Cheshire & Warrington LEP

Report – Development of an Energy Strategy and Implementation Plan for Cheshire & Warrington

Mar 2018

Mickledore Ltd.
Unit 214
The Base
Dallam Lane
Warrington
Cheshire
WA4 4DW
Tel: 01925 837679
Tel: 07747 085400

Email: contact@regionaldevelopment.co.uk
Web: www.regionaldevelopment.co.uk

Contents

Contents *cont*

Executive Summary

The UK is reducing fossil fuel based power generation but all aspects of the energy system need to decarbonise

Background

The Paris Agreement to limit the global temperature rise and the UK Climate Change Act legislating to meet that agreement and for an 80% reduction in CO2 emissions in the period 2008-2050 were the starting point for the decarbonisation of the UK's energy system but in the recent past the largest impact has been through decarbonising power generation. This shift will continue but in order to hit the established carbon budgets decarbonisation needs to take place throughout other aspects of the energy system.

In October 2017 the Government published the Clean Growth Strategy and this set out the roadmap for the UK to achieve clean and affordable growth. It is clear that in addition to Central Government action in this area there is also a need for concerted local action.

Ultimately the purpose of the energy strategy is to understand how clean growth can be achieved in Cheshire and Warrington, and to identify energy priorities for the LEP and its partners, providing a basis to inform future development of the SEP and LIS. In the case of Cheshire & Warrington the plan is particularly important in order to facilitate the considerable growth planned and also to derive economic benefits from the base of knowledge assets in the area.

Cheshire & Warrington

Cheshire & Warrington is an area with a number of different energy challenges and opportunities. The area has a number of large industrial sites and a particular concentration of high intensity energy users along the Mersey Estuary. There are plans for substantial residential growth in some of the urban centres and some of these (notably Chester and Warrington) already have some power capacity constraints, whilst HS2 plans and further growth is likely to cause power capacity pressure in Crewe. Car ownership and usage is high with limited inter-town public transport connectivity.

Heat will need to be decarbonised in the UK. There are substantial areas in Cheshire & Warrington which are not on the gas grid and in many ways these characteristics make the area an ideal location for developing new energy systems including the decarbonisation of heat. In addition, planned higher density developments in the urban centres create opportunities for heat networks.

Cheshire & Warrington also has some important energy assets and specialisms. The area remains at the forefront of the UK's nuclear power initiatives with important nuclear focused businesses across the entire area - but with specialist manufacturing through Urenco at Capenhurst and a cluster of businesses in Birchwood, Warrington.

Further examples include Scottish and Southern Energy, who operate a coal-fired power station at Fiddlers Ferry, Warrington although its long term future is uncertain (and all coal fired power stations are to be decommissioned by 2025); Protos is a new energy generation park at Ince with waste-to-energy and biomass power plants being constructed / commissioned; and Storengy operate a large underground gas storage site in Stublach.

Executive Summary *cont*

It is the commercial model / market failure that is holding back many of the opportunities to decarbonise

In the relatively recent past, the University of Chester has established an energy centre at Thornton and The British Geological Survey has announced plans to establish research facility in the area which will investigate energy related themes such as geothermal opportunities, carbon capture and storage and oil & gas extraction. Initial work suggests that there are geothermal opportunities in the south of the region around Crewe.

Carbon challenges

De-carbonisation is a challenge across a number of areas – notably power generation, industrial processes, heat (domestic and commercial) and transport. It is clear that action across all these areas is essential if the UK is to meet its carbon budget.

Cheshire & Warrington faces these challenges more acutely than much the UK. Manufacturing, and particular energy intensive manufacturing remains very important to the economy but energy costs and the need to reduce carbon intensity will impact on these operations. The area also faces particular transport challenges - with higher car ownership, a greater likelihood to travel to work by car and a greater distance travelled to work than the average. Add to this a similar propensity to have carbon based heating systems to the rest of the UK but with oil frequently used in the substantial off gas grid areas of the area.

Making a material impact on carbon emissions will involve a range of different technologies and whilst those technologies will develop further, it is clear that in many instances it is now the commercial model / market failure that is holding back a low carbon solution. With this in mind, and the risk in the sector to hold out for the next up-coming technology, this report has particularly focused actions around those areas where local agencies can have the greatest influence, and those initiatives where a difference can really start being made immediately.

Drivers of Change

Across the energy system there are a number of drivers of change and these may be summarised as:

Power

The shift towards low carbon power generation will need to continue. It is likely that the shift to EVs and an increasing use of heat pumps will increase electricity usage during the next decade and as a result more non-carbon generating capacity will be required. This is likely to include deployment of more of the current range of renewable sources but also, and most relevant to Cheshire & Warrington further investment in nuclear.

Cheshire & Warrington is, arguably, the centre of the UK's nuclear engineering base with a cluster of design engineering at Birchwood, Warrington (formerly the HQ of BNFL) but also with companies such as Wood , Urenco and Babcock operating significant nuclear related facilities across the wider area.

Local generation, demand management and smart systems

The starting point in decarbonisation across the board is better energy management and efficiency. Demand management and energy efficiency linked to localised energy generation (generally photovoltaic); battery storage; high efficiency devices and tariff changes encouraging better smoothing of demand can make

The vision not only considers how the area plays its part in delivering the Clean Growth Strategy – but how the area secures an economic dividend from decarbonisation

significant changes to usage and the UK's energy consumption profile – essentially the use of smart systems.

Cheshire & Warrington is at the centre of considerable research, development and design in this area through the work being undertaken by the University of Chester at Thornton Science Park through the 'Intelligent Energy System Demonstrator (IESD)' facility and their work could lead to economic advantage for Cheshire & Warrington in this area.

Heat

At present space heating in the UK is most frequently generated by burning fossil fuels and is a significant contributor to carbon emissions. There are low carbon alternatives to heat generation and transmission for both low density and high density developments including biomass boilers, heat pumps or distribution of heat from a low carbon source across a network of users. The report identifies the opportunity to build out from initial systems focused on areas of high density development and demand into a wider network.

This is of considerable interest to Cheshire & Warrington as the area has a large number of residential and some commercial developments which are off the gas grid and could deploy new low carbon technologies for heat rather than relying on boiler systems frequently fired by oil, the area has plans for a number of large scale residential schemes which may benefit from district heating schemes – and in South East Cheshire there may also be a geothermal resource into which schemes could be linked.

Transport

Transport accounts for the highest demand on energy in the UK. A transition to ultra low emission vehicles – mainly electric vehicles (EVs) is underway but this shift is in its infancy and a rapid uptake (perhaps combined with smart transport systems and less private car mileage) will now be required in order for the UK's carbon budgets to be met.

Within Cheshire & Warrington, EA Technology has been one of the leading businesses exploring the potential for EV deployment in the UK through research studies such as Electric Avenue and now Electric Nation.

Cheshire & Warrington has grown historically partly due to its position at the intersection of major transport routes but this has resulted in a high dependence on road transport and its resultant energy use. The area has a particular interest in a transition to lower emission vehicles and making sure that the infrastructure is in place to support this transition.

Industrial

Some industrial processes are large generators of carbon. In addition to implementing efficiency and process improvement measures, there is also renewed interest into whether carbon capture and storage can mitigate the impact of many energy intensive industries on the environment. This could include the production of hydrogen which could then be used as a clean fuel source across the system.

Implementation will require prioritisation, better commercial models and in some cases, notably de-carbonising heat, strong political leadership.

The Mersey basin is a location for many of the specific carbon intensive industries cited by BEIS in their decarbonisation roadmaps up to 2050 (published alongside the Clean Growth Strategy) including chemicals, paper & pulp and glass. Cheshire & Warrington as a whole has additional high energy users in pockets across the area (incl. Tata Chemicals in Northwich, Bentley Motors in Crewe, Barclays at Radbroke Hall and Astra Zeneca in Macclesfield). The BEIS roadmaps highlight the potential future importance of carbon capture and with nearby pipeline access to the Irish Sea gas field this could represent an opportunity for Cheshire & Warrington. In addition the area lies within a grid development system proposed by Cadent for the introduction of hydrogen.

Grid

One of the conduits to the future energy system is investment in the electricity grid. This investment may be required to improve resilience as greater electricity demands come on stream – but it can also allow more feed in locations and a new smart grid can provide more real time information on demand. Grid investments may also, increasingly, allow smaller decentralised grids based on localised power generation and could include additional storage alongside to deal with peaks in demand. One issue is how investment in the power grid can be made in advance of new areas of demand to avoid delays to development.

The power generation capacity being installed at Protos adjacent to the energy intensive users along the Mersey Estuary is seen as one area where a 'private wire' initiative may be undertaken and proposals are being developed to investigate the exact requirements and feasibility of such a grid development.

Energy Efficiency

Energy efficiency more generally (across the entire energy system) is a key feature of the Clean Growth Strategy and an area of importance for Cheshire & Warrington within its energy intensive users, in addressing older housing stock (including in significant areas of fuel poverty), in developing new residential areas and in transport.

What is underway in Cheshire & Warrington

The vision set out in this study is that Cheshire and Warrington develops its decarbonised energy infrastructure to enable economic growth and to capitalise on the economic opportunities and resilience this will bring. The area is already engaged in a large amount of activity. In power the Cheshire & Warrington LEP is ensuring that the areas assets are recognised in the nuclear sector deal. One area for future research is the drive towards Small Modular Reactors (SMRs).

Across the energy intensive industries and energy related companies an industry body called the Cheshire Energy Hub has been formed to address energy related issues. One action being pursued is an initiative known as the Energy Innovation District which will examine ways in which energy intensive industries can improve efficiency, operate off a private grid network and decarbonise.

The Protos Energy Park being developed by Peel has already

Priorities for action have been determined as those areas where technology exists and local intervention can make a difference to take-up

attracted waste to energy, biomass and onshore wind generating capacity to the area – and this may form part of the private grid concept.

The British Geological Survey has established a Geoenergy Observatory at Ince to examine geology related energy issues such as geothermal and carbon capture. Cheshire East Council has plans to commence geothermal testing at Crewe. Cheshire East Council through its ELENA programme is developing battery storage and heat networks in Crewe and Macclesfield, with the aim of capitalising on the deep geothermal resource under Crewe.

All of the Local Authorities across the LEP have examined opportunities to develop heat networks and further work is required to ensure that these are properly investigated as part of future growth – particularly residential growth. This report suggests further ways in which viability of these systems can be improved.

The area is also committed to reducing fuel poverty and encouraging improvements in energy efficiency as well as, in the case of Cheshire East, introducing an alternative energy provider (Fairerpower) and encouraging switching.

Action Plan for Cheshire & Warrington

The report contains a detailed action plan and also sets out how the low carbon energy pathway may look in the area over 5, 10 and 20 years.

Priorities have been determined as those areas where there is considered to be a relatively easy opportunity to decarbonise and where local measures can have significant influence, where the characteristics of Cheshire & Warrington make this a natural fit and where significant further work is required.

As a result residential initiatives are considered important. Cheshire & Warrington has a significant housing stock off gas grid and there are significant new housing developments planned. These two areas suggest a very clear opportunity to start initiatives around energy efficiency, heat and smart systems. This is an area highlighted by the Committee on Climate Change as an area where more could be achieved very quickly.

The largest category user of energy in the UK is transport and as a result those local initiatives that can impact on transport energy usage have been considered.

Finally, in terms of priorities for action, the energy / industrial characteristics of the area have been considered – with actions for the very important nuclear sector in Cheshire & Warrington and the concentration of energy intensive industry.

The action plan priority themes are therefore summarised as follows:

1. Accept that future grid development may need some forward funding through an **infrastructure fund**; continue to press Government to relax legislation preventing speculative grid development and support the further

There is no supposition that large scale subsidy will be required – but in some cases market failure is preventing widescale implementation

1. investigation of a private grid for energy intensive industries on the Mersey Estuary.
2. Provide clear **information and advice** on the cost / benefit and installation of combinations of small scale renewable, smart systems, energy efficiency and energy storage to households, smaller commercial occupiers, property developers and installation businesses. Given that savings can already be achieved despite installation costs, the barrier appears to be information.
3. Seize the potential opportunities that new nuclear and developments in small and modular reactors can bring to the Cheshire & Warrington economy to reinforce its position as the leading nuclear sector location in the UK. There is a case for a **sector development** work stream for the nuclear sector.
4. Use **planning policy**, the public estate and financial mechanisms to kick-start heat networks in higher density developed areas. Investigate heat sources including geothermal in SE Cheshire.
5. **Promotion** of low carbon heating solutions in low density domestic / commercial developments – starting with existing cost neutral solutions in off gas grid areas.
4. Use **planning policy** and create mechanisms for investment in charging points for EVs in a manner which will alleviate anxieties about a transition to EVs.

In all the report sets out 10 themes for action with several individual recommendations within these themes for consideration and so other themes are picked up in detail within the action plan at the end of the report.

Funding

One of the main contentions of the report is that decarbonisation is now more of a commercial challenge than a technical challenge. There is no supposition that large scale subsidy is required but in some cases market failure is preventing widescale implementation.

Market failure in terms of some of the micro-generation, storage, efficiency and heating measures is appears to be mainly a knowledge sharing and typical early adoption issue. Alternative finance models (lease, loan, mortgage) and continued use of incentives such as the Renewable Heat Incentive and Feed-In-Tariffs are important for their continued roll out by households and smaller commercial users where implementation can be initially cost neutral with considerable savings to follow..

In terms of forward funding aspects such as heat networks, EV charging networks and forward funding power grid reinforcement there is likely to be a future return on investment but the certainties / timescales create a market failure. There is a need for a publicly backed but commercially structured infrastructure fund to address issues in this area and the Evergreen / Northern Powerhouse Funds are examples of how this may be addressed.

In addition there is the opportunity to address smaller scale innovation in products, installation and associated training through the planned Cheshire and Warrington Energy Innovation Fund, whilst the remaining ERDF funding linked to low carbon can be used to supplement this approach as well as dealing with some of the knowledge sharing / early adoption issues across

Executive Summary *cont*

Implementation will however require prioritisation, better commercial models and in some cases, notably de-carbonising heat, strong political leadership

SMEs.

Conclusion

The energy sector and the move to decarbonisation when considered as a whole is an extremely wide-ranging agenda for any Local Enterprise Partnership. The Clean Growth Strategy has helped to create a framework to deliver incremental changes and in many of the areas Cheshire & Warrington not only has the environment to allow the introduction of solutions – but also to benefit economically from them. Implementation will however require prioritisation, better commercial models and in some cases, notably de-carbonising heat, strong political leadership.

Introduction

The Clean Growth Strategy has set out the UK's direction to provide clean, secure and affordable energy for future economic growth

In Autumn 2017 the Government (the Department for Business, Energy and Industrial Strategy – BEIS) produced its Clean Growth Strategy (CGS). This set out the next steps involved in the decarbonisation process whilst at the same time allowing growth within the economy.

The CGS seeks to establish an approach which can ensure that the UK has a secure supply of affordable energy which can allow growth whilst at the same time achieving the UK's commitments to reduce its carbon emissions. It also addressed the economic opportunities associated with the transformation of the energy system.

The Government also simultaneously published road maps for industrial decarbonisation and energy efficiency across a number of those sectors which are most energy intensive (cement, ceramics, chemicals, food & drink, glass, oil & refining and pulp & paper). Much of this work is particularly relevant to Cheshire & Warrington because of the large representation of these sectors in the area.

In the same period of the publication of the CGS the Government also published the Industrial Strategy White Paper and the Clean Growth Grand Challenge. These highlighted how decarbonisation and the supply and use of energy are important considerations which cut across the Government's whole approach to economic growth and industrial strategy. The energy strategy represents an opportunity to influence what impact this has across Cheshire and Warrington.

Commission and the area

The commissioning of this report by the Cheshire & Warrington Local Enterprise Partnership (C&W LEP) recognised not only the contribution that Cheshire & Warrington must make to the Government's decarbonisation targets but also the strength of elements of the energy sector in Cheshire & Warrington and the innovation and economic dividend that the area could gain from the shift to a lower carbon economy.

Cheshire & Warrington has a significant concentration of industry and the Ellesmere Port / Mersey Estuary area has a concentration of several companies classified by BEIS as energy intensive. These businesses clearly face a challenge to transition towards a low carbon economy.

Across the UK there is also a need to ensure that domestic and commercial heat sources are de-carbonised and that transport, the largest single area of energy consumption in the UK reduces its carbon footprint – and the population growth projections for parts of Cheshire and the levels of car ownership and usage mean this aspect of de-carbonisation will need to be a significant part of the work undertaken within the area.

In terms of energy expertise, the area has been at the centre of UK nuclear expertise for several decades and has also strengths in gas storage and has both private sector and Higher Education research facilities including the Energy Centre at Thornton Science Park. The area has been selected by the

Introduction *cont*

The report sets out suggested actions which make a distinction between areas of influence and where there is a need for intervention

British Geological Survey for one of two energy research field sites and at Protos, also close to Ellesmere Port, a significant energy generation park is being developed.

Such is the concentration of industry and energy expertise in this area that the 'Cheshire Energy Hub' has been formed which is a concentration of local players with a vision to support the energy industry. The Cheshire Energy Hub demonstrates businesses leadership and is acting as a clear voice for the sector. The group is seeking to lead the discussion on changing the energy system within the area and they have proposed an important demonstrator project for the UK.

The Report

The report sets out the energy context in terms of the national picture, the current baseline position of Cheshire & Warrington, the growth aspirations of the area and what that might mean in terms of energy.

The report then considers the different aspects of the energy mix and the current situation in terms of technology, commercial challenges and the likely stages in implementing future change.

The report then sets out a suggested vision for Cheshire and Warrington in terms of its future energy position and what would be mostly likely to be achieved locally.

The report then draws together a proposed action plan which importantly, distinguishes between those areas in which the local public players can play a supportive role – and those where influence can be brought to bear or a direct intervention is considered most appropriate.

This report was produced in order to feed into the production of the Cheshire & Warrington LEP energy strategy.

Mickledore & Bizcat

Mickledore is a specialist economic development team based in the Cheshire & Warrington area. We have completed a number of projects for the LEP and the Local Authorities in the area and in particular examined the case for Energy being recognised as a fourth priority of the LEP in 2015.

Bizcat is a specialist energy consulting firm made up of specialists with a background in large international energy companies including AECOM, Iberdrola and Vattenfall. The business was founded in Sweden and importantly, has a large amount of experience in implementing decarbonising projects in Scandinavia. Much of this experience is then translated into the specific UK situation.

Context

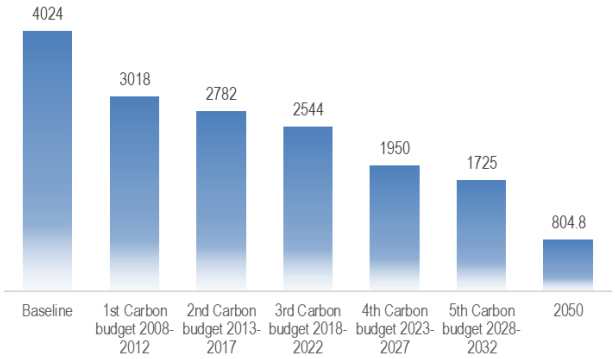
Carbon budgets set out targets for how the UK achieves an 80% reduction on carbon emissions 2008-2050

The roadmap for the UK's strategy to decarbonise and maintain economic growth is set out in the Clean Growth Strategy (CGS) and this was published in October 2017. it ties in close with the Industrial Strategy which was also published in Autumn 2017.

The Clean Growth Strategy sets out proposals for reducing carbon intensity in all sectors of the UK economy through the 2020s. It explains how the whole country can benefit from low carbon opportunities and drive economic growth, while meeting national and international commitments to tackle climate change.

The Clean Growth Strategy also offers the roadmap for how the UK will meet its carbon budgets. The Carbon Budget was established in 2008 and sets out (in five year blocks) how the UK moves towards an 80% reduction in carbon outputs by 2050. The targets which were established are set out in the graph below.

UK Carbon Budget (million tonnes of carbon)



The Clear Growth Strategy is set out against the following aspects of energy:

- Business and Industry Efficiency
- Shift to Low Carbon Transport
- Clean power
- Natural resources
- Domestic
- Public Sector

The strategy then also sets out:

- How Government can accelerate clean growth
- How the Government can show leadership

A diagram showing these themes, their contribution to carbon emissions and the broad themes of the strategy is set out overleaf.

Context cont

High level summary – Clean Growth Strategy

Business and industry efficiency	Shift to low carbon transport	Clean Power	Natural Resources	Domestic	Public sector
25% of emissions	24% of emissions	21% of emissions	15% of emissions	13% of emissions	2% of emissions
- Energy efficiency in buildings; assistance for large businesses to improve efficiency; specific plans for 7 of the most energy intensive sectors. - Invest R&D in carbon capture and storage. - Phase out fossil fuel heating and recycle heat	- End sale of petrol / diesel and create funds for take-up of low emission vehicles; deploy charging infra-structure; retrofit busses; work with industry on automotive sector deal - Increase use of cycling and walking for shorter journeys; shift freight from road to rail - R&D in autonomous vehicles; batteries and HGV platoons	- Implement the smart systems plan; consumers use power flexibly - Deliver new nuclear - Further stimulate renewable power through CFDs; a sector deal; carbon pricing - R&D in smart systems and storage; nuclear fuel and reactors; renewables including turbine design	- Agricultural support aimed at environmental outcomes; forests; timber in construction; aim for zero avoidable waste; manage emissions from landfill.	Energy efficiency: - ECO funding for claimants; aim for Band C in private rented / fuel poor homes; improve social housing, provide smart meters. Increase energy performance standards for new and existing homes. Low carbon heating: - Roll out heat networks; phase out fossil heating in new / off grid homes; improve boiler standards; reform RHI; innovation funding	- Voluntary target of 30% reduction in carbon - £255m for energy efficiency improvements.
Accelerate clean growth:	Establish finance taskforce; develop sustainable finance management standards; clean tech investment fund; green mortgages				
Government leadership	Promotion, inter-ministerial approach and report on emissions intensity				

Context *cont*

Many of the initiatives set out in the CGS have funding streams associated with them.

As part of the Strategy a number of initiatives which will provide funding have also been identified and these are as follows:

Accelerating Clean Growth

- Providing up to £20 million to support a new clean technology early stage investment fund

Improving business and industry efficiency

- Demonstrate international leadership in carbon capture usage and storage (CCUS), by collaborating with global partners and investing up to £100 million in leading edge CCUS and industrial innovation to drive down costs.
- Invest around £162 million of public funds in research and innovation in Energy, Resource and Process efficiency, including up to £20 million to encourage switching to lower carbon fuels.
- support innovative energy technologies and processes with £14 million of further investment through the Energy Entrepreneurs Fund.

Improving the energy efficiency of our homes

- Support around £3.6 billion of investment to upgrade around a million homes through the Energy Company Obligation (ECO), and extend support for home energy efficiency improvements until 2028 at the current level of ECO funding.
- Invest in low carbon heating by reforming the Renewable Heat Incentive, spending £4.5 billion to support innovative low carbon heat technologies in homes and businesses between 2016 and 2021.
- Innovation: Invest around £184 million of public funds, including two new £10 million innovation programmes to develop new energy efficiency and heating technologies to enable lower cost low carbon homes

Accelerating the shift to low carbon transport

- Spend £1 billion supporting the take-up of ultra low emission vehicles (ULEV), including helping consumers to overcome the upfront cost of an electric car
- Develop one of the best electric vehicle charging networks in the world by investing an additional £80 million, alongside £15 million from Highways England, to support charging infrastructure deployment
- Accelerate the uptake of low emission taxis and buses by providing £50 million for the Plug-in Taxi programme, which gives taxi drivers up to £7,500 off the purchase price of a new ULEV taxi, alongside £14 million to support 10 local areas to deliver dedicated charge points for taxis.
- providing £100 million for a national programme of support for retrofitting and new low emission buses in England and Wales.
- Invest £1.2 billion to make cycling and walking the natural choice for shorter journeys.
- Position the UK at the forefront of research, development and demonstration of Connected and Autonomous Vehicle technologies, including through the establishment of the Centre for Connected and Autonomous Vehicles and investment of over £250 million, matched by industry.
- Innovation: Invest around £841 million of public funds in innovation in low carbon transport technology and fuels including ensuring the UK builds on its strengths and leads the world in the design, development and manufacture of electric batteries through investment of up to £246 million in the Faraday Challenge

Context *cont*

The Committee on Climate Change (CCC) is a Statutory Body advising the UK Government on progress being made to reduce carbon.

Delivering Clean, Smart, Flexible Power

- Improve the route to market for renewable technologies such as offshore wind through up to £557 million for further Pot 2 Contract for Difference auctions, with the next one planned for spring 2019.
- Innovation: Invest around £900 million of public funds, including around £265 million in smart systems to reduce the cost of electricity storage, advance innovative demand response technologies and develop new ways of balancing the grid.
- £460 million in nuclear to support work in areas including future nuclear fuels, new nuclear manufacturing techniques, recycling and reprocessing, and advanced reactor design.
- £177 million to further reduce the cost of renewables, including innovation in offshore wind turbine blade technology and foundations.

Enhancing the benefits and value of our natural resources

- Support peatland through a £10 million capital grant scheme for peat restoration.
- Innovation: Invest £99 million in innovative technology and research for agri-tech, land use, greenhouse gas removal technologies, waste and resource efficiency.

Leading in the public sector

- Provide £255 million of funding for energy efficiency improvements in England and help public bodies access sources of funding.

Within each of the themes there is more detail on the exact initiatives being carried out.

Within the 2008 legislation that established the 80% reduction in carbon emissions, the Committee on Climate Change was formed.

The Committee on Climate Change (the CCC) is an independent, statutory body and its purpose is to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

In fulfilling its role its focus is to:

- Provide independent advice on setting and meeting carbon budgets and preparing for climate change.
- Monitor progress in reducing emissions and achieving carbon budgets and targets.
- Conduct independent analysis into climate change science, economics and policy.
- Engage with a wide range of organisations and individuals to share evidence and analysis.

Each year the CCC produces a report which sets out progress. The Executive Summary for 2017 stated:

- "75% of the emissions reductions since 2012 have resulted from reduced burning of coal in the power sector (Figure 2). This is now at low levels, with limited potential for further reductions. Even if all coal generation stopped, which is the Government's announced intention by 2025, emissions would only fall by around 16 MtCO2e, the

Context *cont*

UK Transport and Buildings emissions have been rising and are considered a priority for the CCC.

emissions would only fall by around 16 MtCO2e, the equivalent of less than two years' worth of further progress required to 2030.

- In other sectors, recent progress has been far more limited or emissions have been rising:
  - Transport emissions have risen three years in a row to their highest level since 2009. Thisreflects rising demand for travel and a slowing of progress in improving the efficiency of new vehicles. In contrast, our scenarios for meeting the fifth carbon budget require transport emissions to reduce by an average of 4% per year to 2030.
  - Buildings emissions have risen in the last two years, with the trend only partly attributable to lower winter temperatures than in 2014. Most boilers have now been replaced with efficient condensing models (around 70% in 2016) and rates of installing insulation have been very low since 2012. Uptake of heat pumps and district heating remain minimal and new buildings with high-carbon heating systems are still being built.
  - Industry emissions fell in 2016, but over half of the reduction reflected reduced iron and steel production rather than improvements to energy productivity or shifts to low-carbon fuels. Plant closures have not been a result of climate policies since these had at most a marginal effect on relative plant economics. Effective policy is now needed to support UK industry to move towards low-carbon production methods."

Cheshire & Warrington

In the context of the Clean Growth Strategy and the comments by the Committee on Climate Change, it can be seen that the economy of Cheshire & Warrington will be affected by the initiatives set out in the Clean Growth Strategy. The opportunity is to ensure that changes in the energy system result in an economic dividend for the area.

The areas and the actions that could be undertaken are set out in detail in the pages which follow, but they stem from the key characteristics of the Cheshire & Warrington economy in terms of industry and energy assets.

1. **Clean power.** Cheshire & Warrington is a leader in nuclear energy and the development of both new nuclear in the near term and small and modular reactors in the longer term represent opportunities for continued growth in the sector. In addition, initiatives are underway for further power generation in the area – particularly at Protos in Ellesmere Port.
2. **Transport.** In many ways the Cheshire & Warrington economy has been built on strong road (and to a lesser extent rail) connections. Car ownership is high and journeys to work are both longer than average and more likely to be undertaken by car (check). EA Technology are a leading player in early stage studies on how Electric Vehicles will impact on the energy system and there would appear to be an opportunity in this area for Cheshire & Warrington – although given the current charge point network, the area is starting from a low base.

Context *cont*

The focus of the CGS on clean power, transport, buildings, industry and smart systems aligns with the needs and also opportunities in Cheshire and Warrington

3. **Buildings**. The CCC note that high-carbon heating systems are still being build and in Cheshire & Warrington the large numbers of (often affluent) homes and businesses that are based in an off gas grid area represent a perfect environment to establish heat technologies that will need to transition into replacing heating systems across the whole of the UK. This plus the planned large scale residential growth in large parts of Cheshire – some areas with access to geothermal resource – represents an economic opportunity for the area to develop a growth sector based on installation, maintenance, smart systems and finance.
4. **Industry**. Cheshire & Warrington is an area which retains a large amount of industry – much of this energy intensive industry. The Mersey Estuary industrial belt has opportunities to explore a private network for power linked to the Protos Business Park. In the longer term, the Clean Growth Strategy's focus for energy intensive industry has a focus on Carbon Capture and the proximity to the pipelines for the Irish Sea gasfield and the location of the geo-energy facility of the British Geological Survey provide the area with some future potential in this development.
5. **Smart Systems**. In almost all of the work around the Clean Growth Strategy there will be further work required in development smart systems – managing supply, storage, predicting demand, control systems and pricing models / smart operating systems. Cheshire & Warrington has strengths in control systems more generally – but specifically the work of the University of Chester Energy Centre and Thornton can take a lead on developing new intelligent energy technologies.

These are many of the things that can be considered in developing a future strategy – but before this is examined in detail it is important to establish the baseline position of Cheshire & Warrington.

Cheshire and Warrington baseline position

14% of economic output in Cheshire & Warrington is achieved from the energy intensive sector 'petroleum, chemicals and pharmaceuticals)

Economic Overview

The key economic metrics of Cheshire & Warrington relevant to this study can be considered as follows:

- An economy of £28.5bn GVA (17% of North West England as a whole).
- The largest contributor to the GVA of the area is by the manufacture of petroleum, chemicals and pharmaceuticals – this often energy intensive sector contributes 14% to the economic output.
- In terms of businesses operating in Cheshire & Warrington, in 2017 there were 42,000 business units recorded and 4.5% of these were registered as being involved in manufacturing (similar to the UK)
- When employment is considered, however, 9% of the 488,000 employees recorded as working in the area were involved in manufacturing (compared to 8% nationally).
- The total population of the area is now (2016) estimated at 921,000. At the time of the 2011 Census there were 386,000 households recorded in Cheshire & Warrington.
- The last Census also recorded that 41% of households in the area had access to 2 or more cars (32% for England & Wales) and only 18% did not have access to a car (26% in England & Wales).
- The average distance travelled to work by residents of the Cheshire & Warrington area was 16.5km at the last census (15km for England and Wales as a whole) and 74% travelled by car or van (compared to 63% for England and Wales).

Clearly there is more detailed economic data recorded for Cheshire and Warrington elsewhere but the contribution of petroleum / chemicals to the economy and the reliance of the workforce on car / van journeys helps to inform the baseline energy findings set out below.

The data also highlights the relevance of the Clean Growth Strategy to the area – and the vulnerability of much of the economy if the Strategy is not delivered effectively.

Energy Overview

The total annual energy consumption in Cheshire & Warrington, road transport excluded, was 23,600 GWh in 2015 (the whole of the Liverpool City Region consumes 20,400 GWh; Greater Manchester consumes 33,700 GWh). The energy consumption differs considerably between the Local Authorities, mainly due to the energy intensive industrial cluster at Ellesmere Port. Whilst domestic energy use represents more than 50% of the total energy used in Cheshire East and Warrington (transport not included), the corresponding share in Cheshire West and Chester (CW&C) is only 20%.

The intense use of petroleum products and solid fuels in CW&C highlights the considerable differences in the energy use across the three authorities, but when considering domestic energy consumption only, the three areas show a more equal energy profile.

Besides petroleum (close to 8,000 GWh pa) and gas (over 8,400 GWh pa), electricity (5,000 GWh pa) and solid fuels (2,900 GWh

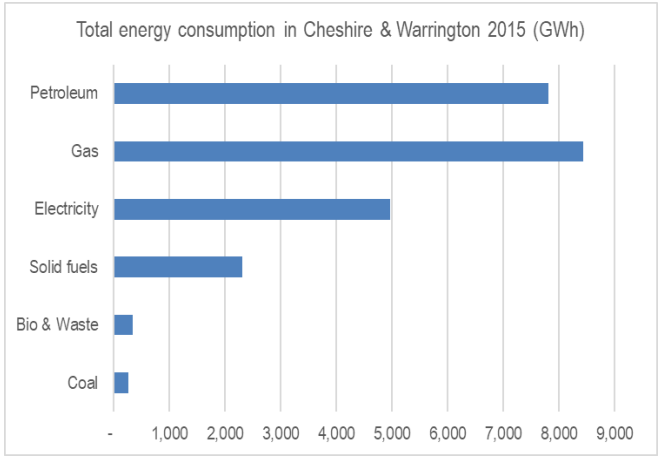
Cheshire and Warrington baseline position *cont*

Fossil fuels (oil, gas and coal) account for 70% of the total energy consumption even before the transport sector is considered

pa) play an important role in the overall energy supply. Fossil fuels (oil, gas and coal) account for 70% of the total energy consumption (16,500 GWh pa), excluding road transport and the fossil share in power generation.

The energy intensive industrial cluster at Ellesmere Port consumes around 2.5% of UK's total industrial energy use. This makes Ellesmere Port outstanding in Cheshire and Warrington, especially regarding the type of energy used; petroleum products totally dominate, followed by solid fuels.

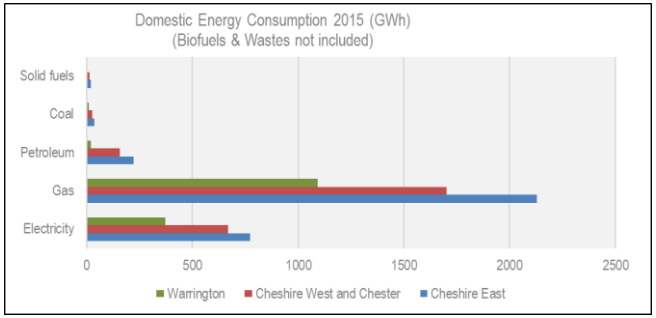
Total energy consumption in Cheshire and Warrington excluding transport



Besides the industrial processes petroleum is mainly used in the transport sector. Due to the mobility in the vehicle fleet, local statistics are not available in the same way. The figures which are made available suggest that the transport sector's energy share in Cheshire and Warrington is 29%, or 9,600 GWh pa, making the total energy consumption of the area just over 33,000 GWh pa.

Gas is the dominating central heating energy source accounting for 88% of the premises in urban areas and 66% in rural. Only 5% of all heating systems are electric and the remaining 11% is based on heating oil, solid fuels or combinations.

Domestic energy consumption in the three Authorities

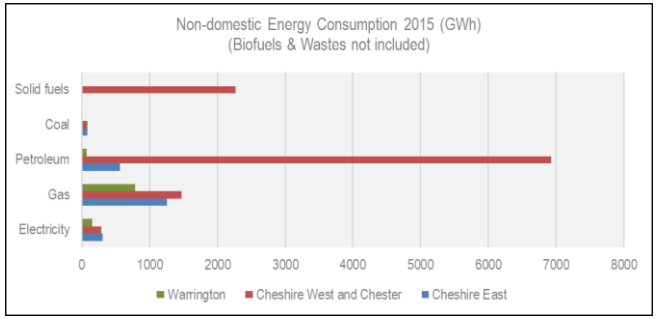


The total energy consumption in the domestic sector is dominated by gas, followed by electricity. Besides cooking, gas is mainly used for space heating and domestic hot water (DHW) making this an important area for decarbonisation. Electricity consumption is approximately 1/3rd of the gas consumption in the domestic sector, but only a fraction is used for heating. Heating oil has a less significant impact impact, although in Cheshire East as much as 15% of the energy demand is oil. This can be explained by large areas not having access to the gas grid.

Cheshire and Warrington baseline position *cont*

Total energy consumption in the domestic sector is dominated by gas

Non-Domestic energy consumption in the three Authorities



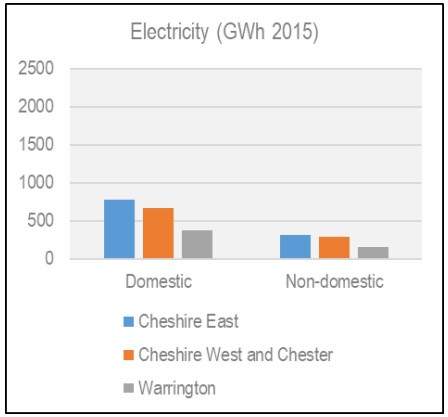
As the energy challenges for the residential, public and commercial sectors differ from the energy intensive industrial challenges in the Ellesmere Port, the report deals with them separately.

