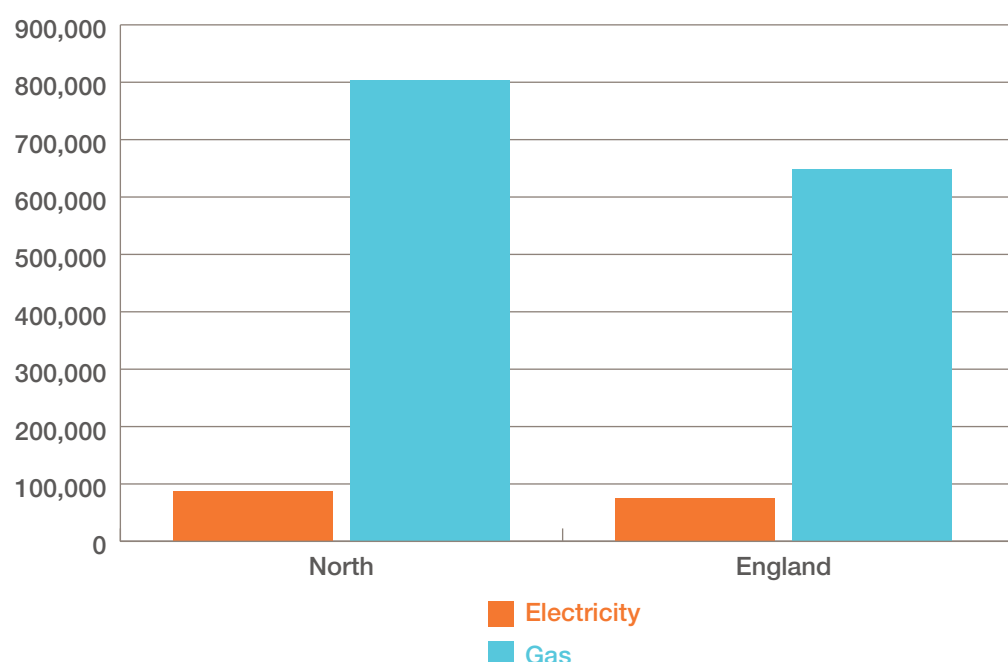
The second challenge facing the northern energy sector is that the region, given its concentration of energy-intensive industry, is a heavy consumer of energy. This is a reality that is likely to continue, so there is a need to ensure that such industries have a sufficient supply – one that is both sustainably produced and reasonably priced so as not to act as a drag on the competitiveness of industry, but is at the same time putting in place measures to increase the efficiency of energy use.

Commercial and industrial energy use is on average 15 per cent higher for electricity and 24 per cent higher for gas in the North compared to the rest of England, as shown in figure 1.5. This reflects the heavy concentration of energy-intensive industries within the region. The North East has the greatest average consumption of non-domestic electricity in the UK, with Redcar and Cleveland ranking as one of the local authority areas with the highest levels of consumption, third only to Port Talbot, home of the well-known steel works, and the City of London (DECC 2016a, DECC 2016b).

**FIGURE 1.5**

**Commercial and industrial energy use is on average far higher in the North compared to the rest of England**

*Mean commercial and industrial electricity and gas consumption (KwH) in the North compared to England as a whole*



Source: BIS, 'Sub-national electricity sales and numbers of customers' (BEIS 2016c)

It is not surprising, then, that the carbon intensity of industry in the North is high. The North East and Yorkshire and Humberside have far more carbon-intensive economies than other English regions, and the carbon intensity of the northern economy as a whole is greater than that of England as a whole.<sup>1</sup> This shows that the region's economy is more dependent on carbon-intensive industries than other areas of country.

Disaggregating information on the cost of energy for industrial users by region is not possible. Many industrial users engage in deals directly with suppliers and so bill data, as is used for domestic consumers, is not available. It is worth noting, however, that electricity costs in the UK are among the highest across the European Union (Europa 2016). Some organisations argue that this acts as a drag on the competitiveness of UK industries. EEF, for example, argues that the cost of energy, particularly electricity, has been a central issue, above taxes such as business rates and climate change levies (EEF 2016).

However, energy costs are only one part of this issue, and there is a significant potential for improving the energy efficiency of industrial processes that is not currently being maximised. The Energy Research Partnership has noted that over the next 20 years the energy efficiency of the energy-intensive sector could be improved cost-effectively by between 10 and 20 per cent, although this would require overcoming deployment barriers and weak incentives presented by relatively low carbon prices in the EU Emissions Trading Scheme (CCC 2012).

In addition, energy costs are important for domestic consumers too. While, energy costs in the North are similar to national averages and the thermal efficiency of the housing stock in the North is slightly higher,<sup>2</sup> the proportion of households in fuel poverty in the north of England is above the English average (12 per cent vs 11 per cent). Deeper investigation is needed to unpick why this is, but there are notably higher rates of households paying for their gas and electricity by pre-payment meter – a proportionately costlier means of payment – in the North compared with the English average (17 per cent vs 11 per cent for gas, and 18 per cent vs 15 per cent for electricity) (NEED 2013).

Projecting forward, this demand is likely to remain relatively high right through to 2030. The National Grid has produced four future energy scenarios (FES) that provide a framework for exploring the ways in which energy demand may change over time. These scenarios are not outright predictions, but rather an attempt to understand the likely effect of external economic, political and technological pressures on the rate of decarbonisation. These four scenarios exist across two axes: the extent to which the goal of decarbonisation is pursued; and the level of national prosperity. They are outlined in figure 1.6.

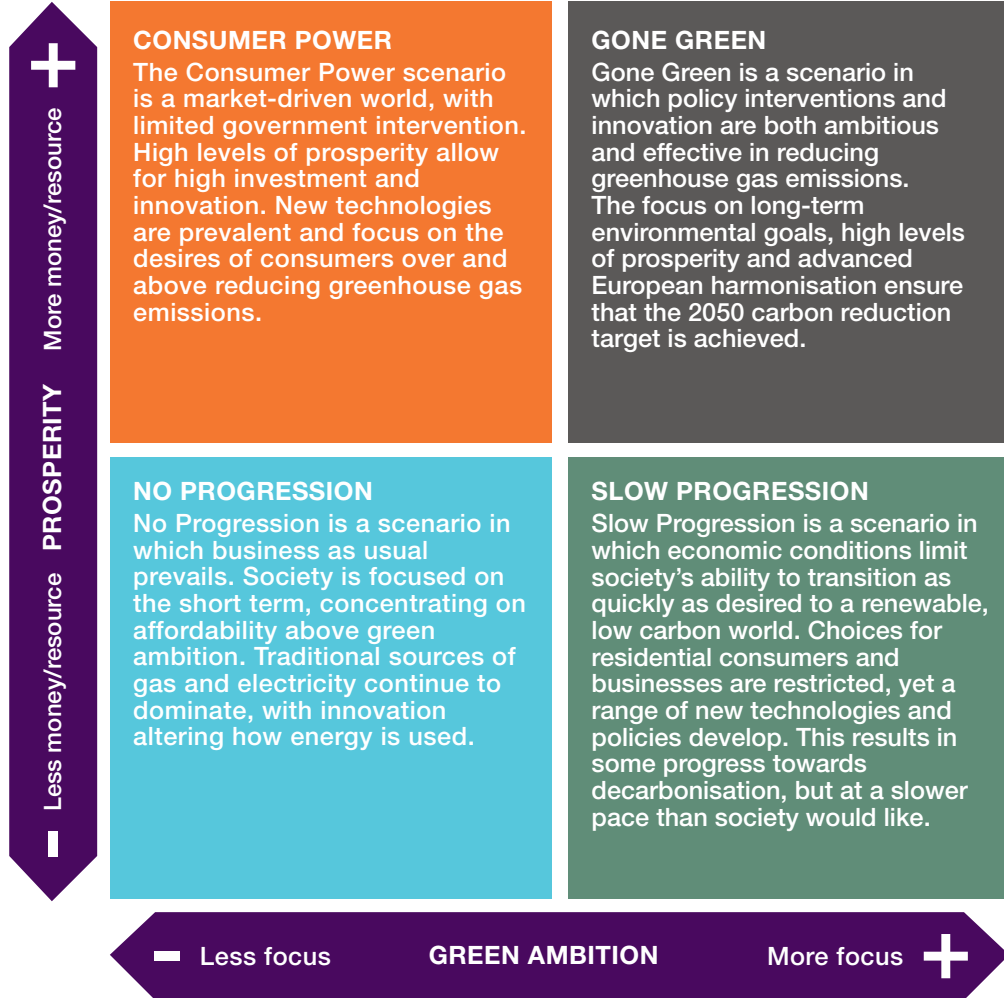
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1 This is calculated from regional carbon emissions (kt CO<sub>2</sub>) divided by regional GVA.

