Regional energy futures as decision support in the transition to net zero emissions: North of Tyne case study

Claire Copeland, Gordon MacKerron, Timothy J. Foxon

Science Policy Research Unit (SPRU), University of Sussex, Brighton, UK

CONTACT: Claire Copeland cc417@sussex.ac.uk SPRU, University of Sussex

NB: Paper not for wider circulation

Regional energy futures as decision support in the transition to net zero emissions: North of Tyne case study

Futures studies have a variety of purposes: to inform policy, assist investment or business strategy. They can even change perceptions of what the future may hold, and are sometimes described as having transformative potential.

This research uses a participatory qualitative scenario approach to explore the development of energy futures for a regional case study of the newly devolved administrative region North of Tyne. Energy futures were developed in two different settings; pre pandemic, and during the pandemic. This is for insights into how the pandemic has impacted futures thinking and drivers for change, as well as highlighting energy futures issues on sub-national spatial scales.

The North of Tyne energy future scenarios were developed based on discussions in two facilitated stakeholder workshops, held pre and during the pandemic. While the pandemic has resulted in shifts in thinking e.g. home working, appreciation of local environments and communities, there were some commonalities too such as the strong decarbonisation driver for change, the need for fairness and for high quality employment in the region. Some barriers in futures thinking had to be overcome during the workshops, notably the presumption that meeting a net zero target was a certainty. This presented difficulties in imagining futures that didn't achieve this target, or did so but more slowly. The importance of being able to imagine living in all kinds of future worlds will be critical in a system undergoing such profound change, so that strategic foresight is developed to minimise risks of missing the net zero target.

Keywords: energy futures; local authority; net zero emissions target

1 Introduction

1.1 Importance of Subnational Regions

This research takes a participatory qualitative approach in the development of possible future scenarios for the energy system as a tool for decision making on a subnational scale. There has been a shift to more general "local energy" rather than specifically community energy projects in contributing to a transition to a low carbon energy system (Devine-Wright 2019). This has led to a focus on local authorities (LAs) and local enterprise partnerships (LEPs) activities, with the goal of attracting and leveraging private business investment to stimulate clean economic growth, creating jobs and develop skills (Devine-Wright, 2019 Table 1).

The government department for Business Energy and Industrial Strategy (BEIS) have established a Local Energy Team to run a Local Energy Programme and has established 5 regional Local Energy Hubs (LEH) in England (Association for Public Service Excellence 2021). The purpose of the Local Energy Programme is to provide capacity and capability support to LAs and LEPs through the LEHs (Association for Public Service Excellence 2021 , and also the LEHs manage the Rural Community Energy Fund (RCEF) reopened in 2019 (Department for Business, Energy and Industrial Strategy 2019). Even with attempts to provide support to LAs and LEPS, there are concerns about the lack of sufficient funding and resources in local and regional government to bring about the local energy transition required (Tingey, M., Webb, J. 2020).

Stimulating economic growth in poorly performing regions has been a key driver behind devolution of central governmental powers (a form of decentralisation), to increase autonomy in local policy making e.g. (Lowndes and Gardner 2016). The most extensive devolved powers are in Scotland, Wales and Northern Ireland that include the ability to vary own legislation and taxes. While devolved powers in England are more limited in scope, these relate mainly to investment funds to create economic growth and jobs, and also adult

education for skills development e.g. (North of Tyne Combined Authority 2018). There has to date, been no statutory responsibility to conduct energy planning on a local or regional scale. However, the Committee on Climate Change has recently recommended that local authorities need central government support to fulfil their roles in the net zero emissions transition, which includes the production of local area energy plans (Climate Change Committee 2021 Table A1 & A7).

Local authorities are at varying levels of advancement in the development of local plans to meet net zero emissions targets in line with meeting net zero emissions ambitions in their Climate Emergency Declarations (CED). A combination of challenges; rebuilding the economy as a result of the global Covid 19 pandemic and Brexit, along with delivering on CEDs has led to the recent development of approaches to support greater understanding of local energy systems and opportunities for clean economic growth e.g. "Local Area Energy Strategy" (LAES) (Energy Systems Catapult 2018). Clean energy is being seen not only as delivering on low carbon objectives, but also as a vehicle to deliver on other objectives such as local economic development, providing a revenue stream and reducing energy bills for households as well as for the local authority (Webb, J., Tingey, M., Hawkey, D. 2017). Combined authorities are able to take advantage of pooled resources and expertise in delivering low carbon projects. Intermediary organisations are also key in providing the necessary expertise often lacking in local authorities as a result of austerity measures, and since there are no formal responsibilities for energy provision (Webb, J., Tingey, M., Hawkey, D. 2017). Further, cross political party support is crucial to the longevity of energy programmes on national scales and more locally or regionally, otherwise there is a risk that a subsequent election will result in the programme being substantially altered or cut (Webb, J., Tingey, M., Hawkey, D. 2017).

The future goal is clear – net zero greenhouse gas emissions – both on a national and sub-national scales, but thus far there is little research in what energy futures might look like on a subnational scale. Underpinning strategies and plans are future visions and pathways that explore the dynamics and risks and opportunities over a timeframe for the future local energy system.

The futures developed here draw on discussions of stakeholders of a region on a subnational scale that are deliberately open in nature rather than normative (i.e. backcasting net zero emissions goal). The aim is to draw on not only a diversity of perspectives within the region in a participatory and democratic fashion, but also to develop a diversity of possible futures.

1.2 Energy Futures

Futures studies can be a useful aid to decision and policy making when faced with an uncertain and unpredictable future, and a wide range of approaches can be taken. In the UK, the National Grid produces annual "Future Energy Scenarios" to determine investment priorities and identify opportunities for the electricity networks, and also in recent years on subnational regional scales reflecting distribution network operators (DNOs) areas. However, the objectives of a local authority differ to those of an (electricity) DNO such as the need to address social welfare concerns and how to improve local regional prosperity. The local authority also has to consider wider energy needs for transport and heating in addition to electricity. Further, the local authority may have ambitions to achieve the transition on a faster timescale than that implied by the DFES.

