KPMG

Energising the North

A report for Northern Gas Networks

April 2016

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Northern Gas Networks

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1 Executive summary

The Government's Northern Powerhouse initiative states that: **'The Northern Powerhouse is about unlocking the potential of the economies of the North of England, and presenting opportunities for companies to grow, and compete more effectively in the global market'**.

Northern Gas Networks has commissioned KPMG LLP to produce a report looking at the potential contribution of existing and future energy initiatives in the North of England[1] to the Northern Powerhouse initiative. The key findings of the report are set out below.

The Northern energy sector is already vibrant

The sector is already contributing strongly to the economy of the region and to that of the country as a whole. Investment is taking place at all scales, from households opting to install small-scale renewable heat and electricity on their properties up to the region's gas and electricity network operators investing hundreds of millions of pounds over the coming years in maintaining and improving the region's networks.

The North is leading energy innovation

Alongside these investments are genuinely innovative new projects aimed at proving new technologies to help address energy affordability, decarbonisation and security of supply. A key example is the Hydrogen H21 Leeds city gate project, looking at ways of replacing natural gas with hydrogen while using existing gas networks. Other examples include pilot schemes in Newcastle for decentralised electricity and heat networks. Cities in the region are becoming a proving ground for smart technologies of the future, allowing energy resources to be used more efficiently, thereby ensuring costs for consumers are minimized, and helping the fuel poor. Regional universities are also playing a key role in these developments.

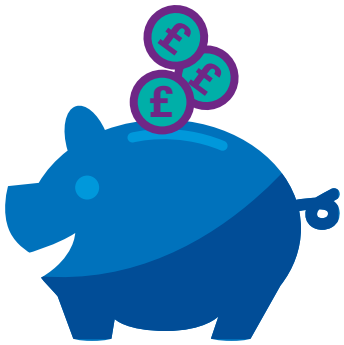
The North is well-positioned to act as an 'energy champion'

The region has impressive natural and human resources that mean it can be at the forefront of new developments and innovation in the energy sector in years and decades to come. Its location means that it is the natural point of contact between the UK and North West Europe, and a point for import and export of resources and products through its interconnectors and ports. The region's human resources reflect its status as the cradle of industrialisation in the UK, with several world–class cities and universities providing hubs for research and development and innovation. In terms of natural resources, the region has the Bowland shale gas reserve, where deposits have been estimated to total 37.6 trillion cubic metres.

[1] Throughout this report, the phrase 'North of England' refers to the area covered by the following counties and unitary authorities: Northumberland, Tyne and Wear, County Durham, Darlington, Hartlepool, Middlesbrough, Redcar and Cleveland, Stockton-on-Tees, North Yorkshire, West Yorkshire, South Yorkshire, East Riding of Yorkshire, York, City of Kingston upon Hull.

Making it happen

The report identifies several initiatives that could ensure that the North's full potential in addressing future challenges and stimulating economic growth is realised. These include:



Ongoing funding for innovation projects like:

- H21 Leeds city gate - Hydrogen project
- Smart Grid and heat projects in Newcastle

Developing regional strategies for key initiatives, including:

- the cost-effective exploration and transportation of shale gas.
- exploitation of carbon capture and storage potential.
- developing whole energy solutions, covering gas, electricity, heat and transport, that exploit existing investment in electricity and gas networks.
- ensuring such developments can help address fuel poverty and economic development in the region.

A co-ordinating group to 'champion' regional energy innovation and development, bringing parties with complementary objectives and expertise together, especially business interests. Initiatives may include:

- co-ordination of development activities and information sharing; suggesting energy initiatives to central Government for the Northern Powerhouse roadmap.
- an annual regional innovation 'summit' to update on progress made and share ideas.
- advising relevant authorities on incentives or actions to drive new 'regional energy innovation hubs' e.g. locations such as Sunderland and Hull.

2 Introduction

2.1 Background

The Government's Northern Powerhouse initiative was announced by Chancellor of the Exchequer George Osborne in June 2014. In his speech which signalled the Government's intent to help northern cities collectively become internationally competitive[2], thereby addressing the economic imbalance between northern and southern England, and attracting investment into northern cities and towns. This tied in with a wider trend towards local devolution: following the 'No' vote in the Scottish referendum in September 2014, the Prime Minister announced that, alongside proposals for additional devolution to Scotland, Wales and Northern Ireland, 'It is important we have wider civic engagement about…how to empower our great cities'[3].

