Northern Powerhouse:

Energy and Clean Growth

November 2019

NP11

An NP11 report

The Northern Powerhouse 11 (NP11) is made up of eleven Local Enterprise Partnerships (LEPs) across the North of England. The Northern Powerhouse Independent Economic Review (SQW, 2016) found that the economy of the North has the potential to grow by 15% by 2050 - creating an extra 850,000 jobs more than the business as usual scenario.

The NP11 has shown that this significant economic potential should be unlocked through greater cooperation between the LEPs in strategic focus areas with a pan-Northern benefits, bringing together the unique characteristics, assets, values and cultures of the different regional cities and centres of growth to create a Northern Powerhouse. This type of transformational economic development would also help the British economy to overcome other structural issues – achieving growth through increasing exports, boosting productivity and closing the regional economic divide.

LEP Chair Foreword

The northern regions of the UK were the driving force behind the UK's first Industrial Revolution. Thanks to our regions' entrepreneurial zeal, energy resources and spirit of innovation, the North quickly became the most productive place on the planet, providing the materials, infrastructure and technology that powered UK economic growth.

While our industrial strengths made us a global economic force, our role in generating much of the UK's conventional electricity and processing a substantial portion of its oil and gas also made us a major source of industrial carbon emissions. Thanks to recent innovations, however, the North is now at the forefront of the UK's response to the growing climate emergency; transforming our significant energy assets to drive a clean growth revolution for the benefit of the environment, our people and the UK economy.

Our industry, our capabilities, our energy infrastructure and our location makes the North ideally placed to lead the UK's journey to becoming Net Zero carbon by 2050 – although several of our northern localities and sub-regions have set more ambitious targets of reaching this milestone much sooner.

Cleaner technologies including offshore wind and nuclear energy, linked to bioenergy and district heat schemes, are already growing rapidly across the North, supported by work to strengthen supply chains, build a skills base to respond to emerging market opportunities, and help businesses make the transition to a low carbon future.

Fuelling this are strong partnerships between local government, academic institutions, local communities and industry, driven through our 11 northern local enterprise partnerships (LEPs). As LEPs, we clearly see the tremendous opportunity of developing a Net Zero carbon northern economy through investment in clean growth. The possibilities outlined in this report around carbon capture, utilisation and storage (CCUS), hydrogen, decentralised renewable energy, smart energy networks, transport, tidal power and the circular economy are all being evaluated seriously as investment opportunities here in the North already.

The NP11 brings together the 11 northern LEPs, working collectively for the benefit of the North. In terms of the clean growth agenda, we must work together to attract public and private investment in these clean growth opportunities across our combined northern region. We must also develop the policies and secure the powers to capitalise fully on this investment. The North has the capacity to deliver on the Net Zero carbon opportunity for the whole of UK, by developing zero carbon energy technologies and by decarbonising our major industrial clusters and wider economies. With the right policies and business models the North can deliver – as it has before – the changes needed to build an economy that balances environmental sustainability with business productivity and increased opportunities for our people.

Roger Marsh OBE

Chair Leeds City Region LEP

NP11 Chair

Paul Booth OBE

Chair Tees Valley LEP

NP11 Energy Lead

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Executive Summary

Executive Summary

The North of England has an illustrious history of energy production and can be a major force for the UK in meeting its Net Zero target

The North of England has made a key contribution to the energy needs of British economy since the industrial revolution. Initially through the use of higher carbon sources of energy such as coal and town gas, through nuclear power, and more recently, for lower carbon sources of energy such as offshore wind and solar power.

The Net Zero commitment made by the UK government is a further step up in the decarbonisation challenge. The progress made nationally over the last decade in decarbonising electricity production now has to be repeated with the decarbonisation of industrial processes and heating for domestic and commercial purposes, as well as transport. Industrial decarbonisation in particular will be critical if the region is to remain home to key economic players in the North's industrial clusters.

The North of England has the position to make a huge contribution to the decarbonisation of the UK. Currently the North of England accounts for about a quarter of the UK's carbon emissions and is home to three of the largest industrial clusters by $MtCO_2e$ emissions. The Local Enterprise Partnerships (LEPs) in the North of England have in place energy strategies that focus on developing the energy sector and supporting the low carbon transformation. There is much activity being undertaken at LEP level to deliver opportunities in the energy sector and simultaneously reduce emissions. In addition to these activities, there are some key areas in which action at a combined Northern Powerhouse level needs to be undertaken, with the support of stakeholders, to allow the benefits of low carbon growth to be achieved in the region.

The North also has the opportunity to show the way for the rest of the UK, leading UK export potential in the energy sector. It should position itself as a centre of innovation and growth, to capitalise on national and global export and inward investment opportunities.

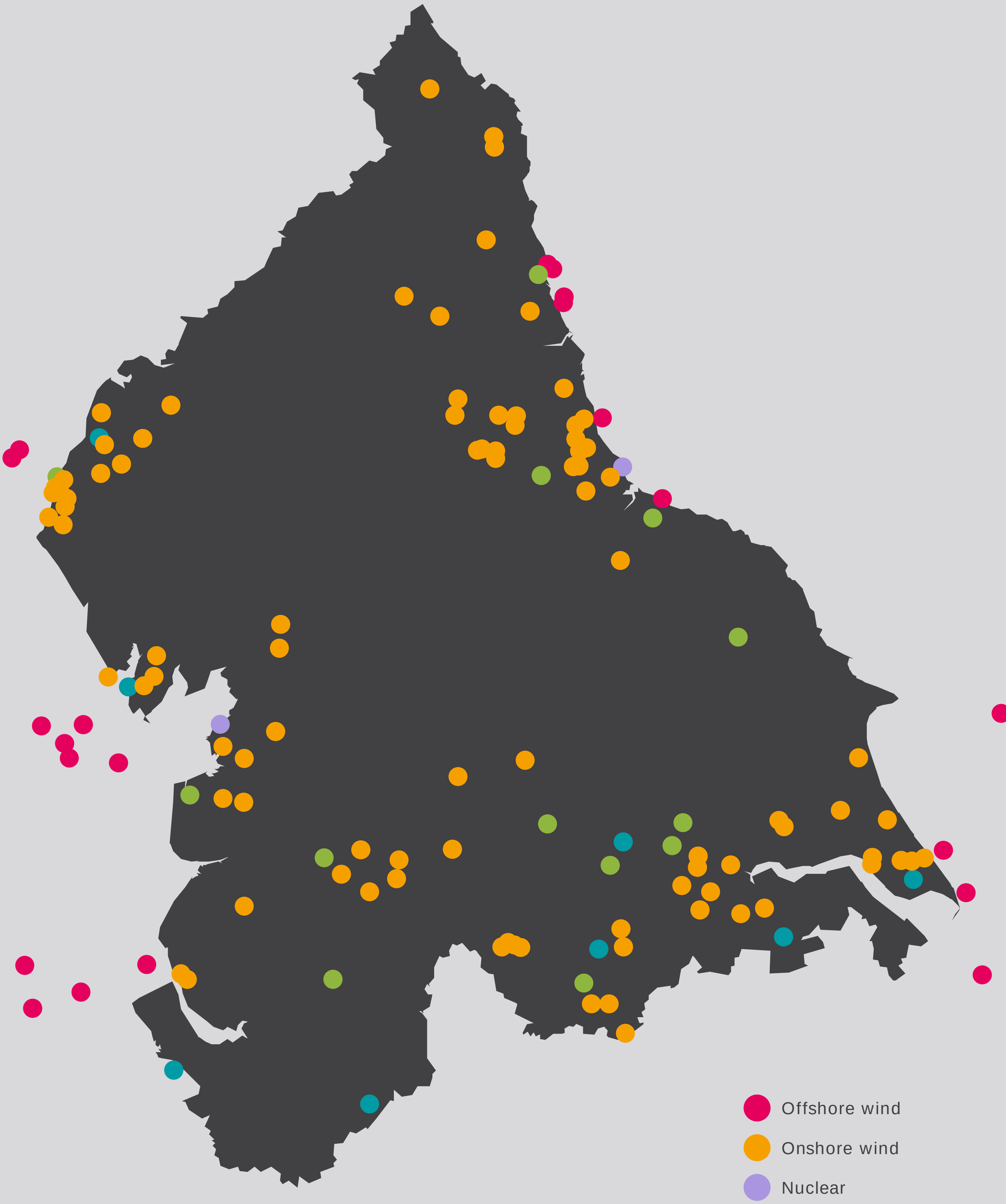
This report summarises the overall priorities of NP11 LEPs and draws out opportunities for coordinated action by the NP11. Notwithstanding individual LEP areas ambitions to go further, for example achieving Net Zero by 2038, delivering existing strategies for the growth of the clean energy sector and decarbonisation of local economies will:

Reduce the region's **carbon emissions by 50% by 2032** against 2005 levels.

Add more than **£2 billion per year to the energy economy** in the region by 2050.

Create around **100,000 new green jobs** by 2050.

Low carbon energy production in the NP11



Source: Carbon Brief 2015, National Grid 2019

Executive Summary– Priority areas for NP11

There are clear opportunities for the North of England to build on its history in energy production.

Based on the assessment presented in this report, beyond the individual local activities of the LEPs the Northern Powerhouse will have the following priorities to support coordinated action. In addition to the priority sectors and pan-Northern collaboration, we list the key cross-cutting enabling factors which are crucial areas for collaboration and required for success in any pathway.

Offshore wind – This is a significant sector that will remain a priority for the low carbon energy development for the Northern Powerhouse. The maintenance of an effective policy regime at a national level to support offshore wind remains a priority and should continue as a focus area for national government.

CCUS and hydrogen – Low carbon hydrogen (produced via steam methane reform) can be deployed for industrial processes and could represent a low carbon source of energy for domestic space heating. The viability of hydrogen as a low carbon fuel source will depend on the deployment of carbon capture, use and storage (CCUS) as a means of reducing the high-emitting hydrogen production processes at scale. CCUS is essential to the decarbonisation of heavy industry in the region.

New nuclear – There are nationally significant assets in the region which, if successfully supported by government policy, could provide the bedrock for new nuclear generation in the North. There are also potentially significant export opportunities. Cooperation across the NP11 could harness this Northern strength as an economic driver for the region as a whole.

Energy efficiency – While schemes for improving energy efficiency in homes, especially existing housing stock, tend to be local in nature, the impact of schemes can be increased through sharing of knowledge and best practice, as well as pooling of financing where possible. This is particularly significant for the North where energy efficiency in homes is substantially below the UK average.

Hydrogen for low carbon transport and heating – There are opportunities to work together to find synergies between hydrogen (produced via electrolysis) for transport and heating and wider investment in hydrogen in the region, this includes increasing economies of scale to support supply chain growth. Finding these synergies, will require cooperation across the region; the region's gas networks are already leading the way on the case for conversion. For transport in particular adequate fuelling stations will be key to encouraging uptake.

Low carbon transport: Electric Vehicles (EVs) – Significant investment in charging infrastructure is needed across the region. There are distinct challenges for rural areas, but there are opportunities for the region as a whole to establish a coordinated approach to deployment of charging infrastructure.

Environmental business – The market in low carbon goods and services is a rapidly growing one. Connecting regional providers with buy-side businesses across the region can help drive economies of scale and speed up development of supply chains and supporting the circular economy.

Delivering cross-cutting enabling factors

Utilities networks and smart grids – The gas and electricity distribution networks are critical infrastructure forming the physical backbone of the energy system. Significant investment in smart, flexible grids and energy storage is required to facilitate the energy transition. This investment requires coordination with local stakeholders to achieve optimal outcomes.

Innovation, research and skills – Cooperation across LEPs is needed to help ensure dissemination of knowledge across the region from the specialist centres that are already growing in the region.

Green financing – Government policy priorities and growing commercial opportunities in the clean energy sector are widening access to financing for green tech, by cooperating LEPs can support the targeting of funding towards regional priorities and attract investment.

Governance, Policy and Planning – Delivering clean growth will require a long-term commitment from local authorities to send clear policy direction to businesses and investors and to provide and stable environment in which new technologies and business models can come forward.

Enabling a Net Zero pathway

Recognising the potential for collaboration identified in this report and in order to realise the ambitions of the NP11 LEPs, there will need to be ongoing strategic thinking to deliver a Net Zero sustainable economy. Regional investment strategies should be predicated on establishing and then continuing to evolve a pathway to Net Zero that makes the most of existing assets and maximises the key opportunities. These strategies should at the same time continue to consider the role that could be played by a diversity of technologies and solutions - from renewable generation like solar, onshore and tidal power, and new biofuels through to new industrial processes that link together areas of the economy to reduce waste, increase resource efficiency and deliver growth.

Executive Summary – Next Steps

Action is required to secure these opportunities.

There are four necessary conditions to ensure that the energy economy in the Northern Powerhouse benefits from the potential clean growth offered through the priorities areas identified.

Deployment of new projects must be ambitious in terms of number and scale; **Local value** in new projects must be high; **Innovation** must be ongoing, for both new and more established technologies, and; **Export opportunities** must be identified and pursued.

Here we summarise the actions for NP11 and government to foster these benefit-maximising conditions. These represent high-level actions for what is needed. It will be for all involved to work together on detailed plans to deliver these.

High deployment

NP11

- Act as one voice in securing Northern priorities
- Make the economic and strategic case for new nuclear generation
- Stimulate energy efficiency measures for business and the public sector
- Have a local view on required EV charging infrastructure, and ensure green hydrogen production is joined up with transport demand
- Showcase projects for green finance providers and foreign investors
- Develop common standards where appropriate to stimulate deployment
- Establish a clear rationale and benefits case for CCUS
- Integrated urban plans to signpost opportunities for developers
- Increase awareness across region of circular economy opportunities in each LEP

High deployment

Government

- Address policy blockers for onshore wind including availability of contracts for difference (CFD) availability and planning rules
- Develop a sustainable funding and governance model for new nuclear generation
- Decide on a funding model for CCUS
- Take policy decisions on enabling the use of hydrogen for heating and on heat policy more generally
- Continued support for ultra-low emissions vehicles
- Provide support at an appropriate level for large-scale retrofit of energy efficiency measures

High local value

NP11

- Ensure skills development programmes address local needs
- Ensure supply chains are visible to developers across the region
- Foster CCUS supply chains
- Give opportunities to local firms in materials and services procurement
- Increase awareness of circular economy opportunities across LEP boundaries
- Ensure infrastructure is in place to exploit local biomass potential

Ongoing innovation

NP11

- Share expertise around CCUS and hydrogen
- Joined up thinking around CCUS and biomass to drive negative emissions
- Scale up local circular economy initiatives
- Knowledge sharing on EV and electric heat
- Joint development of heat decarbonisation opportunities
- Share experience to develop innovative, attractive business cases for subsidy-free solar
- Ensure that scope of regional innovation funding is aligned with local business priorities
- Apply systems planning to integrate offshore wind with other energy sources, including green hydrogen production for use in transport
- Share knowledge around low carbon heat deployment

Ongoing Innovation

Government

- Ensure that innovation competitions do not inhibit collaboration and dissemination of learning between research centres
- Ensure local authorities can play as full a role as possible in whole systems planning
- Ensure funding gaps for place-based innovation are filled

Pursue export opportunities

NP11 and Government

- Develop a joint programme to ensure awareness of NP11 capabilities in key export markets

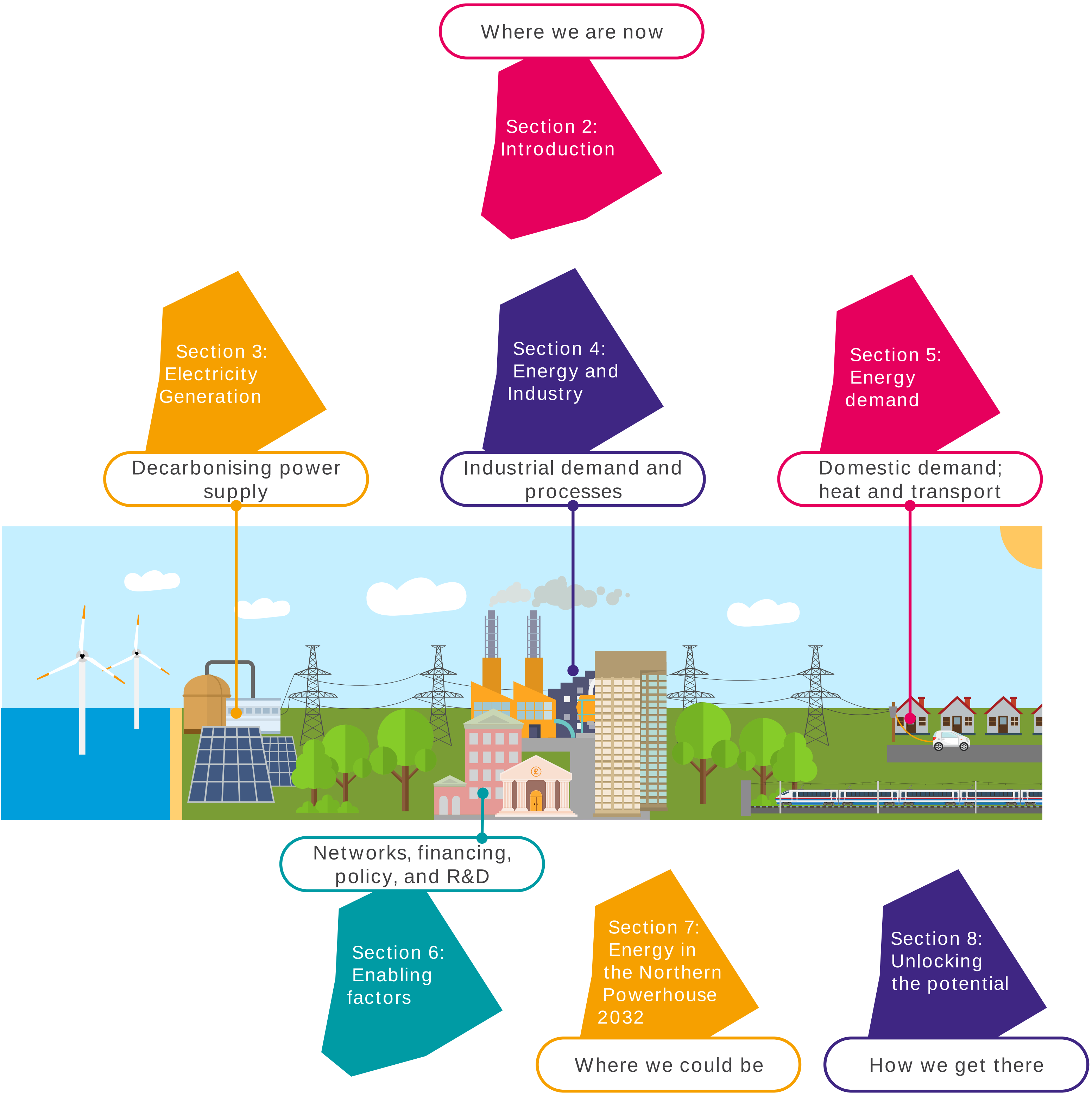
02

Introduction

- National and regional policy context
- Local policy context
- Energy today in the Northern Powerhouse
- This report
- Methodology

This Report

This report covers the full energy value chain in a decarbonised Northern economy, covering energy supply and demand, as well as the aspects of energy use which can feed the circular economy and the cross-cutting aspects of the wider energy and economic system that support clean growth.



In each of these detailed sections (3-6), we:

Review the current status of a range of the core areas of energy and clean growth in the Northern Powerhouse today	Assess the current level of LEP ambition to grow these against the growth potential and potential economic and environmental benefits.	We also consider what is needed to realise these benefits and the potential scope of pan-Northern collaboration to realise them.

In Sections 3 to 5, we consider different elements of the energy system, first covering power generation, then industrial demand and energy processes, before covering other energy demand, predominantly domestic heat and transport. Finally in Section 6 we cover cross-cutting enabling factors required for successful implementation of a clean growth strategy.

In Section 7, we look at where the energy and clean growth sector in the North of England could be by 2032 based on the existing priorities and trajectories of the NP11, and the economic and environmental benefits this could drive.

Section 8 draws out our proposed next steps for collective pan-Northern action to maximise Energy and Clean Growth opportunities which benefit the whole region. We also highlight next steps where government action is needed to unlock pan-Northern opportunities.

National and regional policy context

A key challenge facing policymakers is how to encourage economic growth while reducing carbon emissions and driving sustainability. The Clean Growth Strategy aims to build on efforts to date to help the UK seize future opportunities to decarbonise. The clean growth challenge is particularly important to the North, the home to a significant proportion of the UK's carbon-intensive industries and a traditional hub for energy production in the UK. Local industrial strategies facilitate closer partnerships and establish new ways of working between national and local government, and the public and private sectors.

The Clean Growth Challenge

Global leaders have recognised the need to combat climate change. The UK played a key role in shaping the Paris Agreement and the government has now committed the UK to ending its contribution to global warming by 2050 – the Net Zero target.

Through the framework of Carbon Budgets and financial support for renewable generation, the UK has already been successful in decoupling the historical relationship between economic growth and carbon emissions – having reduced emissions by 42% while also growing the economy by 72% since 1990 (BEIS, 2017).

However Net Zero will require a further step change to continue this trend of clean growth. It will require radical transformation of not just the energy system but all aspects of the economy - from domestic and industrial demand, to heating and transport, through to supply chains. And all regions of the economy will need play their part.

In response to the urgency of the need to address climate change, many local authorities have gone further than the Net Zero target on a local basis. For example, both Greater Manchester and the Leeds City Region have targets to be Net Zero by 2038. Many other local authorities in the region have declared climate emergencies, again signalling the need to go faster on decarbonisation than national targets.

As technology and business innovation continue to develop ways of decarbonising, achieving clean growth is shifting from challenge to opportunity. The question facing national and local businesses and policymakers is how to make the most of this opportunity.

National policy context: clean growth and industrial strategies, sector deals

Government estimates that "the low carbon economy could grow by 11% per year between 2015 and 2030". To unlock this potential government has raised its investment in low carbon innovation with £2.5 billion allocated for 2015-2021 – covering transport, energy, cross-sector investment, smart systems, homes, business and industry and land use and waste.

Alongside the Clean Growth Strategy, the Industrial Strategy identifies clean growth as one of four Grand Challenges. The Industrial Strategy aims to boosts productivity and earning power throughout the UK, by investing in innovation, skills and infrastructure. So far sector deals – partnerships between government, local authorities and industry - have been made in the offshore wind and the nuclear sectors. Government is committed to extending these to other sectors.

The scale of public funding and private finance committed under these sector deals demonstrate the very real appetite to leverage public-private partnerships to unlock the potential of the low carbon economy. The government's Green Finance Strategy aims to align private sector finance with clean, environmentally sustainable and resilient growth, supported by government action.

Regional response: the Northern Powerhouse and NP11

The clean growth challenge is particularly important to the NP11, the home to a significant proportion of the UK's carbon-intensive industries. Decarbonising these will be essential to ensuring the region's economy continues to grow while playing its part in reaching the UK's Net Zero targets, as well as meeting more ambitious local targets that are set.

There is a strong regional and local element to the Industrial Strategy. Government has set out that it will "work in partnership with places to develop local Industrial Strategies, which will be developed locally and agreed with government".

In developing these local and regional plans government is leveraging the existing framework of LEPs. LEPs play a central role in determining local economic priorities and undertaking activities to drive economic growth and job creation. This means they have an important role to play in maximising the benefits from the transition to a low carbon economy.

The Industrial Strategy is further strengthened by the national policy impetus behind the Northern Powerhouse Strategy. Published in November 2016, it aims to deliver a sustained increase in economic productivity across the whole of the North.

Central government's investment in clean growth

Industrial Strategy

- ✓ Invest £725 million in new Industrial Strategy Challenge Fund programmes to boost innovation
- ✓ Invest an additional £406 million in maths, digital and technical education to boost STEM skills in the workforce
- ✓ Increase investment in infrastructure, including £31 billion for transport, housing and digital infrastructure - £400 million for EV charging infrastructure
- ✓ Launch and roll-out sector deals
- ✓ Agree local industrial strategies

Nuclear Sector Deal

- ✓ Target 30% cost reduction for new build plant
- ✓ Target 20% reduction in commissioning costs to taxpayer
- ✓ More UK companies in domestic and global supply chain
- ✓ £56 million government investment in R&D

Offshore Wind Sector deal

- ✓ Industry investment in Offshore Wind Growth Partnership of £250 million
- ✓ £557 million for future CFD auctions
- ✓ Aim to deliver 30 GW offshore wind by 2030

Given its historical strength in the sector, energy is one of four prime capabilities - identified by the Northern Powerhouse Independent Economic Review in June 2016 - where the Northern Powerhouse is highly competitive. This is alongside advanced manufacturing, digital, and health innovation.

Energy and clean growth in the North of England

The region is home to the raw materials, human effort and infrastructure that catalysed the industrial revolution to transform the economy of the UK, Europe and the world.

