Newcastle City Council

Climate change strategy (Mitigation)

Final report

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1 Introduction

This report sets out a set of projects scaled to allow Newcastle upon Tyne to deliver on its commitments to reduce carbon emissions by 2030, and to prepare for longer term emissions reductions out to 2050 in line with commitments to be a "100% clean energy" city.

The programme of projects is extensive, and includes action across all sectors: domestic buildings, industrial and commercial buildings; and transport. The programme also requires the Council to undertake a series of programmes to reduce emissions from its own operational estate and vehicles.

The report draws together the suite of programmes and quantifies the magnitude of the carbon reduction available through them, in order to demonstrate that the council can:

- By 2030, deliver a 50% reduction on 2005 baseline emissions, in line with the longer term 2050 "100% clean energy" aspiration
- By 2030, deliver a 40% reduction in CO_2 emissions on the 2005 baseline under an alternative calculation methodology for the Covenant of Mayors – allowing the Council to re-sign this public commitment

The report is set out in the following sections:

Section 2	reports the 2005 baseline and the available carbon inventory
Section 3	sets out the carbon targets for the city
Section 4	provides a summary of work undertaken since the last Sustainable Energy Action Plan was produced
Section 5	provides background on how the UK energy sector is expected to develop
Section 6	models the projected emissions for 2030 for Newcastle upon Tyne and summarises the projected 2030 CO_2 emissions and describes the scale of the projects that need to be identified
Sections 7-10	set out a suite of projects across different sectors which can delivery CO_2 reductions up to 2030
Section 11	illustrates the impact that these projects have on out-turn emissions for 2030
Section 12	presents some additional initiatives that will support the transition to a low carbon Newcastle
Section 13	presents a range of financing and funding models that might be appropriate to project delivery

Sections 14-15 provide a series of proposals on how projects can be delivered

Section 16 present the conclusions of the report

Appendices provide more detail on the analysis and projects included in the report

2 Baseline and interim reporting

2.1 Main datasets for energy and emissions monitoring

The datasets used for setting the emission baseline for the city, and for measuring changes in emissions in subsequent years, largely come from the Department for Business, Energy and Industrial Strategy (BEIS). The main datasets are the UK local authority and regional carbon dioxide emissions national statistics[1], and the UK Sub-national total final energy consumption statistics[2].

The emissions statistics provide a Local Authority level estimate of carbon emissions (expressed in CO_2 only, not CO_2e[3]) and are published each year, reflecting the emissions for the calendar year 2 years previously (i.e. 2017 saw the publishing of data for the 2015 period).

BEIS regularly review and update the methodologies for collecting and reporting these emissions. When a methodological change occurs in a given year BEIS go back and make adjustments to previous year where required. The result of this is that as datasets are updated over time, the emissions total for the baseline year changes.

When the last Sustainable Energy Action Plan (SEAP) was reported to the Covenant of Mayors it set out the following emissions baseline:

Table 1 2005 Baseline emissions from previous SEAP

Sector	2005 emissions ($ktCO_2$)
Residential buildings	644.23
Industrial and commercial buildings	794.98
Road transport	476.42
Total	**1,915.63**

The most recent statistical release for sub-regional CO_2 emissions provides the following summary of emissions from 2005 to 2015[4]:

[1] https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics
[2] https://www.gov.uk/government/collections/total-final-energy-consumption-at-sub-national-level
[3] CO_2e (CO_2 equivalent) is used to represent the combined effects of a wider suite of greenhouse gases that include methane, nitrous oxide and 'F-gases'. These are often combined to report a 'CO_2 equivalent' values and added to the CO_2 emissions. Reporting CO_2 alone provides a reasonable measure of the GHG emissions which can be controlled by a local authority. CO_2 contributes around 80% of the national GHG emissions. The largest component of the remaining 20% is methane which is largely generated by agriculture and emissions from waste sites. The next largest component is Nitrous Oxide (N_2O) which is mainly attributable to agriculture.
[4] https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2015. Note that annual publication of these statistics include updates to historic datasets to reflect methodological differences. This leads to the values for 2005 differing between Table 1 and Table 2.

Table 2 Annual CO_2 Emissions for Newcastle upon Tyne 2005-2015

Year	Industry and Commercial Total ($ktCO_2$)	Domestic Total ($ktCO_2$)	Transport Total ($ktCO_2$)	Grand Total ($ktCO_2$)	Population ('000s, mid-year estimate)	Per Capita Emissions (t)
2005	794.6	667.8	485.1	**1,948**	269.608	7.22
2006	797.5	657.4	465.4	**1,920**	270.258	7.11
2007	765.9	628.3	469.8	**1,864**	271.577	6.86
2008	777.6	629.6	447.9	**1,855**	271.649	6.83
2009	708.0	563.6	428.8	**1,700**	273.422	6.22
2010	765.1	598.3	425.9	**1,789**	276.681	6.47
2011	681.7	516.8	417.7	**1,616**	279.092	5.79
2012	735.6	561.7	410.2	**1,708**	282.442	6.05
2013	715.6	549.3	403.0	**1,668**	286.821	5.81
2014	589.3	453.9	404.7	**1,448**	289.835	5.00
2015	538.9	440.1	405.5	**1,384**	292.883	4.73

The updated estimate of emissions from 2005 of 1,948 $ktCO_2$ follows on from methodological changes by BEIS, and (for consistency) has now been taken as the updated baseline. This is the value against which the strategic objectives will be measured, and against which annual performance can be benchmarked.