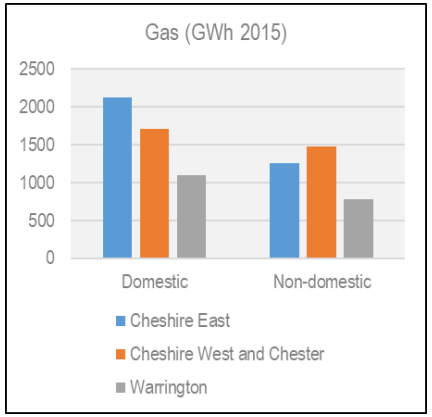
Firstly, however, a more detailed breakdown of the energy use by type and by Local Authority is presented in the pages which follow

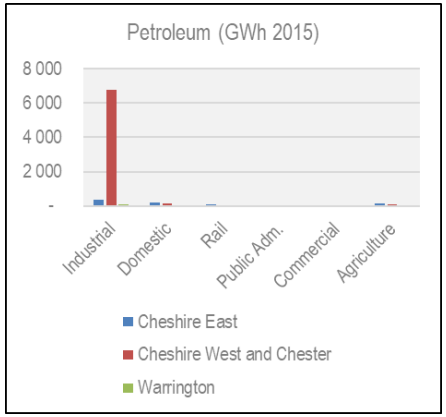
Cheshire and Warrington baseline position *cont*

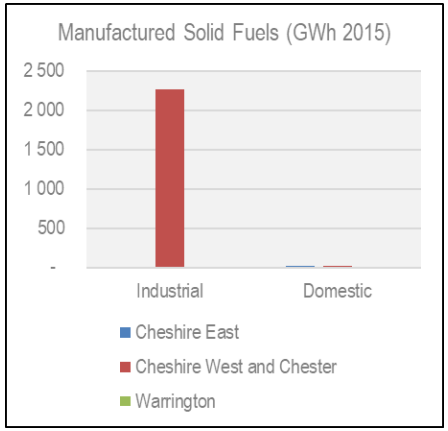
- Gas is a highly significant energy source – but petroleum dominates in CW&C

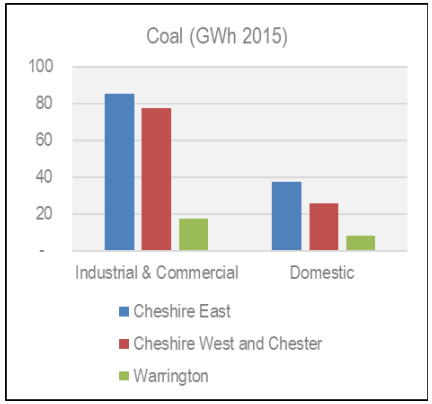
The total energy consumption (transport and power generation excluded) in Cheshire and Warrington 2015

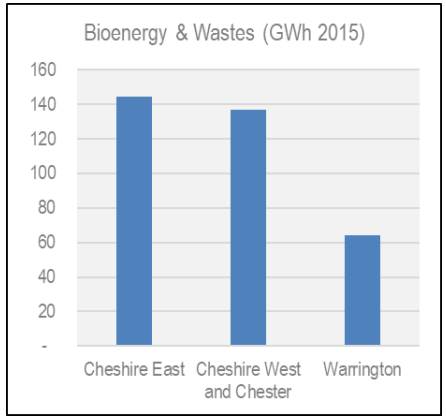








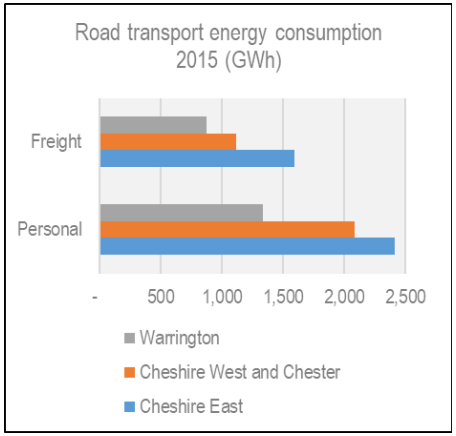


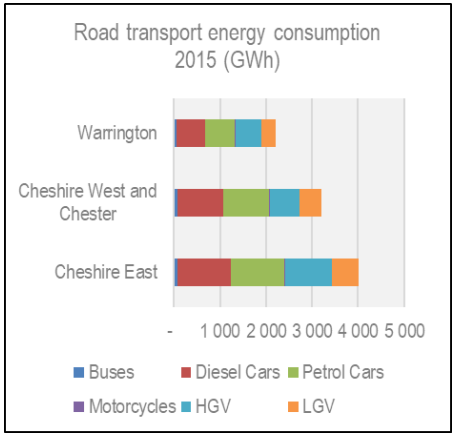


Cheshire and Warrington baseline position *cont*

Cars account for 60% of the total transport energy consumption

Road transport energy consumption in Cheshire and Warrington 2015



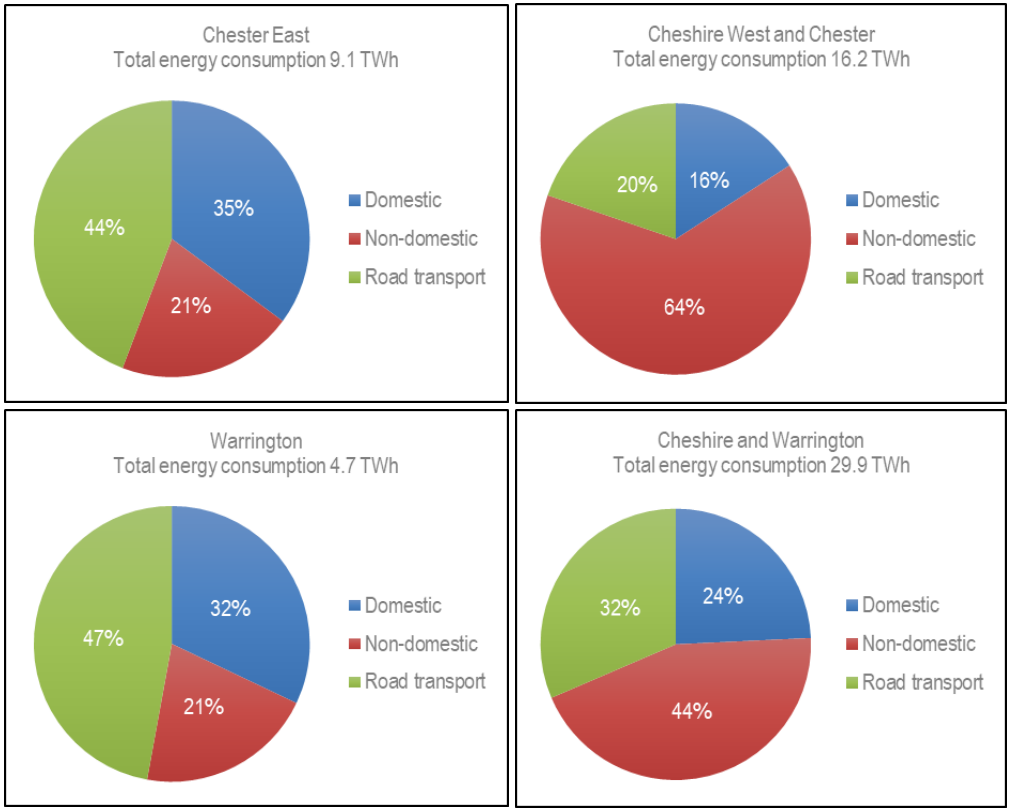


In Cheshire & Warrington the personal transport accounts for 62% of all energy use in the transport sector. Cars totally dominate personal transport (96%) leaving only 4% for buses. This means that cars account for 60% of the total transport energy consumption.

Cheshire and Warrington baseline position *cont*

- More energy is consumed in CW&C than in Cheshire East and Warrington combined

Domestic, non-domestic and transport energy consumption share in each local authority and all of Cheshire & Warrington



As a comparison Greater Manchester has a share of 40% domestic; 30% commercial and industrial and 30% transport therefore illustrating the skewing effect of the industrial cluster in CW&C.

Cheshire & Warrington future development plans

New developments present a tremendous opportunity to start to change the energy system with fewer physical and financial constraints than those presented by retrofit models.

Introduction

In considering the future energy position of Cheshire & Warrington it is important to consider the likely changes to future demand and any constraints which could restrict the future development.

New developments also present a tremendous opportunity to start to change the energy system with fewer physical and financial constraints than those presented by retrofit models.

Local Plans

The Local Plans of all the Local Authorities within Cheshire & Warrington allow for considerable growth in housing and employment space. The plans are summarised in the table below and illustrated in maps which follow:

	Date adopted	Housing	Commercial space
Cheshire East	27/07/17	36,000 homes by 2030	31,000 new jobs
Cheshire West	29/01/15	21,000 homes by 2030	365Ha of employment land
Warrington	'New City' projections	26,000 homes by 2037	381Ha of employment land

Strategic Economic Plan

Since the publication of the Local Plans for the Local Authority areas there have been several further strategies suggesting high levels of growth for the area.

Plans for the Northern Powerhouse, the LEP's updated Strategic Economic Plan and recent statements from the Government about future housebuilding all focus on growth.

In the updated SEP, the LEP sets out a position which stated that, 'that successful delivery of the major projects within its three spatial priority areas (Mersey Dee, Constellation Partnership area and Warrington New City) could lead to a need for up to 127,000 new homes by 2040. This equates to around 9,000 above current local plan targets if current levels were extrapolated to 2040, but this figure remains subject to ongoing strategy development work, particularly in the Constellation partnership area'.

It is clear that, whatever the exact numbers of houses and size of employment allocation, Cheshire & Warrington is likely to see substantial development in the next 15-20 years and this development is likely to be located close to existing settlements. Crewe and Warrington are areas of particular focus.

Key Issue

Whilst mapping various scenarios for future growth is possible, the approach does not match the approach of the Distribution Network Operators (DNOs). The DNOs are able to map their

Cheshire & Warrington future development plans *cont*

Legislation prevents DNOs from building capacity into the network in areas of predicted future demand until there is greater certainty around projects

current capacity and current demand but legislation prevents them from building capacity into the network in areas of predicted future demand – future capacity can only be created in those locations when specific projects are known. This safeguard prevents large speculative capital costs being allocated to the utility bills of existing customers – but at the same time the system rather restricts forward planning for future growth and in those areas where projects are planned in areas where the grid requires an upgrade, there is the potential for the project timeline and budget to be directly impacted by the need to reinforce supply.

One alternative to awaiting investment by a DNO (or potentially developers) would be to speculatively forward fund infrastructure reinforcement through an alternative funding mechanism led, for instance, by a Local Authority and potentially part funded through a rolling investment fund which could include Northern Powerhouse Fund or Evergreen. This would allow a repayment once development has come on stream – albeit with the public body taking the risk that the returns then gained from the development do not match the scale of investment made.

This case for an infrastructure fund is returned to in the funding intervention Chapter.

Ability to undertake development

The current level of network capacity is set out in the maps overleaf.

Electricity North West are the DNO which covers a large part of Cheshire East Local Authority area for the electricity network. The maps overleaf illustrate the current capacity / fault levels using a Red / Amber / Green system to illustrate issues. Apart from some fault issues at one Macclesfield sub-station, the network is reported to have general capacity in the locations where substantial future development is planned across the area.

The Company currently expect to be able to meet future demands although aspects such as EV take-up may impact this in the future.

SP Networks (Scottish Power subsidiary) provide the network across the remainder of Cheshire & Warrington (see following maps). Whilst their mapping is more detailed, the actual capacity position is more constrained than in the Electricity NW area.

Chester and Warrington, in particular, are locations that are likely to need network reinforcement for substantial growth to occur. Crewe and Ellesmere Port are less constrained by the current provision of power.

Cadent are the gas supplier for the area and there reported main issue across some of the Cheshire (less so Warrington) area is the lack of any gas infrastructure. New developments outside the current built boundaries of locations such as Nantwich, Middlewich and Winsford for example may create further off gas grid locations / require infrastructure.

As this report demonstrates, however, issues over future gas connections are not considered as critical as electricity

Cheshire & Warrington future development plans *cont*

infrastructure – and in many ways off gas grid properties could introduce alternative heating technologies which would then provide an opportunity for them to be used as demonstrator projects for future initiatives to de-carbonise other locations.

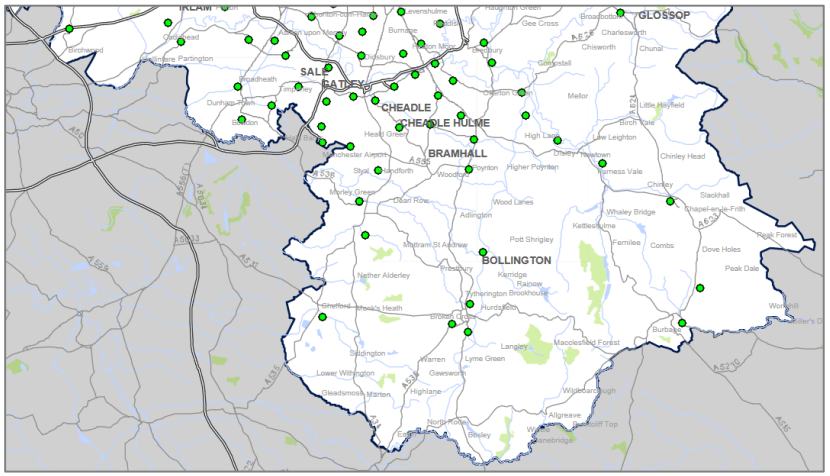
Heating an off gas grid property with a conventional boiler is expensive and low carbon alternatives can now offer a cost saving

Cheshire & Warrington future development plans *cont*

- Electricity North West states good capacity across most of Cheshire East

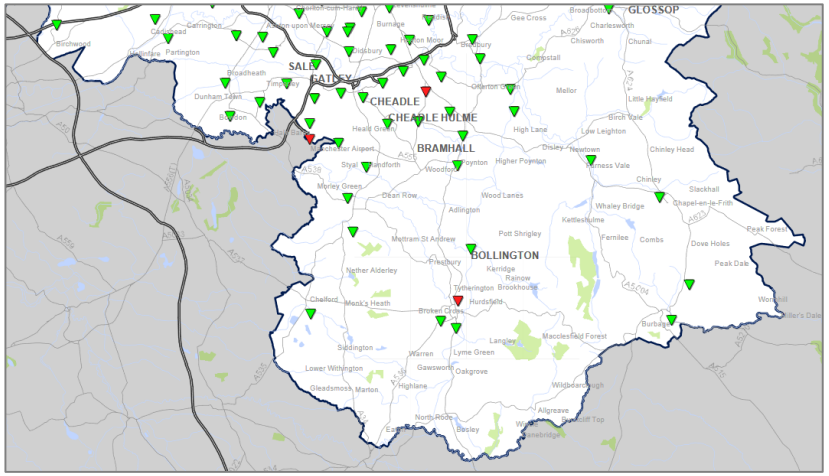
Electricity North West current capacity position

Sub-station capacity



(Red, Amber, Green system – with green illustrating capacity and red illustrating immediate constraints)

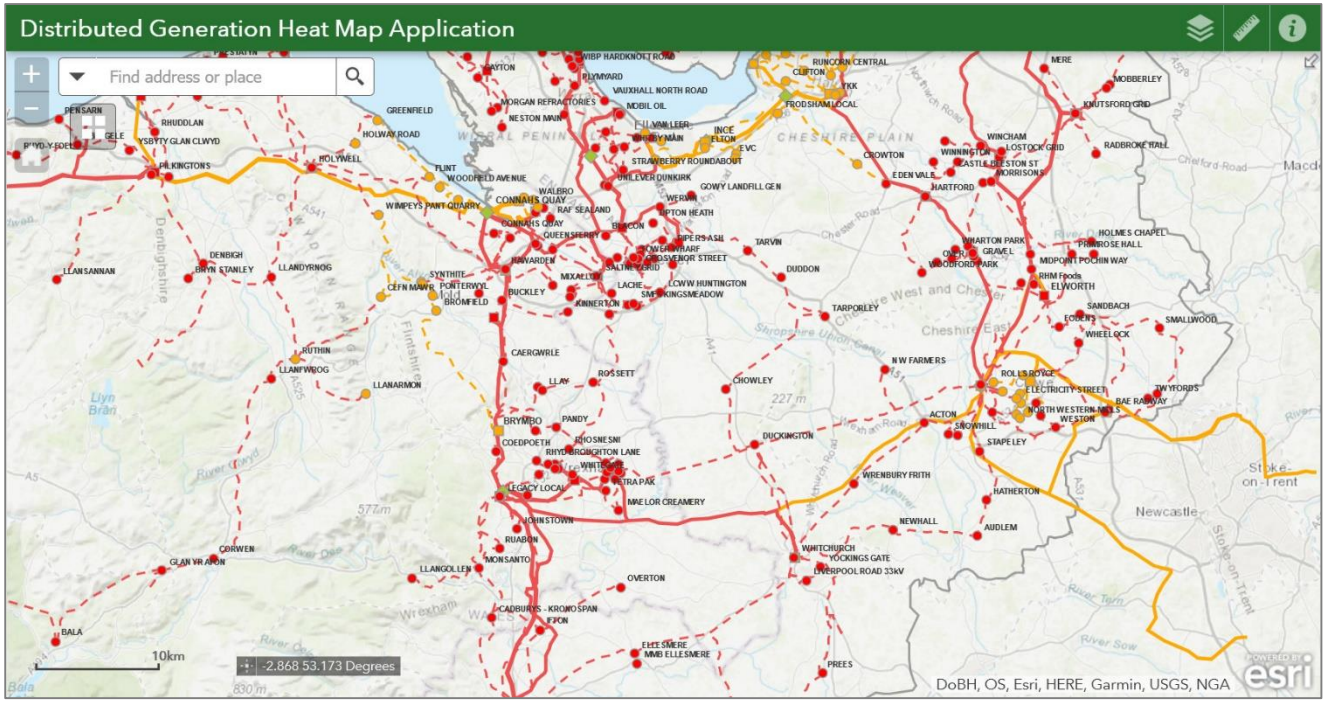
Sub-station network faults



Cheshire & Warrington future development plans *cont*

- SP Networks report some up-coming capacity constraints in Chester and Northwich

SP Networks current capacity position – southern portion of Cheshire & Warrington

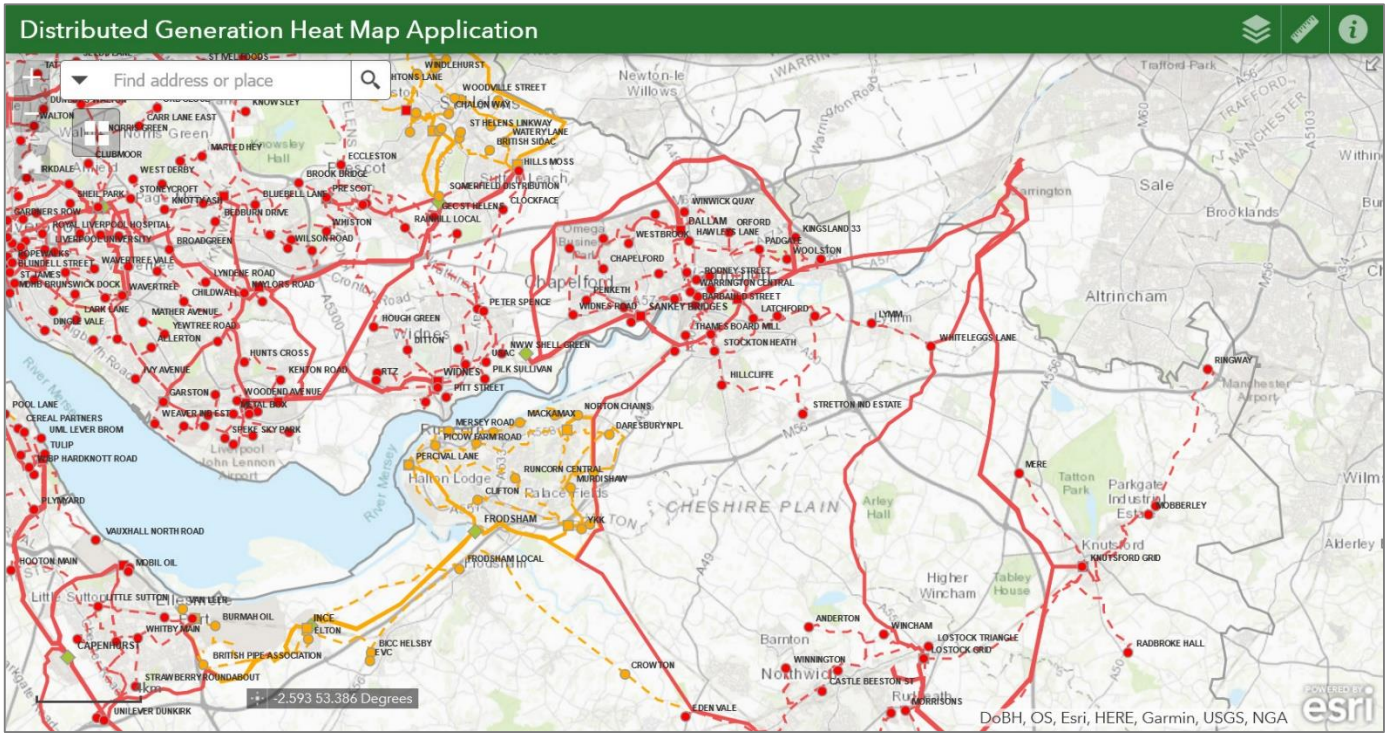


(Red, Amber, Green system – with green illustrating capacity and red illustrating immediate constraints. Solid lines are major pipelines and dotted lines are spurs.)

Cheshire & Warrington future development plans *cont*

- SP Networks report capacity issues in delivering substantial growth in Warrington

SP Networks current capacity position – northern portion of Cheshire & Warrington

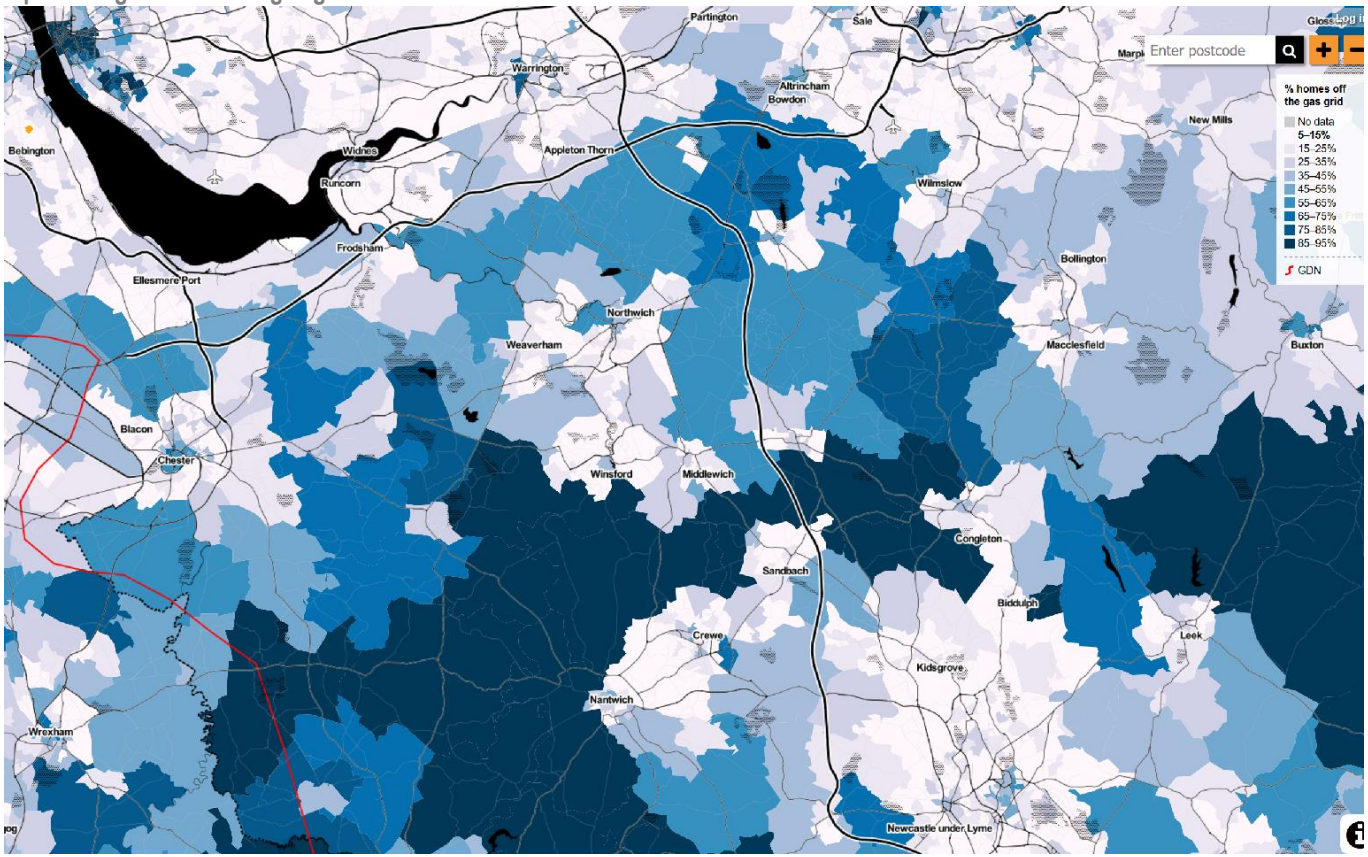


(Red, Amber, Green system – with green illustrating capacity and red illustrating immediate constraints. Solid lines are major pipelines and dotted lines are spurs.)

Cheshire & Warrington future development plans *cont*

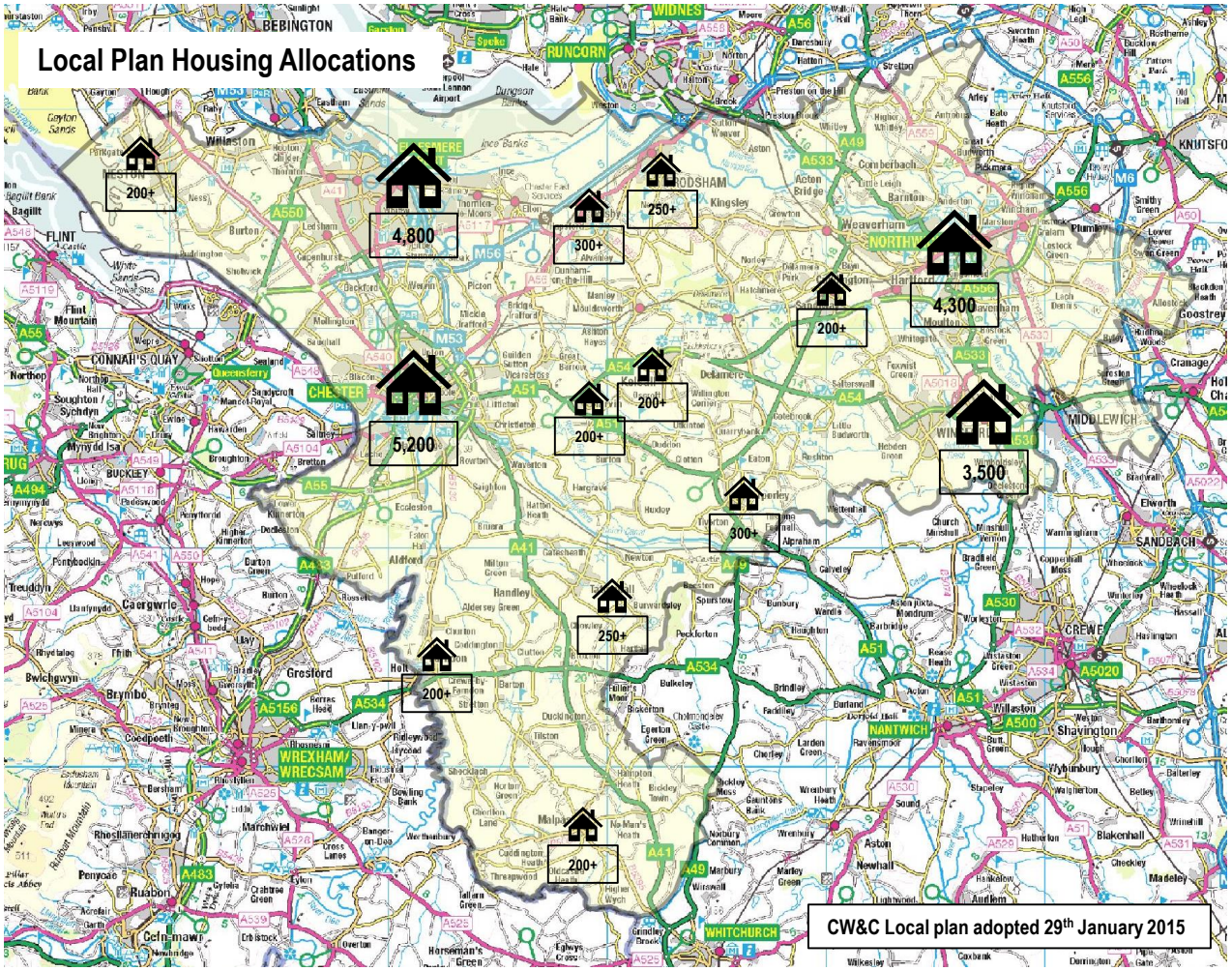
- Substantial areas of Cheshire do not have access to any gas infrastructure

Areas served by Cadent – illustrated by percentage of home off gas grid



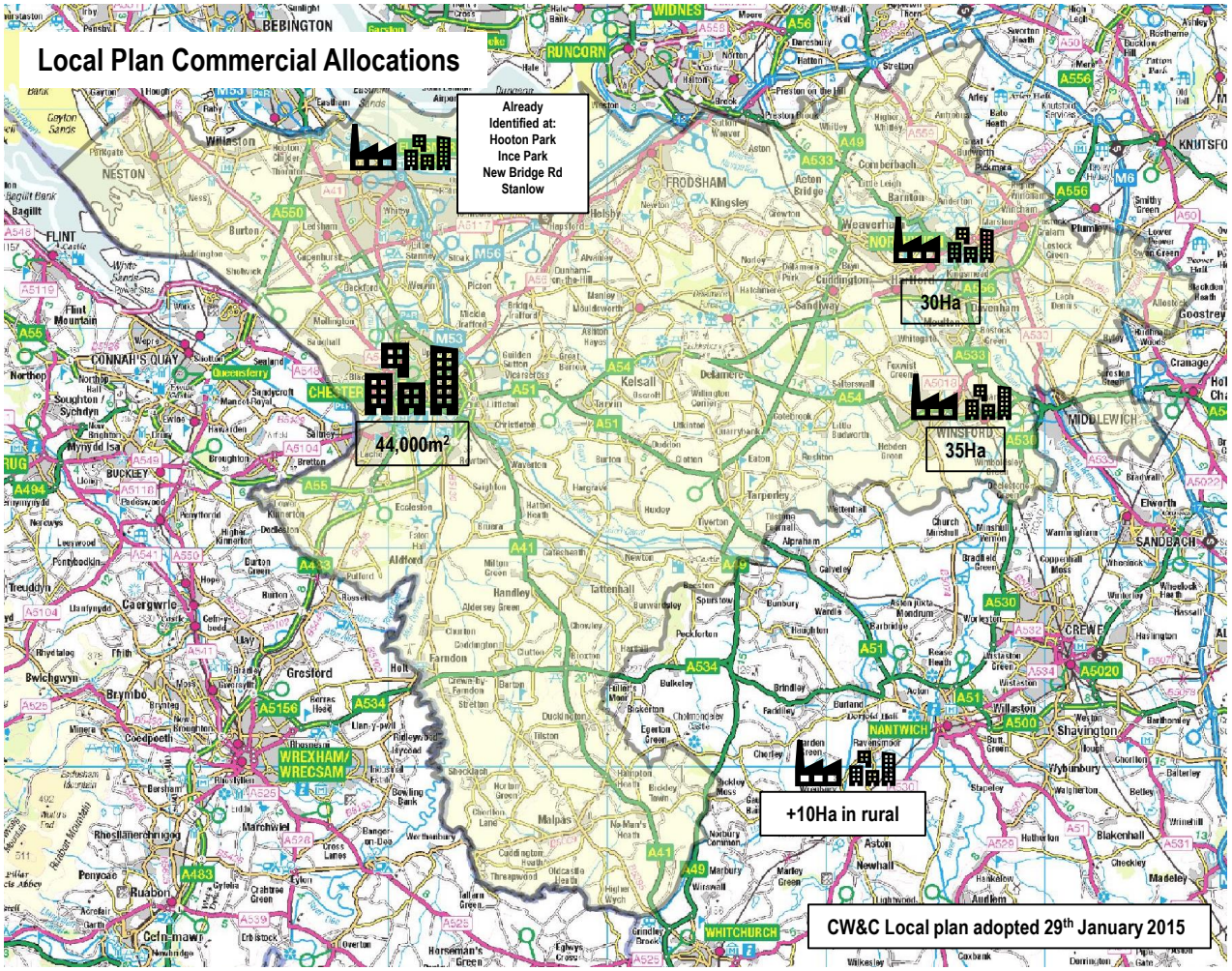
Cheshire & Warrington future development plans *cont*

- In Cheshire West & Chester the largest residential increases are planned for Chester and Ellesmere Port



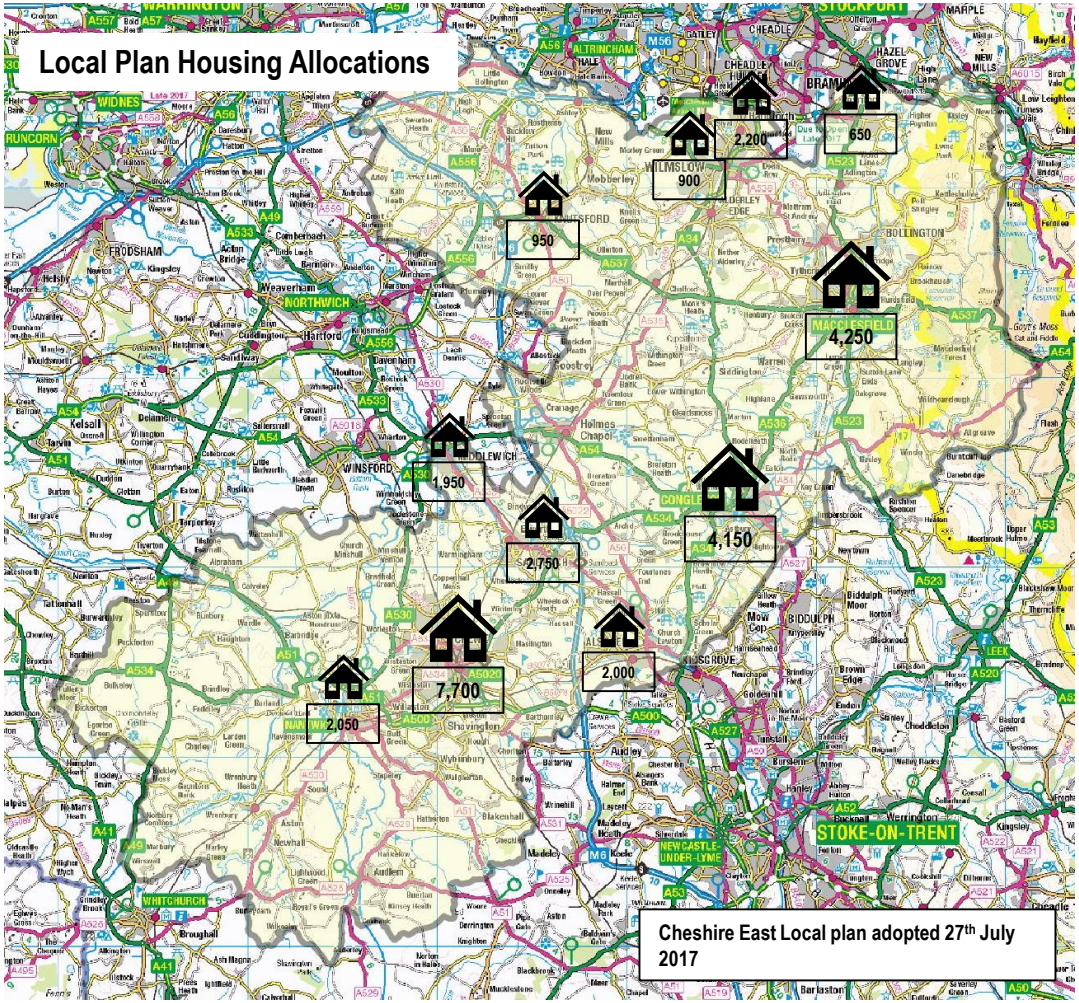
Cheshire & Warrington future development plans *cont*

- In Cheshire West & Chester, there is a commercial focus on Chester (new CBD), Northwich and Winsford