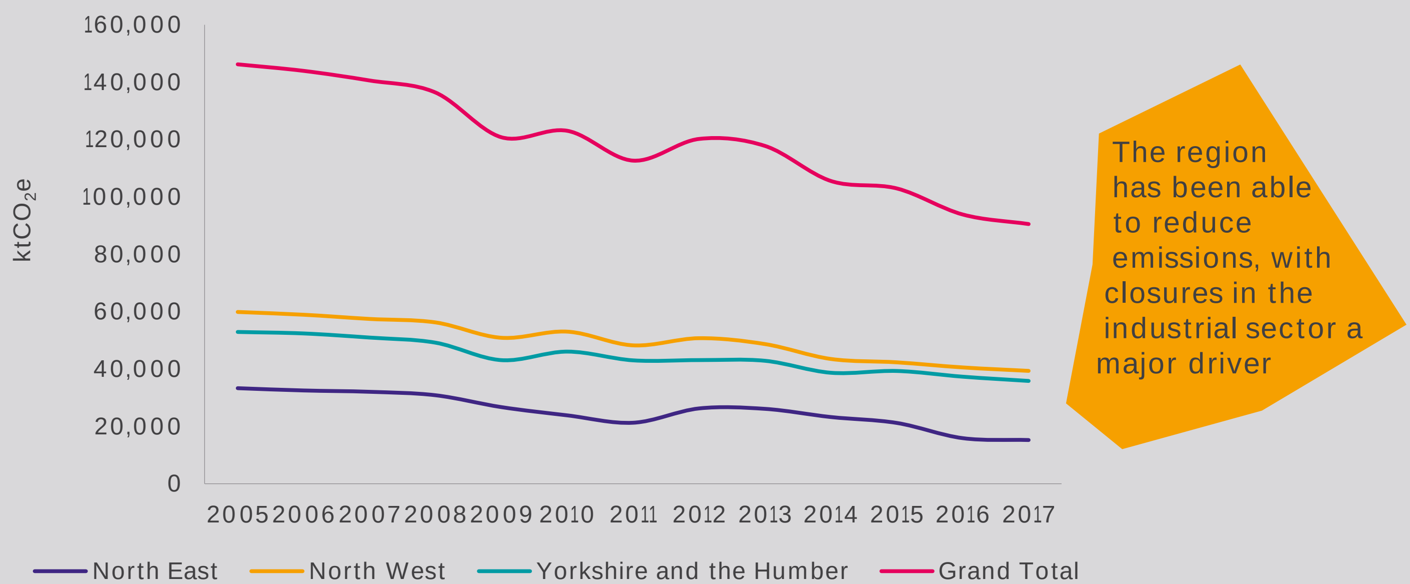
Today, the North continues to generate 41% of England's electricity and consumes 28% of it – exporting 32 TWh to the national grid. However, this energy output is predominantly made up of carbon emitting thermal generation – this causes 26% of total UK emissions.

At the same time, the North's economy is also more carbon intensive than the English average (IPPR, 2017), in part due to the higher prevalence of heavy industry than other English regions. Emissions in the region have reduced significantly, but this has been partly at the cost of economic growth: the North East region has experienced the largest percentage decline in emissions of any UK region over the last decade due to industrial closures.

However, alongside its long established nuclear generation capacity (representing more than 40% of the UK total), the North has also developed a significant and growing renewable energy generation base – at 8GW of installed capacity (33% of England's total). Through trial projects and investment in research and development centres, the North is also home to leading expertise and investment in CCUS and hydrogen technologies.

If capitalised on, the North's traditional strengths, together with the prevailing policy landscape, present a significant opportunity for the region to emerge as the powerhouse for a new green energy revolution.

The Northern Powerhouse emissions reduction trajectory



Source: BEIS data

Local policy context

Together with government, the LEPs are responsible for agreeing local strategies for delivering economic growth in the context of the energy transition.

Local industrial strategies, when finalised and agreed between LEPs and government, will build on the approach followed by government since 2010 – City Deals, Devolution Deals and Local Growth Funds. As set out in the Industrial Strategy white paper, government expects the local industrial strategies to shape how local funding streams are used. The NP11 LEPs are at various stages of developing their local industrial strategies.

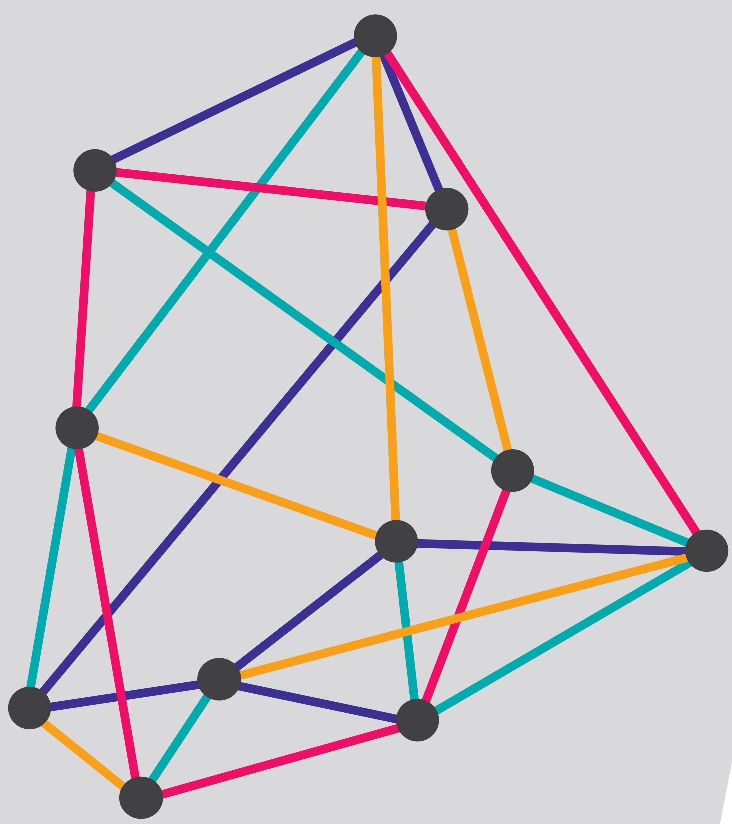
In addition to the local industrial strategies, the NP11 LEPs have also set out local energy strategies. These LEP energy strategies set out how each of the local areas across the Northern Powerhouse aim to align their activities with the government's Clean Growth Strategy.

Through local energy strategies, government aims to empower all LEPs to take greater ownership of the energy agenda in their regions. This allows local business and public sector bodies to be more proactive in pursuing the energy priorities for their communities by working together to raise the funding, support, and resources needed to meet these priorities.

The NP11 local enterprise partnerships

The NP11 is made up of the 11 Local Enterprise Partnerships (LEPs) within the northern region. These are:

1. Cheshire and Warrington
2. Cumbria
3. Greater Manchester
4. Humber
5. Lancashire
6. Leeds City Region
7. Liverpool City Region
8. North East
9. Sheffield City Region
10. Tees Valley
11. York, North Yorkshire and East Riding



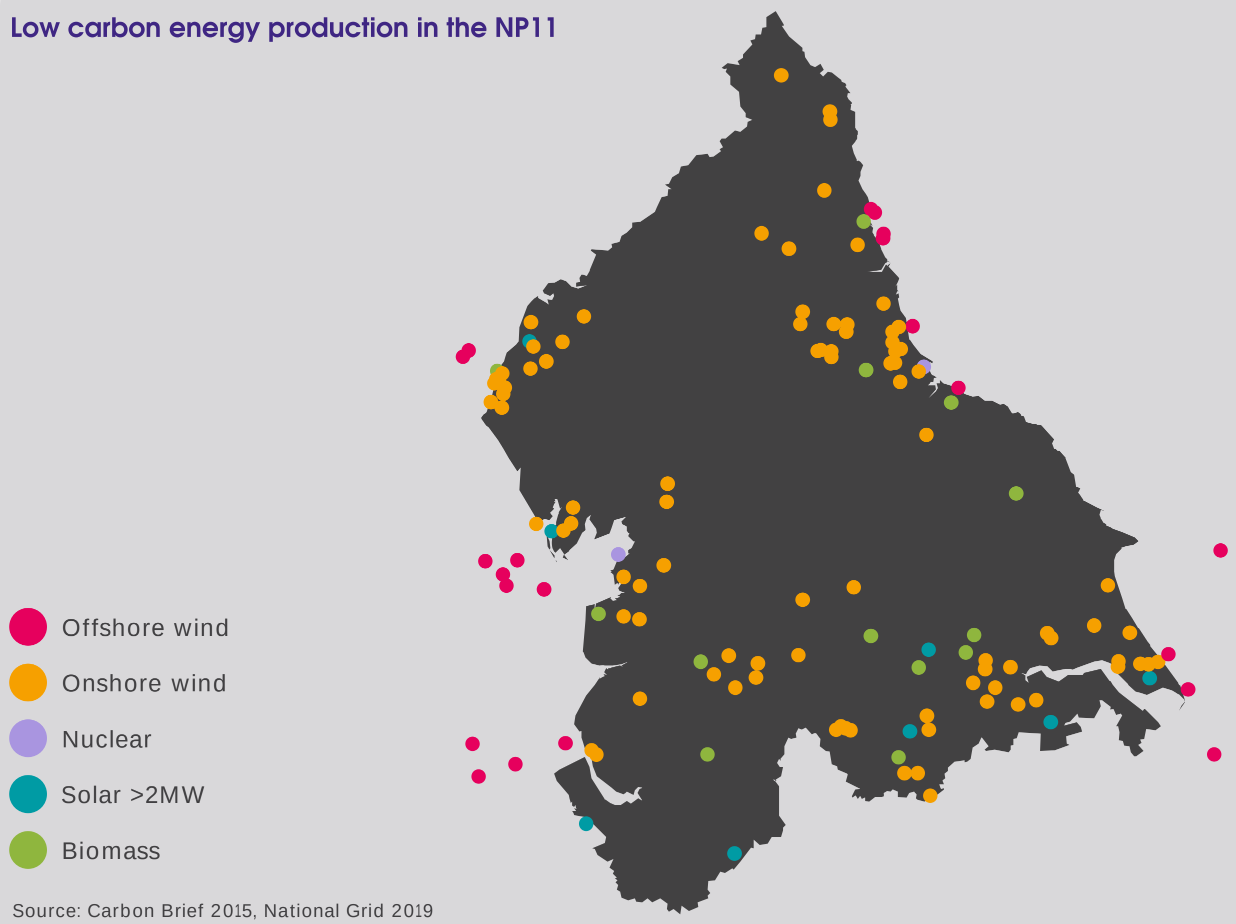
Energy today in the Northern Powerhouse

Historically, the Northern Powerhouse has been a centre of energy production for the remainder of the UK, home to the raw materials, human effort and infrastructure that catalysed the industrial revolution which transformed the economy of the UK, Europe and the world. This continues today, with the Northern Powerhouse's energy sector accounting for 23% of the UK's total economic value for the energy sector between 1997 to 2014 (KPMG, 2017). Within the Northern Powerhouse:

- Industry and commercial uses take up 41% of all energy finally consumed in the North. This reflects the strength of the North's manufacturing, chemicals and process industries when compared to other regions
- The Northern Powerhouse produces a significant amount of electricity, with roughly 17% of electricity generated being exported to the rest of the UK
- Gas is a significant component of the energy mix, fuelling roughly 70% of domestic energy consumption and 34% of industry and commercial use as a direct input. This does not include the gas required for power generation. Finding alternatives to gas as a heating fuel is fundamental to ongoing debates about the decarbonisation of heat
- The transport sector remains overwhelmingly reliant on petroleum fuels, with alternatives in bioenergy and electricity forming <2% of final consumption

Beyond these key points some important successes are visible, particularly the decline of coal which forms a much smaller component of thermal power generation than in the past decades. Renewables are also a growing sector, with significant deployment over the past decade across a range of technologies. The map below shows the capacities of installed generation assets across the region.

Low carbon energy production in the NP11



Source: Carbon Brief 2015, National Grid 2019

Methodology

The key priorities for NP11 action in this report have been identified on the basis of detailed research looking at the specific strengths and weaknesses of the Northern Powerhouse within the energy and clean growth landscape. The assessment presented is based on review of the individual LEP industrial strategies and energy strategies. These documents provide a strong evidence base for the current status of many aspects of the NP11 energy landscape, as well as set out the key priorities within individual LEP areas. This strong body of evidence has been supplemented by reference to wider economic literature on the potential for energy and clean growth in the North of England, including by bodies such as the IPPR, as well as UK-wide sources such as Carbon Brief. We have also carried out new analysis to support the assessment and findings of this report, drawing on BEIS data and data published by National Grid, the system operator, in its Future Energy Scenarios.

In the sections that follow we have drawn on these sources to assess the potential for pan-Northern action across sectors and technologies. To identify priorities from a pan-Northern perspective, we have assessed each sector for:

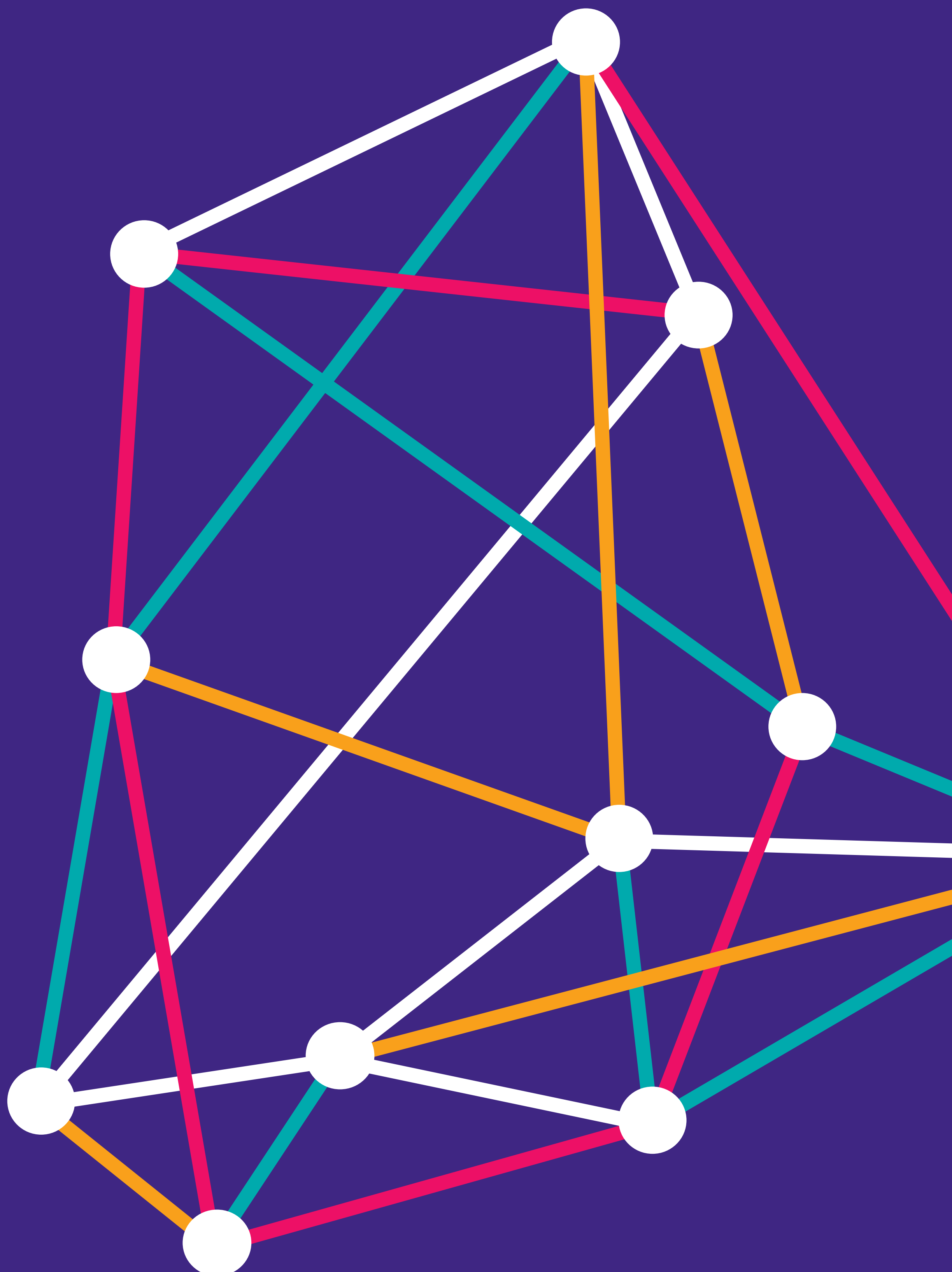
- Pan-Northern strength today: current assets, supply chain and existing research and development projects, plus LEP ambition
- Pan-Northern opportunity tomorrow: economic and environmental benefits to the region for investing resources in developing and deploying each technology area
- Scope for pan-Northern collaboration: where can LEPs acting together (over and above business as usual) unlock additional benefits

Sectors scoring strongly in each of these aspects are identified as most promising for NP11 collaboration. Other sectors remain significant to local or national energy and clean growth priorities, even where the scope for driving additional value through pan-Northern collaboration is more limited.

Owing to the qualitative and quantitative nature of the factors involved in the assessment, and the diverse sectors being assessed (covering supply and demand, emerging and established sectors), in our report we have represented our findings visually. This allows for better comparison of the outcomes of our assessment across different opportunities.

The table below described how the visual ratings for each sector is to be interpreted.

Pan-Northern strength today	UK leader	One of a number of strong regions	Average UK performer	Below UK average
Pan-Northern opportunity tomorrow	Almost certain to happen Strong Environmental and Economic case	Moderate Environmental and Economic case	Potential to happen Medium Environmental and Economic case	Speculative Weak Environmental and Economic case
Scope for pan-Northern collaboration	Clear Case High Benefits Low Barriers	Moderate Case Moderate Benefits Medium Barriers	Soft Case Medium Benefits Moderate Barriers	Weak case Low Benefits High Barriers



03

Electricity Generation

- Offshore wind
- Onshore wind
- Nuclear
- Solar
- Biomass
- Tidal

Electricity Generation – Overview

The Northern Powerhouse has traditionally been a hub for energy production for the UK, with large coal-fired power stations in areas of coal production and nuclear power stations on the coast. More recently, it has been at the forefront of the UK's decarbonisation drive, and has assembled a diverse low carbon portfolio, as well as strong supply chains and research strengths. The decarbonisation trajectory we have mapped out below shows that the region is on track to play its role in the country's push to reach Net Zero by 2050.

In this section, we review the key regional strengths, threats and opportunities, and pan-Northern actions to address these. The underlying detail is set out below on a technology-by-technology basis.

The picture that emerges is that, by 2032 the electricity generation mix in the Northern Powerhouse could include:

12 GW of new renewable capacity

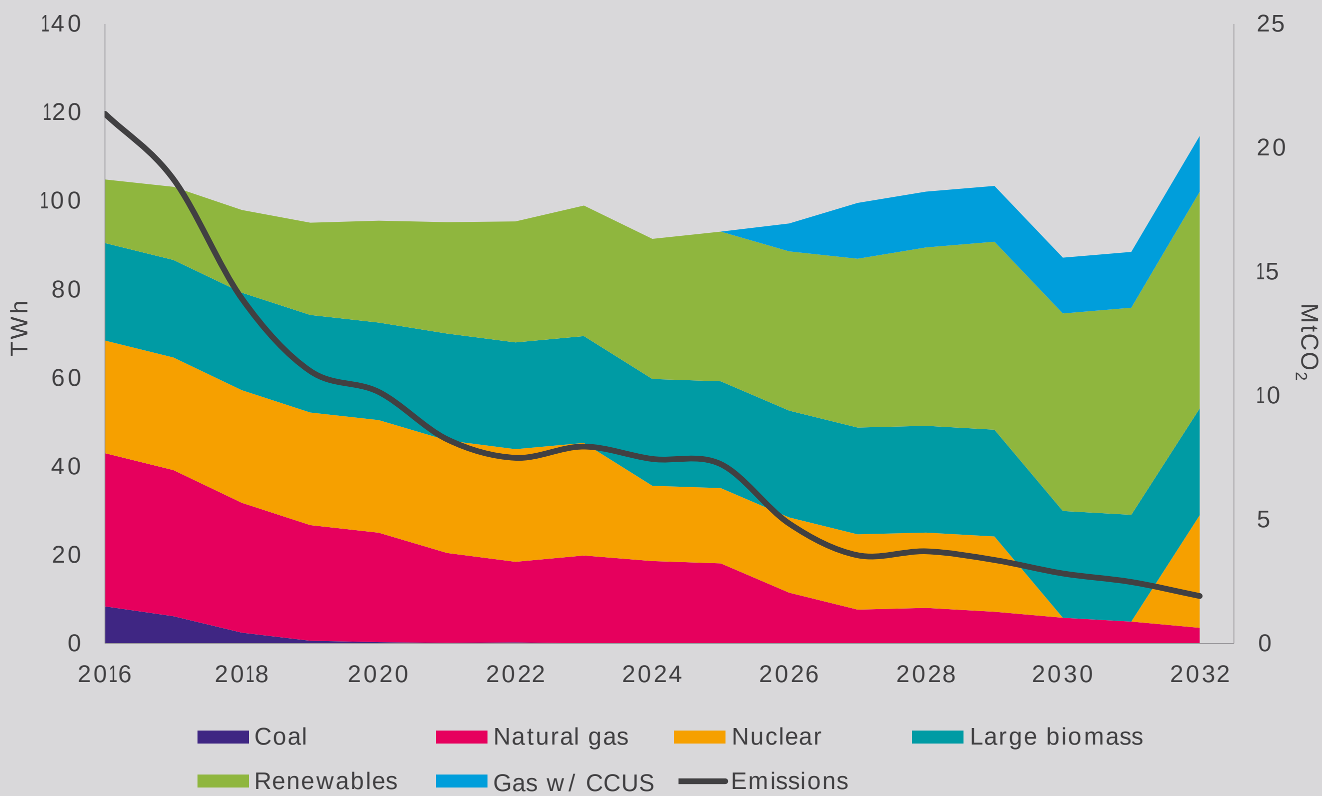
3% generation from fossil fuels without carbon capture and storage

Accounting for **52 TWh** of new low carbon electricity generated per year

Resulting in annual carbon emissions **91%** lower than in 2016

This deployment will maintain the region's status as a net electricity exporter. Regional demand is currently around 65TWh, meaning there is substantial scope for regional demand to grow (due to heat and transport electrification) before it equals future generation in the region.

Anticipated future electricity generation mix and emissions in the Northern Powerhouse 2016-2032



Source: BEIS, National Grid Future Energy Scenarios 2019, KPMG analysis

The graph shows the potential change in the power generation mix in the Northern Powerhouse by 2032, as well as the resulting success in reducing carbon emissions. The opportunity to reduce carbon emissions by over 90% by 2032 relies on developing new nuclear projects, rolling out all renewable technologies at scale, and successfully implementing CCUS on new gas powered plants. Deployment at scale will be complemented by deployment of small-scale decentralised projects (such as solar and wind) across the region, which can bring additional benefits such as avoided transportation losses. Early, steep reductions in power sector emissions will be key to achieving Net Zero targets with increasing levels of electrification in the heat and transport sectors.

If the NP11 is able to seize the available opportunities, the power mix in the Northern Powerhouse will change considerably between now and 2032, with a shift towards renewables away from coal and gas powered generation.

However, in order to build on existing strengths in generation of low carbon power, seize the opportunities linked to the Net Zero targets and growing power demand, as well as overcome threats and weaknesses, the NP11 should focus on collective action in particular areas to maximise economic and environmental benefits for the region.

Priority actions for NP11

- Ensure the benefits of nuclear and offshore wind accrue to the region as a whole rather than just the coastal regions where they are deployed, in particular by extending regional supply chains
- Secure government support for new nuclear in the region

Priority actions for government

- Relax restrictions on onshore wind (CFD availability and planning)
- Develop a funding and governance model for new nuclear

Regional strengths

- World leader in offshore wind (deployment, R&D, supply chains)
- Diverse range of low carbon generation technologies, from distributed to larg- scale and including both intermittent and flexible sources
- World leader in nuclear expertise and experience throughout supply chain
- Most suitable region for CCUS in the UK

Drivers of opportunity

- Net zero/carbon targets driving further development of low carbon power, including flexibility services and storage
- Electrification of heat and transport will also increase demand for low carbon power (especially offshore wind and CCUS)
- This also creates a potential space for new nuclear, allowing the region to build on accumulated expertise and know-how
- Offshore wind sector deal will support job creation and export potential.

Challenges to overcome

- Policy blockers for offshore wind (CFD availability and planning)
- Government support required to bring CCUS networks to fruition
- Nuclear and coal plant closures: if replacement capacity is located outside the region, this will lead to loss of economic value
- Some strengths are locally focussed within areas of the region due to history (nuclear) and/or geography (offshore wind), risking a limit on potential

Offshore Wind

Offshore wind is a significant strength for the Northern Powerhouse today, with 2.2GW capacity installed and the potential to produce 46TWh per annum by 2032. There is a clear opportunity to leverage this growth to avoid 13.54Mt CO_2 emissions, when compared to gas fired generation. The challenge for the NP11 will be ensuring that the benefits are maximised for the region as a whole.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Significant installed capacity + Substantial investment in research and supply chains	+ UK government sector deal + Needed to reach Net Zero targets	+ Collaboration to have 'one voice' in debates + Coordination of supply chain growth – Not all LEPs benefit directly

Where are we now?

