Sheffield City Region Energy Strategy: University of Sheffield Provocation

Final Report October 2019

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The University of Sheffield (UoS) is represented on the Sheffield City Region (SCR) Energy Strategy project board, and recognises that the Energy Strategy is a regionally important initiative. As such the UoS is keen to support the development of a strategy that is robust and fit for purpose. With this in mind, early in 2019 UoS offered to carry out a brief 'provocation' exercise to support the strategy development process and underpin future SCR engagement workshops (Appendix 1). This report represents the current status (October 2019) of that provocation exercise. It is an academic exercise, although we have tried to consult as widely as possible with non-academic departments within the University.

Executive Summary

Our analysis has revealed two key messages:

1. Complete or near complete decarbonisation of **transport** and **buildings** is vital to the Region's emission reduction success. A 25% to 50% reduction in demand, and a near total change to clean energy sources is needed.
2. A programme of devolution to deliver these reductions in energy demand and a transition to clean energy sources is a feasible political project, since such a project presents substantial economic and social opportunities to the region.

Other important points to note are:

- Moving towards a net Zero Carbon economy needs to be the primary purpose of the SCR Energy Strategy and is a key opportunity to create growth across SCR.
- The climate emergency demands a **political programme** for a low carbon economy. We believe this should be coupled with an ambitious devolution deal. This is politically feasible and would bring considerable quality of life benefits to citizens in the region.
- Zero Carbon goals for transport and heat need to be communicated alongside the benefits they will have on quality of life, such as improved air quality; and reduced fuel poverty and winter deaths.
- In domestic, public and commercial buildings there needs to be a step change in insulation and a near total move away from gas as a heating fuel.
- In transport, there needs to be significant investment in public and active transport and support for the infrastructure needed for alternative fuel for private vehicles (electricity / hydrogen).
- There needs to be investment to support the introduction of alternative fuels for public and commercial transport (electricity, hydrogen and biogas).
- Community energy projects offer great scope in terms of regional renewable electricity generation and storage, engagement of the public, increased resilience of regional electricity networks and in terms of helping to upskill the regional workforce around the need to work with and live within our available resources.

1. Introduction - what should the SCR Energy Strategy do?

Climate change is fast climbing the political agenda in the UK due to the IPCC 1.5 degrees report (IPCC, 2018), School Strike 4 Climate, Extinction Rebellion, and record-breaking heat waves. Public concern is also surging. Realisation is dawning that decarbonisation (or at least defossilisation) of our economy is inevitable, that there will be significant regional economic and quality of life benefits arising from this process, and that there are considerable 'early adopter' benefits for regions that take this seriously (Gouldson et al., 2013). The SCR Energy Strategy (SCRES) provides an excellent chance to grasp this opportunity, although it is important to set out some guiding principles around its remit (Black Country LEP et al., 2018; Siemens PTI, 2018). Although a clearly written pragmatic document will help to underpin investment decisions, an Energy Strategy is not primarily a tool for marketing the region to business. Rather, an Energy Strategy:

- Sets out the transition to a Net Zero Carbon economy
- Draws on regional resources and plays to regional strengths
- Provides data that is quantified using standard methods
- Sets out the main co-benefits of decarbonisation of energy
- Explores how regional governance can (or cannot) support Net Zero Carbon

Broadly then, the purpose of an Energy Strategy in the 21st century is clear: *to reduce greenhouse gas emissions in line with agreed local / regional targets, in a socially just and feasible manner* (See Appendix 2 for more details). Therefore, the SCRES must provide answers to four basic questions:

1) **Baseline:** where do emissions occur in SCR?
2) **Targets:** where and by how much do emissions need to be reduced?
3) **Plan:** how can these reductions be made whilst maintaining or improving the lives of SCR citizens?
4) **Strategy:** what sort of political project is required to bring about these changes?

We aim to avoid re-treading ground covered by the existing draft Energy Strategy, and to focus on highlighting the most effective actions for the SCRES team. The existing SCRES draft already tackles question 1 above, so this provocation focuses on providing answers to questions 2-4.

The report is structured as follows. Section 2 discusses which emissions a local Energy Strategy should be concerned with and sets out the scale of reductions required of SCR. We argue that the SCR Energy Strategy should focus on bringing about large reductions and shifts in demand from the domestic heat and transport sectors. Accordingly, sections 3 and 4 focus on these sectors, each first describing the current state of demand in the sector, then outlining different reduction pathways, before finally discussing some ways to implement reductions in a socially just manner. Section 5 then discusses what political decisions could lead to the

successful implementation of such an Energy Strategy. Further information on the detail underpinning our analysis can be found in the appendices.

> Explainer: SCR Geographical Boundaries
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> In the coming months it will be announced that the geographical boundaries of the Sheffield City Region LEP will be reduced to cover only the area known as South Yorkshire. Therefore, in this document we have only focused on South Yorkshire, rather than the current larger area covered by SCR.

2. Energy demand in SCR

The SCR is responsible for three categories of emissions. First, we directly emit greenhouse gases through everyday activities like heating homes, driving vehicles, farming, and generating electricity (Scope 1 Emissions). Second, fossil fuels are burnt directly on our behalf, primarily by electricity producers outside the region (Scope 2 Emissions). Third, emissions are associated with the goods and services imported into SCR, from imported food to the international servers that host our web pages (Scope 3 Emissions). This provocation focuses on how SCR can reduce Scope 1 and 2 emissions, primarily because these emissions are directly under our control. This does not devalue the importance of tackling Scope 3 emissions through reducing unnecessary consumption, and being wary of local action that simply displaces emissions from SCR to other regions. For example, the world needs steel, so it is better to decarbonise SCR's steel industry rather than have those emissions happen in another region or country.

Energy production and energy demand are intricately linked. However, in this report we primarily focus on the demand side of the equation. The reasons behind this are: the higher quality data available for the demand side of the equation; the fact that SCR imports most of its energy, so we have more control over the demand side; and there is limited (though not insignificant) potential for large-scale renewables in the region (see Explainer box below).

Explainer: Current SCR electricity production and potential for renewable generation

The draft Sheffield City Region LEP Energy Strategy claims that 18% (1.4TWh) of the region's electricity demand is imported and also breaks down the current electricity production mix. In order to shift from being a net energy importer to a net energy exporter whilst reducing emissions, the region would need to increase its renewable energy generation capacity significantly (from ~ 100 MW to ~ > 1 GW). (Note that changes in the geographical boundaries of Sheffield City Region LEP have a huge impact on current and future electricity generation capacity). In terms of opportunities for electricity generation from both solar PV and wind there are several important factors for the region. Regional agricultural land is relatively poor, and the land is fragmented by transport networks and suburban neighbourhoods. Therefore, Sheffield City Region is not ideal for large solar farm or onshore wind farm installations, and the ambition to be a net energy exporter is unlikely to be realistic. However, because the agricultural quality is low, and there are large areas of old mine workings and other post-industrial land, it could be argued that smaller scale renewable generation should be favoured over and above agriculture. More work would be required to quantify this potential as there are current discrepancies in data around regional capacity (Appendix 3). See Appendix 4 for maps detailing land types in Sheffield City Region.

2.1 SCR energy demand and projected necessary reductions

Historical SCR Energy demand is roughly equally split between domestic, transport and industry (Figure 1). Here, 'industry' includes manufacturing based industry, commercial, and public sector demand for energy. Industrial demand is actually a combination of energy used in buildings as well as manufacturing processes. This historical baseline can be extrapolated into future energy demand using the National Grid Future Energy Scenarios (FES). These different scenarios show how the national energy infrastructure could change under different political governance arrangements. They provide a way to compare and contrast how the decarbonisation of the energy system can proceed (Figure 2). All scenarios include substantial electrification of private vehicles and domestic heating and a substantial reduction in energy demand. They also include hydrogen as a fuel vector for transport and heating to greater and lesser extent, dependent on the level of investment in nuclear power.

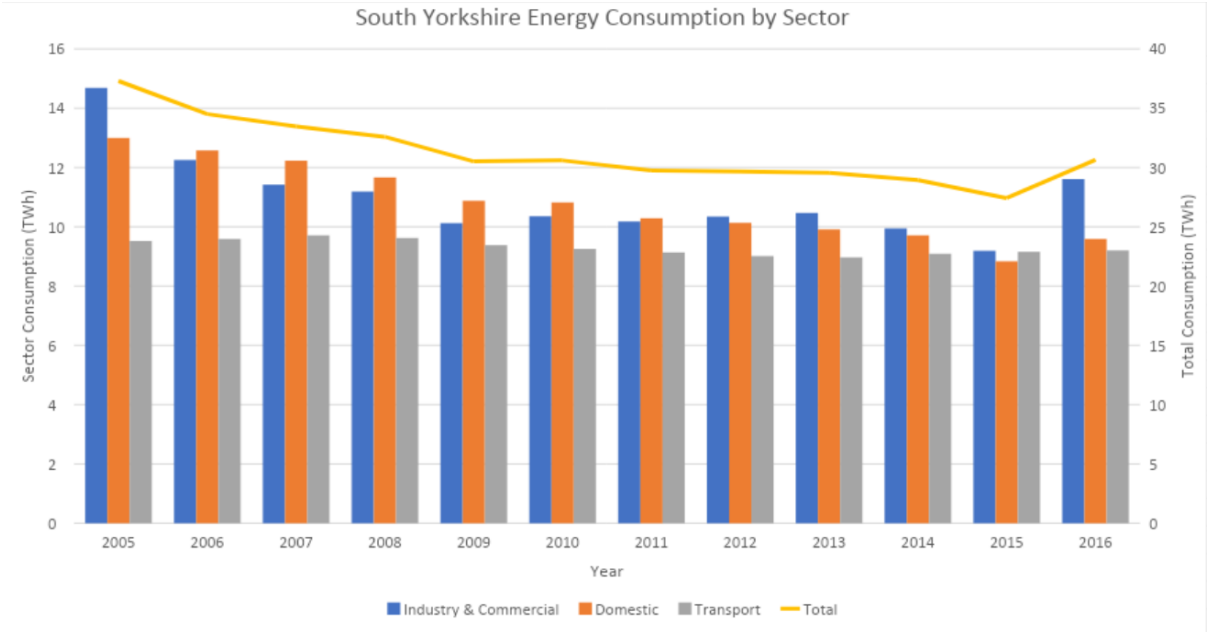


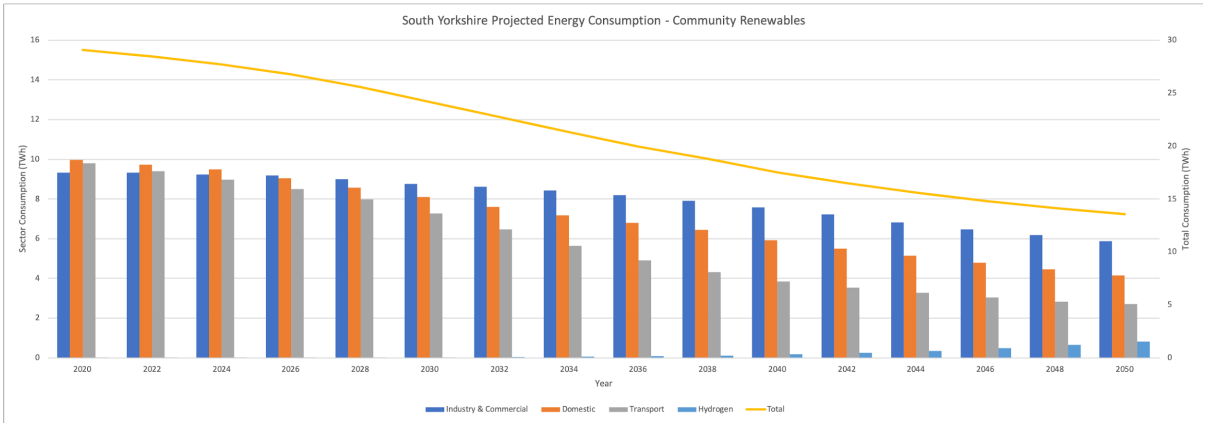
Figure 1: South Yorkshire Energy Consumption by Sector