There is therefore a need to consider explore energy futures on a more granular scale than DFES, to not only identify opportunities to satisfy the multiple objectives of a local

authority or combined authority or local enterprise partnership, but also identify risks in formulating net zero emissions plans. In this research futures are developed for a particular region in the UK that has recently formed a combined authority – North of Tyne. Two sets of futures and pathways were developed in this research; one in 2019, so pre the covid 19 pandemic, and one in 2021. The purpose of the second set was to identify whether the pandemic had led to a shift in the thinking underpinning the future visions and pathways.

This research contributes to energy futures development in two ways;

- Development of energy futures on subnational scales
- Implications of shocks on energy futures development

The aim of the futures approach adopted here is to explore a broad range of scenarios applicable specifically to the North of Tyne region. The exploratory nature of the approach was deemed appropriate due to the extent of uncertainties, societal attitudes and behaviour, and also to facilitate greater consideration as to the roles of actors in the energy system. The repeat of the exercise during the pandemic aims to indicate what shifts in thinking may have occurred either as a result of the pandemic itself or more generally.

This research seeks to address the following:

- How can energy futures support decision making at local or regional scales?
- How have stakeholders' views on energy futures changed as a result of the Covid 19 pandemic?
- What are the implications for energy futures as decision support in other subnational regions and for energy futures development more generally?

This research article first discusses energy futures on the sub-national scale and outlines the energy futures approach and method being applied to a particular case study in section 2. Then in sections 3 and 4 the energy futures for the North of Tyne region are developed from discussions in two workshops held in 2019 and 2021. Section 5 is a

discussion of the findings from the development of these two sets of future scenarios, and section 6 provides summary conclusions for energy futures studies on subnational scales.

2 Local and Regional Energy Futures

2.1 North of Tyne Case Study

The selection of the North of Tyne region as a case study, is largely a pragmatic one. The region is a geographical focus of wider research activity in the UK Centre for Energy Systems Integration (CESI) research programme that has funded this research. The formulation of energy futures for the region forms a useful aid in CESI modelling activities. The region is a subdivision of the North of East of England representing a collective of 3 administration regions Newcastle City Council, Northumberland County Council and North Tyneside Council as the North of Tyne Combined Authority.

The North of Tyne Combined Authority (NTCA) secured a devolution deal with central government on 2 November 2018 for greater autonomy in some local decision making. Devolved powers vary across the United Kingdom, and for the NTCA this is not as extensive as e.g. Scotland and Northern Ireland. For the NTCA, the devolved powers mainly relate to investment funds to create growth and jobs, and adult education for the development of skills in the different regions.

The wider North East region of England historically was at the forefront of the industrial era in the 19th century. It was called the "workshop of the world" at that time, in an emerging global economy founded on coal, steel and engineering (Hudson 2005). Dramatic industrial decline in the region occurred a century later in the Great Depression, and while there have been attempts to regenerate this has failed to recreate economic activity at anything like comparable levels (Hudson 2005). The deindustrialisation era led to high levels

of social and spatial inequality in the region (Hudson 2005) that still persist today (Pike, Tomaney, and Jenkins 2019), and with worsening health inequality (Corris et al. 2020).

Each of the individual local authorities within the North of Tyne region in 2019 have made a Climate Emergency Declaration (Climate Emergency Declaration 2021). NTCA have also made a CED in reference to its own buildings and operations independent from each local authority's CED. While North Tyneside is declaring to be net zero by 2050 in line with the rest of the UK, Newcastle upon Tyne, Northumberland and the North of Tyne Combined Authority have all declared ambitions to reach net zero emissions substantially earlier, by 2030.

In the net zero emissions transition, the energy sector is viewed as being a key sector for delivering economic growth in the region. This is due to its abundance of natural resources, particularly wind (onshore and offshore), and also growth in digital technology (North of Tyne Combined Authority 2018). The £20 million per year for 30 years devolution deal for North of Tyne also aims to address inequality, with a dedicated Inclusive Growth Board and a focus on improved education levels, skills and better quality employment (North of Tyne Combined Authority 2018).

2.2 Methodological Approach

The purpose of this futures study is to develop explorative participatory local regional energy scenarios in two prevailing conditions; pre and during the Covid 19 pandemic. The aim is to identify shifts in societal behaviour and attitudes on a more local level, and as a result of a shock, that are difficult to do with quantitative models. The development of the sets of futures in each prevailing setting draws on diverse perspectives of the stakeholders in the region.

A common and potentially powerful approach to scenario building, and the one used here, involves constructing a '2x2 matrix'. In this method two contextual factors are used as a

basis for the structure of the future scenarios. The most common way of identifying these two factors is through ranking factors according to uncertainty and greatest potential impact over the time horizon and selecting the top two. These two drivers then form the axes of the matrix and the scenarios are developed for each of the four quadrants. A key feature of this matrix approach is that there are no probabilities attributed to any of the resulting scenarios.

The advantage is the development of a "clear, memorable and easy to communicate structure that allows the subsequent scenario storylines that are produced to be compared - even contrasted - with each other" (Ramirez and Wilkinson 2014, p.255). Other authors point to an advantage of this approach as being able to help broaden views as to what are plausible futures, and as such develop different futures with different chains of causality (Wright, Bradfield, and Cairns 2013). The participatory and exploratory nature of the approach means that a qualitative approach was adopted i.e. no quantitative modelling was undertaken.