The Northern Powerhouse is currently home to 2.2GW of offshore wind, close to 30% of the UK total. Coastal LEPs such as Humber, Cumbria, Lancashire, the North East and, York, North Yorkshire and East Riding have some of the largest offshore windfarms in the UK and globally within their areas. The Cumbria LEP area is home to the largest offshore wind farm in Europe, and as a LEP area accounts for more than 20% of UK offshore wind generation. These LEP areas, as well as the Liverpool City Region area, benefit economically from offshore wind, through jobs created by manufacturers of offshore wind components in their areas. The North East LEP area, for example, has significant expertise in offshore wind supply chains relating to subsea engineering and robotics. These supply chains combine with those of other offshore technologies produced in the North to produce significant economic benefits.

The Northern Powerhouse is also a strong research and innovation base for offshore wind, with global companies like Ørsted and Siemens investing to launch research and development centres. These investments are in addition to other key initiatives such as the ORE Catapult testing site at Blyth.

In relation to wider offshore networks, a new 1.4GW interconnector (North Sea Link) will shortly connect Blyth on the North East coast with Norway.

Where could we be in 2032?

There are high levels of ambition from coastal LEPs for offshore wind, both in terms of deployment and supply chain growth. LEPs with existing assets in the offshore wind sector all aim to capitalise on the opportunity presented by the government's offshore wind sector deal and future subsidy auctions.

For example, Humber LEP aims to work with the Department for International Trade to develop a road map for businesses to increase exports and Lancashire LEP aims to leverage support for skills and develop a project pipeline off the Lancashire coast. Tees Valley and North East LEP also have ambitions to collaborate in developing an offshore cluster.

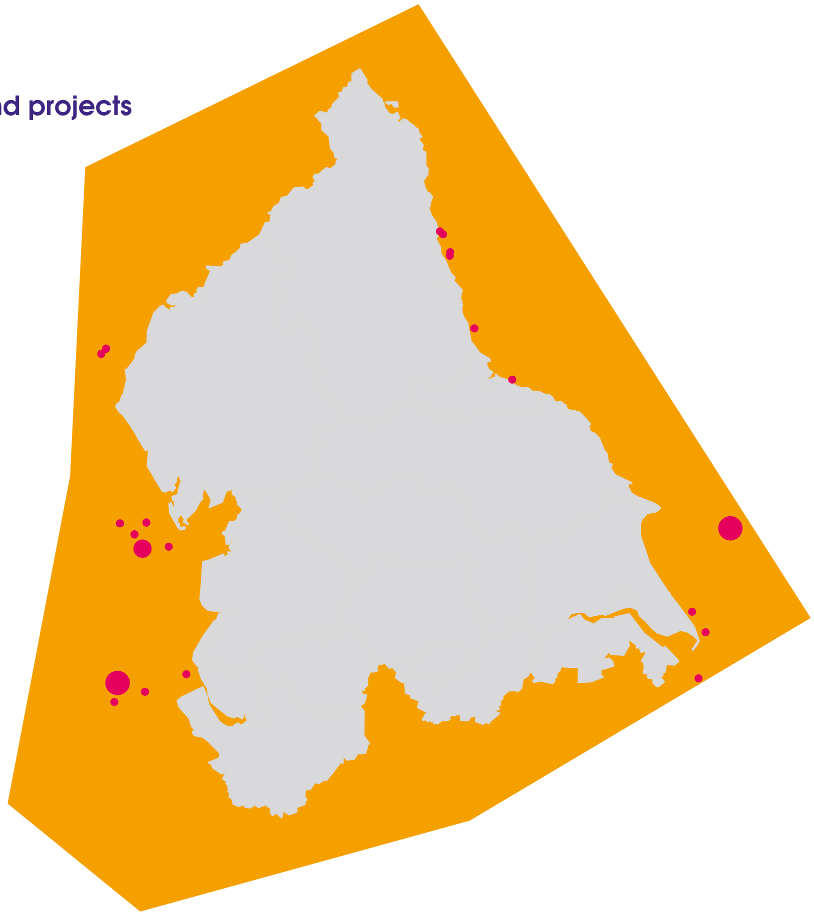
Potential scale

The Net Zero target and government support create significant growth potential for offshore wind. Given the scale of action needed to reach UK climate targets, offshore wind deployment is likely to be scaled up significantly.

For the North's offshore wind sector, the primary challenges to overcome relate to international competition for inward investment, which is likely to grow in the near to mid term.

The CCC estimates that to reach Net Zero, offshore wind capacity in the UK should increase from 7.9GW today to 75GW by 2050. Government has set a target of reaching 30GW by 2030 and calculates that this would mean around £40 billion in infrastructure spending. The recently completed Round 3 CFD auctions indicates that the sector is well placed to achieve these levels of deployment, or maybe even something greater in the drive for Net Zero. In the auction, 5.5GW worth of contracts were awarded at strike prices of around £40/MWh.

Existing offshore wind projects



Source: Carbon Brief 2015, National Grid 2019

This is below the wholesale price of electricity, meaning the budget pot for this auction round will not need to be accessed.

A substantial portion of this could be directed to the North, and would be expected to lead to more high value production in the region and more export opportunities.

Economic benefits

The additional investment in the offshore wind industry will stimulate a range of economic benefits. Several different categories of jobs are created by offshore wind development, including operations and maintenance, construction (although these may be less permanent) and manufacturing in the supply chain. Local services can also be boosted by direct investment into the regions.

However, some of the more high value components of offshore wind systems are still imported. An ORE Catapult report finds that the gross value add (GVA) to the UK increases significantly with cost reduction and higher levels of UK capacity (ORE Catapult, 2014).

Environmental benefits

Offshore wind delivers clean power at a large scale, limited only by grid constraints. Wind is a clean energy source and investment has already substantially reduced the carbon intensity of the UK grid.

With increasing turbine sizes and efficiencies, offshore wind will continue to provide an opportunity for decarbonisation at scale and provide a high volume of clean power. The Northern Powerhouse has approximately 12GW of offshore wind either in construction/consented/planned- if this is all built it will generate around 47TWh per year and save about 3mtCO_2/year.

However, a potential constraint on the potential of this is the ability of the grid to support the new generation capacity. Further investment in flexibility for the power grid is required to facilitate much higher volumes of offshore wind.

What is needed to embrace these benefits?

Offshore wind opportunities are greatest for coastal LEPs as a matter of geography. Nevertheless, the LEPs in the Northern Powerhouse have the opportunity to collaborate through cooperating to influence policy and have 'one voice' in debates on the best pathways and options for national decarbonisation. Strategic coordination of supply chains could reduce costs for investors in the region, maximise the opportunities of having industry locate in NP11 LEPs, and ensure benefits are spread across the region rather than just coastal LEPs.

Coordinated, systems level thinking across the Northern Powerhouse can help integrate offshore wind with other energy sources, while accounting for differences between parts of North. However, LEPs without a significant offshore wind sector, generally due to geographical factors, may have less to gain from investing in cooperation in this area.

Onshore Wind

The Northern Powerhouse had 1.7GW installed capacity in the region by 2018, 13% of the UK's total. This generates 3.2TWh of electricity. The sector is expected to grow to 2.1GW by 2032, generating 4TWh and avoiding 0.3Mt of CO_2 emissions, when compared to gas fired generation. This projection is under current policy, which restricts deployment through planning and by limiting access to financial support. If these restrictions were loosened, deployment could be faster, and onshore wind could provide additional, low-cost generation as the sector decarbonises to drive achievement of Net Zero targets.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Strong levels of existing installation + Very low cost low carbon generation – Growth rates are minimal	– Unclear future highly dependent on government decisions + Likely to be required for Net Zero target	+ Has potential to benefit all LEPs – More urban focussed LEPs could still face space constraints

Where are we now?

There are strong levels of existing deployment in the region. Currently the Northern Powerhouse has 1.7GW installed capacity of onshore wind and this is particularly strong in certain LEP areas such as the North East LEP area and Sheffield City Region LEP area where there is not only good existing deployment but also good technical potential. In addition, several LEPs have identified that their region has stronger than average wind resources, which could represent an untapped energy potential.

The region also has strong deployment of offshore wind which provides some positive spill-over effects from economic clusters manufacturing and researching technology for use offshore, which can also be applied onshore.

Where could we be in 2032?

LEPs have not made onshore wind a priority area and typically LEPs with coastal areas have focussed on offshore wind as the largest clean growth opportunity. However some LEPs such as Sheffield City Region, North East LEP and, York, North Yorkshire and East Riding do recognise that onshore wind has the potential to catalyse investment and improve regional energy independence.

Potential scale

The industry for onshore wind has high technical potential but faces a challenging policy

environment. After the ability of onshore wind developments to receive national subsidies was removed in 2016, national policy may be the largest blocker to higher ambition in this area. Onshore wind is also currently excluded from capacity auctions for new power generation and has to meet rigorous planning requirements.

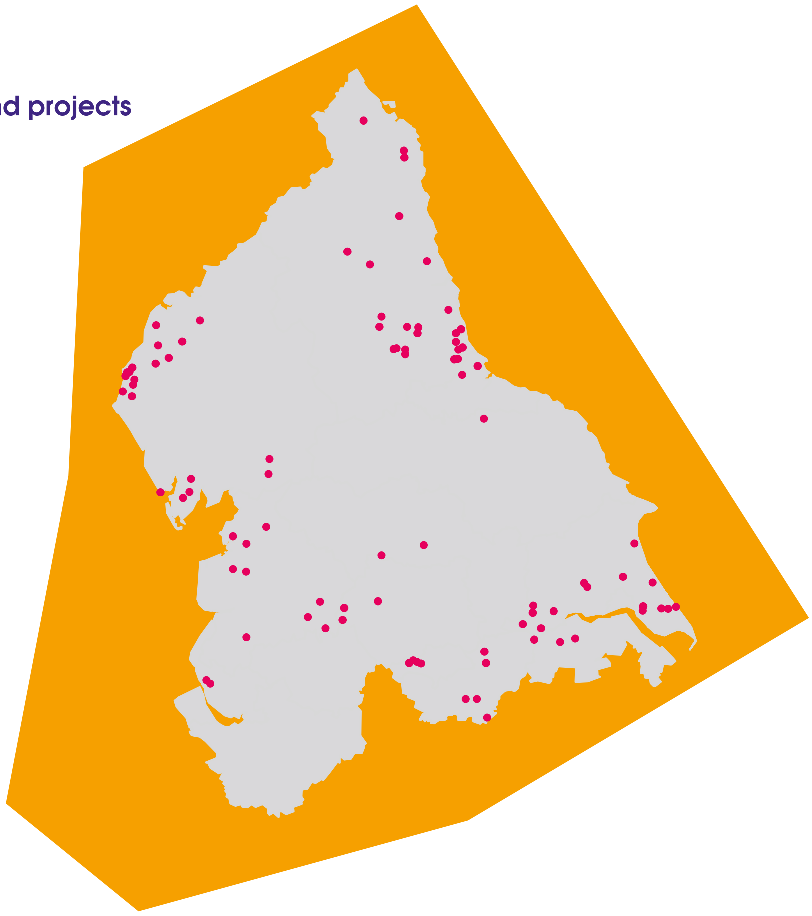
The CFD mechanism has seen reductions in the cost of offshore wind by 65% in the four years since the scheme launched. If onshore wind had access to this mechanism and was able to achieve similar cost reductions, it is conceivable that the scale of uptake could be very significant.

Economic benefits

There are a range of economic benefits associated with onshore wind despite the UK economy slowing. This includes job creation in roles for operations, maintenance and project deployment (even if manufacturing of components takes place elsewhere).

Estimates suggest that if onshore wind installations rise to 1.4GW annually (UK-wide), in line with CCC recommendations for the Net Zero target, this would support 31,000 jobs by 2035 with 14,000 directly employed, creating a GVA uplift of £150 million by 2030.

Existing onshore wind projects



Source: Carbon Brief 2015, National Grid 2019

In addition, the UK exported £52 million worth of onshore wind goods and services in 2017. RenewableUK estimates that installing 35GW onshore wind by 2035 could enable £360 million per year in UK exports (Vivid Economics, 2019).

Community benefits schemes have typically been a part of onshore wind development, and have driven positive relationships between developers and communities. Under the RenewableUK Community Benefits Protocol, developers commit to provide benefits of £5,000 per MW of installed capacity. These can be an important source of income, especially in rural communities where they have funded vital projects such as community-owned renewable energy projects, village halls, recreational facilities or schools equipment.

Environmental benefits

Onshore wind provides a source of clean power at a relatively low cost (similar to offshore wind) and the CCC recommends this is a key technology to be on track to reach Net Zero by 2050 (The CCC 2019 report recommends up to 35GW of onshore wind by 2035).

In addition, its lower cost of energy means that it could provide the most economically efficient source of low carbon electricity in future, particularly given ongoing improvements in wind turbine technology. For example, in 2018, the levelised cost of energy for onshore wind was £49/MW compared to £56/MW for natural gas.

What is needed to embrace these benefits?

Cooperation between areas in the Northern Powerhouse could provide an opportunity to make the case to government to enable onshore wind to compete in subsidy or capacity market auctions, or for local authorities to relax planning restrictions, in order to help reach upcoming environmental goals.

A coordinated strategy and programmatic approach to development may allow the supply chain to better prepare and thereby maximise economic benefits.

Nuclear

The Northern Powerhouse has 3.64GW installed capacity of nuclear assets - 39% of the UK's total. These assets provided 22TWh of low carbon power in 2016. Nuclear can play a key role in maintaining security of supply in a low carbon power grid as the UK moves towards Net Zero, however its future is uncertain. Planned plant closures mean the NP11 need to act to ensure a revival in the sector and maintain the economic and environmental benefits.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
+ Baseload low carbon power – High costs of developing new projects without government support	+ New policy framework likely to create opportunity for a nuclear revival + Nationally significant research assets in the region	– Not all LEPs have an interest in nuclear – Developing new assets requires national government support

Where are we now?

There are nationally significant assets in three LEP areas, including for generation and research. The Northern Powerhouse contains several major nuclear power stations, such as Heysham 1 and 2 - not to mention the now decommissioned Sellafield facility which incorporates the site of the UK's first nuclear reactor. However, several of these assets are ageing and coming to the end of their productive lives. Therefore, there is a need for government support for the initiation of new nuclear projects as there is a lack of a pipeline of new project developments in the sector.

The nuclear sector in the region is a large employer, specifically in LEP areas such as Cumbria, Cheshire and Warrington, and Lancashire. NP11 LEP areas are also home to world leading research and development facilities for nuclear technology, including the nuclear engineering cluster in the Cheshire science corridor and Cumbria's Nuclear Arc consortium. Furthermore, the Sheffield City Region LEP area is set to become home to the UK Atomic Energy Agency's new £22 million nuclear fusion research facility.

Where could we be in 2032?

There are strong ambitions for LEPs with existing industry. LEPs with successful nuclear industries have an ambition to increase their access to international markets for nuclear sector materials, engineering capabilities and decommissioning services. In particular, Cumbria LEP aims to build its reputation as a global centre for nuclear technology, particularly in spent fuel management and decommissioning.

Some LEPs aim to capitalise on the nuclear sector deal provided by government in order to develop a pipeline of new projects, for example Cheshire and Warrington LEP aims to become a local hub for advanced modular reactor development. There are also aims to capitalise on new research in small modular reactor technology over the medium to long term.

In addition, there are benefits to be felt in complimentary sectors. For example, the Cumbria LEP region hosts a high hazard industrial site at Sellafield with a work programme for clean up and decommissioning. The cluster of expertise that has developed around this site is internationally significant and has potential for increased exports. Cumbria LEP is also looking to develop small modular reactors at Sellafield, as well as develop the site as a location for the next generation of nuclear waste storage.

Potential scale

Although there is low growth currently[1], there is increasing government support. The government has released the Nuclear Sector deal as part of the Industrial Strategy, investing £200 million in total and aiming to reduce the costs of new nuclear power stations by 30% by 2030. BEIS is also set to publish a white paper in 2020 which may include reform to nuclear funding models.

Existing nuclear power plants

Source: Carbon Brief 2015, National Grid 2019

Economic benefits

If new projects are launched there will be high investment in the sector and region. Together with the existing nuclear sector this would provide a high volume of jobs. However, there is significant uncertainty over the potential benefits available for new build nuclear over the next decade. In addition, there is the threat of competition for investment in new nuclear in other regions of the UK (for example the Wylfa site in North Wales).

There is a possibility that new markets opened up by research could provide a substantial opportunity in future or that selling the North's world-leading expertise in services such as technical design, development construction, and waste handling or decommissioning services could be an attractive economic opportunity for some LEPs as other national nuclear assets come to the end of their productive lives.

Environmental benefits

The potential for nuclear to provide a reliable, baseload, low carbon power source is a valuable alternative to intermittent renewables. By providing low carbon generation at scale, nuclear power could also make a valuable contribution to the UK's Net Zero targets in its own right.

There may be a negative impact on the local environment through the large resource use and infrastructure requirements of large scale nuclear plant. There is also a risk of radioactive waste which can be an environmental hazard.

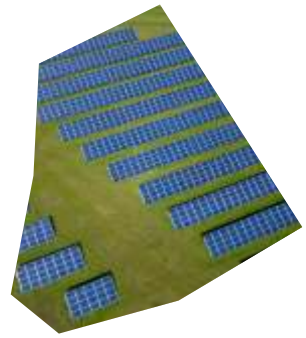
What is needed to embrace these benefits?

Not all LEPs have a strong nuclear sector to build from. Therefore, a pan-Northern opportunity may exist to coordinate and reinforce supply chains to take maximum advantage of economic opportunities.

It may be useful to secure government support for new nuclear in the region. Sharing of knowledge and best practice could place the Northern Powerhouse in the optimal position to take advantage of the government's Nuclear sector deal.

In addition, there may be a requirement for a developer-led approach if nuclear is going to be a key part of the national energy mix. This may require the establishment of a government body with responsibility for the whole nuclear life cycle from power generation to safe disposal.

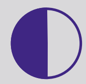
Note (1): The majority of the UK's 9GW nuclear power plants are set to retire by the early 2030s. This will leave a gap in generation capacity which may be challenging to fill with current renewable technology (nuclear provided 19.5% of UK power in 2018). The ETI (2015) has identified potential for up to 35GW of nuclear capacity on existing nuclear sites in the UK.



Solar

The Northern Powerhouse currently has 1.3GW of Solar installed in the region, 10% of the total UK capacity. In future, the sector is forecast to grow to 4.4GW by 2032. This additional capacity would abate 1.12Mt CO_2 per annum, when compared to gas fired power. However, lack of feed-in-tariff (FIT) support could undermine the sector's growth without alternative funding. This would mean that the unique benefits of solar, in particular on-site rooftop generation, are in danger of not being realised in the region.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
– Low installation rates with a lack of policy support – Lower levels of solar energy available to be captured	– Solar could only be more attractive in future if new commercial models can be developed + Opportunity for communities to own projects	+ NP11 potential collaboration in building a prospectus of commercially attractive solar investments in the region + Local Energy Hubs promoting the case for large scale solar

Where are we now?

Current assets have been developed in the Northern Powerhouse (in all LEPs) under the FIT programme but the Northern Powerhouse only has 1.3GW installed solar capacity in the region which is a small proportion of the UK's total of roughly 13GW.

The government closure of the FIT scheme has significantly scaled back the volume of new solar installations nationwide. The replacement Supplier Export Guarantee will take time to become a reliable basis for solar business cases.

Some regions still see this as an important technology for decarbonisation, for example Warrington Borough Council has recently invested around £50 million in solar farms. In addition, the Liverpool City Region's area has university based research centres developing solar technologies. The North East LEP also have several local authority areas in the top 10 in the UK for installed capacity

Less utility scale solar developments exist in the North, with the majority being distribution connected and decentralized.

Where could we be in 2032?

There are no major ambitions for solar for the region as a whole however, there are some targets for solar deployment in certain areas such as in the Humber LEP region and the Liverpool City Region LEP area. These involve support for supply chains and project development, for example Liverpool City Region LEP and Humber LEP both discuss (in their energy strategies) finding ways of supporting projects now central government subsidy support has been withdrawn. Moreover, other city regions in the North such as Manchester and Leeds are developing ambitious plans for delivering Net Zero ahead of the government target for 2050. Rooftop solar will likely need to play a significant part in these plans, particularly in relation to new build developments.

Potential scale

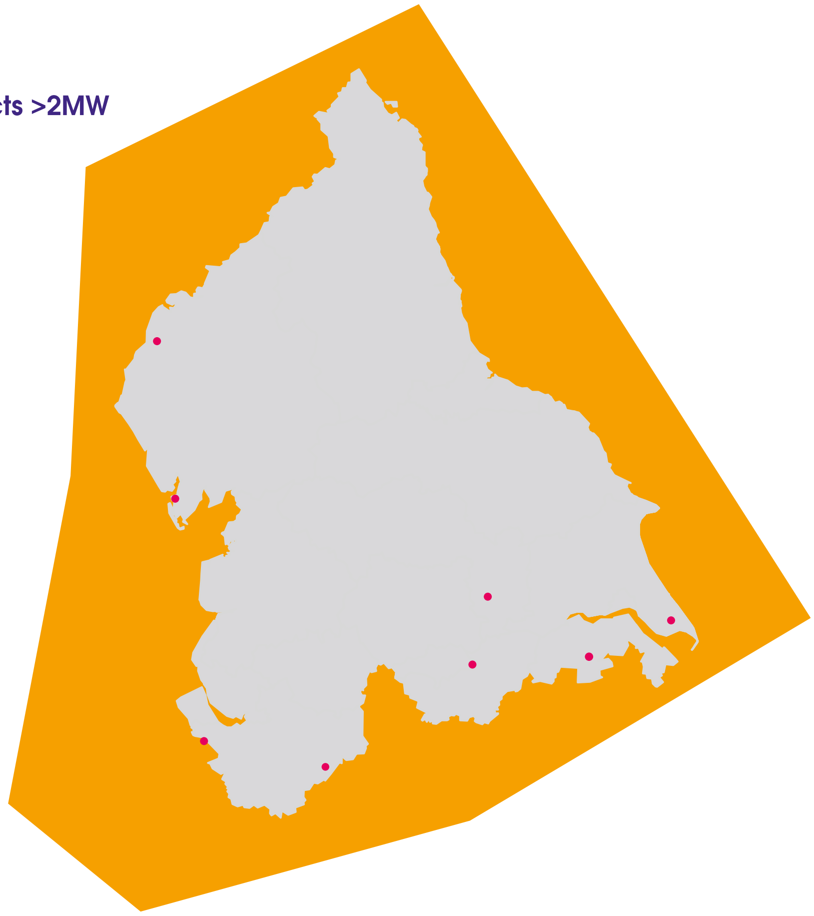
Technical potential is high but there is a lack of viable commercial models. The UK has an estimated 145-615GW potential solar resource available, according to CCC estimates. However, the South of the country receives proportionally more solar irradiance and this is reflected in current installations.

The potential for solar in the Northern Powerhouse does remain significant, with IPPR research showing that the technical capacity for rooftop solar in 10 Northern cities could power almost 280,000 homes, 20% of the households in those cities (IPPR, 2017). This level of deployment would see small-scale solar play a substantial part in decarbonising the power sector.

Economic benefits

There are limited supply chain opportunities beyond installation, operation and maintenance as silicon PV cells are overwhelmingly imported from China. However, the installation of rooftop

Existing solar projects >2MW



Source: Carbon Brief 2015, National Grid 2019

solar does create a relatively higher quantity of jobs per MW installed than other energy technologies. Innovation in solar technology could capture more of these benefits and develop supply chains in the North, as well as in the UK more widely.

There are some economic benefits arising due to PV installations reducing business costs and therefore increasing competitiveness. In addition, if community scale solar projects are developed and can secure alternative funding, they are a good opportunity to secure local economic benefits.

Environmental benefits

Decentralised solar is renewable and reduces system losses – reducing the carbon intensity of the transmission and distribution networks. There are also synergies with the decarbonisation of transport and heat. If some of the increased demand from EV charging and heat pumps can be met through on-site generation, this can reduce the need for increased capacity on distribution networks.

Demand side response capabilities are possible. Solar systems exporting power onto the distribution network can create issues with power export however, solar plus storage systems deployed with digital technology can be highly responsive to network requirements and provide services to the power grid.

Rooftop solar is also a means of driving a Net Zero housing sector by providing zero emissions power, and could provide local authorities with a way of reducing emissions in the short-term while driving social objectives e.g. around fuel poverty.

The potential scale of environmental benefits is currently limited due to the lack of policy support.