Based on the revised 2005 baseline the following target parameters are calculated:

Table 3 Carbon baseline, performance and future targets for Newcastle

Measurement point	Emissions ($ktCO_2$)
2005 baseline CO_2 emissions for Newcastle upon Tyne	1,947.6
21% reduction target (as previously committed to in Covenant of Mayors) by 2020	1,538.6
2015 reported CO_2 emissions for Newcastle upon Tyne	1,384.5
Proposed 2030 target of a 50% reduction on 2005 emissions	973.8

Based on the sub-regional reporting produced by BEIS:

- **Between 2005 and 2015 emissions within the local authority area reduced by 28.9%**
- **Newcastle has therefore achieved the 21% targeted reduction by 2020 set out in the Covenant of Mayors**
- **A further reduction of 411 $ktCO_2$ is required between 2015 and 2030 to meet the proposed 50%reduction (against the 2005 baseline)**

2.2 Understanding the emissions inventory for Newcastle

The most recent BEIS data for the city provides the following breakdown of CO_2 emissions.

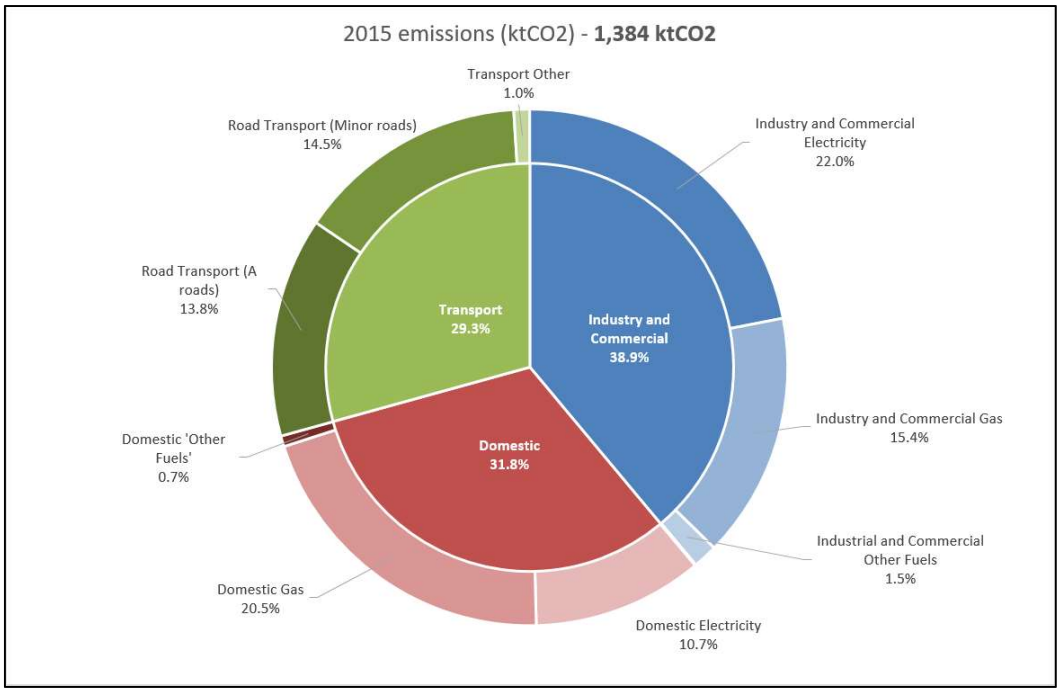

Figure 1 Composition of 2015 CO_2 emissions for Newcastle

Each 1% in this chart represents almost 14,000 tCO_2. This is equivalent to the CO_2 emissions from:

- the electricity and gas usage from 3,500 typical modern homes
- 50 million miles in a typical car

The historic datasets provide a breakdown of CO_2 emissions between 2005 and 2015. These are shown in the chart below.