Some aspects of a national decarbonisation programme are best managed at the national scale, while others are best managed regionally. For example, most industry sector scenarios indicate that demand for materials in the industrial sector (steel, cement, etc.) will increase by between 45 % to 60 % by 2050 relative to 2010 production levels. To achieve an absolute reduction in emissions from manufacturing processes within the industry sector will require a broad set of mitigation options going beyond current practices. Options fall into the following categories: energy efficiency; emissions efficiency (including fuel and feedstock switching, carbon dioxide capture and storage); material efficiency (for example through reduced yield losses in production); re-use of materials and recycling of products; more intensive and longer use of products; and reduced demand for product services. The industrial sector depends on different types of national policy (funding for research/innovation, grid energy mix, demand for products) (IPCC, 2014), so in the medium to long term it is important that SCR helps to shape relevant national policies and strategies, and works with high carbon industries to reduce carbon emissions through innovation via e.g. lightweighting, electrification etc. However, in the short term it is important that the SCRES focuses on the areas that are best managed regionally, prioritising sectors where the opportunity for regional intervention overlaps with significant energy use.

For this reason we focus on Domestic Energy Use and Transport. These are the areas where we have most control and where the biggest wins are to be achieved. Importantly, in all our scenarios, demand in these sectors must significantly reduce, as set out in the following sections.

Explainer: modelling used in this report

We can make predictions about what GHG reductions will look like into the future, under different demand scenarios. As a starting tool we have used the National Grid Future Energy Scenarios (FES) toolkit. This is an Excel based modelling tool that allows the exploration of different energy mix scenarios. National Grid use four different scenarios to illustrate different speeds of decarbonisation and levels of decentralisation. To apply these models to the SCR we have scaled them by the energy demand in each key sector (domestic, transport and industrial) based on historic energy consumption. This allows a simple model of future energy sources to be built. It begins to model the scale of reductions necessary to meet the ambitious targets being set by local authorities in the UK (e.g. Glasgow and Sheffield). The FES 'Community Renewables' and 'Two Degrees' scenarios are consistent with significant decarbonisation and are in line with the government's previous 2050 target of an 80% CO_2 reduction from 1990 levels. The main difference between these two scenarios is that Community Renewables involves a higher level of decentralisation. These scenarios, however, are not yet consistent with the more recently announced Net Zero targets. Updated FES are expected and will include a significant component of carbon capture and storage/utilisation.



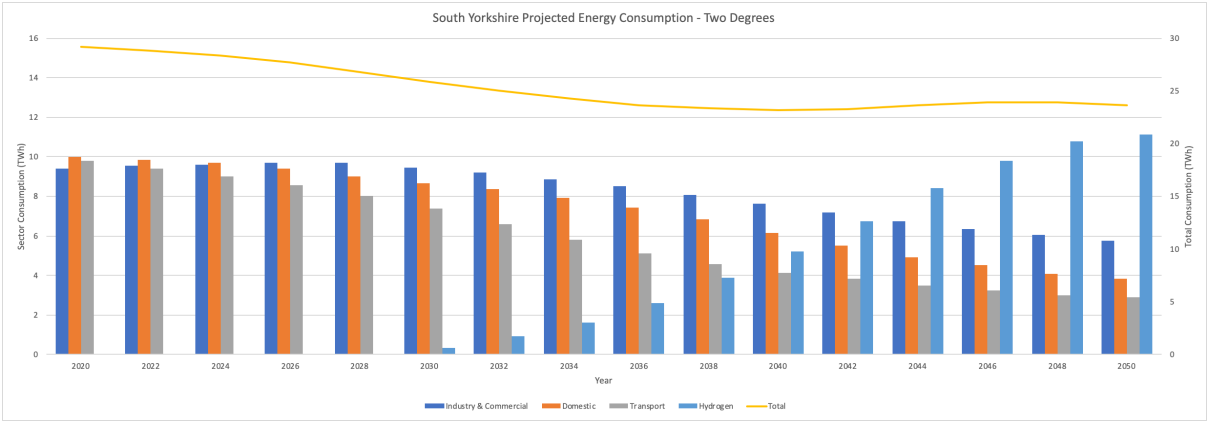


Figure 2: South Yorkshire Projected Energy Consumption by Sector in Different National Grid Future Energy Scenarios (FES). Note that these scenarios are not yet net zero. In FES Net Zero is mostly achieved by substantial bioenergy carbon capture and storage (BECCS). The energy demand (from electricity and gas) required to produce hydrogen energy is included as a separate column to show the distinction between scenarios involving higher and lower levels of decentralisation. SCR should be aware of the big differences in infrastructure requirements of the transition to a significant hydrogen economy (as in the Two Degrees scenario). In all scenarios there is a significant reduction in energy demand - of between 25% and 50%.

3. Domestic emissions

Domestic energy consumption in SCR is currently dominated by gas, which accounts for 77% of total consumption. Electricity makes up another 21% of domestic consumption (Figure 3). To achieve Net Zero by 2050, FES predicts that the average home will need to use 36% less energy than a typical home today, which requires a rapid reduction in the energy used to heat residential buildings. This needs to be achieved by both improving thermal efficiency of domestic buildings, and by moving away from gas as a heating fuel. Currently the housing stock in SCR has a relatively low average EPC rating of D (Figure 4), which although not unusual in a UK context, means that there is much room for improvement in terms of insulation.

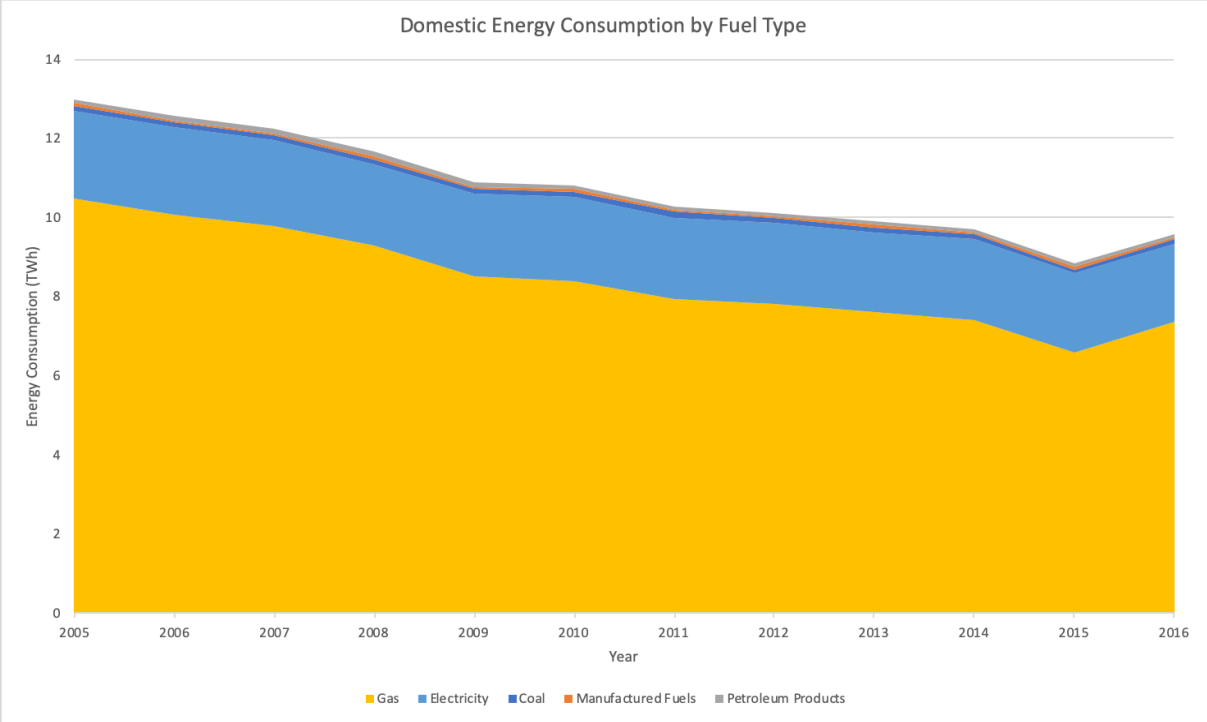


Figure 3: Historical South Yorkshire Energy Consumption by Fuel Type

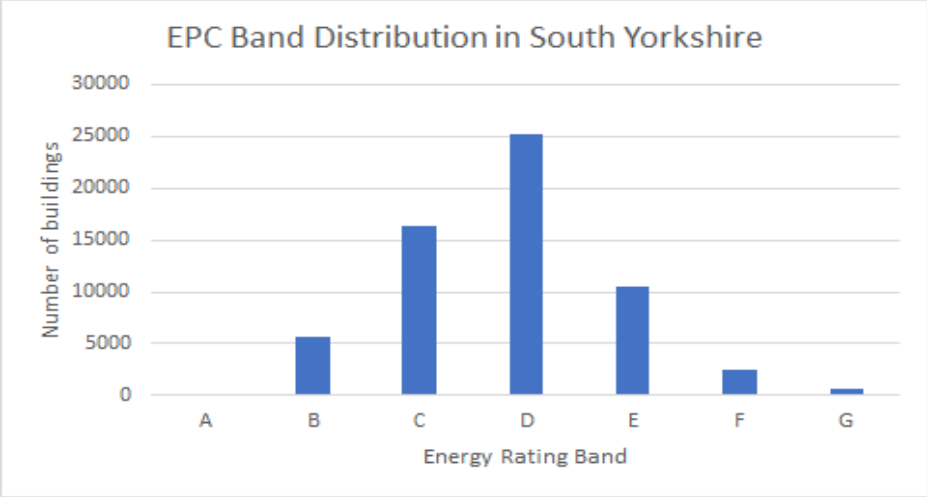


Figure 4: South Yorkshire EPC Band Distribution in South Yorkshire (60,941 Buildings)

As shown in Figure 5, according to FES both of the 2050 target-compliant scenarios require a 78% reduction in domestic gas consumption by 2050 compared to current levels. To achieve Net Zero by 2050, an even larger reduction will be required, meaning almost all domestic heat demand will need to be met by electricity and hydrogen.