2 SAP ratings (a measure of thermal efficiency) are on average 62 in the North compared to 61 in the rest of England (DECC 2016c). The principal reason for this is likely to be the higher activity levels of thermal efficiency schemes in the North. For example, the number of households in receipt of efficiency measures through the Energy Company Obligation is 83.8 per 1,000 households in the North compared to 55.8 across England (DECC 2015).

National Grid’s forecasts suggest that gas demand in the North of England, as with the rest of the country, will decline over time due to increasing energy efficiency and new heating technologies. The drop in demand is predicted to be between 32 per cent (in the Gone Green scenario) and 18 per cent (in the Consumer Power scenario) between 2016 and 2030 (see figure 1.7).

**FIGURE 1.6**  
Future energy scenarios provide a framework for exploring how energy demand may change over time based on the goals of decarbonisation and national prosperity  
*The National Grid’s 2016 future energy scenario matrix*

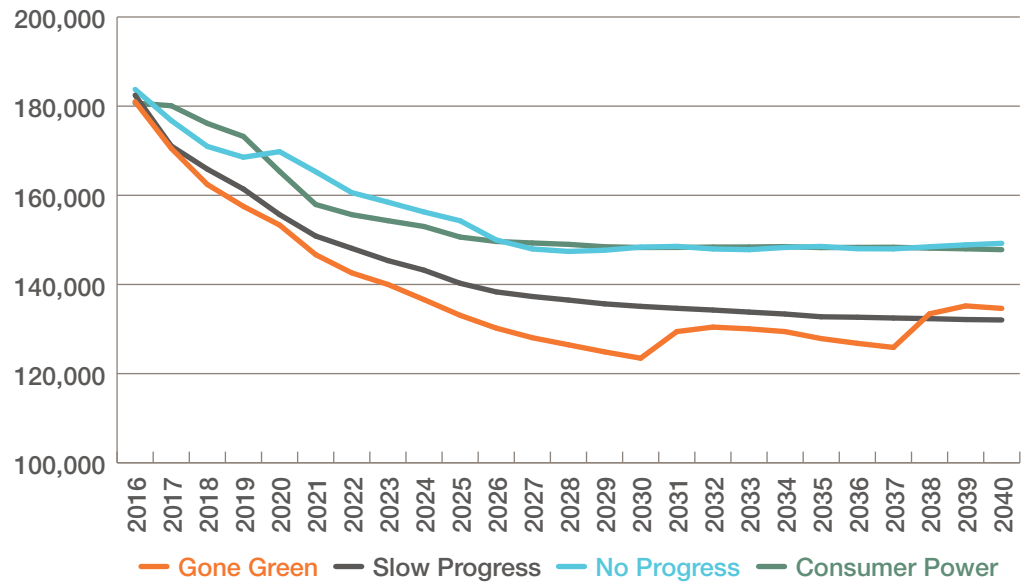


Source: National Grid, *Future Energy Scenarios: GB gas and electricity transmission* (National Grid 2016b)

Electricity demand is also set to decline in the short term, although marginally, in all scenarios except Gone Green. In each, an upward trajectory can be seen towards the end of the next decade. This reflects an initial drop, due to energy efficiency improvements, followed by increase in energy use driven by the increase in the electrification of heat and transport alongside population growth.

**FIGURE 1.7**

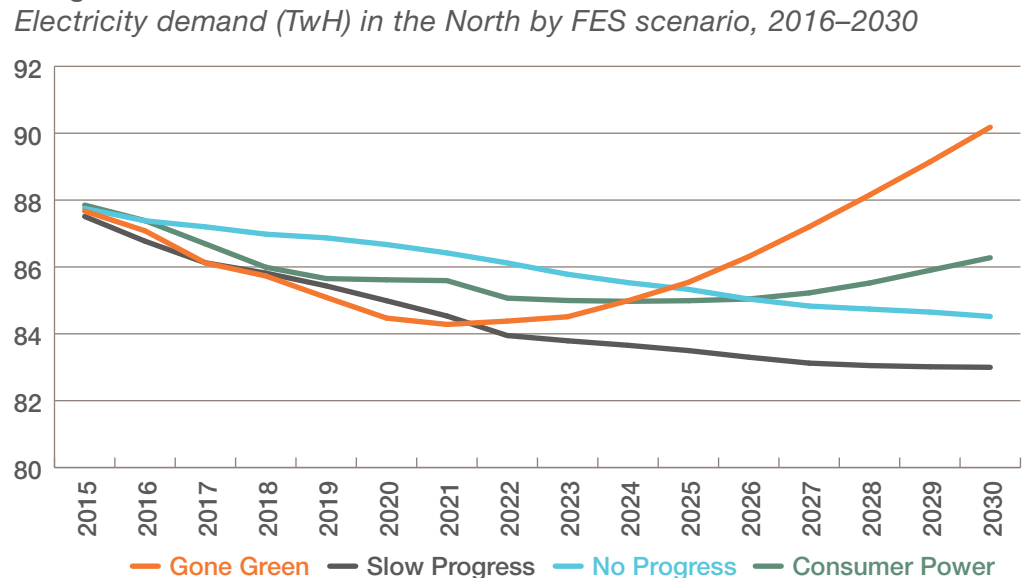
National Grid's forecasts suggest that gas demand in the North will decline over time due to increasing energy efficiency and new heating technologies  
*Gas demand (GWh) by FES scenario in the North, 2016–2030*



Source: analysis by National Grid for IPPR North based on the future economic scenarios model

**FIGURE 1.8**

In all but the Gone Green scenario electricity demand is set for marginal declines in the short term  
*Electricity demand (TWh) in the North by FES scenario, 2016–2030*



Source: analysis by National Grid for IPPR North based on the future economic scenarios model

The overall change in demand is set out in table 1.1, which shows that overall, even in the Gone Green scenario, demand for gas and electricity in the north of England is unlikely to fall radically in the period to 2030.

