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Powering Greater Manchester: how will we fuel our future?

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Abstract

The UK's energy system is changing more rapidly than at any time in the last half century and the changes could directly affect Greater Manchester's (GM) vision for long term, sustainable growth. Consideration of four future energy scenarios has led to the conclusion that Greater Manchester needs to be proactive in its role in shaping and delivering the energy system in order to positively impact on the conurbation's growth, well being and prosperity.

Building on the scenarios, this paper suggests that Greater Manchester needs to: increase the rate of deployment of low carbon and decentralised energy, particularly heat across the conurbation; find ways of making sure that businesses and all parts of the community are involved and can therefore benefit from renewable and low carbon energy developments; and ensure that the economic impact of local jobs and growth is maximised as a result of the investments made to develop decentralised renewable energy.

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Executive Summary

The UK's energy system is changing more rapidly than at any time in the last half century, including during privatisation. The changes are being driven by the need to replace aging generation and distribution assets, maintain a secure and affordable supply, whilst also meeting renewable energy and climate change targets.

How these changes affect Greater Manchester and, in particular, its ability to meet the Vision set out in the Greater Manchester Strategy to "secure long term economic growth and enable the city region to fulfil its economic potential, whilst ensuring that our residents are able to contribute to and share in that prosperity" are discussed in this paper. The Greater Manchester Strategy is complemented by the Greater Manchester Climate Change Strategy and Implementation Plan which contains a target of 48% reduction in CO_2 emissions and has targets of 1TWh of renewable electricity and 3TWh of renewable heat production by 2020.

Increased deployment of renewable energy, particularly in decentralised schemes, provide an opportunity for Greater Manchester to produce more of its own energy, potentially reducing energy costs and creating an income. Moreover, the changes to the energy market will bring about other opportunities such as becoming shareholders in, and owners of community energy schemes which provide additional opportunities for all types of stakeholders.

If supported, businesses, households, communities and the public sector could become players in the energy market and reap the associated benefits of managing energy costs and generating an income.

Currently there is an estimated 0.54TWh of renewable electricity generated across Greater Manchester but it is difficult to be confident about the amount of renewable heat. Including the planned renewable electricity capacity, the renewable electricity target of 1TWh is likely to be achieved by 2020 but the renewable heat target is very challenging. In addition both targets are a very small percentage of the conurbation's overall energy use of 43.7TWh for gas and electricity, and a small percentage of the estimated potential, meaning the targets should be considered as a starting point for the amount of renewable generation required across Greater Manchester.

Through the use of four different future energy scenarios, which vary in the rate of energy price increases and the amount of renewable energy deployment across Greater Manchester, this paper considers the implications in terms of:

- cost of energy for businesses;
- cost of energy for households, particularly households in fuel poverty;
- delivery of jobs and growth - business opportunities for Greater Manchester businesses; and
- reduction of carbon emissions.

Each of the four areas above play a critical role in securing GM's Vision. Under a business as usual scenario, with high and fast energy price rises and a low renewable energy deployment rate, it will be very difficult for Greater Manchester to meet its renewable energy targets which in turn will have a negative impact in terms of costs to businesses, households, securing jobs and growth. However, if a high deployment rate for renewable energy is achieved it, may be possible to reduce the impact of the cost of energy on businesses and households and to meet carbon emissions reduction targets. Investment in renewable energy will benefit the local economy, but the extent of the benefit will depend on how the investments are made and how effectively local suppliers are engaged.

A high deployment rate for renewable energy is not a given. The UK is starting to lose its position as a leading country for renewable energy investments, largely due to inconsistency in national policy. Greater Manchester can try to counteract the impact of national policy but is unlikely to overcome it entirely. However, there is a key role for GM to play in developing decentralised low carbon and renewable energy generation.

Analysis of the scenarios and their impacts has highlighted that Greater Manchester needs to:

- increase the rate of deployment of low carbon and decentralised energy, particularly heat, across the conurbation;
- find ways of making sure that businesses and all parts of the community are involved and can therefore benefit from renewable and low carbon energy developments; and
- ensure that the economic impact of local jobs and growth is maximised as a result of the investments made to develop decentralised renewable energy.

Greater Manchester is showing leadership on the low carbon agenda and has established the Low Carbon Hub (LCH) to oversee activity to implement the GM Climate Change Strategy. However, to achieve the rates of deployment required to meet the targets and to have a significant impact on energy prices will require mobilisation of resources beyond the scope of the public sector and need the engagement of businesses, communities and households across the conurbation.

How energy is measured

The amount of energy available at any given moment is measured in Joules or Watt hours. 1 Watt hour is a tiny amount so kilo-, Mega-, Giga- and Terra -Watts are all used to measure increasing amounts of energy usage.

The output of an energy generating machine is measured by the amount of energy produced per hour eg MWh or GWh and is a function of time, rated capacity and the load factor of the machine.

kWh = kilowatt hour
MWh = Megawatt hour (1000 kWh)
GWh = Gigawatt hour (1000 MWh)
TWh = Terrawatt hour (1000 GWh)

Energy generating machines have a rated capacity which provides an indication of the potential size of their output. For example, wind turbines range in sizes from approximately 5kW to 7MW, gas fired powered stations also vary in size and are in the order of 1-3GW.

If supported, businesses, households, communities and the public sector could become players in the energy market and reap the associated benefits of managing energy costs and generating an income.

1

Context

1.1 Background

The UK's energy system is changing more rapidly than at any time in the last half century, including during privatisation. How it changes, and the choices Greater Manchester makes about its role in shaping and delivering them, have significant implications for the conurbation's future growth, wellbeing and prosperity.

This paper examines the main macroeconomic and policy drivers affecting Greater Manchester's energy system and identifies key opportunities and challenges which will shape its energy future. The paper focuses on the drivers behind renewable energy deployment and the potential consequences. Energy efficiency is also an important aspect of energy policy and the energy hierarchy correctly puts energy efficiency measures above renewable energy deployment. However energy efficiency is not covered in detail by this paper. The aim of this paper is to frame the discussion for the next steps for renewable deployment across Greater Manchester without defining suitable technologies or finance options for deployment.

Energy policy in the UK is driven by three, equally weighted, objectives:

- carbon emission reduction targets;
- affordability for business and households; and
- security of supply.

These three priorities need to be balanced when considering the supply and demand of energy in the UK within the context of a privatised energy industry, where policy and regulation can send market signals but the market is expected to deliver.

This section explains the context for the UK energy sector, which can be summarised as follows:

- the UK has aging energy infrastructure and significant investment is required into both generation assets and distribution networks;
- electricity demand is going to increase as more transport and heat is powered by electricity as a way to meet carbon emission reduction targets;
- for energy prices - the only way is up, exacerbated by a highly complex and segmented market structure;
- an increasingly competitive global market for finite fossil fuel reserves; and
- renewable energy and carbon emissions reduction targets are major market drivers but gas will be part of the UK energy mix for the short – medium term.

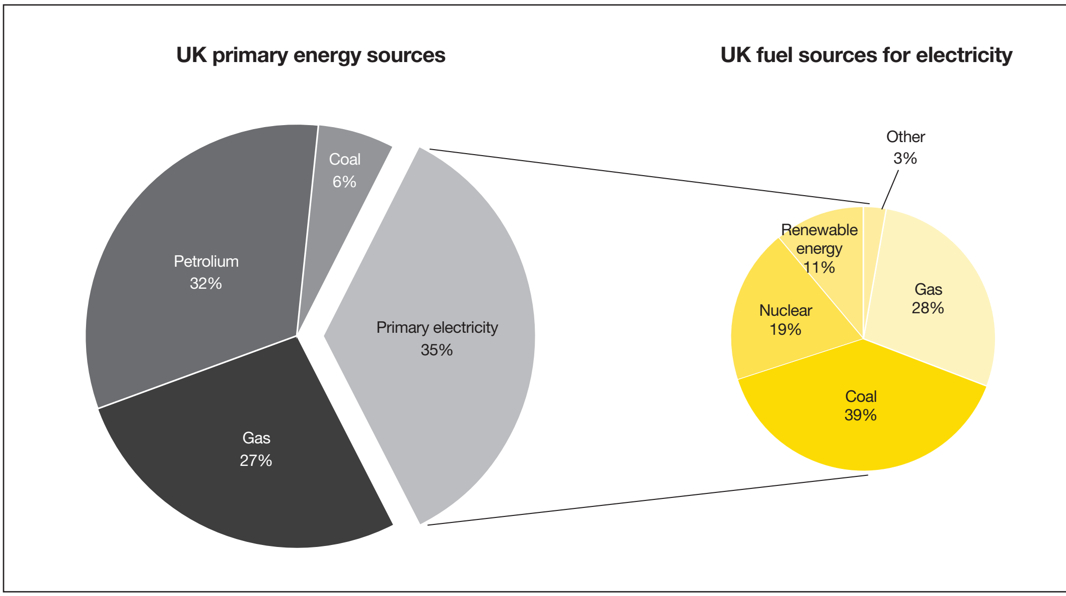
Another key influencing factor in decision-making is the contribution the sector makes to the UK economy, with regard to both the impact of the cost of energy on business and households and the business opportunities arising from the energy sector. The energy sector currently has a 3.5% share of the UK economy (Decc, 2013a p.12).