2.3 Stakeholder Workshops

A necessary activity in the development of futures using this approach, is to facilitate a way for stakeholders in the region is to engage in discussions and exchange thinking, ideas and information. Two workshops were held; one in person on 5 July 2019 and the second using virtual meeting software on 21 January 2021. Both were facilitated by the lead author with support from CESI colleagues.

The 2019 workshop held in Newcastle was attended by 17 North of Tyne stakeholders. At the workshop there was an intentional pre-determined grouping of the attendees, to enable some challenging of different perspectives. The lead author gave an introductory presentation to stimulate discussion, including energy futures for a previous case study (Findhorn an ecovillage in Scotland) to illustrate the approach, and also some information about North of Tyne. Since the Findhorn community is characteristically very

different to the North of Tyne region, it was anticipated that these futures would not unduly influence the attendees.

The 2021 workshop was held using the virtual meeting software within MS Teams and attended by 9 stakeholders. The majority (5) were from either a Local Authority, Local Enterprise Partnership or the local Combined Authority, and in addition there was a representative from a fuel poverty charity, a local resident and 2 academics. 6 of the participants had attended the previous workshop.

At both workshops the participants were invited to represent as diverse a range of views as possible, with representation from local authorities, both renewable energy and fossil energy businesses, NGOs and academia. While the aim was to have as many of the participants at the second workshop that attended the first, recruitment during the pandemic proved challenging.

At the workshops, participants were invited to discuss and agree on key drivers for change in the energy system for the North of Tyne region and to identify key aspects of each of the pathways represented by the drivers framing. The discussions held at the workshops were recorded for further analysis and used to develop the pathways with more detail subsequently. Reports containing this further development were circulated to participants for comment.

3 North of Tyne Futures 2019

3.1 Drivers for Change

The first step in the approach was to determine two key drivers for change in the North of Tyne energy system. The stakeholders were allocated to one of four groups, and assigned one of four topic areas; social, economic, environment and an 'any'. A summary of the points arising from the discussions is given below:

- Decarbonisation targets for many were considered a certainty.
- Monetary cost was also seen as the dominant factor in achieving any change; 'cost drives what is done' to quote one attendee in the Economic grouping. What was also pointed out there is a 'cost' associated with failing to decarbonise too. This led to discussions around the importance of communication, though generally it was acknowledged that the cheaper it is, greater levels of decarbonisation can happen more rapidly.

A theme that arose persistently during the course of the workshop was fairness and equity. This theme was present in discussions around who pays and who costs relate to, and also in ensuring that decarbonisation incentivisation frameworks don't just reward the wealthy. For example those in rented accommodation can be restricted both in their energy use and in the implementation of devices such as batteries, if a landlord wants to maximise receipts from say Feed-in Tariffs (FiT) on solar panels installed.

It was suggested that there should be a policy shift towards meeting minimum energy *needs* rather than focusing on minimum wage levels. This led to questions around who decarbonisation is for, and who benefits? It was further noted that energy needs are not uniform; they can be location specific, and also due to a range of individual socioeconomic characteristics . For there to be a 'Just Energy Transition' this means not leaving anyone behind (economically and socially). It is not just about (wealth and services) distributional justice but also participatory justice (Jenkins et al. 2021). However, how can wide enough participation of everyone be ensured? It was pointed out that the young are now tending to obtain their information from internet tools and social media rather than TV programmes (the main source for older generations). In meeting communication needs therefore we should consider the different ways people obtain information.

The regional identity featured in discussions as follows:

- Devolution deal: There is an opportunity to define a new identity for the North of Tyne specifically. This region is within the North East that also has a particular identity. A vision around the potential for the North of Tyne, along with a regional identity can be a strong motivator for action. Examples given included Tees Valley airport. This vision could be helpful in succeeding in achieving the energy transition and more swiftly.
- North of Tyne is home to a diverse landscape, with very rural and urban areas, a large national park, and areas of designated scientific interest. There has been some push back on extensive deployment of onshore wind in Northumberland, and questions arose as to what would a fair quota be, in meeting national climate targets.
- There is complexity at the boundaries people are crossing these boundaries to live and work – and therefore careful consideration needed for attributing the level of decarbonisation to particular regions.

The North of Tyne region has been hit hard by economic restructuring in the past. The collapse of the coal industry resulted in many facing long term unemployment, and there was a reliance on local authorities providing the support that was needed. Austerity measures following the financial collapse in 2008, have meant that the funds available to provide such support has been scaled back. Nevertheless, reliance on local governance to meet the needs of its citizens within the region has continued, and it is worth noting that this may not be so strong in other regions of the UK.

A list of all the drivers for change mentioned within the workshop are shown in Table 1.

Table 1: Drivers for Change				
Driver	Description			
Cost & Affordability	Phrases used in relation to cost: 'dominates the whole thing', 'cost			
	drives what gets done'. Support for changes needed should be directed			
	by those that need it and not be perceived as making the wealthy			
	wealthier.			
Equity or Fairness	Reflection of people living in different locations with a variety of			
	lifestyles, commitments, abilities and resources means that the energy			
	needs of individuals is diverse.			
Activism	E.g. the success of the Extinction Rebellion, and how the young obtain			
	their information.			
Resistance to Change	Proposing changes as being better than currently (e.g. switch from			
	coal to gas) can help overcome barriers. But there could be legacy			
	issues for North of Tyne due to previous industrial change and impact			
	that has had. Education can help encourage confidence to change.			
Preservation	North of Tyne is home to some beautiful landscape and countryside			
	and there is a concern how this could be impacted by renewable			
	energy deployment. There is a trade-off here between natural capital			
	and climate change mitigation.			