**TABLE 1.1****Change in demand by FES scenario, 2016–2030 (TWh)**

	Gas			Electricity		
	2016	2030	% change	2016	2030	% change
<b>Gone green</b>	181.00	123.46	-31.79	87.08	90.18	2.86
<b>Slow progression</b>	182.44	135.09	-25.95	86.77	82.99	-5.16
<b>No progression</b>	183.76	148.37	-19.26	87.38	84.52	-3.69
<b>Consumer power</b>	180.69	148.29	-17.93	87.39	86.27	-1.79

Source: analysis by National Grid for IPPR North based on the future economic scenarios model

### 1.3 CHALLENGE THREE: NATIONAL ENERGY POLICY AND FUTURE GENERATION

A third challenge confronting the northern energy sector concerns the North's reliance on national policy. Despite the potential for the region to contribute an abundance of low-carbon power generation to the nation, these opportunities are at risk of being missed if not supported by the right policies, strategy or direction of travel.

National Grid future energy scenarios forecast that future levels of power generation on the transmission system in the north of England are likely to drop significantly after 2023/24, but only in the Gone Green scenario will these return to levels similar to those of 2015/16. Figure 1.9 shows that in three of the four scenarios, the North will generate between 43 per cent and 31 per cent less power, whereas under the more ambitious Gone Green scenario this is predicted to be around the same amount as now, dropping by only 3 per cent.

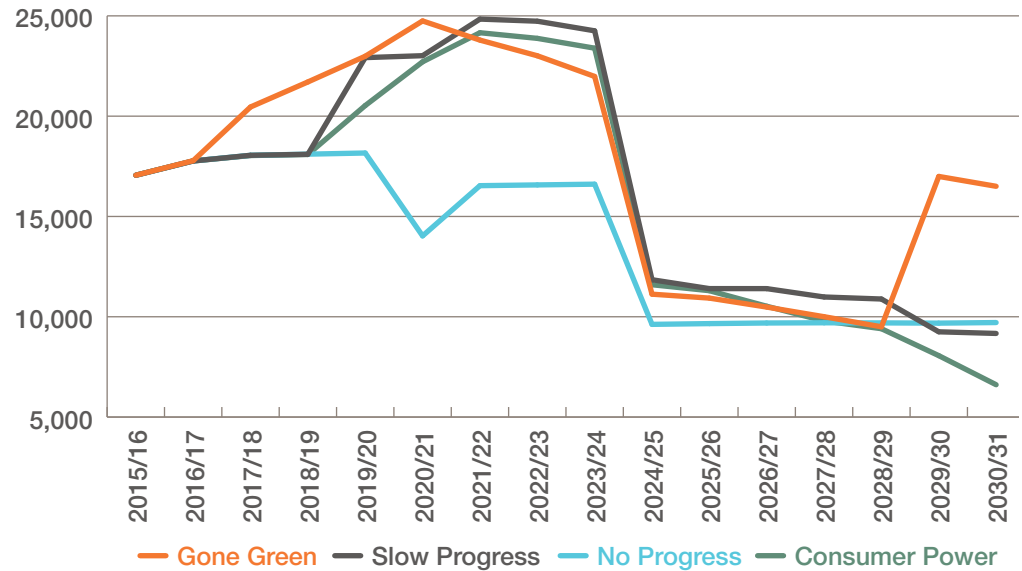
The Gone Green scenario is premised on ambitious policy intervention and innovation within the context of a focus on meeting long-term environmental goals. What is shown in this data, then, is that if an energy strategy that is ambitiously low-carbon and supportive of innovation is *not* pursued there is the potential for assets in the region to go undeveloped – principally sites of development for offshore wind, nuclear and more efficient CCGT plant.

Despite the economic consequences for the North as a region if these assets are not developed, the region has limited recourse to the levers or control over the policies that could drive energy policy in this direction: all of them are held within Whitehall. Central government is rightly focused on macro policy where it has strong competency and key relationships with regulators, commercial actors and institutions that operate at a national level, resulting in a programme of government that focuses on market reform, and fiscal and national political constraints. Important as these may be, they may miss opportunities for strategic thinking at the northern level to address the specific environmental and economic opportunities in the region that would be of both regional and national significance. Particularly, government can sometimes seem unaware of the assets and skills within a region that could be harnessed in order to deliver new technologies.

**FIGURE 1.9**

Future levels of power generation on the transmission system in the north of England are forecast to drop significantly after 2023/24

*Power generation (GWh) on the transmission system in the north of England, by FES scenario, 2015/16–2030/31*



Source: analysis by National Grid for IPPR North

If the targets embedded within the Gone Green scenario are not met, this failure is likely to have significant economic consequences for the North as plant shuts, jobs are lost and new opportunities are not realised; but equally, this would constitute a substantial missed opportunity for the supply of low-carbon energy for the nation as a whole. The North is in a position to deliver large amounts of power to the nation – power that is secure and which will contribute significantly to efforts to reduce greenhouse gas emissions. Chapter 2 explores the opportunities that the North’s energy sector is well-placed to take advantage of, and demonstrates that an alternative future is well within our grasp.

## 2. OPPORTUNITIES FOR THE NORTHERN ENERGY SECTOR

Despite the challenges set out in chapter 1, the north of England has two key opportunities: it has the geological, geographic and industrial history to enable the development of new and emerging energy sources; and it has an emerging low-carbon sector with the technologies and skills to exploit a new era of energy generation, storage and demand management. In pursuing these opportunities as part of a wider industrial strategy for the North, it is possible to restore the northern energy sector to its role of major national significance.

### 2.1 OPPORTUNITY ONE: FUTURE ENERGY GENERATION

Despite its historical association with fossil fuels, the north of England has an abundance of other sources of energy generation. This section outlines some of the geographical, geological and historical advantages that could define future energy generation in both the power and heat sectors as well as the skills and innovation system that supports them.

#### 2.1.1 Power

The North is leading the transition to a renewable energy supply. Figure 2.1 shows that around half (48 per cent) of all the renewable energy generated in England, and a third (31 per cent) of that in the UK, is produced in the north of England (BEIS 2016d). Of this, 31.4 per cent is generated in Yorkshire and the Humber, 12.5 per cent in the North West and 4.2 per cent in the North East. Between 2003 and 2015 the level of electricity generated in the North from renewable sources has increased by 93 per cent. This is 4 per cent higher than the English average of 89 per cent (ibid).