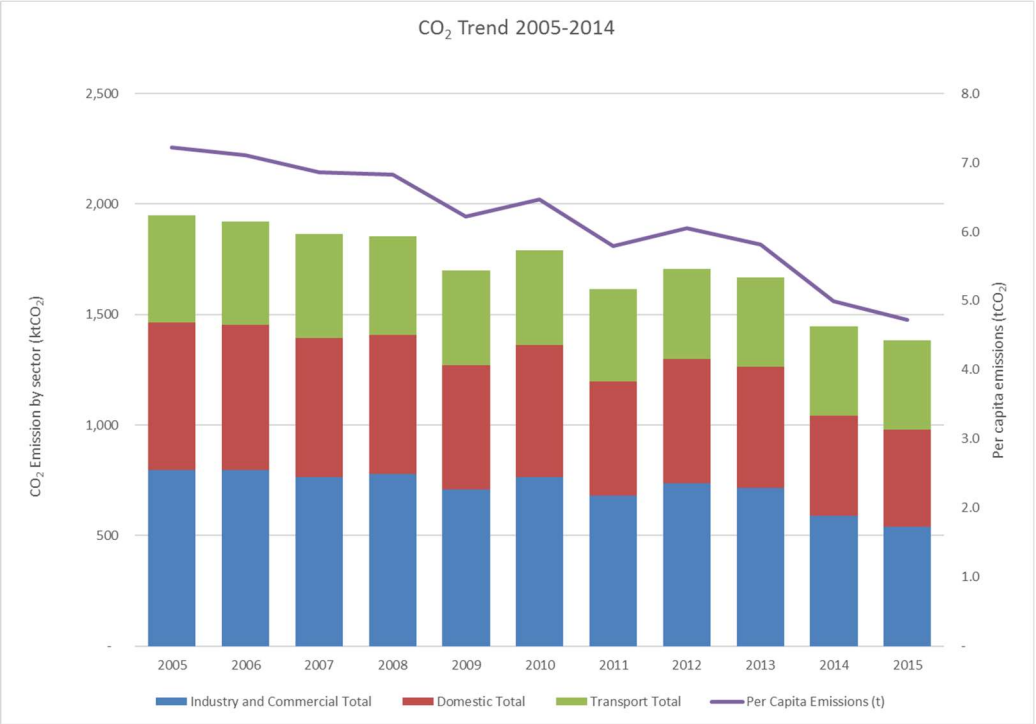

Figure 2 Change in CO_2 emissions by sector from 2005 - 2015

By 2015 the headline trends show:

- absolute CO_2 emissions were 1,384 $ktCO_2$ (a reduction of 28.9% against revised 2005 baseline)
- per-capita CO_2 emissions were 4.73 tCO_2 (a reduction of 34.6% against revised 2005 baseline)

2.3 Domestic emissions

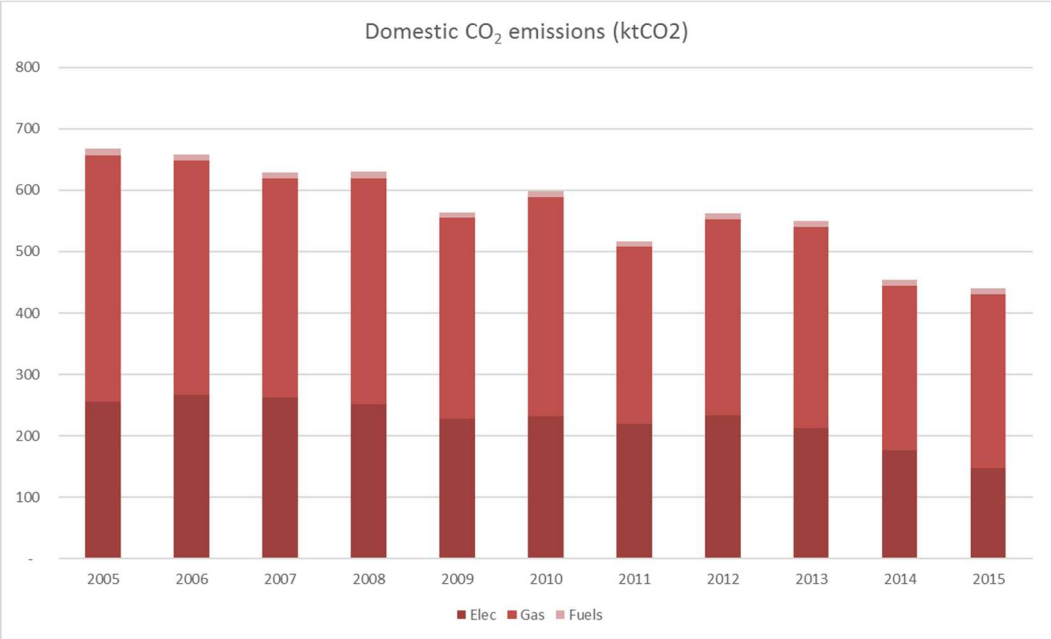

Figure 3 Changes in CO_2 emissions from the domestic sector 2005-2015

Newcastle has approximately 130,000 households[5].

Emissions from the domestic sector have fallen by 34% from 2005 to 2015.

- emissions from electricity consumption have reduced by 42%
- emissions from gas consumption have reduced by 29%

The reduction in emissions from electricity will, in part, be due to decarbonisation of grid electricity (the reduction in coal fired generation, and increased use of renewables). The reduction in emissions from gas consumption is not as great as for electricity, but has been more rapid than for the Industrial and Commercial sector (see later). This may be due to several factors, including changes in Building Regulations, and previous energy programmes (which have seen energy efficiency improvements to homes and installation of more efficient gas heating systems) all of which target reduced energy use for heating (predominantly provided through gas in the residential sector).

2.4 Industrial and commercial sector analysis

Industrial and Commercial emissions represent 39% of overall emissions, and arise mainly from the electricity and gas consumption in non-residential buildings and industrial installations across the city, with small amount of emissions from fuel use and agriculture.

The contributions of electricity, gas, other fuels and agricultural emissions are shown below.