1.2 Energy – where does it come from?

The supply of energy in the UK has traditionally been from large, fossil fuel and nuclear power stations generating electricity, with gas as the main source for heat to households and businesses. Other fuels are primarily used by industry and for transport. Figure 1 shows how primary energy is used in the UK and which fuels currently supply electricity.

This paper is concerned with energy policy for the supply of energy for electricity and heat and only considers transport in terms of its increasing interdependencies with electricity demand, as the number and use of electric vehicles increases and electrification of rail expands.

Figure 1: UK primary energy consumption and fuel sources for electricity production



Source: Decc, 2013a

1.3 Maintaining the System and replacing aging assets

The UK has aging energy infrastructure and significant investment is required into generation assets, transmission and distribution networks.

The majority of the UK's coal and nuclear electricity generating assets are reaching the end of their design life. By 2020, at least 20% of all the UK's plant will be decommissioned and all current nuclear plants are likely to be offline by 2023, apart from Sizewell B. Therefore there is a need for major investment in new power generation.

The power distribution network, which is used to transport electricity, is also aging. A lack of investment and asset renewal in the period following privatisation has only recently been reversed with more than £10bn per annum having been invested in the last two years (Ernst & Young, 2012 and Frankfurt School-UNEP Centre/BNEF, 2013). Major investment is needed to maintain the current standard of service, which is one of the highest in the world at 99.99% reliability (OFGEM, 2013).

The current electricity system design is based around a small number of large generation sites filtering down through a national system. This is unsuited to the modern needs of a decentralised generation system using solar, wind and other local generation opportunities. This means we need to identify new or 'smart' ways to increase the productivity and flexibility of existing systems, and fit existing assets to a new 'smart grid' design. To achieve 2020 targets more heat and energy will need to be deployed at the earliest opportunity.

One of the reasons for investment in the power distribution network is the drive towards developing "smart grids". Smart grids give all actors in the electricity system, from generator to user, access to detailed information which can be used to help inform behaviour. For example, a smart meter is part of a smart grid and can be used to give price signals to customers to assist with managing demand at peak times. A smart grid can also provide aggregate supply and demand information to allow for greater control over the flow of electricity through the network. Smart grids also provide the potential for remote control of generation, distribution and end-user devices to help better match generation to use.

However, even with the deployment of smart grid technology there will need to be investment in power generation assets to maintain supply in the UK; smart grids provide a potential mechanism for reducing the scale of investment, not avoiding it.

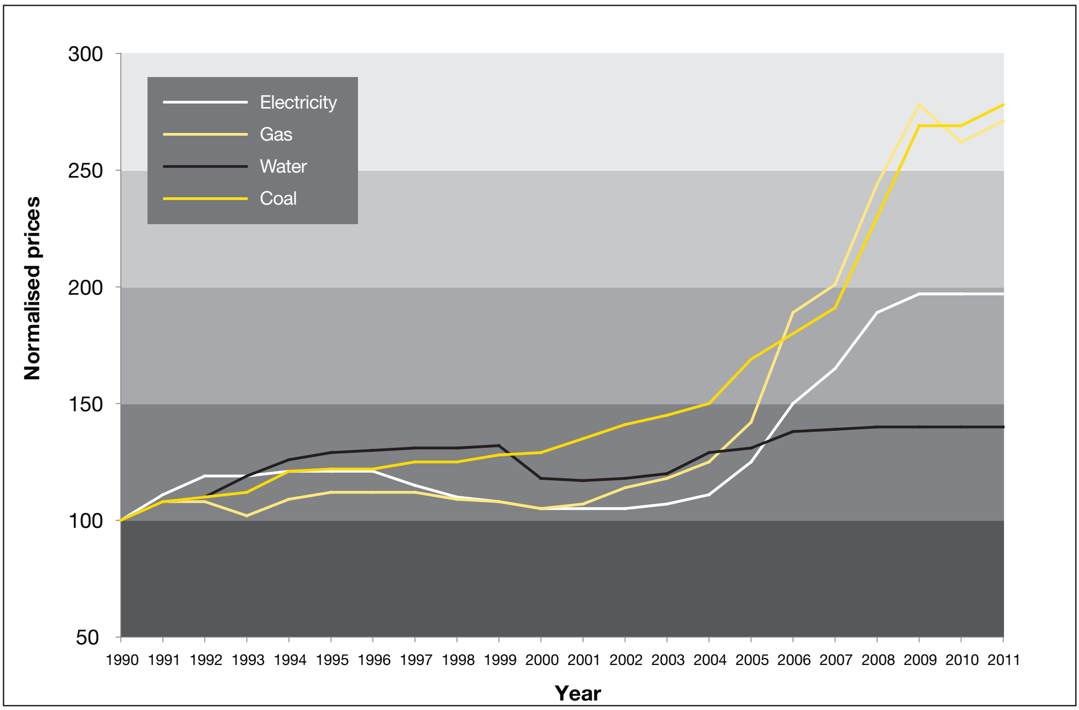
1.4 Electricity demand predictions

Over recent years, electricity demand has been steadily decreasing but that is forecast to change and electricity demand and peak loads will increase as more transport and heat is powered by electricity as a way to meet carbon emission reduction targets. The Department for Energy and Climate Change has predicted that electricity demand will more than double by 2030 (DECC, 2012a).

1.5 Rising price of energy

Energy prices (gas and electricity) have risen steeply since 2004 due to a number of factors but mainly due to the influence of oil prices on all commodity markets. The following graph shows normalised domestic utility prices and illustrates how much energy prices have risen compared to water.

Figure 2: Normalised utility prices



Source: Castle Cover, 2011

The rise in prices since 2004 has largely been driven by supplier and wholesale costs. 62.5% of the increase is due to the link with the wider commodity market whereas renewable energy and green policies have had relatively little impact and are responsible for only 8% of the price rise. (Committee on Climate Change, 2012)

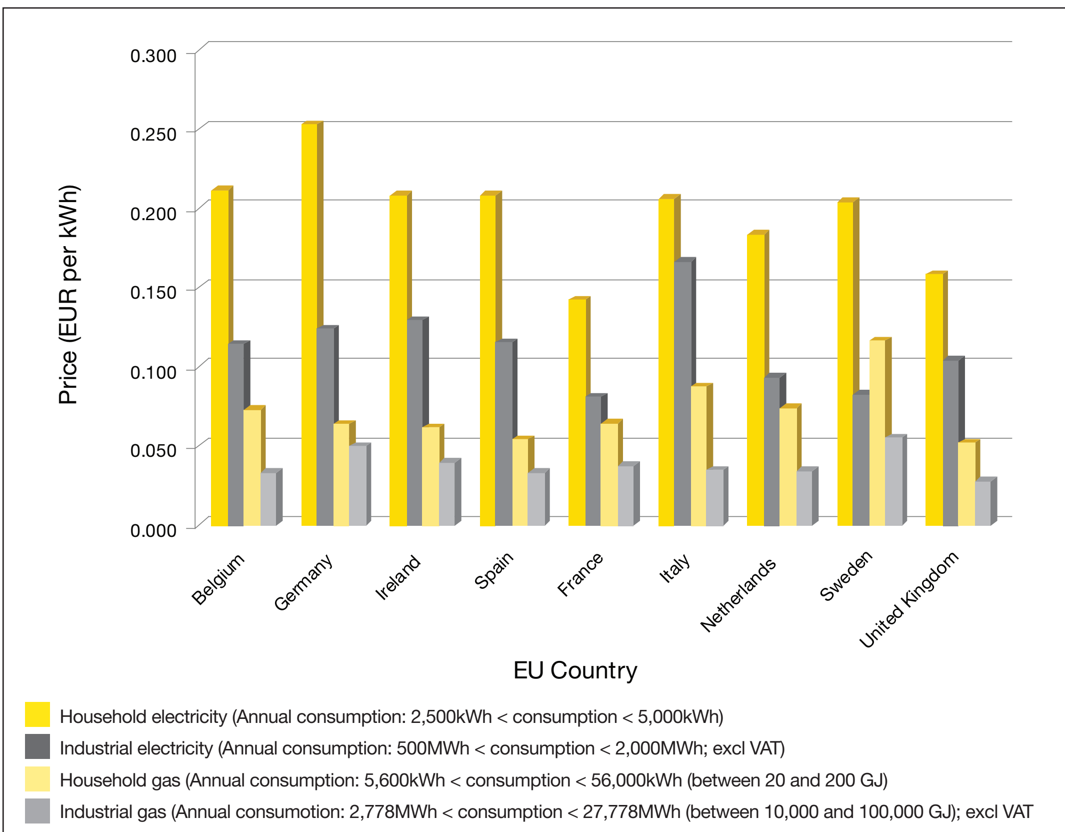
Looking forward, the investments required in the energy system to update and replace ageing assets and to meet carbon and renewable energy targets, will inevitably have an impact on the price of energy. However, not making these investments is not a way to avoid price increases as gas prices will continue to rise as fossil fuel becomes scarcer and global demand increases the impact of carbon tax increases. Investment in the UK's infrastructure could mitigate the impact of global price rises.