Discussing the top drivers for local energy system change with all attendees, equity and fairness was almost unanimous in its high level of importance, even though strong opinions were expressed about financial cost. As mentioned above, it was noted that decarbonisation was not being put forward as a major driver. When prompting attendees as to why, some responded that they had taken this driver as a given. It was further pointed out that this is a fundamental driver for change in the energy system, and the pace of change could be faster or slower depending on a whole host of factors and conditions. Finally consensus settled on the two key drivers for change being decarbonisation and equity. These then formed a 2x2 matrix that was then used to frame the development of four scenarios, each scenario representing a quadrant of the matrix. Each of the four attendee groups was assigned quadrants to discuss how this scenario may evolve over time i.e. a 'pathway', and also a name for the scenario. Figure 1 shows the 2x2 energy futures matrix for North of Tyne.



Figure 1: North of Tyne 2019 Energy Futures 2x2 Matrix

3.2 Pathways

3.2.1 Overview

In the pathways development participants were asked to consider the different sectors of the energy system, types of demand, and sectors of the economy. In the sections that follow are descriptions of each of the four scenarios and the developed pathways are in the Supplementary Material. Table 2 provides a summary of the key features of each of the scenarios; Fair Bare Minimum, Minimal Change, Just and Sustainable, and Draconian Decarbonisation.

Fair Bare Minimum	Minimal Change	Just and Sustainable	Draconian Decarbonisation
High Equity, Low Decarbonisation	Low Equity, Low Decarbonisation	High Equity, High Decarbonisation	Low Equity, High Decarbonisation
 Regional prosperity Carbon tax with waiver for poor Rewilding 	 Capitalism persists and monetary driven basis for any decision making Imports heavily relied on including for skills Increased fuel poverty and inequality 	 Fairness is prioritised Localised development autonomy including development of skills Strong circular economy 	 Heavy carbon taxation - disproportionately impacting on the poor Centralised energy - lots of nuclear power CCS essential

Table 2: Summary of North of Tyne 2019 Scenario Features

3.2.2 Fair Bare Minimum

In this scenario there is an improvement in economic prosperity in the region and this affords people to have higher quality lives. This is driven by the success of the digitisation sector, and results in greater links with corporations globally. There is also a focus on reducing inequality and particularly fuel poverty in the region. Fuel poverty is tackled by providing fuel bill support rather than incentivising energy efficiency improvements in buildings.

For transport there is a diverse range of options in place so people have choice with perceived fairness. There are grants for electric vehicles, but these tend to benefit the wealthy and so progress on electrification of transport is slow. Carbon tax is gradually introduced, and in particular a tax on flights is also seen as fair. However, there are increased flights in and out of the region due to increased prosperity, resulting in increased emissions from this sector. There is a tax on road fuels but with conditions in place to opt out if alternative low carbon transport options are not accessible.

There is an element of rewilding as this is seen as equitable for all. Smart meters are rolled out extensively and this facilitates more time of use tariffs that successfully shift demand so it is less 'peaky'. Carbon capture and storage (CCS) is seen as far too expensive and problematic to roll out. Decarbonisation measures generally are left to market mechanisms and therefore decarbonisation progresses slowly. Local attractive financial regimes bring energy intensive industries back to the region. There are tensions between land

available for housing and industrial development and protecting the landscape. Some green belt land is gradually sold off for high end housing.

3.2.3 Minimal Change

In this scenario the neoliberalist agenda prevails, and the profit incentive approach drives the economy and the energy sector. Costs and benefits of any change are considered only in monetary terms. This means that societal and environmental costs and benefits are only met if it is deemed financially advantageous to do so. Due to powerful lobbying by corporations, there is little political appetite to put in measures to curtail emissions further nationally and regionally. Only slow progress is made in decarbonisation. Any progress made is due to the relative costs of renewable and non-renewable technologies, that are manufactured and developed overseas.

The local skill base is diminished, leading to the best employment opportunities being given temporarily to workers outside the UK. Employment for locals is low skilled and precarious depending on the profitability of the corporations. More interconnectors with Europe are planned and this helps to decarbonise the energy system to some extent. Gas is still heavily relied on for heating. Carbon Capture & Storage (CCS) is extremely slow to get off the ground, due to a lack of incentive to experiment in the UK since corporations want assurances they can achieve sufficient profit levels.

A shift away from petrol and diesel cars occurs but only because global manufacturers have stopped producing them. This leads to a need to roll out EV infrastructure but only where profits can be made for investors. The result is that a significant proportion of the population in the region cannot afford EVs.

3.2.4 Just and Sustainable

In this scenario the low carbon transition also prioritises fairness. Policies are developed with

all of society in mind to bring about fairness and equity.

The egalitarian economy is strongly orientated towards local development, and maximising secure employment of citizens. Devolved administrations ensure that local communities' voices are heard in development of the region, and by appropriately balancing financial and environmental pressures. This stimulates local wealth creation, and local energy generation.

There is an immediate focus and programme of action on education and skills training so that communities benefit from new employment opportunities in the decarbonised economy. There is a surge in community energy projects facilitated and incentivised by the devolved administration. Examples include collective community ownership of renewable technologies, and minimal corporate ownership except for the largest scale projects such as district heating. Regulations ensure that vulnerable members of communities are also able to partake in the benefits of such schemes. Time of use (TOU) tariffs are tempered by measures to protect those less able to pay.

Local banks are established to further ensure local issues are incorporated in financial decision making. There is a strong circular economy and as much recycling and repurposing as possible is undertaken locally.

Rebalancing decisions made towards consumers restores consumers' levels of trust both in corporations and governance. This, along with the roll out of an education programme, enables the decarbonisation path to happen at a faster pace than predicted, and the North of Tyne region becoming a model example for the rest of the world to follow in mitigating dangerous climate change.

3.2.5 Draconian Decarbonisation

Under this scenario high levels of decarbonisation are achieved, but with poor levels of wellbeing and high inequality. The current monetary system persists with recouping costs for decarbonisation falling disproportionately on the poorer members of the community.