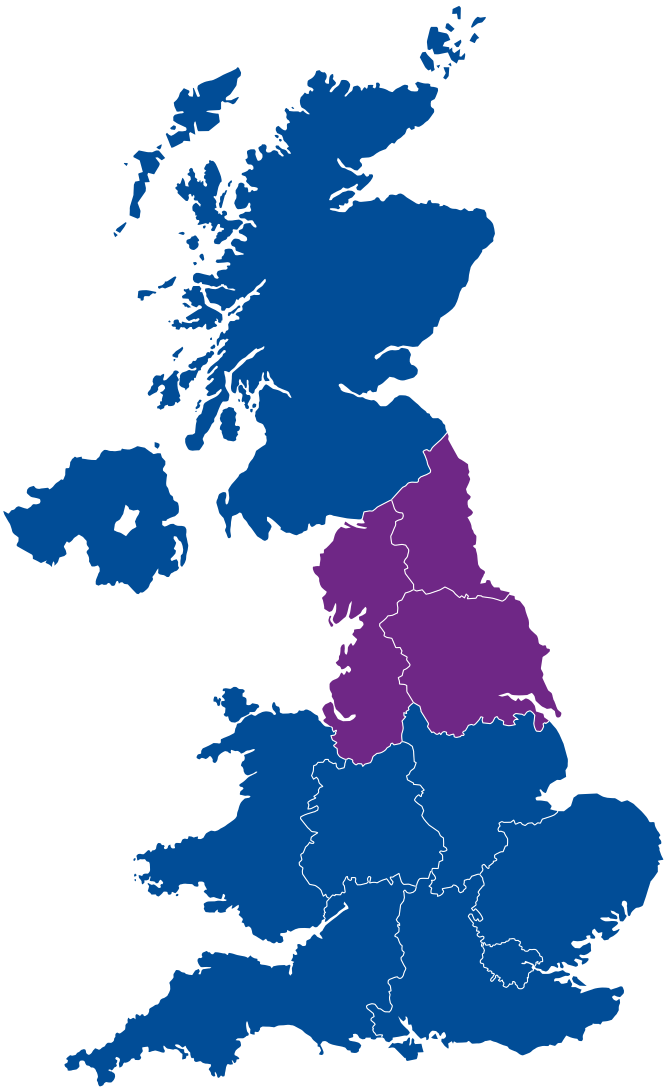
Since then, Government has signed devolution deals with cities and regions in the north of England, including Greater Manchester, Sheffield, the North, Tees Valley, Liverpool and West Yorkshire. For example, on 23rd October 2015 it signed an agreement with the Shadow Tees Valley Combined Authority. This agreement gave voters the power to choose a directly-elected mayor from 2017, who will take on a raft of new powers, including the ability to raise business rates to fund local infrastructure. In financial terms, the deal provides funding of £15m per year for the next 30 years as part of an Investment Fund of £450m guaranteed by Government. The North Combined Authority entered into a similar agreement on the same day, with an investment fund of £900m to provide funding of £30m per year over the next 30 years[4].

"It is important we have wider civic engagement about... how to empower our great cities"

[2] See https://www.gov.uk/government/speeches/chancellor-we-need-a-northern-powerhouse
[3] See http://researchbriefings.files.parliament.uk/documents/SN07029/SN07029.pdf
[4] See https://www.gov.uk/government/policies/city-deals-and-growth-deals

Alongside the need to ensure economic growth in the North and rebalance the economy, the Government also faces pressing challenges in the sphere of energy policy, in particular how to reconcile the different elements of the 'energy trilemma' (driving decarbonisation, ensuring secure energy supplies, and maintaining the affordability of energy). It has thus far proved difficult to do this, as the pressure placed on energy bills by so-called 'green levies' (and the Government's subsequent moves to cut back support for low-carbon energy) show. At the same time, the UK energy system is changing. Large amounts of power generation capacity are being lost as older coal and nuclear power stations close down due to age and environmental legislation. Local, distributed power solutions are becoming more prevalent, with technologies such as solar PV and energy storage coming to the fore.

The energy sector in the North is vibrant, with high levels of investment and innovation already occurring, as it strives to meet the challenges presented by the energy trilemma. It therefore has a potentially significant contribution to make towards meeting the challenges of energy policy, as well as attracting investment and driving economic growth. KPMG have been commissioned by Northern Gas Networks (NGN) to assess the potential contribution the energy sector in the North of England can make to the Northern Powerhouse agenda and to energy policy, and to identify ways in which this impact can be maximised.

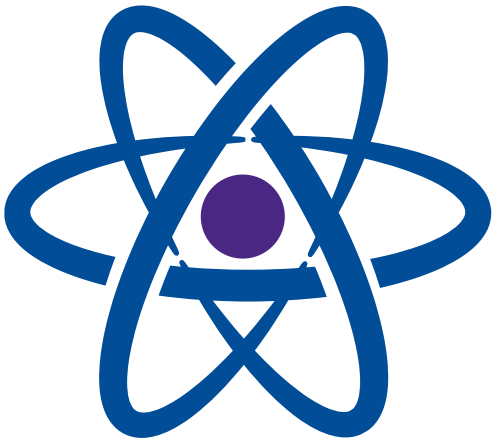


3 The North as an energy leader

3.1 Northern energy sector assets

The energy sector in the North possesses a wide range of assets, stemming both from its natural characteristics and from its heritage as the industrial stronghold of the UK. The energy sector is also able to draw on a rich stock of human capital in the region, which has several major cities and leading universities.

These assets are described in more detail below.