#### *Offshore wind*

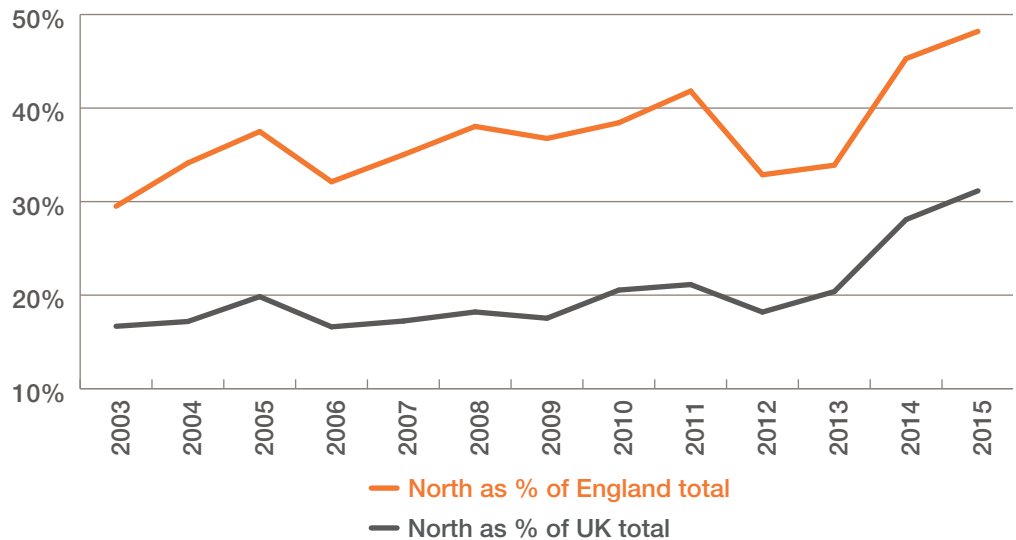
The North is a leader in offshore wind: 41 per cent of the country's wind generation takes place in the north of England, and with 28 per cent of the UK's offshore capacity in its waters the region is a key site for the development of offshore wind. The Humber is a prime example of this: the offshore wind sector has brought significant investment to the region and has allowed the Humber to brand itself as Britain's 'energy estuary', and work on projects such as the designation of Green Port Hull. This project aims to 'establish Hull and the East Riding of Yorkshire as a world class centre for renewable energy, creating wealth and employment for the region' (Green Port Hull 2016). This is being achieved through a number of means, including business support and a significant focus on skills through the Humber local enterprise partnership (LEP) and the designation of a number of enterprise zones which offer tax and financial incentives to companies that locate there.



**FIGURE 2.1**

**Around half of all the renewable energy generated in England is produced in the North**

*Proportion of total electricity generated from renewable sources in the North as a proportion of total generation (%) in England and the UK, 2003–2015*



Source: Department for Business, Energy and Industrial Strategy, 'Regional Renewable Statistics' (BEIS 2016d)

### Case Study: The Hornsea Projects

Hornsea Project One is an offshore wind farm being built by DONG Energy that will be located off the Yorkshire coast within the Hornsea Zone in the southern North Sea. The project is part of a £6 billion investment to transform the Humber region into a hub for the UK's renewable energy sector. At 1.2GW, the project will be the world's biggest offshore wind farm and the first offshore wind farm to have more than 1GW of capacity. The wind farm is expected to power more than one million UK homes and is creating 2,000 employment opportunities during the construction phase, as well as 300 additional jobs during its operational phase.

Hornsea Project Two was granted consent by the energy secretary on 16 August 2016. Consisting of up to 300 turbines located approximately 89km off the Yorkshire coast, it will be capable of generating up to 2.4GW and meet the electricity needs of up to 1.6 million homes per year.

It is estimated that offshore capacity in the North Sea, accessible by the Humber, has the potential to increase by 23GW in the coming years; this would increase the renewable generation associated with the north of England considerably (National Grid 2016b). In addition, plans are currently underway to extend existing offshore sites elsewhere around the North. The extension of Burbo Bank wind farm off Liverpool Bay plans to connect an additional 258MW, and the Walney extension in Cumbria a further 659MW.

### ***Tidal***

The generation of power from tidal lagoons is currently absent from the UK energy mix; however, a collection of companies are aiming to develop the technology at a number of sites. Tidal lagoons collect water at high tide that is then released through turbines to generate electricity at set times, which can be adjusted to meet demand. Most of the potential development sites are located in Wales, but sites in North Wales hold out significant potential for linkages with the wider northern economy and energy system, and one site that has been assessed as viable is located in west Cumbria (Tidal Lagoon Power 2016).

The future for tidal lagoons as a source of energy remains tentative. However, in January 2017 a government-commissioned review backed plans for a £1.3 billion tidal lagoon in Swansea Bay. In its assessment of the viability of the technology and its suitability for the UK, the independent review, conducted by former energy minister Charles Hendry, said the lagoon would make a 'strong contribution' to the UK's energy supply. If the government green-lights the deal, Swansea Bay will be a 'pathfinder' project, the results of which will hold the key to ambitious plans for a network of larger lagoons, including one in west Cumbria.

### ***Nuclear***

A number of authors argue that the nuclear industry has a key role to play in a low-carbon energy system, as shown in the National Grid future energy scenarios. The nuclear industry has a legacy in the north of England, and particularly the North West. Following the decision of the UK's postwar government to develop nuclear weapons, Sellafield in Cumbria was chosen as the location of the plutonium production plant, consisting of the Windscale Piles and accompanying reprocessing plant to separate plutonium from the spent nuclear fuel. This site was later developed to house the world's first commercial nuclear power station, Calder Hall.

Currently, the north of England, with plant in both the North West and the North East – notably including Heysham 1 and 2 – represents 40 per cent of the UK's installed nuclear capacity. Plans by the company Nugen to build another plant in Cumbria expect to bring an additional 3.8GW of capacity. If these Moorside plans go ahead, Nugen expects the plant to be commissioned in 2024. In addition, Hartlepool nuclear power station has had its life extended until 2024, and the LEP has proposed to be the home for future nuclear developments (Teesside Valley Unlimited 2014).

In 2016 David Cameron's government launched a competition to support research and development into small modular reactors (BEIS 2016b). These reactors are set to be factory manufactured so they can be shipped to locations, and have been proposed as being well suited to powering cities (ibid). It may be that these will have a future role in regional- or city-level energy strategies.

### ***Biomass***

Seventy-one per cent of England's total biomass power generation occurs in the North. This generation is heavily concentrated in Yorkshire and the Humber, with the region being home to 98 per cent of all northern production. This is because the majority of these generators, such as Drax,

are based on or adapted from existing coal plants. By way of example, a £300 million multi-fuel waste-to-energy plant, capable of generating around 68MW of low-carbon electricity from various sources of municipal or commercial waste and waste wood, opened at the Ferrybridge C site last year. In addition, there are further plans to convert more coal units to biomass at Drax, currently by far the largest biomass generator in England. However, there are a number of challenges to the role of biomass in the future energy mix. It is costly, particularly when compared to non-fuelled renewable technologies, and its associated emissions are comparable to coal power plants (NRDC 2016).

### **2.1.2 Heat**

Decarbonising the heat system is likely to require a much more widespread change in infrastructure when compared to electricity generation (IPPR 2017 forthcoming). No single solution is likely to be found to decarbonise heat by 2050. Rather, a range of technologies will be adopted that suit different settings, whether these are urban, suburban or rural. These may include heat pumps, biogas or electric heating. There is reason to believe, however, that the north of England can become a national, indeed global, leader in some key areas.

#### ***Gas and fracking***

As demand projections in this report show, gas is likely to continue to play a key role over the coming decades (Loughhead 2015). It should be noted that gas is not just used for heating, but also has a range of industrial uses – including in the generation of electricity. Currently the UK imports the majority of its gas needs – a system some argue is potentially more carbon intensive than domestic production, and which has given rise to concerns around energy security (ibid). There are a number of potential sources of gas. Renewable gas also has the potential to be integrated into the existing gas networks, and already in the region there are a number of plants manufacturing biogas.<sup>3</sup>

Shale gas has been identified as a potentially cheaper and lower-carbon energy source for heating. A large proportion of Britain's potential shale gas is found in the Bowland-Hodder basin, which sits beneath the north of England, with potential well sites across the region (Andrews 2013). The British Geological Survey estimated that there could be 822 trillion cubic feet of shale gas (ibid) in the basin – over 300 times the UK annual gas consumption (Loughhead 2015).