[5] Based on current Valuation Office records for Council Tax

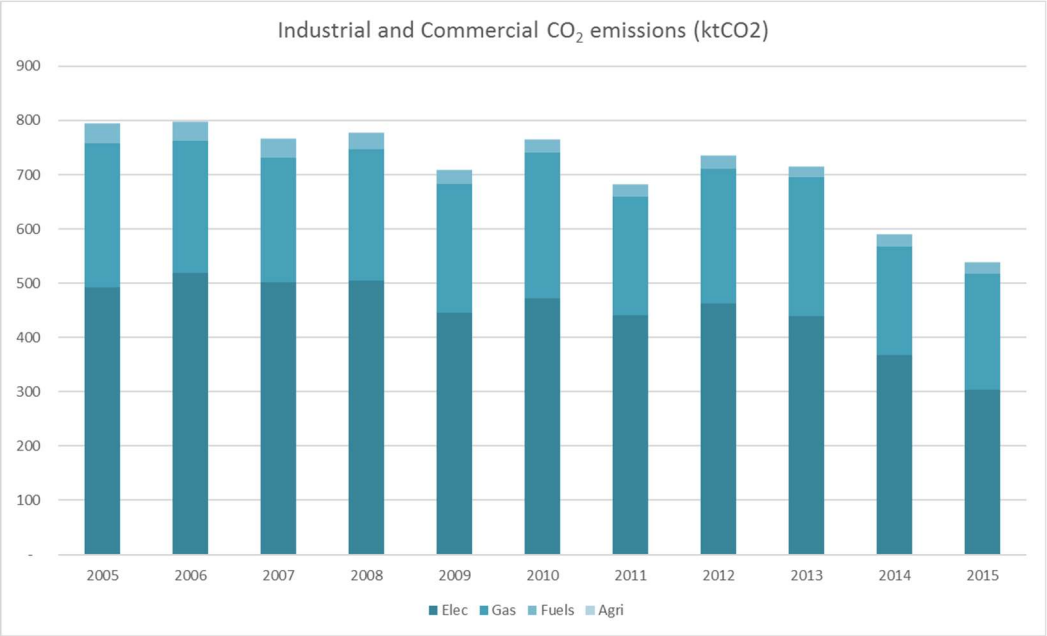

Figure 4 Changes in CO_2 emissions from the Industrial and Commercial sector 2005-2015

In overall terms emissions from Industrial and Commercial sources have reduced by 32% between 2005 and 2015:

- emissions from electricity consumption have reduced by 38%, with rapid reductions between 2013 and 2015
- emissions from gas consumption have reduced by 20%, again with a more rapid reduction between 2013 and 2015

A proportion of the benefit in CO_2 emissions since 2005 is due to the UK producing more electricity from renewable energy sources, rather than from gas and coal fired power stations. However overall consumption of gas and electricity (in MWh) has also reduced in this period – which will be due to improved energy efficiency and efficient equipment, as well as aggregate impacts of changes in the economy of the local area.

This dataset includes emissions from several large consumers of energy in the city, including:

- all buildings operated by Newcastle City Council
- buildings operated by the Newcastle Hospitals NHS Foundation Trust
- Newcastle and Northumbria Universities

Large public sector organisations in Newcastle account for approximately 36% of all Industrial and Commercial CO2 emissions, and 14% of overall city CO2 emissions. For further detail see section 8.2.

2.5 Road transport emissions

The emissions ascribed to Newcastle upon Tyne from road transport are developed from a national model, which BEIS supplements with local fleet data and other local datasets to produce overall emissions estimates.

Figure 5 Changes in CO_2 emissions from road transport 2005-2015

Emissions from 2005 to 2015 have fallen by 16% in the period. The mechanisms behind this reduction will include changes in behaviour, and improvements in the efficiency of the vehicles using the road network. The relative magnitude of these different factors is not clear. These reductions in overall CO2 emissions are lower than those from Domestic and Industrial & Commercial sectors.

3 Citywide carbon targets

3.1 Climate mitigation targets

Newcastle upon Tyne has targets to reduce the emissions of greenhouse gases within the spatial extent of the local authority.

The UK Climate Change Act 2008 sets the requirement on the UK Government to reducing emissions by at 80% of 1990 levels by 2050. The Act requires the Government to set 'carbon budgets' to act as stepping stones towards the 2050 target. The magnitudes of carbon budgets are set by the Committee on Climate Change (CCC) and the Government is obliged to prepare policies to ensure that the carbon budgets are met. The Climate Change Act also commits the Government to limiting global temperature rise to as little as possible above 2º C.

The UK is also a signatory to the Paris Climate Agreement which aims "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.[6]"

Newcastle City Council has made public commitments regarding climate change emissions. This started with the city becoming a signatory to the Nottingham Declaration in 2006. Subsequently Newcastle became a signatory to the Covenant of Mayors for Sustainable Energy[7] (CoM) in 2008 and committed to achieving a 21% reduction on the CO_2 emissions in the local authority area by 2020 against a baseline from 2005.

The city is now looking to become a signatory to an updated version of the CoM which will commit the city to a 40% reduction by 2030.