3.1.1 Natural resources

The region has significant natural assets which currently benefit the energy sector, or which may be tapped in the future. These include:

Bowland-Hodder Shale Gas Formation: this runs across Northern England. The British Geological Survey carried out a resource estimation in 2013, which suggested that total resource was 37tcm in a central scenario.

Ports: the North's long coastline boasts several major ports, which provide a gateway to world markets for UK producers and a source of jobs for the region's inhabitants. These include the Ports of Tyne, Sunderland, Blyth and Tees, which together are estimated to handle 50 tonnes of cargo per year[5].

Of great relevance to the UK's energy sector is Green Port Hull, where wind turbine manufacture and installation facilities are currently being put in place within combined investment from Siemens and ABP of £310m. This investment is expected to support around 1,000 jobs directly, with additional jobs during construction and in the supply chain[6].

Location: the region is close to north-west Europe, and is the location for major electricity and gas interconnectors (NSN and Langeled respectively).

[5] See http://www.thejournal.co.uk/business/business-news/focus-north-east-ports-chief-7600683
[6] See http://www.siemens.co.uk/en/wind/hull.htm

3.1.2 Human resources

The region has several major cities, such as Newcastle, Hull, York, Leeds and Sheffield. Urban areas such as these provide centres for technological innovation, as well as proving grounds for innovative energy technologies such as smart networks and low-carbon heat networks such as the H21 Leeds city gate project.

The region is also home to several world-leading universities, with three (Durham, Leeds and York) featuring in the current top 20 of UK further education institutions[7]. Some of these institutions are heavily involved in research and development in energy projects through a series of innovative initiatives. For example, energy experts at Newcastle University are heading the UK's largest smart grids project, including the development of a £2m energy storage test bed. This is the first project of its type in the UK, and will help pave the way for large-scale deployment of energy storage in the future[8]. The region also hosts the Offshore Renewable Energy Catapult in Blyth, which is the UK's flagship innovation and research centre for offshore wind, wave and tidal energy[9].

The North also has a strong industrial base. This includes the Nissan factory in Sunderland, which supports 6,700 jobs directly and another 27,000 in its supply chain[10]. There will be increasing scope for shared learning and technological development between the transport and energy sectors in the future, as electric vehicles become increasingly prevalent. The region will also become a focal point of the renewable electricity industry with the completion of the Siemens offshore wind factory in Hull.

3.1.3 Energy Networks

The energy network owners in the region are Northern Gas Networks (NGN) and Northern Powergrid (NPg). NGN own and manage 37,000km of gas pipelines in the region, while NPg own and manage 81,000km of electricity cables (overhead and underground).

The networks are regulated by Ofgem under the RIIO framework. NGN's current price control (RIIO-GD1) lasts from 2013 to 2021, while that for NPg (RIIO-ED1) lasts from 2015 to 2023. The regulatory business plans for both NGN and NPg indicate that both firms will continue to make substantial investments to maintain and improve the region's networks over the coming years: NPg plan to invest £170m per year on average over the first RIIO price control[11], while NGN plan to invest £60m per year[12].

Outturn data from the RIIO-GD1 period shows that NGN are currently outperforming their customer service targets[3]. NGN are currently ranked second for customer satisfaction among the gas distribution networks, and have won recognition outside of the utility services for customer satisfaction, including the National Business Award for Customer Focus.

[7] See http://www.thecompleteuniversityguide.co.uk/league-tables/rankings
[8] See http://www.ncl.ac.uk/sciencecentral/urban/smartgrid/
[9] See https://ore.catapult.org.uk/who-we-are
[10] http://www.telegraph.co.uk/finance/newsbysector/industry/engineering/11840148/Nissan-to-invest-100m-in-Sunderland-plant-as-new-Juke-gets-the-green-light.html
[11] See http://www.yourpowergridplan.com/#!what_it_costs
[12] http://www.northerngasnetworks.co.uk/wp-content/uploads/2015/10/business-plan-2012.pdf. See p183: our figure converts rom 2009/10 prices into 2015 prices.
[13] See http://www.northerngasnetworks.co.uk/wp-content/uploads/2015/10/RIIO-GD1-Year-2-Report.pdf

3.1.4 Energy generation

Due to its significant reserves of coal, the North of England has several large-scale coal fired power stations, such as Drax and Lynemouth. Under European environmental legislation such as the Industrial Emissions Directive (IED), these plants are faced with the choice of closure or switching to alternative fuels. Drax has converted several of its units to biomass, and is currently the single largest generator of low carbon power in the world. Drax and other renewable generation assets have allowed the region to become a significant contributor to overall renewable electricity output: in 2014, the region