However, there are significant issues standing in the way of shale gas as a future energy source. First, the figures relating to the amount of gas are estimates of shale gas that is *present*, as opposed to extractable (Andrews 2013). As yet, there is no precise knowledge of the amount of shale gas, if any, that could be extracted from the basin. Second, shale gas, and its extraction through hydraulic fracturing or 'fracking', has led to significant hostile reaction from large sections of the public, particularly those who live close to potential wells.

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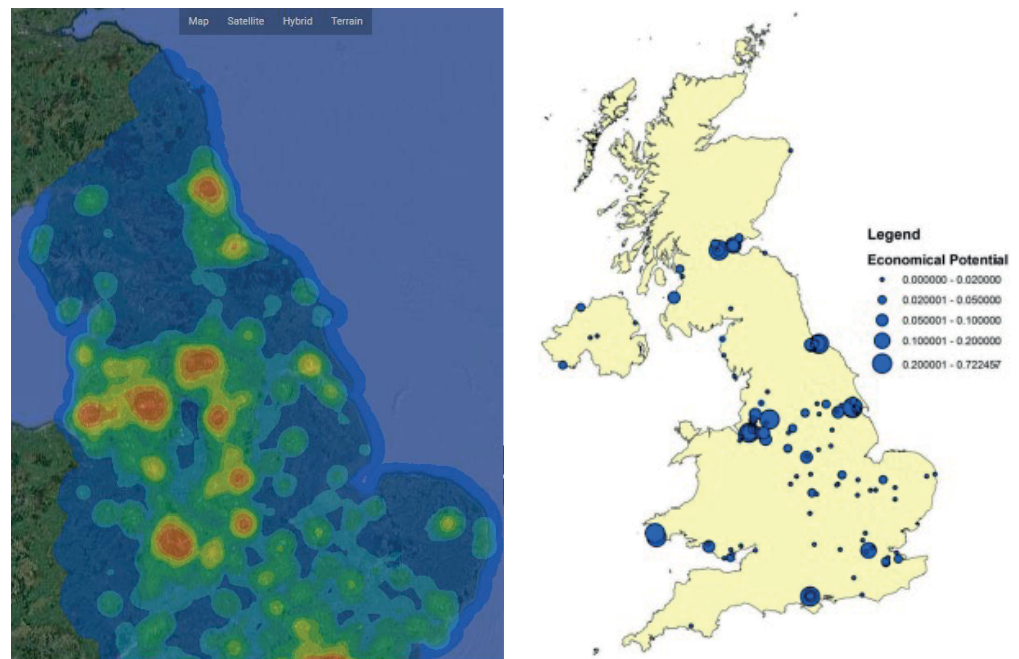
3 See <http://www.biogas.org.uk/plants>

### *District heating*

Another low-carbon heat option is district heating. District heating schemes work in different ways, but share the central characteristic of combining a number of home or business heating systems into a central heat source. These schemes are likely to play a key role in decarbonising heat, particularly in urban areas (IPPR 2017 forthcoming). One way in which district heating works is through harnessing waste heat from industrial processes in a manner that presents a key opportunity for the North as a site of significant industrial activity. Figure 2.2 illustrates a 2013 report by Element Energy for the Department of Energy and Climate Change that revealed three key clusters of sites where the economic potential from harnessing surplus heat is high in the North West, the Humber and the North East (Element Energy 2013). This suggests that energy-intensive industries, while potentially challenged by energy costs, may present mutually beneficial opportunities elsewhere in the energy system. Already, there has been a lot of activity in the North in delivering district heating schemes (BEIS 2017a).

**FIGURE 2.2**

There are three key clusters of sites in the north of England where the economic potential from harnessing surplus heat is high  
*Waste heat and the potential for its recovery*



Sources: (left) Department for Business, Energy and Industrial Strategy, 'Heat maps' (BEIS 2017b); (right) Element Energy, *The potential for recovering and using surplus heat from industry* (Element Energy 2013)

### *Hydrogen*

Another option for decarbonising the heat system is to convert the gas network to run on hydrogen rather than natural gas. Much of the planning with regards turning this idea into a practical and fully costed plan for its rollout has occurred in the north of England. Northern Gas Networks' H21 project has assessed the capacity of the existing gas network in Leeds,

already undergoing upgrade, to run on hydrogen, proposing that for minimal cost to consumers, and no major change to gas pipes, a viable scheme could be implemented by 2025 (Northern Gas Networks 2016).

Northern Gas Networks argues that the hydrogen can be created through four steam methane reformers in Teesside, with the resulting CO<sub>2</sub> then sequestered through a carbon capture and storage (CCS) system in the North Sea. A pipeline would then be created to transport the hydrogen from the production site to the gas network, with sites for storage along the route to manage demand. These schemes will depend upon salt caverns to store hydrogen. With a relatively shallow field of caverns in Teesside together with deeper stores in East Yorkshire and intermediate sites such as the salt caverns found in Cheshire, the north of England – by virtue of its geology – is uniquely placed to become a global leader in this field (ETI 2015).

The reliance of this scheme on CCS may also have additional advantages for the region. CCS refers to the collection of infrastructure through which carbon emissions produced by industrial processes and energy generation are trapped, transported and then stored, typically in offshore geological formations (CCSA 2016). CCS has been identified as essential to decarbonising certain carbon-intensive industries, many of which, as discussed previously, are located in the north of England. Plans were underway to trial commercial CCS through a government competition, but have since fallen away as the competition was abruptly halted. Nonetheless, organisations such as Teesside Collective have continued to develop their plans and have presented a blueprint for industrial CCS in the UK (Teesside Collective 2015). The development of a CCS network necessary to facilitate hydrogen heating would also, therefore, have additional advantages for industry and power generation.

## **2.2 OPPORTUNITY TWO: THE LOW-CARBON GOODS AND SERVICES SECTOR**

The North's natural and industrial resources hold significant potential to establish new generation technologies. However, it is the wider low-carbon goods and services sector that will deliver, run and support this generation. It is especially significant that while the traditional energy sector is in decline, the North has a strong low-carbon economy.

### **2.2.1 Jobs**

The low-carbon goods and services (LCGS)<sup>4</sup> sector accounted for 136,000 jobs in the North in 2013 (BIS 2015). This equates to 21 LCGS jobs per every 1,000 jobs in the North, compared to 16 per 1,000 in England as a whole.<sup>5</sup> The North West has a particularly high rate of LCGS employment, at 27 per 1,000, as does the North East at 20 per 1,000. Yorkshire and the Humber, however, at 15 per 1,000, falls just behind the overall rate for England (see figure 2.3).