What is needed to embrace these benefits?

The solar industry needs a framework to engage investors and revitalise the project pipeline. Pan-Northern cooperation could be the right scale to lobby government or build attractive investment cases designed to achieve this.

Biomass

Biomass power generation is a significant strength for the Northern Powerhouse today with 3.14GW installed capacity - 93% of the UK's total. The region has the potential to produce 24.13TWh by 2032. Used in conjunction with carbon capture technologies, biomass has the potential to make a significant contribution to Net Zero efforts through its negative emissions potential. However, the environmental benefits vary depending on the approach used. The NP11 therefore have an opportunity to grow the sector through pioneering the use of bioenergy carbon capture and storage.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ The Northern Powerhouse has a very high proportion of total generation from biomass in the UK + Biomass is a flexible source of power which benefits the grid	– Likely to be environmental limits on the availability of biomass resource for combustion + Biomass with CCUS has negative emissions potential	+ Biomass technology is versatile and diverse, increasing possibility for collaboration

Where are we now?

The North of England accounts for 92% of the UK's electricity generation capacity from biomass (IPPR, 2017). The largest plants (operational or under development) are Drax in the York, North Yorkshire and East Riding LEP area and MGT Biomass in the Tees Valley LEP area. These and other plants situated across the LEPs, such as Blackburn Meadows and Lynemouth, total 3.4GW installed biomass capacity in the North.

Other LEPs benefit from having businesses which are part of the supply chain providing fuel for biomass power generation, such as Liverpool City Region LEP and Humber LEP.

Where could we be in 2032?

Not all LEPs state strong ambitions however, a small number of LEPs have ambitions to implement programmes aiming to develop biomass as an energy source and develop ancillary industries and supply chains, in particular Humber LEP. Other LEPs acknowledge the benefits of biomass for example, Leeds City Region LEP discusses the role of the Drax plant in trialling bioenergy carbon capture and storage and York, North Yorkshire and East Riding LEP, and Cumbria LEP acknowledge the merits of biomass primarily on a decentralised basis, citing the high proportion of properties not connected to the gas grid. The development of a Northern Forest is a stated aim in some plans and could also produce biomass resources.

Potential scale

Although there is potential for up to 15% of the UK's primary energy demand to be met through biomass by 2050 (CCC, 2018), there would have to be strong sustainability governance on the production of feedstocks. This refers to supply chains in the UK and internationally, as UK imports of biomass would need to increase at least threefold.

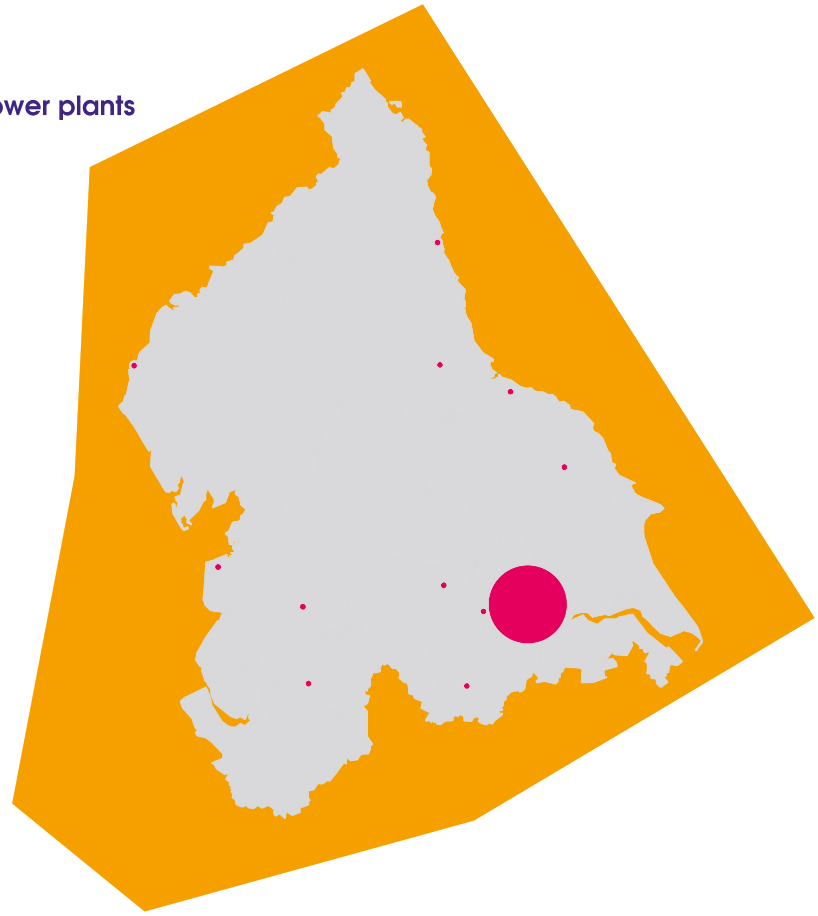
Economic benefits

Biomass is a mature technology in a globally competitive industry, meaning that there can be limited scope for innovation, first mover advantage or domestic capture of competitive advantage in developing biomass assets. This can benefit local businesses and repurpose waste, particularly with smaller biomass assets and selling biomass resources can create an alternative revenue stream for agricultural producers.

Environmental benefits

However, currently biomass is not carbon zero. Some of the larger biomass assets ship fuel internationally, increasing carbon emissions and burning fuels leads to local air quality issues and particulate emissions. Using waste is more environmentally friendly, whereas growing crops for biomass fuel purposes can have negative impacts on the local environment depending on farming practices.

Existing biomass power plants



Source: Carbon Brief 2015, National Grid 2019

Future opportunity for CCUS means that biomass could become a negative emissions technology as CO_2 is sequestered. The CCC has stated that biomass uses that enable long-term carbon storage should be prioritised. For power and heat generation, this is only possible with CCUS.

What is needed to embrace these benefits?

To gain the full benefits of biomass may require coordination and joined-up thinking with CCUS development and roll out to ensure negative emissions.

However, most LEPs do not identify biomass as a priority in their energy strategies. Some LEPs discuss supporting households in accessing renewable heat incentive benefits for biomass boilers, however this has limited relevance for the power sector.

Improving regional infrastructure could improve the importance of biomass in energy strategies, leading to more opportunities for underutilised biomass resources being harnessed, but this would require coordination between the regions.

Tidal

Tidal Range energy resources are abundant in the UK, with the potential to deliver up to 120TWh per year if fully unlocked. Tidal Range will also contribute to diversity in the low carbon energy mix, providing long term predictability and helping to balance the grid more effectively. However, to-date tidal remains an untapped potential as proposed developments struggle to overcome cost barriers and concerns over environmental impacts. Liverpool City Region, Cumbria, and Humber LEPs have identified potential for tidal power in their areas. This zero carbon, potentially large-scale energy source could play an important role in the context of putting the NP11 on a Net Zero trajectory.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
+ Significant tidal resources in the region – No existing or under-construction developments	+ Ambition in some LEPs, including to deliver a large-scale project in the Mersey – Policy headwinds to overcome	+ Synergies with existing supply chains for offshore sector + Scope for shared learning on overcoming commercial and policy barrier

Where are we now?

The 2017 Hendry Review backed the potential of tidal power, supporting the Swansea Bay project as a no-regrets "pathfinder" option that would lead the way for other projects to follow. However, the Swansea Bay project failed to gain the backing of government.

While there are currently no tidal power generation sites active or under construction in the UK, there are operational projects globally, including La Rance and Sihwa power stations located in France and South Korea, respectively. For the North of England, there are significant potential tidal resources in the North West, estimated to be capable of meeting up to 5% of national electricity demand (Yates et al., 2010) and a number of proposed projects have been identified in the region. In addition, the ORE Catapult in the North East LEP area is a nationally significant source of research and innovation in tidal energy.

Where could we be in 2032?

Not all LEPs state strong ambitions for tidal however, the Liverpool City Region LEP plans to construct a tidal power scheme in the Mersey. Cumbria LEP and Humber LEP both also see potential for tidal energy in their areas, if the existing barriers can be overcome.

Potential scale

Successful deployment of tidal faces a number of challenges. Not least of which is a perception among some policymakers that tidal energy is unlikely to become a reality. DECC (2010), the NIC (2018) and the CCC (2011) have all published reports which have addressed tidal energy and highlighted substantial challenges, including adverse environmental impacts and high costs.

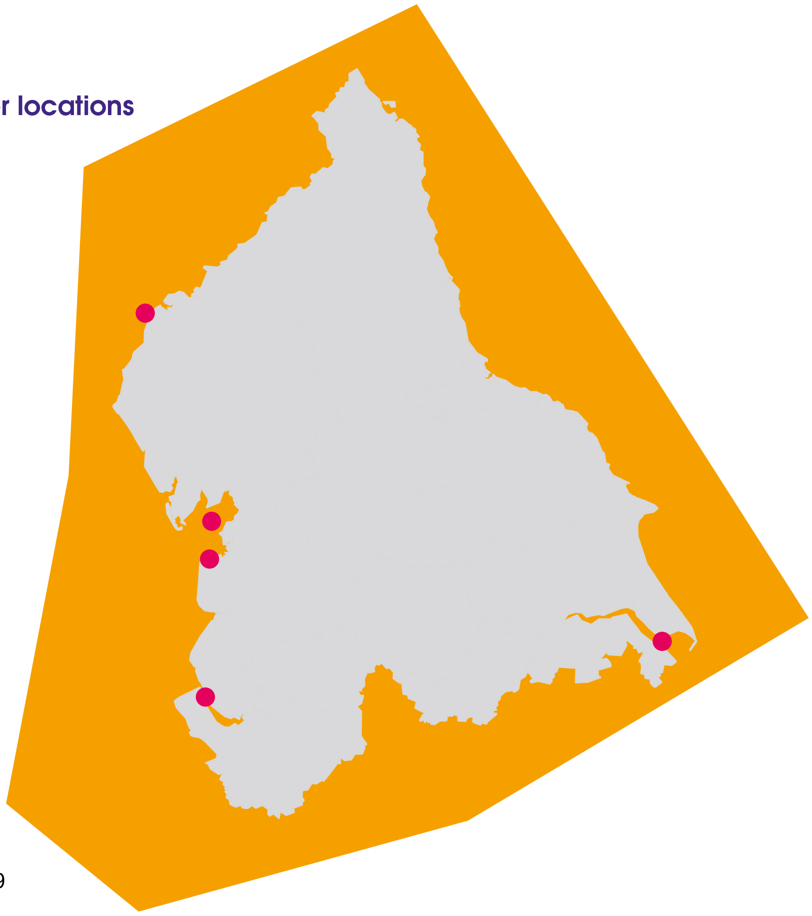
On the other hand however, the Crown Estate estimated that tidal power could provide in the region of 120TWh/year in the UK, if fully exploited (Crown Estate, 2012). Researchers have identified substantial tidal resources in the North of England, with schemes and proposals identified in Solway, Wyre, Morecambe and Mersey potentially delivering up to 15.3TWh/year (Petley et al, 2019). Tidal could also add significant power capacity to coastal regions that would align to new hydrogen production locations, creating scope for the green hydrogen production needed to meet decarbonisation objectives.

Economic benefits

Tidal generation is very different to other sources of clean energy, providing much higher degrees of predictability in terms of generation output. Tidal range generation sites are also productive for longer timescales than more conventional renewables, potentially being operational for over 120 years.

Large-scale deployment would bring high-value specialist jobs to the region, as well as support the development of supply chains. Tidal assets can have a projected lifespan of in excess of 100 years, providing operation and maintenance jobs long

Potential tidal power locations



Source: Petley *et al*, 2019

into the future. There are cost overlaps between tidal and other offshore technologies, including offshore wind (Magagna and Uihlein, 2015), suggesting that there are positive synergies and opportunities for mutual costs savings across these two technology groups.

In addition, compared with other forms of zero carbon renewable generation (particularly wind and solar) tidal generation is particularly predictable both in terms of when it produces electricity and how much it outputs. Some tidal generation technologies allow generation to be brought forward or delayed by up to an hour, providing additional flexibility meet grid requirements in a similar fashion to storage.

Environmental benefits

As a zero carbon source of energy, tidal can contribute to the continued decarbonisation of power, and provide additional diversity to the UK's generation capacity. Tidal Range generation can also be controlled more than wind or solar assets, with generation being held off or brought forward by up to an hour in each direction. At scale, tidal range could therefore contribute significantly to meeting the Net Zero target.

Potential environmental impacts of tidal projects have been raised as a concern. Approaches which minimise these impacts are seen as viable, but this will need to be demonstrated to relevant planning authorities on a case-by-case basis.

What is needed to embrace these benefits?

A re-examination of the potential of tidal range and tidal barrage schemes is needed, taking into account latest technology, policy and commercial developments.

Approaches to funding that enable projects to progress through the costly exploratory, design, and planning consent stages should be developed.

04.

Energy and Industry

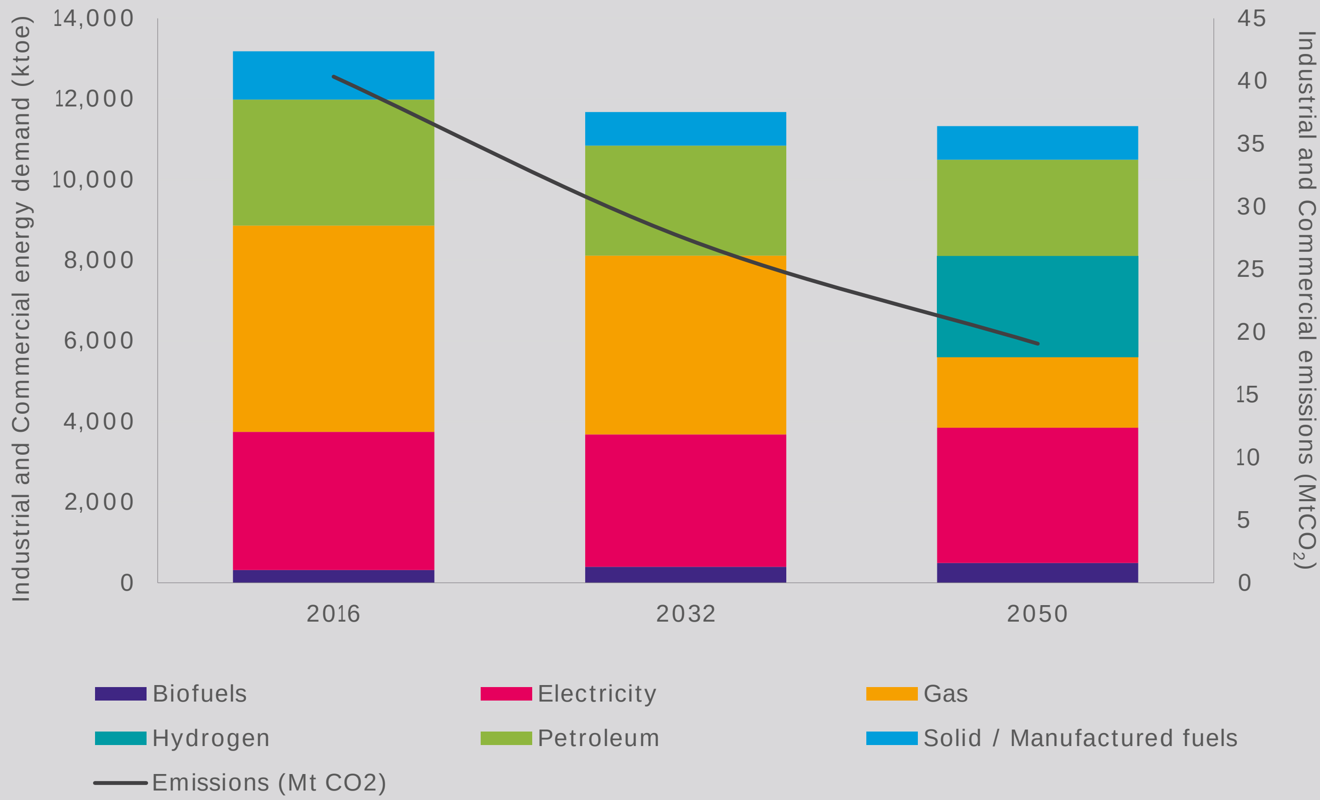
- CCUS and hydrogen
- Energy intensive industry
- Alternative fuels and the circular economy
- Low carbon and environmental goods and services

Energy and Industry- overview

The Northern Powerhouse is an integral part of the UK's industrial base, with major hubs on both coasts and high levels of inward investment. However, the region's industries operate in globally competitive markets. Unless a way is found to mitigate the impacts of rising carbon and energy costs, global conglomerates may find the region less attractive. CCUS will need to be a key part of reducing industrial emissions to avoid this, thus allowing the region to secure economic growth and reduce emissions in line with the UK's Net Zero target.

Below we set out our summary of key regional strengths, threats and opportunities, and pan-Northern actions that can be taken to address these. The underlying detail is set out below for different parts of the industrial sector.

Potential future energy mix for industry in the Northern Powerhouse



Source: BEIS data, National Grid Future Energy Scenarios 2019, KPMG analysis

BEIS estimate industrial energy consumption to fall across the UK between 2016 and 2032, primarily due to industrial closures and an increase in process efficiency. This trend is likely to continue in the North, although this is dependent on economic conditions. Whilst a growth in automation and robotics is likely to increase electricity consumption out to 2050, overall energy use in the industrial sector is expected to reduce slightly between 2032 and 2050. Emissions, on the other hand, will continue to drop steeply, driven by a growth in the use of clean hydrogen as a replacement fuel for natural gas.

Priorities for LEPs

- Industrial CCUS clusters work together to share expertise and insight, focused on developing solutions and enabling commercial delivery at scale
- Increase awareness across LEP boundaries on circular economy opportunities to widen pool of potential suppliers and develop supply chains
- LEP-led demand stimulation for energy efficiency measures for business and public sector

Priorities for government

- Develop funding model for CCUS networks and storage
- Create conditions for collaboration between CCUS hubs, ensuring that competition for funding does not prevent knowledge sharing

Regional strengths

- World leader on CCUS, with diversity of potential storage options
- Location of UK hydrogen production (via steam methane reform and electrolysis)
- Large industrial clusters can offer synergies and economies of scale (e.g. industrial heat networks)
- Agricultural sector with scope to develop capability in anaerobic digestion to decarbonise gas

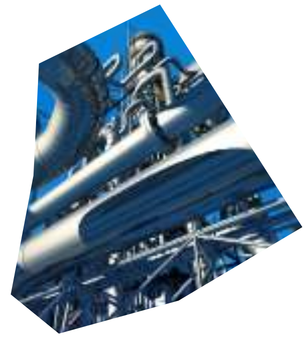
Drivers of opportunity

- Collaboration between industrial CCUS clusters to drive cost reduction
- Ensure that opportunities for use of waste industrial heat are maximised
- Large-scale roll-out of energy efficiency measures (encompassing large-scale, energy intensive sectors, SMEs and public sector) with accompanying supply chain development

Challenges to overcome

- High levels of current emissions, cost pressure from rising carbon and energy prices
- Diversified industrial ownership means lack of joined up thinking around issues such as using waste industrial heat
- CCUS requires government support in the development of networks- competition between potential CCUS hubs would lessen potential for wider synergies/efficiencies

CCUS and Hydrogen



There is significant potential for the decarbonisation of energy production and use through a symbiotic growth of large-scale carbon capture, use and storage (CCUS) and a hydrogen economy. The Northern Powerhouse is currently a leader in the research and demonstration of these technologies. Some LEPs have high ambitions in this area and the NP11 have an opportunity to act collectively to leverage the existing strength to deliver environmental and economic benefits for the region. CCUS is key to the achievement of the UK's Net Zero targets, particularly in relation to high-emitting industrial sectors.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ UK leader in research and demonstration – No full scale, fully commercial deployment	+ Regional co-location of hydrogen production and demand with CCUS + Route to decarbonise energy intensive industry	+ One voice needed to drive policy agenda to support deployment + Pooling of resources to accelerate deployment and development of supply chains

Where are we now?

The major clusters of energy intensive industry, for example, in the Cheshire and Warrington LEP area, the Humber LEP area and the Tees Valley LEP area require CCUS to meet emissions targets and to remain economically competitive in a world in which higher carbon prices are likely to feature in the drive towards Net Zero.

Equally, a number of LEPs have high ambitions for the growth of the hydrogen economy as a means of decarbonising heat and transport (see section 5). CCUS is likely to be required to deliver this as the most economic way to make low carbon hydrogen at scale is currently thought to be reformation of methane with CCUS. Hydrogen produced in this way – sometimes called 'blue' hydrogen – is particularly suited to use in the heat and industrial sector, but less so for transport where 'green' hydrogen produced via electrolysis is more suitable.

Significantly, the Northern Powerhouse also has distinctive scope to deploy CCUS through existing offshore storage facilities, for example in the North sea, which have a storage potential of up to 14,250Mt CO_2 (IPPR, 2017).

Trials of CCUS technology are ongoing at Drax. The Teesside Collective's OGCI-backed Clean Gas Project; the Hynet project running through Liverpool, Cheshire and Warrington and into Greater Manchester; as well as the H21 project in Leeds to convert the gas network to use of hydrogen, all represent strong pockets of innovation in the region that could develop hydrogen and CCUS into future opportunity.

Where could we be in 2032?

There are strong ambitions in CCUS, clearly linked to the decarbonisation of heavy industry and the development of a hydrogen economy. LEPs citing clear CCUS ambitions include Humber LEP, York, North Yorkshire and East Riding LEP, Liverpool City Region LEP, Tees Valley LEP and Cheshire and Warrington LEP.

Potential scale

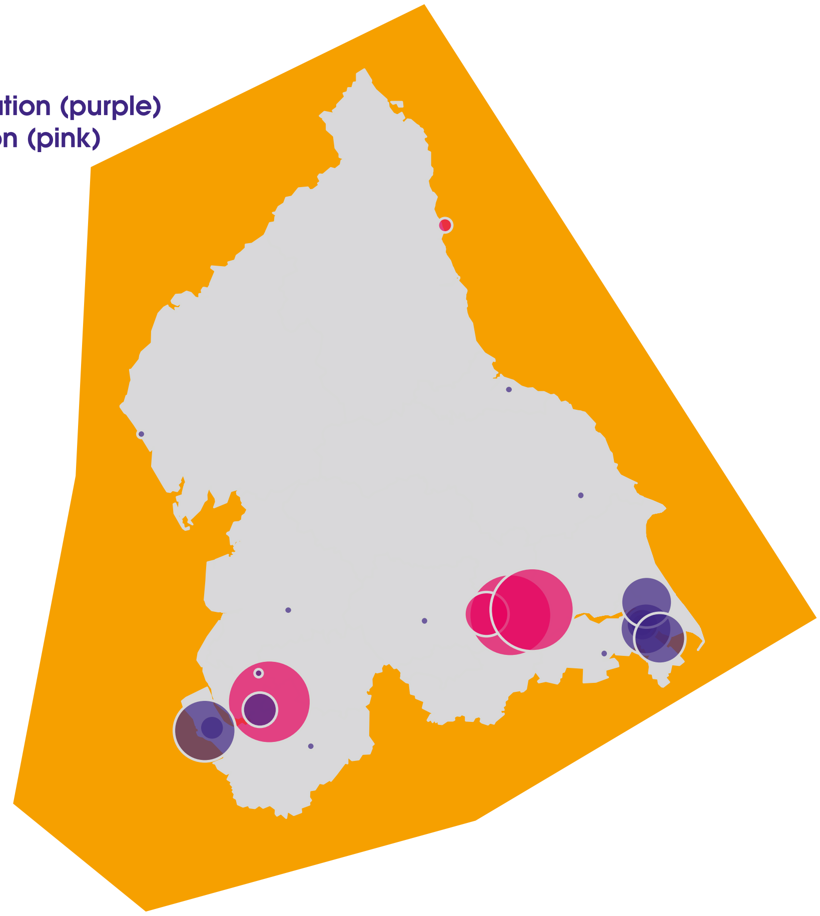
Clusters of high-emitting industry and prospective growth in hydrogen production from steam methane reformation represent a significant potential demand-side for CCUS.

Driven by energy intensive industry (such as steel and chemicals) the regional carbon intensity per capita in the Northern Powerhouse in 2017 was 5.9 tCO2 compared to 5.1 tCO2 in England overall (BEIS, 2019).

Domestic production of hydrogen is also likely to need to scale up substantially from the 26.9 TWh produced today, if hydrogen is to play a significant role in the energy mix in the Northern Powerhouse (Policy Exchange, 2018).

Scale, and collaboration on delivery, is needed in the deployment of CCUS and hydrogen schemes to support the efficient development of supply chains for resources and materials.

Current gas generation (purple) and coal generation (pink)



Source: Carbon Brief, 2015

Economic benefits

Climate and environmental ambitions, nationally and globally, rely on CCUS. Therefore, becoming an early adopter or developer of cost-effective CCUS technology could be a highly lucrative opportunity for the North, in terms of potential export of technology and intellectual capital. Globally, it is predicted that 94GW of CCUS will be needed by 2050 to meet environmental targets – this is estimated to be a market worth over £100 billion a year (IPPR, 2017).