The Committee for Climate Change (CCC) has undertaken research on the likely impact of different energy futures on price rises in their report, Energy prices and bills (CCC, 2012). This report shows that supporting the development of low carbon technologies could increase bills by £100 in 2020 meaning the average bill will be £1,300, but the impact of low carbon policies on cost will then tail off as the technologies mature. However, after 2020 continued reliance on gas-fired generation, instead of developing a low carbon future carries the risk of electricity bills for the typical household being up to £600 higher by 2050 than under a low carbon power system.

Both the price rises to date and the predicted price rises demonstrate that renewable energy policies may lead to a small price increase but an over-reliance on gas will lead to a greater price increase and therefore developing renewable energy is key to keeping overall energy price rises down.

Historically, the United Kingdom's domestic gas reserves and early start in developing a national grid meant that energy prices were generally lower than in other European countries. Despite recent price rises, the UK still experiences some of the lowest energy costs in Europe as the following graph shows (European Commission Eurostat, 2013a). This further illustrates that there is considerable scope for significant price rises in the UK unless action is taken to maintain UK based supply where costs can be managed.

Figure 3: Comparison of European energy prices: Half-yearly electricity and gas prices, second half 2011



Source: European Commission Eurostat, 2013a[1]

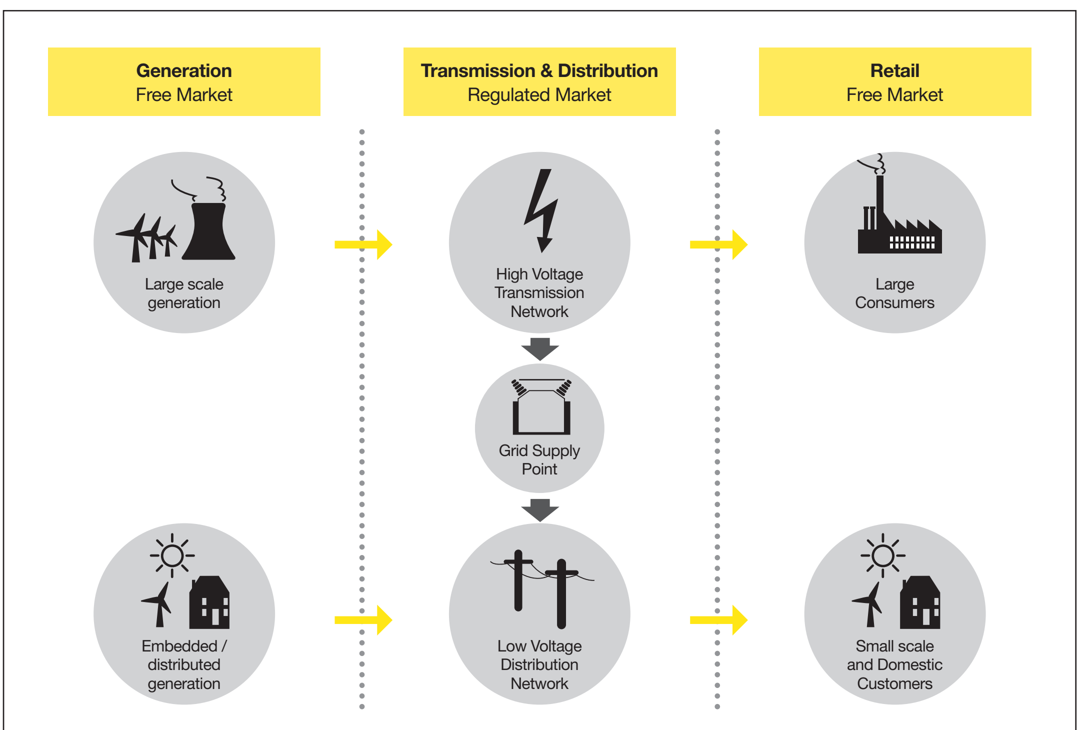
[1] Zero price results arise from non-availability of data, not free provision

1.6 The energy market

The current structure of the energy market was designed for a system where retailers purchased power from a small number of large generators, and paid national and local distributors to distribute the power to their customers. However there are six big retailers, who are also generators, which means that some of the power generated by the 'big six'[2] retailers never enters a competitive wholesale market, leaving smaller retailers at a disadvantage. Figure 4 illustrates the structure of the electricity market in the UK.

In an environment of increasingly diverse generation, this system disadvantages otherwise cheap generation from intermittent renewable sources. A number of the changes proposed by the UK Government to the energy system are designed to overcome some of these issues and are outlined in section 3.7 below.

Figure 4: Electricity generation and distribution system in the UK



[2] The "Big Six" energy suppliers are: nPower, ScottishPower, Scottish and Southern, British gas, E.ON and EDF Energy

	Structure of the Market	Companies	Activities
Generation ⇩	Competitive	The main generators are the large energy companies such as nPower, ScottishPower or EON but also include smaller generators such as Peel Energy.	Generation of electricity from large scale power plants powered by coal, nuclear, gas, hydro, wind or energy from waste.
Transmission ⇩	Regulated monopoly	National Grid	Distribution of electricity by high voltage (HV) power lines from power station to local grid supply points.
Distribution ⇩	Regulated monopoly	Nine regional distribution network operators (DNOs): Electricity Northwest, Scottish and Southern Energy, Scottish Power Networks, Northern Power Grid, Western Power Distribution, UK Power Networks and Northern Ireland Electricity.	Distribution of electricity to the final supply points for customers using the low voltage grid. Renewable and distributed energy connects to the LV network.
Supply / Retail	Competitive	Electricity supply in the UK is a competitive market dominated by the "Big Six", nPower, ScottishPower, British Gas, EON, EDF and Scottish and Southern. There are also smaller companies such as Good Energy and Ovo Energy.	Supply companies sell electricity to the customers. Suppliers buy electricity from generators and pay transmission and distribution charges for the transportation of electricity across the network.

1.7 UK Policy response

Energy Policy in the UK is mainly driven by the Energy Bill 2012 and the Climate Change Act 2008, which both support carbon emissions reduction targets and asset renewal of the energy system. They also contain mechanisms to incentivise the increased deployment of renewable energy such as the Carbon Price Floor[3] (CPF). While the 2014 Budget saw the CPF capped at £18 from 2016-17 to 2019-2020, the Government remains committed to using this mechanism to support investment in low carbon infrastructure. Specifically fuel used in Combined Heat and Power plants for electricity generated to supply manufacturing firms will be exempt from the CPF (HM Treasury, 2014).

In addition, the UK is legally bound by the EU 2020 targets which include a commitment to produce 15% of all energy from renewable sources which is likely to mean 30-40% of all UK produced electricity will need to come from renewable sources and 12-14% of all heat from renewable sources. Furthermore, the Committee for Climate Change estimate that, by 2050, 92% of electricity will need to be powered by renewable sources (CCC, 2012).

The UK Renewable Energy Roadmap shows that the UK's renewable electricity target for 2020 will be delivered by offshore wind but that other technologies such as onshore wind, biomass and microgeneration within buildings also play an important role. The UK's renewable heat target is likely to be delivered by biomass and ground source and air source heat pumps (DECC, 2013b).

The 15% renewable energy target has been translated into policy via the Energy Bill with financial incentives linked to renewable energy generation which are intended to help it gain parity with the price of generation from established gas, coal and nuclear assets. The Energy Bill also provides a further incentive for investment for research and development of new renewable energy generation assets and deployment of existing renewable energy technologies.

The Energy Bill also sets out changes to how energy is traded, and how responsibilities such as support for vulnerable customers, are placed on energy companies. The changes include expanding certain levies beyond the use of the big 6 energy providers and changes to energy pricing structures. The aim of the changes is to ensure the market can effectively deliver and all consumers, both households and business, can benefit.

Much Government policy was developed before the emergence of the very recent identification of fracked gas resources in the UK. There is however emerging research that provides an initial position for how fracking may impact UK energy policy. A number of firms have recently been granted licences to explore the feasibility of producing unconventional gas from onshore fracking in England.