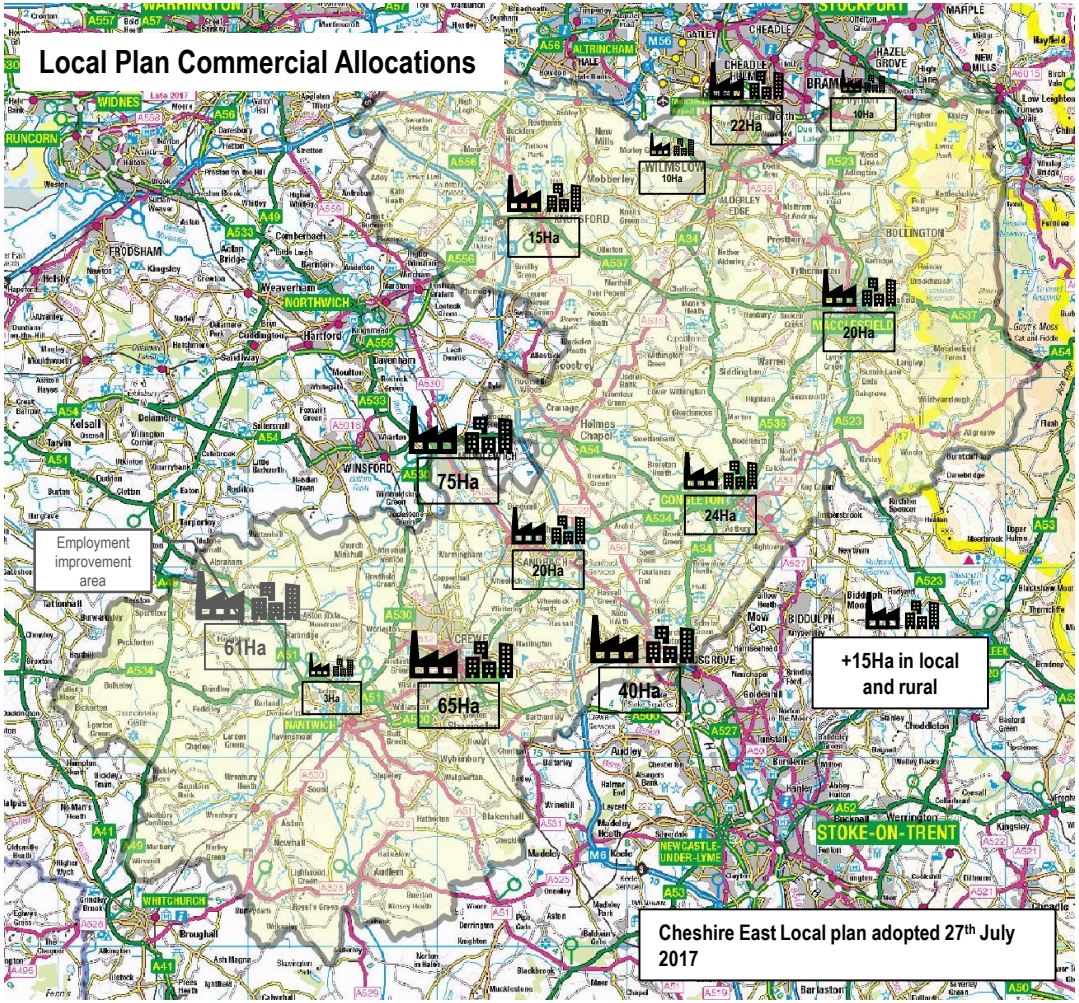
Cheshire & Warrington future development plans *cont*

- Cheshire East has published growth proposals – the largest focus of which is Crewe



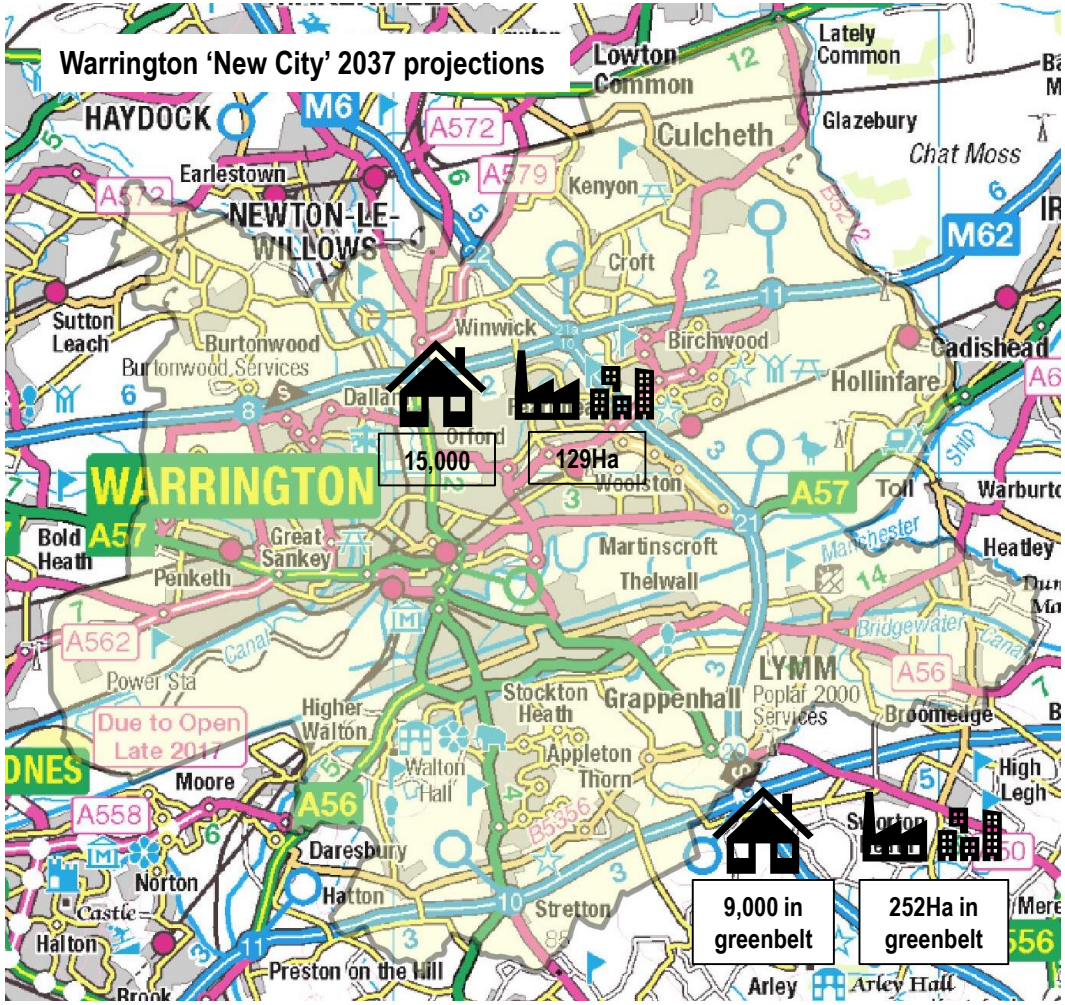
Cheshire & Warrington future development plans *cont*

- The largest proposed increase in commercial space in Cheshire East is targeted at Middlewich



Cheshire & Warrington future development plans *cont*

- Warrington is proposing large scale growth under a 'new city' proposal



Electricity

Technology is having impact across all aspects of the electricity and gas supply chain and the lead time for technology deployment is shortening

The electricity industry in the next 5 - 20 years is likely to see a revolution in technology, commercial structure and investment.

Such a development is obviously not exclusive to Cheshire and Warrington, but it is vital the C&WLEP have a good understanding of these changes in order to prepare for challenge and opportunity that could arise.

Recent studies have identified change via:-

- New technology deployment - great change in technology relating to transportation, IoT, smart grids, demand side management, micro generation, home heating, thermal electricity generation and geo-science is enabling a revolution in the economics of energy supply. This is having impact across all aspects of the electricity and gas supply chain. The lead time for technology deployment is shortening
- Digitisation of electricity supply - the improvement in our understanding of energy performance from the adoption of IoT, together with the digitisation of electricity and gas industry systems is creating the impetus for change. Smart metering and smarter infrastructure on grids and network together with the adoption of industry wide systems for trading and settlement in the next decade will create a very different environment for commercialisation and innovation, especially for new entrants to the energy market.
- Change occurring from greater energy decentralisation - increasingly, electricity generation is decentralised. Over 900,000 points of electricity production existing in the UK today compared with around only 90 points of production twenty years ago. In the C&W LEP area, there are around 13,000 small scale points of electricity generation (mostly Photovoltaic - PVs). As the economics of PV continue to improve, it is likely we will continue to see further deployment of decentralised generation (in some cases combined with storage and EV charge capability).
- Increased electrification of transport. In accord with central UK Government policy, the sale of fossil fuel vehicles will be prohibited from 2040. This has created a further push to the promotion and adoption of electriv vehicles (Evs) into the mainstream. We are also seeing the emergence of fuel cell EV's (FCEVs) to be fuelled by hydrogen and the deployment of compressed natural gas (CNG) for fleet use. Together with changes in rail use technology (electric and H2), the make up of energy demand from transport is likely to be very different from that seen in the last number of decades.
- New technology impacting electricity distribution and storage. Energy storage technology (for both heating, cooling and electricity) is improving at both micro and larger scale. This is likely to have an impact at both site level and also within the electricity grid in the period of the energy strategy. IT has the potential to change the usage behaviour as well as the economics of energy supply.

Baseline

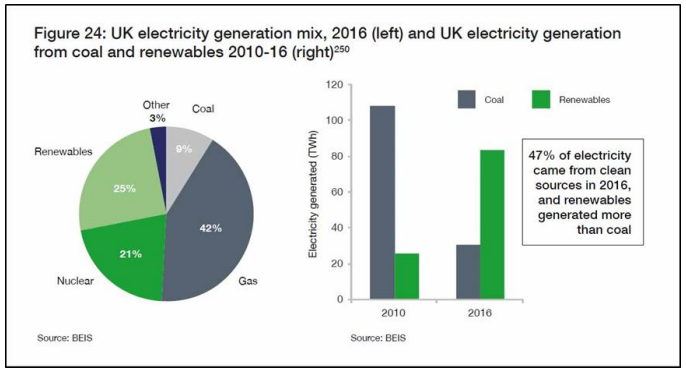
The UK is currently undergoing a transition towards a lower carbon energy system. The electricity generation mix has moved from coal based generation to gas and renewables in the last

Electricity *cont*

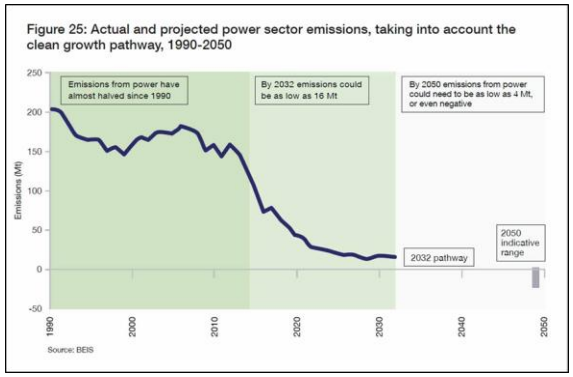
- It is considered likely that further small scale generation is likely to occur in the LEP area in the next 5 to 15 years, mostly in distributed energy

decade. In the near future, this trend is expected to continue augmented with further additions of low carbon electricity generation, much of it decentralised.

UK electricity generation mix and transition from coal to renewables (Source: BEIS, Clean Growth Strategy)



Actual and forecasted emissions from UK power sector (Source: BEIS, Clean Growth Strategy)



Electricity Generation

Within the C&WLEP area, there are almost 13,000 points of electricity generation, including:

- Centralised power plants, fossil fuelled, biomass, EfW, wind farms, hydro power
- Decentralised electric generation; wind turbines, micro hydro, solar PV etc.

For small scale electricity generation, this is shown in the Table below.

Our forecasts indicate that further small scale generation is likely to occur in the LEP area in the next 5 to 15 years, mostly in distributed energy (including micro generation).

Number of small scale electric generation in Cheshire and Warrington

	Dwellings	Solar PV	Wind	Hydro	AD	Sew. gas	Landfill gas	Bio-mass
CE	163,864	4,413	17			3	5	3
CW&C	146,454	5,022	5		2	2	3	
Warrington	88,193	3,475	2			1	8	
Total	398,511	12,910	24	3	2	6	16	3

Electricity *cont*

For some of these trends, the challenge for LEP is to be a valuable stakeholder, for others it is to be an active project participant.

Power Grid

As part of the report, it is important to examine how changes in technology and regulation impact upon the common electricity infrastructure. In particular, how the preparedness for the changes that are likely to occur in the short, medium and longer term.

In the short term (i.e. 5 years) our review of the current plans from the electricity network operator and local gas network operator indicate that investment plans are well structured and focused on current needs. They each have a flexible approach via regulation that can respond to the needs of the LEP. Our view is that the LEP should encourage a strong engagement with the local companies as leading members of their stakeholder forums (perhaps through an infrastructure group) to continue to act as a group that can set out likely future demand and grid issues.

In this time period, further work is likely to be required in work relating to demand side management, early take up of new electricity storage and readiness for expansion of the EV network. This is an area of technology opportunity in which Cheshire & Warrington has a USP through the location of EA Technology (and their work in this area) and the University of Chester Energy Centre at Thornton.

There is also a leading role for the Cheshire Energy Hub in this period to help define requirements for future decentralised infrastructure.

In the medium term (i.e. 5 to 10 years) , we forecast a greater requirement for the LEP to be working in partnership with the local electricity and gas companies to help shape the needs of the electricity and gas networks. The issue during this time frame (which is re-visited in the report) is the inability of the network to make speculative investment to meet future demand (and this inability is enshrined in regulation – with the original intent of allowing other providers to invest in infrastructure).

During this time, we forecast a significant increase for new EV charging infrastructure, an associated increase in self generation (PV) and storage, a noticeable growth for electrical heat demand (from heat pumps) and an associated increase in smarter energy applications as a result of the introduction of smarter metering and new electricity industry arrangements for flexible networks. We forecast that there may be a particular emphasis in the rural network which could see a shift from oil heating systems towards electric heat pumps as well as EVs. This could create the need for more capacity to be built into the network – although Electricity North West in particular thought that capacity was in place especially if one off sites for EV charging (in towns) were planned for a concentrated future users.

For some of these trends, the challenge for LEP is to be a valuable stakeholder, for others it is to be an active project participant. The role of the LEP / Local Authorities will only become clear on a project by project basis – but its involvement should be measured by considering the extent to which there is market failure and the extent to which local players can directly influence the outcome (rather than simply act in a supportive manner).

Electricity *cont*

The UK Government Clean Growth Strategy defines the incentives and regulation, intended to drive the move towards an emission free transportation systems.

Technological development has made it possible to generate electricity locally and in a small scale, especially from solar PV and wind turbines, but the grid is needed for balancing local generation. Therefore the grid is not just about providing electricity but being able to offtake when local generation exceeds demand. The power grid will have to cope with new challenges.

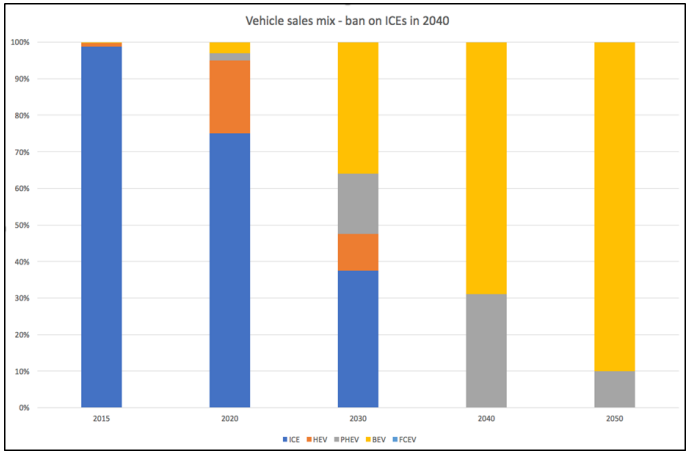
- Baseline grid system (one way) and upgrading programmes
- Requirements to meet future demand
- Requirements to meet future small scale generation
- Responsibility for grid development

Electric Vehicles

The main interfaces between the transportation system and the energy system, are principally in the power sector and the use of fuels, currently predominantly fossil. The UK Government Clean Growth Strategy defines the incentives and regulation, intended to drive the move towards an emission free transportation systems.

The likely trends are illustrated adjacent:

Graph: Shares of car sales in selected years in a model that imposes steady progress towards a petrol and diesel ban in 2040. ICE is internal combustion engine; HEV is hybrid electric; PHEV is plug-in hybrid; BEV is battery electric and FCEV is fuel-cell electric vehicles.



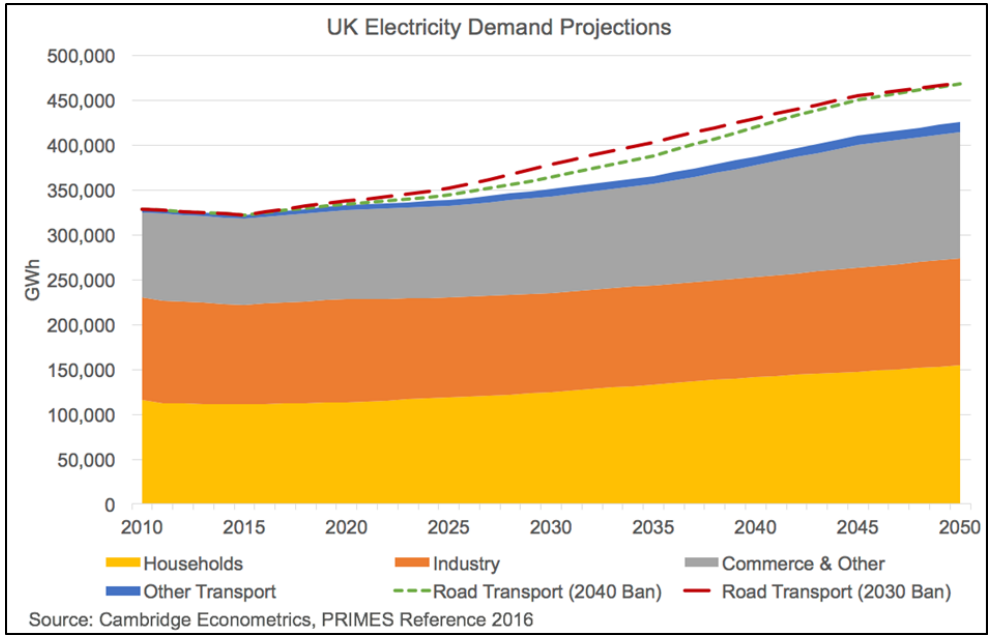
Source: Cambridge Econometrics E3ME model.

Electricity *cont*

To meet the Government's 2050 target, almost every car and van will need to be zero emission by 2050

To meet the Government's 2050 target, almost every car and van will need to be zero emission by 2050. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040. Emissions from heavy goods vehicles (HGVs) will also need to reduce significantly to make a meaningful contribution.

Graph: UK electricity demand by sector (blue, grey, orange and yellow areas) and the additional demand due to EV demand with a 2030 (red dashed line) or 2040 ban (green dashed line).



Source: Cambridge Econometrics E3ME model and the EU PRIMES Reference 2016 scenario.

Electricity *cont*

A wholesale move to Electric Vehicles (EVs), in order to meet a potential ban on petrol and diesel cars, would add just 10% to UK electricity demand

Government investment will help bring down the cost of EVs and increase their range and to support innovation in energy storage, demand side response and other smart energy technologies, including vehicle-to-grid products and services.

The Cambridge Econometrics model expects petrol and diesel cars to be totally replaced by EVs and that battery electric cars will account for 90% of all cars by 2050 and plug-in hybrids for the remaining 10%.

A wholesale move to Electric Vehicles (EVs), in order to meet a potential ban on petrol and diesel cars, would add just 10% to UK electricity demand (40-45 TWh), new analysis from consultants Cambridge Econometrics shows. This would also dramatically cut car CO2 emissions, even after accounting for electricity generation.

In the short term electric vehicles offer the best decarbonising transition of the transport sector, but over time hydrogen may become an additional opportunity, especially considering Heavy Goods Vehicles (HGV) and trains.

Key elements of the Government's strategy are as follows:

Innovation – The strategy forecasts spend of £841 million out to 2021 in innovation in low carbon transport technology and fuels. Alternative low carbon fuels, such as hydrogen and biogas cars, vans HGVs and aviation. A new £23 million fund was recently announced to boost the creation of hydrogen fuel infrastructure and encourage roll-out of hydrogen vehicles. At least £70 million over the next five years will be provided to support innovation in energy storage, demand side response and other smart energy technologies, including up to £20 million for vehicle-to-grid products and services.

Infrastructure – leading to "one of the best electric vehicle (EV) charging networks in the world". To that end an additional £80 million to support charging infrastructure deployment, alongside £15 million from Highways England to ensure rapid charge points every 20 miles across 95 per cent of England's Strategic Road Network.

New regulation will also allow the Government to set specific requirements for the provision of EV charge points or hydrogen refuelling infrastructure at motorway service stations and large fuel retailers.

Local Implications

Whilst the development and introduction of ULEVs is a global initiative and the figures relating to vehicles and emissions tend to be at a national level, the issue is particularly important for Cheshire & Warrington for three reasons:

- The economies of the area have been predominantly developed on the basis of car / HGV connectivity. The economic bases of the area are widely distributed and public transport linkages are poor.
- Significant national motorway routes pass through the area (M6/M62/M56/M53) with the heavy use of vehicles that these accommodate.
- The manufacturing output of the area often results in road movement (with some limited rail and port use)

On this basis the changing nature of vehicle propulsion is an

Electricity *cont*

Wherever there is enhanced R&D activity this offers GVA enhancing opportunity to create spin out technologies and new ventures

area which is important to the area and the manner in which it can be effected locally is to ensure infrastructure is in place to accommodate EV development.

GVA opportunities for Cheshire & Warrington from low carbon transportation transition include:

Innovation:

- Benefit from spend on low carbon technology and fuels, drawing from local examples such as Argent Energy's £75 million production plant in Cheshire which is using innovative technology to turn sewage waste into biodiesel.
- EA Technology innovation in electric vehicle infrastructure (picked up later).
- Build on Crewe's railway heritage to develop a UK centre for development and demonstration of carbon free train systems, specifically utilising batteries and fuels such as biogas and hydrogen. It should be noted that Alstom is expected to develop the UK's first hydrogen train at its Widnes facility (and supported from Allerton or Chester).

.

Infrastructure:

- Leverage UK Government investment in EV infrastructure to become an early adopter of EV charging points at scale.
- Support the development of an EV infra-structure installation, operations and maintenance supply chain, building on early adopter advantages.
- Explore opportunities in the emerging hydrogen and fuel cell arena – especially given the work being undertaken by Cadent on the possibility of developing a hydrogen network in Cheshire, Warrington & the Liverpool City Region and the excess hydrogen produced at Ineos (on the boundary of Cheshire & Warrington.

Wherever there is enhanced R&D activity this offers GVA enhancing opportunity to create spin out technologies and new ventures in addition to the creation of high quality employment.

Electricity *cont*

- **Private grid systems maybe one method of reducing costs to large users / reducing demand on a constrained network – but they challenge the current tariff system**

Why is a private grid concept attractive to large energy users?

The National Grid
The National Grid in the UK was conceived through the 1926 Electricity Supply Act. The grid was developed to link electricity generation in the largest and most efficient power stations to demand across the country in a single cable backbone.

The National Grid has continued to expand in terms of capacity and now requires a further change in terms of its operation to allow the input of power from multiple small sites as well as the large power station sites for which it was originally designed. Digitisation to allow balance between demand and supply will also be a feature of the new grid development.

Tariffs
With the privatisation of the Central Electricity Generating Board and the break up into different suppliers (and the National Grid as the private grid operator), tariffs varied slightly between providers but clearly within a range that reflected the UK cost of production.

In 2001 the UK Government introduced a Climate Change Levy which placed an additional charge on energy used by business.

In addition, with the increase in investment in clean power, the cost of generating electricity has increased.

Private Grid
The pricing structures have resulted in an anomaly where large power users would gain a significant discount in energy costs if they created a private relationship with a local energy supplier.

A long term contract between the private user with a price slightly higher than the tariff that would be received by the generator from selling into the national grid system could still result in a substantial discount to the private user.

The Issue
At present this situation is unattractive to the industry as a whole. This is because firstly the levy which would have been raised from large scale users is lost and secondly the legal structure of the grid is such that the National Grid would always need to provide sufficient back up supply if the local users supply failed.

Would this work in Cheshire & Warrington?
The concept of a private grid has been discussed for the Mersey Estuary energy intensive area. This is based on new energy suppliers locating on the Protos business park adjacent to some of the larger power users in the UK economy.

Whether the scheme would work will relate to the one-off infrastructure costs of creating the network and the required inter-connections. More work is also required on capacities required - base and peak usage and the profile of demand. If this (across multiple users) can be linked to a commercial structure that is satisfactory for the energy supplier, then the concept could work.

Fuels

Fuels used in heating, transport and industrial processes remain predominantly carbon based

Besides the use of fuels in the heating sector (see previous) and power generation (see previous) the big users are process industry and transport.

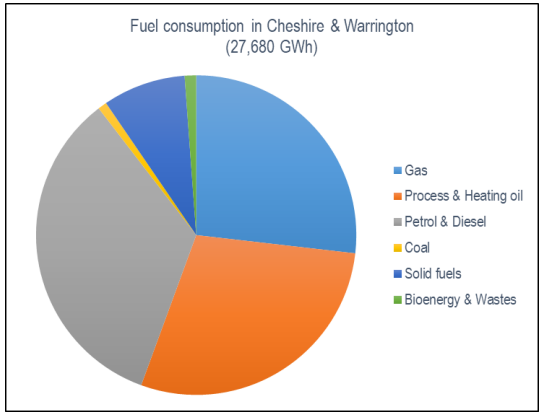
This report will not look into all the different fuel types but focusing on possible ways to reduce carbon emissions. Identifying the main sources for CO2 emissions and to match this to ongoing development makes it possible to make some future projections.

The process industry is part of the non-domestic statistics where petrol accounts for 60%, natural gas for 20% and solid fuels for 18% of the non-domestic fuels used in Cheshire and Warrington. It is not known how much of solid and processed fuels that is fossil based, but the majority is expected to be recovered biomass (generally biomass pellets but also refuse derived fuels).

The road transport sector in Cheshire & Warrington is almost entirely based on fossil fuels and electric vehicle take-up is not sufficiently material to show up in the statistics yet. Cars account for 60% of road transport energy and petrol and diesel share the use equally. The freight transport share (HGV and LGV) is 38% and public bus transport is having the final 2%. Graphs relating to this are set out in the baseline data and the data is published by BEIS as part of its sub-national road transport fuel consumption statistics.

Focusing on fuels only and leaving electricity aside, natural gas and oil for industrial use have about 27% each, while the transport sector accounts for 32%. When the transport sector is included and electricity excluded fossil fuels totally dominate the energy mix and account for some 90% of fuels.

Total fuel consumption in Cheshire and Warrington and fuel type



Industrial processes

Fossil fuels play an important role in UK as discussed in the heat and power generation sections. Besides heat and power generation and the transport sector, petroleum products are mainly used in industrial processes. In Cheshire and Warrington the use of petroleum is highly concentrated to the industrial cluster at Ellesmere Port – and the large Essar petroleum refinery at Stanlow is a large consumer for its own industrial needs.

The position of this refinery, total refining capacity in the UK and a future shift away from refined oil products was discussed in the

The Cheshire Energy Hub launched the concept of an Energy Innovation District – an area which could drive innovation, support industry to succeed and encourage growth and investment

earlier report 'Should Energy be a Fourth Priority'. In the medium term refining capacity may be considered at risk – albeit because of the UK refining mix, the current trend to move away from diesel, may assist existing UK refineries.

Cheshire Energy Hub

The Cheshire Energy Hub is an energy sector support organisation, which has been entirely funded and strategically driven by industry. It started in 2014 and works with its member organisations and key stakeholders in promoting collaborative action, advancing the skills agenda and working towards business solutions. It initially established a successful Graduate Recruitment Programme and now provides the conduit for collaboration across various energy initiatives.

Members include C-Tech Innovation, EA Technology, Encirc, Essar Oil UK, Peel Environmental, Protos, Storengy UK and URENCO, Cheshire West and Chester Council and the University of Chester Thornton Science Park. This existing cluster represents an area that currently consumes around 2.5% of the UK's energy and contains some of the UK's most significant and energy intensive infrastructure, including Ineos Chlor, Essar's Stanlow Refinery, CF Fertilisers, Encirc and URENCO.

In August 2017 the Cheshire Energy Hub launched the concept of an Energy Innovation District (see https://energyinnovationdistrict.com), and area which would provide the overarching environment which – as a result of lower energy costs – could deliver a strategy to drive innovation, support industry to succeed and encourage growth and investment.

Among other ideas the Cheshire Energy Hub has suggested within the Innovation District is for the following:

- The provision of a regulatory system that supports the delivery of a District wide micro-grid, distribution connected generation and energy storage, hydrogen and bio-methane injection to the grid and the support of hydrogen trials and pilot hydrogen storage.
- A review of Carbon Capture and Storage feasibility in the Southern Irish Sea.
- Innovate UK to engage specifically in a project to determine the potential role of electric vehicles within a significant micro grid to provide local balancing services.
- Enhanced capital allowance benefits to underground gas storage companies and a review of the approach to determining the rateable value of underground storage assets.

It is not the intention of this report to re-visit these ideas or cut across existing ideas but to highlight the thought leadership that the Cheshire Energy Hub is bringing to energy system issues in the UK.

Carbon Capture Usage & Storage (CCUS)

Carbon Capture Storage (CCS) was an important part of the previous UK blueprint for tackling climate change published by the coalition government in 2011. Two experimental CCS projects did not proceed in 2015 after funding was withdrawn. Promoters argue that significant public funding may be required

The British Geological Survey (BGS) will place its only English Geo-energy Observatory at Ince and can become a natural partner to the Cheshire Energy Hub in any RD&D projects regarding Carbon Storage.

to pursue this technology fully because of the technical challenges and uncertainties involved.

CCUS is however a core technology outlined in the sector specific industrial carbonisation and energy efficient road maps. To this end, specific measures have been announced by Government and these include:

- Demonstrate international leadership in carbon capture usage and storage (CCUS), by collaborating with global partners and invest up to £100 million in leading edge CCUS and industrial innovation to drive down costs.
- Work in partnership with industry, through a new CCUS Council, to put the UK on a path to meet its ambition of having the option of deploying CCUS at scale in the UK, and to maximise its industrial opportunity.

The Liverpool City Region and Cheshire & Warrington combined have been the centre of a study by Cadent to consider whether a hydrogen fuel network can be delivered using the gas network which might otherwise become a legacy asset (the HyNet project). The move to plastic gas piping across this entire network is an enabler.

In addition Protos and the Energy Centre at Thornton has explored the opportunity for hydrogen production, capturing emissions from the generated energy required through Carbon Capture into the Hamilton gas field in the Irish Sea – a pipeline for which is in place in N. Wales (in close proximity).

This no doubt represents one potential opportunity (although the technology is, as yet, unproven) and could be delivered in the future – the strategic roadmaps set out in this document predict any such technology as being 10-20 years away from being in mainstream usage. Clearly Cheshire & Warrington has some unique advantages in this space should the technology progress to full maturity.

Also carbon gas removal:

- The Energy Centre at Thornton is examining how hydrogen can be formed from natural gas extraction – and could therefore 'decarbonise' natural gas.

The British Geological Survey (BGS) has announced that it will place its only English Geo-energy Observatory at Ince Marshes (CW&W) in a £31m new development. The BGS will have a wide ranging role including geothermal, storage systems and also monitoring and potentially mitigating any effects of any potential shale gas developments across the North of England – potentially capturing economic value from shale gas R&D in Cheshire & Warrington.

Unconventional Oil & Gas

Government nationally believes that unconventional gas has the potential to provide the UK with greater energy security, growth and jobs. The Local Authorities of C&W are not in favour of the approach. Fracking, or hydraulic fracturing, is a technique used in the extraction of gas from shale rock by drilling down into the earth before a high-pressure water mixture is directed at the rock to release the gas inside.

The UK has a strong regulatory regime for exploratory activities,

Fuels *cont*

During 2017 a major hydrogen proposal was developed by Cadent for the Mersey Estuary area – with a start date of 2026 if the project proceeds

What is the prospect for the use of Hydrogen?

The Proposal
Cadent has developed a proposal to create a hydrogen backbone stretching from Manchester to the Wirral with a spur to St. Helens from a central new hydrogen production facility between Runcorn and Ellesmere Port with the capture of the CO2 bi-product from production using existing pipeline and rig infrastructure in the Irish Sea.

Hydrogen would then be supplied in place of gas to a mixture of large industrial energy users and into the domestic gas network as well as to vehicle refuelling stations.

Environmental benefits
Cadent estimate that the low carbon heat that could be generated by such a source (5-5TWh) could surpass all current UK heat networks and air source heat pumps. They also predict that such a network could remove >1m tonnes of CO2 emissions with 75% of this saving arising from energy intensive industries which have few means of lowering their carbon footprint.

In terms of the other benefits, Cadent predict that the impact on carbon emissions will be less costly for general domestic consumers because of the lack of need for domestic conversion whilst vehicle emissions would be reduced if hydrogen gains a foothold as the alternative fuel for transport.

Economic benefits
The proposal, if it was fully implemented would help underpin the energy intensive manufacturing base of Cheshire & Warrington and would also potentially attract other users because of the supply of reliable, clean energy. The investment could also place Cheshire & Warrington at the centre of hydrogen technology and carbon capture technology with the resultant supply chain benefits.

The project would also make use of otherwise legacy assets in terms of the UK's gas network.

Next Steps
Cadent is working up its 'Liverpool-Manchester Hydrogen Cluster' project in greater detail and is seeking to gain further political support for the project before submitting detailed planning applications for work to be undertaken.

One of the critical decision milestones will be the RIIIO2 price control decision for the gas distribution network which will come into force from 31st March 2021 and will be a determinant in the viability of the project.

If the project proceeds against the current plan, Cadent has modelled a start date for 2026.

In the short term electric vehicles will offer the best decarbonisation transition

and over 50 years of experience of regulating the onshore oil and gas industry nationally.

Scientists from the British Geological Survey (BGS) have estimated that the total volume of gas in the Bowland-Hodder shale in northern England to be some 1300 trillion cubic feet (central estimate). But it is not possible to estimate how much shale gas and oil the UK can produce until there has been some exploration and testing.

Shale gas is natural gas having the same basic chemical composition, but the extraction of shale gas (fracking) is controversial and highly debated, particularly from an environmental issue.

IGas has applied to drill a test well to fracture underground rocks to release gas at a site in Grinsome Road on Ince Marshes, close to a collection of energy projects that have located to the business part known as Protos, as well as the major industrial areas of Runcorn and Ellesmere Port.

Irrespective of the shale gas position in the UK, this report has set out a clear direction which would allow the reduction in the importance of gas particularly in the provision of heat. Shale gas is returned to in the recommendations.

Transport

The baseline and technology section are sourced from BEIS' report 'Clean Growth Strategy'.

Baseline

While new cars in the UK are up to 16% more efficient than they were in 2000, the improvement has been largely offset by a nine per cent increase in road traffic to 2015. The transport sector now accounts for 24% of the UK's carbon emissions.

Improvements by manufacturers in the fuel efficiency of vehicles have largely been driven by tighter regulation, mainly set at an EU level. The fuel we use in our cars is also lower carbon, with the Renewable Transport Fuel Obligation (RTFO) driving the greater use of biofuels. Biofuels now account for around 3% of fuel sales, with around half of that derived from waste. Average greenhouse gas savings from biofuels are around 70% compared to petrol and diesel.

To meet the Government's 2050 target, almost every car and van will need to be zero emission by 2050. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040. Emissions from heavy goods vehicles (HGVs) will also need to reduce significantly to make a meaningful contribution.

Part of the solution to the transport emissions is planned to be achieved through improved rail access and initiatives such as the Constellation Partnerships Growth Track 360 which are aimed to maximise the impact of HS2 hub at Crewe.

Transport Technology

In the short term electric vehicles offer the best decarbonising

Fuels *cont*

The Government are spending £1bn to drive the uptake of ULEVs whilst adjusting taxes to further incentivise the consumer

transition of the transport sector, but over time hydrogen will become another opportunity.

Electricity

An ultra-low emission vehicle is a vehicle that produces less than 75g/km of CO2. Today there are less than 10 car models that are considered Ultra Low Emission Vehicles (ULEVs), all of them being electric or hybrid cars. ULEVs should become progressively more affordable as economies of scale are realised and they could provide savings for consumers compared to equivalent internal combustion engine cars by the mid-2020s or sooner. There uptake would then start to have a commensurate impact on vehicle emissions. As a result, at least 30% of new car sales are expected to be ULEVs by 2030, and possibly as many as 70%. For new vans, up to 40% of sales could be ULEVs by 2030. The Government are spending £1 billion to drive the uptake of ULEVs.

Government investment will help bring down the cost of EVs and increase their range and to support innovation in energy storage, demand side response and other smart energy technologies, including vehicle-to-grid products and services.