Implementing CCUS at a low enough cost will allow energy intensive industries to become environmentally sustainable and remain in the region for the longer term, preserving their economic benefits. Without an economically viable means of reducing emissions, there is a risk that these industries could relocate elsewhere as national policy evolves to deliver Net Zero by 2050.

Environmental benefits

CCUS is considered essential for full decarbonisation of the economy. CCUS will facilitate decarbonisation of the hardest to reach sources of emissions, in particular heavy industry. It is also seen as necessary for the economic production of hydrogen from steam methane reformation, which has a potentially significant role in some areas in reducing emissions, particularly for heating and industrial processes. Successful combination of CCUS and hydrogen is therefore essential for successful economy-wide decarbonisation as required to meet Net Zero.

What is needed to embrace these benefits?

The industry needs to be clear in its rationale for CCUS and explore cooperation between LEPs. For example, pooling resources and sharing knowledge could help to significantly accelerate cost reductions and the deployment of CCUS and hydrogen. It will also assist in avoiding future supply chain pressures and establishing the infrastructure across the Northern Powerhouse for transporting and sequestering carbon. Additional positive spill-over effects may also be experienced if the CCUS industry provides a forum for industrial collaboration across the different regional clusters.

This collaboration needs to extend to the development of a hydrogen economy across those areas of the Northern Powerhouse that this is seen as a priority for. The case for hydrogen conversion needs to be built together with the case for CCUS.

In addition, if the region acts with unity and engages with national government using a single voice on these areas, it could increase the potential of a strongly supportive policy or regulatory environment and a clear funding model communicated by government.

Energy from waste and the circular economy

Achieving a more sustainable economy is a key objective for all NP11 LEPs and resource efficiency is a core part of achieving this. The region already has some notable strengths in the area, in particular deployment of energy from waste technologies and leading biofuel production facilities. The region stands to benefit from building on these strengths. Reducing waste can drive efficiencies for businesses as well as economic growth. Although much of the momentum in this area will come from LEPs acting individually, there is still scope for cooperation, for example in relation to shared standards and certifications for businesses.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Significant deployment base across waste technologies – Deployment generally at small scale – Robust supply chains not yet in place	+ High levels of LEP ambition + Large pipeline of potential projects + Backed by government Resource and Waste Strategy	+ Opportunities around shared standards + Potential to collaborate on driving scale in supply chains

Where are we now?

Developing a circular economy is a broad subject. As such, pockets of innovation and the development of new technology is taking place across the Northern Powerhouse at a small scale.

In 2017, total installed capacity of energy from waste power generation from municipal solid waste, landfill gas and solid gas totalled 673MW across the North.

There is also innovation in the region relating to recycling in urban areas, for example in the Greater Manchester LEP area and Liverpool City Region LEP area.

The North West Business Leadership Team focusses on supporting businesses in reducing their resource impact.

Another example of the North's leadership in developing an approach to a circular economy is the use of anaerobic digestion of agricultural waste in the production of biomethane which can be used to decarbonise the gas sector – reducing the carbon intensity of heating. This is a particular focus for rural areas and the North has a number of existing research centres.

Where could we be in 2032?

Ambitions are broad and high level, particularly in the area of the circular economy and energy from waste.

For example, York, North Yorkshire and East Riding LEP have developed a Circular Economy Strategy and Action Plan to deliver a competitive, carbon-neutral circular economy by 2030 that benefits businesses, society and the environment. The LEP has the ambition to be a global leader in the delivery of circular economy excellence and achieve transformation across sectors at scale and speed.

Greater Manchester and Liverpool City Region LEPs also have ambitions to support circular economy projects at the urban scale.

Tees Valley LEP has identified 160 potential industrial symbiosis projects where waste resources from one sector form an input into another.

Potential scale

The government is acting to support circular economy principles in practice, with the 2018 Resources and Waste Strategy and the enactment of the 25 Environment Plan.

There is a significant opportunity for waste heat capture. Humber LEP cite a study in their local energy strategy showing that it is commercially viable to recover 5 TWh/year of industrial heat in the UK each year (Element Energy, 2014).

Given the current and future resources in this space, there could be a potential opportunity for the Northern Powerhouse to work as a UK Hub and to develop sophisticated technologies and systems.

Economic benefits

Several studies have shown the possible benefits of developing a more circular economy - potentially increasing GDP by 8% and creating over 200,000 UK jobs in the period up to 2030. These jobs are also forecast to have a significantly greater impact on areas with higher unemployment, such as parts of the North of England (Business in the Community, 2018).

Repurposing waste materials can create new products and services, capturing local economic benefits for businesses of different sizes and boosting competitiveness.

Avoiding the need for waste to be processed on the municipal level will also reduce pressure on public funds and services.

Environmental benefits

The development of a circular economy has clear benefits in terms of emissions reductions, through approaches that reduce waste from the design stage, keeping materials in use.

Developing new approaches and technologies which scale up could also lead to a significantly larger positive impact over time and once the innovation diffuses into different areas.

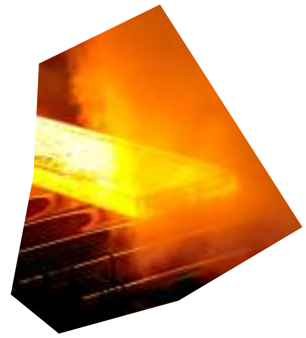
What is needed to embrace these benefits?

Extending industrial and large scale circular economy solutions from the more industrialised LEPs could be an opportunity. This could be done through increasing awareness of successful approaches across the LEP boundaries on the opportunities available.

There could be scope to cooperate in developing shared standards or certifications for businesses.

Using the NP11 to scale up individual initiatives to grow impact is a potential avenue. For example, the Greater Manchester sustainable Business Partnership aims to drive innovation in this area, an approach that could be implemented at a larger scale. The Merseyside Circular economy club is another example of an organisation forming part of an international network.

Energy Intensive Industry



The North of England is home to some of the UK's most important industrial clusters, which make up a significant proportion of national emissions. These include many carbon-intensive facilities which operate in globally competitive markets and are facing increasing pressures from rising carbon costs. In order to keep these economically valuable entities and the jobs they support in the region and achieve Net Zero, it will be vital to ensure the development of CCUS networks to capture emissions. The successful development of CCUS will require collaboration and knowledge sharing across industrial regions, as well as a clear framework for support from central government.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Strong industrial base + CO_2 storage opportunities in North Sea and Irish Sea – Highly carbon intensive	+ With CCUS, large emitters can continue to drive economic value for the region + Without CCUS, there is the risk that industries relocate	+ Opportunities for knowledge sharing between hubs + North to act as one voice in discussions with government

Where are we now?

In 2016, the industrial and commercial sector consumed 41% of total final energy consumption in the North.

The sector also has a large carbon footprint. Industry and commerce in the Northern Powerhouse created 39.3Mt CO_2 emissions in 2017. Several Northern regions also have some of the highest absolute commercial and industrial emissions - with Yorkshire and the Humber and the North West being the two highest sources in 2014 (BEIS, 2017).

There are several innovation hubs, for example the Cheshire energy hub which aims to reduce energy costs for high emitting companies.

There has been investment in fuel switching to reduce carbon emissions – for example in the York, North Yorkshire and East Riding, and Cheshire and Warrington LEPs there has been investments in co-firing biomass and waste.

Where could we be in 2032?

More industrial areas of the region such as Tees Valley have made the case for industrial CCUS in recent years, and are now looking to take forward plans to develop projects and infrastructure.

Decarbonising energy intensive industry is closely linked to CCUS and therefore LEP strategies mirror ambitions in that sector to a large extent.

Energy intensive industry has significant cross-over with the technological application of CCUS, circular economy principles and energy from waste, as well as district heating networks.

Potential scale

There is significant scope for waste heat to be captured and contribute to the decarbonisation of heat through industrial heat networks. The Northern Powerhouse has specialist industries – including iron, steel and chemicals production – which have the high heat loads when compared with other industries.

Key sites identified by the Northern Energy Taskforce (IPPR, 2017) as having a high economic potential for the recovery of waste heat are also situated close to high heat demand areas.

Economic benefits

Achieving decarbonisation of industry is crucial to retain the economic benefits brought to the region by large industry, particularly in the steel and chemicals industries. Without CCUS, many large industrial emitters could be forced to close their UK operations as the carbon price rises. A high carbon price could impact the competitiveness of the region's industry, without economic deployment of CCUS.

Innovation in terms of technology and business processes is required to keep costs competitive as policy requirements to decarbonise grow.

Environmental benefits

Given the increasing cost pressures facing heavy industry as the carbon price increases, doing nothing would create some environmental benefits as carbon intensive producers relocated away from the region, but this would involve a heavy price for the region's economy. By deploying abatement technologies such as CCUS, the region can ensure it plays its part in driving emissions reductions while facilitating economic growth.

What is needed to embrace these benefits?

Given the diversity of business and sectors across the LEPs, there is substantial scope for sharing information, best practice and data to reveal insights and opportunity.

Low carbon and environmental goods and services

The market in low carbon and environmental goods and services is a highly productive sector across the UK and the Northern Powerhouse holds a competitive advantage in its growth. As a sector, the decarbonisation commitment set by the Net Zero target means government policy will support its growth, making the low carbon and environmental sector in the Northern Powerhouse an ideal place for industry to invest.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
+ Significant source of employment and innovation	+ Clear growth potential identified for important low carbon sectors	+ Diverse sector with scope for collaboration to match NP11-based providers of low carbon goods and services with buy-side businesses across the North and beyond

Where are we now?

Environmental business is a broad term, covering firms in sectors which directly respond to environmental needs and efforts by all companies to reduce their impact on the natural world. This includes supply chain businesses for a wide variety of technologies mentioned elsewhere in this report, as well as project developers and other businesses delivering energy efficiency, professional services.

In the UK overall, the low carbon and renewable energy economy grew by 6.8% to £44.5 billion in 2017, employing 209,500 people in 2017 (ONS, 2018). Government data shows the low carbon economy employing 136,000 people in the Northern Powerhouse in 2013, demonstrating the size of the contribution made by the region to a nationally significant and rapidly growing sector.

Clean technologies require investment in skills to create new employment. In the North East LEP area, Nissan is the largest regional employer, with EV production driving a growth in the supply chain for lithium-ion batteries.

Development and deployment of new technologies in the low carbon sector also accelerates with proximity. The Northern Powerhouse is benefitting from clusters developing as industries transition. For example, the Humber Clean Energy Cluster has shown the benefits of agglomeration in growing advanced industries, with major infrastructure companies developing supply chains for the offshore wind sector.

The low carbon economy also supports service providers, consultants and IT companies. Greater Manchester LEP is building its competitive advantage in this area, with professional technical services active in multiple sectors, such as waste, energy and environmental services. Greater Manchester's low carbon sector employs over 45,000 people with the third highest growth rate in the UK.

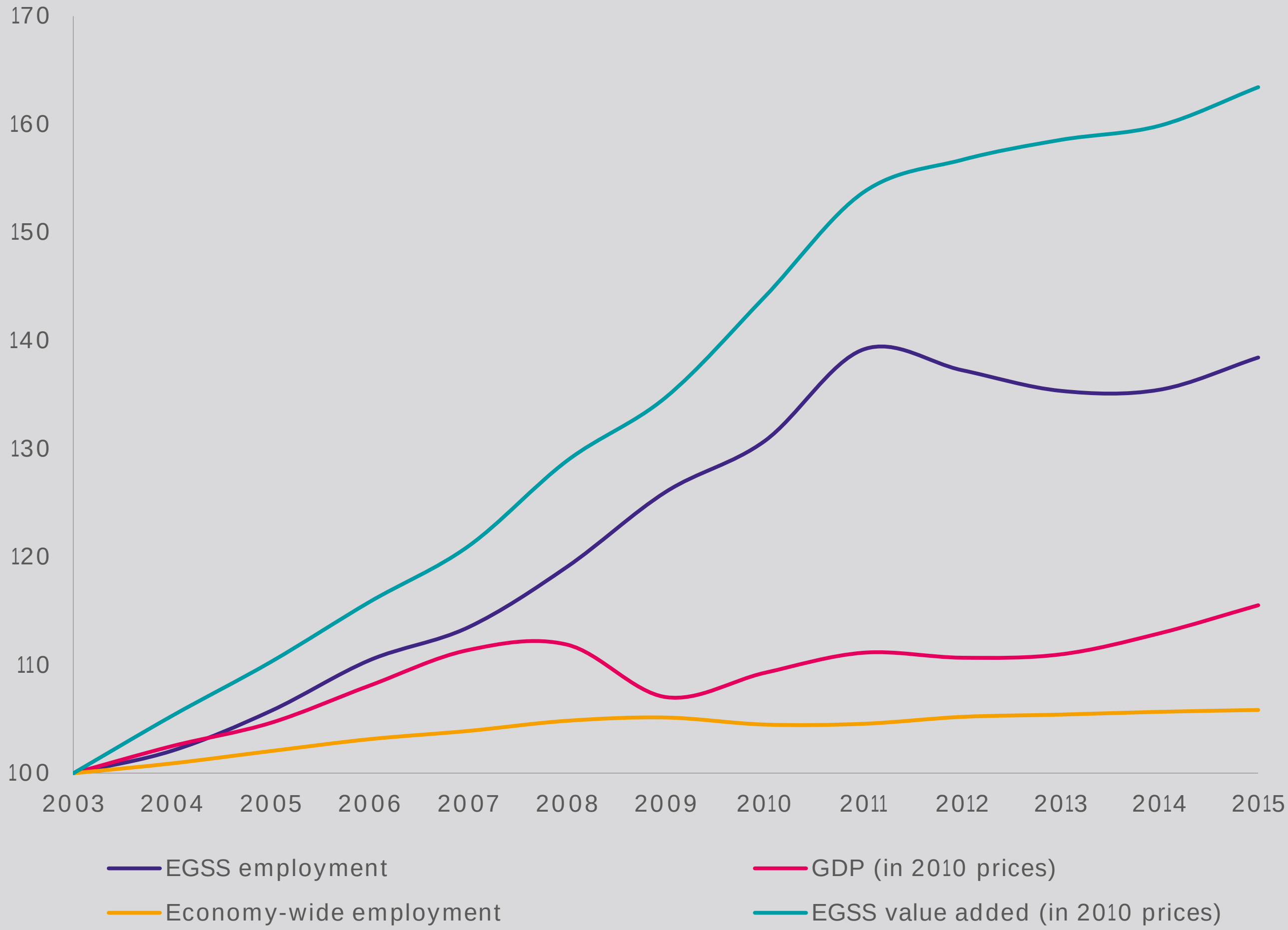
Where could we be in 2032?

Engagement from the private sector is essential to meeting decarbonisation and economic growth targets out to 2032. The Northern Powerhouse has the opportunity to prosper from this need by investing in the overlap between the interests of the environment and the interests of business.

Potential scale

Decarbonisation presents both a challenge and an opportunity for the North's preeminent industrial centres. Companies able to invest in new technology will secure a growing competitive advantage in years to come as the imperative to reduce emissions grows. Carbon capture and storage for heavy industry could be a key supply chain opportunity for the Northern Powerhouse in this regard.

EU data shows how the environmental goods and services sector (EGSS) has grown at a significantly faster rate than the wider economy



Source: European Environmental Agency, 2018

Economic benefits

The Northern Powerhouse independent economic review (SQW, 2016) identified four prime capabilities where the Northern Powerhouse is highly competitive. Of these, advanced manufacturing and materials, energy and digital all have an important role to play in growing the low carbon economy. Environmental business should therefore act as a catalyst in creating demand for outputs from all of these sectors. The economic review forecasts that by 2050, GVA could be 15% higher than it would otherwise have been with 850,000 additional jobs created, with a 1.9% growth rate in the energy sector from 2030 to 2050. Ensuring this growth come from environmentally sustainable sectors will be crucial for securing these benefits in the context of the Net Zero carbon target required by 2050.

Environmental benefits

By building up the capabilities to service the energy transition, providing parts and goods, as well as professional services, this sector will play a key role in facilitating the decarbonisation of the regional economy – i.e. in realising the environmental benefits outlined elsewhere in this report.

What is needed to embrace these benefits?

The NP11 will coordinate to capture the supply chain benefits arising from trade in low carbon goods and services within the North. Recognising that large national and international companies are often structured in a way that overlooks the North, we will lead on encouraging procurement of materials, professional services or infrastructure leads to contracts being awarded to suppliers based within the region.

The NP11 will also support the low carbon business agenda on the national stage, providing insights and encouragement to government to strengthen the environmental policies that the low carbon sector relies on.

In parallel, we will work to facilitate knowledge sharing and best practice with the most energy intensive businesses in the region. Investing in energy efficiency and cleaner fuels can increase commercial competitiveness and reduce emissions, thus delivering win-win outcomes.

The NP11 will work to find with the businesses that are proud to invest in the North.

05

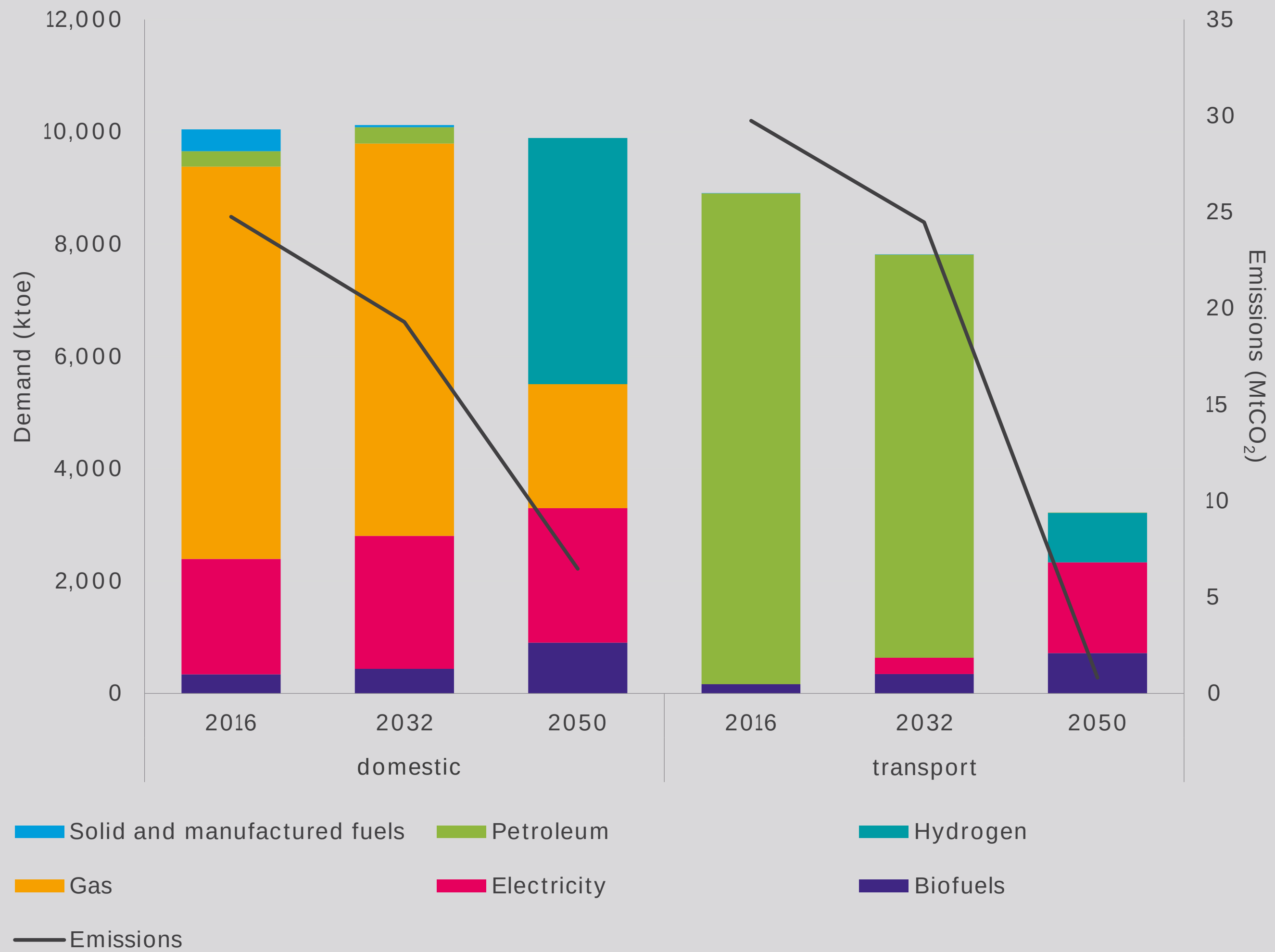
Energy Demand

- Decarbonising heat
  - Energy efficiency
  - Heat networks
  - Electric heating
  - Hydrogen
- Decarbonising transport
  - Electric vehicles
  - Hydrogen

Energy demand – Overview

The Northern Powerhouse can lead the way in decarbonising the UK's heat sector, through world-leading low carbon gas networks. It can play a leading role in the development of large low carbon vehicles and trains powered by hydrogen, although it needs to ensure it is ready to take advantage of the economic and environmental potential of EVs.

Potential future energy mix for domestic heat and transport in the Northern Powerhouse



Source: BEIS data, National Grid Future Energy Scenarios 2019, KPMG analysis

Priority actions for NP11

- Plan collectively for EV infrastructure to prevent under or over-provision, recognising rural and urban differences
- Knowledge sharing around electric heat and heat network deployment
- Shared standards for new infrastructure and building regulations
- Ensure green hydrogen production is joined up with centres of transport demand
- Jointly develop approaches to decarbonising heat which reveal the most efficient technology or solution in given circumstances solutions

Priority for government:

- Clarity on the policy direction for decarbonising heat, including clarity on the framework heat networks
- Continued commitment of funding for Ultra Low Emission Vehicles (ULEV) and EV rollout, particularly taking into account funding challenges in rural areas

Regional strengths

- Leading biofuel production
- Source of hydrogen for low carbon gas networks, site of UK CCUS
- Intermittent renewables can provide low-cost power for green hydrogen production
- Good potential for heat networks- diverse sources (geothermal, biomass, water heat, industrial) and urban demand
- Leading development of hydrogen vehicles and fleets, potential for hydrogen trains

Drivers of opportunity

- Power from renewables can be used to produce green hydrogen
- Leading the way on hard-to-decarbonise areas of transport (e.g. freight, heavy good vehicles)
- Ensure regional EV charging network is rationally designed

Challenges to overcome

- Behind rest of UK on EV deployment - charging infrastructure required, and attitudes addressed
- Different nature of challenge for heat/transport decarbonisation in urban vs rural areas- no 'one size fits all' solution
- Issues around affordability and acceptability of new solutions needs to be addressed
- Decisions need to be taken at national level on hydrogen heating

Decarbonising heat – Energy efficiency

The North's housing stock is particularly energy inefficient, making improving energy efficiency a priority in most LEP areas. The current weakness means that large-scale investment in energy efficiency in the Northern Powerhouse could have a particularly large impact. The positive wider impacts, in addition to the long-term payback in reduced energy costs, mean that the benefits substantially out-weigh the costs of investment. Energy efficiency therefore represents a no regrets option in the move towards Net Zero. While implementation of schemes will necessarily be locally specific, the significance of the topic to all LEPs means that pan-Northern collaboration make sense to maximise the benefits.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
– Below UK average energy efficiency + LEP ambition high	+ Scope for large scale investment + Lowers costs and lowers carbon + Positive social and economic spill-overs	+ Cooperation can increase impact – Locally-designed schemes needed

Where are we now?

The Northern building stock is comparatively more energy inefficient compared with the South. Between 2008-2019, 32.7% of EPC lodgements in the South and London were grade A-C, compared with 29.5% in the North.

Local supply chains exist for the fitting and installation of energy efficiency options but will need to scale up to deliver the number of energy efficiency measures required.

Poor energy efficiency is a contributing factor to fuel poverty, a particular problem for the North. In 2017 the National Energy Efficiency Dataset (NEED) classed 2.9 million properties in the Northern Powerhouse as being in the highest two quintiles for fuel poverty indicators. This compares to 1.6m properties for the same measure in London and the South East.

LEPs have a key role and a history of providing energy efficiency improvements to households, for example through the Leeds City Region Better Homes Yorkshire programme, which has delivered energy efficiency improvements to nearly 5,000 properties.

Where could we be in 2032?

Government policy is that all homes should reach EPC Band C by 2035. Retrofitting energy efficiency improvements is recognised by a majority of LEPs as a priority area. In addition, a number of local authorities in the Northern Powerhouse are members of the Northern Housing Consortium representing housing organisations and pushing for a joined up message about the need for investment in poor quality housing. Recommendations from this group are important but would require buy-in from government.

Different LEPs focus on both domestic and industrial energy efficiency. Domestic efficiency is particularly cited as a focus for those LEPs with dense urban areas.