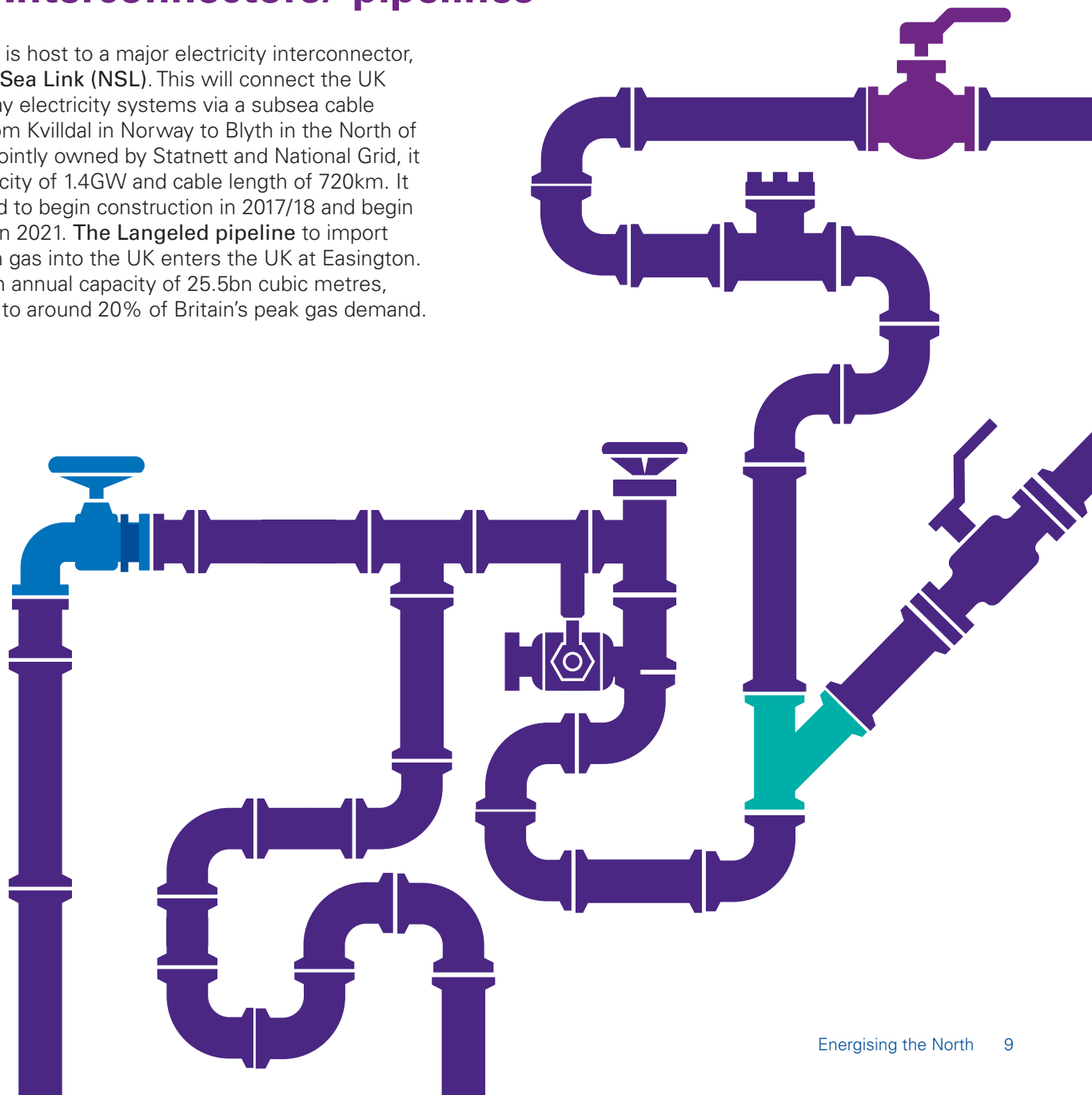
TOTAL INVESTMENT OF

£650M

generated over 12TWh of renewable electricity, 31% of England's total[14]. There is also investment in new biomass capacity taking place in the region, with the MGT dedicated biomass project in Teesside (299MW) bringing a total investment of £650m whilst supporting 600 jobs during construction and 100 when operational. The region also makes up a significant proportion of renewable heat capacity: as of January 2016, 14% of capacity accredited under the non-domestic RHI scheme was in the region[15].

3.1.5 Interconnectors/ pipelines

The region is host to a major electricity interconnector, the **North Sea Link (NSL)**. This will connect the UK and Norway electricity systems via a subsea cable running from Kvilldal in Norway to Blyth in the North of England. Jointly owned by Statnett and National Grid, it has a capacity of 1.4GW and cable length of 720km. It is expected to begin construction in 2017/18 and begin operation in 2021. **The Langeled pipeline** to import Norwegian gas into the UK enters the UK at Easington. This has an annual capacity of 25.5bn cubic metres, equivalent to around 20% of Britain's peak gas demand.