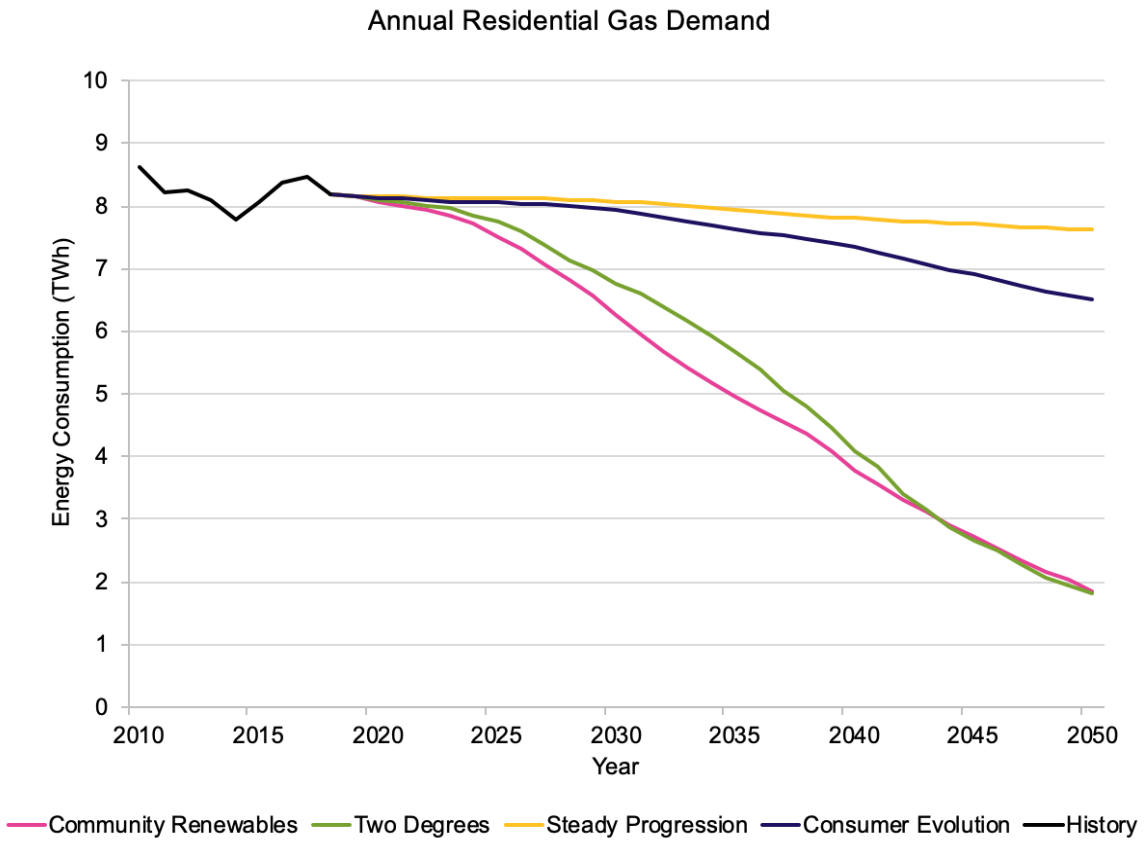


Figure 5: Projected SCR domestic gas reduction by FES scenarios.

3.1 Key benefits of reducing domestic emissions

A strategic intervention to improve housing stock efficiency (and decarbonise heating) would have a number of significant societal benefits for the region. First, **jobs would be created**, which would need to be underpinned by a comprehensive training programme to upskill workers.

Second, improving the efficiency of housing stock in the region would have a **significant impact on household fuel poverty**. Sheffield, Doncaster and Barnsley have almost identical rates of household fuel poverty (Appendix 5). There are three types of neighbourhood that exhibit high levels of fuel poverty:

1. Areas with a high proportion of BAME residents either predominantly living in rented accommodation or in owner occupied housing.
2. Areas of student accommodation in inner-urban Sheffield (e.g. Crookesmoor)
3. Inner-urban areas of Doncaster with high percentage of rental properties (e.g. Hexthorpe).

These types of neighbourhoods also tend to have buildings with a low average EPC rating (See maps in Appendix 6). All these three areas share the common trait of terrace housing dating from the mid 19th century through to 1910 predominating the housing stock and, although they are not necessarily the areas of highest deprivation, they are all in the lowest 20% Index of Multiple Deprivation cohort. Tackling fuel poverty effectively requires a geographically targeted approach that is able to engage with a variety of ethnic communities, private sector landlords and student organisations.

Third, improving the household energy efficiency of those experiencing fuel poverty could **positively impact on health outcomes and reduce pressure on local NHS services**. In young children cold homes have been linked to weight gain, asthma (due to mould, dust mites and damp), cardio-pulmonary disease and increased hospital admissions (Dear and Mcmichael, 2011). These health conditions often have impacts throughout the life course, can affect school achievement levels, and represent a large economic burden in terms of healthcare costs and lost working days.

3.2 Interventions to reduce domestic emissions

We believe that there is much more work to do in finding interventions that are both effective and socially desirable. As such, the below should be seen as a provisional list.

3.2.1 Reducing energy demand for heating

Retrofitting existing homes with insulation and draft reduction and ensuring new builds are insulated to the highest standard is a proven method to reduce household emissions from heat, as well as providing the benefits discussed. These could be subsidised or otherwise supported by SCR.

The region also needs to invest in low carbon domestic heating systems. From 2025 gas heating systems will no longer be allowed in new homes, and retrofit programmes should

include replacing gas based heating systems with electric (heat pump or resistive heating, hydrogen or in some cases biomass systems). The choice of technology should be planned at regional level to take into consideration local electricity grid capacity, heat availability (from mine water for example) and access to Hydrogen gas and district heating networks. An example of how such a programme of retrofit could work is given by Energiesprong, a Dutch organisation (https://www.energiesprong.uk/). Changes in regulation were coordinated with investment and a first market through the social housing sector. SCR has the skills within The University of Sheffield to drive the acceleration of this work through data analytics and advanced manufacturing.

In the short term some progress can be made by reducing the carbon intensity of natural gas by blending hydrogen with domestic heating gas. This approach can deliver carbon savings of around 5%. However, this method is still being trialled and undergoing safety tests. It is doubtful whether such an approach has the necessary impact in terms of carbon reduction in isolation, although it could form part of a suite of interventions.

There is also significant potential in the region to use mines for heat storage (see Appendix 7 for more detail).

3.2.2 Community energy

Since community renewable projects feed into the distribution network, they can be conceptualised as a demand reduction measure. Similarly community energy storage could also be important, e.g. where community scale batteries store community produced renewable energy to increase self sufficiency and self consumption. The recent change of policy by the UK government has had a negative impact on community renewables capacity, and will be aggravated by the plans to increase VAT on panels and batteries. The SCR has the ability to create an environment where community energy can be encouraged and facilitated. This can be done by boosting community energy schemes and implementing community energy in housing/spatial planning. The largest engaged programme in the SCR addressing fuel poverty and household interventions in energy conservation is run by the Sheffield Energy Centre based at Heeley City Farm, Sheffield. To demonstrate the ‘hand to mouth’ contract nature of this work and the consequential difficulty in planning and delivery such service options, a list of contracts totalling less than £100,000 over four years, including sources of funding and targeted outcomes, is provided for the Sheffield Energy Centre for 2018-19 (See Appendix 8). Central to putting the financial footing for such programmes on a firmer basis right across the SCR is the Mayor’s Community Energy Fund which could be used to support current initiatives as well as new initiatives across the SCR.

3.2.3 Household energy use

Sustainable additions to the home, such as second generation smart meters (SMETS2) and smart appliances, may enable households to better manage their energy use. While these metering devices do not currently contribute to significant energy demand reduction on their own, they do enable energy companies to manage homes within the smart grid and this can have a significant impact on overall decarbonisation through greater utilisation of renewable sources of electricity. These devices can also support households to make lower-carbon

decisions through education and awareness, for example improving understanding of appliance energy labels.

4. Transport emissions and interventions

Given the emphasis placed on transport related emissions in this document, it is essential that there is close alignment between the SCR Energy Strategy and the SCR Transport Strategy.

In terms of land use, SCR is relatively mixed for a region that could be described as a semi-urban conurbation. As might be expected, the majority of road transport emissions stem from private cars, with most of the remainder accounted for by road freight vehicles (Figure 6). Buses represent a relatively small proportion of emissions.

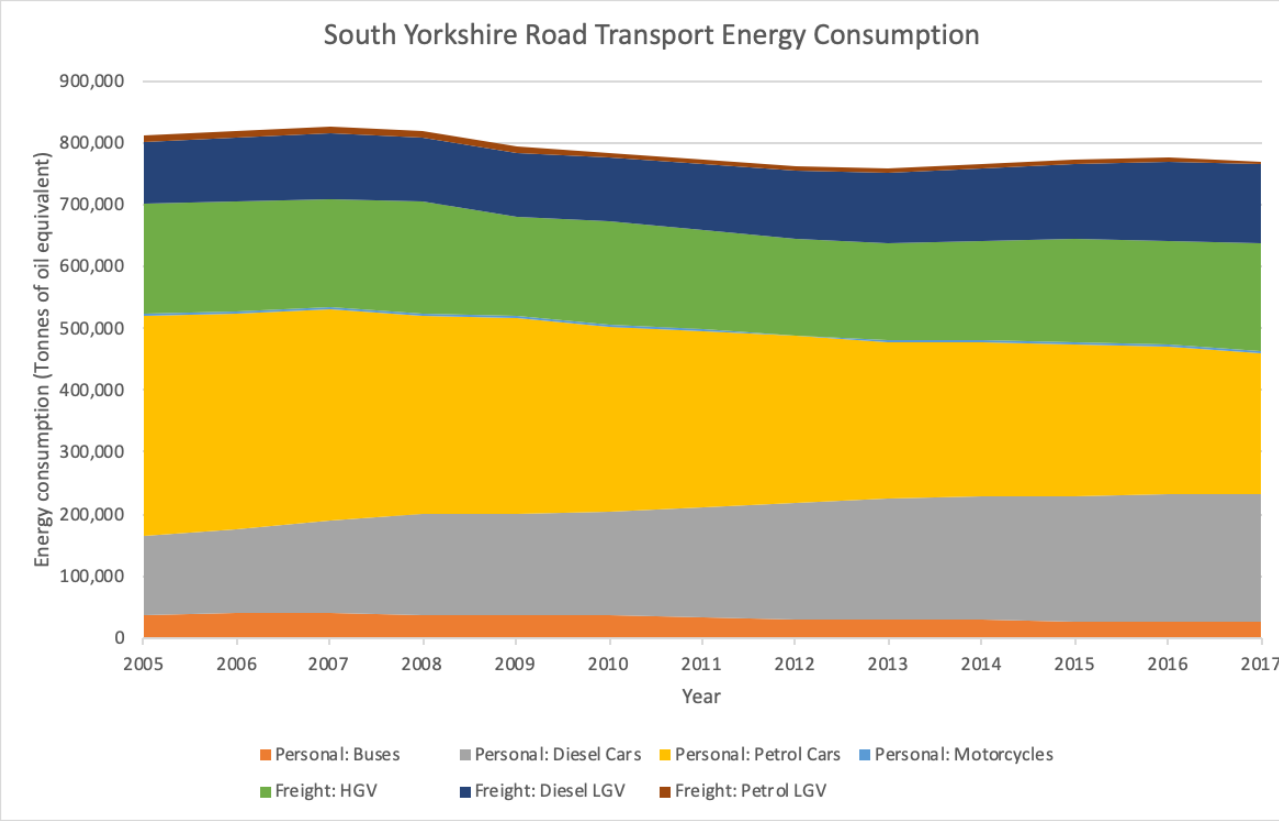


Figure 6: South Yorkshire Road Transport Energy Consumption

As can be seen in Figure 7, to meet the 2050 Net Zero carbon target, petrol and diesel will need to be phased out completely in favour of electricity, hydrogen and a small proportion of natural gas. At the same time, overall energy expenditure on transport will need to decrease by around 70%.