To achieve high levels of decarbonisation strong restrictions from central government and devolved regions on activities and energy technology deployment are in place. The energy system is predominantly a centralised system and tightly under government control.

The protection of the green belt is weakened, and this has led to a dramatic increase in onshore wind development as well as more housing being built for predominantly the affluent. Housing is under mandatory energy efficiency improvement ratings and this has led to landlords passing on costs to those renting. Fuel poverty increases as the poor and more vulnerable members of society struggling to meet the higher housing costs.

Low carbon investments in the region are mainly from global corporations who recruit skilled employment mainly from overseas. Limited skills training undertaken within the region leading to many in insecure employment.

4 North of Tyne Futures 2021

4.1 Drivers for Change

As for the 2019 workshop, the first part of the futures development involved considering what are the main drivers for change for the energy system in the North of Tyne region. Participants were divided into breakout rooms to consider different types of factors; economy, society, environment and other/any. All these factors were then put to an online poll for the workshop participants to allocate two votes to decide their top two drivers for change. The results of this poll are shown below in Figure 2. As seen the top two drivers were found to be decarbonisation and place based approaches, closely following by

jobs/skills and changes in energy demand profiles.



Figure 2. Poll on Drivers for Change in the energy system in the North of Tyne region

A notable change from the previous workshop is that notions of equity are not such a strong driver. That does not mean that it is no longer an issue, and could be seen as relevant across other drivers e.g. reflecting characteristics of locations in place based approaches, and also in the jobs and skills agenda. Therefore, while the strongest two drivers were agreed to be decarbonisation and place based approaches, other drivers can of course be present in each of the future views to some degree.

The 2x2 matrix of futures developed in this stakeholder consultation is illustrated in Figure 3. The pathways for each of these four future views for the energy system in the region are outlined in the section that follows.



Figure 3. North of Tyne 2021 Energy Futures 2x2 Matrix

4.2 Pathways

4.2.1 Overview

In the pathways development participants were asked to consider the different sectors of the energy system, types of demand, and sectors of the economy as before. This time participants were asked to consider in addition the roles of the different actors in each future scenario. Actors were grouped as follows; policy and governance, industry, business & institutions, and households.

In the sections that follow are the descriptions of each of the four scenarios, and the developed pathways are provided in the Appendix. Table 3 provides a summary of the key features of each of the scenarios; Local Good Life, Missed Opportunities, Greta Green and Electric Central.

Local Good Life Place Based Approaches: High Decarbonisation: Low	Missed Opportunities Place Based Approaches: Low Decarbonisation: Low	Greta Green Place Based Approaches: High Decarbonisation: High	Electric Central Place Based Approaches: Low Decarbonisation: High
 Devolved powers Regional prosperity 	 Low levels of funding Wind power increases 	 Appraisal activities and tailored approaches to 	 Decarbonisation more nationally driven than
 "15 minute 	on and offshore but	decarbonisation	local – electrification
 Community diversity and increased green 	stalls No new technological	area – inwards investment	emissions help speed up decarbonisation
spacesFlourishing local businesses	 Lack of inclusivity – inequality and fuel 	• Battery industry developed and brings prosperity to region	• Communities form groups to take advantage of incentives
• Missed net zero targets for the region mainly due to misjudging	poverty levels riseMissed net zero targets for the region (and	 Partnerships with clean industries develops skills within region 	• Prosperity is patchy within the region as the lack of tailoring
hydrogen availability	likely nationally too)	 Reforestation and rewilding 	benefits some and not others

Table 3: Summary of North of Tyne 2021 Scenario Features

4.2.2 Local Good Life

A core feature of this scenario is local governance, and in this future the region secures greater devolved powers having built trust with the government and local people. This results in the region being granted block funding by central government rather than needing to apply for competitive funding for particular projects.

There is a drive to create '15 minute communities' across the region and to bring diverse communities and neighbourhoods closer together, leading to improvement in quality of life. This has the effect of increased walking and cycling and more pedestrian and green areas in towns. There are also local hubs to reduce the working commute. The region will also experience growth in SMEs due to increased local activities. Partnerships with industry and businesses for vocational training helps ensure the right skills for employment in the region. Improved skills in the region in turn attracts more industry and businesses to the area. Growth in the region reflects its strengths; tourism, agriculture, ports, offshore, automotive and digital technology.

In rural areas there is support for agriculture and therefore increased jobs in that sector. There are incentives to improve biodiversity and drive to improve quality of produce leads to shift in practices more to organic and permaculture, and this in turn helps decarbonisation to some degree.

Due to costs involved in improving thermal efficiencies in buildings in rural areas, there is a switch from oil heating to gas connecting these to the gas grid. This is as a result of the expectation of hydrogen that does not happen at scale by 2050, leaving these homes, along with many urban ones, dependent on gas grid. There is some deployment of heat pump technologies, but not enough to meet net zero targets.

4.2.3 Missed Opportunities

The underpinning characteristic of this future is little change from current times. Government support for decarbonisation is limited, however pressure has built up some decarbonisation momentum through other channels – local authorities, businesses. Progress is though slower than that required for meeting net zero emissions targets.

An area where decarbonisation progress is especially slow, similar to the Local Good Life scenario, is in meeting heating demand. Here there is very little government support and incentivisation for decarbonisation in particular for heating. Adoption rates for heat pumps slow further in the North of Tyne, and particularly in rural areas, as costs and disruption remain a persistent barrier to adopting home energy efficiency improvements. This leads to enduring dependence on existing heating solutions. Those that can afford to do so however, do decarbonise their homes as this is seen as a status symbol, attracting a premium on valuation. The resulting disparity in house prices results in widening inequality in the region.

Businesses and industry decarbonise to extent that may be required to remain competitive elsewhere in the UK, and also overseas. However those in rural areas remain fossil based including diesel generators for electricity due to lack of government incentives, and lack of funding following the pandemic.