3.2 Investment in the Northern energy sector

The energy sector is an important driver of growth and investment in the region. We have developed a high-level estimate for current annual investment in key parts of the energy sector in the North to give an indication of the sector's scale relative to the rest of the regional economy. This is summarised in the table below:

Sector	Sub-sector	Current annual investment[16] (£m, 2014/15 prices)
Networks (gas and electricity)	National Grid Gas Transmission	**81**
	National Grid Electricity Transmission	**301**
	Northern Gas Networks (Gas Distribution)	**130**
	Northern Powergrid (Electricity Distribution)	**170**
Renewable electricity generation	>50kW	**220**
	>50kW	**190**
Renewable heat	Non-domestic	**110**
	Domestic	**10**
Conventional electricity		**50**
Total investment		**1,100**

This estimate does not take account of investment in firms in the supply chains of these sectors in the region. Research for the recent Infrastructure North 2015 report suggested that every £1 of direct investment by utilities in the North of England creates a 'ripple effect' of 87p additional spend in the region[17]. Applying this ratio to energy sector investment would suggest that investment of £2.1bn per year was generated in the North by the energy sector.

[14] See https://www.gov.uk/government/statistics/regional-renewable-statistics. Figures quoted above relate to Yorkshire and Humber and the North.
[15] See https://www.gov.uk/government/statistics/rhi-deployment-data-january-2016. Figures quoted above relate to Yorkshire and Humber and the North.
[16] 'Current annual investment' refers to capital expenditure in 2015.
[17] See http://infrastructurenorth.co.uk/safewarmincontrol/wp-content/uploads/2015/12/24542-Infastructure-North-Report-WEB-VERSION.pdf

3.3 Innovation in the Northern energy sector

The region is also home to a number of innovative projects in the energy sector, covering smart and low-carbon networks and Carbon Capture and Storage. Some of these projects are described in more detail below.

3.3.1 H21 Leeds city gate project

This project is looking into the feasibility of substituting hydrogen for natural gas in the gas network in Leeds. The use of hydrogen would mean that gas can be more than a 'transitional fuel' on the UK's pathway to a low-carbon economy and play an important role in the low-carbon future. Hydrogen leaves no carbon footprint (the combustion of hydrogen results in water and heat). If proved technically feasible, hydrogen-based distribution systems for heating and domestic cooking could be connected with fuel station forecourts to make hydrogen available for new generation low-carbon vehicles.

The H21 Leeds city gate project has proved, via a desktop exercise, that the current gas network in the UK (and in particular Leeds) is large enough to convert to hydrogen. It is therefore likely that, were the hydrogen economy to commence in the UK, Leeds would be the first network to convert.

The project is now seeking to secure £55m funding develop a 'roadmap to hydrogen' by compiling evidence to underpin any decision to convert the Leeds gas network from natural gas to hydrogen. The roadmap is split into 16 work packages covering over 50 projects. These projects are expected to provide a higher level of confidence in the feasbility of hydrogen conversion by:

1. **Covering any remaining technical evidence gaps;**
2. **Preparing the correct regulatory and social frameworks to allow conversion to happen; and**
3. **Determining the overall strategy for UK-wide conversion over time.**

The H21Leeds city gate project has identified a number of economic benefits from the hydrogen conversion programme to Leeds and the wider region. These are driven by the establishment of Leeds as a 'centre of excellence' for the hydrogen economy, which would in turn lead to the development of 'hydrogen clusters' by technology developers and other parts of the supply chain.

The greatest economic benefits would be driven by a decision to convert the gas network in Leeds to hydrogen. The conversion would be a major infrastructural transformation, requiring the manufacture of large quantities of new hydrogen-compatible appliances and burners, and the training of a large workforce to undertake the conversion. The Leeds workforce could then form the basis of the teams that converted other cities' networks to hydrogen.

3.3.2 Newcastle Smart Grids project

Experts from Newcastle University are leading the UK's largest smart grid project looking at how different power sources can be managed at an acceptable cost. The University has collaborated with industry to set up a Smart Grid laboratory and energy storage test bed, the £2m cost of which has been met through funding from the Engineering and Physical Sciences Research Council (EPSRC), Newcastle University and industrial partners Northern Powergrid and Siemens.

The Smart Grid lab is designed to simulate distribution networks under future scenarios. The lab is able to simulate the working of energy networks in real time, enabling the evaluation of new network technologies. The energy storage test bed is a grid-connected facility which houses a variety of electrical energy storage technologies with a wide range of performance characteristics, enabling a wealth of grid services and case studies to be supported.

4 Northern Energy opportunities

4.1 Northern Powerhouse initiative

As set out in section **2.1**, George Osborne has signalled that the Northern Powerhouse initiative is a policy to promote the economic development of northern cities, enabling them to become competitive at a global level, and rebalancing England's economy between the north and the south of the country.

10 of the 12 most declining UK cities are in the north of England

Thus far, policy measures around the Northern Powerhouse have focused on political devolution, through City Deals which provide for an elected mayor with enhanced powers, and on improving transport links[18], with pledges to improve east-west and north-south transport connectivity in the region.

Recent reports highlight the scale of the challenge. Research by the Joseph Rowntree Foundation found that 10 of the 12 most declining UK cities are in the North of England, and that growth in many northern cities is lagging behind the national average[19].

4.2 National energy challenges

The energy sector is already a major economic driver in the UK economy, with over £100bn of investment projected over the next decade. This includes billions of pounds invested in energy networks, which are national assets for essential services.