Several sources (including Energy and Climate Change Committee, 2011, Ofgem and Poyry 2011 and Stevens, 2012) have concluded the price of gas is likely not to decrease in the UK as a result of fracking. Partly because it will be more expensive to recover in the UK than the US, where the gas price

[3] The carbon price floor (CPF) is a tax on fossil fuels used to generate electricity. It came into effect on 1 April 2013. It changes the existing Climate Change Levy (CCL) regime, by applying carbon price support (CPS) rates of CCL to gas, solid fuels and liquefied petroleum gas (LPG) used in electricity generation.
Source: HMRC

has plummeted, but also due to more stringent health and safety, and environmental regulatory framework in the UK. However, the most significant factor affecting price is the difference between the American and UK gas market structures. The UK is part of the EU wholesale gas market and UK fracked gas will be traded within this market; the volumes likely to be produced are unlikely to have a significant impact on the EU market price. Whereas the US is a closed gas market meaning the supply of cheaper gas has a more direct effect on the cost.

The Committee on Climate Change expects shale gas to make up the current short fall in North Sea gas to reduce the UK's dependence on imported gas but only for a short period of time. There is a need for fossil fuels to continue to be a part of the UK energy mix for the short term but, after 2030, it will be difficult to meet the UK's climate change budgets (as set out in the Climate Change Act) without a dramatic increase in the amount of renewable energy being produced.

Depending on when the fracked gas resources are accessed and whether carbon capture and storage technologies are adopted, it may be possible to utilise fracked gas within the post 2030 carbon budget. However, setting aside climate change considerations, the wider impacts of fracking on quality of life including landscape impacts, water pollution and geological stability make its use controversial and not necessarily beneficial to host communities.

1.8 Carbon emissions reduction

The Climate Change Act 2008 commits the UK Government to legally binding carbon reduction targets "it is the duty of the Sectary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than 1990 baseline" (HMG, 2008) and has resulted in pressure on the electricity industry in the UK to decarbonise.

By way of context, 80% is the internationally agreed minimum level required to stay within dramatic but manageable levels of climate change (European Commission, 2014). If 80% reductions are not achieved and the world's climate warms more than 2°C, dramatic climate change is likely to include the sea level rises (Anderson, K and HMG, 2009) which could lead to flooding of low lying countries and many major world cities by the end of this century.

A key measure to implement the Climate Change Act is the introduction of a carbon floor price (introduced by the Energy Board), and an extension of emission limits on new power stations, which currently effectively limits their lifespan and results in closure of large, polluting power plants.

The Committee on Climate Change has modelled the required emissions reduction from electricity generation to achieve carbon budgets. Currently, the carbon intensity of the grid is approximately 500g CO_2/kWh and by 2030 it needs to reach 50g CO_2/kWh, a tenfold decrease (Committee on Climate Change, 2013).

The 50gCO_2/kWh target is not compatible with Government suggestions of expanding the UK's gas capacity; the Government's 2012 Autumn Statement referred to a need to amend carbon budgets post 2030 placing uncertainty on the binding 80% emissions reduction by 2050. The 2014 Budget announced the introduction of a Capacity Market which will incentivise investment in new gas capacity and maximise existing gas capacity (Budget 2014). The level of up front capital investment required to deploy gas plant risks locking the UK into gas fired power stations which could limit the UK's ability to reduce long term prices and meet its 80% CO_2 reduction target.

1.9 Investment level benchmarking

The UK Government's estimate of the level of investment required to maintain and upgrade the UK's energy infrastructure is £110bn by 2020 (DECC, 2012b).

Thanks largely to the amount of investment required, a recent report published by the Green Alliance shows the UK is established as one of the top ten global destinations for renewable energy investment (Green Alliance, 2013), alongside the USA, Germany, China, India, Italy and Japan. The report highlights the short term prize if the UK can attract and keep investors. [Currently], "there are [already] £60bn of low carbon projects listed in the Treasury's infrastructure pipeline for the next two years which would add at least 0.7% to GDP by 2015, if investors are convinced to back them". (Green Alliance, pg 25)

This leading position has been built on strong political leadership, domestic carbon policies and clear political commitment. However, faced with increasingly strong competition, the UK will have to fight to keep this position. The report concludes that there is a risk this position will not be maintained as the UK is currently facing a "lack of political leadership [which] is undermining businesses confidence and the UK's ability to compete". (Green Alliance, p.21)

In its 'Investment-Grade Climate Policy Report', (UNEPFI, 2012) the UN's Finance Initiative evaluated factors which made countries attractive to international climate change and low carbon technology investors. It identifies the frequency of UK policy changes in the area of climate change and clean energy (e.g. four Energy White Papers in the past decade alone) and the tendency for policy to change (e.g. reversal of the Carbon Floor Price Policy within 3 years of its introduction) both before and after it is implemented, as key issues adversely affecting investment in the UK.

Despite the strong start, the recent weakening of political support for, and changes to, the energy markets has actually led to a lack of investment in the UK's capacity. This is demonstrated by the low levels of renewable energy deployment in the UK. The UK's share of the legally binding EU 2020 targets is for 15% of final energy demand to be supplied by renewable energy. The UK shows one of the biggest gaps between the allocated target and actual deployment, with only 3.3% of final energy consumption currently being produced from renewable energy (HMG, 2010).

1.10 Security of supply

Security of supply is desirable because it provides certainty and stability over the price of energy, which is notoriously volatile, and surety of supply in a world of increasing competition for finite fossil fuel resources. Security of supply is therefore a key factor which needs to be considered by Government when considering future energy investments, irrespective of carbon emissions reduction or renewable energy targets. Developments in the Ukraine have brought wider attention to the UK's imported gas and its geopolitical implications.

In 2004, the UK became a net importer of primary fuel and by 2012 net imports accounted for 42% of energy used in the UK (DECC, 2013a, p. 13). In 2011, the UK imported more gas than it produced for the first time since 1967 and oil production levels fell to the lowest levels since 1970 (Gosden, 2012) demonstrating that, for the first time in recent history, security of supply is set to become a real issue for the UK.

1.11 Greater Manchester policy context

The Great Manchester Strategy (GMS) sets out the Vision for Greater Manchester for 2020 “to secure long term economic growth and enable the conurbation to fulfil its economic potential, whilst ensuring that our residents are able to contribute to and share in that prosperity” with the precondition that economic growth is sustainable (GMCA, 2013a). The investment opportunity associated with the planned new energy infrastructure and the cost of energy to both businesses and households directly affects the achievement of this vision, particularly the cost of energy for energy intensive businesses and vulnerable households.

Greater Manchester recognises this and has committed to a 48% reduction in CO_2 emissions by 2020 in the Greater Manchester Climate Change Strategy, which is supported by the Climate Change Implementation plan for 2013-2015 which starts to set out how the emissions reductions might be achieved.

The plan highlights the need to develop specific proposals for heat networks, energy from renewables and building-scale renewable heat models, which, by 2020, would result in the local / locally owned low carbon generation of 3 Terrawatt hours (TWh) of heat and 1TWh of electricity per annum. (GMCA, 2013b p. 15)

Metrolink, rail electrification, Airport City, Cutacre, Port Salford, Mediacity and many other key programmes for Greater Manchester require major shifts in the generation and supply of electricity and fuels. Their success and viability is predicated on being able to offer affordable, clean, reliable and secure energy infrastructure.

2

Implications of the UK's Energy Policy for Greater Manchester

The issues outlined above, the rising cost of energy, aging assets, security of supply and the EU and UK policy drivers are all resulting in monumental changes to the UK energy system. The need for increased amounts of renewable energy, for both heat and electricity is clear, regardless of other developments with new gas fired power stations or fracking.

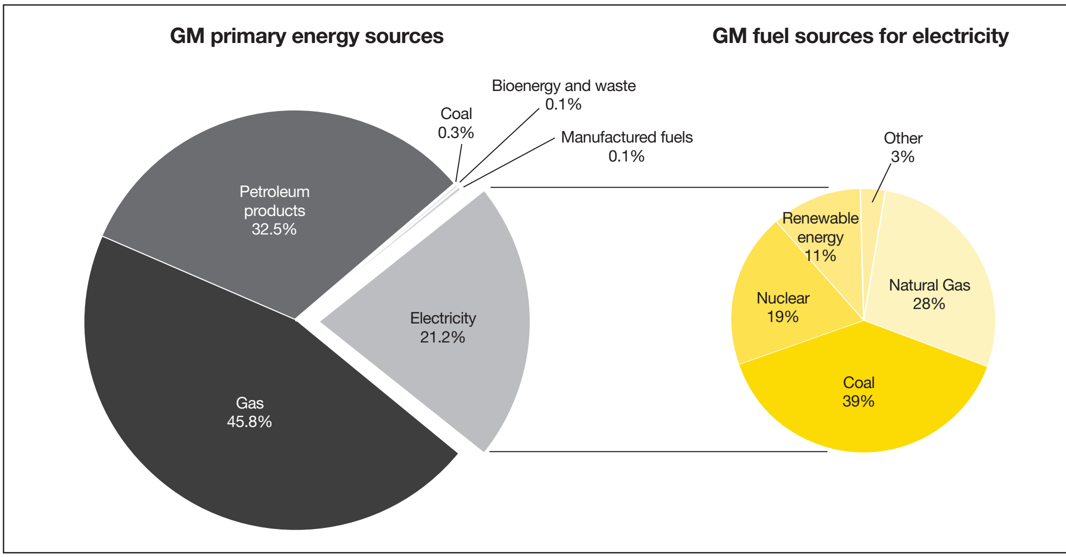
Deployment of renewable or low carbon energy sources has already started to take place across Greater Manchester but statistics on deployment rates and total generation capacity are not easy to find. The potential implications on the rate of deployment for Greater Manchester need to be considered in the context of the conurbation's wider policy objectives.