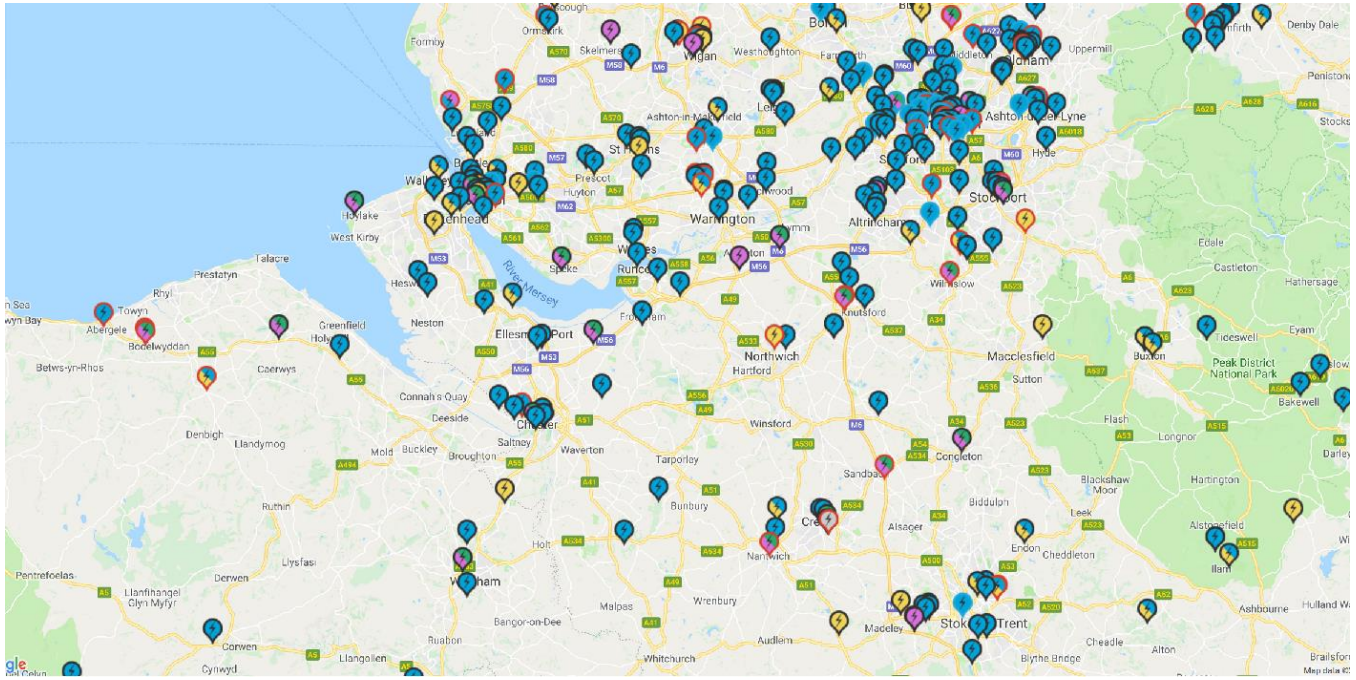
Cheshire & Warrington has some particular challenges in this area. Car ownership, the use of a car in travelling to work and the distance travelled to work are all higher in Cheshire & Warrington than in the UK as a whole whilst the level of investment in charging points is far behind urban areas where there is a greater density of demand and where journey types currently more closely match the capability of most electric vehicles.

The charging point map for the area is shown in the map overleaf:

Fuels *cont*

- Charging point investment to date has been in city centres where demand is most dense and journeys better reflect most current electric car capabilities

Zap-map charge points 2018



Fuels *cont*

Diesel based rail transport will have to be converted to renewable energy sources. The two main opportunities are electricity and hydrogen fuel cells

Hydrogen

Hydrogen and fuel cell (HFC) technologies can provide transport services. The UK has competitive strengths in HFC and could exploit technology opportunities at home and abroad.

The UK Hydrogen Fuel Cell Association states that the UK is home to leading international hydrogen supply and storage companies. Large global players such as Air Products and BOC / Linde have particular strengths in stationary gas and liquid fuel storage and handling. Other players, such as ITM Power, are working on the integration of hydrogen systems with renewable generation, including electrolysers and fuel cells.

The UK fuel cell industry is characterised by a number of world class system developers, active across a range of application areas. Companies such as Ceres Power, Intelligent Energy and Rolls-Royce Fuel Cell Systems are designing products which will revolutionise transport and stationary power markets. Others are developing and supplying innovative materials and components; these range from established players such as Johnson Matthey and UCM Advanced Ceramics through to innovative start-ups, such as BAC2 and Acal Energy

Whilst there is no known active HFC strength in Cheshire & Warrington, the production, transport and use of the product has been identified as an issue by the University of Chester at Thornton.

As noted above, hydrogen is also increasingly being explored as a piped fuel source potential utilising legacy pipelines / gas replacement).

Initial exploration of such pipeline systems are cited in the Gas Innovation Network Competition Report (Oct 2017) which particularly highlights plans in Leeds and also through initial plans put forward by Cadent for a Liverpool – Manchester Hydrogen Cluster.

The opportunities are detailed for hydrogen in transport. While application in cars is important, hydrogen is also well suited to heavier vehicles operating daily duty cycles. The UK could benefit from a focus on developing larger buses, trucks, vans and even boats, where there is already significant industrial strength.

The Liverpool City Region is keen to pilot hydrogen powered trains, potentially on the Liverpool-Chester line via the Halton chord.

For many HFC technologies, the period before 2025 is preparatory, readying the technologies, companies and markets for more extensive deployment beyond 2025.

Biofuel

The Government also want to see a near doubling of sustainable bioenergy used in the transport sector. Argent Energy, one of the largest bio-fuel producers in the UK has a major facility located in Ellesmere Port.

Local opportunities

Besides road vehicles diesel based rail transport will have to be converted to renewable energy sources. The two main opportunities are electricity and hydrogen fuel cells (HFC).

Fuels *cont*

As a major rail hub with maintenance facilities, Crewe can benefit from some investment in this area

Crewe is well known for locomotive maintenance and a rail hub, and railways still play an important part in local industry at Crewe Works. Building on its historical heritage, Crewe offers an opportunity to develop a ‘centre of excellence’ in alternatives to diesel fuels. A train RD&D centre developing and testing electric storage, HFC and biofuel train options is a possibility.

Heating

The heating sector provides a good opportunity for C&W to take a leading role in the UK partly driven by the number of properties off the gas grid.

It has been seen that the CCC considers that efficiency measures around gas boiler systems have reduced emissions and that this technology has now reached the extent of its contribution – the CCC remark that 'uptake of heat pumps and district heating remain minimal and new buildings with high-carbon heating systems are still being built'.

The CGS, however, states that "Beyond the RHI, our ambition is to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid residential buildings (which are mostly in rural areas) during the 2020s, starting with new homes as these lend themselves more readily to other forms of low carbon heating

Given the maturity of some of the technologies – and the extensive residential development planned in Cheshire & Warrington, this ambition seems to be an area where Cheshire & Warrington needs to (and could) move more quicky.

For this reason, there is an argument which can be made that the heating sector provides an opportunity for C&W to take a lead role in the UK. It is considered likely that heat pumps will play an important role in decarbonising the heating system, currently held back by low awareness of the technology and its benefits, married to a lack of supply chain capacity and experience. Heat networks have been intensively studied around the country (HNDU funded) but to date only a fraction of those studied have been installed.

HNDU applications have been successfully made in Cheshire East (in Rounds 1,4,5 and 6 with a total of £419,100 secured); Cheshire West & Chester (successful in Rounds 3 and 6 with a total of £314,900 secured; and in Warrington in Round 1 with £80,400 secured).

Off gas grid opportunities to role out heat pumps commercially and their adaptability as a retrofit low carbon solution are predicted to make this the most prevalent low-carbon heating solution in the UK in the future – despite the attractiveness of heat networks in new build solutions. Heat pumps represent a major opportunity for Cheshire and Warrington to take the lead the UK in efficient and economic heating systems based on renewable energy sources outside metropolitan areas and big cities. A national hub for knowhow, design, advice and supply chain in 'Local heating' based on the complementary systems heat networks and heat pumps can be developed across the area.

Electricity will become even more important when in a future integrated, decarbonised energy system. Electricity will power the heat change (e.g. heat pumps) and the role of electricity is picked up in a later section.

It is considered likely that the current short term UK logjam in the heat networks development pipeline will be resolved by a combination of political will at a local level, and development of commonly accepted business models for financing, ownership and operation of heat network assets. This is because the decarbonisation of heating is a major plank in the achievement of UK CO2 reduction targets and the development of heat networks and the deployment of heat pump technologies offer the principal technological means of decarbonisation.

Heating *cont*

> "Heating our homes, businesses and industry accounts for nearly half of all energy use in the UK and a third of our carbon emissions."

Baseline

Gas heating accounts for 84% of all households in Cheshire and Warrington. In urban areas the share is 88% and in rural areas 66%. As the entire heating sector needs to be decarbonised by 2050 replacing natural gas as the principal fuel is imperative. In the short period though, reduction of oil and electric heating present prime opportunities for transition.

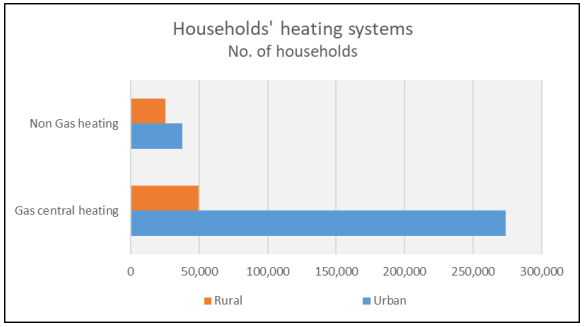
The Clean Growth Strategy:

"Heating our homes, businesses and industry accounts for nearly half of all energy use in the UK and a third of our carbon emissions. Nearly 70 per cent of our heat is produced from natural gas. Meeting our target of reducing emissions by at least 80 per cent by 2050 implies decarbonising nearly all heat in buildings and most industrial processes.

Reducing the demand for heat through improved energy efficiency will have an important role to play but will not by itself suffice to meet our 2050 target. We need to lay the groundwork in this Parliament to set up decisions in the first half of the next decade about the long term future of heat. The demands on our energy infrastructure will change as low carbon heating technologies take over from fossil fuels, with a greater dependence on electricity and potentially new infrastructure needed for system balancing and the generation of low carbon gases. Supply chains will need time to grow to provide products and services consumers across the country will need.

There is a range of low carbon heating technologies with the potential to support the scale of change needed. These include the electrification of heating with households moving away from gas or oil boilers, to electric heat pumps; decarbonising the gas grid by substituting natural gas with low carbon gases like biogas and hydrogen; and heat networks (which are likely to be particularly effective in dense urban areas). At present, it is not clear which approach will work best at scale and offer the most cost-effective, long term answer. We will work with industry, network operators, manufacturers, and consumers to achieve a clear and shared understanding of the potential as well as the costs and benefits and implications of different pathways for the long term decarbonisation of heat. This includes modelling the costs and benefits of different approaches, establishing the likely level of change for households and demands on the electricity grid building on the work of others in this field."

Gas central heating in dwellings in Cheshire and Warrington



The study team shares the UK Government view that the heating sector will play a central role in reaching the carbon goals of 2050, and presents a strategic approach presented aligned to the strategic guidance below.

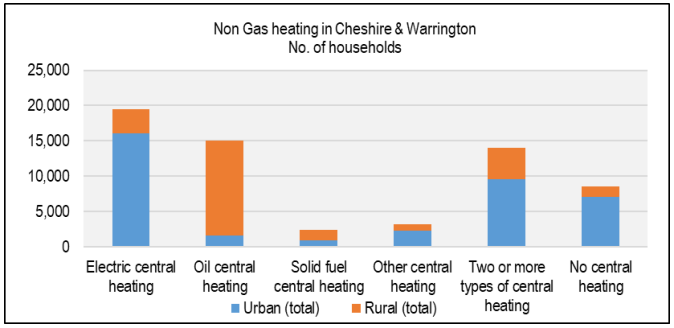
Heating *cont*

Heat network systems need significant heat densities to become viable. Therefore the potential heat networks will be largely found in urban areas

Gas central heating is the overall dominating heating system in Cheshire and Warrington. In urban areas gas central heating accounts for 88% (~275,000) of all homes, and the corresponding figure in rural areas is 66% (~50,000 homes).

Interestingly, electric central heating is the most common non-gas heating system in urban areas while oil is dominating in rural areas. As electric heating is not directly compatible with district heating or wet heat pumps, these homes have to be treated separately.

The non-gas heating systems in urban and rural Cheshire and Warrington



Technologies

Besides conventional heating systems (gas, oil, solid fuels and electricity) there are two systems that can be deployed more or less immediately; heat networks and heat pumps.

Based on Scandinavian experience there is no doubt that heat pumps and heat networks provide the best opportunities in the period considered. If hydrogen is able to make a breakthrough, it will still take time to overtake the market, especially since there is limited international experience.

Heat network systems need significant heat densities to become viable. Therefore the potential heat networks will be largely found in urban and / or industrial areas, although small networks combining big heat users can be developed in rural villages. Heat networks also require high connection rates, i.e. large portion of the potential clients have to become customers.

Connecting large detached residential houses to a heat network is also a challenge. This is basically due to multiple connections and small individual loads. But for heat networks to make a real impact on carbon reduction, cheaper and more energy efficient systems have to be developed. There is a lot of experience in Scandinavia in this area, which can be drawn on.

Both Cheshire East and Cheshire West have been successful in more than one round of HNDU funding. There is a Council appetite for developing heat networks and Warrington, Chester, Ellesmere Port, Macclesfield, Crewe and Northwich are all towns potentially well suited for heat networks.

In addition to this, Cheshire East Council has secured (October 2017) £1m of European funding to help establish a landmark community heating pilot scheme. The investment will contribute to setting up the heat networks and help fund feasibility studies, development activities, market testing and supply chain development. Cheshire East is the first non-city region to receive funding for this type of project and will act as a pilot for similar schemes.

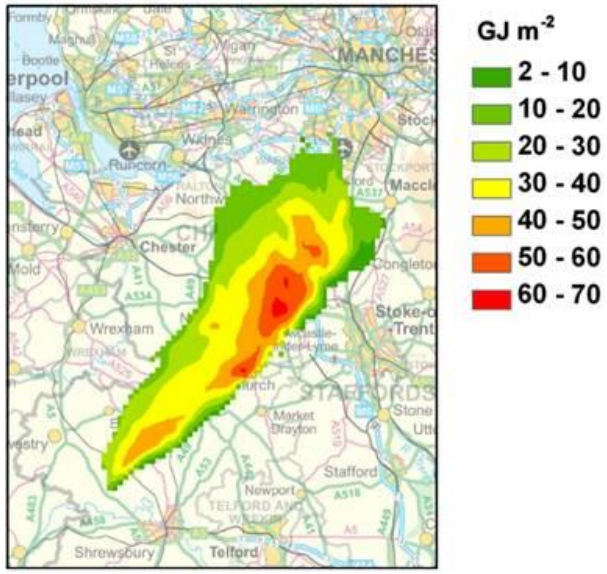
Cheshire East has an additional potential resource to strengthen

Heating *cont*

The fast and high peak gas boiler heating profile is unfortunately commonly used for designing heat pumps and heat networks in UK – and this is one of the fundamental reasons why modelling suggests that such systems are not viable

its position in developing on heat pumps and this is its geothermal resource. Whilst detailed work would need to be undertaken to fully understand the heat potential within the area, the map below sets out the estimated heat map.

SE Cheshire estimated geothermal resource



Local Opportunities

This report will focus on the two internationally mature systems that provide a great opportunity for Cheshire and Warrington to decarbonise the energy system:

- Heat pumps, mainly air source (ASHP) and ground source heat pumps (GSHP), and air-to-air heat pumps (A/AHP) primarily for electric heated premises.
- Heat networks in heat dense areas and potentially in housing areas.

As heat pump and chiller technology are basically the same, with the difference of using opposite sides of the machine's output, one machine can be used for space heating in winter and space cooling in summer. Drilled boreholes can serve as a seasonal thermal storage improving performance factor (COP) for heating as well as cooling. This type of system is common in hotels, office buildings and hospitals in Scandinavia.

There are Governmental incentives to promote heat networks and heat pumps, but to make a real difference there are some important issues that have to be addressed:

- In all new developments, domestic and non-domestic, the heating system must be designed for 'low temperature' not exceeding 60°C. This will pave the way for heat pumps in houses/buildings as well as central generation in heat networks.
- The fast and high peak gas boiler heating profile is unfortunately commonly used for designing heat pumps and heat networks in UK. By flattening the profile heating homes 24 hours a day, the heat supply capacity (generation and pipe network) may reduce by 50%, reducing capex considerably. The increase in energy consumption (a few percent only) is highly out-weighed by better indoor climate (health and wellbeing) and

Heating *cont*

The take up of ground source heat pumps could be dramatically changed through the addition of different financing options

What is the potential for Ground Source Heat Pumps

The principles

A ground source heat pump system harnesses natural heat from underground by pumping water through it in pipes. The heat pump then increases the temperature through compression, and the heat is used to provide home heating or hot water.

The ground source heat pump needs electricity to run, but the idea is that it uses less electrical energy than the heat it produces - it uses ambient heat from the ground, rather than burning fuel to generate heat.

The economics

The Energy Saving Trust (EST) estimates it can cost between £13,000 and £20,000 to install and using current prices, the Trust also estimates that for a four bedroom house the savings over an old electric heating system or an old LPG system could be between £800-£1,500 per annum plus the ability to gain a c£3,400 per annum through the Renewable Heat Incentive (RHI) for 7 years.

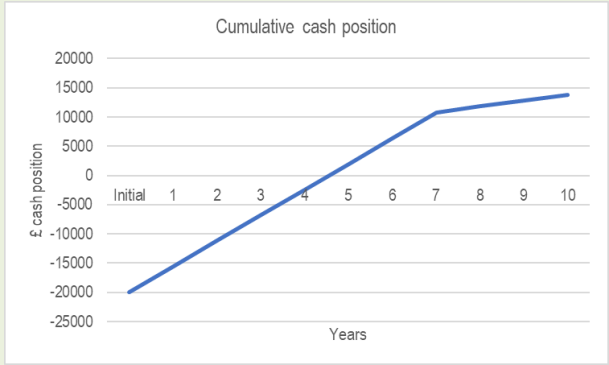
Assuming a £20,000 installation cost, £1,000 per annum energy saving and £3,400 RHI contribution the payback on the system is 5 years.

If the initial outlay is financed, at current interest rates it is estimated that the annual payments would be fractionally less than the combined value of RHI & energy saving – and as a result the consumer has no out-going and sees a large benefit after year 5.

The conclusion

With greater publicity and the addition of innovative purchase options, there is the possibility to significantly increase the take up of ground source heat pumps.

Straight purchase option



Financed option

Heating *cont*

Financial products alongside air source heat pumps can also make a difference – particularly air to water pumps because of their RHI eligibility

What is the potential for Air Source Heat Pumps

The principles

There are two types of air source heat pumps – air to water – which work in a similar manner to ground source heat pumps, providing heat into a wet based heating and hot water system; and air to air which provide heat into a room by using a fan.

Only air to water heat pumps receive the RHI in the UK.

The economics

The Energy Saving Trust (EST) estimates it can cost between £7,000 and £11,000 to install and using current prices, the Trust also estimates that for a four bedroom house the savings over an old electric heating system or an old LPG system could be between £700-£1,300 per annum plus the ability to gain a c£1,400 per annum through the Renewable Heat Incentive (RHI) for 7 years.

Assuming a £11,000 installation cost, £900 per annum energy saving and £1,400 RHI contribution the payback on the system is 5 years.

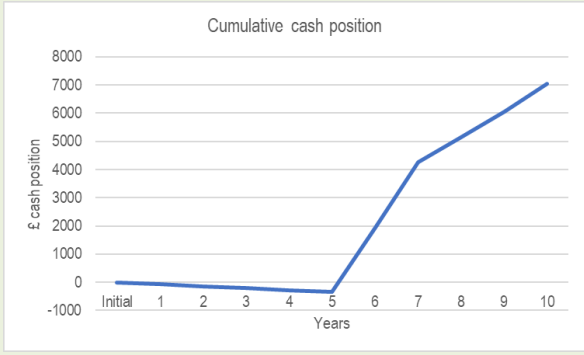
If the initial outlay is financed, at current interest rates it is estimated that the annual payments would be fractionally more than the combined value of RHI & energy saving – nevertheless, the consumer has low out-goings for the first 5 years and still sees a large benefit after year 5.

The conclusion

Some financial management offer alongside air source heat pumps can also make a significant difference to initial affordability and therefore likely take up.

Straight purchase option (RHI eligible)

Financed option (RHI eligible)



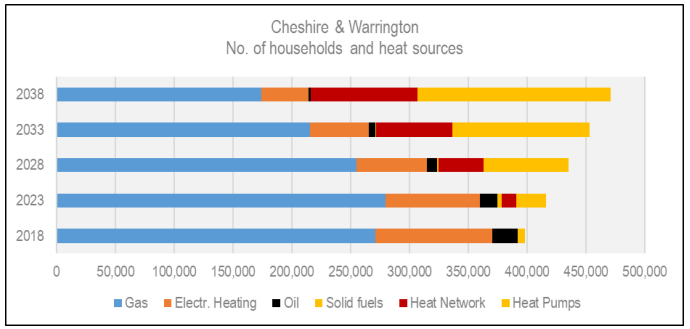
Heating *cont*

Heat networks are not limiting the heat pump potential in the UK and the installation is easier especially in legacy real estate

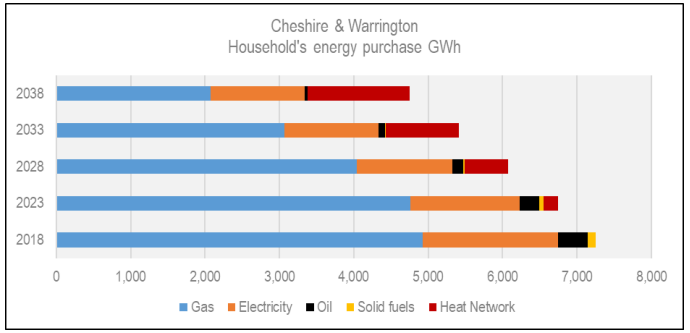
reduced pipe losses.

- The central heating systems (water pipes) in existing homes are normally designed and sized for a quick raise in indoor temperature due to on/off heat profile, e.g. in the mornings. It is possible to reduce supply temperature in existing buildings if they are heated evenly and this approach tends to allow the introduction of heat pumps.
- The strategic start-up plan for ASHP and GSHP is to replace oil in rural areas, and for A/AHP to reduce the electric consumption in electric heated homes.
- Heat networks suiting residential houses have not yet been widely implemented in the UK. For heat networks to be able to meet the expectations of decarbonisation and fuel poverty reduction in legacy developments, the technology has to be further developed. Building on Scandinavian experience a Government funded research, development and design programme could be carried out for retrofit schemes (ie research into how networks can cost effectively be linked in to legacy wet heating systems).
- Given the scale of the task and the structure of the C&W economy, it is suggested that Cheshire and Warrington seek to gain a UK leading position in 'Local Heating' building expertise, demonstration, supply chain and experience in heat pumps and heat networks. By branding Cheshire & Warrington as an 'Area of Excellence' in Local Heating, involving universities, retail and service sectors it is possible to develop a template to be deployed all over the UK.
- Heat pumps as a replacement technology in wet systems off the gas grid (replacing oil fired systems) is now commercially viable using a combination of RHI and commercial finance and this is demonstrated overleaf.

The graphs below show an illustrative scenario where by 2038 domestic heating systems have transitioned as follows (model included as an annex provided to C&W LEWP):



If the domestic heat systems transition against this model the change in energy use (and type) would then result in the following energy use profile.



The graphs illustrate that with a sustained but relatively modest take-up of heat pumps and heat networks over the next 20 years

Heating *cont*

Heat networks are not limiting the heat pump potential in the UK and the installation is easier especially in legacy real estate

could significantly de-carbonise domestic heat and as power Generation and heat sources were also de-carbonised this would have a dramatic effect on carbon emissions driven by domestic consumption.

In Sweden district heating is the dominating heating system (55%) and limiting the potential for heat pump expansion. Heat pumps currently account for 20% and are expected to have a 30-35% market share by 2030. Heat networks are not limiting the heat pump potential in the UK and with a relative ease of introduction as a retrofit solution into many properties, there is rapid growth potential.

The barriers to take up and the actions recommended are set out in the later sections.

Energy Vision

The report's aim is to propose a strategy which results in an energy system that is affordable, clean and secure

The report's aim is to propose a strategy which results in an energy system that is affordable, clean and secure. It will require a mix of technologies which are designed to work together and are optimised wherever possible. Besides these general aims, we suggest that the C&W LEP promote UK leadership in research, development and demonstration (RD&D) in specific areas where there either is a strong heritage (nuclear), a national research centre (British Geological Survey), or an area which has not penetrated the UK market as extensively as in other countries (local heating).

The strategy formed must head for a future target – a vision. In our case we are looking 20 years ahead (2038). The report sets out a compelling vision – and builds (rather than contradicts) the visions or ambitions already stated by the three councils.

Local Authority ambitions

Each of the Local Authorities have set out clear visions for how they intend development to be more sustainable and each demonstrate clear ambition.

The published position of each is reproduced in Appendix 4.

There is a need to consider a collective vision behind which each Local Authority could rally and such a suggested vision is outlined below.

Energy Vision - Cheshire and Warrington

The proposed Cheshire and Warrington vision is bringing the UK Government's ambitious 'Clean Growth Strategy' to a LEP geographical level aligning with the three councils' visions and ambitions as well as other key stakeholders' expectations. The region's vision has a 20 year perspective supporting the climate change target 2050 decided by the UK Government.

Proposed Energy Vision

By 2038 Cheshire and Warrington will have a resilient energy system, based on locally integrated power and heat systems, reducing climate gas emissions by at least 50%. Supported by a resilient and smart power grid:

- More than 50% of the heating energy will be provided by heat pumps and heat networks using renewable or waste energy sources
- Self-generated renewable electricity account for 20% of all domestic and commercial electricity used
- The majority of cars are electric powered (EV) and the vast majority of buses, heavy goods transport and trains run on electricity, hydrogen or biofuels.

Cheshire and Warrington will be leading the UK's clean growth and energy system in 'Local Heating' and 'Small Modular Reactors' as well as being significantly involved in 'Hydrogen', 'Geothermal Energy', and 'Low Carbon Trains'.

Locally sourced energy, better efficiency and integrated energy system will have eliminated fuel poverty and significantly increased the region's GVA.

Energy Vision *cont*

The proposed Cheshire and Warrington vision is bringing the UK Government's ambitious 'Clean Growth Strategy' to a regional level aligning with the three councils' visions and ambitions

Building on each council's heritage or specific opportunities, the vision addresses the possibility to create 'local values' in terms of skills, employment, economic development leading to positive social effects. The identified 'Centres of Excellence' (CoE) are:

- Local Heating – A UK leadership in heat pump and local heat networks. Cheshire East Council have progressive heat network plans (and have recently secured £1m in EU funding to help establish a landmark community heating pilot scheme). CEC is the perfect council to position itself as the UK leader in 'Local Heating'.
- Energy System Demonstrator – Energy Systems Research – The Energy Centre at Thornton and the BGS UK Geo-energy Observatory both at the University of Chester's Thornton Science Park will make hubs for expanding energy research and demonstration.
- Nuclear Energy Centre – Building on the nuclear R&D cluster in Warrington a UK research centre for nuclear energy can be developed at Birchwood Business Park.
- Energy Innovation District – The district is being established to be an exemplar project for the provision of reliable, lower cost, clean energy for intensive energy users.

In addition to these CoEs, Crewe has an opportunity to position itself as involved in the Future Rail Demonstrator where stored electricity, hydrogen fuel cells (HFC) and biofuels are tested and demonstrated in trains (albeit the centre of this activity is more likely to be at either end of the Halton Curve).

A branding of specific 'centres of excellence' or 'hot spots' could help attract expertise, investments, development and demonstration to the region. Differentiating the local councils' energy profile as proposed above, will enhance the region's attraction for businesses, commerce and residents, improving the GVA.

C&W could ideally link such centres of excellence into the existing policy frameworks in the UK – Institutes, HEIs and Catapults.

Wherever there is enhanced R&D activity this offers GVA enhancing opportunity to create spin out technologies and new ventures in addition to the creation of high quality employment.

Heating pathway

A basic requirement for a resource efficient energy system is to match energy supply to demand from a qualitative perspective. In this report low grade heat sources are primarily directed for space heating and hot water production, while electricity and fuels are prioritised for powering electric devices and machinery, engines etc. The high quality electricity should not be used directly for space heating, but powering heat pumps can reduce purchased energy considerably using ambient heat sources (typically air or ground).

Heating pathway – 20 years

- By 2038 Cheshire and Warrington are in the lead of UK heat transition
- Oil and coal heating are eliminated
- Gas heating is reduced by more than 50%
- Heat pumps provide 35-40% of heat demand
- Heat networks account for more than 20% of total heat demand

Energy Vision *cont*

A branding of specific 'centres of excellence' or 'hot spots' will attract expertise, investments, development and demonstration to the region

Table: Home energy use and home energy CO2e emissions in C&W roadmap 2018-2038 compared with the UK Government's Clean Growth Strategy 2015–2032. A projected estimation of CGS 2018-2038 reduces the total CO2e emissions by 41%, to be compared with the 61% reduction C&W roadmap

Comparing the Government's Clean Growth Strategy with C&W Compass roadmap	CGS 2015-2032	C&W 2018-2038
Home energy use (MWh/household)	-12%	-20%
CO2e emissions in home energy use (kg/MWh)	-14%	-40%
Total CO2e emissions (tonnes/year)	-21%	-61%

(Modelling provided as an annex to C&W LEP)

As shown in the table the Cheshire and Warrington CO2e emission targets for the residential sector is considerably higher, although the time periods are not quite the same. The main difference is due to the proposed extensive use of heat pumps in Cheshire and Warrington, but heat networks are also an important part of the outcome.

Important measures to meet the vision

An extensive deployment of heat pumps and heat networks call for a reduction in design heating temperatures to some 60°C or less, which could be a regulated requirement in all new buildings either through national regulations or local additional building control requirements. Some older buildings may be suitable for deployment or may need supplementary measures – and more R&D in retrofitting new technologies is required.

Another key issue for heat pump and heat network deployment is to avoid morning and afternoon heating peaks, which is created by systems which are turned off during the night and working day. This is not entirely a technical issue as it relates to people's behaviour, but it is fundamental to the effectiveness and specification of a system. There may also need to be some smart monitoring and deployment of loads.

It is also highly recommended that the councils always consider heat networks as a potential energy supply system in all new developments. The council may even consider heat net connection to be a permit requirement in new developments. The suitability will depend on the development – but a more rigorous requirement methodology, approval and appraisal system is required with assumptions that better mirror those locations that have successfully implemented heat networks.

Social aspirations

The heating strategy will help residents and small businesses to reduce their heating bill and at the same time improve health and wellbeing. This is possible due to affordable heating 24 hours a day.

Investing in efficient heating system (heat pumps or heat networks) or home generated electricity may be a barrier for many residents. Leasing agreements should be tested as an opportunity to expand the deployment, especially for vulnerable residents. There is also a role for Registered Social Landlords to extend these systems of housing schemes.

The potential expenditure profile of lease costs in heat pump deployment compared to an oil based heating system was set out above.

Energy Vision *cont*

An extensive deployment of heat pumps and heat networks call for a reduction in design heating temperatures to some 60°C or less

Electricity pathway

The future energy system suggested in this report will rely on the power grid being the 'backbone' in the transition. We expect small scale electric generation like solar PV and wind turbines to become a significant part of a local 'energy sharing economy'.

The power grid will have to support increased loads in rural and off-gas grid areas where heat pump expansion will commence, but also be open for locally generated electricity offtake.

Table: UK power generation emissions clean sources' share of electricity supply in UK Government's Clean Growth Strategy

UK Government CGS million tonnes Co2	1990	2015	2032	Change 2015-2032
Emissions from power generation	204	104	16	-85%
Share of electricity supply from clean sources	21%	45%	85%	89%

For C&WLEP area, a vision for a lower carbon electricity system was identified exhibiting:

- Generation mix – to increase the proportion of electricity generation from within the LEP area, from renewable and low carbon sources and mostly decentralised
- To promote the use of co-generation capacity within the LEP area using both biomass and natural gas as a means of delivering local thermal heat and power
- To promote a new, dynamic and responsive smart grid in the LEP area that responds to the needs of the four main economic development zones, namely the Cheshire Science Corridor, Mersey Dee Economic Axis, Constellation and Warrington New City
- To foster a leading emphasis for R&D development for electricity generation, distribution and supply within the LEP area, leveraging the capabilities in the Cheshire Science Corridor.

Transport pathway

To meet the 2050 target, almost every car and van will need to be zero emission by 2050. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040. Emissions from heavy goods vehicles (HGVs) will also need to reduce significantly to make a meaningful contribution.

UK road transport emission according to the Government's Clean Growth Strategy

UK Government CGS	1990	2015	2032	Change 2015-2032
Emission intensity in road transport kgCO2e/MWh	231	227	183	-19%
Emissions in road transport MtonCO2e	120	118	83	29%

Road transport

For Cheshire & Warrington to decarbonise the road traffic in line with the Clean Growth Strategy, the transport sector's CO2e emissions reduction has to be >50% by 2038 (and the vision is that the majority of road transport should be electric by this point).

Energy Vision *cont*

For Cheshire & Warrington to decarbonise the road traffic in line with the Clean Growth Strategy, the transport sector's CO2e emissions reduction has to be >50% by 2038

As shown in table 6 the total road traffic emissions have to decrease by almost 30% by 2032 while the reduction in emission intensity is only about 20%. The explanation is that the total energy consumption is reduced by 13% in the same time period.

It is not expected that Local Authorities will have impact on the vehicle industry, but in terms of providing alternatives for car the opportunities are many. Local cycling, better developed public transport (buses and trains) can all reduce the use of cars, and facilitating car-pooling is another opportunity for the local council.

At an important confluence of motorway routes (M6/M62/M56) decarbonising represents a particular challenge for Cheshire & Warrington. This is only likely to be addressed through a combination of fewer car journeys (public transport and better use of technology to reduce business travel), more intensive use of cars (sharing using technology platforms to aggregate journeys), and a transition to ULEVs brought about by national policies including fiscal measures and local investment in charging points including rapid charging as part of the motorway infrastructure.

Rail transport

The UK Governments 2016 Rail Freight Strategy highlighted the potential to reduce emissions by growing rail freight and reducing HGV journeys. The Government's ambition is to accelerate the activity to enable cost effective options for shifting more freight from road to rail, including using low emission rail freight for deliveries into urban areas, with zero emission last mile deliveries.

In Cheshire and Warrington the strategy in the short term is to electrify rails and to use biofuels instead of diesel. In the longer term hydrogen powered fuel cells may replace the remaining diesel.

Waterways

Parts of Cheshire & Warrington have a somewhat unique position as having access to the inland waterway corridor created by the Manchester Ship Canal (as well as the other waterways such as Weaver navigation and wider canal network). This is a resource which has already allowed the replacement of some road freight and there is the potential for this resource to be used more extensively – albeit only with the potential for a modest impact.

Strategic Roadmap

Homes account for 22 per cent of the UK's emissions when electricity use is taken into account. The average household's energy consumption has fallen by over 17 per cent since 1990

The UK's approach to reducing carbon intensity in the economy, has been to break the challenge down into five-year chunks, accepting that some change is easier to achieve and that technology is likely to move on.

This section seeks to set out those areas of change in those aspects of the energy economy which have been considered most relevant to Cheshire & Warrington. Clearly this is not an entire review of the future technology of the entire energy sector.

As a result the report brings together threads of the earlier sections and some technology viewpoints to provide a roadmap for the next 5, 10 and 20 year time horizons.

The Chapter considers:

- Demand side management
- Electricity and transport
- Heat

The later action plan also sets out consideration of aspects such as:

- Nuclear
- Carbon Capture & Storage
- Smart systems

Demand Side Management (DSM)

Baseline

The Government is upping its ambition on domestic energy efficiency, which will mean more work for the construction industry in making and fitting insulation to homes. A new target will see most homes brought up to at least an EPC C-rating by 2035. All this should help expand the home energy performance market benefiting local manufacturers and installers.

Homes account for 22 per cent of the UK's emissions when electricity use is taken into account. The average household's energy consumption has fallen by over 17 per cent since 1990. This has been driven by a combination of tighter building and products standards.

While there are now approximately a quarter more homes than in 1990, the overall total of emissions from the sector has reduced by about a fifth over this period. Almost 79 per cent of homes in England in 2015 had an Energy Performance Certificate (EPC) rating of Band D or better compared to 39 per cent in 2005.

The EPC ratings of domestic dwellings in the period 2008-17 as a whole and the EPC ratings for 2017 alone are shown in the tables below for Cheshire & Warrington demonstrating the increase in efficiency of newer homes in the area.

Strategic Roadmap *cont*

24% of new homes in 2017 in C&W had an EPC rating of B – only 10% achieved this in the longer period 2008-2017

EPC Ratings 2008-2017

2008-17	No.	A	B	C	D	E	F	G
Cheshire East	107,668	110	10,308	25,773	42,987	20,362	6,174	1,950
Cheshire West & Chester	97,911	117	10,825	26,046	38,310	16,427	4,681	1,503
Warrington	63,683	45	5,218	21,319	25,928	8,981	1,709	482
Total	269,262	272	26,351	73,138	107,225	45,770	12,564	3,935
Percentage		0.10	9.79	27.16	39.82	17.00	4.67	1.46

Source: DCLG Live Tables

EPC Ratings 2017

2008-17	No.	A	B	C	D	E	F	G
Cheshire East	8,239	15	2,256	1,674	2,768	985	378	163
Cheshire West & Chester	7,295	59	1,929	1,837	2,314	813	232	111
Warrington	3,419	1	327	1,216	1,398	366	85	26
Total	18,953	75	4,512	4,727	6,480	2,164	695	300
Percentage		0.40	23.81	24.94	34.19	11.42	3.67	1.58

Improved energy efficiency also offers substantial health benefits. There is a clear link between cold homes and ill-health where existing conditions (such as respiratory illnesses or mental health conditions) are exacerbated.

Technology

- Building envelope insulation, including window upgrade
- Improved energy performance in electric machines and devices
- Storage
- Building management systems (BMS)
- Ventilation heat recovery
- Human behaviour

New developments

The easiest way to make a transition in the built environment is to start with new developments. As local councils have some authority to decide the rules for planned developments including building control / planning processes, this seems to offer part of the key for success – although higher standards in building regulations in this area adopted nationally would be the more straightforward solution.