Government funding, including the "levelling up agenda" results in very little funding being directed to the region. This hampers decarbonisation progress throughout the region. The government then claims that devolution is not working, and takes much of the devolved powers back to central control. By not having resources to be on the decarbonisation pathway compared to other regions, the North of Tyne misses the net zero emissions target by some margin. There is a prosperity disparity compared with other regions, and the ability to attract and retain skilled workforce becomes ever more difficult. There is a rise in those in fuel poverty in the region, and low emissions technologies are only available to the wealthy.

Wind power persists as the cheapest form of generation, so see further deployment in the region both on and offshore. There are jobs for repair and maintenance, and also stimulates a battery storage sector. Wind deployment however is deemed for the benefit of decarbonising the national grid rather than North of Tyne specifically, so there is a net electricity export to other regions. The energy system as a whole remains largely centralised.

4.2.4 Greta Green

In this future view, the potential of the region to deliver on the net zero target is fully appraised with locations for deployment identified and actioned early. There is lots of community and local business engagement and information sharing, to improve understanding on how to deploy the different technologies. Tailored approaches with activities devised in both urban and rural areas determine the action required down to individual household level. This in turn means identifying opportunities for local businesses, and signals direction of travel for local investment and also for attracting inwards investment.

Within the region there is substantial further deployment potential both for offshore and onshore wind power, mainly in Northumberland, despite previous resistance to onshore wind. Contracts for Difference (CfDs) help provide a case for onshore deployment for

landowners, and the Crown Estate plays a big role in offshore wind with floating schemes to avoid degradation of seabed. There is scope for smaller scale renewable energy projects from hydro and also district heating, and the potential for heating from old coal mines in the region.

Potential for economic growth opportunities from battery storage (whole supply chain) leads to the region becoming a global leader. This is in contrast to wind power where much of the valuable parts of the supply chain will remain elsewhere in Europe. An upskilling local people programme is commenced in schools. There is growth in UK engineering and in the North of Tyne region in particular.

Hydrogen availability is centred around industrial clusters which the North of Tyne region lacks - the nearest being Teeside just south of the region. Therefore much of the investmenet and deployment activity is around other technologies to meet the net zero goals. Potential for carbon capture and storage is limited.

With Northumberland being a destination region, many travelling within the UK and particularly in the summer months, there is pressure to provide the appropriate infrastructure for decarbonised transport. Charging points for electric vehicles (EVs) being installed in such as Kielder Castle and will be deployed elsewhere. Challenges in deploying enough renewable electricity and balancing with need for growing numbers of EVs but smart infrastructure and tariffs help manage this effectively. Hydrogen vehicles become more available in later decades.

Lack of power in rural locations is an issue in the deployment of decarbonised technologies and that issue to be addressed early. Following this, broadband connectivity is deployed to all areas to ensure no one left behind in harnessing benefits of smart technologies.

4.2.5 Central Power

In this future view there is very much a revert to more centralised control and devolved powers are dissolved. The strong national drive for decarbonisation leading to government overturning any local planning and opposition, to further deployment of renewable energy technologies in locations where financial returns are most favourable. This leads to widespread onshore wind deployment in Northumberland and offshore wind along the coast of the North East. A new two-way interconnector with Europe is also developed in North of Tyne.

There is rapid electrification of transport first, and then heating with a ban on new gas boilers from 2030. Those not connected to the electricity grid are connected in the early 2020s. District heating schemes using mine water are developed in urban areas and are in use in the 2030s, biomass CHP are also deployed in the 2030s. Towards end of the 2030s and in the 2040s the energy system is mostly electrified with some of the gas grid used as a hydrogen store (the rest is decommissioned) when there is surplus wind.

Gas turbines producing electricity are switched over to hydrogen in the 2040s. In the 2040s there is the development of bio-energy with carbon capture and storage (BECCS) plant connecting to a national carbon capture and storage (CCS) grid. This net negative emissions technology is via the gasification route producing hydrogen that is used for electricity.

The rapid deployment of renewable energy technology creates jobs in the region, but the majority of the higher skilled being imported in from other regions and particularly overseas. There is a national reskilling program, but this is not taken up widely in the region, largely due to disenchantment with the central regime, but also resentment that North of Tyne are expected to meet the majority of the net zero emissions target but with financial benefits going elsewhere.

There is a rapid retrofit program over the 2020s driven by minimum energy efficiency regulation. Following the pandemic and lack of available funds however, the burden of costs fall on home owners, housing associations and councils. There are a variety of financial mechanisms to help, but those that least afford it go with cheapest poorest quality installers and performance fails to match regulation requirements.

The centralised control results in worsening inequality within the region as little attention is paid to the financial impacts of the rapid decarbonisation program on certain households. There is an increase in fuel poverty until the late 2030s/2040s when the whole system has decarbonised and there is a public enquiry into addressing fairness and more help is provided to support those more vulnerable in society. There are community action groups, and this is around campaigning for more green spaces and improved biodiversity in their local areas. This is supported by central government as seen as part of meeting the overall decarbonisation drive.

Businesses and industry are incentivised to rapidly decarbonise, and they can then maintain their competitiveness in international markets. Agriculture is incentivised to diversify revenues, by accepting wind deployment on their land and they are also incentivised to improve biodiversity and switch to organic and permaculture methods. Batteries for storage is a big growth area for the region as is digital technologies. This does encourage some training and skills development in the region and in turn does attract workers to the region reversing the ageing population trend.

5 Discussion

5.1 Overview

In this section the research findings are applied to address the questions raised in section 1.3. These are as follows:

- How can energy futures support decision making at local or regional scales?
- What shifts in futures thinking have arisen as a result of the global pandemic?
- What are the implications for energy futures as decision support in other subnational regions and for energy futures development more generally?
 These questions are addressed in turn.