This paper will consider the implications in terms of:

- cost of energy for businesses;
- cost of energy for households, particularly households in fuel poverty;
- delivery of jobs and growth - business opportunities for Greater Manchester businesses; and
- reduction of carbon emissions.

Each of the four areas above play a critical role in securing GM's Vision and are used to evaluate the implications of future renewable energy scenarios for Greater Manchester developed in this paper. First, the current state of play for energy in Greater Manchester and each of the criteria is explored in more detail below.

Figure 5 showing primary energy consumption in Greater Manchester in 2010



Source: GM Energy Plan and DECC Energy Trends (DECC, 2013c)

2.1 State of play

2.1.1 Greater Manchester energy data

Primary energy consumption in Greater Manchester is mainly supplied by gas and electricity for households and businesses and petroleum for transport fuel, as shown in figure 5.

The electricity mix in Greater Manchester reflects the mix of fuels for the UK electricity supply. Efforts to produce renewable energy across the conurbation could distort the mix and increase the percentage of renewable energy used in Greater Manchester. In Greater Manchester the use of electricity, gas and other fuels account for 72% of direct greenhouse gas emissions, 35% from the domestic sector and 37% from the commercial and industrial (GMCA, 2013b). The renewable electricity target at 1TWh is less than 10% of the overall electricity usage of 11.8TWh and it is low compared to the UK target of 30-40% of electricity production from renewables.

Currently 25.5TWh of gas is used annually across Greater Manchester. The majority of this will be used for heat (though it is acknowledged a small proportion will be used for cooking). The GM 2020 renewable heat target is 3TWh, which equates to 12% of current Greater Manchester demand. Interestingly, the UK renewable heat target is 12-14% of current demand.

2.1.2 Cost of energy for businesses

The 2012 GM business survey, conducted by BMG on behalf of New Economy, cites finance and productivity base as the most common barrier to GM business growth, and rising energy costs as the most significant cost pressure on their businesses finance and productivity base (BMG Research, 2012). The survey also found the top cost pressures for 65% of businesses is energy prices (BMG Research, 2012, p. 14). In addition, when businesses were asked how they supported their local economy and community, over four in five said that they actively reduce company waste (84%) and that they actively try to improve their energy efficiency (81%) (BMG Research, 2012, p. 15), demonstrating the importance of the cost of energy on businesses, future price rises are only likely to increase the importance. The findings from the 2013 GM business survey are broadly similar though interestingly, the proportion of companies saying they actively reduce company waste (88%) and improving their energy efficiency (87%) increased.

According to the Greater Manchester Mini-Stern, 4% of Greater Manchester's employment is within energy intensive manufacturing (Deloitte, 2008), further demonstrating how Greater Manchester's productivity is directly affected by the price of energy. There are however a range of energy efficiency measures businesses can adopt to reduce their energy use and mitigate against price rises such as installing energy efficient equipment and lighting, voltage optimisation, using better energy management practices and renewable energy.

2.1.3 Cost of energy for households, particularly households in fuel poverty

The 'GM Poverty Commission Report' highlighted that the cost of energy is one of the three key factors causing poverty in GM (CLES, 2012). The report also identified over 220,100 fuel poor households (CLES, p. 69); equating to 19.8% of total households. This calculation (using 2010 data) of fuel poor was based on households where fuel costs represent more than 10% of the households' income and is above the national average.

It should be noted that in August 2013 the Government changed the definition of fuel poverty to a Low Income High Cost definition which means "a household is considered to be fuel poor where they have required fuel costs that are above average (the national median level), and were they to spend that amount, they would be left with a residual income below the official poverty line." (DECC, 2013e). The number of households in fuel poverty in Greater Manchester is estimated under the new figure (2011 data) to be just over 141,000, equating to 12% of households.

Fuel poverty mainly relates to the supply of energy for heat and the comfort it provides for households; it is a problem that disproportionately affects the elderly. Household energy bills have doubled since 2005. In the same period, the proportion of disposable income spent on energy has increased by 55% for the under 50s, 63% for the 50 to 64-year-old age group and 57.5% for the 65s and over. (Saga, 2013)

Insulation and improved energy efficiency is the primary way to deal with fuel poverty and schemes such as the Energy Company Obligation (ECO) mainly fund energy efficiency measures. However, once all appropriate energy efficiency measures have been installed renewable energy options can then be considered. Renewable energy technologies that can provide heating to households include ground source and air source heat pumps, district heating schemes (either gas or biomass fired) and biomass energy. Solar hot water heating can be used for providing hot water. Renewable electricity sources include photovoltaic panels and wind energy; it should be noted the latter is not always appropriate in built up areas.

In addition to ECO, which provides support to vulnerable households, there are also a number of schemes to help those more "able to pay" households for example, the Green Deal. Community energy schemes can also be a way for communities to help themselves to share the cost of renewable energy or energy efficiency and potentially receive a return on their investment. Community energy is defined as “energy projects that are led by a community group for the benefit of their community” and can involve shared ownership by the community. Businesses are key players in local communities and can take part and benefit from involvement in community energy schemes.

The capital cost of renewable energy can be more expensive than gas central heating which is why community schemes can be a useful way of sharing the cost. There are an increasing number of community schemes being deployed across the UK and the UK Government has started to quantify the impacts and benefits of community schemes. Although, there is incomplete evidence to show the full impact of community schemes, because community schemes haven’t been around that long, there is evidence of some emerging benefits including instances of job creation, skills development, reduced energy costs and financial gains from electricity generation (DECC, 2013f p.9).

Finally, it is important to note that all households in Greater Manchester are likely to need to change from gas central heating systems in the future. Indeed, the UK’s Energy Strategy fundamentally depends on a midterm shift (within the next 10-15 years) from using gas directly in homes. Instead, gas from all sources will be burned in larger facilities, its energy then being distributed as heat (heat networks) or electricity (used to top up local renewable heat). This indicates that over time an approach may need to be agreed to replace existing household gas boilers in around cc 1 million homes in Greater Manchester (and the wider UK housing stock) as they reach the end of their life during the next decade.

2.1.4 Delivery of jobs and growth

Meeting renewable energy targets will generate business opportunities. It has been estimated that there are a £110 billion worth of investment opportunities (DECC, 2012b) and a number of sources agree the UK has the ability to develop jobs from the investment. The UK Renewable Energy Strategy predicts that up to half a million jobs will be created in the UK renewables sector by 2020 (HMG, 2009 P.19).

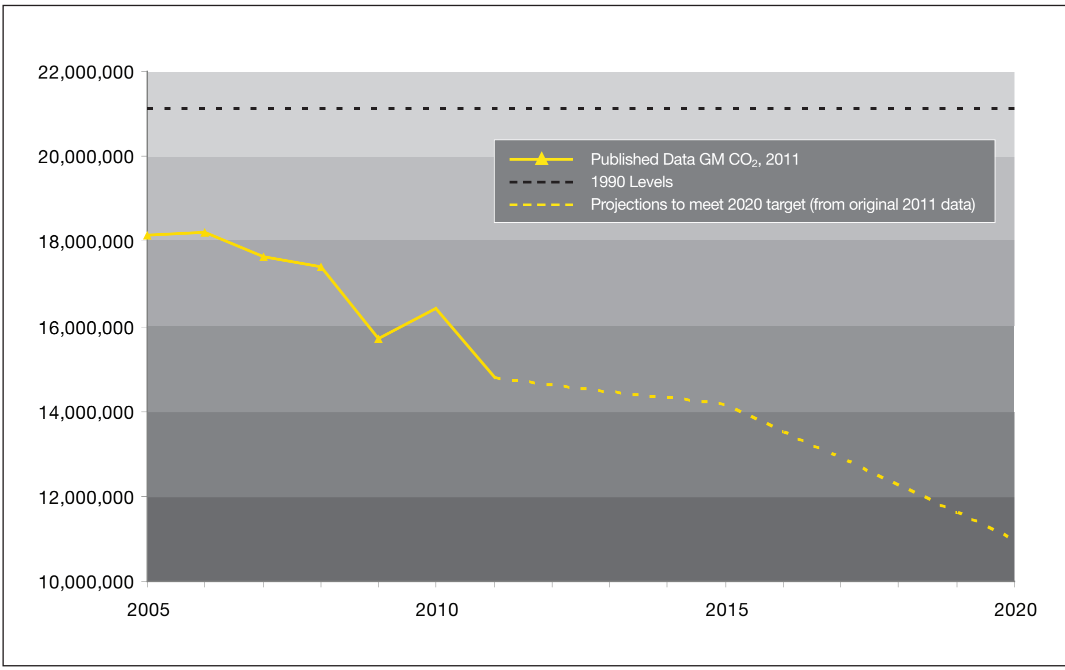
Greater Manchester is ideally placed to take advantage of this growth with more than 37,000 employed in 2,000 companies in the wider low carbon environmental goods and services sector (LCEGS) and 10,000 employed in over 500 companies in the renewable energy element of the sector (ENWORKS, 2013). The LCEGS has been one of the UK’s fastest growing major employment sectors for the last 4 years and is expected to grow in Greater Manchester at over 4%, a rate significantly higher than the UK economy’s average over the coming five years (ENWORKS, 2013). However the renewable energy sector in Greater Manchester is characterised by small and medium sized companies with only one or two market leaders, meaning the sector will need support to compete with the large, multi-national global companies which also operate in the renewable energy industry.