In March 2015 Newcastle made a longer term pledge to "power the city with 100% clean energy by 2050". The precise definition of what clean energy means in technical terms is not defined, nor what activities in the city would fall under the target definition. For the purposes of this strategy the assumption is that this target relates to the scope of emissions included in the UK Government's Local Authority Carbon Dioxide emissions, i.e. emissions from:

- Industry, commercial and public sector
- Domestic sector
- Road transport

These datasets exclude:

- emissions from motorway transport
- aviation

[6] http://unfccc.int/paris_agreement/items/9485.php
[7] http://www.covenantofmayors.eu/index_en.html

- shipping
- certain sites which fall under the EU Emissions Trading System (EU ETS)
- Diesel railways
- Land use, land use change, and forestry
- Wider greenhouse gases beyond CO_2

The Local Authority CO_2 emissions dataset also do not account for any 'Scope 3' emissions (i.e. emissions embodied within the supply chain of organisations and households).

It is important to note that the national climate commitments include a broader range of emissions (e.g. not just CO2 emissions) and sources, many of which are considerably more challenging to reduce. The city-level CO2 emissions targets may appear more challenging, but in the context of the reduced scope that they represent are, in fact, potentially more feasible.

The 100% clean energy commitment provides a clear direction of intent beyond the CoM 2030 target. For the purposes of this strategy it is assumed that the 100% clean energy is a commitment to pursue an approach to achieve zero-carbon for the emissions set out above by 2050. As an interim milestone by 2030 the city must deliver a significant reduction in emissions against the most recent inventor year of 2015.

3.2 Summary of targets

Clean energy commitment: as stated in Section 3.1 the city has previously committed to a reduction in CO_2 emissions of 21% on 2005 emissions by 2020. **The city is now committing to meeting a 50% reduction by 2030 against the same 2005 baseline.**

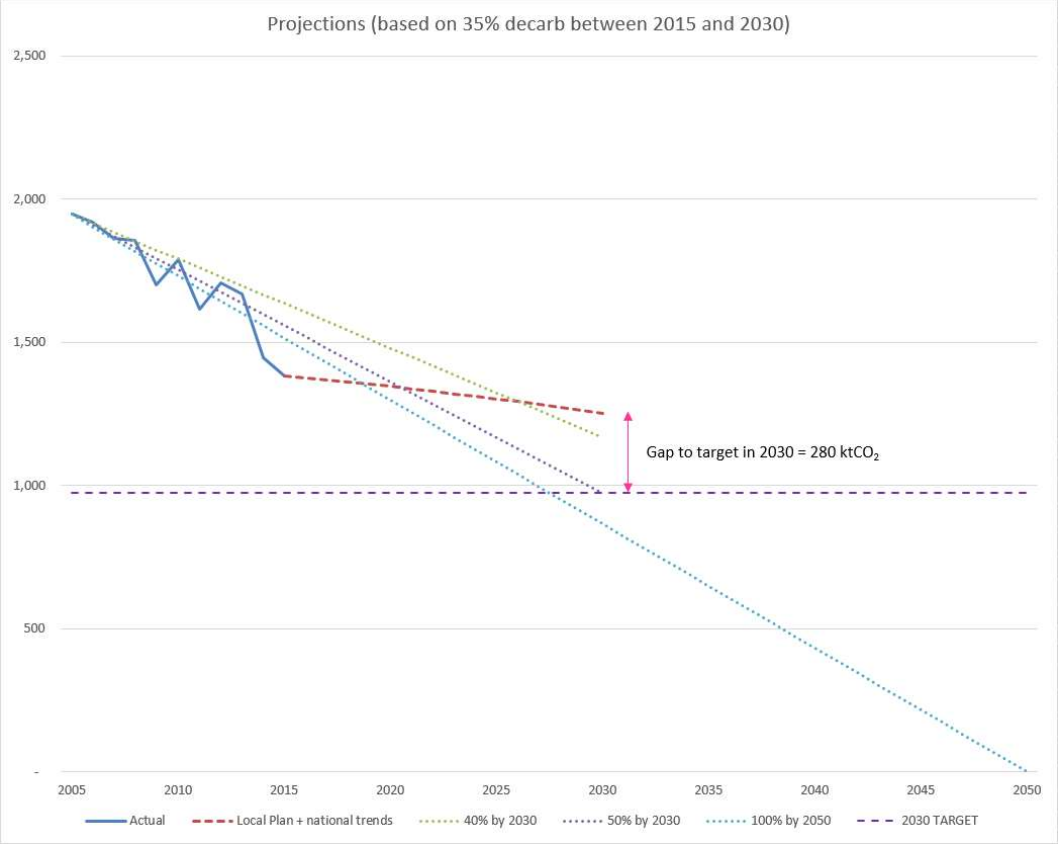

Figure 6 "Local Plan + national trends" to 2030 and comparison against targets.

Figure 6 shows the projected emissions scenario and the 50% target (in purple). The dotted lines show different % trajectories for 2030 and 2050 timescales. Also shown is the trajectory (blue dotted line) to meet 'zero emissions' in 2050.

Covenant of Mayors: the city is recommitting to the Covenant of Mayors which requires a 40% reduction in CO_2 emissions against a selected baseline, taken to be 2005. The method for calculating the scale of this reduction is specific to the Covenant of Mayors and is provided in more detail in Appendix D.