5.2 Local Regional Energy Futures as Decision Support

With the region having suffered badly from economic restructuring in the past, along with a recognition of the need for a 'just transition' so that no-one is left behind, there are strong elements of equity and wellbeing in both sets of futures. Interestingly, this was more pronounced pre pandemic, yet there are signs that the pandemic has led to growing inequality (Stantcheva, S. 2021). During the pandemic the importance of the 'place based approach' driver could be a direct consequence of people spending more time at and around their homes due to lockdown restrictions. In addition there is a sense of needing to take into account the particular characteristics in a region, and its history, for delivering on climate emergency declarations; the devolution deal for NTCA highlights these. However securing funding from central government is with the expectation of attracting substantial private sector investment, and there is a need therefore to appeal to investors – within and external to the region. It was pointed out in the first workshop that having a vision for the region to provide a recognisable identity reflecting characteristics of the region was a strong motivator for action and investment.

A further observation is the approach facilitated exploring non-normative futures. In other words, futures where the net zero emissions target was not met, or at least not met in the required timeframe. This, for some, was a cognitive hurdle to overcome during the course of the workshop. While energy futures studies are increasingly focusing on meeting the net

zero emissions target such as National Grid's Future Energy Scenarios, these now look at 3 out of 4 scenarios meeting the net zero emissions target by 2050 e.g. (National Grid 2019; 2020). There is a danger that narrowly focusing on normative futures leads to a lack of furthering understanding as to how the system might behave as it shifts in the transition. Further it could lead to a form of cognitive dissonance where thinking is of the form realworld-is-wrong, models-are-right leading to further poor outcomes in policy and decision making e.g. (Wilson, A., Copeland, C., Tehrani, E., Dent, C. 2017).

5.3 Shocks and Futures Thinking

There were some similarities in the discussions at both workshops, such as the decarbonisation driver, but also some differences that are not all pandemic related. By the second workshop there was a sense of a need for action in the very near term, and also more certainty around the electrification of transport, and awareness of challenges in decarbonising heat.

The need for 'quality' employment was strong in both sets of futures. In the pandemic workshop there was also discussion of home working becoming the new working model and implications this has for energy demand in homes, offices and also for transport.

A key difference in the pandemic workshop was the recognition of the need for access to green spaces. This is to some extent encapsulated in the 'place based approach' driver and there was further discussion about local services creating '15 minute communities'.

5.4 Implications for Energy Futures as Local and Regional Decision Support

The qualitative futures approach adopted in this research enabled participants to discuss and develop energy futures in an open way that was not necessarily tied to the current operation of the existing local energy system. It also facilitated the exploration of societal drivers and behavioural change over time and to imagine 'living in' a diverse range of futures. Both of

these gave an advantage over quantitative modelling methods.

The outcomes of the futures exercises can be twofold; policy and decision makers in the region can overcome barriers in strategic thinking by exploring a broader range of futures than they may do otherwise, and the modelling community can identify improvements that can be made so that they are more useful to decision and policy makers. The futures developed here also deliberately did not seek to create scenarios around a normative approach i.e. around the net zero emissions target goal. This is in contrast to other futures developed for local energy planning e.g. (Upham, Klapper, and Carney 2016).

The qualitative approach is not a replacement for quantification which is still needed, not least for identifying progress to net zero greenhouse gas emissions, but also to identify potential costs and revenue streams for projects. The qualitative approach is helpful in framing broader plausible futures than would be possible with a quantitative model, as a range of perspectives can be incorporated and also allowance for societal and institutional behaviours and change.

6 Conclusions

Futures approaches can be a useful tool for exploring how futures may evolve and to identify key early investment decisions and policies required to shape the future in aggregate in the required direction. It is important that when there is considerable uncertainty that futures thinking will evolve over time. Factors that appear to currently dominate can be overtaken by other factors, and in a relatively short period of time compared with the futures time horizon. Shocks to the system can and do happen – as the pandemic has shown. The repercussions of such shocks, the global pandemic in this case, can be difficult to fully comprehend in advance of their occurrence.

There is a need to develop energy futures thinking on local and regional scales. If the UK is to meet its legislated climate mitigation targets, this requires the collective efforts of all local areas and regions. It has already been highlighted that some parts of the UK may need decarbonise at a slower rate than others e.g. it was recommended that Wales has a target of 95% reduction by 2050; and some faster with Scotland setting a net zero target by 2045 (Priestley 2019). While the Distribution Network Operators (DNOs) have begun to develop their own Future Energy Scenarios (DFES), and there is interaction with the National Grid's Future Energy Scenarios (FES), there needs to be similar activities for local and regional government and combined authorities.

This research explored the development of participatory qualitative energy futures on a sub national scale representative of the North of Tyne Combined Authority. The energy futures were developed from discussions in two workshops held pre and during the covid 19 pandemic. Participants from a range of perspectives at both workshops were able to discuss challenges in sectors such as agriculture, transport and heating and explore the pathways of these for each of the four discrete worlds framed by the agreed drivers for change.

In both workshops there was a sense that the transition to a low carbon transition needed to improve aspects that the region suffers from economically (inequality and fuel poverty), and also respect geographical characteristics of the region (especially the rural areas). Another strong aspect that arose out of the discussions was the sense of identity as well as place; drawing on its world leading industrial past for the skills required for the future energy system. Though there were concerns that quality employment should be created for those within the region and not imported from elsewhere.

Some complexity and tension arises particularly at boundaries. Employment in the region is not entirely served by its residents, with many workers living outside North of Tyne.

This is seen elsewhere in the UK. This can create issues in attributing levels of decarbonisation to particular regions and could hamper democratic relations between regions.