2.1.5 Reduction of carbon emissions

Greater Manchester recognises that sustainable growth needs to be green growth and has committed to carbon emissions reductions. A GM wide target of 48% CO_2 reduction by 2020 from a 1990 baseline was approved by AGMA Executive / GMCA Board in July 2011. Figure 6 shows the current progress towards this target and the trajectory that needs to be taken. The Low Carbon Hub has calculated that the target will not be met at the current trajectory and therefore Greater Manchester needs to take local action to ensure a 48% reduction by 2020.

Achieving affordable energy for businesses and carbon emissions reductions is intrinsically linked to security of supply because having control over energy production ultimately means control over the cost.

Figure 6 Direct emissions from Greater Manchester actual and predicted



Source: DECC 2013d Sub-national total final energy consumption 2005-2011

2.2 Scenario development – exploring Greater Manchester's energy future

In order to be able to explore the impact of likely energy prices and renewable energy deployment rates across Greater Manchester up to 2020, four scenarios have been developed describing four different potential energy futures for the conurbation:

Stagnation: low renewable energy deployment rate combined with slow and variable increases in energy prices.

Business as usual: low renewable energy deployment rate combined with fast and continuous energy price rises.

Utopia: high renewable energy deployment rate and slow and variable energy price rises.

The Big Bang: high renewable energy deployment rate combined with fast and continuous energy price rises.

These scenarios speculate about how the energy sector, and in particular renewable and low carbon energy deployment rates in Greater Manchester, could develop between 2013 and 2020. The scenarios are conjecture based on the GM policy context and are designed to inform discussion about potential options for the development of renewable and low carbon energy across Greater Manchester.

2.2.1 Greater Manchester potential energy future scenarios

Stagnation: low renewable energy deployment rate and slow and variable increases in energy prices.

Central Government energy policy remains insufficient to provide investor confidence about its support for new renewable energy generation schemes. The nuclear new build programmes is further delayed, but gas flourishes and a new "dash for gas" is seen, diverting investment from renewables. Greater Manchester's support for renewable energy suffers from the inconsistent national Government policy which affects industry's appetite for investment.

Energy prices increase slowly because the flood of gas powered energy keeps prices down in the short term but they still steadily increase. A Greater Manchester target of 1TWh of renewable electricity target is met by the market, but the 3TWh of heat target is only partially met as the rate of investment in energy infrastructure does not increase beyond current rates, and is directed towards big ticket offshore and nuclear schemes with little impact on Greater Manchester's security of supply or economy.

Business as usual: low renewable energy deployment rate and fast and continuous increase in energy price rises.

Central Government energy policy remains insufficient to provide investor confidence, about its support for new renewable energy generation schemes. The nuclear new build programmes is further delayed, but gas flourishes and a new "dash for gas" is seen, diverting investment from renewables. Greater Manchester's support for renewable energy suffers from the inconsistent national Government policy which affects industry's appetite for investment.

Despite the "dash for gas" in the UK, external factors such as supply shortages globally affect energy prices which rise quickly and steeply, affecting businesses and households in Greater Manchester. Whilst the 1TWh of renewable electricity target is met the 3TWh of heat target is only partially met because the rate of investment in energy infrastructure is not significantly increased beyond current rate, and is directed towards big ticket offshore and nuclear schemes with little impact on Greater Manchester's security of supply or economy.

Utopia: high renewable energy deployment rate and slow and variable increase in energy price rises.

Government policy and in particular the Electricity Market Reform (EMR) send the required market signals resulting in the required £110bn of investment being made in to the UK energy system. This leads to rapid rates of renewable energy deployment and GM level policy initiatives, favouring renewable energy investment, leading to the conurbation attracting more than its fair share of investment. The 1TWh renewable electricity target is exceeded and 4.8TWh is generated. The 3TWh renewable heat target is met through investments in heat networks and microgeneration technology.

The rate of energy investment in the UK helps to shield the UK from global price rises meaning energy price rises are lower than anticipated. The amount of renewable energy deployed means communities, households and businesses have become energy generators further controlling their own costs and also generating an income.

The Big Bang: high renewable energy deployment rate and fast and continuous increase in energy price rises.

Government policy and in particular the Electricity Market Reform (EMR) send the required market signals resulting in the required £110bn of investment being made in to the UK energy system. This leads to rapid rates of the renewable energy deployment and GM level policy initiatives, favouring renewable energy investment, leading to the conurbation attracting more than its fair share of investment leading to increased deployment rates. The 1TWh renewable electricity target is exceeded and 4.8TWh is generated. The 3TWh renewable heat target is met through investments in heat networks and microgeneration technology.

The cost of the energy investments in the UK is higher than predicted due to a number of reasons including global demand energy infrastructure leading to increases in commodity, such as steel and other materials prices. Community, households and businesses are limited in their ability to generate their own energy because of high capital costs, the majority of renewable energy projects are developed by the large, global companies with little regard for local economic impact; as a result there are limited benefits for customers, businesses, households and communities in Greater Manchester.

2.2.2 Assumptions and data used to build the scenarios

The scenarios above have been built using baseline data for renewable energy generation across Greater Manchester, combined with consideration of the context outlined in the first section, and its likely impact on Greater Manchester. The following section outlines the assumptions and data used to build the scenarios following three main steps:

1. Establish the Greater Manchester renewable energy generation baseline
2. Build the scenarios
3. Implications of the scenarios for Greater Manchester in terms of:
    - cost of energy for businesses;
    - cost of energy for households, particularly households in fuel poverty;
    - delivery of jobs and growth - business opportunities for Greater Manchester businesses; and
    - reduction of carbon emissions.

Step 1: Greater Manchester renewable energy generation baseline

Existing data on the current available renewable energy and low carbon energy generation assets across Greater Manchester is not easily accessible. Government publishes national, and in some cases regional, energy datasets but does not always publish LEP or local authority energy data. However it was necessary to develop a method to collate data on renewable electricity and heat production in GM to inform this paper.

Four key steps were used to establish Greater Manchester's renewable energy production:

1. Identification of large scale renewable assets, both actual and planned, in Greater Manchester from the DECC ReStats database (Accessed August 2013)

2. Identification of the combined installed capacity of microgeneration schemes for the production of renewable electricity from the DECC FiT cumulative total database[4] end of Quarter 4 2012 (Accessed August 2013)

3. Identification of the number of renewable heat microgeneration schemes from the RHI DECC database (Accessed August 2013)[5]