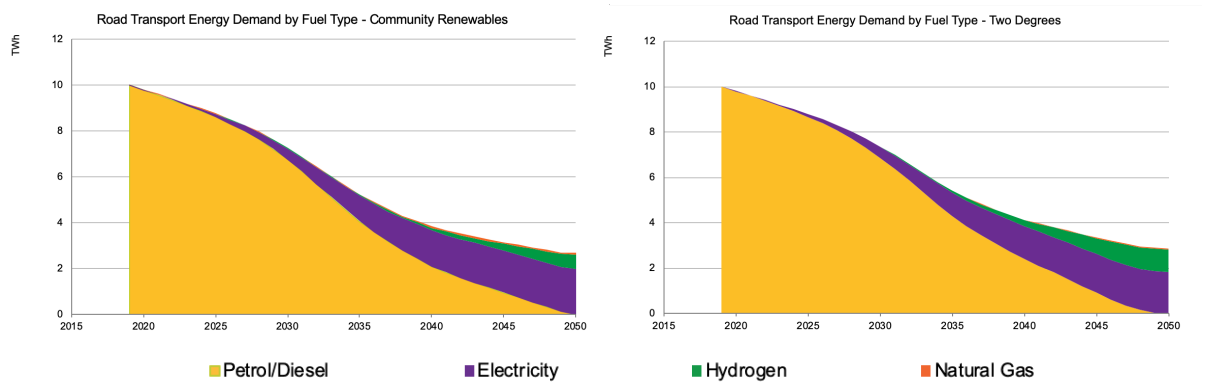


Figure 7: Projected South Yorkshire Road Transport Fuel Mix to 2050 for 'Community Renewables' and 'Two Degrees' Scenarios

4.1 Key benefits of reducing transport emissions

There are several key benefits of reducing emissions from transportation in SCR. Strategic support for more **active modes of transportation (walking / cycling) will improve citizen health**. Gross Domestic Product of SCR transport is £500m alone (Trading Economics, 2019), and **significant commercial opportunities** could arise out of the Zero Carbon transition (both through the provision of transport and the indirect benefits of improved transport on the local economy). The region should be ready to take advantage of them, rather than trying to align the transition with the current existing strengths of the region. Finally, **air pollution would be significantly reduced.**

Air pollution adversely affects human health through exacerbating respiratory conditions, and has recently been estimated to account for up to 500 premature deaths per year in Sheffield. Air pollution also causes chronic conditions that result in lost working days. These have estimated economic costs of around £160 million per year in Sheffield. Current air quality policies are in place, although in Sheffield several air quality objectives have been exceeded (the annual average level of nitrogen dioxide, the hourly mean level of nitrogen dioxide and 24-hour mean level for fine particles), meaning overall air quality has not improved, particularly in places near motorways and busy trunk roads.

4.2 Interventions to reduce transport emissions

There are areas where SCR is well placed to deliver improvements, as well as the associated benefits. LEPs are expected to deliver major local transport schemes, and SCR published its transport strategy in March 2019 (Sheffield City Region Local Enterprise Partnership, 2019a). The main goals of the strategy are:

- Residences and businesses connected to economic opportunity
- A cleaner and greener Sheffield City Region
- Safe, reliable and accessible transport network.

However there is now a need to review the region's transport strategy to ensure it aligns with the emerging Energy Strategy, and that it contributes towards the Net Zero Carbon target. Both documents should be mutually supportive. The current transport strategy does not prioritise the

need to reduce carbon emissions and energy use, nor does it consider how suggested changes could be implemented - such as through further devolution (Sheffield City Region Local Enterprise Partnership, 2019b). Similarly the current Energy Strategy mentions the transport strategy, but does not acknowledge the importance of increasing use of public transport and active transport towards reducing carbon emissions, as well as electrification. These conflicts must be addressed.

The University of Sheffield and Sheffield City Council are part of the DecarboN8 project, led by the University of Leeds (EPSRC, 2019). Partners across the North of England will collaborate to identify and evaluate approaches to decarbonise the transport sector. The project will look specifically at how cities can switch to electric vehicles and how different decarbonisation management strategies interact. SCR should seek to be an active partner in this research project.

In terms of suitable interventions for SCR, we will follow the four approaches identified by the IPCC (2014) to reduce transport emissions, which are: avoidance of journeys; shifting to more efficient modes (such as from private cars to public transport, walking and cycling); improving efficiency; and switching to lower carbon fuels or energy carriers (for example electric or hydrogen vehicles).

4.2.1 Avoidance of journeys

Reducing transport activity can be achieved by avoiding unnecessary journeys in the following ways:

- Encouraging businesses to allow flexible working times and tele-commuting which would reduce rush hour congestion and number of journeys
- Widening support for school buses
- Shortening travel distances through densification and mixed-zoning of cities. (IPCC, 2014). The SCRES should include consideration of how SCR can work with local partners to ensure travel distances are considered in planning activities and regulations

4.2.2. Shifting to more efficient modes

Shifting transport choices towards more efficient modes such as public transport, walking, and cycling, can be encouraged by urban planning and the development of a safe and efficient infrastructure (IPCC, 2014). This is acknowledged in the current draft SCRES, although it does not identify how these changes might be delivered. The current transport strategy recognises that public and active transport also have further benefits, such as improved public health, greater social inclusion and access to economic opportunities.

One key SCR issue is low public transport use, and the current complexity of bus provision (Figure 8). This may be explained by an over-reliance on a market-led approach, meaning that routes with low demand have been abandoned altogether, reducing the catchment area, and bus times are limited and inconvenient for many users.

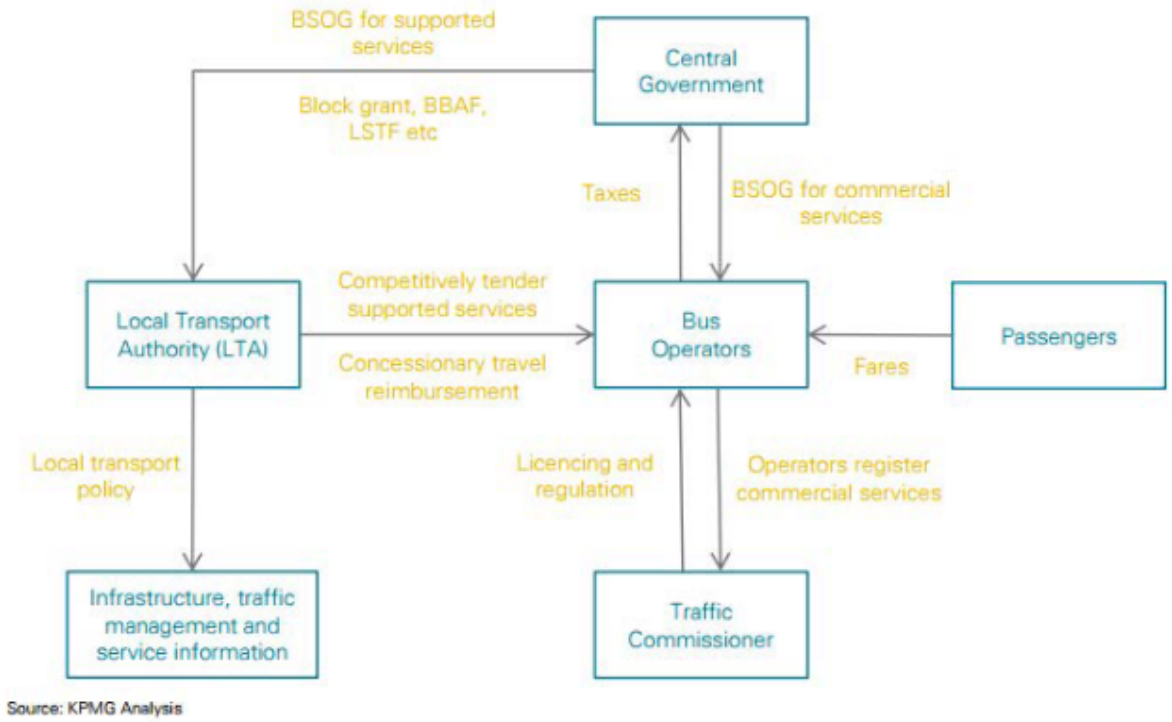


Figure 8: The UK System for Bus Service Provision (KPMG, 2015)

Another factor is strategic coordination. Implementation plans for Rail, Active Travel, Roads and Strategy Transport Network are all currently being worked on, although they are at different stages of development. These plans will need to be developed coherently to align with each other and with the SCRES. Air quality and future mobility are seen as cross-cutting issues across these plans, but to develop a more coherent strategy for the region, decarbonisation should also be considered as a cross-cutting issue in transport. This is particularly relevant when there appears to be more progression on developing the implementation plan for roads rather than for more low-carbon transport modes.

It is also worth mentioning that emissions from air travel are not captured in our models, however the proposed expansion of Doncaster Sheffield airport and the necessary associated extra infrastructure is unlikely to align with energy and emissions strategies for the region.

4.2.3 Improving efficiency

Encouraging improvements in the performance efficiency of vehicles and engines is best tackled at a national level by influencing manufacturers and raising public awareness (e.g. properly inflated tires improve miles per gallon, using the correct grade of motor oil and keeping the engine tuned can increase fuel efficiency). Similarly optimizing operations and logistics (especially for freight movements) can also result in lower fuel demand, and is probably best tackled nationally (IPCC, 2014). However, at a regional level SCR could employ approaches that improve traffic flows and reduce emissions from congestion, such as improving public transport infrastructure, and advocating for Low Emission Zones.

4.2.4 Switching to lower carbon fuels and energy carriers

Switching to lower carbon fuels and energy carriers is technically feasible, such as by using sustainably produced biofuels or electricity and hydrogen (when produced using renewable energy) or other low-carbon technologies. (IPCC, 2014). Encouraging private and freight vehicles to be electric, hydrogen or hybrid is part of the SCR implementation strategy for a low carbon transport system. However, it does not address how this should be done. This will involve SCR advocating at a national level for policy changes, supporting appropriate incentives to switch fuel type (at the moment, EVs can only be promoted to those with the means to purchase), as well as addressing barriers such as availability of charging points locally.