4 Initiatives undertaken since the last strategy

4.1 Initiatives undertaken in the city to reduce emissions

The period since the commitment to the Covenant of Mayors has seen initiatives across the city to deliver lower carbon operations across the local authority and other sectors. A summary of the types of projects and interventions carried out is provided below.

4.2 Council operations

Council operations include the operation of many buildings (offices for council staff, depots, schools, care facilities etc). Salix Finance provides a mechanism for councils to fund and deliver energy efficiency projects across the estate from which they operate. Since 2009 the council has delivered over 60 projects (typically including energy efficient lighting, insulation, boiler replacement, and better controls for building systems) which have delivered annual CO_2 savings of over 1,000 tCO_2.

The Council has also undertaken a programme of solar PV installation across the council operational estate, with 26 non-domestic installation carried out prior to 2015 totally 227 kWp of installed capacity.

4.3 Residential

In line with national campaigns targeting energy efficiency in homes, many of which were funded through the Energy Company Obligation and similar schemes, thousands of homes have had insulation installed – either loft insulation (new or topped up) or cavity wall insulation. Across the large number of properties involved this delivers a significant reduction in the overall consumption of gas and other energy sources for space heating.

In addition to these efficiency measures targeting houses, the city (directly and also through Your Homes Newcastle (YHN)) has delivered energy efficiency projects in tower blocks. Some of these include improvements to building fabric to reduce heat loss, and some have looked at innovative ways in which energy demand for electrical heating can be managed (such as at Adelaide House). The council has also been involved in delivering a biomass system at Riverside Dene (Cruddas Park) tower blocks and at the Byker Heating Plant.

Newcastle has also been involved in the delivery of new energy systems for new-build properties – including the Scotswood Energy Centre which provides low carbon energy for the new developments to the west of the city centre.

Your Homes Newcastle (YHN) has ongoing projects to upgrade the thermal performance of its properties, reducing energy consumption for occupants. This has seen improvements to buildings through loft and cavity wall insulation,

overcladding of properties, and research into under-floor insulation installed using the Q-Bot system.

Other initiatives to reduce emissions from social housing has seen the replacement of inefficient electric heating with the installation of gas boilers, the replacement of poorly performing old gas boilers with more modern systems, and the provision of Energy Advice services.

Social housing in Newcastle (as with elsewhere in the UK) made use of the Feed in Tariffs to deliver solar photo-voltaic (PV) systems on many properties.

4.4 Commercial and Industrial

The commercial and industrial sector is extremely challenging to work in for a variety of structural reasons around building ownership and leasing. Newcastle has prioritised working with other large estate managing organisations (such as the NHS and the Universities) to try and develop cross-party projects to reduce emissions within the city.

Other sources of emissions in this category are commercial buildings (e.g. offices / retail) and industrial facilities. One area for further action, albeit extremely challenging, is around the energy performance of leased commercial premises. In many cases the occupant has little control or opportunity to improve the overall performance of the building.

Achieving CO_2 reductions from industrial facilities is a sector where the UK Government believes significant improvements can be made. The potential scale of this in Newcastle is not well understood at present due to the lack of available data.

4.5 Transport

Emissions from transport continue to be a significant challenge for all cities – with interventions being hard to implement, and hard to monitor the impact of. Newcastle has invested in the creation of improved cycling infrastructure in the city centre and on strategic routes in the wider area. These are beginning to show benefit in increased cycle usage.

Newcastle has also recently introduced Mobike – a bicycle sharing system – to make cycling more accessible for short trips. This complements a wider programme of investment across the city in improved cycle infrastructure to support key commuting routes.

Newcastle public transport providers, and other regional local authorities continue to work on delivering smart ticketing systems to support the use of public transport.

5 Planning for change – the UK's Energy future

5.1 National influences on carbon emissions

The likely trajectory of CO_2 emissions from Newcastle will be influenced by activity undertaken in the city, but also by wider national trends and changes in energy and transport strategy. There is considerable uncertainty in how the UK's energy strategy will unfold, but in line with the carbon budgets in place at a national level there will be changes in how electricity is generated, and also (importantly) how the UK can move to a strategy of providing space and water heating at a lower carbon intensity than using natural gas. Reducing carbon emissions from transport is also a key strategic area which the UK must address in order to achieve its international carbon commitments – which is expected to be delivered by shifts towards alternative fuels and electric vehicles, as well as efficiency improvements in fossil fuel engines.

The policy levers that will be used by central Government to deliver on carbon budgets at a national level remain unknown.

5.2 Changes in energy efficiency, generation and supply

It is a time of considerable uncertainty in the UK energy strategy. UK action is publicly following climate commitments – but there is a general lack of clarity on how the UK intends to deliver the different elements of an energy generation and supply strategy that meets the needs of climate commitments.

National Grid also produces forecasts for how the UK's energy system will develop, most recently set out in their Future Energy Scenarios document[8]. The document sets out a suite of future scenarios which look in detail at the links between electricity and gas demand – especially regarding the heating market, where an increase in one can lead directly to a reduction in the other. This is a key factor in the uncertainty for cities around the generation of energy (heat or power), how it is used to address heating demand, and the implications for future local energy strategy (and the infrastructure required to deliver it).