Strategic Roadmap *cont*

The easiest way to make a transition in the built environment is to start with new developments

Baseline

In Cheshire and Warrington about 72,000 new households and 840 ha of commercial allocations are planned in the coming 10-20 years even before the newer more ambitious plans discussed but not enshrined in Local Plans are taken into account:

New Planned Developments in Cheshire & Warrington

	New households	Commercial allocations
Cheshire East	27,750	380 ha
Cheshire West and Chester	20,100	381 ha
Warrington	24,000	79.4 ha

Source: Published Local Plan information

Electricity and Transport

This is a shorthand for the issues and actions required for the development of the electricity grid in the short, medium and longer term.

Short Term – up to 5 years

In the short term it is expected that the power grid will form the 'backbone' for energy system transition. This will involve powering some (increasing) heat generation for heat pumps and some (increasing) vehicle power source whilst at the same time the grid will also enable small scale generation.

The ever more complex demands on the grid will therefore require some smart grid development and some of these will arise in the short term from developments in regulation, RIIO and the smart energy code (RIIO is Ofgem's framework for setting price controls for network companies *Revenue = Incentives + Innovation + Outputs*, This is a new performance based model for setting the network companies' price controls which will last eight years).

There are approximately 13,000 power generating instalments (mostly solar PV) in Cheshire & Warrington representing about 3% of the households. This share is expected to increase over the next five years, especially as the specific costs of solar PV in particular have decreased considerably.

Strategic Roadmap *cont*

At present DNO's are prevented from investing in network upgrades in areas where development is forecast but there is no end user

The anticipated result of all of these changes, even within the sort term planning horizon is that there will need to be consideration of some adjustments in demand side management and emergence of EV frameworks for the increase in electrification of transport. The accelerating take-up of EVs is likely to make this a necessity.

One predicted outcome of the need for increased demand side management will be that DNOs are likely to adjust to cope with technology changes and demand through more graduated price controls and tariff plans – effectively trying to iron out usage peaks through graduated pricing.

There is also likely to be a focus (where capacity allows) for an increase in electricity capacity for new homes allowing these homes to benefit most from new technologies and a reinforcement of rural electrification due to greater penetration of heat pump technology.

To enable better localised planning and no inhibitors to growth there is also a need to change the DNO speculative investment preclusion. At present DNO's are prevented from investing in network upgrades in areas where development is forecast but there is no end user / no certainty of a project. As a result, even in those areas planned for significant growth, there is no ability to front load utility investment until specific development projects are certain.

Medium Term 5-10 years

In 5-10 years, it is anticipated that the drivers which are already in place will continue resulting in a further need for low carbon generation, micro-generation and an increased investment in the resilience of the grid. Specifically these changes are considered against each of the elements of the change:

The impact of the drive for increased house building is anticipated to lead to:

- A larger and accelerated increase in electricity connections
- An increase in demand due to greater electrification of homes

At the same time self-generation and storage will lead to:

- Increase in micro generation - especially PV in medium to longer term
- Increase in local electricity storage or local grid flows
- Increase in appliances and EV charging options

Overall it is anticipated that EV take-up will increase – and this is likely to become a requirement for the UK to meet its carbon budgets. These changes to due to EV transportation will then lead to:

- Managed increase in electrical grid capacity due to EV charging. 'My Electric Avenue' (work carried out by the Cheshire West & Chester based EA Technology for Ofgem) estimates 32% of local energy networks will require intervention when 40-70% of customers have Evs.
- New management of demand side services

The electrification of rail routes and the investment in major new rail infrastructure such as HS2 and potentially more cross-pennine investment will result in:

- Major infrastructure for new rail / traction services

Strategic Roadmap *cont*

Increased housing, self-generation, EVs, and heat technology demand will all lead to changes in the grid and demand management within 10 years

Changes in heating with an anticipated increasing shift towards heat pump technology resulting in energy use will lead to:

- Change in rural electrification due to much greater penetration of heat pump technology
- Urban reinforcement for new supply due to electrification of new homes

All of this is therefore likely to lead to innovation and digitisation within the decade and this will result in:

- More efficient use of resources and utilisation of electricity assets through smarter grid technologies
- LEP partnership with DNOs to review heat maps for management of existing and new infrastructure

Long term 10-20 years

It is anticipated that the changes over the first decade will continue but in addition to the continuation of the trends shown above it is considered likely that:

- Demand increases resulting from new housing will be proportionally lower as efficiency measures increase
- Grid improvements and maturation of self generation will result in a substantial increase in local electricity storage or local grid flows
- There is likely to be investment in new management of demand side services in a more dynamic and responsive grid
- Major new infrastructure is possible in H2 and industrial supply
- Potential electricity infrastructure for industrial developments – eg electrolysis (electrolysing water to produce hydrogen is an area of considerable research in order to investigate whether a plentiful supply of hydrogen can be secured with reduced energy input), small and modular nuclear reactor (SMR) connections, and research and development for other new technologies etc

Transport

The main interfaces between the transportation system, the multimodal and systemic movement of people and goods, and the energy system, are principally in the power sector and the use of fuels, currently predominantly fossil. The UK Government Clean Growth Strategy will define the incentives and regulation, intended to drive the move towards an emission free transportation systems. One of the headline measures in the strategy was the announcement of an end to the sale of all new conventional petrol and diesel cars and vans by 2040. As a result at least 30 per cent of new car sales are expected to be ULEVs by 2030, and potentially as many as 70 per cent.

Infrastructure – The Government's strategy is aimed at creating "one of the best electric vehicle (EV) charging networks in the

Strategic Roadmap *cont*

The UK Government Clean Growth Strategy will define the incentives and regulation, intended to drive the move towards an emission free transportation systems

world". To that end an additional £80 million has been allocated to support charging infrastructure deployment, alongside £15 million from Highways England to ensure rapid charge points every 20 miles across 95 per cent of England's Strategic Road Network. New regulation will also allow the Government to set specific requirements for the provision of EV charge points or hydrogen refuelling infrastructure at motorway service stations and large fuel retailers.

GVA Opportunities for C&W from low carbon transportation transition

Innovation

- Benefit from spend on low carbon technology and fuels, drawing from local examples such as Argent Energy's £75 million production plant in Cheshire which is using innovative technology to turn sewage waste into biodiesel.
- Build on Crewe's railway heritage to develop a UK centre for development and demonstration of carbon free train systems, specifically utilising batteries and fuels such as biogas and hydrogen.
- Build on the leading work of EA Technology in EV infrastructure development

Infrastructure

- Leverage UK Government investment in EV infrastructure to become an early adopter of EV charging points at scale – in particular to make the Science Corridor a particular focus for future investment.
- Support the development of an EV infrastructure installation, operations and maintenance supply chain, building on early adopter advantages. Explore opportunities in the emerging hydrogen and fuel cell arena.

Wherever there is enhanced R&D activity this offers GVA enhancing opportunity to create spin out technologies and new ventures in addition to the creation of high quality employment.

Carbon emissions

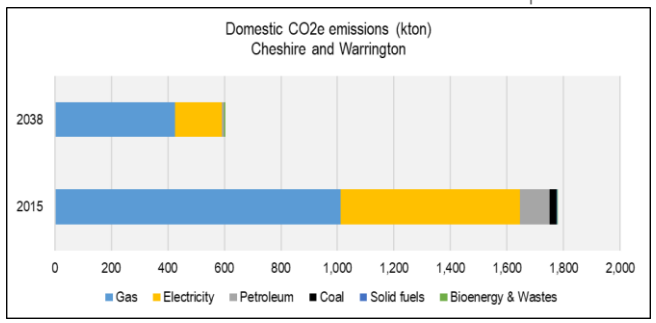
This section is presented to show what an energy transition can achieve in terms of reduced CO2e emissions. The calculations are based on a number of assumptions and the spreadsheet used is presented as an Appendix.

One assumption which is the same for all calculations is that the carbon emissions from the power grid will being reduced from 0.35 to 0.13 kgCO2e/kWh, which is a 63% reduction over 20 years. This has an impact on the extensive use of heat pumps and electric vehicles which are part of the strategy.

Strategic Roadmap *cont*

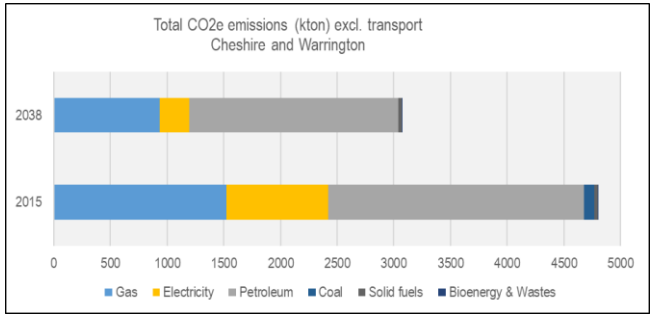
- One assumption which is the same for all calculations is that the carbon emissions from the power grid will being reduced from 0.35 to 0.13 kgCO2e/kWh (a 63% reduction over 20 years)

Carbon emissions from the domestic sector – an example



Transition of space and water heating replacing all oil, some gas and direct electricity by heat pumps and heat networks in the way proposed will reduce CO2e emissions by more than 60%.

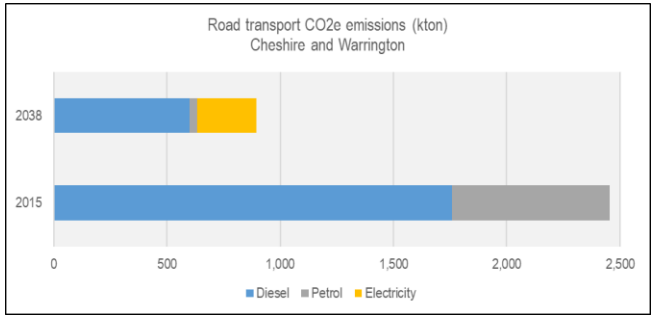
CO2e emission reduction from the energy system (excl. transport) in C&W



The strategy presented for the domestic and non-domestic sectors has a potential of reducing carbon emissions by 36% in 20 years, a reduction in industrial fossil fuels is not included. We recognise that the Cheshire Energy Hub is developing additional measures for energy efficiency and carbon reduction besides providing a resilient energy supply system in the energy intensive area of Ellesmere Port.

Carbon emissions from road transport has been calculated and is illustrated in the graph below. This example, being one of numerous calculation alternatives, is showing a total of 63% reduction in CO2e emissions when almost all cars are running on electricity and 30% of HGV and 60% of LGV are doing the same.

Road transport emissions in Cheshire & Warrington 2015 and 2038 if net transport energy demand remains the same, 95% petrol and 65% diesel is replaced by electricity and power grid carbon emissions is reduced by 63%



Strategic Roadmap *cont*

The easiest way to make a transition in the built environment is to start with new developments

Heating

As has been noted, from a heating point of view it is important that, in the future, houses and buildings are designed with future potential heating systems in mind.

The councils should also consider heat networks in all new residential developments and business parks. Infrastructure costs are lower in new developments than in retrofit areas.

Another very important issue is to make heating systems in all existing buildings, originally designed for 82^{o}C, to be compatible with heat pumps working up to 60^{o}C. This is possible by changing the heating operation; instead of turning off heating during nights, and potentially days, which require high radiator capacity for increasing room temperature quickly after being switched off. This radiator capacity can be used for lowering the supply temperature, but only if the heating is kept on when there is a heat demand (compare with a car driving constantly in a town at 20mph hitting a green wave, and another car speeding up between the lights having to stop for red lights all the time).

Also, similar to new residential development, the councils should always consider heat networks in commercial developments.

To decarbonise the heating system, which is a prime challenge for the UK, the report has identified heat networks and heat pumps to form the foundation for the strategic roadmap. The two complementary technologies, if deployed proactively, can provide a faster decarbonisation than the UK Government scenario in the 'Clean Growth Strategy'.

Short Term – up to 5 years

The most important actions in the first 5 year period will be to pave the way for future achievements in making the energy system transition an engine for economic growth.

The UK Government has identified decarbonisation of the heating sector to be of highest priority, but the policy, regulation and incentive framework has yet to be determined to drive technology options such as; heat pumps, heat networks or hydrogen, or any combination of these.

The special effort in the C&W Energy Compass directed at decarbonising the heat energy system calls for a proactive engagement from all three local authorities as well as Cheshire and Warrington LEP, starting at day one. This will not only position Cheshire and Warrington as the UK leader in heat energy transition, but will also help the UK Government to decide the national route forward.

Technologies

The two main technologies available today for reducing carbon emissions are heat pumps and heat networks. They are complementary technologies as heat networks can be applied in heat dense areas while heat pumps are a more effective technology where homes and businesses are less dense.

Heat pumps are normally powered by electricity and besides the reduction in purchased energy (3-4 times lower) the

Strategic Roadmap *cont*

Heat networks and heat pumps if deployed proactively, can provide a faster decarbonisation than the UK Government scenario in the 'Clean Growth Strategy'

decarbonising of the power generation system will have a direct additional effect on carbon emission from heat pumps.

Heat pumps are available at all sizes and developed to extract heat from a variety of ambient heat sources. They can be installed as solitary heating solutions in homes and buildings, but also as energy centres serving heat networks. The flexibility in applications makes the opportunity for a commercial breakthrough very good.

Heat networks normally have a phased development where the long term achievements in client connection and carbon reduction must have a serious impact on the start-up schemes. It is likely that a high proportion of heat networks deployed over the short term will be fuelled by gas boilers or gas engines. This should be considered as acceptable where these is then a development plan showing a transition to renewable and carbon neutral heat sources as loads increase. The higher the load the greater distances over which heat can be distributed.

It is a challenge to make heat networks commercially viable, and one reason is that the systems designed in the UK normally often seek to mimic the heating profile of gas boilers in conventional systems. This approach increases the capital expenditure requirement considerably with the consequent impact on viability. Making clients aware of the need for 'even heating' will reduce peak heat capacity and supply temperature in favour of further heat energy transition and reduced carbon emissions.

The councils in Cheshire and Warrington should promote heat networks and/or heat pumps in all new developments – making this a statutory planning condition for high density developments. The 'Heat Network' issue is set out overleaf.

Heat network development

The study team has segmented the emerging heat network market by three distinct project types (as per Greater London Authority analysis), based on the scale of the heat network, as follows:

- Type 1 - Single sites; Small/medium up to 10GWh pa (<1,000 residential units), mostly mixed public and commercial facilities, Capex up to £10m,
- Type 2 - Multi-site mixed use schemes 10 to 70GWh pa (1,000 to 10,000 residential units), a range of mixed residential units, public and commercial facilities, Capex up to £100m
- Type 3 - Area wide heat transmission networks; Extensive heat pipe networks connecting multiple heat producers such as power stations, industrial waste heat or energy from waste facilities. May serve 100,000+ residential units and a large range of mixed public and private commercial facilities.

It is important to note that schemes can still be viable at a small scale with a centralised but conventional heat source with the joining of 'island' sites then improving viability for low carbon heat sources and the development of a true network.

Heat network development is therefore based on phasing, starting with small network 'islands' served by local energy centres that may be mobile and temporary (type 1). It is also a smart strategy to search for excess heat capacity in existing boiler plants to reduce upfront investment costs.

Strategic Roadmap *cont*

The study team has segmented the emerging heat network market by three distinct project types

The island network schemes may expand due to organic growth, but at some stage these schemes have the potential to be interconnected, building a wider network that can utilise bigger and more energy efficient heat sources (type 2).

Type 3 networks will probably only be developed in metropolitan areas and are unlikely to be applicable for Cheshire and Warrington certainly in the near term.

There are serious plans for heat networks in Crewe and Macclesfield, and the recently secured £1m of EU funding to Cheshire East will support their implementation. A district energy centre (Hot Spot Stoke) is up and running in neighbouring Stoke-on-Trent, and the first pipes were in the ground in September 2017. A cross border collaboration between Cheshire & Warrington and Stoke City Council regarding heat networks should be established.

Multiple and large scale residential developments planned for Chester, Warrington, Macclesfield and Crewe are all likely to create opportunities to explore initial small networks then becoming 'island' networks with multiple developments fed from larger low carbon heat sources.

Heat network ownership and governance

Investment in heat networks is a fairly immature but rapidly developing sector in the UK. As a result of their experience in the development and execution of heat networks, the consulting team has identified a number of potential ownership models:

- Public sector delivery – direct customer interface with local authority (e.g. Islington Council) or customer interface through ESCo (e.g. Pimlico, Westminster)

District heating networks drive demand for heat – new networks are unlikely to justify expensive investment in heat generation / transport from the outset.

Turning District Heating on its head

What is District Heating?

At its simplest as district heating is the provision of a heating system to multiple users by pumping hot water from a central source.

Discussion on the system has been linked to the low carbon agenda but the system itself could be run from any heat source. In some cases linking district heating to low carbon has created a problem.

The problem for the UK

A huge amount has been written about district heating / heat networks in the UK – but the conversion rate of reports written to schemes completed is extremely low.

In many UK studies a large amount of effort has been focused on identifying the heat source and working out the engineering solution for heat distribution. Insufficient focus has been placed on the likely demand from end users.

In many cases the viability of planned schemes has also been compromised by using a usage profile from the current gas network. District heating schemes should not allow for sudden bursts of high heat demand typical of schemes driven by the high calorific content of gas – district heating schemes work best when creating 'always on' background heat. When a fairly constant demand is modelled, scheme capacities (and cost) are reduced.

Why is District Heating important?

In an de-carbonised UK there is little place for a gas grid with individual homes each using a small gas boiler. Changing the fuel used for heating away from a specific type of fuel will take a huge amount of time because it requires millions of households to switch.

District heating systems bring greater system flexibility. There is no reason why a UK District Heating system could not start with a large gas fired boiler – but in such a system, the change of a single heat source could change the heating energy mix for hundreds of homes very quickly. A system could switch to Energy from Waste, Biomass, Geothermal or industrial waste heat in a matter of months.

You have to start somewhere

Rather than trying to engineer new heat sources and create engineering challenges, the simplest method of introduction in the UK would be to insist on a district heating approach at the planning stage for large new build residential schemes. In fact just such an approach has been taken in Greenwich.

To engage with current utility providers the initial heat source could even be a large gas fired boiler – or biomass boiler to keep the scheme simple. The connection of a new build schemes is easier and future demand for heat is introduced with each new scheme completed.

Strategic Roadmap *cont*

It is important that gas heating demand profiles are not simply lifted and applied to district heating schemes – to work effectively they are used in different ways

It is expected that as the schemes are rolled out, adjacent areas express an interest in joining the network especially if public buildings are also connected – retrofitting can commence.

The future

As demand increases, the economics of different heat sources changes.

The very high initial capital costs of CHP / EfW or geothermal / waste heat connections are now offset by customers already connected to the network. Heat can be transported over greater distances because the load is higher and the pipes are larger.

So what is required?

- Future heat network studies need a greater element of economic / commercial input
- Usage assumptions need to reflect the unique characteristics of heat networks rather than simply transpose current gas usage assumptions.
- Implementation (at the outset) will need to be a condition of planning consents.

Conclusion

- In the UK scheme viability has been compromised by building gas usage patterns into district heating scheme design – and adding complex and expensive heat sources before basic customer networks have been created.
- Areas with planned housing increases create a tremendous opportunity to allow this system to be introduced.
- There is a large first mover advantage to those economies introducing this first in terms of equipment, installation and maintenance.
- Whatever heat generation best suits an area in the future, heat networks allow future connection.

It is likely that, in the short to medium term local authorities will take the lead in owning and financing the development of heat networks, either directly or through an ESCo or in a joint venture

- Private sector led
- Joint venture
- Private sector concession – where the public sector tenders a long term concession to private sector
- Community ownership through an SPV such as an ESCo or CIC (Community Interest Company).

The commercial risk is more pronounced in the early phases when the technology is still considered as being new, but over time more widespread clients and better known potential signature clients are likely to be more keen to connect. Therefore it is likely that, in the short to medium term local authorities will take the lead in owning and financing the development of heat networks, either directly or through an ESCo or in a joint venture with a developer. As more organisations connect and the risks reduce, different ownership models will be possible.

A key issue will be the development of a preferred business model, specifically whether the ownership of heat networks and energy centres will be separate as in a PipeCo and AssetCo model or combined as in an ESCo type arrangement. Initially this may be driven by scale with smaller networks more likely have common ownership of energy centres and pipes. As networks grow and coalesce, it is considered more likely that separate ownership of each asset class will occur.

Heat pump development

Besides building a supply chain, advisory support and financial offers for heat pumps, the initial market penetration should focus on off gas-grid areas replacing old oil and solid fuels and reducing electric heating. These energy users suffer the most from the size of their heating bills and these customers also represent the lowest barrier for new technologies. The gas off-grid heating market is substantial in Cheshire making it possible to build the supply chain in all aspects.

Heat pump ownership and governance

The normal ownership model for heat pumps is the same as for gas boilers; the owner of the dwelling or building owns the heat pump. But, while people have complete confidence in gas boilers heat pump technology is new to the vast majority of UK residents. To boost the heat pump expansion it is important to give advisory support and to de-risk the investments.

A good way would be for the three councils in Cheshire and Warrington, together with the LEP, to create a joint organisation for advisory support in heating homes and businesses, and to offer leasing contracts for heat pumps. The leasing offer will de-risk the client's investment, but the advice can also enable the client to make the best technology choice rather than push a specific product. Any joint organisation could also contract local heat pump retailers and maintenance support.

Medium term 5-10 years

After the initial 5 years when advisory support, retail, installation, maintenance, ownership and market information structures are in place, it is time to enhance the deployment rate of heat pumps and heat networks. This calls for an active market promotion, ideally led by the local councils. Natural gas is still expected to have a low price making the competition on the heating market from a commercial point of view tough.

It is expected that market acceleration for heat network system will be slower than for heat pumps. But once networks are in the ground and experience is being shared, the expansion will

Over time there will be transition to a 'heat sharing economy'. The reliance on primary heat sources will be reduced, with increased use of secondary waste heat.

increase. Due to heat density requirements heat networks have geographic limitations which is one reason for this report to consider the heat network's market share to be smaller than for heat pumps.

As the technologies by this time have become fairly mature, and the local councils have gained confidence, the councils can turn from promoting to requiring the use of heat networks or heat pumps in all new developments.

Heat network development

If heat networks are to be successful, over time there will need to be a transition to a 'heat sharing economy'. Under such a scenario, the reliance on primary heat sources would be reduced, with increased use of secondary waste heat. In parallel there would need to be an increase digitisation and associated use of lower temperature in heat networks to facilitate the use of secondary heat. There will be a requirement to build local supply chains to ensure resilient installation.

Type 1 projects have the potential to coalesce into larger networks (Type 2) over the medium term. The scale of project opportunities will allow a range of new companies to enter the market, with a range of business models and technology solutions.

There are multiple sources of waste heat across Cheshire & Warrington from the large industrial complexes in Ellesmere Port, chemical facilities in Warrington and Northwich, potentially Bentley Motors & Astra Zeneca (Cheshire East) as well as a potential geothermal resource in Crewe. In addition hospital incinerators and Fiddlers Ferry power station (assuming that its planned lifespan is long enough to be worth the investment).

The issue is not, however, the heat source – but the demand for heat and therefore the load that would be carried. Waste heat can be transported over large distances efficiently but only when there is significant load required. Heat is quickly lost over distance if the pipe capacity is small (and the cost of introduction for limited scale is prohibitive).

This load issue and use of secondary heat is the rationale for the long term 3 stage roadmap – not individual schemes in isolation.

Heat network ownership and governance

During this 5-10 year period the early developed heat network schemes may see an ownership transition, while new network schemes are implemented. For the public sector to promote heat network developments they may still be involved in new schemes, but the ones brought up to a commercial level may be sold providing revenue for further expansion. The key issues:

- Transition period – public vs private ownership.
- Local ownership of energy assets under question as networks grow and coalesce.
- Opportunity for assets under public ownership to flip providing revenues for further investment in networks.

Heat pump development

The UK Governmental decarbonising ambitions are high and gas heating has to be reduced considerably as quickly as possible. The heat pump market penetration is expanding from off gas-grid areas to on-grid, competing with grid gas. At this time heat pumps have been widely recognised and accepted, basically due to a planned and effective introduction. It is assumed that over the 10 years period from today, gas prices may rise and heat pumps become even more competitive.

Strategic Roadmap *cont*

Heat networks are grown over time with concerted action – the more demand is developed the greater the viability of the network

Heat pump ownership and governance

The two ownership models introduced in the start-up phase will be kept and the leasing contracts combined with the advisory mechanisms will help people that either don't have the skills to make a good choice or the financial capability to invest in a heat pump up front.

.

Long term 10-20 years

In the long term both heat networks and heat pumps have become common technologies and the initial client barriers are gone. By this time all oil and coal heating should be replaced and gas heating being reduced considerably. Electrically heated houses that don't have wet central heating system will use an air-to-air heat pump to reduce heating costs and carbon emissions.

Heat network development

Ultimately the heating grid will mature allowing efficient capture and distribution of waste heat from industrial sources and power plants, geothermal, biomass etc. feeding Type 2 networks, which reflects Swedish experience.

- The use of secondary waste heat or renewables predominates, up to 95%
- Low temperature systems, include extensive use of heat pumps.
- Integrated energy systems using power for heat pump operation
- Type 1&2 networks predominate, island networks only exist where expansion is not viable

It is envisaged that heat network will account for 20% of all heating to households by 2038 and 50% of public and commercial heat demand.

Heat network ownership and governance

The UK heat market should develop through at least three distinct phases, with ownership consolidating ultimately in a few large companies specialising in heat grids. It is possible that large companies (such as Engie, Veolia, E.on, Centrica and National Grid etc) become long term owners and operators of heat networks, particularly in the metropolitan areas. But it will be important to consider local ownership models through, for example, PipeCo and AssetCo models?

Heat pump development

The early public promotion and support of heat pumps and heat networks in Cheshire and Warrington could have positioned the region and is recognised as a national leader in 'Local Heating'. The built up supply chain has developed branches all over UK.

Heat pump ownership and governance

As the main ownership model for heat pumps is similar to the one for gas boilers, this model will remain and become more common when the technology is well recognised. Leasing contracts will still play an important role, but directed to economically vulnerable households.

Strategic Roadmap *cont*

Each council or all three together can form an energy organisation with the specific task of promoting low carbon energy systems to residents and businesses

Summary of energy system opportunities and risks

Opportunities

The principal opportunities identified to deliver affordable energy and clean growth across Cheshire & Warrington are as follows:

General

- Each council or all three together can form an energy organisation with the specific task of promoting low carbon energy systems to residents and businesses. This includes professional advice in energy efficiency, alternative energy supply options, heat pump and heat network promotion and financial solutions (e.g. leasing), but also information and branding campaigns.

Heat

- Cheshire has a real opportunity to claim a position of UK area of excellence in 'Local Heating' if the current heat network plans proceed and a knowhow centre (or hot spot) in heat pump technologies is created and developed.
- Heat pumps offer a competitive alternative to oil in off gas grid areas and can be promoted from day one, if serious advisory support is available. Initially heat pumps are offered as off grid solutions for rural communities and later as a general solution where ever heat networks are not viable.
- Because Local Authorities have few policy making powers but they do control local planning and building control – and they are also the direct interface with individual home owners, it is considered likely that heat energy transition offers the best opportunity for local authorities to have a direct influence on decarbonising energy systems.
- Digitalised smart heat network provide an opportunity for future 'energy sharing economy', which can offer benefits in cost, resilience and CO2 reduction.
- Developing small and local 'islands' of heat networks will provide an opportunity for organic growth and interconnection forming neighbourhood and town scale networks.
- Fossil fuels and other primary heat sources can be replaced by secondary waste industrial heat (heat networks) and ambient heat sources (heat pumps).
- Empty pipes for broadband to all heat network clients (pipe collocation) reduces construction costs and provides high speed connectivity and digitised system.
- The traditional heavily oversized design of heating systems provide an excellent opportunity to reduce system temperature and inviting heat pumps for efficient heat supply – in solitary houses as well as heat networks
- A distinct and firm local heating strategy will help building a local supply chain for resilient installation
- Seasonal energy storage in Ground Source Heat Pumps can be used for buildings having space cooling demand in summer (e.g. hospitals, offices, hotels)
- Poor and mostly arable land provide an interesting opportunity for cultivation of Short Rotation Coppice (SRC) like willow to be used as carbon neutral renewable and local fuel. Farmers get an opportunity for additional revenue streams

Power

- Promoting the development of 'smart grids' will support 'energy sharing economy' and self-generated electricity and power storage

Strategic Roadmap *cont*

There is a risk that a low appetite and capacity to innovate in the energy ecosystem leads to slow adoption of beneficial new technologies

- 'Smart grids' will also support home-charging of electric vehicles (EV)
- EV expansion is depending on quick-charging opportunities on places where people travel (e.g. main roads, shopping centres, business parks)
- The potential for solar PV is far from maximised whilst smart systems and local storage has barely begun - further deployment should be promoted.
- There needs to be action to allow DNOs to invest in areas where they know that capacity is likely to be needed in a manner that is ahead of defined schemes coming forward and potentially being delayed.
- Local industrial cluster cost drivers to reduce demand/increase efficiency in grid and buildings.
- Nuclear industry efforts to develop SMR nuclear solutions. (SMR narrative provided overleaf).

Industry

- Cheshire & Warrington has a somewhat unique opportunity to apply the Government's high energy intensity industry strategies – and an opportunity to engage with Government in this implementation.
- There is the opportunity for a decentralised energy distribution network across the Ellesmere Port high intensive energy users linked to the Protos energy park (or other source)
- Opportunities have been identified to use legacy infrastructure for carbon capture in the Morecambe Bay gasfield.
- Cheshire & Warrington is also part of a Cadent proposal to introduce a hydrogen as an energy feedstock across the Atlantic Gateway.
- The Cheshire Energy Hub has the potential to demonstrate national industry leadership in developing energy systems to demonstrate affordable energy and clean growth across high intensity users.
- There is more that can be done with waste heat both within and between industrial facilities but also as a feedstock as islands of demand reach a critical mass.
- Many business sites / parks also have the potential to undertake the same generation & decarbonisation changes as identified for the domestic sector.
- Longer terms developments in SMRs also have the potential to contribute to high energy intensive users.

Transportation

- Facilitating safe bike commuting by developing bike tracks away from roads and in towns
- Facilitating carpooling by arranging for parking next to commuter roads and motorways
- Expanding public transport
- Expanding EV charging infrastructure
- Public transport to be running on biogas (AD or landfill gas), electricity or later on hydrogen fuel cells (HFC)
- Crewe has a role with other LEPs in the development and demonstration of carbon free trains with an objectives of bring future opportunities to Crewe.

Risks

The generic risks that are required to be mitigated are as follows:

- The appetite and capacity to innovate in the energy ecosystem leads to slow adoption of beneficial new technologies – consequent loss of first mover advantage, e.g. active promotion of heat pumps in off gas grid areas

Strategic Roadmap *cont*

We have grouped future actions into areas where the LEP can act as an advocate, can facilitate or can intervene

- Design risk – designing heat networks and heat pump systems to try and mimic the scale and immediate heat supply provided by gas boilers has a serious negative effect on capex and viability (ie networks supply continuous heat to iron out the need for peaks in demand and can therefore run at a lower capacity than is often suggested in viability studies)
- Construction risk – immature supply chain (mainly in installation and maintenance since many of the technologies have been developed and refined elsewhere) leads to high rate of failure
- Reputational risk – poor installations slow adoption of technologies and interrupt the market
- Ownership and financing of infrastructure – absence of preferred model delays deployment at industrial scale, particularly heat networks
- Stranded assets – what happens to gas grid if district heating and heat pumps prevails?
- Resilience during transition – risk of poor alignment between infrastructure investment cycles e.g. power grid and demand.

Maximising GVA potential from energy transition

The proposed C&W energy strategy is to maximise economic and social opportunities and mitigate risk arising from the transition to a low carbon energy system by promoting investment in local energy production, wise use of energy and supporting local ownership of energy assets.

The main linkages between economic development and investment in sustainable energy systems should frame C&W LEP strategic objectives as follows:

- Leveraging investment in low carbon infrastructure, to generate sustainable employment opportunities;
- Create a supportive and vibrant energy ecosystem to assist companies in the commercialisation of their new products, applications and service delivery models;
- Supporting a local, flexible and durable supply chain, which can respond to new opportunities in the green economy;
- Capturing more profit from energy spend in the local economy;
- Improving energy efficiency in businesses to boost profitability;
- Creating competitive, compelling and energy efficient business locations to attract inward investment;
- Create a supportive and vibrant energy ecosystem to assist companies in the commercialisation of their new products, applications and service delivery models; and
- Ensuring energy resilience and security by exploiting local and renewable resources, matched to local demand.
- These ways of linking GVA to the low carbon energy transition process should be at the heart of the LEP energy strategy.

LEP role and response

What the LEP can do:

- Advocate – speaking out for the low carbon agenda;
- Facilitate – bringing together communities, entrepreneurs, support agencies and funders, connecting

Strategic Roadmap *cont*

There are a number of areas which are immediately deliverable and can be directly influenced by local intervention

entrepreneurs, support agencies and funders, connecting ideas with capital; and

- Intervene – direct action and investment to address areas of market failure, use LEP resources to leverage exponential and transformational change.

Therefore the consultancy team has constructed a potential short and medium term programme based around the potential role of the LEP in each opportunity area, summarised in the action plan which follows.

Strategic Roadmap *cont*

Cheshire & Warrington has a growing base of SMR expertise including Wood, Rolls-Royce Nuclear, NNL and Nuvia.

Small Modular Reactors (SMRs)

SMRs are defined by the International Atomic Energy Agency as being advanced reactors producing up to 300MWe of electric power and that can be largely built in factories as modules to minimise costly on-site construction. SMRs are suitable for smaller sites as well as for new applications such as hydrogen production. In 2014, a National Nuclear Laboratory study suggested a market for 7 GWe of SMR power plants could exist in the UK by 2035, with further opportunity beyond this to 2050.

In March 2016, the UK government launched Phase One of the SMR competition to ascertain the market for developing, commercialising and financing SMRs. The competition received 32 expressions of interest, including from Hitachi/Westinghouse; NuScale; Urenco /U-battery and Rolls-Royce. The latter is a high profile consortium consisting of Wood (formerly Amec Foster Wheeler), Nuvia, Laing O'Rourke, Arup and the Nuclear Advanced Manufacturing Research Centre. Wood is also in the Urenco consortium. U-Battery (a micro SMR) is a 10MWt (4MWe) gas-cooled reactor that can provide heat at 710°C.

The consortium also includes Cammell Laird. The concept design of U-Battery was developed by the University of Manchester and the Technology University of Delft. The consortium has registered its reactor technology for pre-licensing vendor design review with the Canadian Nuclear Safety Commission. U-Battery also intends to proceed with licensing in the UK. The micro SMR is anticipated to take 10 years to become operational.

Rolls-Royce is the highest profile of a number of companies shortlisted in the UK's competition for the best value SMR design. The Rolls-Royce consortium research claims that once mature, SMR technology will deliver power at £60 per megawatt hour. This compares with £92.50 per megawatt hour stated for the Hinkley Point power station.

Rolls-Royces' SMR capabilities are already generating overseas interest. In November 2017, Rolls-Royce signed a MOU with Jordan Atomic energy Commission to conduct a technical feasibility study for the construction of a Rolls-Royce SMR in Jordan.

Cheshire & Warrington SMR Capabilities

Cheshire and Warrington has a growing base of SMR capability. Rolls-Royce Nuclear has its Nuclear Services and Projects Engineering Office in Warrington and Wood, a key partner in this consortium is leading the work from their operations based in the LEP area. Nuvia UK is also headquartered in Warrington and the capability in Warrington originated from BNFL placing its headquarters there. Capenhurst (Cheshire West) is the base for the uranium enrichment facility operated by Urenco.

The wider area holds significant wider expertise including a fuel production facility at Springfields, Preston, the reprocessing plant at Sellafield, power production at Heysham and Wylfa and new power plants ear-marked for Wylfa and Moorside, Cumbria. This supports a wider nuclear enabled supply chain – with companies such as Cammell Laird seeking to enter the large scale nuclear fabrication sector.

Strategic Roadmap *cont* (SMRs)

The size of the potential global SMR market is approximately 65-85GW by 2035, valued at £250-£400bn.

Local capabilities will be enhanced further following the award of a £2.9m contract from the government to Wood to lead a key nuclear research programme to enhance the techniques used to design reactors and optimise their performance. This new UK Digital Reactor Design Partnership headed by Wood includes partners and sub-contractors including Rolls-Royce, EDF Energy, NNL, The Hartree Centre and Virtual Engineering Centre (STFC Daresbury), the University of Cambridge and Imperial College).

In early 2017, Cammell Laird established a partnership with the Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) which will lead to investment in their facilities and workforce to meet the demands of modular new build.

Rolls-Royce has stated that its deployment of a UK-developed Small Modular Reactor (SMR) could support 40,000 jobs in the next 20 years and add £100bn to the UK economy in 2030-2050. If the government commits to delivering a coherent SMR strategy, depending on the chosen consortium, this could represent an opportunity for Cheshire and Warrington to further build on its nuclear strengths. Whilst SMRs are less likely to be built locally, particularly given the nearby Cammell Laird and NAMRC construction facility; SMRs opportunities for Cheshire and Warrington are more likely to arise around R&D, testing, design, licensing, fuel production and the safety case.

Current Policies and drivers

The lack of clarity and direction by the government following Phase One of the SMR competition in 2016, has created uncertainty in the industry. As SMRs represent an investment programme of over 15 years, without a clear government strategy, industry is unlikely to invest without some sort of government commitment.

The size of the potential global SMR market is approximately 65-85GW by 2035, valued at £250-£400bn. The domestic market is likely to represent less than 10% of the global demand for SMRs, so export markets will be critical to make a return on investment.

Other countries, particularly China and Canada are making faster headway with SMR technologies and if the UK does not accelerate development to keep pace, the opportunity for a UK designed and manufactured SMRs may be lost.