Nevertheless there are significant challenges which the sector needs to meet- these are outlined below.

4.2.1 Driving decarbonisation

The UK has a challenging long-term target (enshrined in law through the 2008 Climate Change Act) to reduce carbon dioxide (CO2) emissions in 2050 by 80% against a 1990 baseline. It is also required by the EU to source 15% of its energy from renewable sources by 2020. The EU has recently agreed a 2030 framework for renewable energy whereby 27% of member states' aggregate energy needs are sourced from renewable sources (targets for individual countries are yet to be agreed).

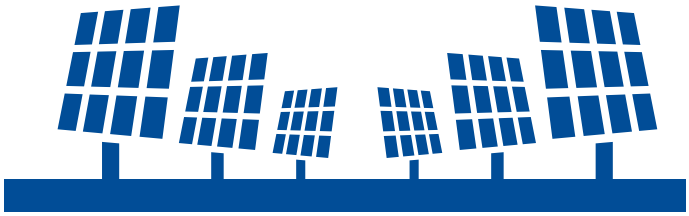
In order to set the UK on a pathway to achieve its 2050 emissions target, the Government has set a series of 'carbon budgets' setting limits on greenhouse gas emissions allowed in successive five year periods. Under the third carbon budget, the UK must reduce its emissions by 34% compared to 1990 levels.

[18] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427339/the-northern-powerhouse-tagged.pdf

[19] See https://www.jrf.org.uk/report/uneven-growth-tackling-city-decline

4.2.2 Ensuring security of supply

Reliable, secure energy supplies are a vital factor in the wellbeing and comfort of households, in the performance of businesses, and in economic growth. The UK faces a challenging outlook on security of supply, with declining domestic production from the North Sea, an ageing nuclear fleet and coal power stations facing closure or reduced running hours under EU environmental directives. In addition, the increasing penetration of variable renewable energy sources such as wind and solar PV, and the advent of decentralised energy, make the challenge of balancing the electricity system even more demanding.



In 2013, the number of households in fuel poverty in England was estimated to be 2.35 million, 15% of these were in the North

4.2.3 Ensuring affordable energy supply

Energy is an essential good for households and businesses. Households that are not able to adequately heat their home run an increased risk of ill health, while expensive energy makes businesses less competitive. Lower energy costs free up household and business financial resources that can be directed to more productive, value-adding activities.

Affordable energy supplies are a major issue for many households in the UK. In 2013, the number of households in fuel poverty[20] in England was estimated to be 2.35 million, representing approximately 10.4% of English households. The issue is particularly prevalent for the most vulnerable groups in society, such as the unemployed and single parent households.

[20] A fuel poor household is defined by the Low Income High Costs Indicator as one which has required fuel costs above average and (were this amount to be spent) residual income would be below the poverty line.

4.3 The potential contribution of the energy sector to the policy agenda

The energy sector in the North is well placed to help meet the nation's energy challenge and to drive growth in the region.

Energy policy has traditionally been centrally planned in the UK, with policy decisions taken centrally in Whitehall or by the regulator. However, rapid technology advances have made decentralised energy technologies such as solar PV and energy storage increasingly important, giving local communities more power to take control of how they use and produce energy. This has been recognised by DECC's Community Energy Strategy[21], and has started to affect energy markets with initiatives such as Bristol Energy, a municipal energy company wholly owned by Bristol Council. These trends mean cities in the north of England can start to take more of a role in energy policy for the benefit of their inhabitants.

Secondly, the 'north-south divide' is not as pronounced in energy as it is in other economic sectors. Northern energy companies are already providing a strong source of innovation and investment, leading the way in areas such as customer service, renewable deployment and preparing for a low-carbon economy. The region can therefore be a leader in national energy policy, addressing the various elements of the energy trilemma. As well as generating benefits in terms of energy policy, this could potentially generate economic benefits for the country as a whole when the expertise and skills developed in the region are exported to other countries.

There are many ways in which stakeholders in the energy sector in the North could work together to meet energy challenges in ways that would be more effective than traditional, Whitehall-based policymaking. Below we set out how innovative approaches in the region can help drive investment and growth and address the energy trilemma.

4.3.1 Driving decarbonisation

In terms of driving decarbonisation, the region could develop an effective cross-sectoral decarbonisation pathway which takes account of the region's natural resources, and makes the appropriate trade-offs between investments in different technologies. Northern cities could act as the testing ground for new technologies (such as hydrogen networks, as envisaged by the H21 Leeds city gate project) and municipal energy delivery models which harness the region's decentralised energy resources. The experience from projects such as these would provide a model for similar developments in other parts of the country, and help identify the low carbon technologies which will allow the UK to meet its decarbonisation targets at least cost. As well as providing the model for similar developments in other parts of the country, and driving least-cost decarbonisation, the concentration of expertise and know-how in the north would act as a powerful driver of economic growth, as northern cities became centres of energy excellence 'exporting' to the rest of the UK and beyond.