The National Grid has set out how the complexity of energy technology and policy can affect the overall grid profile through four. These are based on axes reflecting Prosperity vs. Green ambition. They are summarised in the figure below:

[8] http://fes.nationalgrid.com/fes-document/fes-2017/

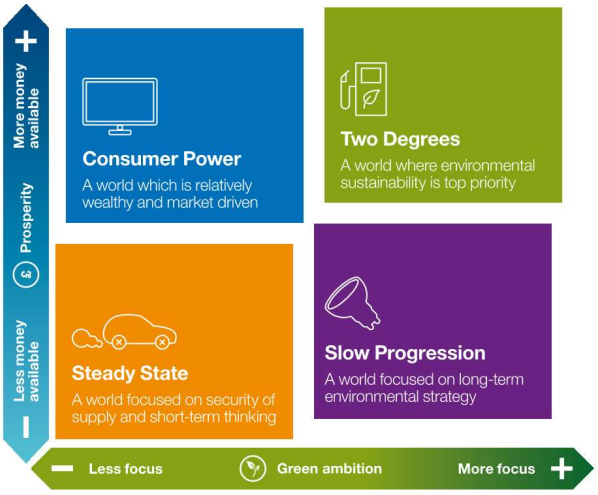

Figure 7 Conceptual representation of the National Grid future scenarios

Based on the National Grid scenarios there are various trends which might be seen in the period up to 2030

Increased decentralised and renewable electricity generation from renewables (such as solar PV and onshore/offshore wind) or from distributed CHP projects. These will increase the complexity of the electricity storage and distribution system, and are expected to require improvements and investments at all levels in the electricity distribution and transmission networks. Decarbonisation of electricity provided by the national grid is expected to include a proportion generated from distributed renewables

Increased decentralised gas supply is present in some future scenarios. A reduction in natural gas from the UK Continental Shelf will be seen, and may be replaced by increases in imported gas, or on alternative gas sources such as shale or green gas. Hydrogen may also be used to mix, or entirely feed, a gas distribution network for all sectors, but CCS will be required to deliver an overall carbon benefit. The influence of this is unlikely to be seen before 2030 and does not influence the carbon projections in this report before 2030.

Electricity generation moves from approximately 27% decentralised generation to between 34-40% for future scenarios, with increases in generation from sources including biomass, offshore and onshore wind, solar and nuclear power.

Electrical appliances are expected to deliver carbon benefits at a household level through reduced energy consumption, although in aggregate this could be offset by population increases. European targets for 2030 would see a 30% efficiency saving from appliances by 2030, although this is a challenging target and would require UK targets to mirror those for Europe.

Gas combined heat and power continues to increase in the short term, but for scenarios where environmental impacts are considered a priority the use of CHP increases by around 15% between 2016 and 2025, and then (in the 'Two Degrees' scenario) falls to sub-2016 levels of usage by 2050. Usage of gas for heating has a limited shelf life (as a strategy for reducing CO_2 emission) as the UK electrical

grid decarbonises, as alternative strategies for space heating (such as heat pumps) will offer a better carbon benefit.

Residential heat supply needs to be delivered at lower carbon intensity to meet carbon reduction targets, which will drive a reduction in the use of gas boilers, with heat pumps replacing them. Gas hybrid heat pumps will act as a transition step to full electric heat pumps beyond 2030. Less environmentally-targeted scenarios see the retention of gas boilers (although they may be supplied by lower carbon gas sources, or even hydrogen). Most scenarios are predicated on improved thermal efficiency across the UK housing stock.

Energy storage is a key area where technology is rapidly changing. Electrical storage is projected to potentially increase from 4GW in 2016 to 6GW by 2020, with some industry specialists forecasting up to 12GW by 2021. Local generation and storage of electricity brings immediate carbon benefits by using a lower carbon generation source, and also reducing the efficiency losses attributable to transmission and distribution. Increased use of 'smart' energy networks offers the potential to make optimal use of energy storage to reduce the overall carbon intensity of supply.

Demand side response sees the turning off, up, or down, of electricity or gas consumption, brought about by a signal from another party. It offers the opportunity for reduced generation capacity to be required during peak times, and reduced the reliance on carbon-intensive additional generation capacity. It also offers the facility to increase usage when there is a surplus of available low carbon electricity. Battery storage improvements may reduce DSR for a period around 2020, but then it is expected to increase for those scenarios where environmental impacts are prioritised.

Decarbonisation of space heating is an area where whole system costs are lower if it happens sooner – leaving until later increases the size of the challenge, and opportunities to low carbon heat are missed. Early options for domestic heating are Air Source Heat Pumps (ASHP) and will play a significant role out towards 2030. In less green scenarios the electrification of heat is less significant, relying on (for example) gas fired district heating.

Three broad solutions for heat decarbonisation are:

- Repurposing the gas grids with hydrogen (which may require CCS to allow for SMR to provide a carbon benefit) – where the gas network has been upgraded to plastic it is suitable for hydrogen use
- Electrification – using heat pumps, but will require electricity network upgrade and is expensive to provide storage
- District heating – from biomass, geothermal, waste heat and heat pumps

Hydrogen offers a potential alternative to various fuels in use at present. It can be mixed (or potentially replace) gas supply to individual properties for use in a boiler and appliances. It can also offer an alternative fuel option for large vehicles. At present, however, a key challenge is that the processes to generate hydrogen are emitters of CO_2. Additionally, there would be a need for changes to

distribution networks at a household level if it was to be used as a sole fuel for household heating – but these are unlikely to be realised before 2030.