As well as costs, other issues include the potential delays in regulatory approval and potential locations where SMRs could be sited. The Energy Technology Institute has identified 250 potential sites where SMRs could be deployed, with sites identified based on the need for baseload and load-following generation and for district heating.

The General Design Assessment Process (GDA) for SMRs is likely to take 4 to 5 years. The GDA is the process by which the Office for Nuclear Regulation assess the potential suitability of a nuclear reactor design for development. The GDA combined with the development period means that SMRs are not likely to be operational until c.2030

Strategic Roadmap *cont* (SMRs)

Cheshire & Warrington LEP could work with local industry partners to ensure that a strong proposition is put forward for hosting such innovation hubs to be hosted locally

Actions required

Cheshire and Warrington's nuclear expertise and number of companies involved in SMRs consortiums based locally presents opportunities if and when SMRs are developed.

Key to maximising these opportunities is to ensure that the area's nuclear capabilities as a whole and growing SMR expertise, particularly in engineering design are well articulated and promoted.
The Nuclear Industry Council's Nuclear Sector Deal (October 2017) document highlighted openings for creating innovation centres to encourage new research capabilities through industry collaborations and partnerships. These included innovation hubs in equipment qualification and Control and instrumentation (C&I) technologies, both of which are areas of expertise where Cheshire and Warrington has existing strengths.

Once the Nuclear Sector Deal is approved and there is an understanding of the new initiatives which may be developed; the Cheshire & Warrington LEP could work with local industry partners to ensure that a strong proposition is put forward for hosting such innovation hubs to be hosted locally. This is particularly important given that in terms of 'place', the Nuclear Sector Deal document has a strong focus on the South West and as such Cheshire and Warrington's nuclear expertise including in SMRs needs to be positioned effectively.

A recognition of the areas expertise and future potential could be underlined through the mapping of the supply chain locally and the skills which are already in place. With greater certainty regarding future development, further work could then be undertaken to attract further businesses and reinforce the supply chain and at the same time invest in the skills which will be required to support it.

Financial Intervention

It is likely to be technology which is already currently available that will have the biggest impact (and needs to be implemented most quickly) on the carbon budget period 2018-2022.

There are a number of principles of the action plan (following chapter). They include the view that the aspects that can be dealt with through a solution locally are as much addressed through commercial structures as technology.

There is a further principle that whilst technology will emerge, it is likely to be technology which is already currently available that will have the biggest impact (and needs to be implemented most quickly) on the carbon budget period 2018-2022.

Once these principles are accepted, it is clear that those areas recommended for intervention in the near term are those in which resources should be committed.

The three locally influenced actions with commercial challenges appear to be:

- Uptake of decarbonised household / commercial heating and energy efficiency
- Heat network implementation
- Vehicle charging point infrastructure

Uptake of decarbonised heating & smart power systems

The uptake of decarbonised heating solutions and smart power systems for domestic and business premises requires an increased awareness and trust of potential solutions and the interaction between different systems and a method of encouraging up-front spend for a longer term saving.

The current level of RHI and interest rates can allow older (non-gas) heating systems to be replaced with alternative heating systems (such as heat pumps) in a manner where the up-front

cost is spread over time with finance and avoids any increase in payments to the consumer - with savings once the finance is paid off.

A similar financially structured approach can increase the adoption of smart power systems and storage.

There is a strong case for a promotion / education / advisory campaign linked to a revolving fund to provide finance for implementation whilst the traditional finance market catches up with the opportunity. This would not be a grant based approach – but a revolving fund which generates a market return.

Heat networks

The viability of heat networks is complex. The viability issue is scheme specific, is wrapped up in the heat infrastructure plus heat source versus a conventional gas connection and domestic boiler. Viability issues could be addressed by varying the s106 contributions / affordable homes requirement.

It is likely that greater levels of implementation and penetration will reduce unit cost in new developments (with a hope that retrofit solutions will follow).

A fund that helps to plug the viability issue in the initial heat network developments is likely to be beneficial and this could be linked to an equity share in the heat network eventually creating the opportunity for an investment return..

Financial Intervention *cont*

The report has identified significant structural, knowledge and behavioural barriers to decarbonising and some financial viability issues

Wider Network Resilience

A similar issue arises in the case of increasing power / gas resilience in locations where investment is required in advance of substantial development. The current situation does not allow investment in advance of development by the DNO with a complicated charging structure then creating a barrier for the first developer in a location.

Network resilience is equally an issue for existing communities when the uptake of electric vehicles and heating reaches a greater level, in fact it could be more of a challenge to resolve in those cases. Part of the solution will be in upgrading the grid infrastructure, but the solution will also be about providing the technology and business models for smart and flexible management of supply and demand in a local area (and EA Technology have been leading trial work in this area as noted above).

There is a further case for an infrastructure investment fund that can remove market failure and cashflow network development whilst still gaining a return on the final investment over time. Clearly the ability to fund will be influenced by the risk / certainty of scheme developments and the time period over which the funding could be recovered – this is a commercial arrangement reflecting the public sectors greater tolerance for longer term returns rather than some type of subsidy arrangement.

Vehicle charging point infrastructure

There remain competing views over the future of EV uptake and re-charging methods. It is clear, however, that widespread EV adoption is unlikely to happen until a comprehensive and reliable network of charging opportunities is available.

A fund could be considered to create charging points in all Council owned car parks and / or in locations where there is a paucity of rapid charging points within the rural areas of Cheshire & Warrington.

The fund possibility itself is set out below but in addition it is also noted that the Government has introduced grants to support the wider use of electric and hybrid vehicles via the Office of Low Emission Vehicles (OLEV) and the Electric Vehicle Homecharge Scheme (EVHS) both of which can support further development in charging infrastructure.

Range anxiety is one of the barriers to EV take-up.

Energy Infrastructure Fund

Overall therefore, there are a number of areas where the creation of an energy infrastructure fund could address market failure, encourage early adoption and make a longer term return. This could have the added benefit of propelling Cheshire & Warrington into an exemplar location for the take-up of new technology both by business and domestic consumers. This would be a potential Evergreen / Northern Powerhouse Fund initiative (both are UK / ERDF funded revolving finance vehicles).

Financial Intervention *cont*

The fund could encourage applications innovating product, innovating installation and training advisors and installers.

Grant Funds

On a smaller scale there is the opportunity to intervene directly using two different sources of funding. Cheshire & Warrington has been awarded:

- £4.15m to create a low carbon Energy Innovation Fund; and
- £12.9m of Priority 4 ERDF funding to 'support the shift towards a low carbon economy in all sectors', of which a residual amount remains.

Energy Innovation Fund

The funding for the Energy Innovation Fund (which was gained as part of the Local Growth Fund allocation) was sought by the LEP to support the delivery of its Low Carbon Action Plan by stimulating innovation in SMEs working in the low carbon and energy sectors, and by increasing skills and capacity of SMEs and their workforce to expand services into low carbon market.

The purpose of the fund is therefore clear and would appear to suit the creation of a competitive grant fund which could be awarded to those businesses which demonstrated a strong development opportunity. In these circumstances this would generally mean:

- Sound technical idea and R&D process
- Commercial rationale
- Match funding and viability
- Value for money in terms of outputs (generally intervention rate and jobs)
- A clear case for why funding was required
- Strong management and project plan
- Deliverability within the timescale

,

Under such schemes a 'call' for applications is usually established as this allows a number of applications to be compared through the competitive process although this is not a requirement.

With limited funding, an aim to build capacity in a focused number of technologies and to allow the easiest comparison between applications, it is suggested that such a call would more usefully focus on a limited number of technologies.

Clearly the LEP and its members will have a view on the nature of such a competitive fund but given the scale of funding (which is considered too limited to address grand industrial challenges) and the identified need to address domestic low-carbon issues such as smart systems, storage and heat we would suggest this as the theme for a competition – and encourage applications innovating product, innovating installation and training advisors and installers.

Irrespective of the subject matter of a call it is clear that all applicants would need to be compliant with European State Aid Legislation. There is scope for the fund to remain State Aid compliant through the application of a number of exemptions set out in the General Block Exemption Regulations (GBER).

Exemptions typically set out the requirement of the applicantnature of the project, eligible expenditure and the intervention rate allowable in the circumstances.

It has become commonplace in grant funds for the applicant to set out how their application is State Aid Compliant but it is likely that the following articles of GBER are most applicable to the scheme envisaged:

Financial Intervention *cont*

A R&D grant scheme providing 35% of eligible costs can be established within state aid rules

- Article 25 – Aid for research & development projects
- Article 28 – Innovation aid for SMEs
- Article 31 – Training aid

As a result there is scope to run a reasonable grant scheme which aligns with the actions highlighted in this document.

There is also the possibility of using the Energy Innovation Fund as match against the residual Priority 4 ERDF funding therefore upgrading the funding available.

Essentially the grant scheme would be able to support R&D projects by SMEs undertaking work that supported the strategy up to a 35% of the eligible costs for medium sized businesses and up to 45% for small businesses so long as the work being undertaken was experimental development or more fundamental research.

ERDF Priority Axis 4

Nationally, Priority Axis 4 was allocated to Supporting the Shift Towards a Low Carbon Economy in All Sectors. Cheshire & Warrington LEP then established its European Structural and Investment Fund Strategy to align the national priorities with the specific requirements of the programme within Cheshire & Warrington.

In this process, £12.9m was allocated although through the ERDF process this is further split between investment priorities (in this case IP8 and IP9) and all ERDF also has a requirement for match funding and the estimated split between private and public sector is shown in each case in the table overleaf.

P4 C&W ERDF Allocation

Totals reflect some rounding errors £m	IP8 – Low carbon markets and technologies	IP9 – Energy and resource efficiency for SMEs	Ever-green	Total
ERDF	4.6	5.4	2.8	12.9
Public match	4.0	5.1	0	9.1
Private match	1.0	0.7	3.0	4.7
Total	9.6	11.2	5.8	26.7

The ERDF programme has been running since 2014 and as a result there is only residual funding available but the following are considered appropriate for calls:

- Allocate any remaining Evergreen funding to an SME seeking to roll out new low carbon infrastructure which has a high upfront cost but the opportunity for a longer term return (eg heat network infrastructure or EV charging points). This small scale funding could act as a proof of concept fund for a larger future fund.
- Under IP8 there is the prospect of supporting demonstration projects in low carbon solutions which could then be rolled out at a commercial level. As any call requires match, the types of technologies which could be encouraged could be relatively broad – but in line with the overall LEP low carbon strategy.
- Under IP9 there is the opportunity to part fund a programme which provides advice and support to SME

Financial Intervention *cont*

ERDF funds can develop SME understanding of the benefits of installing low carbon smart systems

- businesses exploring opportunities such as smart systems, storage and low carbon heating. This could be seen as a particularly effective programme to introduce new low carbon products to those businesses off the gas-grid (although this would not need to be a requirement) and could increase their competitiveness.
- Poor uptake of any of the above would present the opportunity to part fund the Energy Innovation Fund which could be used as match as set out above.

Action Plan

A detailed action plan is provided but the approach is based on some high level principles

The action plan is set out in detail below based on the finding of the report. The approach is however based on some high level principles – all underpinned by the Clean Growth Strategy requirement for affordable clean energy. This will ensure that clean growth is linked explicitly to the Local Industrial Strategy.

The work has not been developed in isolation. As part of the completion of the project the Local Authorities within the area and the LEP were extensively involved. The work also included presenting early findings and seeking views from the LEP Strategy Board and the Cheshire Energy Hub. In addition several of the major energy businesses and energy users were interviewed and the those organisations involved in the consultation are set out in Appendix 5.

The action plan is underpinned by some broad principles which are shown below:

1. Less is more
The Strategy sets out those areas where the LEP and the Local Authorities can make the largest difference. The approach has been to arrive at a relatively small number of practical and achievable actions.

2. Requirement to hit carbon targets
The Government's carbon budgets have been set for the Country and whilst Central Government will take the lead, there is a responsibility on Local Government especially in those areas where it is in the strongest position to take action.

3. Certainty and consistency in regulation
The work required across Cheshire & Warrington is likely to require significant investment by the private sector with the prospect of a return which takes a number of years to fully materialise. In order for the private sector to work effectively in an area such as this there is need for certainty around legislation and a consistency in the adoption of regulations.

4. Actions focused on heat, transport, nuclear and industrial process
The action plan predominantly focuses on heat, smart systems / efficiency / storage, transport, nuclear and industrial process as these are either those areas where local agencies can play a significant role or where Cheshire and Warrington has a unique position.

5. More technology coming but don't delay
There is a risk that the promise of further innovation creates a delay in the areas of implementation available to us now. In fact the solution to decarbonising is a gradual process and is likely to result in a mix of technologies – the breakdown of the 2050 targets into 5 year blocks in some ways recognised this.

Deployment of technology will lead to development in that technology and further game changing developments might follow – but there is a strong rationale to implement now. In areas such as heat networks, the network infrastructure helps introduce new and innovative central sources of heat in the future rather than creates barriers.

Action Plan *cont*

The action plan places the highest priority on practical actions that can make an impact on existing technologies locally

6. The solution is wrapped up in commercial structures as much as technology

Whilst the report recognises that there is likely to be further great innovation, there are some decarbonising technologies available immediately which are being held back by the commercial model rather than a technological problem. The solution is therefore at least as likely to be a commercial arrangement as it is an innovation requirement.

7. Smart Agenda for the urban environment

Within the built environment level there is the opportunity for more renewable generation, smart systems and storage which is likely to incorporate greater levels of energy efficiency, feed-in / take power from the grid, EV charging / storage and making better use of storage all within a smarter grid with differential tariffs.

8. Cheshire & Warrington has R&D assets which can be built upon

Underpinning the economic benefits which can be gained from the sector is the R&D activity (Thornton Energy Centre, EA Technology and many other private sector players). Whilst funding for innovation is identified as an offer in the strategy, developing models similar to the Energy Innovation Centre in Ellesmere Port will be important to allow nascent technologies to be brought to market more effectively.

Overall

The study team has sought to prioritise the recommended actions. It should also be recognised that these are the.

recommended actions of the study team, and whilst views across Cheshire & Warrington have formed part of the findings of the report, the actions are only recommendations which the Cheshire & Warrington LEP and its partners will consider on their merits

Action Plan *cont*

Programme Element	Issue	Recommended Action
A Decarbonising heat in low density developments	Domestic and commercial heating is a significant contributor to carbon emissions and can be addressed with current technology. A good example of this is heat pumps. Such technology offers a low carbon opportunity in off grid locations and in retrofitting to the existing urban built stock particularly where the current heating is non-gas. The current barrier to large scale implementation appears to be the up-front cost and education / information. This issue can be most effectively dealt with through practical measures at a local level. Roll out is likely to be most effective when local heating installation businesses are engaged – but at present there is a lack of awareness / willingness on the part of these companies to embrace the new technology.	A1. Local Authorities to promote current informative websites on lowering household utility bills and carbon emissions – many outline the benefits of different low carbon technologies such as heat pumps. In particular work with the Parish Councils (and other community groups) within the off-gas grid area to kick-start this approach. A2. Identify and work with existing heating installation providers to create: i. Awareness programmes ii. Training for advisors, installers and maintenance engineers. There is a clear need for the provision of high quality and trusted advice in this area. iii. A lease fund that allows installers to offer finance at the point of installation to avoid up-front costs and maintain a similar heating cost profile A3. Promote early adopters as part of the general awareness raising – particularly commercial users such as hotels, rural enterprises, social housing and farms. A4. Develop an investment proposition that encourages others to invest in Cheshire & Warrington to create a 'Local Heating Area of Excellence'. Cheshire & Warrington has the opportunity to gain an economic advantage from being one of the first movers in this area.

Action Plan *cont*

Programme Element	Issue	Recommended Action
B. Decarbonise heat in higher density areas	A second strand in decarbonising heat is the provision of heat networks. Heat networks are struggling to gain traction in the UK for a number of reasons – higher costs for a new system to the UK, a tendency to model capacity based on the current UK heat profile, building in a renewable heat source from the outset even when demand is low. Heat networks work extremely efficiently when loads are high (and a variety of heat sources can be introduced). Viability at the early stages is proving problematic. Gas can be used as a central heat source in the initial stage – and this solution allows hundreds of units to then be decarbonised at a later date by switching the heat source – removing the need for retrofitting / persuading hundreds of individual consumers to convert at that later date.	B1. All new homes / offices should be fitted with low temperature heating systems as a planning requirement. B2. For developments beyond a specific density, planning requirements should require a heat network with a central heat source. B3. Engagement is required with the utility companies to discuss how they might put in place a distributed heat network at the outset in return for the capability to run the heat source / and where this isn't possible to create a Local Authority asset ownership model. This will need to be examined on a scheme by scheme basis. B4. Challenge the viability models of residential developers – heating system viability will need to be part of the s106 and affordable homes ratio discussion. Viability will need to be considered on a scheme by scheme basis. B5. Significant attention should be focused on educating consumers on how to operate their heating (ie continuous). This would principally be the role of the network operator. B6. Identify and work with existing heating installation providers to create training for installers and maintenance engineers. B7. Promote early adopters as part of the general awareness raising – particularly large new residential developments. B8. Develop an investment proposition that encourages others to invest in Cheshire & Warrington to create a 'Local Heating Area of Excellence'. Cheshire & Warrington has the opportunity to gain first mover advantage in this area. B9. Identify the opportunity to use geothermal energy as a viable heat source for heat systems as development is rolled out – particularly in the South East of Cheshire.

Action Plan *cont*

Programme Element	Issue	Recommended Action
C. Small scale renewable, smart systems, efficiency and storage	Significant developments have taken place in the area of solar pv, energy efficient homes and devices, power storage and smart building management for both homes and commercial premises. This is increasingly being combined with electric vehicles. Consumer knowledge lags significantly in the area of energy systems. Awareness and advice across the spectrum is preventing more widespread take-up of solutions. Technologies such as solar PV, micro-wind, battery storage, heating systems, low energy appliances and building materials – and the interface between them combined with financial measures such as the Feed in Tariff and Renewable Heat Incentive need to be better understood by consumers, small businesses and landlords. Particularly the likely performance of different devices and how they can be combined.	C1. There is a need to collate all the current independent information on likely cost / benefit, performance and installation of different devices. C2. The ERDF P4 funding within the overall activity of a growth hub could offer such support for SMEs through a business support package. C3. There is the opportunity to create a centre for advice which could be kick-started using local funds and could either be wound down over time as awareness grows – or spun into a commercial venture based on fees / commission once the initial funding had been exhausted. C4. It is recommended that the Energy Innovation Fund is aimed at innovation in this area – and not just in devices but also in funding models, installation techniques and training in installation and maintenance. C5. The public estate should be the early adopter of this smart / efficient energy systems technology and such work should deliberately aimed at being a demonstrator for others.

Action Plan *cont*

Programme Element	Issue	Recommended Action
D. Decarbonising Transport	There is a need to have almost entirely decarbonised transport by 2050 and as a result the transition to this model needs to start quickly. EVs are available but take-up has been affected by a number of factors including range anxiety and charging point reliability. There remains some debate as to how EVs will be charged in the future but in the meantime there is a need to roll out a greater density of charging infrastructure. The decarbonisation of transport has a direct link to the Cheshire & Warrington LEP transport strategy.	D1. Further work is required, particularly within urban centres, to create easy alternatives to private car use. D2. All new commercial developments which incorporate car-parking must have a specified number of charging points as a planning requirement. D3. Local Authority vehicle fleets should transition to EVs as fleets are renewed. D4. Local Authorities to work on the provision of charging stations every 20 miles across Cheshire & Warrington A-roads. There is a good case for early intervention to create such a network across the Cheshire Science Corridor. D5. Create recognition of Cheshire & Warrington as an early adopter in EV infrastructure and EV infrastructure technology. D6. Further discussions will be required with DNOs on the location of larger scale commercial charging stations to ensure that they are best positioned within the existing power infrastructure.

Action Plan *cont*

Programme Element	Issue	Recommended Action
E. Nuclear	Cheshire & Warrington is the national centre of excellence for nuclear technology (new build and decommissioning). Recent new-build work at Hinckley Point; the establishment of The Nuclear Advanced Manufacturing Research Centre in Sheffield and work on SMRs in Derby threatens to dilute the core message and this needs to be re-affirmed. Whilst Cheshire & Warrington has a number of energy sector strengths, it has a position of national excellence in nuclear.	E1. There is a strong case for the area to employ a nuclear sector lead who would work on initiatives arising from the nuclear sector deal, the nuclear supply chain and capturing economic value from nuclear opportunities. E2. Undertake a pro-active inward investment campaign around nuclear technologies and re-affirm the area as the UK's centre of excellence. The work should engage specifically on Wylfa and Moorside supply chains and SMRs. E3. Continue to make the case with government that statutory nuclear functions should be located within the area – including departments such as the nuclear health and safety site inspectorate. E4. There is an opportunity to position Cheshire & Warrington as a centre of thought leadership on SMRs – helping industry to gain PR from articles and hosting a series of small conferences in the area. E5. All of this work could result in a research centre for nuclear based at Birchwood – and if nothing else a 'virtual centre' of nuclear knowledge and technology could be established to kirk start such an ambition. There are many other locations in the UK with elaborate sounding branding around nuclear that have significant less in terms of capability depth.

Action Plan *cont*

Programme Element	Issue	Recommended Action
F. Grid development	There is a need to accelerate the development of smart grid plans as part of the RIIO 2 process with Ofgem and local Distribution Network Owner. Progress has not kept pace with the changes in the way in which the grid operates, there is a case for more distributed networks and there is a change needed in how DNOs / or other providers can invest for the future.	F1. There is a clear lobbying role with BEIS for LEPs and Cheshire & Warrington could take the lead in and this is on 3 fronts: i. Smart grid roll out to better encourage micro-generation. ii. Allow local distribution networks with decentralised power to be taken out of grid planning. This is a complex area with a potential impact on the tariffs faced by other consumers - as large users stopped paying into the central tariff system. Conversely such an approach may also result in improving capacity across the network. It is also a consideration that without work on electricity costs the large users may not remain large users in the long term. iii. Relax the rules on speculative grid reinforcement in areas where there is a clear expectation of development. With the alternative to forward fund through the creation of an infrastructure fund. F2. In addition to lobbying activity there is likely to be a requirement for the creation of an investment fund that can forward fund some of this advanced infrastructure – likely to be particularly acute in Chester and Warrington. This could be examined as part of Evergreen and / or the Northern Powerhouse Fund or potentially established as an investment grade vehicle for external infrastructure investors (such as Macquarie). F3. More work is required to examine the opportunities for a demonstrator smart local distribution network with decentralised power on the Mersey Estuary with a strong case for such an initiative to then be supported by Central Government. The scope of such a study has now been developed by a separate firm of consultants acting for the Cheshire Energy Hub. There may be a role for the Thornton Energy Centre in much of this (especially as it is located in the area).

Action Plan *cont*

Programme Element	Issue	Recommended Action
G. Business Parks	Designing the most effective energy infrastructure for new business parks is essential to avoid the requirement to retrofit systems. The requirement is similar to the requirements for residential developments in terms of heat – but may also include a locally distributed power network using a clean power source.	G1. Prepare energy masterplans, for key business park locations, which include future planned development and related electricity, heating and cooling demand, local energy supply options and energy infrastructure (electricity, gas and heat). Where such developments are being brought forward by private developers this should be self funded. G2. Prepare a detailed investment grade implementation plan. G3. Prepare an investment prospectus to underpin external investment in energy infrastructure.
H. Business Networks	The Cheshire Energy Hub is a key network of energy businesses and through its 'Energy Innovation District' plan it has started to develop solutions in line with the Clean Growth Strategy – with the potential to be a demonstrator for how energy intensive industries can be decarbonised. The area has the potential to trial carbon capture and storage, develop a power distribution network linked to a new energy park and trial a hydrogen network, reform (decarbonise) natural gas and develop new approaches to energy storage. There is a risk that UK Government funding for innovation and trials is provided in a silo approach which will not allow the examination of an energy system solution in an area of high energy intensity. This would be a lost opportunity.	H1. Cheshire & Warrington LEP should support the planned work to examine the energy system which could be developed along the Mersey Estuary. H2. Cheshire & Warrington LEP should help promote the concept of the energy innovation district with Government and help develop a network of interested parties across the area to assist in this process. H3. There is an opportunity to examine individual components of the Energy Innovation District and gain incremental funding through the internal grant schemes, any further rounds of LEP capital funding programmes, Northern Powerhouse Fund and the Industrial Strategy Challenge Fund. H4. There is a need to collate and promote all the potential funding sources for energy projects which are now available in the UK.

Action Plan *cont*

Programme Element	Issue	Recommended Action
I. On-shore Gas	There is a risk that unconventional gas extraction creates a long term low cost supply of gas which threatens progress in decarbonising heating systems. At the same time, it is likely that gas will remain part of the UK power generation mix for many years and work is underway on how natural gas may be reformed (decarbonised).	H1. A case should be taken to Government that if unconventional gas is developed it should be used only for power generation / industrial feedstock (and for a limited time); H2. If unconventional gas is developed anywhere in the UK the 'community bonus' should be spent on decarbonising the local community and creating exemplar villages of low carbon use. H3. Maximise the impact of the UK Geological Survey Earth Observatory by linking findings into the potential for industry and the supply chain. This is an opportunity for Cheshire & Warrington to lead in research and development for environmental safety.
J. Hydrogen deployment	There is an opportunity to trial hydrogen as a fuel for heat and transport – with associated infrastructure. In the immediate terms there is an opportunity to integrate hydrogen in public transport including rail. Hydrogen can also be used as a fuel for industry.	J1. The LEP should support the work of others – The Cheshire Energy Hub, Cadent etc in the deployment of an early stage hydrogen adoption. This will specifically involve working with neighbouring LEPs. J2. There is an opportunity to place Crewe as a component of a hydrogen rail hub for installation, maintenance and repair.

App 1: Energy Intensive Industries

Energy Intensive Industries (UK Government definition)

Mining of hard coal	Manufacture of other textiles nec	Manufacture of industrial gases	Manufacture of plastic packing goods
Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate	Manufacture of other outerwear	Manufacture of dyes and pigments	Manufacture of builders ware of plastic
Operation of gravel and sand pits, mining of clays and kaolin	Manufacture of other wearing apparel and accessories	Manufacture of other inorganic basic chemicals	Manufacture of other plastic products
Other mining and quarrying nec	Manufacture of knitted and crocheted hosiery	Manufacture of organic basic chemicals	Manufacture of flat glass
Processing and preserving of poultry meat	Manufacture of other knitted and crocheted apparel	Manufacture of fertilisers and nitrogen compounds	Manufacture of hollow glass
Operation of dairies and cheese making	Tanning and dressing of leather; dressing and dyeing of fur	Manufacture of plastics in primary forms	Manufacture of glass fibres
Manufacture of prepared feed for farm animals	Manufacture of veneer sheets and wood based panels	Manufacture of synthetic rubber in primary forms	Manufacture and processing of other glass including technical glassware
Manufacture of malt	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	Manufacture of pesticides and other Agrichemical products	Manufacture of refactory products
Preparation and spinning of textile fibres	Manufacture of paper and paperboard	Manufacture of perfumes and toilet preparations	Manufacture of ceramic tiles and flags
Weaving of textiles	Manufacture of corrugated paper and paperboard and containers of paper and paperboard	Manufacture of man made fibres	Manufacture of bricks, tiles and construction products in baked clay
Manufacture of knitted and crocheted fabrics	Manufacture of household and sanitary goods and of toilet requisites	Manufacture of rubber tyres and tubes, re-treading and rebuilding of rubber tyres	Manufacture of other technical ceramic products
Manufacture of carpets and rugs	Manufacture of wallpaper	Manufacture of other rubber products	Manufacture of other ceramic products
Manufacture of other technical and industrial textiles	Manufacture of refined petroleum products	Manufacture of plastic plates, sheets, tubes and profiles	Manufacture of cement

App 1: Energy Intensive Industries *cont*

Energy Intensive Industries (UK Government definition)

Manufacture of lime and plaster	Cold drawing of bars	Other non-ferrous metal production	Manufacture of light metal packaging
Manufacture of plaster products for construction purposes	Cold rolling of narrow strip	Casting of iron	Manufacture of electronic components
Manufacture of fibre cement	Cold drawing of wire	Casting of steel	Manufacture of batteries and accumulators
Manufacture of other non-metallic mineral products nec	Aluminium production	Casting of light metals	Manufacture of other electronics and electric wires and cables
Manufacture of basic iron and steel and of ferro-alloys	Lead, zinc, and tin production	Casting of other non-ferrous metals	Manufacture of machinery for metallurgy
Manufacture of tubes, pipes, hollow profiles and related fittings of steel	Copper production		

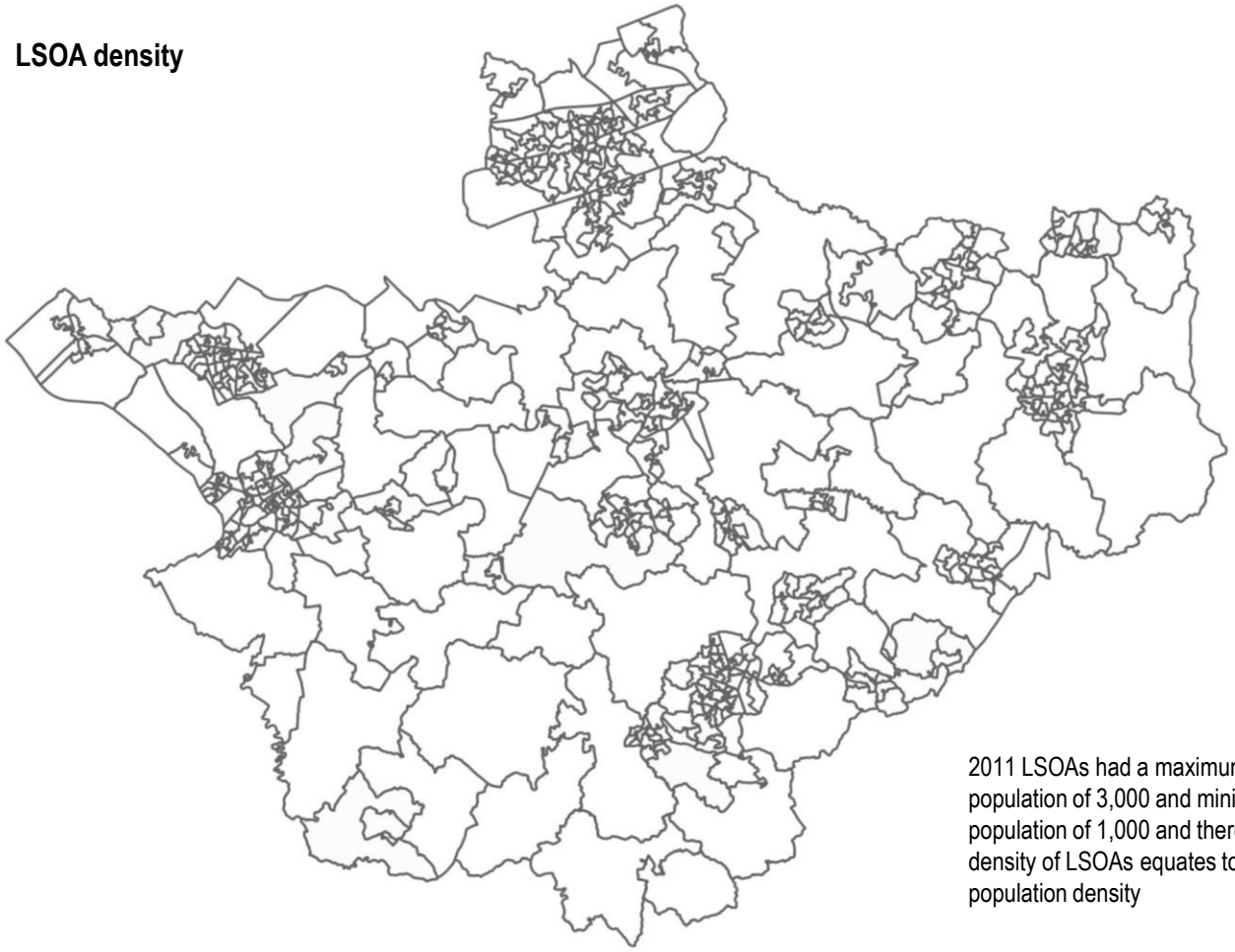
App 2: Mapping Baseline Position

The following maps show a spatial representation of some of the issues considered in the report:

1. Population density
2. Domestic electricity consumption by Lower Level Super Output Area (LSOA)
3. Domestic gas consumption by LSOA
4. Percentage no gas meter by LSOA
5. Households in fuel poverty by LSOA
6. Cabin / pre-fabricated dwellings by LSOA
7. Manufacturing employment by LSOA
8. Non-domestic electricity consumption by Mid Level Super Output Area (MSOA)
9. Non-domestic gas consumption by MSOA
10. LSOAs with employment in Electricity, gas, steam and air conditioning supply
11. LSOAs with employment in energy intensive industries
12. National heat map for the relevant area
13. Households with no cars by LSOA
14. Households with 2 or more cars by LSOA

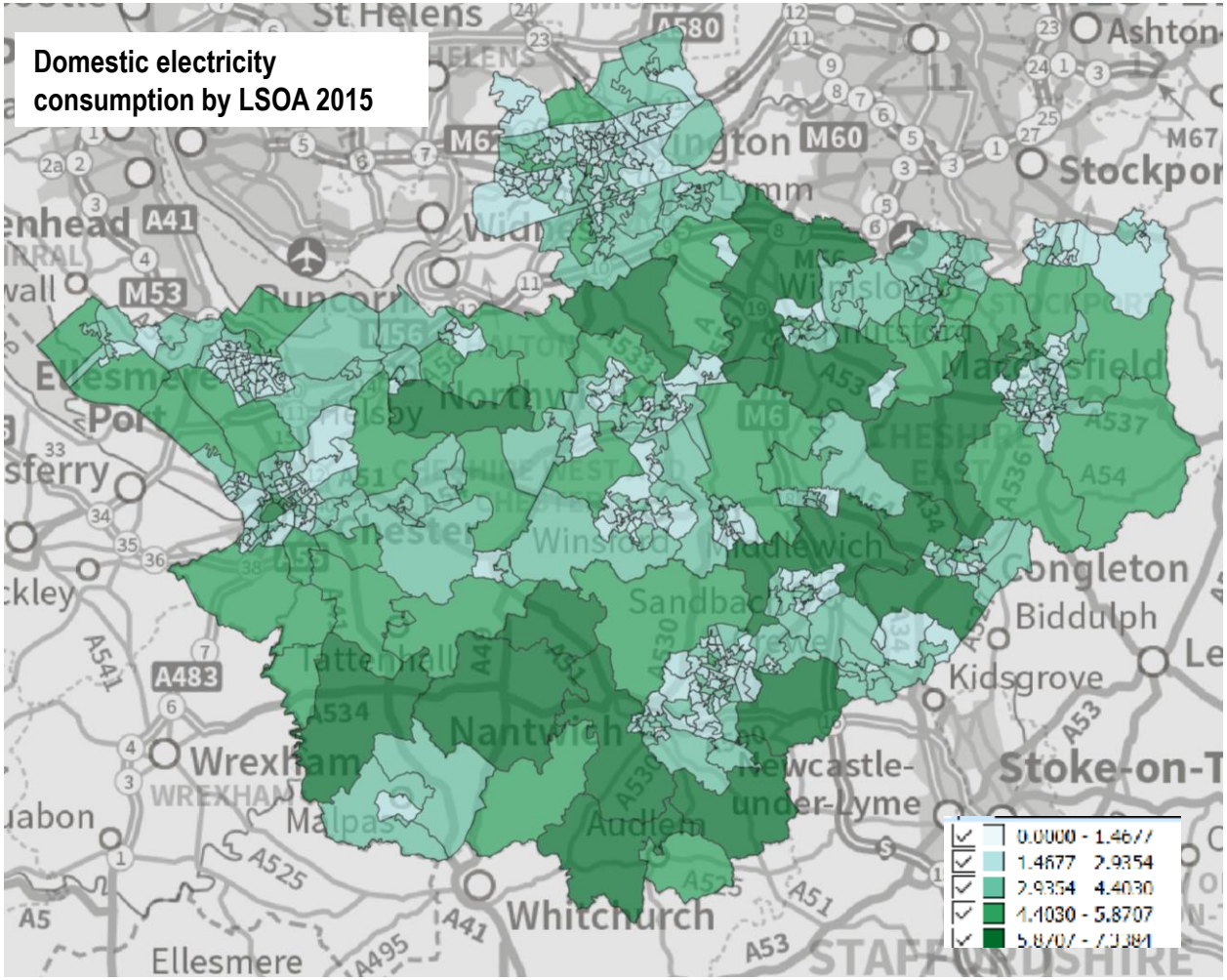
App 2: Mapping Local Position

LSOA density

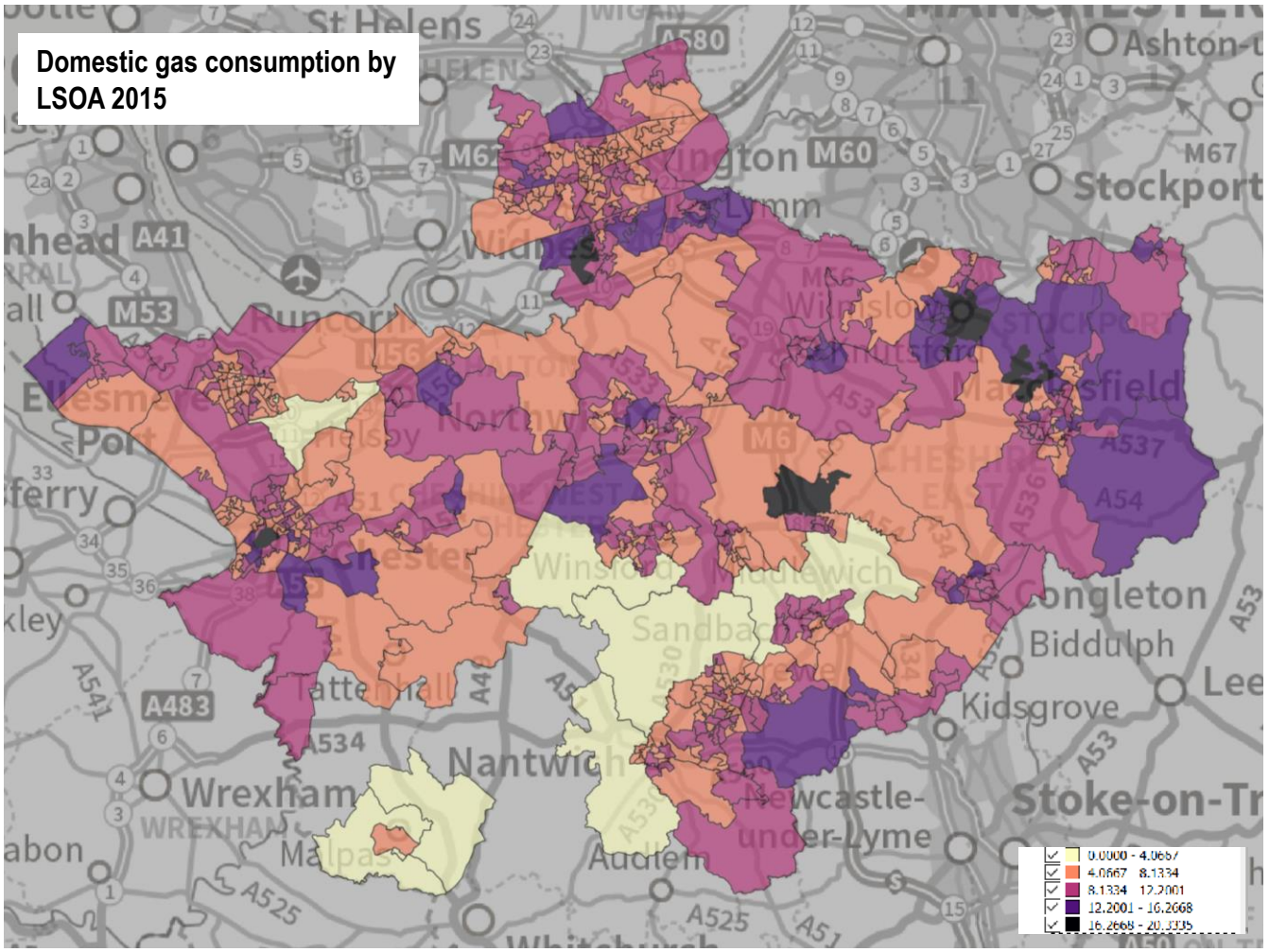


2011 LSOAs had a maximum, population of 3,000 and minimum population of 1,000 and therefore density of LSOAs equates to population density