Potential scale

The International Energy Agency attribute a range of positive spill-over effects to energy efficiency investments, including emissions reductions, job creation, reducing business costs and improving public health (IEA, 2015). These factors are substantiated in the UK context by primary research conducted by multiple bodies, including the NEA, Age UK and Public Health England. For example, improving all UK households to EPC grade C is estimated to return £3.20 of increased GDP for every £1 invested by government (Cambridge Econometrics, 2014). Recognition of the positive spill-over effects makes energy efficiency investments a priority for public agencies.

Economic benefits

Improving the housing stock is a task of vast scale. The UKERC estimate that making all energy efficiency investments classed as cost-effective by HM Treasury policy appraisal standards would cost £85.2 billion between 2016 and 2035 (UKERC, 2017).

Investments in energy efficiency often capture bottom-up economic benefits, reducing energy bills for families and therefore increasing spending power for local products and services.

Reducing fuel poverty also leads to secondary positive impacts on health and wellbeing, with the further economic benefit of a more productive workforce.

Investments are always paid back over time through reduced energy costs.

Environmental benefits

Energy efficiency improvements permanently reduce the use of gas and electricity, reducing associated environmental impacts. Direct emissions from buildings (arising primarily from fossil fuel use for heating) accounted for 17% of UK GHG emissions in 2017. Improving homes classed by the CCC as less costly to decarbonise could avoid 77% of these emissions (66Mt CO_2).

In the North alone, domestic (gas) heating resulted in 16Mt CO_2 emissions in 2017.

What is needed to embrace these benefits?

Although energy efficiency investments are necessarily made at the local level, there is scope for a pan-Northern programme of advice, engagement and support for households accessing energy efficiency investment.

Accessing sources of finance could require NP11 engagement.

Sharing knowledge, data and approaches for identifying the most in need areas for energy efficiency can also lead to synergies and improved outcomes.

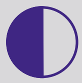
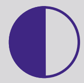
Developing shared standards could also support the industry in raising energy efficiency standards for new-build housing.

Retrofitting existing buildings will require a massive mobilisation of resources. National government must ensure that there is the right support to drive the scale and pace of activity required.

Decarbonising heat – Heat networks

The Northern Powerhouse is among the strongest regions in the UK in terms of adoption of heat networks. The sector will play a leading role in heat decarbonisation as the UK progresses towards its Net Zero targets as renewables replace traditional gas-fired boilers. The Northern Powerhouse also has a diverse range of sources of heat to draw on for deploying different technologies, although some of these, such as mine water, geothermal, and to an extent waste heat from industry, have natural limits. As a solution heat networks are also less suited to rural areas where homes and businesses tend to be more spread out.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
+ Strong existing deployment + Strong LEP ambition + Diverse sources	+ Growing market with government support + Strong potential for heat decarbonisation – Potential limitations on scale	+ Ambition/relevance across most LEPs + Consider as wider programme for heat decarbonisation + Solutions tend to be locally specific

Where are we now?

Heat networks have the potential to deliver lower cost and lower carbon heating – however they are most likely to be suitable in towns and cities and where there are existing potential sources of heat

The region already has significant existing networks of long standing. For example, Sheffield's heat network has been in place since 1989 and currently has 45km of pipework.

Several LEPs have already begun to deploy heat networks, particularly in urban areas where the business case is most robust. LEPs mentioning heat networks in their local energy strategies include Greater Manchester, Sheffield City Region, Leeds City Region, towns and cities in the North East LEP and also the Tees Valley LEP with the Middlesbrough district heating scheme.

In terms of heat networks based on combined heat and power (CHP), the Northern Powerhouse is a UK leader. In 2017, the Northern Powerhouse had 648 CHP schemes, generating 20,612GWh of heat - almost half of the UK CHP heat production total of 42,238GWh.

Industrial areas also have potential for recycling waste heat from industry for use in heat networks in the local area. The North East LEP is working with colleagues in Sheffield and Scotland to use substantial geothermal resources within abandoned flooded mines to help commercialise low carbon heat.

In terms of policy, the government is currently working towards a national framework for heat network regulation to ensure can benefit from effective competition.

Where could we be in 2032?

A majority of LEPs have significant ambitions for developing heat networks within their own areas. In some places this includes linking heat networks and engaging new forms of thermal storage or heat sources, such as geothermal and mine water.

The North East LEP aims to take steps to commission studies investigating how to de-risk and commercialise district heating as a strategic growth sector.

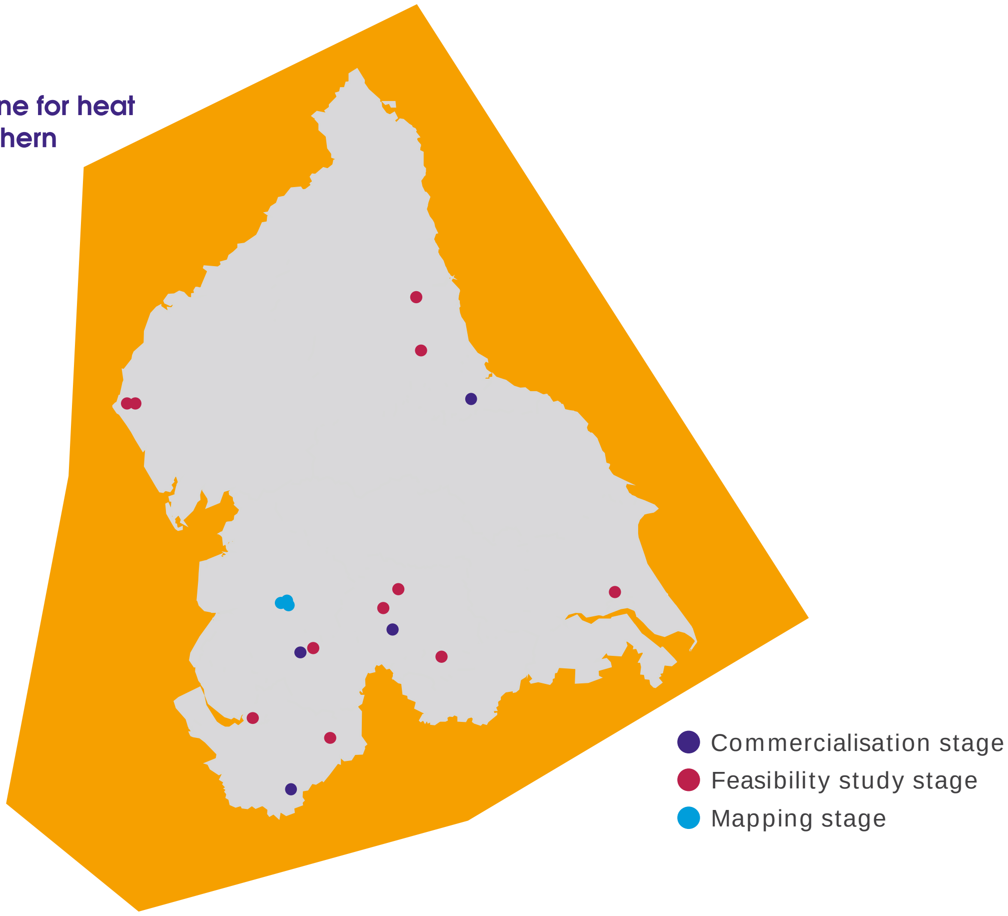
Potential scale

Heat networks are expected to grow substantially nationally and the Northern Powerhouse has some unique and diverse resources to draw upon. Heat networks are projected to meet 17% of heat demand in homes by 2050 in the government's Clean Growth Strategy, with £16 billion investment potentially required to deliver this. The government is currently taking action to grow the heat network pipeline (BEIS, 2018).

However, there may be limitations on scale, depending on the future of hydrogen as a heating source and also because heat network projects are difficult to execute from a financial and engineering perspective.

Nevertheless, the Northern Powerhouse is

Map of future pipeline for heat networks in the Northern Powerhouse



Source: BEIS Heat Network Delivery Unit Project Pipeline Q2 2019

home to some unique resources. For example, over 30% of the UK's coalfields are in the North of England, creating scope for this resource to be exploited. The Coal Authority estimates that there is 11MW of geothermal heat available below Sheffield, which could be deployed through heat pumps using mine water.

Economic benefits

There are positive economic spill-over effects from the deployment of heat networks that can be leveraged to make use of otherwise wasted resources – such as heat from industrial processes.

District heating development and deployment can lead to construction and operations and maintenance jobs.

The current annual turnover of the UK heat network sector is currently £300 million. This could increase by eight to nine times to meet the heat supply forecast in the Clean Growth Strategy.

Environmental benefits

Environmental benefits vary depending on the source of the heat (fuel). The CCC report on Net Zero (CCC, 2019) notes that only 7% of the heat in heat networks comes from low carbon primary fuel sources. However, in the case of waste heat recovery, harnessing heat in a heat network is always more efficient than wasting it.

The CCC fifth carbon budget found that low carbon heat networks would make a cost-effective decarbonisation option for 1.5m homes to 2030, across the UK. There are currently 446,517 connections across the UK (CMA, 2018).

What is needed to embrace these benefits?

With heat networks being a technological opportunity for all LEPs, there is scope for sharing expertise on delivering industrial heat networks and installing heat networks to heat new housing developments.

As the government seeks to develop a national policy framework for heat networks, the NP11 could be an effective forum for influencing national policy.

Holistic approaches to decarbonising heat which consider local and regional specifics, such as availability of high-density housing, or sources of waste heat, are needed to reveal most suitable and economic solutions for decarbonising. Heat networks may not always be suitable in, for example, rural settings.

Decarbonising heat – Electric heating

Electric heating, particularly air-source heat pumps, has potential to decarbonise heating in areas that are off the gas grid or hard to reach by heat networks, thus providing a valuable contribution in the drive towards Net Zero. There are currently cost limitations and also limited opportunities for pan-Northern collaboration on electric heating in isolation.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Strong deployment in some LEPs – No specific targets in other LEPs	+ Viable and proven technology + Significant proportion of off-grid homes – Cost barriers, including network – Higher proportions of off-gas homes could benefit	– Local delivery most likely + Consider as wider programme for heat decarbonisation

Where are we now?

Air source heat pumps (ASHP) have been deployed to differing extents between LEPs. For example, heat pumps produced 2,844MW of heating energy in the Lancashire LEP area.

Several projects and installations have been developed under the renewable heat incentive.

LEPs such as York, North Yorkshire and East Riding, and Cumbria have a higher than average proportion of properties off the gas grid, making such buildings clear use cases for electric heat technology.

Where could we be in 2032?

ASHP are discussed in some of the LEP energy strategies, such as Greater Manchester and Lancashire.

While there is no significant deployment of electric heating assets, all LEPs are targeting future roll-out of heat pumps – or at least consider the potential of the technology – within their energy strategies.

Some urban areas with service economies, such as the Liverpool LEP area, discuss electric heating as a potential optimum solution for facilitating automated energy management.

Potential scale

Electric heating will be a key technology in the decarbonisation of the UK heat sector, either through heat pumps or smart electric heating in homes with space constraints. The exact scale of deployment is unclear at this stage, and clarity will only come as the government clarifies its heat decarbonisation strategy, and the role of hydrogen in particular. The CCC's central scenario for the fifth carbon budget assumes heat pumps in 2.3m UK homes by 2030.

Economic benefits

Localised installation of ASHP and associated technology can create employment. If value chains can be captured locally this is a positive.

Manufacturing of ASHP products may be an opportunity, but it will be small if the national uptake of this technology is limited.

York, North Yorkshire and East Riding LEP discusses the value of heat pumps being installed by local skilled tradesmen. The value of installing heat pumps in all 30,000 off-gas houses in North Yorkshire is expected to be in the range of £60-240 million.

Environmental benefits

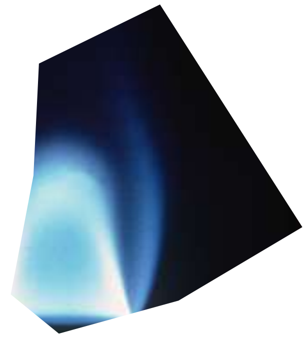
With the carbon intensity of the electricity grid continuing to reduce, electric heating forms an environmentally friendly heating alternative. Where electric heating replaces on-site diesel or oil combustion as an energy source (quite common for off-gas grid premises), this has a significant positive effect on the environment.

What is needed to embrace these benefits?

There is strongest scope for electric heating to be considered alongside hydrogen and heat networks as part of a wider project to decarbonise heating. Sharing best practice, approaches, data and knowledge will be the best opportunity for pan-Northern collaboration in this area, rather than considering electric heating in isolation. ASHPs are a modular technology and local delivery is best.

A significant shift towards electric heating would require further reinforcement of the electricity network in order to meet demand. Joined up planning will ensure optimal levels of investment.

Decarbonising heat – Hydrogen



While hydrogen is not the only low carbon gas and while some LEPs have a focus on biomethane, the Northern Powerhouse is a clear strategic leader in this sector. There is strong LEP ambition to invest in hydrogen. There is certain growth in use of hydrogen for heat, but uncertain magnitude. Likely use of H_2 as low carbon fuel brings clear commercial opportunity. The benefits case is currently contingent on the production method, with further efficiencies required in the production of hydrogen via electrolysis for it to become truly commercial in the UK. There is a clear case for competitive advantage in the North due to its existing hydrogen production capabilities and proximity to bulk renewable production.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
◐	●	●
+ High proportion of UK H_2 supply + Home to key hydrogen trial projects	+ Clear commercial opportunity – Some uncertainty on scale	+ NP11 potentially to be leader in hydrogen + Regional synergies across hydrogen, industrial clusters and CCUS

Where are we now?

The Northern Powerhouse contains three steam methane reformers (SMRs), used to produce hydrogen fuel. The Tees Valley LEP area currently produces around 50% of the UK's hydrogen. The Liverpool City Region LEP area also contains a large chlor-alkali hydrogen producer.

The geological conditions onshore and offshore provide space for hydrogen storage at scale.

Offshore renewable assets and future developments are an opportunity to utilise renewable energy to electrolyse hydrogen and store the energy.

There are existing demonstrations and trials in the North, such as the H21 project, which are at the forefront of understanding the scale of the hydrogen opportunity nationally and globally.

Where could we be in 2032?

There are ambitions in the LEP strategies to develop systems for hydrogen as a fuel source.

Hydrogen has already stimulated cross-LEP cooperation, for example between Cheshire and Warrington LEP, Greater Manchester LEP and Liverpool City region LEP, exploring the use of hydrogen as an alternative fuel for industrial use.

Humber LEP aims to develop a hydrogen task force in the region, working with potential industrial partners such as British Steel, VPI, Drax, National Grid and Equinor.

Tees Valley LEP has formed the decarbonisation leadership group linking CCUS, renewables and hydrogen to decarbonise industrial and domestic heat and transport.

Potential scale

The CCC report on hydrogen in a low carbon economy (CCC, 2018) discusses hydrogen having a part to play in the future decarbonised energy system, providing a molecular fuel for heat, heavy transport, industrial use and replacing natural gas in peaking plant electricity generation plant.

However, CCC forecasts for UK hydrogen consumption in 2040 range from roughly 50 to 400TWh, depending on which pathway is taken.

Economic benefits

There are potentially significant economic benefits from the use of hydrogen as a low carbon heating source, if gas networks do not require a high amount of investment to repurpose.

The growth of a global market for hydrogen fuel systems could present a export opportunity for LEPs who are moving quickly into the sector, however the development of an international hydrogen market is both long term and uncertain. The most ambitious scenarios for hydrogen use by 2050 comprise only 8% of global energy demand.

Siting hydrogen production near coastal CO_2 storage facilities will decrease costs, for example on the North East and North West coasts (Element Energy, 2018).

Environmental benefits

The relative environmental benefits of hydrogen depends on the viability and cost of CCUS. Different hydrogen production methods have different costs and CCUS is required to fully unlock the environmental potential of hydrogen.

Gas reforming with CCUS to produce hydrogen is not zero carbon but it reduces lifecycle emissions when compared with unabated natural gas by 60-85%.

On the other hand, using renewable energy to produce hydrogen through electrolysis is carbon free but currently expensive. However, UK H_2 Mobility estimate that by 2030 electrolysis could produce roughly 50% of the hydrogen in the UK (UK H_2 Mobility, 2013).

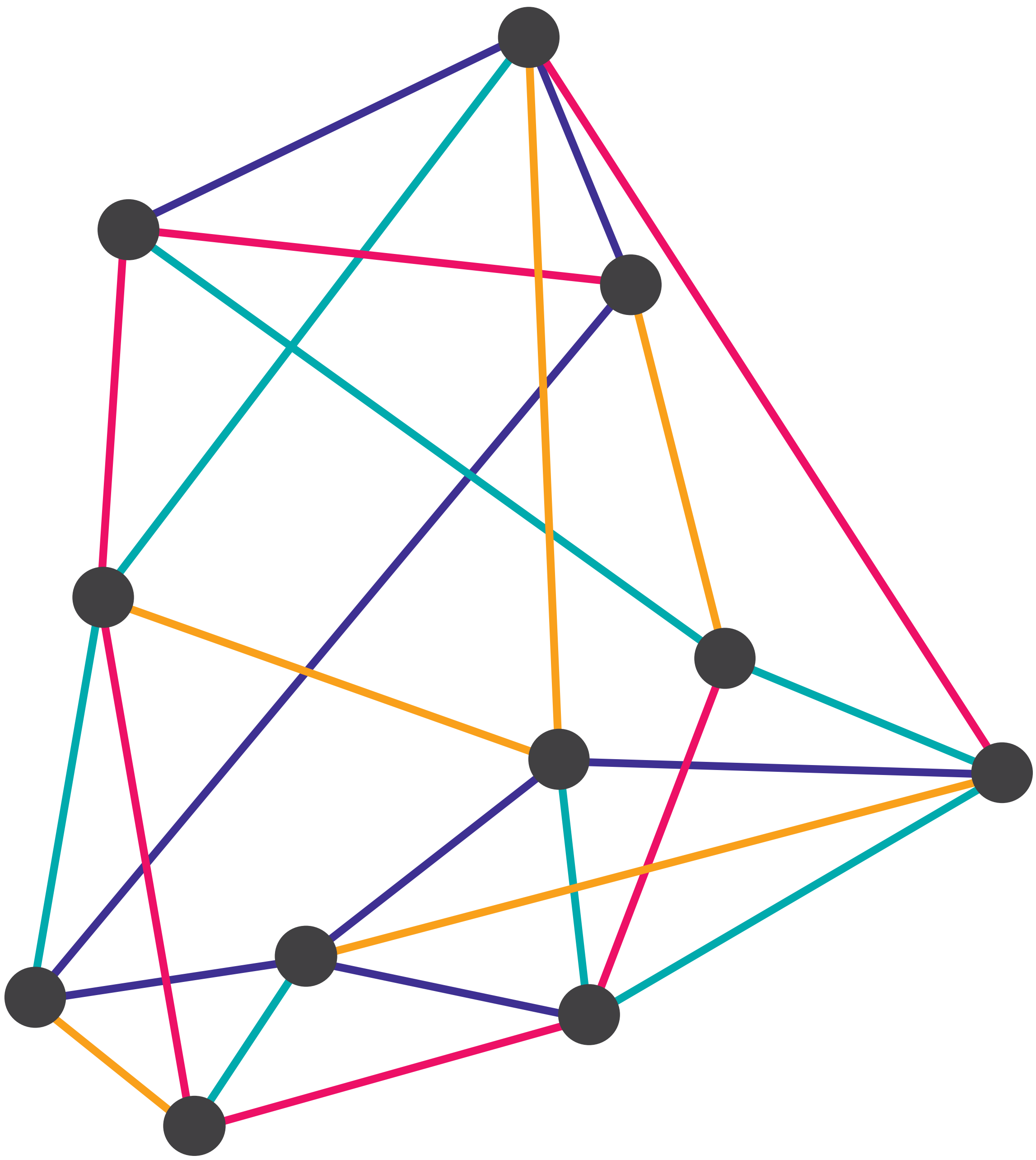
What is needed to embrace these benefits?

Investing in hydrogen represents an opportunity for the NP11 to position the Northern Powerhouse as a leader in developing an integrated hydrogen economy.

The overlap of industrial clusters and geological or salt cavern based storage gives clear synergies for hydrogen production and could be an advantage for the North. Further opportunities could arise from sharing resources in developing CCUS between heavy industry and hydrogen production.

Cooperation to produce investable projects could increase direct investment in the region.

Leadership could increase the opportunity for the NP11 to influence government policy and create a positive feedback loop for hydrogen business in the region.



Decarbonising transport – Electric Vehicles

Electric vehicles (EVs) will play a major role in the decarbonisation of passenger transport and the achievement of Net Zero. In order to ensure that the North does not get left behind in the transition, the NP11 must work collaboratively to facilitate the move to EVs, in particular by supporting infrastructure rollout, in particular channelling appropriate funding to hard to reach rural areas. The North is well positioned to take advantage of the shift to EVs given existing supply chain strengths.

Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
+ Centre for development of EV technology – Deployment below average – Particular challenges for charging infrastructure	+ Transition to EVs most viable way of decarbonising passenger transport + Clear government intent to phase out petrol and diesel vehicles by 2040 - Challenges ensuring economic viability of rural infrastructure	+ Significant opportunities to rationalise charging network + Collaborate on developing suitable common standards for charging infrastructure in new housing developments

Where are we now?

Charging infrastructure is nascent but growing across the North, sometimes coordinated by public bodies. However, the large rural areas in the region make the installation of charging points more challenging and can reduce the commercial viability of EVs.

Several LEPs have opportunities to produce components in the supply chain for EVs or batteries, such as the production of graphite coke in the Humber LEP area. Another example is the North East LEP area which produces just over a quarter of European Light Commercial Vehicles (LCVs), with significant investments in battery technologies and private sector innovation investment e.g. Hyperdrive Innovation clustered around Sunderland.

Several small scale trials are taking place on charging technology, such as vehicle to grid applications being trialled by Nissan and Northern Powergrid.

Public sector bodies in several LEPs have taken a lead by beginning to electrify their own vehicle fleets.

Electricity grids in the region are also taking the lead on developing an understanding the impact of EVs on their networks. The £8.5 million ‘Charge’ project run by SP Networks and sponsored by Ofgem is a key example of this.

Where could we be in 2032?

The NP11 LEPs have ambitions to deploy EVs, with some public bodies having targets to electrify their vehicle fleets, such as in Cumbria and Humber LEP areas.

Several LEPs also aim to further develop more wide-scale charging infrastructures in future. Liverpool LEP, for example, states an aim to develop one of the best charging networks in the world.

Several other LEPs aim to pursue further research and understanding of how to adapt electricity and transport systems to the growth of EVs, such as Cheshire and Warrington and York, North Yorkshire and East Riding LEPs.

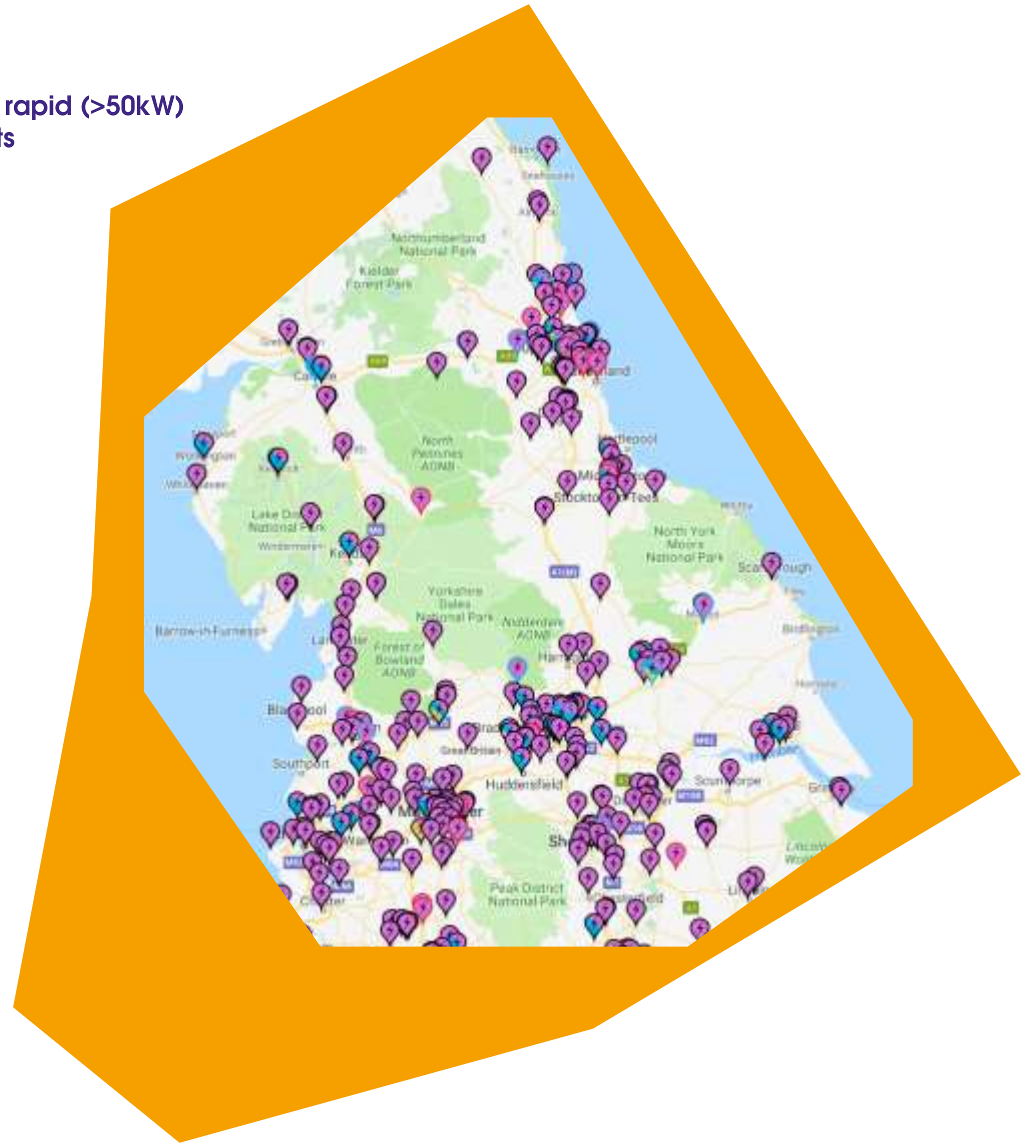
Existing investment in battery technology in the region could deliver a first mover advantage in a growing global market and represent significant export opportunities.