The SCR transport strategy acknowledges that private vehicles should be used '*primarily for trips that cannot be made by sustainable alternatives, such as public transport, walking and cycling*'. This demonstrates a recognition that electrification of transport alone is not the solution to decarbonising the sector.

5. The politics of change

Our core argument here is that a business as usual approach cannot bring about the decarbonisation required, and therefore cannot deliver the economic and societal benefits desired by policy makers. In this section we therefore set out an alternative approach, examining the national political context; the strategy for implementation; and finally the argument for a devolved response to the climate emergency.

5.1 National political context

In 2017 (HM Government, 2017), BEIS requested that the devolved regions of England create energy strategies to support the long term goals of decarbonisation. These strategies have become even more important since the UK government has committed in law to a Net Zero Carbon target.

Currently action from central government is behind where it should and could be (see Appendix 9 for diagnosis of current policies). Some headway has been made decarbonising the power sector, but lack of progress is particularly stark in the sectors upon which this report has focussed. Transport is the UK's largest emitting sector, and emissions from buildings were higher in 2018 than in 2015, partly due to weak policies addressing emission reduction in the area. However, as momentum for climate action increases, SCR governance should be prepared to act dynamically according to, and exceeding, national policy.

Explainer: policy commonalities between future scenarios

See Appendix 10 for expected future policy scenarios. There are some policies that all the scenarios share. These are useful to identify, since they represent low risk areas that should be prioritised for strategic development. They include:

- Strong, no regrets policy action can be taken immediately to improve the thermal efficiency of housing, and to accelerate the decarbonisation of domestic heating
- Prioritisation of active transport and efficient public transport networks
- Installation of smart EV infrastructure (although the amount varies)

While this report has focussed on reducing the region's emissions, there is a consensus that regions must also focus on adapting to the impacts of climate change. SCR is particularly vulnerable to climate induced drought and flood events (Hunter, 2019; Blöschl et al, 2019). Extreme heat events are also occurring with more intensity and frequency (Kendon et al, 2018). The 2018 National Adaptation plan asks local authorities to "Embed climate risk management in the built environment; strengthen the climate resilience of infrastructure; address and build resilience to the health and wellbeing impacts of climate change; address climate impacts on Business and Services" (DEFRA, 2018). No regrets policy planning and implementation can be taken immediately in these areas.

5.2 Strategy for implementation

There are currently two other key strategies being written by SCR: the 'refreshed' Strategic Economic Plan (SEP) and the Local Industrial Strategy (LIS). It is important that these strategies are consistent with the Energy Strategy, which will present challenges because decarbonising economies cannot be achieved whilst continuing business as usual. For example, sectors of the economy which are often argued to be central to economic development, like aviation, must be deprioritised in favour of other sectors (Vogel et al., 2019). Yet integrating climate action with broader economic strategy will also present considerable opportunities such as increased jobs in building retrofit and public transport; these should be identified and quantified by SEP and LIS.

Making strategies consistent with one another is important, but how should SCR think about the challenge of implementing the Energy Strategy? Broadly, SCR has three options:

1. **Try and do everything but probably fall short.** SCR currently has limited powers to effect change in the region. Nonetheless, SCR could write a strategy that tries to negotiate its way to Zero Carbon using these powers. This would be an exercise in compromise, since it would have to align with the priorities of local industries and the higher profile companies in the region. It could pay lip service to the other regional strategies and plans without really addressing the key purpose of the Energy Strategy - i.e. decarbonisation.
2. **Do nothing (by design).** The braver and more honest approach is to openly acknowledge that currently SCR only has very limited powers to intervene in the region's

GHG emissions. The SCR strategy could say this and pass back responsibility to central government.

3. **Ask for the powers to implement effective interventions.** We believe the right thing to do is identify the powers that are needed to action decarbonisation at the regional level and then to go back to central government to ask for these powers by negotiating a Local Energy Devolution Deal - as proposed in Dan Jarvis' Manifesto (Jarvis, 2018). The next section gives more detail about what this proposal might contain.

5.3 The argument for a devolved response to the climate emergency.

It is worth noting that if we see more action from central government then local energy strategies could conceivably become less important (see Appendix 10). However, in the event that we see strong climate action from central government, it is still likely that action would be needed at a local level. Indeed, there are certain sectors where interventions at a local level are necessary. One of the main reasons the decarbonisation of transport and domestic sectors has stalled is that action is required at the local level, yet regional and local authorities lack both the obligation and capacity to confront carbon emissions (Willis, 2019). As authorities in SCR voluntarily take on the obligation by announcing climate emergencies, they must now find a way to build the necessary capacity.

We believe that for the Energy Strategy to have teeth, the mayor would have to ask central government to devolve substantial power to SCR. This would not be without precedent; London is the obvious example, and Andy Burnham is currently pressing for new devolution of powers to Manchester. SCR's mayor could justify the demand for devolution by appealing to the UK's newly amended Net Zero Carbon legislation, which when taken seriously will entail urgent action at all levels of government.

What sort of powers could the mayor ask for? Detailed work needs to be done, but as a starting point it is instructive to look to a report produced by SPERI and CLES in 2016 (McInroy et al., 2016), which argues that devolution should '*[enable] local authorities to forge a progressive social, economic, democratic and environmental future*'. Drawing from this, three powers to underpin a climate emergency could be powers to borrow, to manage transportation, and to control local employment policy and support. These would have wide ranging applications, but the following examples illustrate the point.

1. Powers to control borrowing and to manage transportation would allow the SCR's authorities to revitalise public transport, an essential step to reducing the transport sector's emissions and to achieve national government's goal to ensure citizens *'choose the most sustainable mode of travel'* for each journey they take (HM Government, 2018).
    a. There is evidence that the current methodology that governs investment in infrastructure is biased towards the South East (Coyle and Sensier, 2018), meaning valuable infrastructure projects that would drive the development of regional transport infrastructure currently struggle to get funding.
    b. Given new powers to borrow, SCR could invest in local rail, for example Stocksbridge to Sheffield City Centre (donvalleyrailway.org, 2019), and at the same time take control of buses (an idea that is gaining support at the grassroots

level (ACORN, 2019)), to ensure fast, affordable, and integrated public transport throughout the region
    c. It has been demonstrated that improved public transport results in robust economies (e.g. Campaign for Better Transport, 2014; Mackie et al, 2012).
2. Powers over borrowing would also allow enable the aforementioned Mayor's fund, which could support domestic and council owned renewable projects, domestic insulation schemes, and development of low carbon heating solutions. There are several examples for Energy Service Companies (ESCOs) in the UK that provide potential models for SCR, including Robin Hood Energy (RobinHoodEnergy, 2019). This model could be expanded from energy generation and storage to also include assets such as low carbon buses/taxis.
3. As noted earlier, research shows that there are considerable commercial and employment opportunities that will arise out of strong climate action in the region (Baxter & Cox, 2017; Robins et al, 2019).
    a. The SCRES should take aim to take advantage of these opportunities, and not rely too much on aligning a low carbon transition with the current existing strengths of the region.
    b. Therefore, a key pillar of moving to a low carbon economy must be a just transition (Page, 2019). This means genuinely supporting people whose jobs have been displaced, or businesses have been impacted by the changing economy. With a higher proportion of workers employed in high carbon industries, SCR will be more impacted by this shift than other regions (Robins et al., 2019). Local authorities are best placed to understand local labour markets and provide appropriate support, which they can best accomplish with control over employment policy and resources.

Even the brief examples above have the potential to be extremely popular with citizens of SCR. As detailed earlier in the report, reducing demand in the domestic and transport sectors comes with a host of direct benefits to citizens in SCR. A fifth of households in SCR are in fuel poverty and would benefit considerably from high quality insulation and heating systems. Air quality is at illegal levels in numerous parts of the region, something that cannot be tackled without addressing private car use, which in turn requires fit for purpose public transport. Improving transport links is a proven way to create jobs and strong local economies. Most politicians recognise that a just transition is desirable, but it is usually spoken about abstractly; much more concrete is actually providing the support and training required for people to move to new high quality work created by the low carbon transition. This is a politically feasible project that would have significant benefits on the region's social, environmental and economic capital.

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Appendices

Appendix 1: The Provocation Exercise Process

This Provocation Exercise involved the following steps:

- The collation of feedback from UoS academic and professional services staff on the Jan 2019 draft of the SCRES in March 2019
- An internal facilitated workshop for 28 participants in June 2019 to widen out the pool of UoS respondents and a series of interviews with key UoS employees. Workshop participants included:
    - Dr Sol Brown
    - Dr Rob Marchand
    - Dr Alistair Buckley (Energy Institute)
    - Keith Lilley (Director of Estates & Facilities Management)
    - Professor Tony Ryan (Grantham Centre for Sustainable Futures)
    - Jenny Patient
    - Dr Alan Dunbar
    - Dr Janice Lake
    - Yasmin Knight
    - Dr Nick Taylor Buck
    - Professor Neil Hyatt
    - Katie Johnson
    - Dr Rachel Lee
    - Tom Wild
    - Sourabh Devardekar
    - Shruti Patil
    - Ismail Aboufirass
    - Carl Lee
    - Alex Riley
    - Rowena Harris
    - Phil Riley
    - William Mai
    - George Coiley
    - Dilek Arslan
- The collection of background research data relating to UK and SCR decarbonisation in the areas of transport technology, transport strategy, power generation, energy use, policy scenarios, building energy performance, land use impacts and opportunities, mine water heat sources, air quality, fuel poverty, community energy and the co-benefits of decarbonisation. This background data has been shared with SCR.
- The synthesis of this background data into recommendations and reviews. The culmination of which is this report.