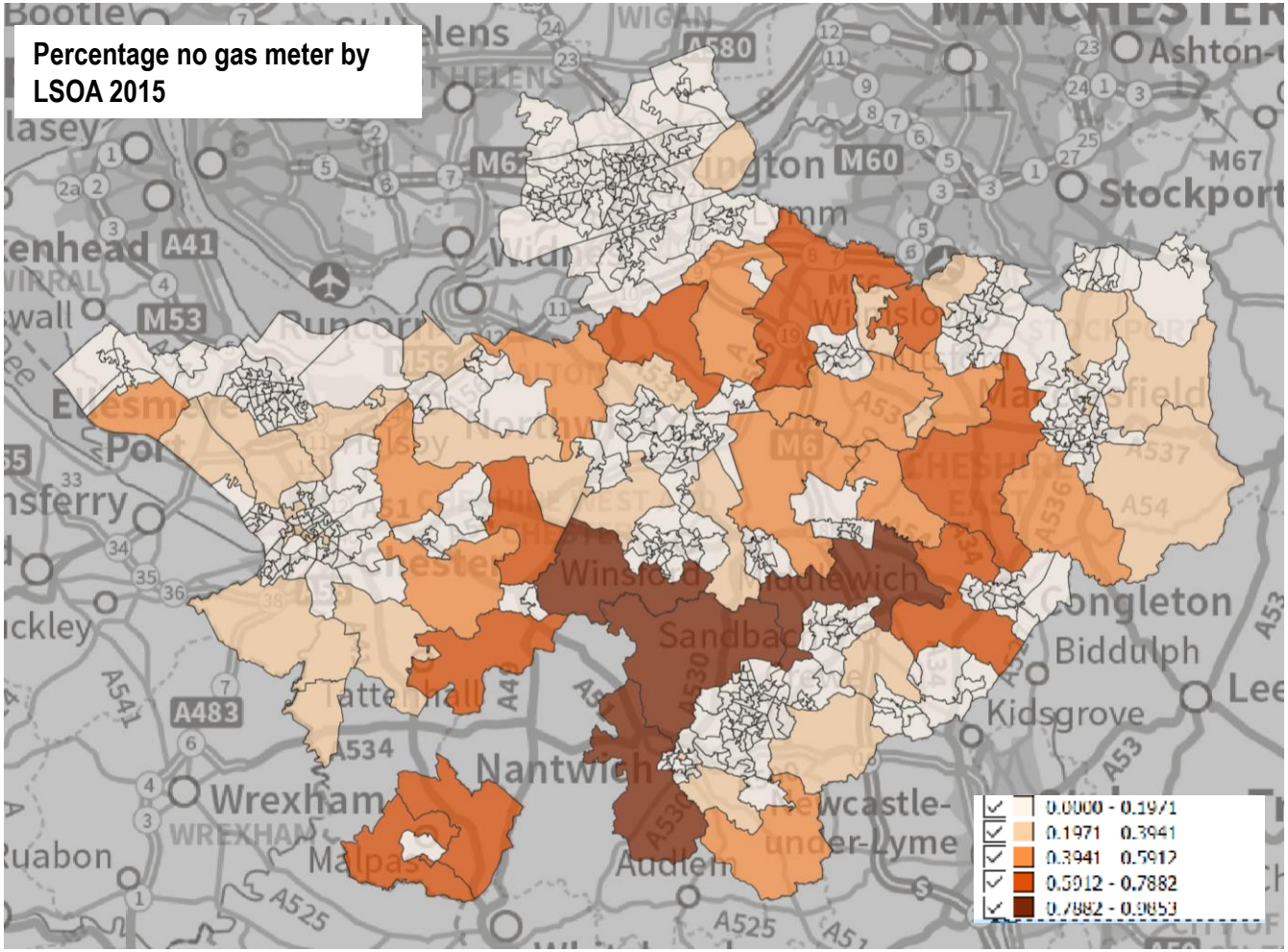
Cheshire and Warrington baseline position *cont*



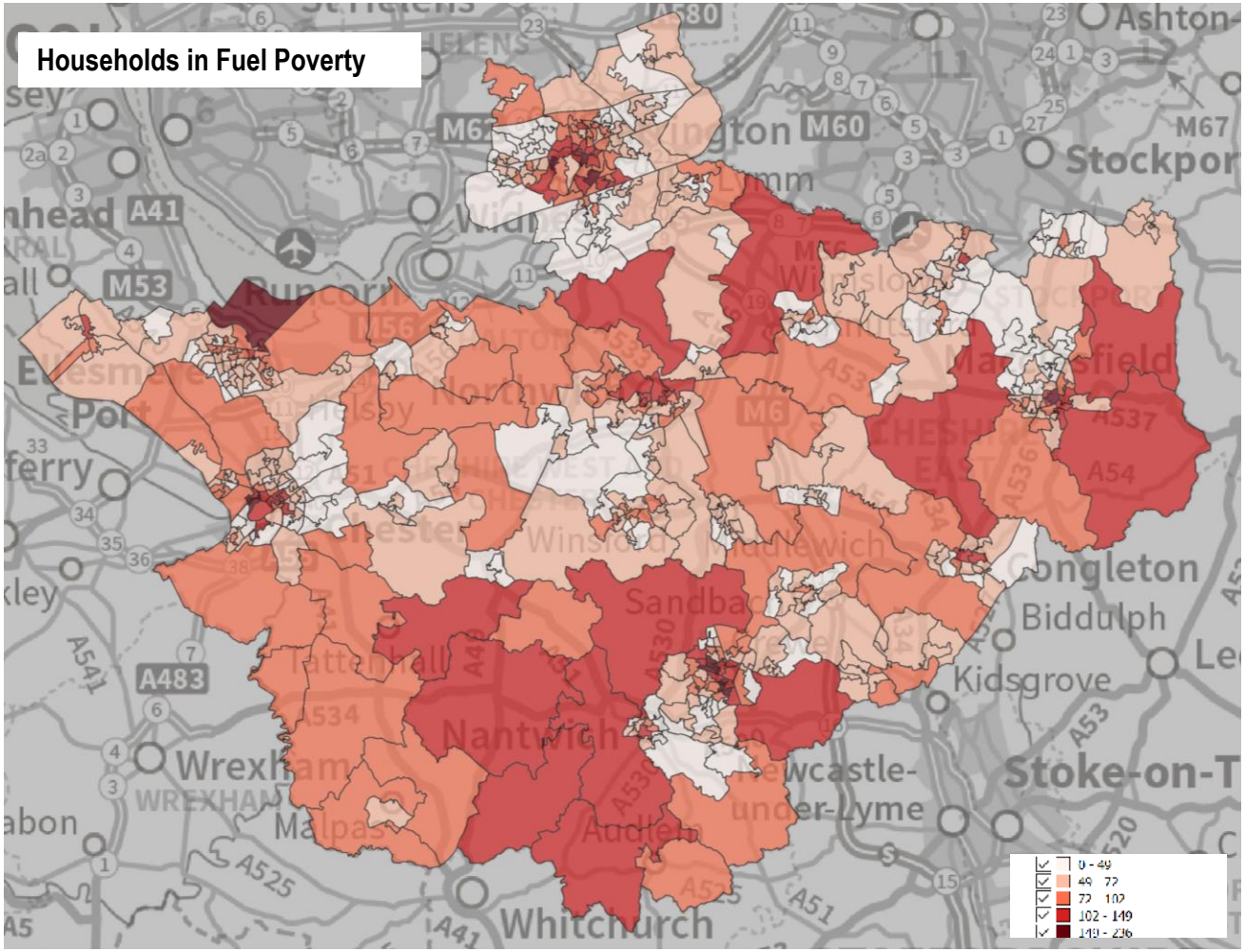
Cheshire and Warrington baseline position *cont*



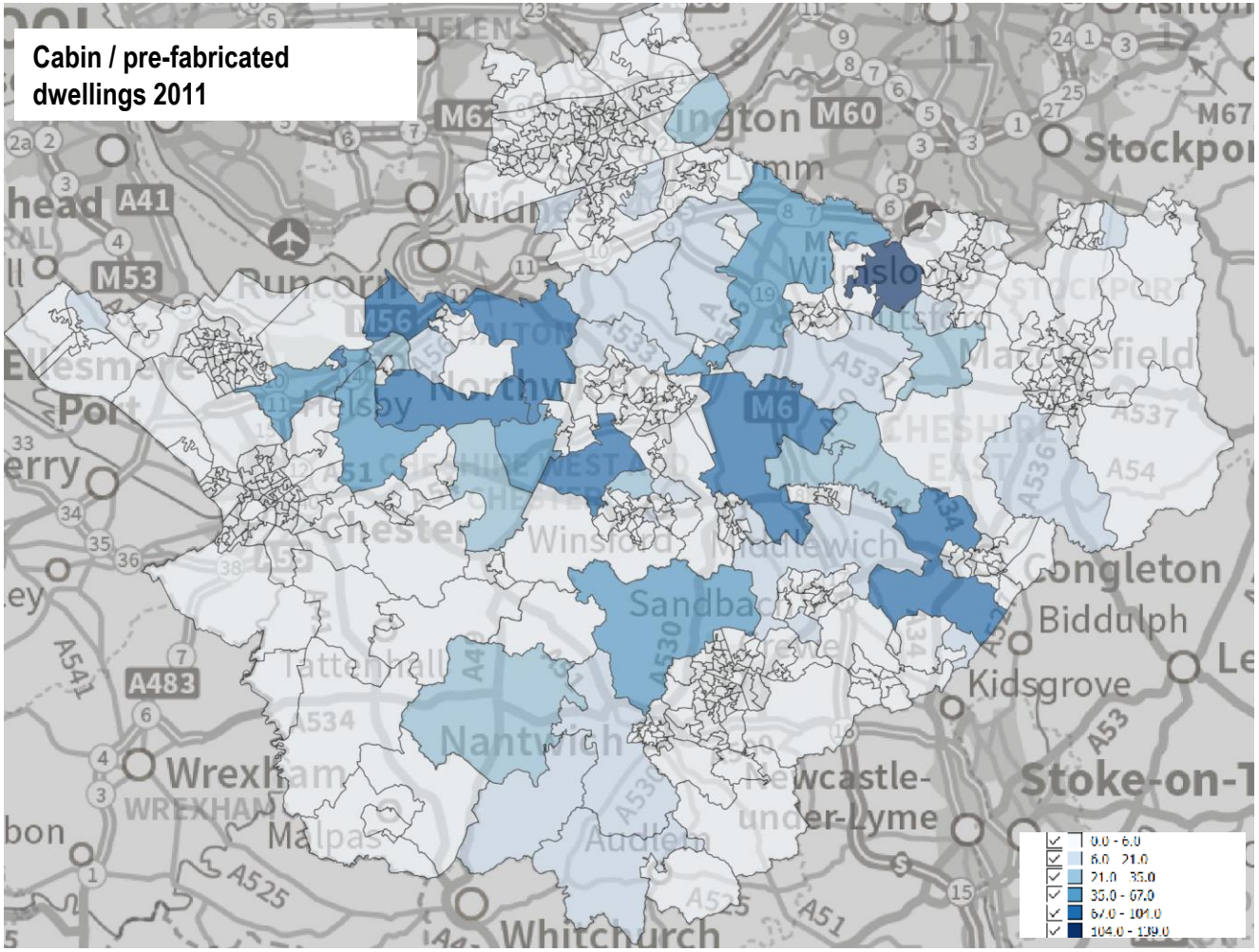
Cheshire and Warrington baseline position *cont*



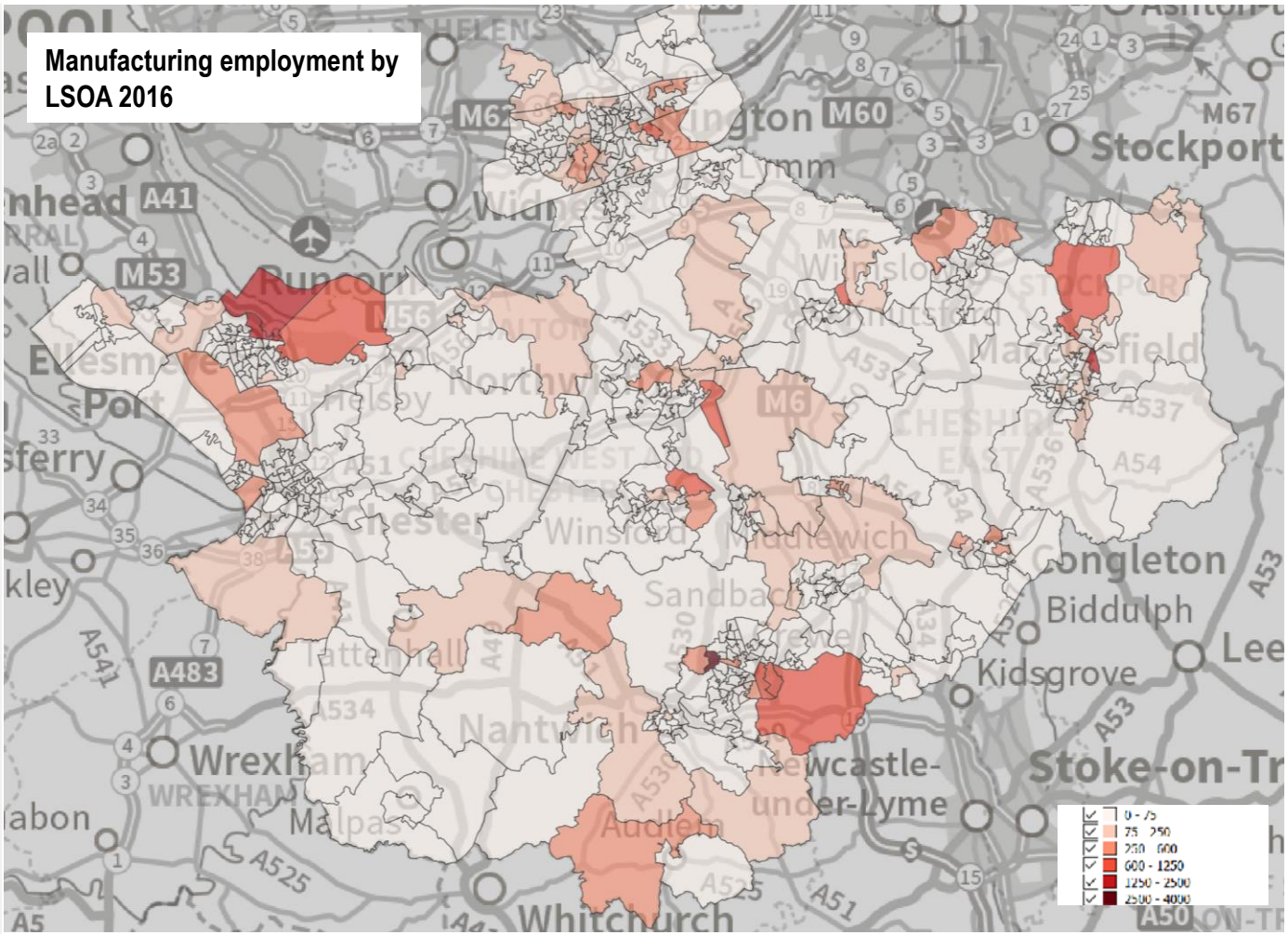
Cheshire and Warrington baseline position *cont*



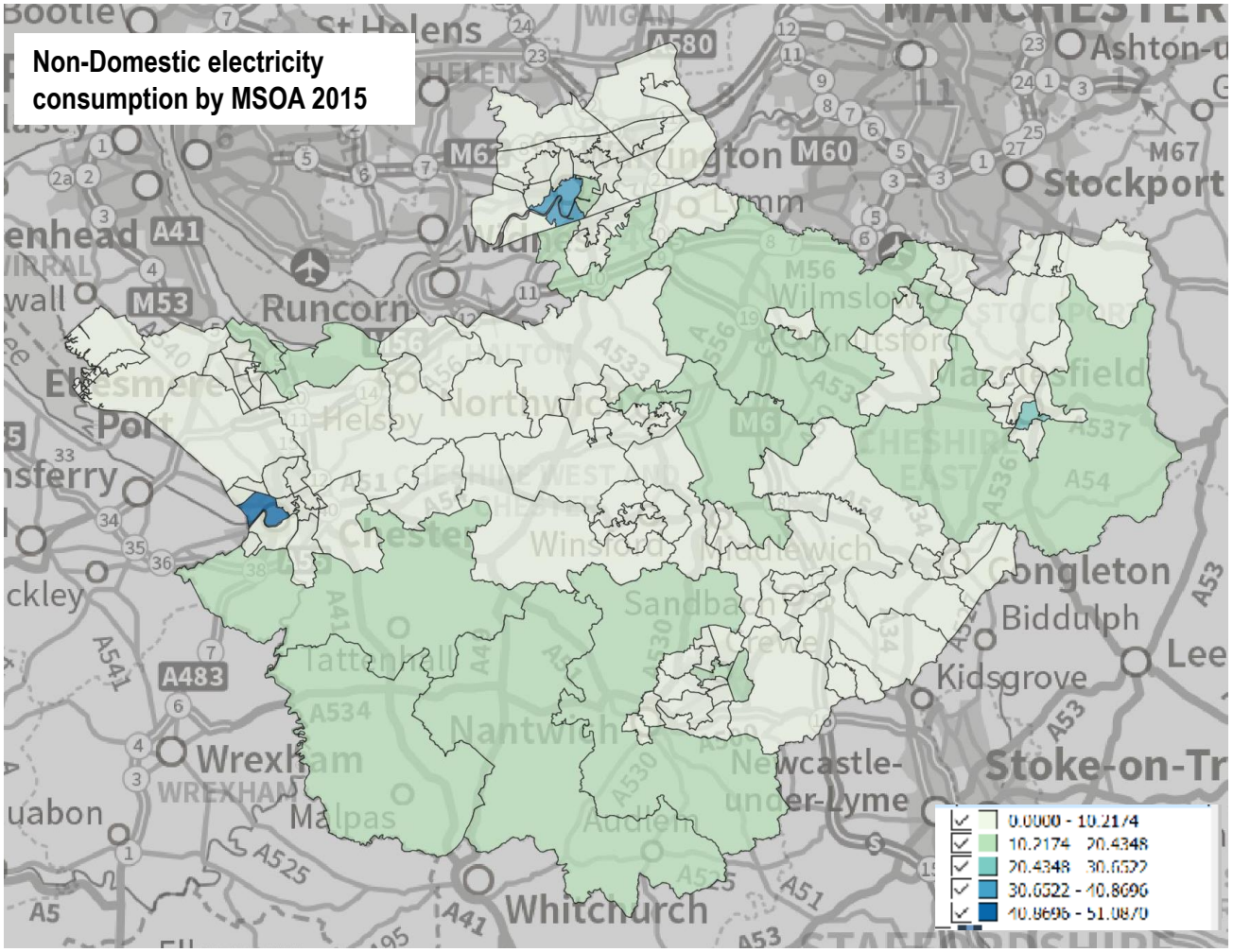
Cheshire and Warrington baseline position *cont*



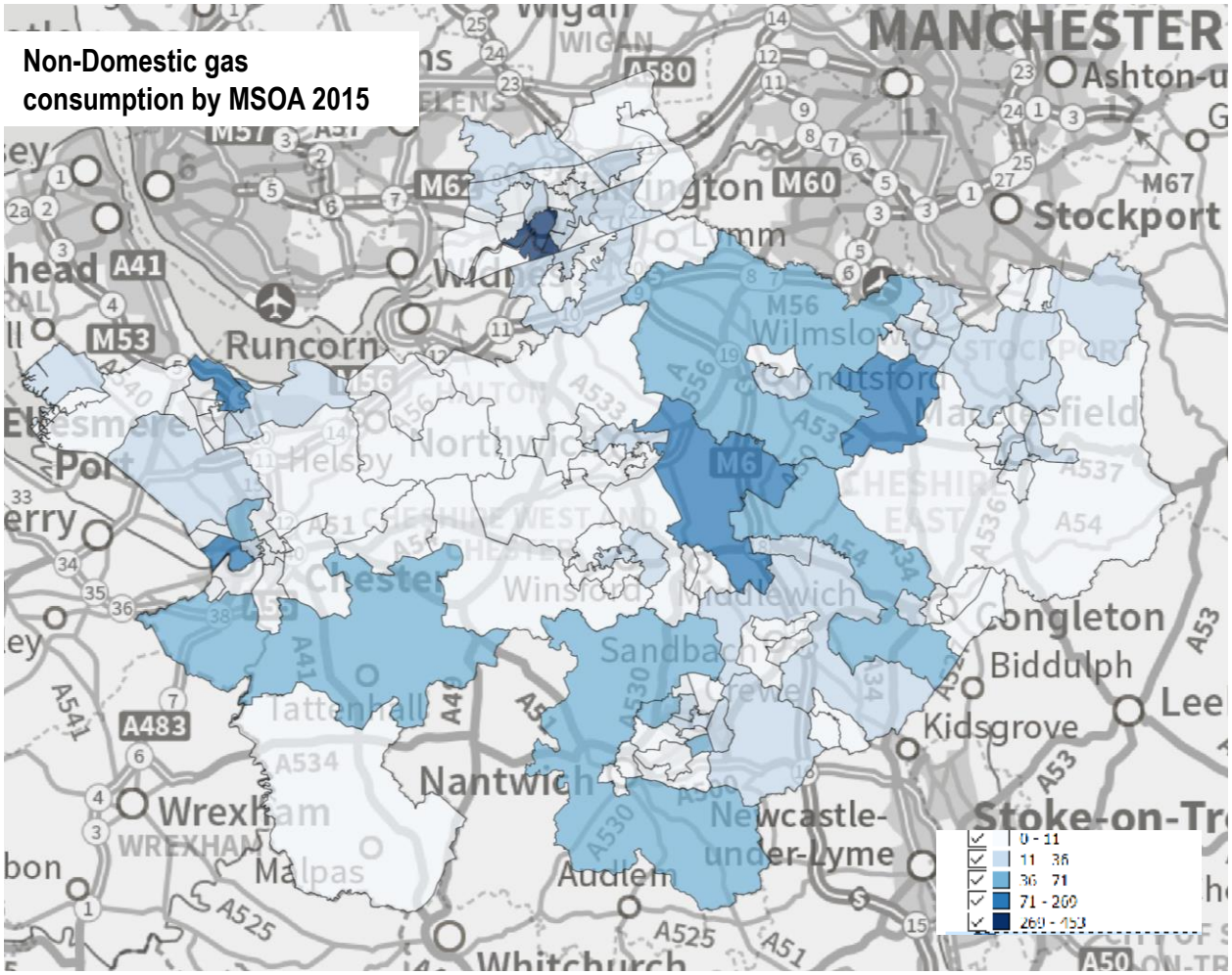
Cheshire and Warrington baseline position *cont*



Cheshire and Warrington baseline position *cont*

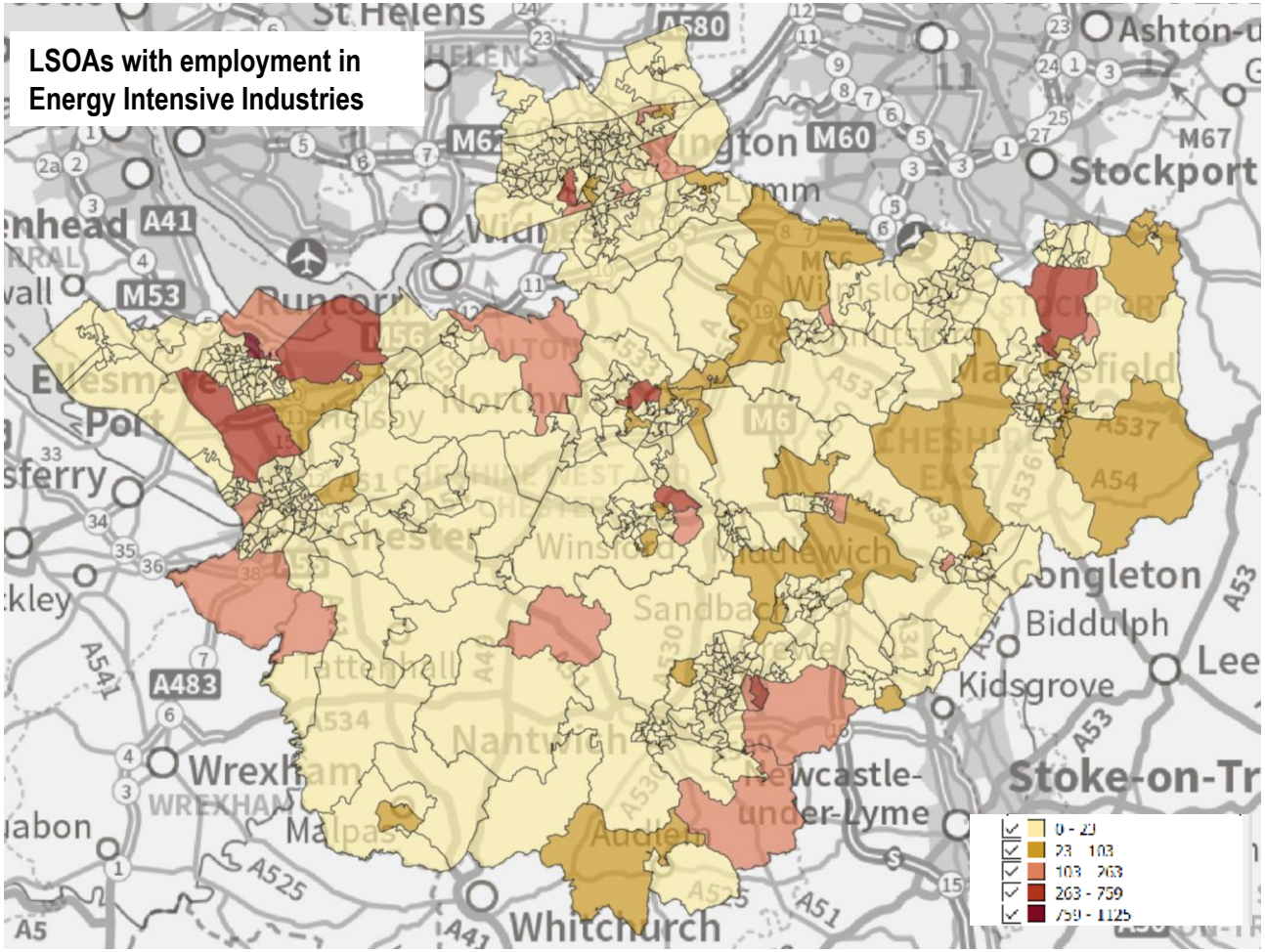


Cheshire and Warrington baseline position *cont*

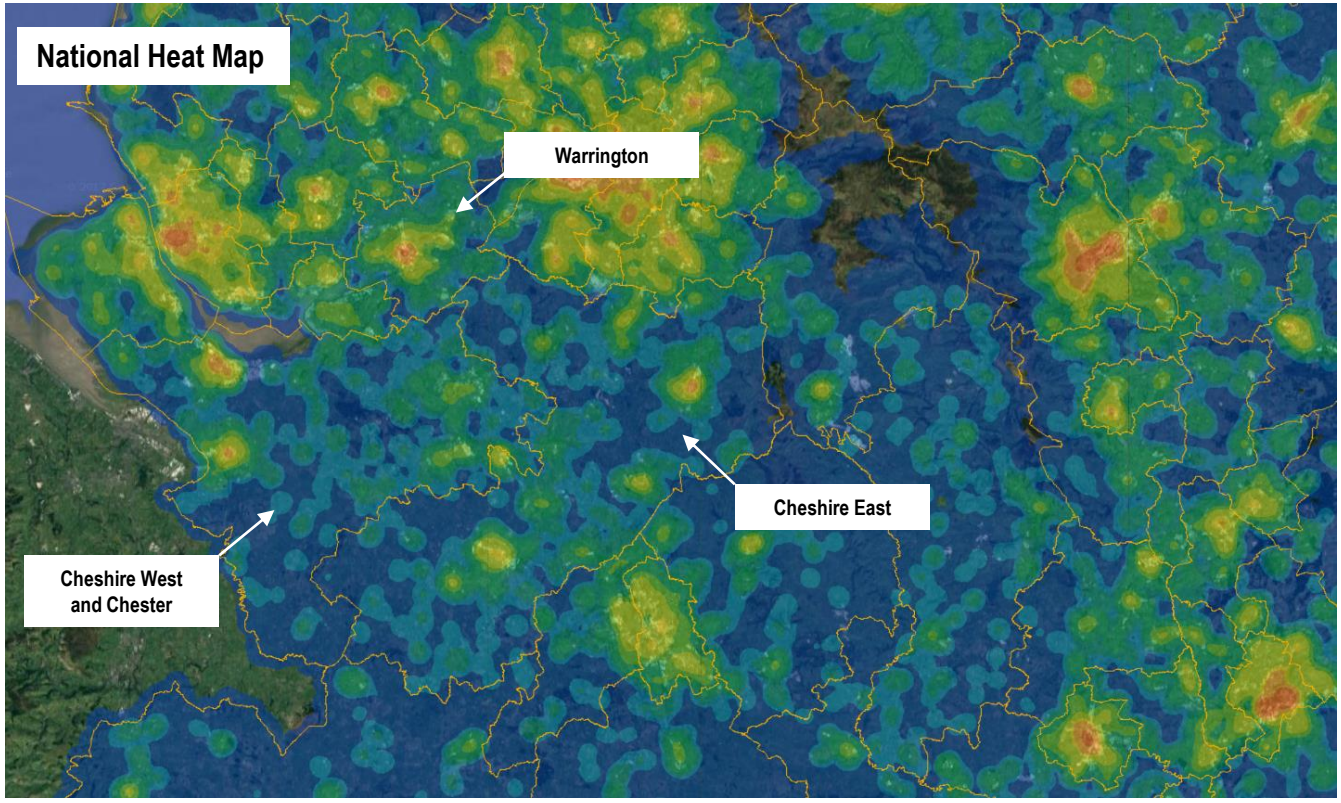


Cheshire and Warrington baseline position *cont*

Cheshire and Warrington baseline position *cont*

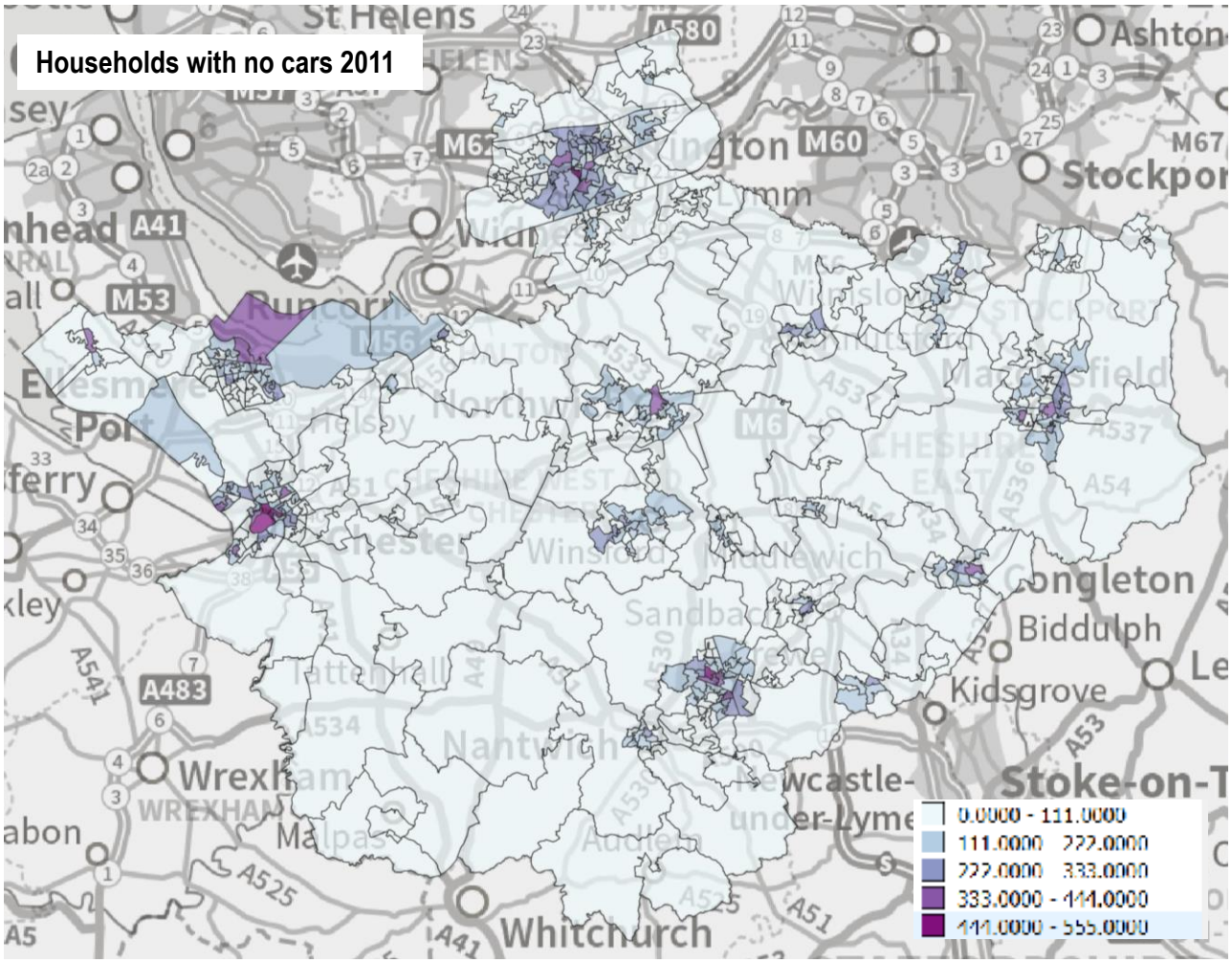


Cheshire and Warrington baseline position *cont*

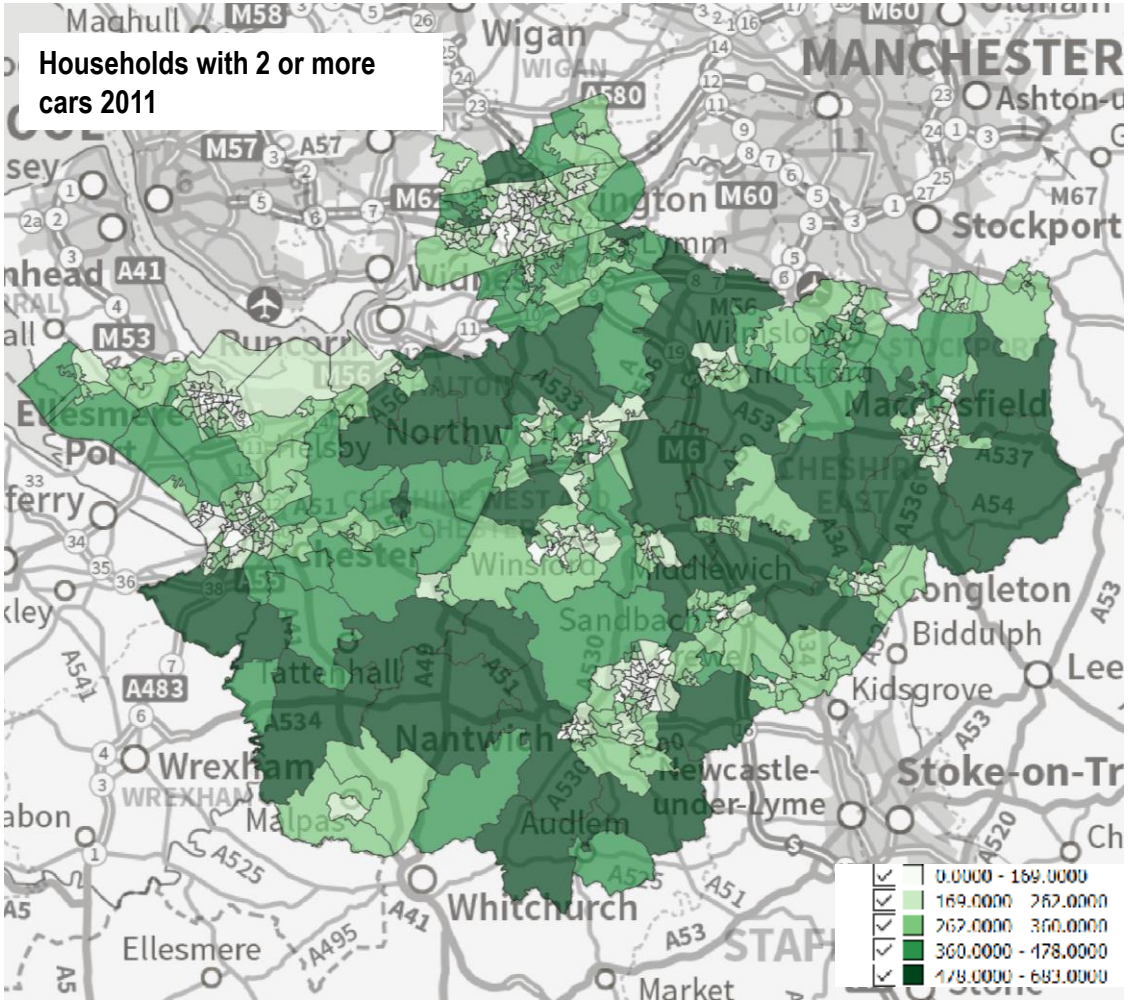


Source: Centre for Sustainable Energy

Cheshire and Warrington baseline position *cont*



Cheshire and Warrington baseline position *cont*



App 3: Context - current energy position

- The total annual energy consumption figure has remained relatively stable over many years but masks a shift in energy consumption away from industry towards individuals

Background

National
In response to the predicted damaging consequences of global warming and the recognition that a reduction in carbon emissions could arrest the problem, the global community signed the Paris Agreement

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

The agreement came into force in November 2016 and requires countries to undertake work to limit their carbon emissions.