Potential scale

The economic potential of the future mobility market is significant. KPMG estimates the global value to be more than US$1 trillion by 2030 (KPMG, 2019).

This market has already been accessed by the North, with the Nissan Leaf (the world’s most popular electric car model) being manufactured in Sunderland.

Existing public rapid (>50kW) charging points



Source: ZapMap

Because the Northern Powerhouses has large rural areas, there may be a role for LEPs and local authorities to aggregate demand for these to develop investable projects.

Economic benefits

EVs are a global growth industry, creating opportunity for manufacturers to export if they have a competitive position in battery or vehicle supply chains.

The nature of EV charging infrastructure as an enabler for up-take of EVs themselves means that as more infrastructure is rolled out, it will become easier for consumers to use EVs. This will lead to further demand for charging infrastructure. This positive feedback loop and the potential huge scale of EV rollout presents an economic opportunity for those in the business.

Environmental benefits

In 2016, the transport sector consumed 28% of total final energy consumption in the North. 99.7TWh of energy came from petroleum combustion to meet this demand. This resulted in 28.2Mt CO_2 emissions in 2017.

There are significant improvements in air quality to be had, with concurrent positive impacts on health.

Transport is a major source of carbon emissions meaning that its decarbonisation is essential and EVs are the key technology for achieving this.

EVs could potentially provide increased flexibility to the electricity grid, acting as mobile batteries and facilitating a growth in renewable generation.

What is needed to embrace these benefits?

Having a coherent strategic view across the Northern Powerhouse will be needed to plan charging infrastructure, particularly in rural areas to avoid under or over provision. As discussed above, aggregating demand in more rural areas may assist with developing investable projects.

Cooperation is beneficial to make sure investments are economical and make sense given the development of charging technology in the future.

Since EV roll out will be a nationwide priority as the 2040 ban on new petrol and diesel cars approaches, coordination between NP11 LEPs in influencing government will be valuable to ensure continued commitment to funding.

Developing shared standards for infrastructure could be beneficial and provide certainty to project investors.

Decarbonising transport – Hydrogen (and alternative fuels)

The use of hydrogen is a potential means of decarbonising heavier modes of transport, including public transport and freight. The North has been leading on the demonstration of the viability of hydrogen conversion. Decarbonisation of hard to reach transport such as marine can also benefit from the North's strength in biofuels. This will make the achievement of the UK's Net Zero targets much easier. Policy clarity will be required from government in order to enable conversion of transport at scale. Similarly, the viability of biofuels relies on policy changes to allow higher percentages of ethanol in fuel mixes.

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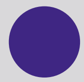
Summary of pan-Northern potential

Pan-Northern strength today	Pan-Northern opportunity tomorrow	Scope for pan-Northern collaboration
		
+ Leading the way on demonstration of hydrogen for transport + Existing strengths and home of innovation in biofuels	+ Hydrogen is a potential way to decarbonise heavier modes of transport - Hydrogen and biofuels dependent on policy support	+ Synergies with wider hydrogen investment in the North + Potential for supply chains across the North

Where are we now?

As is the case with hydrogen for heat, several LEPs are developing hydrogen production assets and infrastructure in anticipation of hydrogen growing as a future fuel source.

Strong research and development projects are contributing to solutions for the transport sector as well as heating. For example, ITM Power in the Sheffield City Region LEP area is a leader in developing hydrogen for fuel cell vehicles through electrolysis.

Using hydrogen as a fuel for vehicles, in particular public transport, has been trialled in LEP areas such as Tees Valley and Cheshire and Warrington.

There is also potential for using biofuels, an area in which the Northern Powerhouse has traditionally been strong, with two of the largest bioethanol plants in Europe (Vivergo in Hull, Ensus in Tees Valley), and the Ellesmere Port facility in the Cheshire and Warrington LEP area. The success of the sector is highly dependent on appropriate levels on prevailing policy: the Vivergo plant is currently mothballed due to lack of policy certainty.

Where could we be in 2032?

There are clear ambitions for alternative fuels and use of hydrogen in transport – these are linked to the existing hydrogen production base. There is ambition to develop hydrogen as a fuel source, particularly in the form of installing fuelling infrastructure and using hydrogen to decarbonise public transport. One example of this is the Tees-Leeds hydrogen corridor that will provide hydrogen infrastructure between the two regions for transport, domestic heating and industrial use. These transport based opportunities are identified primarily by Leeds City Region LEP (particularly through the H21 Project and hydrogen corridor), Sheffield City Region LEP and the North East LEP.

Potential scale

Hydrogen as a fuel source is unlikely to overtake EVs overall but it may be useful for some transport. The use of hydrogen fuel cells could be highly viable for buses or trains, due to 'return to base' fuelling reducing the need for hydrogen infrastructure development. In addition, hydrogen fuel cells can be a more suitable fuel for heavy goods vehicles, rail or other freight transport due to their higher energy density than current battery technology.

Refuelling stations would need to be rolled out from the 2020s for a viable hydrogen HGV system, developing 350-400 by the mid-2030s from 65 today (CCC, 2018).

The EV sector is further ahead, with 7,000 public charging locations in the UK and more than 50 models of car available, compared to two hydrogen fuel cell models.

Economic benefits

Hydrogen and other alternative fuels for transport are likely to be an emerging market, but there are clear economic opportunities. A growth in the hydrogen transport sector could opportunity to develop supply chains provide economic across the North. For example, studies conducted for the North East LEP suggest hydrogen production for transport could yield cumulative revenues of around £850 million between 2020-2030 (E4tech, 2014).

Environmental benefits

Hydrogen fuels have potentially strong decarbonisation credentials, particularly for heavy transport. In 2016, the transport sector consumed 28% of total final energy consumption in the North. 99.7TWh of energy came from petroleum combustion to meet this demand. Hydrogen fuelled vehicles would substitute these emissions and are more mechanically efficient.

Hydrogen has a higher energy density than batteries, making it a strong option for decarbonising heavy transport. Avoiding the use of diesel in heavier transport modes will have significant positive impacts on both carbon emission and local air quality.

As with using hydrogen for heat, the full environmental impacts are contingent on the technology used to produce the hydrogen itself.

What is needed to embrace these benefits?

Strong synergies with wider hydrogen investment in North. Since transportation infrastructure naturally crosses boundaries between LEPs, there is a clear case for coordinating infrastructure investments in this area.

Hydrogen for transport should be viewed as a component of a wider hydrogen economy, the successful development of which in the Northern Powerhouse will require cooperation between the NP11 LEPs. The production of hydrogen should be joined up’with centres of transport demand. Advantages are also shared between hydrogen for transport and hydrogen for heat.

In addition, increased political support could improve the importance of bio-fuels in energy strategies, but this may require coordination between the NP11 LEPs to influence policy and so requires a desire from LEPs to deploy resources in this area. As part of this, the government needs to take action on legislation for the percentage of fuels that can be made up of ethanol. Currently the E5 standard is in place (up to 5% ethanol in the mix) but the industry (and Humber LEP) support E10 (up to 10%). Lack of parliamentary time and other priorities have stalled progress on this issue. The introduction of E10 would allow the bioethanol industry in the region to return to a position of growth.

06

Enabling factors

- Utility networks and smart grids
- Innovation, research and skills
- Green finance
- Local governance, policy and planning

Enabling factors – overview

As outlined in the previous section, the Northern Powerhouse LEPs have multiple opportunities to act together to maximise the benefits from clean growth. As well as specific actions the NP11 can take in relation to each opportunity, there are also a series of cross-cutting ‘enablers’ which can create the right conditions for clean growth. In this section we cover four key enablers – energy networks, green finance, innovation, and governance and planning. The key messages are summarised here, with more detail on each on the pages which follow.

Enabling factors are key to ensuring clean growth

- Networks will be a key factor in decarbonisation- see gas networks’ leadership role in H21 and Hynet
- Coordination between gas and electricity networks will facilitate whole system planning and the transfer for energy between vectors through solutions like power-to-gas
- Investment from global sources of capital will be required to make the shift to a low carbon economy
- Given the scale of investment, continued cost reduction is key, so the region’s considerable research and development (R&D) strengths will need to be leveraged
- A stable planning regime is needed to ensure project pipeline and consistent standards across the Northern Powerhouse
- In the RIIO2 price control period, a key requirement for network companies will be to work with local authorities to coordinate infrastructure investment and delivery to facilitate decarbonisation

National policy context: clean growth and industrial strategies, sector deals

- Onshore wind deployment is currently frozen at a national level due to lack of CFDs and planning restrictions
- Differing planning requirements and processes across regions can act as a barrier to businesses capturing economies of scale when operating across the region, increasing costs and limiting potential benefits of deploying new technologies
- Directing financing towards strategic priorities for clean growth can be challenging at a LEP level where there are limited directly controllable funding sources
- Disseminating the knowledge and skills developed in specialist research hubs across the region and fostering regional collaboration between hubs can be hampered where innovation funding at national level is allocated on a ‘one-winner-many-losers’ competitive basis
- Getting new connections to the utility network can be slow and expensive, delaying or deterring investment in new businesses and developments

Priority actions for NP11

- LEPs input to networks' whole systems thinking and identification of future needs, and engage with regulatory environment
- Organised, cross-LEP energy project portfolios which maximise chance of attracting investment, and allow investors to identify complementary projects
- Build on existing LEP/UK government capabilities to showcase NP11 energy projects for overseas investors
- Ensure building regulations are as standardised as possible to create level playing field across region for developers
- Joined up thinking to ensure R&D is in tune with both regional and local needs
- Leverage expertise and know-how of regional early adopters to ensure project learnings are captured across region

Priorities for government:

- Review current constraints on onshore wind, with a view to maximising the North's potential in this area
- Ofgem's RIIO framework for regulated energy networks needs to balance efficiency and fair returns with incentives for innovation, and to provide sufficient flexibility to be responsive to local and regional needs

Utility networks and smart grids

RIIO2 needs to provide the energy networks with the right balance of incentives on investment and innovation to drive them to meet the demands on NP11's clean growth ambitions.

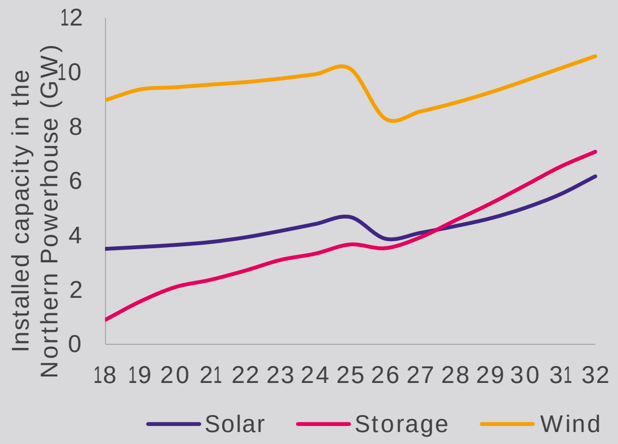
To realise the full benefits of the energy transition, both economic and environmental, it is vital that the energy networks provide the capacity and services consumers and businesses need, where and when they need them and at a fair cost. As the technologies using the system change – both generation and demand – the utilities will need to change they way that they operate. This applies not just to the physical system, but also the way the network businesses run themselves.

Where are we now?

Electricity

Deploying smart grids – adapting to changes in supply and demand on the electricity distribution network known – in practice is about the networks using digital solutions to monitor and manage the system more effectively, allowing them to connect new customers more cheaply and more quickly. It is also about the networks making use of non-network solutions such as demand side response (DSR) and storage to manage the system more efficiently. The electricity networks need to develop these capabilities to keep pace with the growth in both demand (fig. right) and connection of distributed renewable energy (fig. below).

Distribution connected generation is set to grow through 2032



Source: National Grid Future Energy Scenarios 2019

The Northern Powerhouse is well positioned in the development of the smart grid approaches. Several research centres exist which are trialling new energy technologies and solutions. Key examples of innovation hubs include:

- NEDO smart heat project in the Greater Manchester LEP area
- The Smart Grid Lab in the North East LEP area
- The National Centre for Energy Systems Integration (CESI) at Newcastle university, which is being used by Northern Powergrid to develop smart grid solutions which may be rolled out across the region in future
- Smart grid demonstration project at the University of Chester
- National Renewables Energy Centre in the Tees Valley LEP area

The region will also play host to the new North Sea Link interconnector connecting the GB and Norway systems. This will come ashore at Blyth and is expected to be commissioned in 2021. This will increase the security of energy supply in the UK, and offer the potential for synergies with other supply chains such as those related to the offshore wind sector.

Gas

For gas networks, the trend in decentralised gas generation is less significant. However, anaerobic digestion plants producing biomethane are often distribution connected, which may require changes to the way networks are operated in the coming years. At present, this is not expected to represent a change or challenge on the same scale as for electricity. Nevertheless, the gas networks will have an important role in enabling distributed gas technologies to play their role in the future energy mix.

There is also a possibility for the gas networks to be adapted for transporting hydrogen as an alternative source of heat and transport (see Section 5). The Northern Powerhouse is at the forefront of current work to understand the scale and practicalities of hydrogen conversion. Through projects like the H21 and Hynet, the gas networks in the Northern Powerhouse are well placed to understand their role in enabling and responding to future changes.

Where could we be in 2032?

LEP strategies include several examples of initiatives beginning to achieve this. For example, in the York, North Yorkshire and East Riding LEP, the York smart city plan is aiming to upgrade infrastructure across the city with digitally enabled energy technologies, potentially showcasing the role of smart technology in the 2032 power system. This opportunity will grow in the coming years as smart meters become fully deployed across the system along with 5G telecommunications infrastructure.

LEPs will also be supported by policy at a national level. BEIS and Ofgem are working towards a national transformation of the electricity network through the Smart Systems and Flexibility Plan. The Clean Growth Plan also commits the government to investing £70 million before 2022 to promote smart grid technology.

Improving the power networks will deliver significant economic benefits for the Northern Powerhouse and reduced carbon emissions. Distribution Network Operator (DNO) investment to develop smart grids will return an estimated 1-3% GVA growth rate in the Northern Powerhouse up to 2050 (KPMG, 2017). A more flexible system can work to reduce emissions by facilitating more renewable generation.

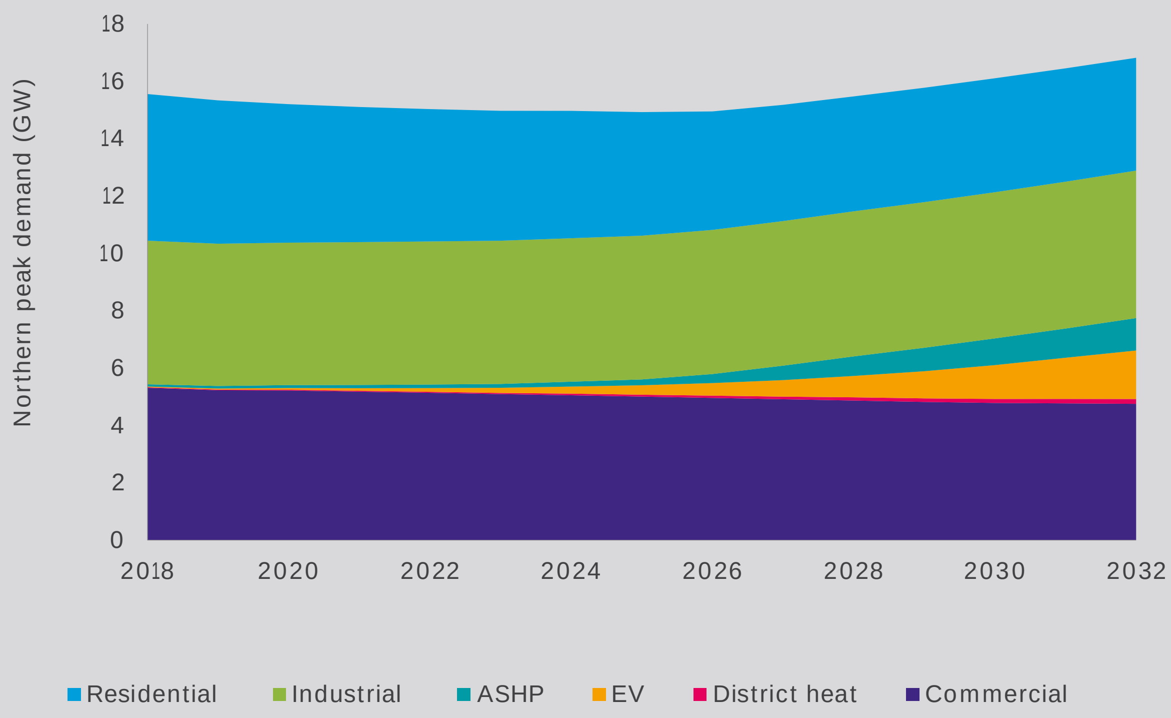
What is needed to achieve the 2032 vision?

The RIIO2 price controls for the electricity and gas networks need to balance driving efficiency and fair financial returns with appropriate incentives for network innovation. The framework also needs to provide the networks with sufficient flexibility and incentives to be responsive to local and regional needs.

Beyond this, the LEPs have a key role to play in coordinating the DNOs, gas distribution networks and project developers (and potentially other utilities such as water and telecoms) in the Northern Powerhouse to ensure that new connections and new services are delivered at a low cost and with reduced risks. This can include working together to provide the networks with visibility of the pipeline of projects to enable forward planning.

Where LEPs are working to support the demonstration and scaling of new technologies, including energy storage, EVs, steps to involve or share learnings with the networks will help to avoid potential blockers to roll out.

Peak electricity demand is set to increase with new technology



Source: National Grid Future Energy Scenarios 2019

Innovation, research and skills

Allocation of funding for research and innovation needs to reward collaboration and dissemination of knowledge and skills across the region.

Innovation and skills are intrinsically connected in the modern economy. This is because the development of knowledge relies on research produced by highly skilled individuals, which is then shared to develop others. For this reason, coordinating and investing in the North's unique and highly developed tertiary education and R&D sector is crucial to unlocking the potential of clean growth. Investing in upskilling across the work force is also essential, ensuring that the Northern Powerhouse can continue to compete and remain an attractive place for businesses to invest. LEPs have a key role to play in supporting SME growth, particularly in the low carbon sector which is identified as a priority by the NP11.

Where are we now?

Innovation

The Northern Powerhouse has strong innovation facilities and assets across the region, as evidenced in all LEP Energy Strategies.

Different local areas are leading in different aspects of technical innovation and have different skills profiles. For example, nuclear innovation is a particular priority for LEPs such as Cheshire and Warrington, Cumbria and Lancashire, and from 2020 the Sheffield City Region LEP. In particular, the development of nuclear engineering technology to produce advanced modular reactors is discussed as a rewarding area of current research. Developing cost effective CCUS, essential for several other components of the future low carbon economy, is also a core innovation objective, particularly within LEPs such as Humber and Tees Valley. There also leading innovation centres in the region on battery technology, with the Sheffield City Region hosting the Centre for Research into Electrical Energy Storage and Applications (CREESA). The ORE Catapult in Blyth area is an internationally unique test centre for offshore renewable energy research.

There is a broad range of other technology areas being pursued across the Northern Powerhouse within corporate R&D functions, accelerators and university labs. In the North East, universities such as Durham and Newcastle have developed research centres/ institutes to tackle challenges related to the energy sector. In addition, network companies such as Northern Powergrid and Northern Gas Networks have set up testing facilities for new technologies to tackle the UK's energy challenges. Research areas relating to energy and clean growth include vehicle to grid technology, battery storage, micro grids and digital energy management.

Skills

Addressing the growing skills gap in the energy sector also presents an opportunity to upskill workers and deliver jobs in the North.

The Northern region faces higher than average unemployment and too many people remain excluded from the labour market due to a range of socioeconomic factors. Investing in clean growth is one component of what must be a multifaceted response to these problems, driven by the NP11, individual LEPs and by central government.

The energy sector also faces a significant risk of large proportions of the workforce retiring in the near future – a trend reflected across manufacturing, energy, construction and transport sectors. There is a role to play for regional bodies to deploy resources for training young people to join the energy sector, particularly leveraging government support through the apprenticeship levy.

Where could we be in 2032?

Innovation

Innovation is vital to decarbonise the economy, with support from businesses and government increasing to meet the challenge. The Northern Powerhouse can build on its existing strengths to take advantage of this trend. In particular, aggregating the current innovation capabilities (mentioned above) could potentially bring wider benefits, creating a 'northern asset' as the North East LEP has started to consider through ongoing work on energy systems integration and offshore systems development.

Other sectors – and the associated economic and environmental benefits - discussed in this report rely on innovation for their potential to be achieved. Hydrogen infrastructure for heat and transport, as well as carbon capture and storage, are both sectors which are highly contingent on continued support for innovation.

In addition, there are wider UK initiatives that the Northern Powerhouses could benefit from. This includes the wider 'Industrial Strategy', which not only provides funding to specific projects across the country through its Industrial Strategy Challenge Fund, but also sets out 'grand challenges' to focus on to put the UK at the forefront of the industries of the future. Part of this is focused on clean growth and maximising the advantages for UK industry from the global shift to clean growth.

Skills

Several LEPs have regional skills strategies aimed at supporting the sectors which provide opportunities in their region. By 2032 the energy sector in the Northern Powerhouse could be continuing to provide high labour productivity and creating jobs at a range of educational or skill levels. Future employment will include demand for skills ranging from technicians employed in installing solar or air source heat pump technology, to researchers based in the high tech innovation clusters.

What is needed to achieve the 2032 vision?

LEPs have an important role to play in acting as an intermediary between educational institutions and the businesses located in the region. Ensuring that commercial needs for skills in the region are met will both increase employment levels, economic growth and support the energy transition.

The NP11 should explore the scope for regional programmes for developing skills that complement local plans. The aim of a regional programme would be to ensure that expertise from the developing specialist research and innovation hubs can be disseminated across the region - enabling ideas and innovation to spread and new clean growth sectors to grow beyond R&D and/or highly localised deployment.

The NP11 can also support innovation in their regions through collaboration with local start-ups, technology developers and research institutions. Bringing together the right mix of skills and providing resources is an essential prerequisite for new technology, and reaching across LEP boundaries will accelerate this process.

Funding for research and innovative trial projects, particularly where allocated from central government, is frequently structured as a competition with one winner and many losers. This can act to inhibit collaboration between research centres across the region – resulting in loss of synergies or slower development of mature solutions.

Green financing and funding

Accessing the right quantities, sources and types of finance will underpin clean growth in the North and across the UK. Green finance is also a rapidly expanding sub-sector of finance, with new asset classes and investment strategies being designed to deliver low carbon infrastructure and support responsible businesses. The NP11 are well positioned to coordinate access to both public and private finance for business within their area and harnessing this trend will accelerate clean growth across the region.

Where are we now?

The Northern Powerhouse has strong innovation facilities and there are a range of public finance sources available which LEPs can act to increase regional access to by coordinating bids:

- Devolution deals for some combined authorities
- UK shared prosperity fund
- Industrial Strategy challenge fund
- Heat network delivery project/ Heat network investment fund
- RHI/ CFD schemes
- Industrial heat recovery scheme
- Salix Finance (public sector energy efficiency)
- Innovate UK
- Public works loans board (issues loans to local authorities)
- Horizon 2020 R&D funding
- BEIS energy entrepreneurs scheme

Direct private investment is also required to develop capital intensive assets, for example offshore wind farms. The NP11 LEPs are currently exploring a range of approaches to unlocking this form of financial support for projects. As the energy transition develops, private capital will be essential to achieve the scaling of technologies required for successful clean growth.