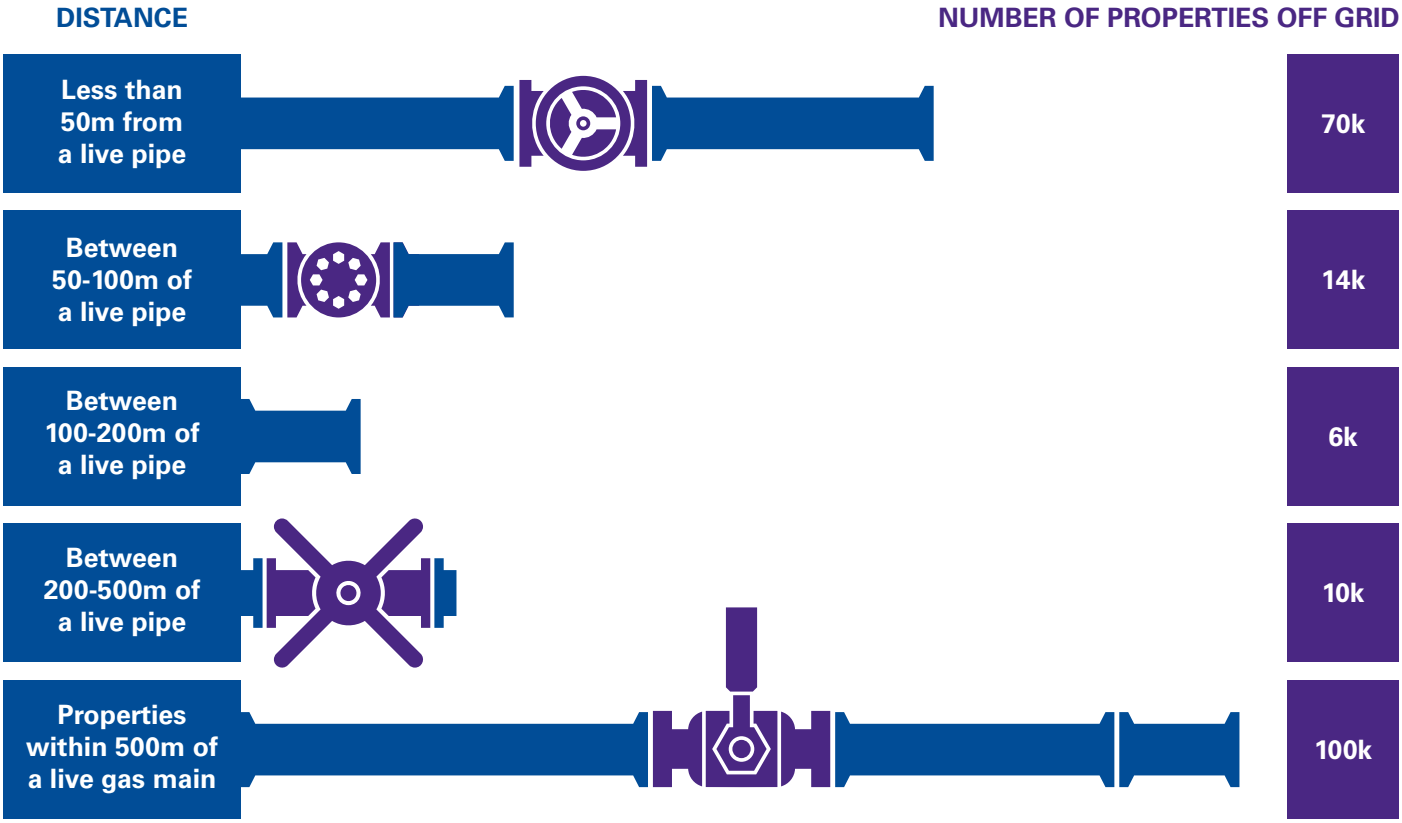
[21] See https://www.gov.uk/guidance/community-energy

4.3.2 Ensuring affordable energy

Similarly, the region's energy sector could play a major role in ensuring that energy supplies for the region's inhabitants are affordable. This could be driven by the region's energy networks exploring innovative ways to deliver the energy network of the future at least cost. For example, using energy storage as a way of meeting peak electricity demand, thereby delaying the need for conventional investment in pipes and wires. It could also involve local authorities working with the sector in order to identify and help the fuel poor in the region with targeted interventions. Again, this would drive a mix of benefits at both a local and national level, with networks in other parts of the country learning from those in the North. Any reduction in energy costs would stimulate economic activity by increasing households' disposable income and improving the cashflow of businesses.

Although storage capacity is not an issue for gas, the fuel poor in the North could also benefit from investment to expand the gas grid. Off gas grid properties are often forced to rely on higher cost alternatives. Research by Northern Gas shows there are large numbers of these properties located close to a live gas pipe, meaning they could easily be converted to mains gas at a relative low cost.