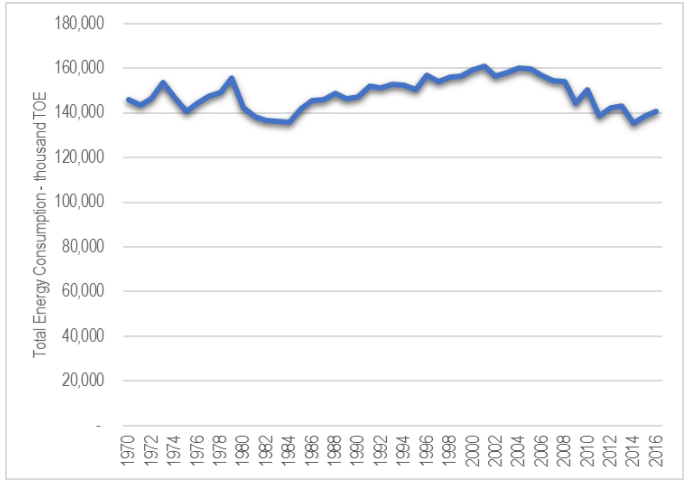
The UK had already introduced legislation to achieve significant reductions in carbon emissions. The Climate Change Act commits the UK government by law to reducing greenhouse gas emissions by at least 80% of 1990 levels by 2050. This has been broken down into 5 years stages where different targets will need to be achieved (Carbon Budgets).

Recent Activity
The UK has been significantly decarbonising power generation over the last decade, although there is still significant decarbonisation activity required. If the 2050 carbon budgets are to be achieved, however, significant work is required in decarbonising heat, transport and energy intensive industry.

Current Position
Annually the UK consumes energy to the value of 141m tonnes of oil equivalent. This total figure includes energy consumption by domestic households, industry and transport. The figure includes power for equipment and also heating.

In fact this annual consumption figure has remained relatively stable over many years but masks a shift in energy consumption away from industry towards individuals. This is illustrated by the charts below.

Total UK Energy consumption 1970-2016



(Source: All Digest of UK Energy – BEIS unless stated otherwise)

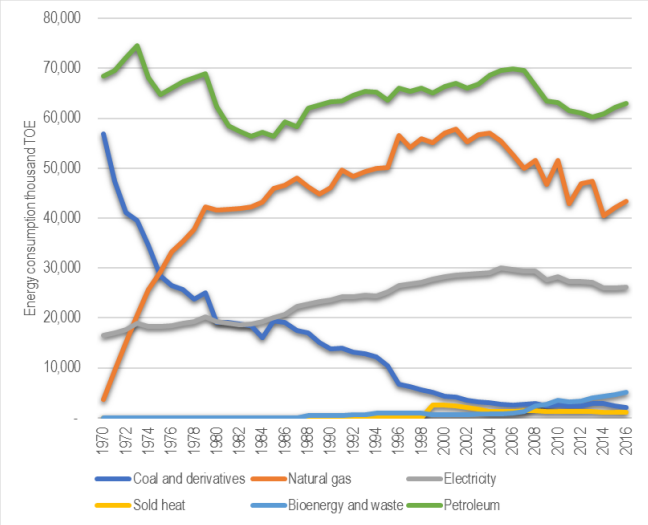
Context - current energy position *cont*

It is clear that transport and domestic heating (which primarily uses natural gas) are now actually more important to consider in terms of decarbonisation

The total consumption in 2016 was in fact 4% lower than the consumption in 1970.

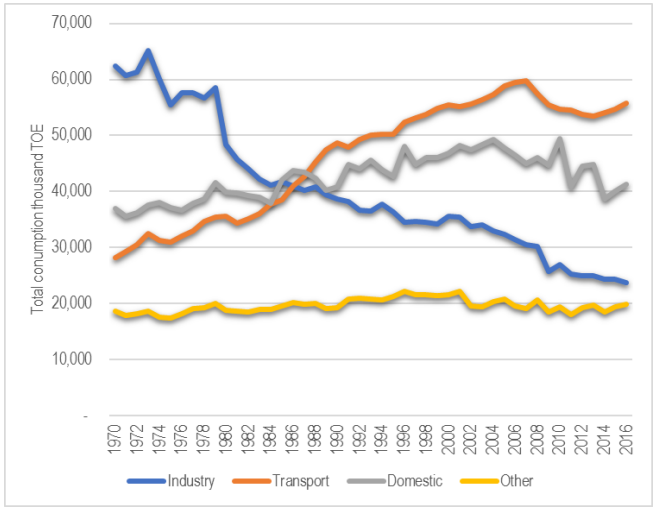
The different aspects which make up the total consumption are shown in the chart below.

Total UK energy consumption by type 1970-2016



The most striking aspect of consumption over the period has been the almost total eradication of coal from the energy mix and its replacement (until recently) with natural gas. It is also notable that petroleum is the largest single aspect of energy consumption in the UK – and has been throughout the period.

Total energy consumption by sector



The chart above demonstrates that de-industrialization during the mid-1980s resulted in a decline in the energy consumed by industry and this decline has continued over the period. Domestic consumption has risen slightly over the same period but transport has become the largest consumer of energy in the UK – with its total consumption also increasing over the period.

This is not simply statistically interesting, it has implications for any policy seeking to de-carbonise the energy mix. Whilst a large amount of public attention has been focused on de-carbonising electricity generation, it is clear that transport and domestic heating (which primarily uses natural gas) are actually more important to consider.

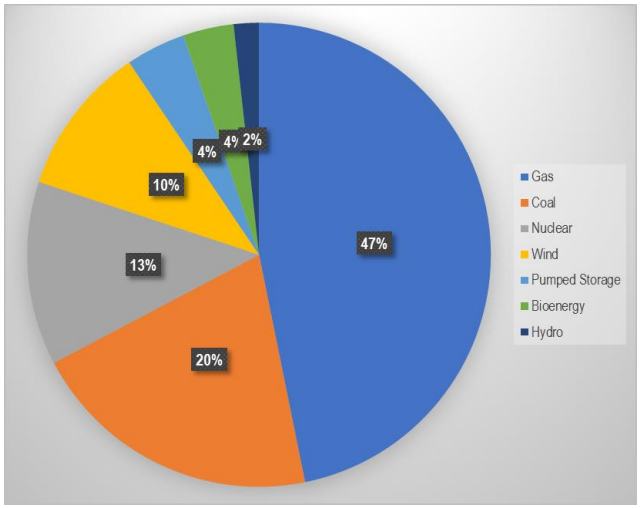
Context - current energy position *cont*

The UK has made significant strides in decarbonising power generation – although gas now the most important source

The importance of gas in UK energy consumption (currently more important than electricity) also explains the, at least short term, interest in alternative gas supplies. The UK's own gas production peaked in 2000 (at c1.2m GWh) and has since declined producing c460,000 GWh in 2016. The result is that the UK has a significant balance of payments deficit in gas – recording net imports of c420,000 GWh in 2016.

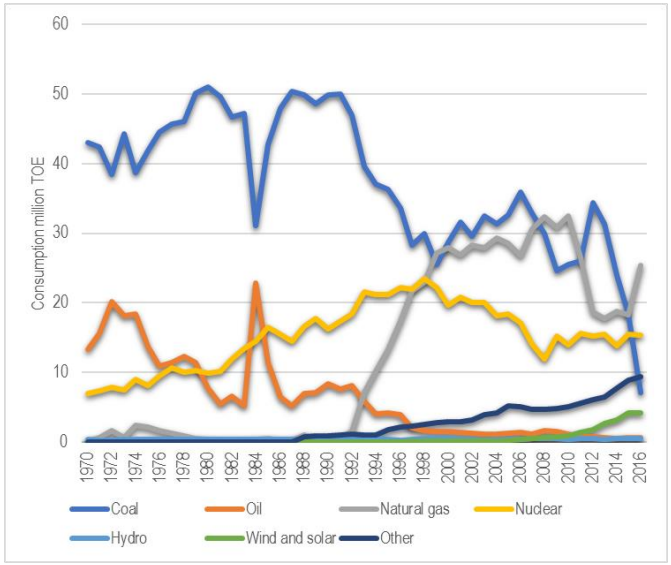
The area where the shift to renewable sources in the energy mix has been increasing has been in the generation of electricity. In terms of installed capacity low carbon sources (including nuclear) accounted for 33% in 2016. This is illustrated below.

Installed power generation capacity 2016



Total electricity generating capacity – by installed capacity 2016
Annual energy generation by source differs slightly from installed capacity.

Total electricity generation by type 1970-2016

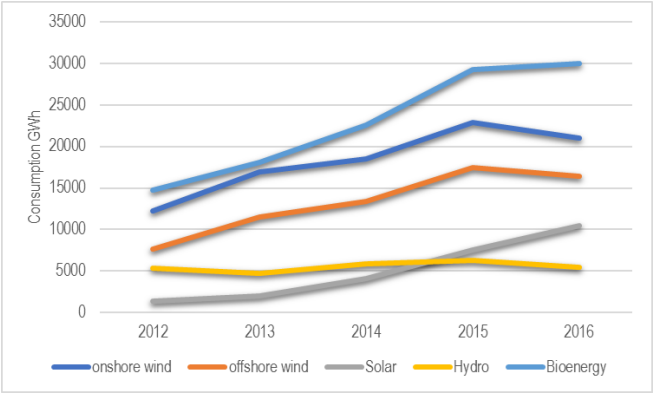


The chart shows the dramatic reduction in coal (and oil) in generating electricity and the increase in renewable sources – including a relatively large rise in 'other' sources and these include the switching of power stations to biomass and waste fuels. This is illustrated in more detail in the chart below.

Context - current energy position *cont*

The Government does not determine the mix of energy supply. It makes market (price / subsidy / fiscal) interventions developed to support its decarbonisation objectives.

Contribution of renewables to electricity generation



The conclusion that can be drawn from the current position is that any strategy that focusses solely on electricity generation is a strategy that misses the largest energy users in the UK (transport and household heating).

This is a theme that is driving current policy including the Clean Growth Strategy.

The Energy Market

The largest emphasis in decarbonisation thus far may have been on electricity generation because of some of the legacy issues associated with domestic heating and the technology issues with de-carbonising transport. The natural gas grid and the price of natural gas has not created an incentive to dramatically shift away from the current model of domestic heating and technologies and the future model for transport systems are only starting to emerge into the mainstream now.

Electricity generation is slightly different. Since the UK's electricity market was privatised in the late 1980s, the private sector has been responsible for financing and building the infrastructure to generate and transport electricity. The Government does not seek to determine the precise future mix of generating technologies. It oversees policies aimed at helping developers overcome barriers to investment to encourage competition, leading to a supply mix that supports its decarbonisation objectives.

Policy Position

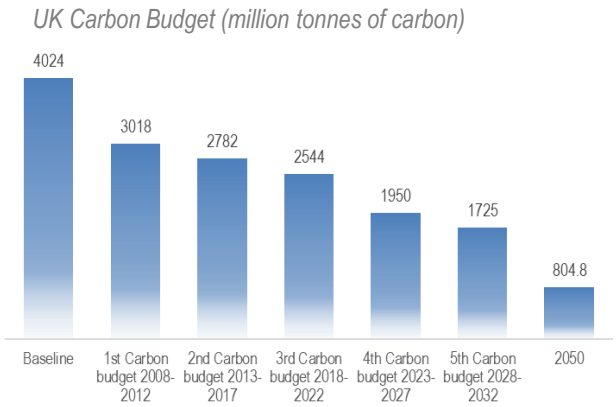
At the same time, the UK is committed to ambitious reductions of its greenhouse-gas emissions. The Climate Change Act 2008 requires the UK to reduce greenhouse-gas emissions by 80% from 1990 levels by 2050. Existing power stations emit around 25% of the UK's greenhouse gases. Government policy is therefore aimed at stimulating new generating capacity to come mainly from lower-carbon sources, such as wind, solar, nuclear and to some extent gas, to help meet its decarbonisation goal.

Given the stretching carbon targets and the carbon output of transport, domestic / commercial heating and industry, Government policy is also now aimed at aggressively reducing the carbon output of these areas of the economy.

The current carbon budgets for the UK are shown in the graph overleaf.

Context - current energy position *cont*

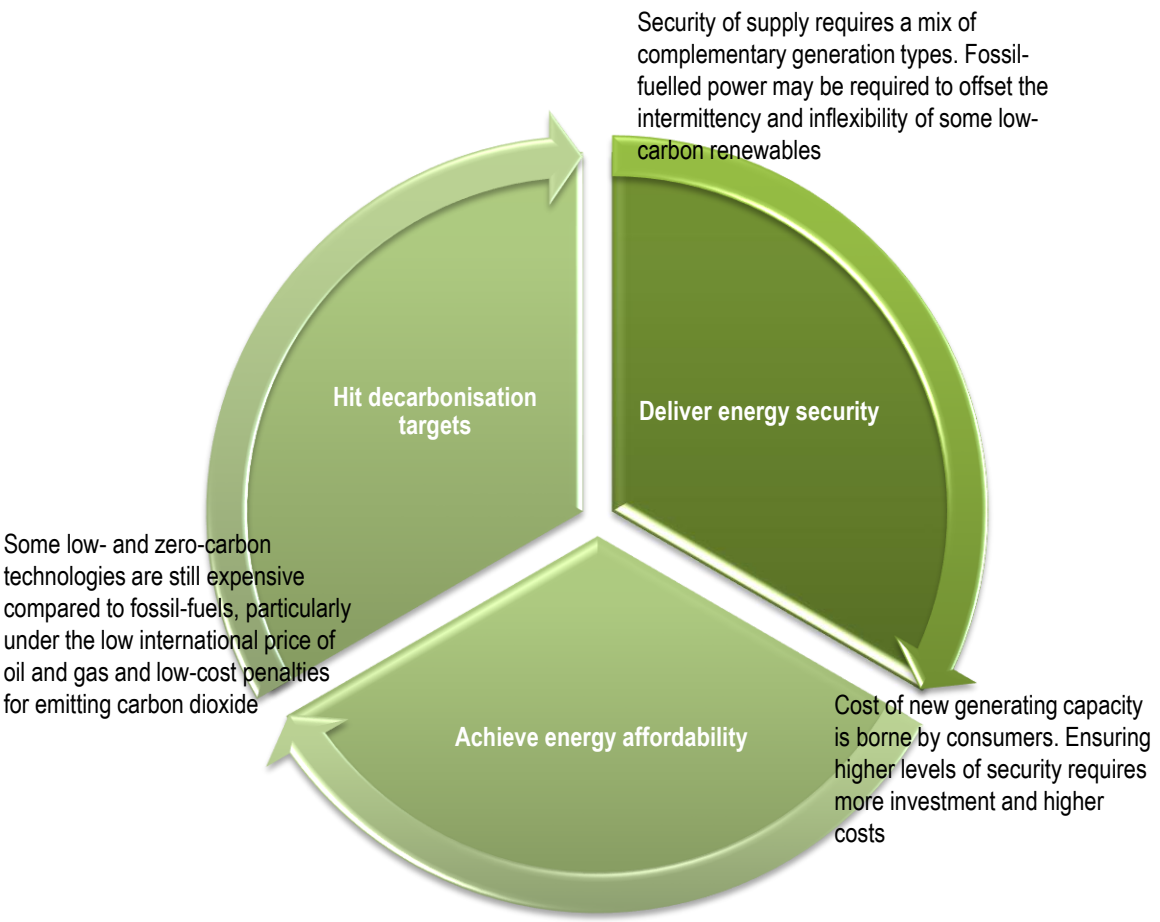
- The Government has legislated for a phased reduction in carbon over the period to 2050



Context - current energy position *cont*

- Whilst the energy situation has been described as a 'trilemma' – those able to deliver are likely to gain a significant economic dividend by securing supply and creating new business opportunities

The apparent 'trilemma'



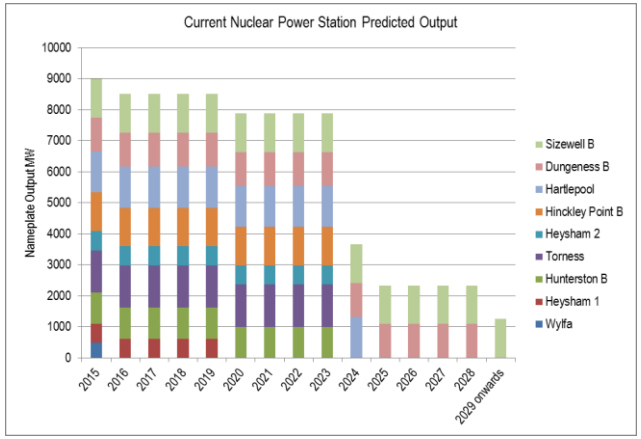
Context - current energy position *cont*

The immediate term challenges faced by the generating industry also mean that the decarbonising of the remaining parts of the energy mix are increasingly important.

The 'trilemma' is not a future theoretical problem – it is a crucial issue facing the Government and the UK as a whole. Significant generating assets will be decommissioned in the near term including remaining coal power stations and most of the existing fleet of UK nuclear power stations.

Mickledore analysis for Cheshire & Warrington LEP in 2015 showed the following anticipated fall off in electricity generation from the current nuclear power stations and this is shown again below:

Impact of planned decommissioning pf existing nuclear power



Source: Mickledore Analysis of installed capacity and estimated decommissioning dates 2015 (Nuclear Decommissioning Agency)

Whilst nuclear plant life extension projects are being examined the analysis remains broadly valid. The anticipated decommissioning of coal and nuclear power plants is predicted to remove 16% of current UK generated electricity and will need to be replaced. Hinckley Point C and was originally due to be operational by 2023 (with installed capacity of 3,200MW) but the project is delayed with further doubt over the other nuclear projects which were to follow – notably the Moorside scheme at Sellafield where NuGen (a JV between Engie and Toshiba) ran into financial difficulties and is now expected to be taken forward by the Korean Company Kepco albeit after delays and now with the need for the Korean reactor design to gain UK approval.

A full review of the delivery of required capacity for the UK is outside the scope of this project but the delivery of new capacity is required with some urgency.

The immediate term challenges faced by the generating industry also mean that the decarbonising of the remaining parts of the energy mix are increasingly important in order to hit the carbon target.

Future Approach

Whilst challenges remain in terms of power generation in the next few years, what is clear is that patterns of consumption and generation are changing. There are also major changes which will take place in terms of heat and transport.

Power

Historically electricity generation was undertaken at a relatively small number of large installations across the UK and fed into the national grid. Demand was managed on a national basis with

Context - current energy position *cont*

Aside from power, however, changes may take place more rapidly in the areas of transport and heating where consumer uptake has not kept pace with technology.

a baseload topped up by additional capacity when required. Most (smaller) consumers paid a single constant tariff for power.

The advent of ever greater number of renewable generation sites has
changed the nature of the grid requirements but the somewhat unpredictable nature of renewable sources of energy also means that demand management needs to change. Added to this is the likelihood that electricity consumption will rise (at least in the short term) as domestic heating systems and transportation are decarbonised.

The management of the future system was set out in Ofgem's paper 'Upgrading Our Energy System' (July 2017) and BEIS Smart Systems and Flexibility Plan (2017) and these stated that the future system would require:

- Removing barriers to smart technologies including storage.
- Enabling smart homes and business.
- Making markets work for flexibility.

What such an approach would mean in practice, is that generation is likely to become ever more distributed across numerous sites, that batteries and other forms of storage will be essential to iron out differences between supply and demand at any given time. Large scale storage is likely both at generation sites (although standalone sites are also possible but there is likely to be an improved business case for on-site storage) and at a smaller scale within user premises. There is likely to be an increase in localised energy distribution rather than national energy transmission being the only model.

Tariffs will be far more sophisticated ensuring that higher prices are charged at higher period of demand and smart meters and smart management of devices (for example to switch on when demand is lower / prices cheaper) would allow more even demand side management.

Aside from power, however, there is scope for significant changes to now take place in the areas of transport and heating where widespread consumer uptake has not kept pace with technology.

In terms of implementation, however, unlike power generation where a limited number of large projects can make a material difference to the carbon output, heating and transport will require a shift in the behaviour of millions of individual consumers and local developers.

Some of the technology shifts that consumers may select are also likely to result in power consumption and this may result in a requirement for further investment in clean power - decarbonising transport is likely to lead to a large increase in consumer demand for electricity (although Ofgem note that even this technology, with the increase in battery storage provide opportunities for this storage potential to be harnessed for the grid – with the potential to both charge / discharge batteries according to grid demand).

Changing the default domestic heating model may also result in higher electricity usage – directly for heat or to power different types of heat pumps for example. In heat, however, there is also the potential to harness the waste heat that is produced across

Context - current energy position *cont*

The nature of heat is such that supply and demand will need to be considered at a far more local level.

the economy for heating purposes – whether recycling heat generated from industrial processes to heat the buildings in that facility and in neighbouring commercial buildings – or if loads are created at scale, in the longer term to heat residential areas from waste heat transferred in district heating schemes..

Relevance of Local Intervention

In the recent past, energy has been an area of the economy managed nationally and where local strategies have had little relevance. The changes which are arising in the nature of the grid and the shift towards more emphasis on heat and transport are changing this. The future is likely to result in some closed / local distribution networks and the nature of heat is such that supply and demand will need to be considered at a far more local level.

There is a potential economic dividend from such an approach. Investment in new low carbon technology will help create new technology businesses and supply chains. Where such businesses are created they will generate investment and employment. Where this investment can improve resilience and / or lower cost power and heat, local businesses will improve competitiveness and for consumers, fuel poverty may be reduced.

There is no doubt that local infrastructure changes will be needed to support the shift to the low carbon economy (whether this is heat networks, carbon capture, hydrogen transmission or electric vehicle charging points etc) and in some cases there will be a case for public sector intervention because of the market failures that prevent the upfront investment.

There are many challenges behind the development of such a system and this is the reason behind the need for a local strategy for Cheshire and Warrington.

App 4 – Local Authority Visions

Cheshire East's strategy has strongly supported renewable growth

Local Authority ambitions

Each of these visions have been taken from the Local Plans of the Local Authorities.

In Cheshire East, however, in addition to the 2030 Vision (set out below), to deliver the Council's energy aspirations, an Energy Framework and Vision was adopted in 2015 and Cheshire East Energy Limited (CEEL) was created to oversee the initial development. This has enabled the development of a joint venture with Engie, Cheshire Energy Networks (CEN) Ltd, to exploit the geothermal and heat network potential in the Borough, and other work has been embedded into the work of the Skills and Growth Company, a wholly owned company of Cheshire East, through programmes such as ELENA and Fairerpower.

The stated ambition of Cheshire East around affordable energy also resulted in the creation of 'Fairerpower' in March 2015, now operated by the Skills and Growth Company'.

Cheshire East's 2030 vision

The following energy related vision 2030 by Cheshire East was presented in the Local Plan Strategy 2010-2030 which was adopted 27 July 2017:

"Cheshire East will have made a significant contribution to reducing carbon emissions and tackling climate change through the high energy efficiency of new and existing buildings; generation of renewable energy; and sustainable patterns of development that enable a high proportion of people to travel by public transport, cycle or on foot."

Cheshire East's Local Plan, once adopted, provides strong energy policies, particularly around decentralised heat networks, that has to be consolidated with Supplementary Planning Documents. As the Waste and Minerals Plans emerge, officers should ensure they include supportive energy policies that will serve Cheshire East well in developing Independent Energy from economically and environmentally sound technologies in appropriate locations.

To deliver the Council's energy aspirations, a wholly owned company, Cheshire East Energy Ltd (CEE Ltd) has been established. While CEE Ltd will develop projects and carry out certain functions directly, it is likely to develop a range of separate partnerships and joint ventures to deliver the strands of the Energy Vision including services aimed at Growing Energy Businesses.

Energy Vision 2030

Cheshire East's Energy Vision is distilled into three strands:

1. Affordable Energy – putting residents first
2. Growing Energy Businesses – Developing a local energy economy
3. Independent Energy – Secure, decentralised and locally managed energy services

Affordable Energy

As of 2014 there are an estimated 18,500 households defined as being in fuel poverty in Cheshire East. These are some of the

Energy Vision *cont*

Cheshire East, first and foremost supports the reduction in energy use and energy efficiency measures to make energy more affordable

borough's most vulnerable residents. Many purchase their energy on a Pay-As-You-Go basis. Even though they pay upfront, they are more likely to be paying more per unit of electricity than those paying by other methods. Those not connected to the mains gas network will also end up paying more to heat their properties. The rural areas to the West of Crewe contain some of the highest proportions of households not connected to the mains gas network in North West England.

Cheshire East, first and foremost supports the reduction in energy use and energy efficiency measures to make energy more affordable. However it believes that this is not enough. It will actively support measures to disrupt the existing energy supply market locally and drive down the cost of energy to residents and businesses. Initially this will be done by working with other organisations to establish a local energy supply company, which offers affordable, simple price tariffs irrelevant of the payment method.

Growing Energy Businesses
Over 160,000 households in Cheshire East spend on average £1300 a year each on energy, predominantly with the Big Six energy companies. This means that over £200 million of residents' money per year ultimately leaves Cheshire East to companies outside the Borough. By using local energy supply companies who purchase locally produced energy, more income will recirculate in the local economy, improving prosperity.

Independent Energy
The aim to secure, decentralised and locally managed energy services.

Virtually all of the electricity and heating used in the Borough originates from elsewhere. This is neither sustainable nor healthy. The majority needs to be generated, distributed and supplied locally; a move towards a more decentralised and resilient energy economy.

Key to this will be;

- The creation of local energy companies capable of generating, purchasing and supplying power to residents and businesses.
- Local heat distribution networks in urban areas utilising geothermal and other low carbon heat sources.
- A rapid move away from electric and oil to renewable heat in the extensive off-gas areas in rural Cheshire.
- Renewables such as solar electricity deployed more widely and appropriately located with any surplus sold to local energy companies.
- More combined heat and power schemes serving major developments.
- Energy generation from locally produced alternative fuels such as biomass and biogas.
- New building design and orientation optimised for low carbon energy generation.
- Retain fuels produced in the Borough for local energy generation rather than export them wherever practicable.

Cheshire East Council will not discount any potential energy source and will seek to embrace new and emerging low carbon energy sources and technologies. By being a leading authority in the energy field and championing innovation, Cheshire East Council is demonstrating how it is putting residents and businesses first.

Energy Vision *cont*

The University of Chester has refurbished and developed a large building which houses an 'Intelligent Energy System Demonstrator' (IESD)

Cheshire West and Chester

Council vision by 2030

- By 2030 Cheshire West and Chester will be a desirable and attractive place to live, work, learn and visit with vibrant towns and rural villages, reflecting the vision of the Sustainable Community Strategy. Development will reflect the character of local areas, conserving, managing and enhancing the valuable natural and historical environments, resources and assets.
- New housing and employment opportunities in sustainable and accessible locations will have enabled the Borough to attract inward investment and business growth and enabled skills and jobs to be retained locally.
- Residents will have access to a range of high quality market and affordable homes and the needs of all our communities, in particular those of an ageing population, will be provided for. Opportunities for healthier lifestyles will be delivered through the provision of sport, recreation and social facilities.
- Positive adaptation to climate change will continue to be promoted and communities will be supported in taking positive action towards sustainable living. Sustainable use of resources and improved energy efficiency will achieve a reduction in greenhouse gases and our carbon footprint. Waste will be managed in the most sustainable way and will be utilised as a valuable resource.
- Chester will continue its development as a prosperous sub-regional employment location, shopping and international tourist destination. The city will be a key asset to the borough with a thriving business, retail and tourism economy and as a centre for learning. The setting and special character of Chester will be maintained.
- Ellesmere Port will be a confident industrial area, a hub for high quality industries and technologies including the green energy and waste sector, attracting inward investment. Perceptions of the town will be enhanced as a result of improvements to the image of the town as a prosperous area.
- Northwich will have a vibrant town centre based around the regeneration and development of new retail, leisure and housing development opportunities. The waterways and surrounding countryside will provide an important resource for the recreational needs of local residents and visitors.
- Winsford will be integral to the improved prosperity of the borough particularly through development to meet the needs of local communities, whilst protecting the character of the Cheshire countryside and individual identity of rural settlements. The market towns and villages identified as key service centres will remain viable settlements and will fulfil their role and function in providing access to services and facilities for their local and surrounding communities.

With LEP / Local Growth Fund support, The University of Chester has refurbished and developed a large building which will house an 'Intelligent Energy System Demonstrator' (IESD). The building sits on the University of Chester's Thornton Science Park and the Demonstrator will be a flagship innovation project of the Cheshire Science Corridor - the new Enterprise Zone announced by the Government last autumn and developed by Cheshire and Warrington Local Enterprise Partnership.

Designed to promote growth and acceleration in the

Energy Vision *cont*

By 2027 Warrington aims to be widely recognised as one of the best places to live and work in the UK

development and exploitation of technologies for the energy market, the new Energy Centre is already providing a flexible place where industry and academia come together to innovate, develop and demonstrate new intelligent energy technologies.

Examples of technologies that may be tested and developed include:

- New types of photovoltaic solar cells
- Innovative electrical energy storage solutions
- Developments in low power motor drives
- New algorithms for load balancing on micro-grids
- Non-electrical energy systems such as heat networks and thermal storage.

Warrington Council vision by 2027

Warrington is one of the best places to live and work in the UK, where everyone enjoys an outstanding quality of life. The town continues to be a key economic driver for the surrounding area and its pivotal location within the 'Atlantic Gateway' is an advantage to residents and businesses and gives them unrivalled access to both the Manchester and Liverpool conurbations and national transport infrastructure.

The town has grown by strengthening its existing neighbourhoods especially in areas around the Town Centre. Investment has regenerated these areas and made the best use of infrastructure as well as providing high quality, safe and secure living environments that meet residents' needs and encourage healthy lifestyles. The focus on regeneration has limited outward growth of the town and has enabled the continued protection of the Green Belt.

The rivers and waterways continue to play a significant role in the borough reinforcing the unique character of Warrington and providing a new focus in the Town Centre as well as recreation and sustainable transport opportunities. The Town Centre has reinvented itself as a well-connected employment and business location. This has helped to diversify and strengthen the centre which now serves the borough's population better as well as being attractive to a growing number of visitors.

Those who live and work within the borough enjoy access to an extensive network of Green Infrastructure, which is effective in fulfilling a wide range of functions at the heart of which is supporting a diverse range of flora and fauna and protecting against the impacts of climate change.

The unique elements of the historic built and natural environment that Warrington possesses are looked after; well managed; well used and enjoyed; and also contribute to a successful local economy and the attractiveness of the Town Centre.

The borough is home to a highly skilled workforce that serves the local economy well and the town continues to be a focus for employment for a wide area - reinforced by the development of significant sites in and immediately surrounding the borough.

New housing has focused on achieving the outcomes of regeneration and creating sustainable communities and has delivered the homes needed to meet identified general and specialised housing needs. This has helped reduced commuting and has contributed to the population growth that was necessary for Warrington to sustain and enhance its economy and services.

.

Energy Vision *cont*

The borough's carbon footprint has reduced and new development is generating a proportion of its energy needs from renewable sources. Locating new development in accessible locations and securing changes in travel modes and patterns has assisted in securing this reduction and alongside providing appropriate infrastructure contributed to making it much easier to get to and around the town to access services and employment opportunities without a car.

The borough has sufficient facilities to meet its own waste management needs and the only wastes sent to landfill constitute residual waste with no further potential for recycling or re-use. Quantities of municipal, commercial and industrial wastes imported into the borough have been significantly reduced through collaborative working with adjacent authorities to help them achieve maximum self sufficiency and lower levels of residual waste for disposal

App 5 – Consultation

Cheshire

As part of the project we have engaged with the following organisations:

- C&W LEP
- Skills & Growth Co.
- Cheshire West & Chester UA
- Warrington BC
- C&W LEP Strategy Board
- Cheshire Growth Hub
- Energy Innovation Centre
- Storengy
- Electricity NW
- Scottish & Southern Energy
- EA Technology
- C-Tech Innovation
- Peel Energy
- Burns & McDonnell
- University of Chester

App 6 – Energy Innovation Fund

Cheshire

Energy Innovation Fund

The funding for the Energy Innovation Fund (which was gained as part of the Local Growth Fund allocation) was sought by the LEP to support the delivery of its Low Carbon Action Plan by stimulating innovation in SMEs working in the low carbon and energy sectors.

The grant scheme can stimulate innovation in the technology development, commercial model development or product implementation in those areas which tie into the strategy.

The funding is aimed at SMEs.

Any grant scheme will need to consider the following things:

- Overview of the scheme and its objectives (to tie in with the energy strategy and the outputs required).
- Summary requirements for eligibility (based on technologies that match the strategy and within the parameters for SME / R&D state aid in terms of intervention rates, eligible expenditure, incentive effect, additionality and value for money measures).
- How the scheme operates (calls or always on, timescale, deadlines and application process including the interface between the operator and the applicant).
- Systems for payment of funds (governance per application). This will include the documents to prove that grant is now due, how funding claims are audited and vetted, how the payment is agreed, how and when the payment is made).
- Systems for the operation of the scheme – how the LEP maintains the systems required by the funding providers.
- Performance management. How the overall scheme is performing against objective at different stages – in terms of applications, successful offers and money drawn down against outputs).
- Monitoring and evaluation. Evidence, safeguards in terms of audited statements and checks made directly.
- Governance. Overall control of the entire scheme. The role of evaluation panels and a Board.
- Establishing the key posts. Maintaining a division of responsibility between applicant project manager, decision making panel, and scrutiny body that signs of award funding transfer.
- Marketing the fund. Developing a promotional campaign to attract interest and applications.
- Receipt of applications. Whether these can be unsolicited or only received after discussion (initial gateway) with a case officer who then provides the means of application.
- Assessment of application. The key measures, the process, the timescale and the team involved – then the panel for final assessment. Also eligibility against key aspects such as State Aid and Financial Due Diligence.
- Banking. How funds are transferred.
- Reporting requirements placed on the LEP.
- How business make claims against their award.
- How instalment payments are performing / forecast to perform against forecast.
- Timetable and projected outputs.
- Publicity

Energy Innovation Fund *cont*

Cheshire

To support this process we would therefore expect to be produced in advance of scheme launch:

- Appraisal Manual (for the team)
- Pro-forma offer letter
- Application form
- Appraisal summary documents to take to funding panels
- Quarterly report pro-forma
- Grant progress summary sheets
- Award claim forms

Mickledore / Bizcat 2018