Appendix 2: Parameters for the Energy Strategy

General principles for an Energy Strategy

1. Use clear and consistent terminology e.g. does “clean” mean zero or low carbon?
2. Science-based carbon targets should be adopted
3. Plan for meaningful participation of communities, businesses and other stakeholders - A diverse range of people and organisations will need to be involved for successful implementation of the strategy
4. Its structure should be easy to understand for a wide range of stakeholders and build on and communicate global, national and regional contexts. e.g. National goals > Establish energy baselines > Justify carbon targets and present scenario model > Establish strategic priority areas > Delivery plan
5. Its structure should be driven by goals and content rather than trying to duplicate the structure used in other SCR strategies
6. The SCRES should be explicit about social and environmental co-benefits and risks, such as fuel poverty and public transport infrastructure
7. It should use a “biggest first” approach and prioritise sectors where the opportunity for regional intervention overlaps with significant energy use
8. It should reflect national policy and ambition for carbon reduction i.e. moving away from a purely economic focus towards a carbon / climate focus
9. The SCRES should be rich in region-specific details that can have a significant impact
10. The SCRES should be aligned with other regional and local strategies, including the strategic economic plan, to capitalise on their interdependencies. This could be achieved under the umbrella of a region-wide Climate Emergency declaration from the Mayor
11. Regional planning policies should actively enable local energy initiatives (production, storage, integration and efficiency improvements) whether these are community led or commercially led
12. Impact statements should be bold and significant rather than focusing on e.g. solving “range anxiety”
13. Policies should have enough detail to evaluate, and it would be useful to see policies far more focused on fewer high impact interventions
14. The SCRES could make more explicit use of policy scenarios to aid decision making

Appendix 3: SCR Renewables Capacity

Fuel Type	SCR Draft (MW)	NPG capacity register (MW)
Solar PV	275	64.7
Natural Gas	4,796	705
Hydro	2	1
Waste	62	2

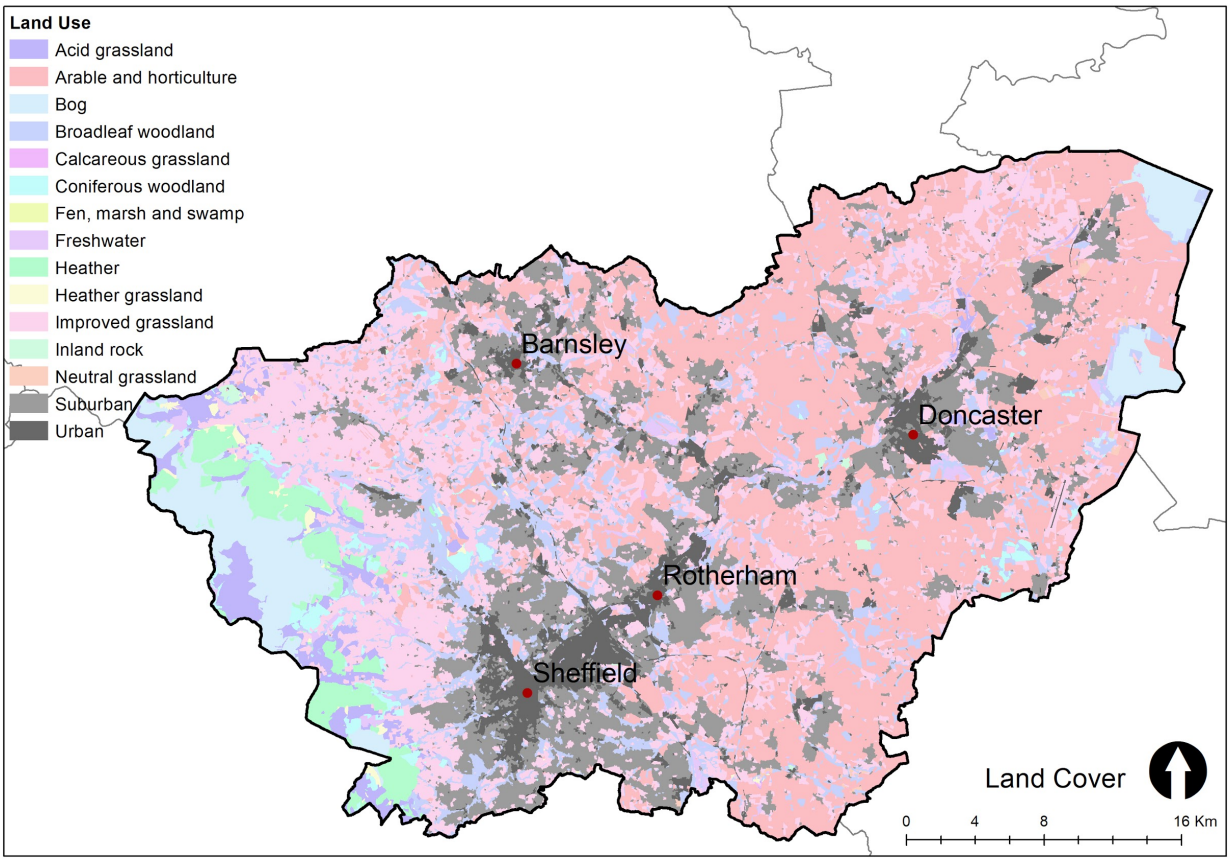
SCR Renewables Capacity as set out in current SCRES draft and Northern Power Grid Capacity Register. The difference between renewable generation capacity between the two different data sets is partly due to changes in the regional definition of SCR (this was originally South Yorkshire plus North Derbyshire plus North Nottinghamshire, but the new definition will be South Yorkshire only) but also partly due to differences in the source data used. NPG solely uses the renewables register maintained by Northern Power Grid. The table highlights the difficulty of monitoring deployed renewable capacity.

Appendix 4: SCR Land Types

Our agricultural areas are important elements of our clean energy and climate mitigation policy, as they cover majority of SCR region: 50%, 63%, 54% of the total land area of Barnsley, Doncaster and Rotherham, respectively. These areas could provide space for renewable energy generation through solar PV farms or PV combined with soil grown crops (Agrivoltaics).

Approximately 11% of SCR land is forest. Forestry currently provides 43.000 jobs in the UK and adds £2 billion to the economy.

Data from the Centre for Ecology and Hydrology and DEFRA were extracted to identify the land types and distribution within the SCR.



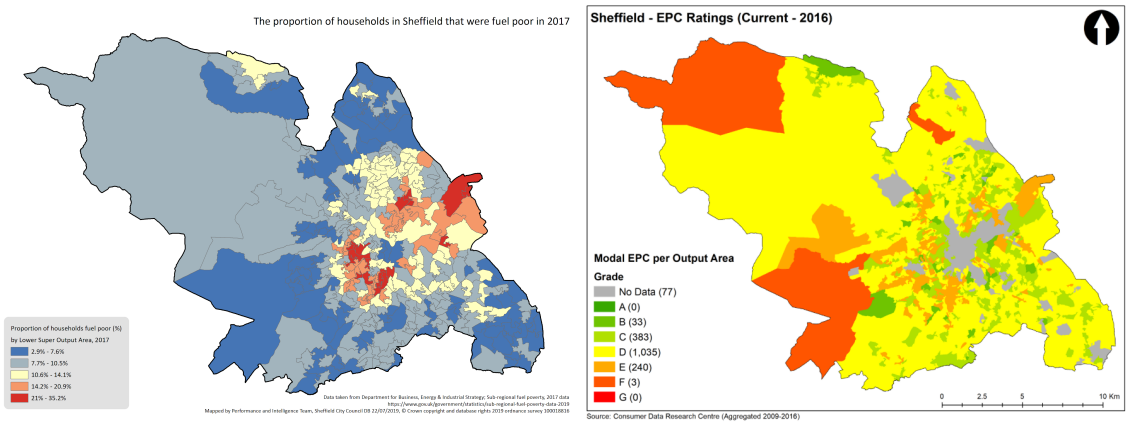
South Yorkshire Land Use Map

Habitat	Area (km²)	% of SY Area
Agriculture	781.2	49
Forestry	176.76	11
Industry	34.06	2
Landfill and Waste Disposal	0.51	0.03
Minerals and Mining	0.98	0.06
Offices	1.04	0.07
Residential	35.17	2.2
Retail	2.68	0.17
Transport	10.9	0.68
Water	22.7	1.42
Other	531	33.27

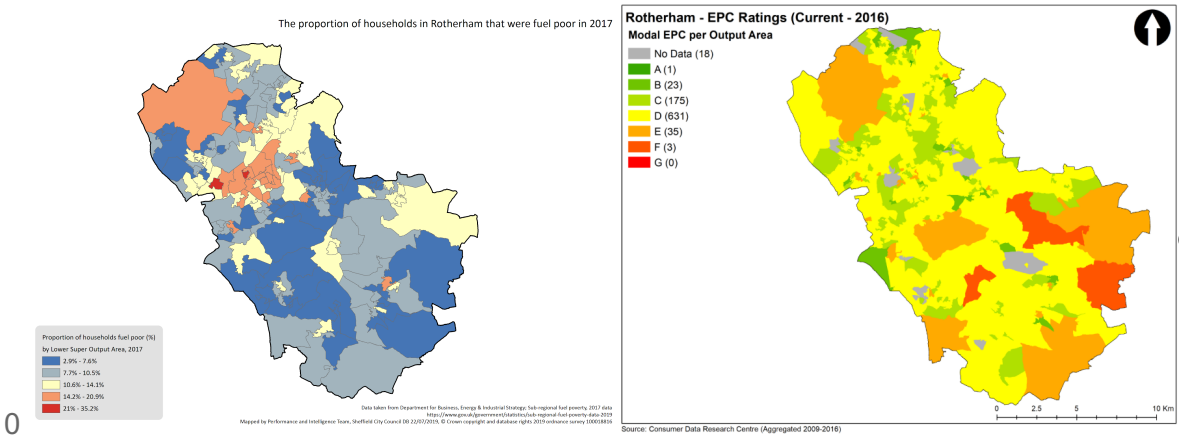
Appendix 5: Fuel Poverty & Household Disposable Income

	Fuel poor households	**Average annual household disposable income**
Sheffield	10.76%	£15,057
Doncaster	10.77%	£15,595
Barnsley	10.57%	£15,552
Rotherham	7%	£15,465

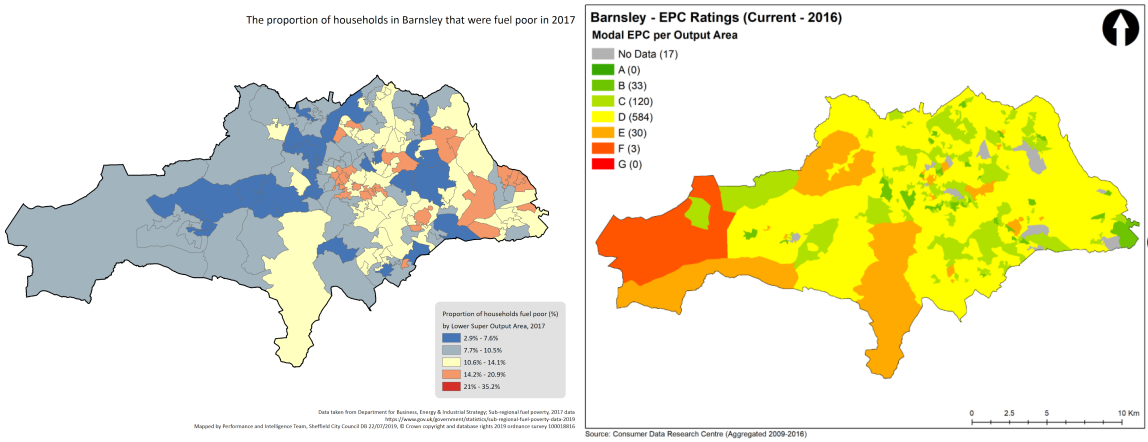
Appendix 6: EPC ratings and fuel poverty