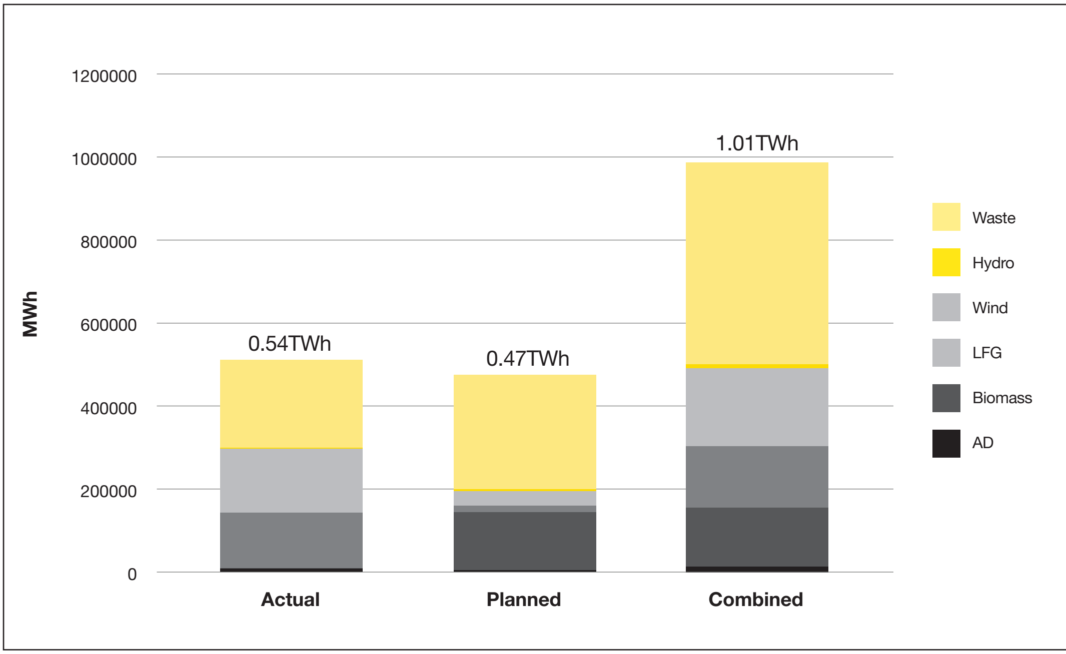
4. Calculation of generation capacity (Megawatt hours (MWh) per year) from the installed capacity given by the above datasets[6]

[4] The FIT data doesn't differentiate between different types of microgeneration technologies (eg photovoltaics (PV), micro-CHP or micro-wind) however it does indicate that most of the schemes are PV and therefore the data is allocated against PV.

[5] The generation capacity was calculated using the standard calculation of rated capacity x load factor x number of hours in the year. The load factors used were based on published averages for each technology type and it was assumed each installation operated all year round.

[6] Calculating the generation capacity, which is how much energy is produced per year is necessary to compare the total against the target in the Climate Change Implementation Plan which is stated in generation capacity and not installed capacity.

Figure 7 Actual, planned and combined total of renewable electricity generation in Greater Manchester



Source: DECC Restats database http://restats.decc.gov.uk/app/pub/map/map/ (Accessed August 2013)

Renewable Electricity Generation

The results of the data collection show Greater Manchester has 144MW of installed renewable electricity generation capacity across a range of technologies. However, 12% is from landfill gas which is a finite resource and will decline over time. Calculations indicate that the installed renewable electricity in Greater Manchester currently generates an estimated 0.54 TWh of electricity, which is about half of the total required by 2020 Climate Change Implementation Plan target.

The results also show that Greater Manchester currently has 106MW of renewable electricity in the planning system and it has been calculated that this could generate 0.47TWh of electricity or just under half of the 1TWh required by 2020 Climate Change Implementation Plan.

If the estimated amounts of installed and planned renewable electricity in Greater Manchester are combined it appears that the 1TWh target for renewable electricity will be met and this is illustrated in figure 7.

Renewable Heat Generation

Information and data on renewable heat is not as easy to collate as it is for renewable electricity. Data on large scale installations is not routinely published on the DECC ReStats database and it has not been possible to find another reliable source of data. The DECC ReStats database does record some heat from installations where combined heat and power are produced and it shows that Greater Manchester has 69MW of installed renewable heat in Greater Manchester. This figure is backed up by a study undertaken in 2010 (SQW, 2010) which also identified 69MW of installed heat across Greater Manchester and anecdotal evidence from the Low Carbon Hub which is unaware of any new large scale renewable heat installations having been developed in the last few years. 69MW is therefore taken as the baseline for the amount of large scale renewable heat in Greater Manchester. It has also not been possible to find a reliable source of data for renewable heat installations in planning[7].

It is recognised that there are a number of small scale renewable heat installations across Greater Manchester such as solar hot water heating. The best source of reliable data for this is Renewable Heat Incentive but this only goes back to 2012 and only records data at a Northwest level. The number of installations recorded so far on the RHI scheme at a Northwest level is very low and it has not been possible to find another reliable record of renewable heat installations for Greater Manchester. It is has therefore not been possible to collect data on small scale renewable heat installations. However, it has been assumed that the level of installation is relatively low and therefore unlikely to make a significant impact on the production total.

The analysis outlined above shows that Greater Manchester has 69MW of installed capacity and this is a long way from the 3TWh required for the Climate Change Implementation Plan target.

It is important to consider both actual and potential renewable electricity and heat generation across Greater Manchester. In terms of the latter, a study by SQW in 2010 identified the potential for renewable energy deployment across Greater Manchester based on a methodology that assessed how much could be installed to exploit all the available resources across the city. The study concluded that Greater Manchester has the potential for 6,871MW of installed renewable energy capacity; 1,877MW of accessible renewable electricity (27%) and 4,979MW of renewable heat installations (73%). If this potential was achieved, both Greater Manchester's renewable electricity and heat targets could be exceeded.

The main conclusions from analysis of the baseline data are:

Greater Manchester is well on its way to reaching the 1TWh of installed renewable electricity capacity required to meet the 2020 carbon emissions reduction target. However, this is achieved from 250MW of installed capacity which is only 13% of the available predicted potential of 1877MW across Greater Manchester.

Greater Manchester has a long way to go to meet the renewable heat target or reach its full potential. It is recognised that the data for renewable heat is not fully comprehensive and therefore comes with some limitations, but nevertheless the data provides a useful starting point. Analysis suggests that there is only an estimated 69MW of installed renewable heat capacity across Greater Manchester which is a long way from installed capacity that is required to meet the 3TWh target by 2020, which is estimated to be about 700MW. The current installed capacity is also a very small proportion (1.5%) of the available predicted potential of 4979MW.

These conclusions and figures were used to build four scenarios for renewable energy deployment in GM between 2013 and 2020.

[7] The author is aware the Barton Renewable Energy Plant, a 20MW biomass-fired power station has been granted planning permission on appeal in February 2014

Step 2: Building the scenarios

The scenarios are based on two variables, with two options for their impact:

Variable	Low / High scenarios	Definition
1. The impact of policy on the renewable energy deployment rate	Low (Government policy and GM initiatives only result in weak market signals and therefore a low rate of renewable energy deployment)	• Meeting 1TWh for renewable electricity generation through deployment of all planned schemes and replacement of declining landfill gas capacity with alternatives such as waste or wind • Partially meeting the 3TWh heat target with deployment of one gas fired district heating scheme and 200MW of installed microgeneration heat technologies.
	High (Government policy and Greater Manchester initiatives send strong market signals and result in high levels of renewable energy deployment)	• All the identified renewable electricity potential is realised above and beyond the 1TWh target which provides 4.8TWh of electricity • The 3TWh renewable and low carbon heat target is met and includes four gas fired district heating schemes and significant amounts of microgeneration.
2. Pace of energy price increase	Low (slow and variable increase in energy prices)	• The price peaks predicted by the Committee on Climate Change are met by 2020 (£1,300 average household fuel bills) not as result of a steady, continual rise but following a series of peaks and troughs, similar to recent price trends. Business energy costs mirror the same trends.
	High (fast and continual increase in energy prices)	• The Committee on climate change price peak is reached earlier than 2020 and achieved by a steady and continual increase in price driven by delays in the UK nuclear and offshore wind programmes. Business energy costs mirror the same trends.

Each scenario was built based on these variables and the baseline data.

Step 3: Implications of the scenarios

The next section focuses on the implications of each scenario in terms of:

- cost of energy for businesses;
- cost of energy for households, particularly households in fuel poverty;
- delivery of jobs and growth - business opportunities for Greater Manchester businesses; and
- reduction of carbon emissions.

Table 1 summarises the implications of each scenario on Greater Manchester's policy aspirations, and they are discussed in further detail after the table.