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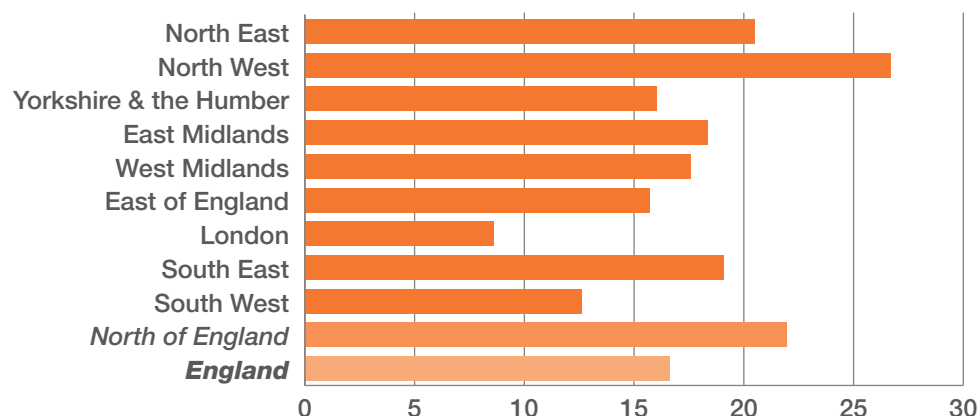
4 LCGS is an 'umbrella' term for capturing a range of activities spread across many existing sectors like transport, construction, energy and so on, but with a common purpose – to reduce environmental impact.

5 IPPR analysis derived from BIS 2015.

**FIGURE 2.3**

**The North West and North East have particularly high rates of LCGS employment**

*Employment in low-carbon goods and services (per 1,000)  
by English region, 2013*



Source: Department for Business, Innovation and Skills, *The size and performance of the UK low carbon economy* (BIS 2015)

### 2.2.2 Regional assets and strengths

Driving this employment are a number of sites of major LCGS assets and businesses within the northern energy sector, which are distributed across the region, with key specialisms in certain areas. These are outlined in the map below.

These assets are closely related to generation associated with the area.

- The nuclear industry dominates the North West, with key assets in Cumbria, Lancashire and Cheshire and Warrington reflecting the region's research assets in the area.
- Offshore wind assets are located in Humberside, Liverpool and the North East.
- Biomass is centred around Drax in Yorkshire.

Furthermore, the region also has a number of energy-related advanced manufacturing assets in marine and subsea engineering (North East and Liverpool), nuclear materials development (Manchester and Sheffield), biofuels processing (York, North Yorkshire and Easting Riding), and electric motors, generators and transformers manufacturing (Leeds).

This demonstrates that the northern strengths are diverse. Furthermore, the recent Northern Independent Economic Review has identified three other 'prime' economic capabilities alongside energy (SQW and CE 2016). The ability to draw on these prime capabilities also puts the North in a strong position to extract further value from the LCGS sector. For example, the review observes the interaction between advanced manufacturing, energy and digital capabilities, arguing that they have a multidirectional relationship wherein energy enables the advanced manufacturing sector, while the advanced manufacturing sector develops the new materials and processes that develop energy generation and storage technology. Digital

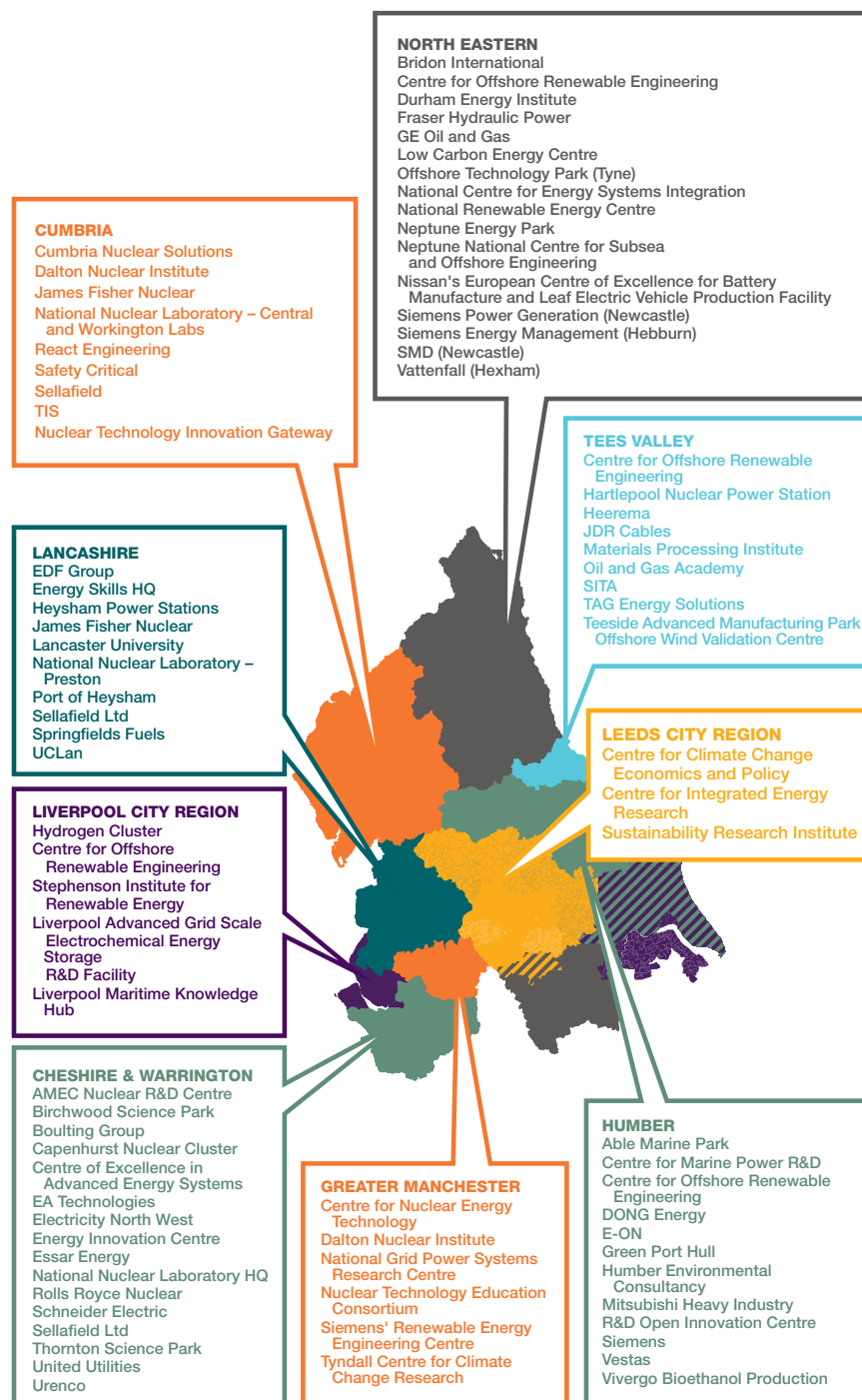


capability is seen to underpin both, providing the computation, software design and data analysis necessary in each of these capabilities.

**FIGURE 2.4**

LCGS assets in the North are closely related to the energy generation associated with the area – for example, the nuclear industry dominates the North West

*Map of sites of major LCGS assets and businesses within the northern energy sector*



Source: adapted from SQW and Cambridge Econometrics [CE], *The Northern Powerhouse Independent Economic Review Workstream 3* (SQW and CE 2016)



### 2.2.3 Industrial opportunities aligned to generation

The nature of power systems is changing. The higher proportion of renewable technologies on the transmission network will mean power generation is more intermittent, and through an increase in technologies such as roof-top solar, generation will become more local. These factors will need to be managed, and new technologies and business models are emerging that can help deliver carbon commitments while providing reliable and secure supply at minimum cost. These generally incorporate three key strands.