OFF GRID PROPERTIES IN PROXIMITY TO A LIVE GAS PIPE, NORTHERN GAS NETWORKS AREA



4.3.3 Ensuring security of supply

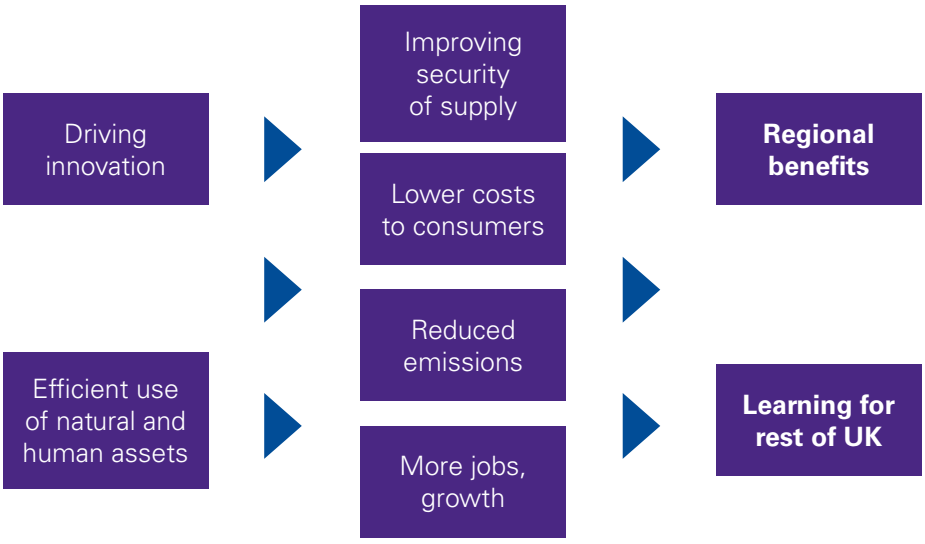
Energy supply is becoming increasingly decentralised, with technologies such as solar PV and energy storage. This poses both challenges and opportunities in terms of ensuring the security of energy supplies. For an energy system built around large scale generation and centralised planning, there will be costs involved in transitioning to a more decentralised system. However, this also offers the prospect of closer matching of local energy supply and demand, as well as the appropriate usage of local energy assets. Local authorities can work with the energy sector in the North East to drive the decentralised energy systems of the future, driving the efficient use of local assets, developing local expertise, and providing a blueprint for the rest of the country.

Another key to energy security is being able to draw on a sufficiently diverse range of energy sources, and being protected where possible from geopolitical risk. The North East can make a positive contribution to the UK's energy security through the development of the Bowland shale gas field, which would provide a native source of natural gas at a time when output from the North Sea is going into long term decline. The development of Bowland would drive jobs and investment in the region, and would potentially allow the UK to lead the way in the European unconventional oil and gas sector. Another new technology which the North East can play a leading role in developing is carbon capture and storage (CCS). CCS is expected to play a key role in the decarbonisation trajectory of many countries besides the UK, including Canada, Japan, Russia and the US. The skills and expertise developed on projects in the North East can be exported to other countries which need to develop CCS, thus driving exports and growth.

4.3.4 Realising the benefits

This section has highlighted that there are major challenges ahead for the UK's energy industry, but also many opportunities for innovation and growth as illustrated below in Figure 1.

Figure 1: how the energy sector in the North can drive regional and national benefits



The North has many strong attributes to help realise these benefits, including:

- Northern cities can be important proving grounds for energy sector innovation
- The region has the skills, knowledge and appetite to exploit these innovations
- The region can show leadership in tackling the challenges facing the national energy industry

5 Northern regional initiatives - making it happen

While the energy sector in the North is well placed to deliver benefits at both a regional and a national level, it will be important to have a clear strategy and action plan to maximize the new economic opportunities emerging in the energy sector across the entire value chain, running through manufacturing through asset provision to customer services.

We have identified a series of policy measures that could be taken in order to maximize the contribution of the energy sector in the north east to meeting the energy trilemma and driving economic growth. These include:

- Ongoing funding for innovation projects and especially the H21 hydrogen project based in Leeds, the smart grid and heat projects based in Newcastle.
- Developing regional strategies for key initiatives, including:
    - the cost effective exploration and transportation of shale gas
    - exploitation of carbon capture and storage potential
    - developing whole energy solutions, covering gas, electricity, heat and transport that exploit existing investment in electricity and gas networks
    - ensuring such developments can help address fuel poverty and economic development in the region.
- A coordinating group to 'champion' regional energy innovation and development, bringing parties with complementary objectives and expertise together, especially business interests. Initiatives may include:
    - co-ordination of development activities and information sharing
    - suggesting energy initiatives to central Government for the Northern Powerhouse roadmap
    - an annual regional innovation 'summit' to update on progress made and share ideas
    - advising relevant authorities on incentives or actions to drive new 'regional energy innovation hubs' e.g. locations such as Sunderland, Hull

Contact us

Robert Hull
Director, Power and Utilities
+44 (0)7825 645516
Robert.Hull@kpmg.com

Andrew Jones
Manager, Power and Utilities
+44 (0)7468 715945
Andrew.Jones3@kpmg.com

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