Table 1 Potential implications of the renewable energy deployment scenarios for Greater Manchester

Success of Government policy and GM initiatives	Price of energy £	
	LOW **Slow and variable increase in energy prices**	**HIGH** **Fast and continual increase in energy prices**
LOW **Government policy and GM initiatives only result in weak market signals and therefore a low rate of renewable energy deployment**	**Stagnation** • No real change in number of households classed as fuel poor • Energy prices continue to be a major concern for businesses but with uncertain trends in price rises the business case for energy efficiency and renewable energy is weak • Limited business development opportunities for GM businesses meaning the Low carbon and environmental goods and services (LCEGS) sector does not grow significantly • GM carbon emissions targets are not met because the 3TWh heat target is not achieved.	**Business as usual** • Increase in the number of households classed as fuel poor directly impacting the ability of individuals and communities to leave poverty • Energy costs cripple businesses with small profit margins and / or a high energy demand and directly impact the viability of key sectors • Limited business development opportunities for GM businesses meaning the LCEGS sector does not grow significantly • GM carbon emission target is not met because the 3TWh target is not achieved.
HIGH **Government policy and Greater Manchester initiatives send strong market signals and result in high levels of renewable energy deployment**	**Utopia** • Extensive investment in decentralised energy reduces fuel costs for large numbers of fuel poor contributing to improved quality of life for GM's vulnerable residents • Businesses benefit from being connected to district heating schemes and other community decentralised energy which help to reduce energy costs which increase business competitiveness • The energy sector is thriving, small scale, local developments favour GM businesses which enables them to also take advantage of a UK buoyant market • The renewable electricity and heat targets are exceeded and therefore the energy sector contributes more than its fair share to GM's carbon emissions reduction targets	**Big Bang** • Households are partly shielded from the impact of energy prices due to extensive investment in decentralised energy by large global companies and there is some progress in removing households from fuel poverty but limited due to lack of community ownership of such schemes • All businesses are partly protected from the energy prices rises and key, energy intensive sectors continue to contribute significantly to GM's GVA but there are limited other benefits due to lack of business involvement in developing energy schemes • The LCEGS sector is doing well. It takes advantage of a buoyant UK market but doesn't do any better in GM than elsewhere because energy investments are largely led by large, international firms • The electricity and heat targets are exceeded and therefore the energy sector contributes more than its fair share to GM's carbon emissions reduction targets

2.3 Implications of the future energy scenarios

The following section discusses in more detail the issues raised in each scenario and how the different energy futures could impact on:

- cost of energy for businesses;
- cost of energy for households, particularly households in fuel poverty;
- delivery of jobs and growth - business opportunities for Greater Manchester businesses; and
- reduction of carbon emissions.

2.3.1 Cost for businesses

Under the Stagnation scenario, the variable pattern to the price increase means it is difficult for businesses to make the business case for investment into energy efficiency and therefore their ability to reduce the impact of energy price rises is reduced. Under Business As Usual, businesses also suffer from high energy costs but it is easier to demonstrate the return on investment from energy efficiency technologies and therefore businesses have the ability to protect themselves, to a degree. Under both Stagnation and Business as Usual the low renewable energy deployment rate means there isn't widespread adoption of renewable energy within the business community with the result businesses are still reliant on large energy companies and their prices.

However, in the Big Bang and Utopia scenarios businesses have access to large amounts of decentralised renewable energy – both electricity and heat - but the effect on the prices is different due to assumptions about how renewable energy will be owned and operated. Under the Big Bang scenario the investment is made by large multi-national companies who develop decentralised renewable energy across Greater Manchester but with limited involvement from local stakeholders. The market is driven by continual prices rises and it is too rampant to require or need local involvement, therefore businesses loose the opportunity to take part in local renewable energy schemes. Under the Utopia scenario, the slower, more variable pace of price rises gives time for the market to be developed by smaller, more community focused companies who involve local stakeholders. This gives businesses across Greater Manchester the opportunity to become involved with their local renewable energy schemes which means they have both greater control over their energy costs and a return on investment, if they become shareholders as well.

2.3.2 Household Energy Costs

Under the Stagnation scenario fuel poverty numbers remain static because the investment case for energy efficiency remains low due to the slow, variable increases of energy prices. Under the Business as Usual scenario the number of fuel poor is predicted to increase across Greater Manchester as energy prices rise quickly and outpace any impact energy efficiency measures may have and renewable energy is not deployed in sufficient quantities to provide an alternative source of energy or income to offset the price rises.

In the Utopia and Big Bang scenarios fuel poverty numbers fall due to investment in renewable energy which provides cheaper energy to fuel poor households. However, the impact on fuel poverty is greater under the Utopia scenario where energy schemes have greater involvement from, and deliver more benefits to, the local community than the large multi-national companies that lead the developments under the Big Bang scenario.

2.3.3 Creating jobs and growth

The Stagnation and Business As Usual scenario result in weak market signals and a lack of investor confidence in renewables deployment. Therefore the renewable energy sector in Greater Manchester suffers in the same way as the UK industry, which means a number relocate internationally to more supportive environments.

Under both the Utopia and Big Bang scenarios local businesses benefit from the significant amount of renewable energy that is predicted to be deployed. However, it is predicted that under the Big Bang scenario, the high energy prices attract so much interest from large, multi-national businesses that it affects local Greater Manchester businesses ability to be involved, so there is some benefit to the Greater Manchester economy, but not as much as under the Utopia scenario. Under the Utopia scenario, renewable energy deployment strongly involves household and business communities in Greater Manchester giving a greater chance for local economic benefit through supply chain opportunities and local ownership.

2.3.4 Carbon emissions

Under the Stagnation and Business as Usual scenarios, the low amount of renewable energy deployment means the 1TWh renewable energy target is met but the 3TWh heat target is not met, which limits Greater Manchester's ability to meet its carbon reduction emissions targets.

Under both the Utopia and Big Bang scenarios, both targets are exceeded which means Greater Manchester's carbon emissions reductions targets stand a better chance of being achieved. Under the Utopia scenario, where local households and businesses become part of the energy market, it is assumed these citizens will become energy conscious and go further with their energy efficiency and smart energy use, further reducing the conurbation's carbon emissions.

3

Conclusions

This paper has identified that Greater Manchester needs access to secure, affordable low carbon and renewable energy to meet its Vision "to secure long term economic growth and enable the city region to fulfil its full potential whilst ensuring that our residents are able to contribute and share in that prosperity". This has been explored by considering four energy scenarios in terms of the cost of energy for businesses and households, the delivery of jobs and growth and the reduction of carbon emissions.

The scenarios suggest that if the conurbation continues "business as usual" the 1TWh of renewable electricity target set out in the Greater Manchester Implementation Plan is likely to be met but the 3TWh renewable heat target is unlikely to be achieved by 2020 and is very challenging. However, there are caveats to achieving the renewable electricity target such as the declining landfill gas resource which may not easily be replaced and 0.47TWh of the target being reliant on planned schemes coming to fruition.

Despite the above, analysis of the national targets and the evidence base suggests that there is actually scope to increase these targets. Indeed, the 1TWh renewable electricity target is less than 10% of Greater Manchester electricity usage and the current installed capacity is only 13% of the estimated potential capacity for the conurbation. The 3TWh renewable heat target is 12% of the Greater Manchester's heat usage and about 14% of the estimated potential capacity across the conurbation.

It is highly unlikely that "business as usual" will deliver the required levels of renewable energy deployment by 2020, which affects Greater Manchester's ability to achieve its carbon reduction target of 48%. In addition, it is recognised that there are often long lead in times for developing low carbon and renewable energy schemes, with many schemes taking 5-7 years from concept to deployment due to a complex business case, investment and consenting processes. Therefore Greater Manchester needs to **increase the rate of deployment of low carbon and decentralised energy, particularly heat, across the conurbation.**

This paper also suggests that economic and social objectives will be undermined unless wider society, including communities and businesses, become involved in energy developments. Participation in community schemes or development by businesses and householders of their own renewable energy projects can give them control over energy costs and an additional income stream. Citizens active in energy schemes may also further reduce carbon emissions as they become fully aware of all energy saving and smart energy management options. This suggests that it is advantageous for Greater Manchester to facilitate community involvement in renewable and low carbon energy developments. Consideration of the scenarios shows this won't happen as matter of course. It will depend on how energy prices and the market develop and thus a key challenge is **how Greater Manchester can ensure businesses and all parts of the community are involved and can benefit from renewable and low carbon energy developments**.

A major consideration for Greater Manchester, and for delivery of the Greater Manchester Strategy, is how to ensure investment in the energy sector results in the maximum economic value for Greater Manchester. The scenarios show that it is not only the rate of development of the renewable energy sector that will affect how business in Greater Manchester can benefit but also how the market develops. There is a sizable renewable energy sector in Greater Manchester, but it is characterised by small and medium sized companies with only one or two market leaders. The scenarios show that the positive impacts for the local economy will be greater if the energy market is developed in ways that involve local stakeholders and local businesses. It is therefore critical for Greater Manchester to **ensure that the economic impact of local jobs and growth is maximised as a result of the investments made to develop decentralised renewable energy.**

Greater Manchester is already taking the lead on the low carbon agenda, through the establishment of the Low Carbon Hub in 2012 to oversee activity to implement the GM Climate Change Strategy. However, to achieve the rate and scale or change required to meet and exceed the 1TWh electricity target and 3TWh heat target, activities beyond the scope of the current plan will need to take place.

In conclusion, Greater Manchester needs to take action related to the supply of energy across the city in order to meet its Vision for the conurbation as set out in the GMS "to secure long term economic growth and enable the conurbation to fulfil its economic potential, whilst ensuring that our residents are able to contribute to and share in that prosperity". Key action includes:

- increasing the rate of deployment of low carbon and decentralised energy, particularly heat, across the conurbation;
- finding ways of making of making sure that businesses and all parts of the community are involved and can therefore benefit from renewable and low carbon energy developments; and
- ensuring that the economic impact of local jobs and growth is maximised as a result of the investments made to develop decentralised renewable energy,

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