One approach LEPs are pursuing is developing green bond business models, enabling local authorities or LEPs to raise finance for projects with an environmental benefit by selling bonds on the financial markets. For example, Leeds City Region LEP plans to develop a green bond business model. LEPs are also reducing the information barriers to investment by building investment prospectuses for energy projects in their region, or even playing a role in aggregating smaller projects (e.g. EV chargers or housing retrofits) to create new commercially viable investment products.

Changes to the ECO energy efficiency scheme in 2017 now also see local authorities having a role in identifying eligible homes. There is an opportunity for LEPs to provide coordination between local authorities as they look to direct energy efficiency investments to households and areas most in need.

In addition to direct private investment, community energy projects have sought to link small scale investors to decentralised energy schemes. However, uptake in the North has been lower than elsewhere in the country.

Local government in the North has a strong record in establishing successful funds to attract private finance into projects with social benefits. Examples include the Social Impact Fund in Warrington.

At a wider regional level, there are significant sources of funding available supporting deployment of investment and infrastructure that support low carbon growth such as the Northern Powerhouse Investment fund. Furthermore, the Borderlands Inclusive Growth Deal shows the ambitions for regionally or locally focussed funds to boost investment in climate and economic growth. Through investment in energy projects stimulated by the Borderlands growth deal, the Borderlands aim to be the UK's first carbon neutral region. Similar aims have been stated by Greater Manchester and Leeds.

Where could we be in 2032?

By 2032, inward investment to the Northern Powerhouse could have made a significant impact in developing and deploying the technologies discussed in this report. The NP11 strategies are the first step in this direction, with the potential for the Northern Powerhouse to set an example in regional coordination to access financial support and new investment mechanisms for low carbon growth.

There is an opportunity to benefit through the wider UK green agenda, with local authorities gaining funding from government to decarbonise specific regions, for example Liverpool City's Mayor has recently submitted its 'Green City Deal' to government to make the city carbon neutral.

Post-Brexit the government has brought forward plans to introduce a Shared Prosperity Fund to replace EU Structural Funding. The aim of this new UK fund will be to support business and employment, and to reduce inequalities between communities. This fund has the potential to drive significant investment in low carbon infrastructure.

What is needed to achieve the 2032 vision?

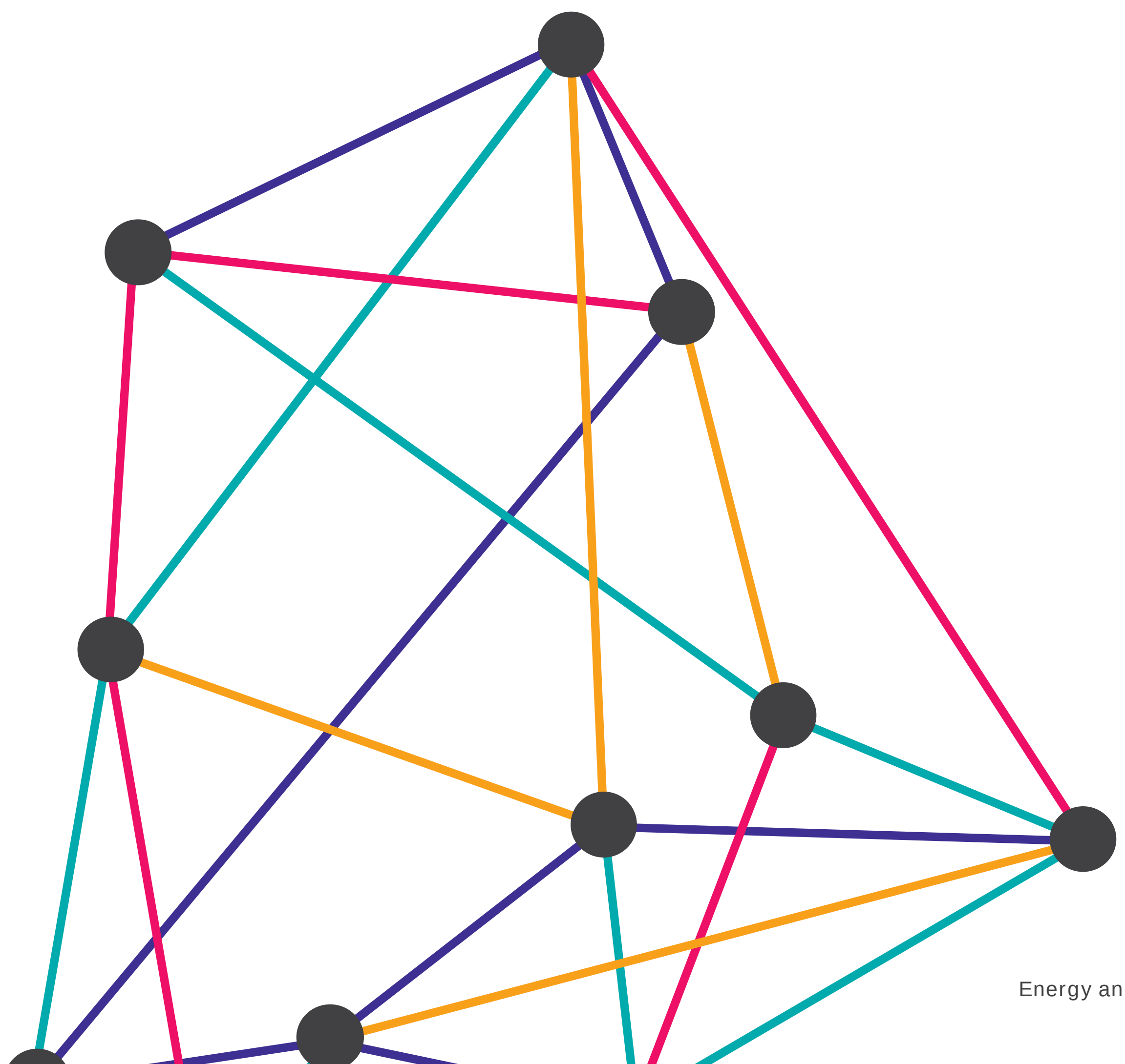
Whilst the NP11 are not principally finance providers, they can act to strengthen the portfolio of investable projects in their region, through coordination of cross-LEP energy project portfolios, and therefore facilitate more inward investment into the North.

The government is also currently consulting on new financing models for CCUS infrastructure and nuclear energy. For NP11 LEPs strategically positioned to take advantage of growth in these sectors, this reform could represent an opportunity.

It will also be important for the government to ensure post-Brexit that the planned Shared Prosperity Fund is brought forward in a way that at least matches the existing EU Structural Funding – or where possible goes further in driving investment in Northern infrastructure.

By 2032, the NP11 could have made headway in unlocking finance for several strategic focus areas, including:

- There is a significant opportunity for financial engineering to unlock the able-to-pay energy efficiency market. Green mortgages are one example of an initiative with this aim
- In working to deliver the local energy strategies, BEIS has provided £4.8 million to establish five local energy hubs across England which will implement energy projects. The North West and North East Energy hubs are successful examples that will continue to function, overseen by the regional LEPs to invest in local projects. This is a model that could be expanded on a regional basis with the cooperation of local business
- Local pension funds could be incentivised to invest in the North. The NP11 could engage with institutional investors like this by developing more coordinated and deep prospectuses of energy projects which have a sound business cases and will deliver local benefits
- The UK government green finance strategy is another significant opportunity for the NP11. For example, the government has proposed to increase GDP investment in R&D to 2.7% by 2027, with clean growth a strategic focus area. Projects within the NP11 could capitalise on this in years to come
- Funding for projects with social impact should increase. There is scope for the NP11 to share learning around where projects with social impacts have been successfully leveraged to unlock finance.



Local governance, policy and planning

Clean growth requires the right mix of central coordination with local action. This report has demonstrated which areas of the transition are best approached on a pan-Northern basis, what the responsibility of central government should be to complement this, and what areas are best further devolved. Establishing the optimal governance structures is a challenge, but it is clear from evaluating the role of different technologies that local factors are the most important factor in determining what gets deployed, where and when.

Where are we now?

The NP11 LEPs are working with local authorities to find way to best leverage planning frameworks to deploy low carbon technologies.

Energy solutions need to be identified and driven locally. For example, the Energy Systems Catapult has worked with authorities in Newcastle and Manchester to develop an approach to local area energy planning that drives clean growth. This approach, as exemplified by the Greater Manchester Infrastructure Framework, emphasises the need for approaches that identify the optimal mix of solutions for an area not just from a planning perspective but cutting across strategic focus areas such as housing. From an energy perspective, this means thinking holistically about generation, transportation, and demand across electricity, transport and heating within a local area.

However, local authorities need to avoid planning approaches, standards and regulations becoming too fragmented and locally specific. There are potential benefits to the region or businesses being able to take advantages of economies of scale by acting across the Northern Powerhouse – including lowering costs and speeding up deployment.

Where could we be in 2032?

One area of importance for local governance and planning is the decarbonisation of heat. Pathways to low carbon heat necessarily rely on different technological solutions for different areas and are also impacted by the rural/urban divide within and between LEPs.

For new build projects, some LEPs aim to increase energy performance standards. Planning requirements for developers to explore options for district heating or electric heating are also a key driver for low carbon heating, particularly with the government policy of restricting the use of gas heating post-2025. LEPs can also play a coordinating role with local planning authorities to standardise the use of smart energy technology in new developments (e.g. microgrids or onsite generation), working with network operators. Holistic sustainability based assessments or checklists can be integrated into planning requirements to achieve this.

A similar approach could be taken for the transport sector, with local authorities and LEPs having a role to play in coordinating the deployment of electric vehicle charging points and hydrogen refuelling stations.

Planning also has a role to play in delivering community owned renewable energy projects, a sector which has been facing challenge since the reduction of the feed-in-tariff scheme.

One of the limitations of using planning as a lever to deliver low carbon technology is that it is necessarily forwards looking only. Retrofitting technology cannot be supported through planning, but local authorities can use other approaches to support this.

The transition to a low carbon economy has the potential to create winners and losers, and a 'two speed' energy system whereby those unable to access new technologies do not enjoy the same service quality and price as those that can. Local government can play an important role in identifying and representing more vulnerable residents.

What is needed to achieve the 2032 vision?

Through common standards where these are appropriate, the NP11 could support development of supply chains – allowing business to produce products and deliver services that can be rolled out at scale across the region – with minimised barriers between local areas which might otherwise arise from varied or diverging standards and requirements.

The NP11 should act together to strategically increase planning requirements with the aim of accelerating low carbon deployment. Increased standards can support more energy efficient houses with the necessary infrastructure to benefit from the growth in EVs and the smart grid.

Requiring renewable generation in new developments, or an equivalent power purchase agreement for assets located off-site, can also support the low carbon sector when applied to commercial developments. This approach should also be explored in the context of heat networks. Deploying planning mandates to guarantee heat offtake from new projects can strengthen the project pipeline by reducing the level of risk faced by developers.

Transport should also be considered from the perspective of local governance in the context of new mobility technologies. Where possible, planning should increase the role of cycling and walking and the use of EVs to reduce air pollution in urban centres. Working to scope the role of hydrogen in decarbonising public transport, particularly buses and potentially rail, should also be pursued.

The energy requirements and priorities of local areas within the NP11 vary by geography, economics and historical strengths. This is most evident between the rural and urban areas of the Northern Powerhouse where technologies with significant potential in one setting, may not be as suitable in the other – for example EV uptake is likely to be most significant, and potentially most advantageous, in urban areas. Conversely, air source heat pumps are potentially more suitable for decarbonising heat in rural areas relative to urban ones.

These kinds of differences imply different priorities for planning and governance arrangements, and demonstrate that there is no one-size-fits-all model that can be applied across the NP11. The NP11 should therefore focus on cooperation on those aspects of planning and governance that have potential application across different geographies, or that can be adapted for local needs.

07

The Northern Powerhouse 2032

- What we can achieve by 2032
  - economic growth
  - carbon savings
- Seizing the opportunity

What we can achieve by 2032

The year 2032 will mark the end of the fifth carbon budget for the UK, as set out in the climate change act 2008. By law, the UK will have reduced its carbon emissions by 57% since 1990 levels, which is a reduction of more than 460 million tonnes of co_2 equivalent per year – this is the equivalent of taking 200 million cars off the road.

Meeting this stretching interim target on the path to Net Zero will require a major shift in the UK economy, and that of the North of England. It will not be possible to continue in the same fashion as today with many activities in the energy and industrial sectors, in particular:

- Carbon-emitting industries in the region's industrial hubs will come under increasing cost pressure as the costs of CO_2 and energy increase
- Coal-fired power generation will be phased out under current government policy by 2025, and gas-fired generation will be increasingly used to meet peak rather than baseload demand
- Manufacturing of petrol vehicles will start to fall as the switch to EVs accelerates

The transition away from these carbon-intensive activities represents a threat to economic value and jobs in the North. However, the transition to a cleaner economy also creates massive opportunities for the region which, if correctly harnessed, can drive lasting environmental and economic benefits.

In this report, we have identified a range of projects which address the decarbonisation challenge by building on the region's strengths, in particular:

- Offshore wind: continued deployment off the region's coastal areas, development of supply chains
- CCUS: development of networks to abate industrial and power emissions, including those from hydrogen production
- New nuclear: ensure that the region's nuclear generation is replaced as it becomes obsolete, and exploit the region's considerable sectoral know-how
- Low carbon transport: ensure a fit-for-purpose EV charging network, and lead the development of heavy-duty hydrogen vehicles
- Decarbonisation of heat: reduce emissions by rolling out electric heating and starting the roll out of hydrogen heating alongside heat networks

The economic and environmental benefits on offer from successfully delivering these programmes are immense – these are described in the section which follows. However, for the region to maximise these benefits, a number of steps need to be taken to ensure frictionless deployment, drive local content where possible, maximise innovation and create a strong export capability – our proposed next steps for creating these conditions are summarised in Section 8 below.

2032 and beyond…

Beyond 2032, the NP11 can expect to see significant acceleration in decarbonisation out to 2050 as replacement of fossils fuels for transport and heat by hydrogen and electricity picks up pace.

Government has legislated a Net Zero target by 2050 and a number of LEPs and city regions have ambitions to achieve this even sooner. Doing so will require further actions over and above the current trajectory. The Next Steps set out in this report provide a platform for identifying and delivering these further actions, as well as for accelerating and maximising the benefits of current plans.

As the NP11 sets its course to meet important decarbonisation milestones in 2032 and 2050, it needs to do so with a longer-term vision for a low carbon, sustainable economy – one that continues to drive growth while pushing on to become net carbon negative and zero waste.

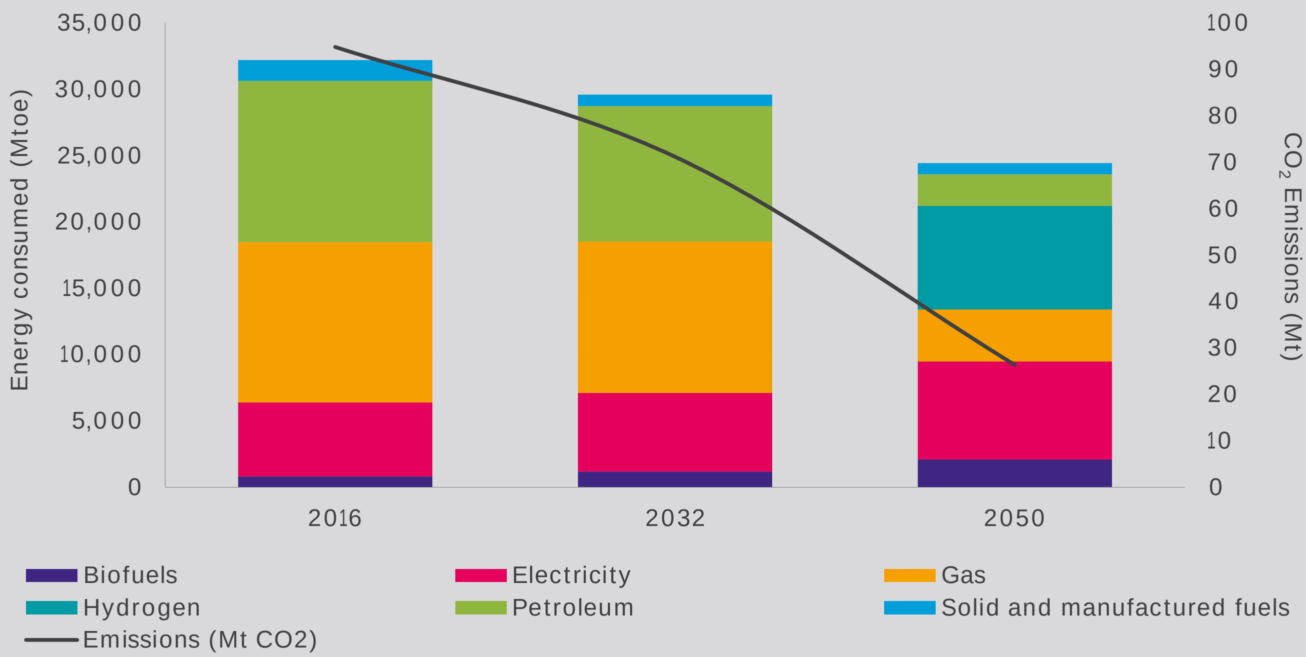
To deliver this, and even to meet Net Zero, will require coordinated deployment of technology that applies whole system thinking, not just to the energy system but across all areas of the economy – from energy production, through industry, and to waste recycling. Policymakers, local authorities and businesses alike will need to bring forward plans that find the synergies, for example, between hydrogen production for demand decarbonisation with hydrogen use for improved waste plastic recycling; or integrated planning of hydrogen electrolysis and electricity network infrastructure to optimise cross vector energy transportation.

The actions delivered by the NP11 and government between now and 2032 will set the platform for what can be achieved in the future.

What we can achieve by 2032 – carbon savings

We have produced a high-level estimate of the emissions savings that could be achieved in the North by deploying the projects and programmes we have identified in this report out to 2032, with further roll out of low carbon technologies in the run up to 2050. The reduction in carbon emissions as the energy mix evolves is set out in the chart below:

NP11 energy consumption and carbon emissions



Source: KPMG analysis; BEIS data, National Grid Future Energy Scenarios

Total annual emissions from the Northern Powerhouse stood at around 93.1 million tonnes of CO2 in 2016. This represents approximately 26% of the UK total emissions, and per capita emissions above the national average.

The ambitious CO2 emissions trajectory shown above for 2032 would represent a 51% reduction in emissions compared with 2005, suggesting that it would put the Northern Powerhouse on track to meet the fifth carbon budget target of 57% reductions when compared with 1990.

However, it should be noted that additional effort may be required in order to meet the Net Zero target, and it will be important for the government to provide clarity around the pathway for this. In addition, some cities in the North have adopted even more ambitious targets to reach Net Zero in the 2030s, which will require steeper and earlier emissions reductions than those outlined here.

The emissions reductions achieved in the electricity sector alone would amount to savings of 227 million tonnes of CO2 compared with maintaining the status quo – using today's carbon prices this saving would have value of between £1.6 billion and £11.8 billion.

>20 million tonnes

Carbon emissions saved annually by 2032

£1.6 - £11.8 billion

Carbon savings from cleaner power generation

227 million tonnes

Total emissions saved by 2032 through low carbon power generation

What we can achieve by 2032 – economic benefits

The Northern Powerhouse Independent Economic Review highlighted the significance of the energy sector to the economy in the North of England. That review estimated the current GVA of the electricity and gas sectors in 2013 was £3.6 billion. The Energise the North report estimated that around 60,000 people are employed in the energy sector in the region, including around 27,000 employed in supply chain jobs.

£2.3 billion

Increase in GVA growth in the Northern Powerhouse by 2050

100,000

New green jobs by 2050

The literature around clean growth clearly demonstrates that the potential benefits in the Northern Powerhouse would be very significant:

- The Northern Energy Strategy (IPPR, 2017) sets out an ambition for the energy economy in the North to be worth £15 billion per year by 2050, supporting 100,000 green jobs
- ORE Catapult estimate the GVA of offshore wind at £1.8 billion/GW, with this figure forecast to rise as more content is manufactured locally
- The Energise the North report (KPMG, 2017) identifies the potential for energy to increase GVA growth by up to £2.3 billion by 2050

What is clear is that clean growth can provide high value, sustainable jobs across broad parts of the economy. These range from work in highly technical, specialist R&D fields, through to modern professional jobs providing engineering, economic and legal support to project developers, to construction and maintenance jobs as large assets are built and operated, as well as a significant installation sector driving the energy transition at a household and business level.

Seizing the opportunity

It is by no means guaranteed that these economic and environmental benefits accrue to the North. Some of the activities and projects highlighted in this report could take place in other areas of the country, or not at all. New technologies may not achieve the cost reductions necessary to become commercially viable. Local supply chains may struggle to provide the goods and services required by project developers. In order to avoid missing the clean growth opportunity, policymakers and stakeholders at a regional and national level must work together to ensure that these blockers are addressed, and the benefits from clean growth maximised.

We have identified four necessary conditions that are required to ensure that the energy economy in the North can enjoy the benefits from clean growth. These are set out in the table below, alongside potential blockers:

	Benefits drivers	Why this matters for high value growth	Why potential may not be realised
1	Deployment of new projects must be ambitious in terms of number and scale	Higher volume of projects means greater levels of investment Healthy project pipeline encourages clustering and spillover effects	Lack of policy clarity Planning restrictions New technologies fail to reach commercial stage Lack of investment
2	Local value in new projects must be high	This ensures clean growth supports jobs in the region Many supply chain jobs are high value e.g. precision engineering	Undeveloped local supply chains Lack of skills provision Low visibility on project pipeline/demand
3	Innovation must be ongoing, for both new and more established technologies	Innovation and learning reduces costs, increasing profits for local businesses New product development can allow firms to capture growing markets	Lack of early stage funding Learnings not shared
4	Export opportunities must be identified and pursued	Export growth creates jobs and drives scale in production.	Lack of brand presence in other markets Lack of networks with overseas buyers Domestic markets prioritised over overseas

08

Unlocking the potential

→ Next Steps

Unlocking the potential – Next Steps

Necessary condition	Priority actions	Who?
High deployment	**High priority:**	
	• Make economic and strategic case for new nuclear	NP11
	• Stimulation of energy efficiency measures for business and public sector	NP11
	• Have a coherent local view on required EV charging infrastructure	NP11
	• Showcase projects for foreign investors	NP11
	• Address policy blockers for onshore wind (CFD availability, planning)	Government
	• Develop sustainable funding and governance model for new nuclear	Government
	• Funding model for CCUS	Government
	• Policy decisions on hydrogen for heat	Government
	Medium priority:	
	• Act as 'one voice' in securing northern priorities e.g. around onshore wind, solar support	NP11
	• Develop common standards where appropriate e.g. building regulations	NP11
High local value	**High priority:**	
	• Ensure supply chains are visible to developers across the region	NP11
	• Foster CCUS supply chains	NP11
	• Ensure skills development programmes address local needs	NP11
	Medium priority:	
	• Increase awareness of circular economy opportunities across LEP boundaries	NP11
Ongoing innovation	**High priority:**	
	• Share expertise around CCUS	NP11
	• Ensure that innovation 'competitions' do not inhibit collaboration between research centres	Government
	Medium priority:	
	• Systems planning to integrate offshore wind with other energy sources	NP11
	• Share knowledge around low carbon heat deployment	NP11
Pursue export opportunities	**High priority:**	
	• Develop strategy to ensure awareness of NP11 capabilities in key export markets	Government and NP11

Glossary of terms

Term	Definition
ASHP	Air Source Heat Pumps
BECCUS	Bioenergy Carbon Capture and Storage
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Committee on Climate Change
CCUS	Carbon Capture , Use and Storage
CESI	National Centre for Energy Systems Integration
CFD	Contract for Difference
CHP	Combined Heat and Power
CMA	Competition and Markets Authority
CO_2	Carbon Dioxide
DNO	Distribution Network Operator
EGSS	Environmental Goods and Services Sector
EPC	Energy Performance Certificate
EVs	Electric vehicles
GVA	Gross Value Added
GW / MW	Gigawatt / Megawatt
H21	A study of converting existing gas networks to 100%hydrogen
HGVs	Heavy Goods Vehicle
Hynet	Project on carbon, capture usage and storage in the North West
IEA	International Energy Agency
IPPR	Institute for Public Policy Research
LCOE	Levelised Cost of Energy
LCVs	Light Commercial vehicles
LEPs	Local Enterprise Partnerships
NEA	National Energy Action
NEED	National Energy Efficiency Dataset
NP11	The Northern Powerhouse 11
$MtCO_2$	Million tonnes of carbon dioxide
mtoe / ktoe	Million tonnes of oil equivalent / thousand tonnes of oil equivalent
Ofgem	Office of Gas and Electricity Markets
ONS	Office for National Statistics
SMRs	Steam Methane Reformers
UKERC	UK Energy Research Council
ULEV	Ultra Low Emission Vehicle

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