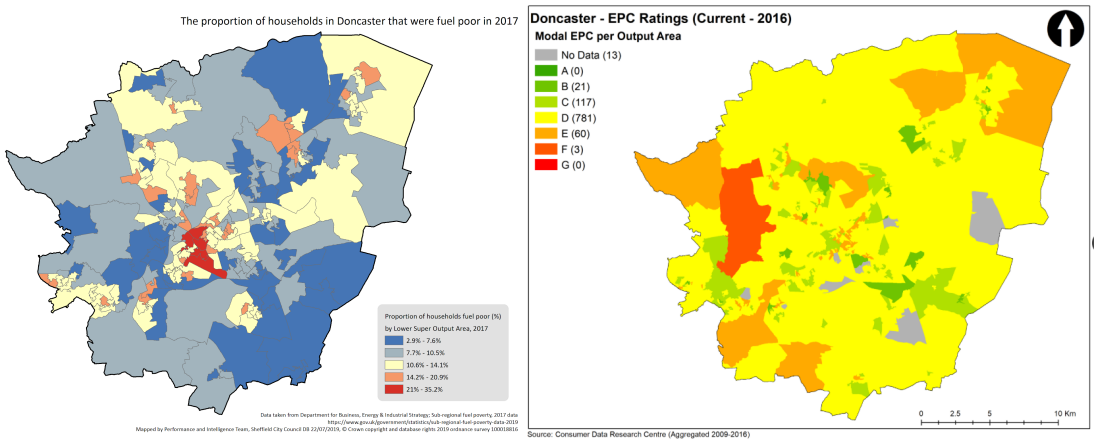
Sheffield



Rotherham



Barnsley

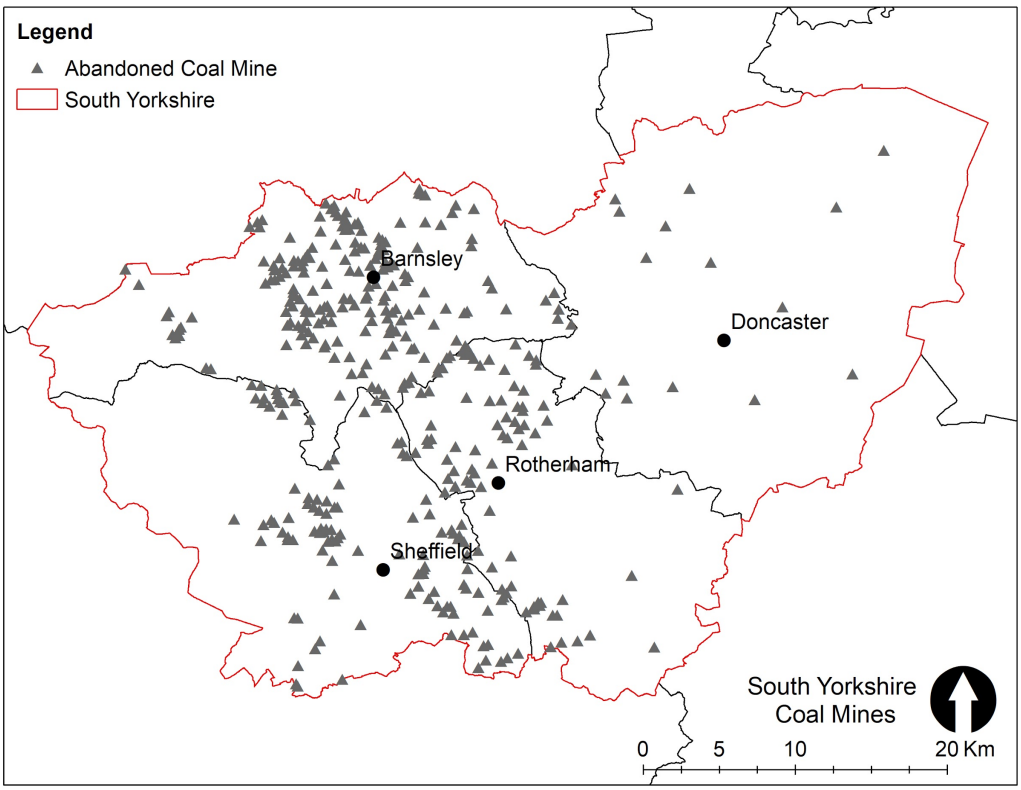


Doncaster

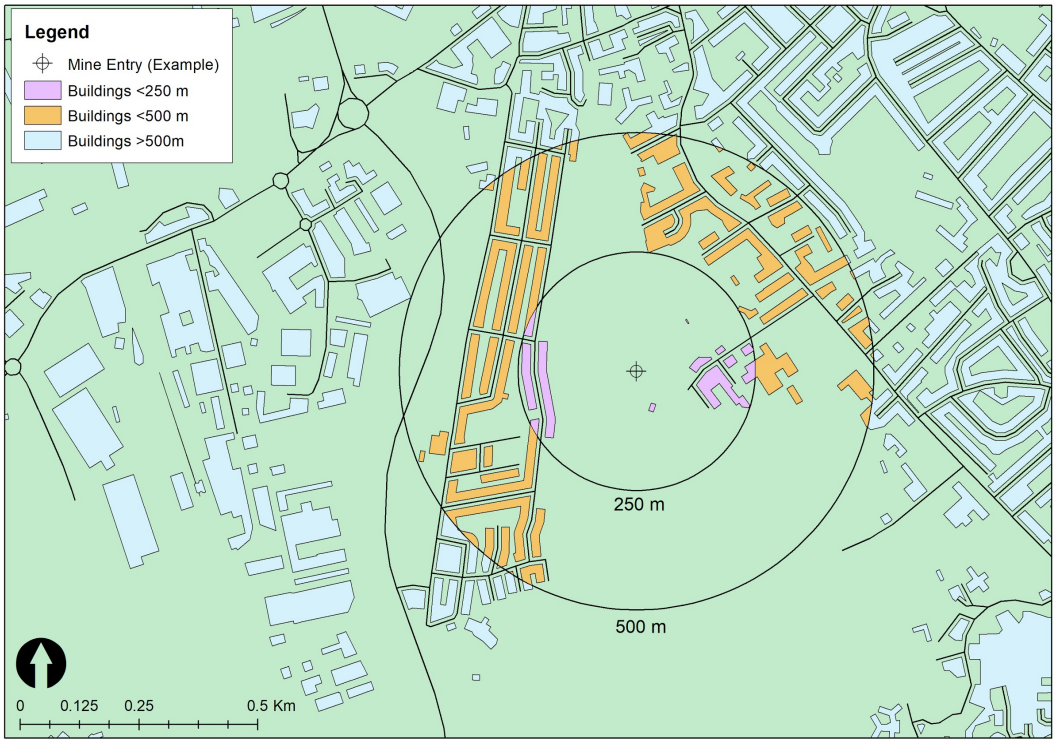
Appendix 7: Mines for heat

The SCR has a long history of coal mining, which rapidly declined during the late 20th century, resulting in an abundance of legacy abandoned coal mine networks in the region. Following mine abandonment, pumping efforts to keep mine workings dry and accessible are switched off, allowing for gradual rebound of groundwater levels within the system. Given the high volume and connectivity of flooded mine networks, there is potential to harness the thermal storage potential of such artificial aquifers through heat-exchange technology. Given that mine water temperatures can increase by 1-3°C with every 100m depth, and given the high efficiency of modern heat pumps, extraction of a few °C from mine waters can produce significant thermal potential. The thermal storage potential of abandoned mine systems can be used for both space heating (e.g. domestic heating, pre-warming of industrial machinery) and space cooling (e.g. cooling of industrial warehouses in summer, removal of waste heat from large-scale computing servers) (Banks et al., 2019).

Data adapted from the Northern Mine Research Society suggests a total of 402 coal mines in South Yorkshire, predominantly in the Barnsley and Sheffield districts (196 and 112, respectively), with a lower occurrence in Rotherham and Doncaster (78 and 16, respectively). To identify opportunities for mine heating/cooling in SCR, mine entries must be assessed on a case-by-case basis, primarily considering; the accessibility of mine waters (i.e. depth of groundwater and proximity of mine entry to end-user), the suitability of waters (e.g. mine water temperature and chemistry), and engineering aspects (e.g. the required heating/cooling demand, and efficiency of heat pump employed) (Ramos et al., 2015). An example feasibility study based upon building proximity to mine entries is provided below, whereby two radii of 250m and 500m are used to highlight the effect that increasing pumping distance can have on potential reach. Given the appropriate dataset (available from the Coal Authority), such desk studies could be performed for all mine entries in the SCR for each of the considerations listed previously, with areas of overlap being the buildings most-suited to this technology. Given the high degree of interconnectivity between variables (e.g. lower feasible pumping range for lower temperature waters), a thorough suitability assessment must be performed before candidate schemes proposed.



Abandoned Coal Mines in South Yorkshire



Example Feasibility Study (Proximity-Based)

Domestic mine water heating schemes have been successful elsewhere in the UK. In 1999, 16 new-build dwellings were provided with heat in Shettleston, Glasgow. Mine waters were extracted from 100m depth at 12°C, circulated through a heat pump, and returned at 3°C, producing water at a temperature of 55°C for use in domestic radiators and immersion heaters. As a result, annual heating costs were reduced to £19-30, and annual hot water costs reduced to £55-60 per annum per dwelling (2003 prices). Domestic heat pumps were also successfully used in 2001 to heat 18x 1950s three-storey tenement flats in Lumphinnans, Fife, indicating that retrofitting to existing housing is a possibility.

While the potential benefits of mine water domestic/district heating are clear, there remain obstacles to implementation which must be addressed, the key risks and considerations being (in no particular order);

1) The use of high Fe content mine waters (common for coal mine waters in the UK) runs the risk of ochre (iron oxyhydroxide) precipitation clogging heat pumps/pipes if water becomes oxygenated. This may be mitigated against by using a closed-loop system (immersed underground pipelines) rather than an open-loop (direct water abstraction) system, and regular maintenance schedules.
2) The risk of reinjected (cool) water breaking through mine pathways to the abstraction (warm) shaft, adversely affecting heat exchange potential.
3) Uncertain legal issues - must guarantee longevity of pumping operations and accept future liability for any resulting mine water pollution. This was one of the factors contributing to the failure of the proposed Shawfair development.
4) Borehole drilling, if required, would require costly licences and permissions which could add years to the payback period for smaller-scale schemes.
5) A long-term heating/cooling demand must be established in the vicinity of the mine entrance. For new builds, this requires a commitment to mine heating from project initiation.