- **Storage:** technologies that enable the network to make the most of times when generation exceeds use; batteries can store electricity when generation is greater than demand, to be used later when needed.
- **Interconnection:** the exporting of electricity at times of surplus and importing at times of demand overseas through cables to balance generation and demand.
- **Demand-side response services:** reducing demand at peak times through special tariffs and schemes that reward consumers for changing how and when they use electricity, combined with smart meters and real-time monitoring to enable consumers to better monitor and manage their energy use.

While changes to the grid system are needed nationally, efforts to adapt to these changes, through Distribution System Operators (DNOs), will happen at a local and regional level. This opens key industrial opportunities for DNOs and regions that take on the challenge of delivering new technologies and take a more active role in network management.

One example of such work already occurring in the region is the Customer-Led Network Revolution (CLNR) project run by Northern Powergrid and partners (British Gas, EA Technology, Durham Energy Institute, Newcastle University). This four-year smart grid demonstration was awarded £26.8 million from Ofgem's Low Carbon Networks Fund in 2010, the largest single award made by Ofgem, and described in the following case study.

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#### Case study: Customer-Led Network Revolution (CLNR)

The CLNR project brought together key stakeholders in the electricity industry – customers, suppliers and distributors, to develop innovative solutions and commercial arrangements together. This involved exploring how new tariffs can encourage customers to be more flexible in their use of electricity, how networks can respond more flexibly by using more advanced voltage control devices, real-time thermal rating and energy storage, and how to deploy and work with smart meters.

CLNR concluded that industrial and commercial demand-side response is a viable and reliable option today to address future network constraints, both in terms of customer co-operation and post-fault response. However, there are presently few customers willing or able to provide this service. Good engagement by the industry will be critical to overcome the challenge of finding suitable DSR provision in the right geographic locations. The

engagement in trials was through commercial aggregators as well as direct with the customer.

This project generated important new learning on technology deployment and customers' energy practices that has enabled Northern Powergrid to develop a route map to guide the development of smart technology systems to 2050. This will act as a springboard for Northern Powergrid, its partners and the energy industry as a whole to drive forward the development of a smarter powergrid that ensures customers continue to receive a safe, secure and affordable supply of electricity, both now and in the low-carbon future.

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Many of the new technologies that will facilitate this transition are being developed in the north of England alongside hosting sites to take these to market through cutting-edge energy demonstrator projects. For example, the SmartGrid testbed and Digital Catapults in Newcastle, Manchester's Triangulum – a smart city project delivered by the University of Manchester and Siemens – and the Energy System Demonstrator project at the University of Chester's Thornton Science Park. The region is also home to the Nissan car plant, which is currently manufacturing batteries for electric vehicles and that is considering their application in other contexts (Nissan 2016).

In the heat sector, there will be a need for the rollout of energy efficiency schemes and products for domestic, commercial and industrial users. Historically, government policy has been criticised for being ineffective in delivering sufficient amounts of energy efficiency products (ECCC 2016). However, the region has been home to examples of effective schemes such as the Kirklees Warm Zone, which is believed to be the largest and most effective energy efficiency scheme delivered in England to date (Webber et al 2015, Kirklees Council 2011).

This suggests that were the North to draw on its skills base and history of innovation and develop the first steps towards effective products in these areas, it would have the opportunity to export them to the rest of the country and, ultimately, the world.

### 3.

## LOCAL AND REGIONAL APPROACHES TO ENERGY POLICY

The previous chapters have shown that the energy sector in the North faces a number of challenges, but it has the capacity to address them through its sites for generation, economic assets and skills base. Doing so should not just be a northern imperative – although it will of course be of significant economic benefit to the region – but a national one. This is because delivering a strong northern energy sector will lead to the generation and transmission of a significant amount of low-carbon energy, ensuring energy security while powering and heating the nation's homes and businesses. This is alongside working towards meeting of greenhouse gas emission reduction targets and positioning the UK as a leader in the innovation and technologies that are necessary to deliver generation in a low-carbon energy system.

However, the region is overly reliant on national-level policy and strategy and – as with other aspects of economic development – this risks failing to appreciate and support the ambition necessary to make the best of the region's assets. It is therefore timely that the UK government has formed a new department for Business, Energy and Industrial Strategy (BEIS) and announced a desire to pursue a place-based industrial strategy.

At the local level, local enterprise partnerships are doing a great deal of thinking in the energy sector, and it is mentioned as a key priority in the strategic economic plans of all 11 northern LEPs. While there is clearly good work being done at the local level, there is a risk that opportunities to maximise the benefits of the energy sector are being missed through a lack of strategic co-ordination and shared learning between LEPs; what's worse, LEPs may actually be competing with one another in relation to particular opportunities and technologies.

Additionally, local authorities have been heavily engaged in facilitating thinking about the city-region roles in relation to energy through a series of mini-Stern reviews of northern cities (for example Leeds, Manchester and Sheffield) that have identified the role the city-region can play in driving low-carbon growth (Gouldson et al 2014). In some cases, local authorities have steered industries to their regions – in Humber, for example, where Hull city council was an integral part of the designation of Green Port Hull, which in turn played a key role in locating much of the offshore wind industry in the region (Green Port Hull 2016). Too often, though, local authorities lack the powers they need to intervene sufficiently in industrial location (Cox et al 2016).

It is also the case that many of the factors that may facilitate the growth of the energy sector or specific projects rely on infrastructure at a regional level. Northern Gas Networks' plans for hydrogen show that it is infrastructure that exists *across* the North – such as CCS, salt cavern storage and hydrogen production – that will be needed to deliver the project. This is very difficult to achieve without significant local authority collaboration, for which there is very little institutional capacity even where there is goodwill. Ensuring that the necessary technologies can be delivered at scale is therefore unlikely to be achieved at the very local level.

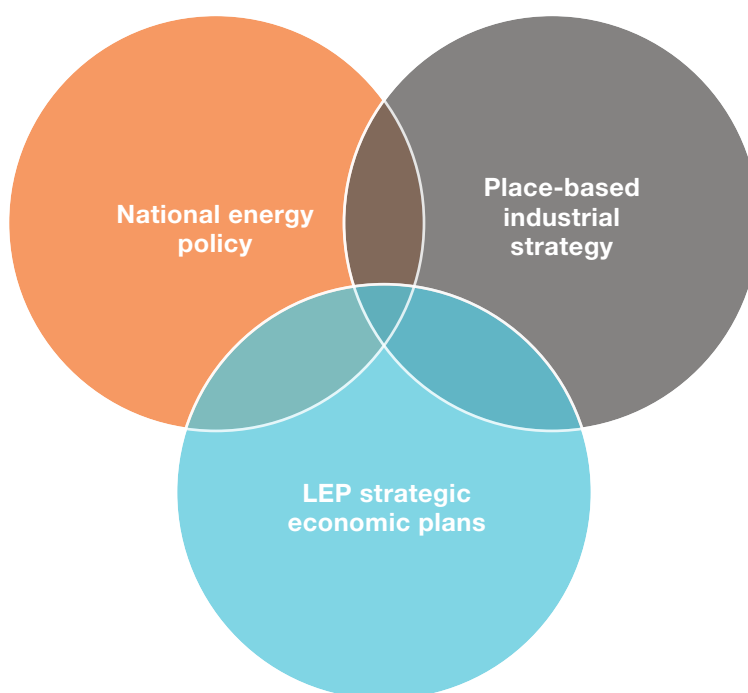
Given these challenges, it is plausible to suggest that there might be an intermediate tier of strategic thinking and policymaking, as exists in almost all other developed nations, to deliver this strategy. As presented above, the future generation capacity associated with the North and the economic growth and jobs associated with it, currently relies upon national energy policy. The extent to which national policy pursues, or enables, ambitious decarbonisation targets will have a direct bearing on how far the northern economy will benefit. Similarly, the shape and scope of a place-based northern industrial strategy could and should promote decarbonisation, demonstrating further that there are not just environmental but also economic gains to be made from a cleaner energy supply.