Further research is required to understand the opportunities, the needs of local people and businesses, and the barriers in other local and regional areas in the transition to a net zero emissions energy system. It is only by doing this, that the feasibility of meeting net zero emissions targets in aggregate on a national scale can be fully appraised and understood. Alongside this an investigation also as to how to monitor levels of equity and wellbeing on a subnational scale given the importance in discussions, and also what 'place based approaches' could mean in practice.

Acknowledgements

The authors are grateful to the support of CESI colleagues in the running and organising of the workshops; Alison Norton, Laura Brown, Lyndsey Allen, Gareth Powells, Kevin Wilson all at Newcastle University and Britta Turner previously at Durham University.

Funding

The authors are grateful for the funding of this research through the Centre for Energy Systems Integration Programme (CESI) funded by EPSRC and Siemens.

REFERENCES

Association for Public Service Excellence. 2021. 'We Are the Local Energy Team and We Sit within the Department for Business, Energy and Industrial Strategy (BEIS)'. 2021. https://www.apse.org.uk/apse/index.cfm/local-authority-energy-collaboration/beislocal-energy-team/.

Climate Change Committee. 2021. '2021 Progress Report to Parliament'. https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/.

Climate Emergency Declaration. 2021. 'The Climate Emergency Declaration and Mobilisation'. Climate Emergency Declaration. 2021. https://climateemergencydeclaration.org/about/.

- Corris, Valerie, Emily Dormer, Andrea Brown, Paula Whitty, Paul Collingwood, Clare Bambra, and Julia L Newton. 2020. 'Health Inequalities Are Worsening in the North East of England'. *British Medical Bulletin* 134 (1): 63–72. https://doi.org/10.1093/bmb/ldaa008.
- Department for Business, Energy and Industrial Strategy. 2019. 'Guidance: Rural Community Energy Fund'. GOV.UK. 2019. https://www.gov.uk/guidance/ruralcommunity-energy-fund.
- Devine-Wright, Patrick. 2019. 'Community versus Local Energy in a Context of Climate Emergency'. *Nature Energy* 4 (11): 894–96. https://doi.org/10.1038/s41560-019-0459-2.
- Energy Systems Catapult. 2018. 'Local Area Energy Planning: Guidance for Local Authorities and Energy Providers'. *Energy Systems Catapult* (blog). 2018. https://es.catapult.org.uk/brochures/local-area-energy-planning-guidance-for-localauthorities-and-energy-providers/.
- Hudson, Ray. 2005. 'Rethinking Change in Old Industrial Regions: Reflecting on the Experiences of North East England'. *Environment and Planning A: Economy and Space* 37 (4): 581–96. https://doi.org/10.1068/a36274.
- Jenkins, Kirsten E. H., Benjamin K. Sovacool, Niek Mouter, Nick Hacking, Mary-Kate Burns, and Darren McCauley. 2021. 'The Methodologies, Geographies, and Technologies of Energy Justice: A Systematic and Comprehensive Review'. *Environmental Research Letters* 16 (4): 043009. https://doi.org/10.1088/1748-9326/abd78c.
- Lowndes, Vivien, and Alison Gardner. 2016. 'Local Governance under the Conservatives: Super-Austerity, Devolution and the "Smarter State". *Local Government Studies* 42 (3): 357–75. https://doi.org/10.1080/03003930.2016.1150837.

National Grid. 2019. 'Future Energy Scenarios 2019'. 2019. https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2019documents.

National Grid. 2020. 'Future Energy Scenarios 2020'. 2020. https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020documents.

North of Tyne Combined Authority. 2018. 'North of Tyne Combined Authority: Devolution Deal'. https://www.northoftyne-ca.gov.uk/who-we-are/about/.

- Pike, A., J. Tomaney, and M. Jenkins. 2019. 'The North of Tyne Metro Mayor'. https://www.ncl.ac.uk/media/wwwnclacuk/curds/files/North%20of%20Tyne%20Metr o-Mayor%20-%20An%20Office%20Without%20Power.pdf.
- Priestley, Sara. 2019. 'Net Zero in the UK'. CBP8590. House of Commons Library.
- Ramirez, Rafael, and Angela Wilkinson. 2014. 'Rethinking the 2x2 Scenario Method: Grid or Frames?' *Technological Forecasting and Social Change* 86 (Supplement C): 254–64. https://doi.org/10.1016/j.techfore.2013.10.020.
- Stantcheva, S. 2021. 'Inequalities in the Times of a Pandemic'. In Economic Policy. Harvard.
- Tingey, M., Webb, J. 2020. 'Net Zero Localities: Ambition & Value in UK Local Authority Investment'. EnergyRev. https://www.energyrev.org.uk/outputs/net-zero-localitiesambition-value-in-uk-local-authority-investment/.
- Upham, Paul, Rita Klapper, and Sebastian Carney. 2016. 'Participatory Energy Scenario Development as Dramatic Scripting: A Structural Narrative Analysis'. *Technological Forecasting and Social Change* 103 (February): 47–56. https://doi.org/10.1016/j.techfore.2015.10.003.
- Webb, J., Tingey, M., Hawkey, D. 2017. 'What We Know about Local Authority Engagement in UK Energy Systems'. UKERC. https://ukerc.ac.uk/publications/whatwe-know-about-local-authority-engagement-in-uk-energy-systems/.
- Wilson, A., Copeland, C., Tehrani, E., Dent, C. 2017. 'Modelling in Public Policy'. HubNet. https://www.research.ed.ac.uk/en/publications/modelling-in-public-policy.
- Wright, George, Ron Bradfield, and George Cairns. 2013. 'Does the Intuitive Logics Method

 and Its Recent Enhancements Produce "Effective" Scenarios?' *Technological Forecasting and Social Change*, Scenario Method: Current developments in theory and practice, 80 (4): 631–42. https://doi.org/10.1016/j.techfore.2012.09.003.