Appendix 8a: SYEC Contracts and funding for 2018/19

Project title and funder	**Dates – from and to**	**Activities**	**Notes**
Scottish Power Energy People Trust Wiser and Warmer	December 2016 – March 2018	To support families and older people in some of the city's most hard to reach neighbourhoods providing peer-to-peer support around energy efficiency, affordable warmth and fuel poverty. Targets: 250 fuel poor/vulnerable individuals	Total grant, £49,425 Target achieved - reached a total of 772 vulnerable individuals – more than 3 times the original target.
Department for Business, Energy and Industrial Strategy and Citizen's Advice Bureau Big Energy Savings Network (BESN), 2018-19, across the city with focus in key areas: Lowedges Jordanthorpe and Batemoor; Darnall and Tinsley; Heeley and Sharrow	October 2018 – March 2019	Targets: 200 consumers 80 Front Line Workers	Funding £10,000 £8,000 paid in November 2018 £2,000 to be paid on completion of project Targets achieved – reached 205 consumers and 86 front line workers

National Lottery Awards for All Green bees – buzz around our energy trail	No start or end date set but aiming to develop over spring 2019 for delivery in the summer holidays	Eco detective trail and crafts around the Farm and in the Energy Centre	Funding £8,750 – paid November 2018 No formal reporting but photos of completed trail encouraged
PKW Heeley and Gleadless Community Partnerships Development programme Fuel poverty advice in Heeley and Gleadless areas	January 2018 – December 2019	Energy bills weekly drop-ins	Total contract £25k per annum for 2 years to support the delivery of health and well-being activities and the management of the Community Partnership
PKW Community Wellbeing Programme for Darnall and Tinsley Fuel poverty advice in Darnall and Tinsley areas	September 2018 – March 2019	2 drop ins Partnership meetings - attend at least one a quarter Carry out at least 10 face to face appointments or home visits.	Funding £1,350 Quarterly reporting through PKW channels
PKW Community Wellbeing Programme for Lowedges, Batemoor and Jordanthorpe Fuel poverty advice in LBJ in particular at the 2 local Foodbanks	2019-2020	To support the delivery of community based activity relating to ABCD outputs	Funding £1,750
Community Benefit Fund – Sheffield Renewables	March 2019 – February 2020	To work with 100 households in Sheffield in fuel poverty	Funding £2,400

Appendix 8b: SYEC Potential contracts and funding

Source	**Amount (£)**	**Notes**
Sheffield City Council	No current funding	Could propose that the Council buy the SYEC building as an asset and lease to the Farm on a peppercorn rent. Would demonstrate an investment in fuel poverty and climate change action for the city.
Individual Energy Companies	Approx £20k	Warm Homes Discount – industry initiatives scheme.
Esmee Fairbairn Foundation	Up to £20k	As part of our winter preparations offer – organise 'make do and mend' events to add linings to curtains, make draught excluders, make foot warmers and include our energy advice
Smart Meters GB	£25k	No date for applications currently but offered annually Target group is older people (60+) and involves highlighting the benefits of installing a smart meter
Energy Redress Scheme – Energy Saving Trust	Minimum grant is £20k – includes revenue and capital Total of £2.5m available for voluntary and community organisations	Applied in May 2018 but registration failed on the financial due diligence test of the Farm's accounts. Encouraged to apply again if the situation improves.
Northern Powergrid Partnering Communities Fund	£10k bid submitted	Applied in January 2018 – proposed project was a good match for the fund criteria but there were concerns about the financial viability of the Farm. Encouraged to apply again if the situation improves.

Ebico Trust	Bid for £40k submitted in January 2018	Application submitted in February 2018 – response 'plan was considered to be a worthwhile venture but there are a great many calls on the Trust funds and regretfully your application has not been successful on this occasion.' Encouraged to apply again.

Appendix 9: Current policies

Diagnosis of current policies and expected future policy environment

According to the UK Climate Change Committee, current policies are currently insufficient to meet UK decarbonisation targets: *'Progress in deploying measures to reduce emissions is off-track across transport, buildings, agriculture and land use. In these areas, progress to date is behind virtually every indicator we track, often by a wide margin.'*

Nonetheless, climate change will continue to gain political salience in the UK as the climate crisis worsens. As this document is being written, several countries in Europe are experiencing record breaking heat waves, attributed to climate change. Simultaneously, public opinion is already overwhelmingly supportive of taking climate action. Therefore, it is extremely likely that climate mitigation policy will become central to any administration's policy platform within the next few years. If the UK had a change in administration, climate policy is likely to accelerate even faster. For instance, the 2019 Labour Party conference passed a motion for a 'Green New Deal', which aims to get the UK's emissions to Net Zero Carbon by 2030.

1. Current national policies

1a) Legislated targets

The original 2008 Climate Change Act (CCA) legally bound the UK "to reduce [scope 1 and 2] carbon emissions and associated greenhouse gases by at least 80 per cent from 1990 levels by 2050" (FES, p. 31). In 2019, the CCA was amended to a net zero emission target by 2050. This new target permits international offsets, however it still constitutes a considerable increase in Parliament's ambition to reduce greenhouse gas emissions. The target does not include emissions from international aviation and shipping, which went against the recommendation from the CCC.

Parliament is responsible for delivering emission reductions according to a "a series of five-yearly carbon budgets. So far, the Government has set carbon budgets up until 2032, and these progressively reduce the amount of greenhouse gases the UK can legally emit in each five-year period" (FES, 31)

1b) Governance over targets

Since meeting the CCA's target is a statutory duty, responsibility to ensure that targets are met ultimately falls on the Prime Minister. However, currently responsibility for implementing the required changes in policy primarily falls with BEIS.

1c) Existing national climate change policies

These are some national policies already in place or promised.

Policies:

- Transport
    - Government will end the sale of all new conventional petrol and diesel cars and vans by 2040. “By 2040, we want cycling and walking to be the natural choices for shorter journeys, or as part of a longer journey… we are spending £1bn to drive the uptake of ULEVs [ultra low emission vehicles]” (clean growth strategy)
    - “Increasing the supply and sustainability of low carbon fuels in the UK through a legally-binding 15-year strategy to more than double their use, reaching 7% of road transport fuel by 2032” (road to zero)
    - “Continuing to offer grants for plug-in cars, vans, taxis and motorcycles until at least 2020.” (road to zero)
    - “Introducing a new voluntary industry-supported commitment to reduce HGV greenhouse gas emissions by 15% by 2025, from 2015 levels.” (road to zero)
- Domestic
    - Banning new gas boilers by 2025
    - Promised: £3.6bn to upgrade the energy efficiency of a million homes, with the Energy Company Obligation (ECO) extended to 2028 at its current level.
    - As many homes as possible” to reach Energy Performance Certificate (EPC) Band C by 2035. Private rental properties already have to meet E
    - Renewable Heat Incentive is already being reformed to focus more on long-term decarbonisation via technologies such as heat pumps and biogas. It will spend £4.5bn to support innovative low-carbon heat technologies in homes and businesses between 2016 and 2021.
- Energy
    - Unabated coal phase out by 2025
    - Offshore wind will compete for up to £557m in low-carbon support, confirmed yesterday but first announced in 2016
    - Innovation and collaboration to develop carbon capture, usage and storage, with a commitment to deploy subject to cost reduction
    - Carbon price floor capped at £18.08 till 2021
- Industry
    - £2.5 billion will be invested by the government to support low carbon innovation from 2015 to 2021
    - Develop a package of measures to support businesses to improve their energy productivity by at least 20% by 2030
    - To publish joint industrial decarbonisation and energy efficiency action plans with 7 of the most energy intensive industrial sectors
    - Energy Entrepreneurs fund to support the development and demonstration of state of the art technologies, products and processes
- Other
    - Research and development commitments
        - £900m between 2015 and 2021 in power sector
        - £265m to “reduce the cost of electricity storage, advance innovative demand response technologies and develop new ways of balancing the grid”
        - £177m renewables

    - £162m Energy Resource Process Efficiency

1d) Expected policy in the near-term

A white paper on energy policy was expected from BEIS in July '19, but due to political circumstances its publication has been delayed. Nonetheless, some more expected policy can be gleaned from a tranche of consultations released in the place of the white paper. These include:

- Citizens will part fund the construction of new nuclear generation through their energy bills, including taking on investment risks. This set-up is known as the Regulated Asset Base Model.
- Considering funding Rolls-Royce to develop advanced modular reactors.
- Harness existing oil and gas infrastructure to develop CCS, to potentially reduce costs for the industry that is yet to get off the ground. The government will suspend decommissioning wells and pipelines to give projects time to develop.
- Policy is being considered regarding creating a market for Carbon Capture and Underground Storage (CCUS). This would probably be based on penalties being levelled against emitters.
- The government will likely comply with new EU rules that stipulate that for generators to receive payments on the capacity market they must emit no more than 550 grams CO2 per KWh. This will prevent coal power stations from participating in the capacity market.
- Allow new suppliers to more easily enter the energy retail market, to promote innovation and the smart grid.
- Policies to encourage energy efficiency improvements for businesses are likely to be introduced.
- Policies to bring as many fuel poor homes up to EPC rating C as possible are likely. These will be aligned with a sustainability principle, avoiding fuel poverty to be tackled at the cost of carbon reduction targets.

Appendix 10: Policy Scenarios

Diagnosis of current policies and expected future policy environment

Given our political context, what sort of policies should we expect to emerge in the short to medium term? There are several options.

1) Benchmark - Business as usual

Electricity production continues to slowly be decarbonised, but by 2050 natural gas still provides a significant proportion. Government support continues to be unambitious and piecemeal regarding the key sectors of transport, domestic housing, and land use & agriculture. This means that progress slows closer to 2050 as low hanging fruit disappears. We can expect to see some support for higher proportion of hydrogen in the gas network, some support for renewables, and maintained support for electric vehicle charging.

2) Climate Change Committee (CCC)

The CCC does not propose specific policies, but benchmarks by which progress can be measured. By 2050 all electricity generation is low carbon and is likely to be quite centralised due to a high reliance on CCS, all surface transport, including HGVs is decarbonised, industry emissions have reduced by 90% through the use of CCUS, large-scale emissions removal and hydrogen production is in place, policies supporting the decarbonisation of aviation and shipping are well-established, hydrogen use and production is well-established, and the UK has seen a 20% fall in consumption of beef, lamb, and dairy.

It's unlikely that such a transformation could occur without significant government intervention, which would likely be focused on incentivising large companies to decarbonise energy production (through the continued use of mechanisms like the carbon price floor), allowing citizens access to low-carbon versions of consumer goods available today, significant investment in low carbon domestic heating (probably hydrogen), and large investment in research and development.

3) Green capitalism

This scenario holds that a low carbon transformation of the UK is feasible through primarily market driven innovation. Proponents of this approach argue that it can enable the 2050 targets to be met, although this is not uncontested. At the very least, this scenario requires that the decarbonisation of the UK economy will become a top priority for consumers.

If such consumer action materialised, under this scenario, it is likely that current incentivisation to decarbonise a centralised power sector is gradually ramped up alongside the incentivisation of CCS, electric cars would become the dominant mode of transportation, and many individuals would install high quality home insulation and low carbon heating solutions.

4) Green New Deal

Passed at the 2019 Labour conference (motion here), the Green New Deal (GND) is a Keynesian-style programme that proposes massively increased government investment in low carbon infrastructure and associated industries: “a systematic programme of investment in green infrastructure of at least £50 billion a year”. It explicitly aims to provide social benefits alongside carbon reductions, “providing skilled-jobs, making homes warmer and keeping energy costs down." Such a programme would see the UK reach net zero emissions as early as 2030.

The GND has not yet been brought together into one coherent policy programme, but policies would include properly funding many of the projects proposed by the CCC, plus enabling community energy projects (both power generation and district heat systems), empowering local government to make decisions regarding low carbon development, and a concentrated focus on a just transition. If this policy scenario occurred, a focus on low-carbon development should be the mainstay of industrial strategy within SCR.

How do these scenarios map onto the energy projection scenarios?
The National Grid Future Energy Scenarios (FES) are the industry standard for future energy demand projections. While the following above policy scenarios do not map perfectly onto the FES scenarios, each one has a close relative. Note that each would have to be adjusted to be aligned with the new 1.5°C goal.

Policy Scenario	FES scenario
Business as usual	Steady Progression
Committee on Climate Change	Two Degrees
Green Capitalism	Consumer Evolution
Green New Deal	Community Renewables/1.5°C