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**FIGURE 3.1**

**A northern energy strategy should pull together national energy policy, a place-based industrial strategy, and the strategic economic plans of relevant local economic partnerships (LEPs)**

*Situating a northern energy Strategy*



Previous work by IPPR North has argued for a ‘mezzanine level’ to policy at a regional level which allows the co-ordination of these local, and vital, economic plans within macro-level economic and policy thinking (Cox et al 2016). This would see a regional tier to industrial strategy which would

- co-ordinate the economic capabilities of that region
- bring them together with regional infrastructure as part of an overarching vision, complete with key projects and investment opportunities.

This report is not the place to set out a place-based energy strategy or energy-based industrial strategy. This will be achieved in collaboration with the Northern Energy Taskforce and will be the focus of subsequent work. That said, it is of value to set out three key elements that may feature as part of such a strategy and their likely benefits: the devolution of powers over energy policy; a strategy for co-ordination at the northern level; and the creation of northern projects and markets.

### **3.1 THE DEVOLUTION OF POWERS OVER ENERGY POLICY**

A regional approach to energy opens up the possibility for the devolution of policy over energy to a regional level. Already, some powers have been devolved to Northern Ireland, Scotland and Wales. Each country has a different arrangement, with Northern Ireland having full devolution, Scotland control over renewables obligations certificates (ROCs), energy consents and planning, and operational control over market support, and Wales some planning policy control.

Devolution has a number of impacts in these areas of the UK (Cowell et al 2013).

- The ability to differentiate ROC levels has allowed the pursuit of regional priorities in technologies – in Northern Ireland this has been small-scale renewables and anaerobic digestion, and in Scotland, wave and tidal generation in Scotland.
- In Scotland, the government has been able to direct proportionately greater levels of funding for research and demonstration for on- and offshore wind and tidal technologies.
- The Welsh government’s control over planning has been advantageous in leading to comparably high rates of onshore wind generation.

As the North is home to so many sites of potential development and the workforce and research assets necessary to develop them, it may be possible to make the case that the region could utilise such devolution to the nation’s advantage.

### **3.2 A STRATEGY FOR CO-ORDINATION AT THE NORTHERN LEVEL**

There is also a clear need for co-ordination and strategic working across the region. This may be as part of a body or institution, as is currently the case for Transport for the North, or through working groups. Already many LEPs have areas of joint concern that are articulated in their strategic economic plans. In particular, in the energy space they have identified a need to develop spaces for innovation and to develop skills. While it has already been acknowledged that the North is home to many

R&D assets, it was felt by a number of LEPs that there is a need to ensure there are sufficient spaces in which to develop new innovations and to take them to market and the expertise to support this.

Furthermore, in responding to new technologies and driving the low-carbon economy, many strategic economic plans observed the need to ensure a skills base for the energy sector. Both Humber and Liverpool city-region LEPS have undergone programmes of skills development in specific areas related to local labour markets. In the case of Liverpool this has involved both general STEM skills development and working with colleges to examine specific energy sector needs.

As such issues arise at the local level across the region it is likely that a more regional co-ordination may tackle such gaps. For example, the skills necessary for industry growth in relation to offshore wind in Liverpool are similarly desired in Hull and the Humber.

### **3.3 THE CREATION OF NORTHERN PROJECTS AND MARKETS**

The North also has a significant population and economy that might represent a more appropriate scale from which to manage projects that have typically been pursued at a more local level.

Working at a pan-northern level may also open up opportunities for achieving economies of scale and customer bases that northern business, established or new, could serve. A number of LEPs highlighted a desire to address energy efficiency for both business and domestic users, as have local authorities. It is conceivable that directing schemes, often managed on a local level, across the northern region may achieve cost savings. The same could be achieved for district heating schemes, for example, where a sufficient customer base could see the development of an industry to serve it in the North itself, rather than buying in expertise from elsewhere.

## 4. QUESTIONS FOR FUTURE ANALYSIS

This landscape analysis has set out a series of challenges and opportunities for energy generation and supply in the north of England, and has begun to explore the way in which strategic working across a large-scale geography could bring these together in relation to a place-based industrial strategy. As the first output in a longer process of analysis and deliberation, this report raises a series of questions for future consideration that will guide the next steps for the Northern Energy Taskforce.

### 4.1 FUTURE DEMAND AND THE LOW-CARBON TRANSITION

- How far do current demand projections reflect the level of ambition required to both provide energy security at a reasonable cost to the North's businesses and consumers while at the same time put the nation on track to meet its climate change commitments?
  - What can be done to support businesses and consumers to reduce their demand for power and heat?
  - What potential exists for very local approaches to energy efficiency, generation and transmission?
- What are the respective roles of national, regional and local bodies in supporting the low-carbon transition?

### 4.2 POWER, HEAT AND ENERGY SECURITY

- How much can each of the significant opportunities in the North – both in terms of power and heat – contribute towards the nation's transition to a low-carbon economy and reduce its dependency on energy imports?
  - What would an appropriate energy 'mix' look like under a range of different scenarios for power and heat?
  - What kind of timescales might be required to achieve a steady transition?
- How can national, regional and local policymaking support investment in key infrastructures and technologies?

### 4.3 THE ENERGY ECONOMY

- How can we make sure that place-based industrial strategy maximises opportunities for the north of England to continue to drive the energy sector in the UK and exploit its comparative advantages in order to maximise its leading role in energy systems innovation on a global stage?



- What can be learned from existing practice about supply chain development, for example in the nuclear sector?
- How do we develop the knowledge and skills to support the continued development of the energy sector in the North?
- What support is required in taking new innovations to market?
- How can we ensure the North develops its role as a key destination for energy innovation?
- How do we build links between the energy sector and wider industry?

#### 4.4 STRATEGIC PLANNING AND CO-ORDINATION

- What aspects of energy policy are best addressed by national government and local players such as local enterprise partnerships, and to what extent is there value and scope in devolving certain powers and strategic responsibilities to a pan-northern level of co-ordination?
  - Is there a place for the devolution of energy policy and delivery to a regional or local level?
  - How is it best to promote interregional co-ordination and good-practice sharing?
  - How will key energy investments be financed and funded?
- What institutions might be necessary to build strategic capacity across the North?

The Northern Energy Taskforce will work to explore these and other questions in the months ahead, with a view to producing an interim report in spring 2017 setting out some of the principles, priorities and scenarios relating to the future of energy policy in the North. This will be followed by a high-level Northern Energy Strategy in September 2017.

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