5.3 Changes to carbon intensity of grid electricity

The Valuation of Energy Use and Greenhouse Gas (BEIS, 2017)[9] provides guidance from the UK Government on the quantification and appraisal of greenhouse gases. The accompanying data Table 1 within the document sets out a range of emissions factors trajectories by sector (domestic, public/commercial, and industrial) and also sets out long-run marginal and grid average rate projections[10]. For the purposes of estimating changes in emissions from changes in grid electricity the 'Long run Marginal' consumption based electricity emissions factors are recommended for use.

The absolute emissions factors vary across the sectors, but the rate of decrease between 2015 and 2030 is constant.

Table 4 BEIS electricity consumption factors 2015-2030

Grid average consumption based emissions (incl transmission and distribution losses) $kgCO_2e/kWh$						
Year	Domestic	% change from 2015	Commercial / Public sector	% change from 2015	Industrial	% change from 2015
2015	0.336	100%	0.330	100%	0.324	100%
2016	0.327	97%	0.321	97%	0.315	97%
2017	0.317	94%	0.311	94%	0.306	94%
2018	0.307	91%	0.301	91%	0.296	91%
2019	0.296	88%	0.291	88%	0.285	88%
2020	0.285	85%	0.280	85%	0.274	85%
2021	0.273	81%	0.268	81%	0.263	81%
2022	0.260	77%	0.255	77%	0.250	77%
2023	0.247	73%	0.242	73%	0.238	73%
2024	0.232	69%	0.228	69%	0.224	69%
2025	0.217	65%	0.214	65%	0.210	65%
2026	0.202	60%	0.198	60%	0.194	60%
2027	0.185	55%	0.182	55%	0.178	55%
2028	0.168	50%	0.165	50%	0.162	50%
2029	0.149	44%	0.147	44%	0.144	44%
2030	0.130	39%	0.127	39%	0.125	39%

9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/615374/1._Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal_2016.pdf

10 BEIS provides further detail on the use of the 'long-run marginal' and 'grid average' intensities -but these broadly split into factors for discrete entities (which should use average factors) and factors reflecting changes in generation technologies over time (long run marginal)

Across these projections the emissions ($kgCO_2e/kWh$) are projected to reduce to 39% of the 2015 factor by 2030. In practice this allows us to estimate that all existing electricity usage in Newcastle will be reduced to 39% of its carbon intensity by 2030 (i.e. a 61% reduction). It also states CO_2e/kWh values ranging across different uses of:

- 2015: 0.324 to 0.336
- 2030: 0.125 to 0.130

However, there is considerable uncertainty in this projection, and alternative sources of carbon projections have also been investigated.

The UK National Grid scenarios (see above) result in different developments taking place within the UK energy market, with differing trajectories around energy generation and supply. The different scenarios lead to a range of carbon intensities for power generation (the factors reflect carbon intensity of the generation output, and do not account for transmission and distribution losses and will therefore be generally lower than the BEIS projections).

Table 5 National grid electricity factors under different scenarios

	Carbon intensity (gCO_2/kWh) of total generation output			
Year	"Two Degrees"	"Slow Progression"11	"Steady State"	"Consumer power"
2015	0.296	0.258	0.290	0.296
2016	0.243	0.243	0.243	0.243
2017	0.189	0.227 *	0.195	0.190
2018	0.181	0.212 *	0.212	0.173
2019	0.155	0.196 *	0.222	0.159
2020	0.141	0.181	0.234	0.152
2021	0.119	0.168 *	0.230	0.142
2022	0.098	0.155 *	0.205	0.134
2023	0.085	0.141 *	0.209	0.133
2024	0.090	0.128 *	0.192	0.147
2025	0.087	0.115	0.173	0.154
2026	0.067	0.111 *	0.171	0.145
2027	0.073	0.107 *	0.184	0.142
2028	0.060	0.103 *	0.192	0.142
2029	0.061	0.099 *	0.189	0.135
2030	0.054	0.095	0.193	0.135
Change from 2015 – 2030	**-82%**	**-63%**	**-34%**	**-54%**

[11] The 'Slow progression' scenario does not include carbon factors for all interim years. Those marked with * have been linearly interpolated from the 2016, 2020, 2025 and 2030 factors.

The most conservative scenario (in carbon terms) sees a reduction in carbon intensity of 34% between 2015 and 2030, with the most optimistic seeing a reduction of 82%.

While the two sets of intensity factors from BEIS and National Grid are not directly comparable, they do provide an indication of the relative change in grid intensity between 2015 and 2030. The range of the extent of reduction across the BEIS forecast, and the four National Grid forecasts, are shown below[12]. This chart shows the carbon intensity in a given year as a percentage of the 2015 factor (i.e. by 2030 the 'Two Degrees' scenario has a carbon intensity that is 18% of the 2015 intensity).

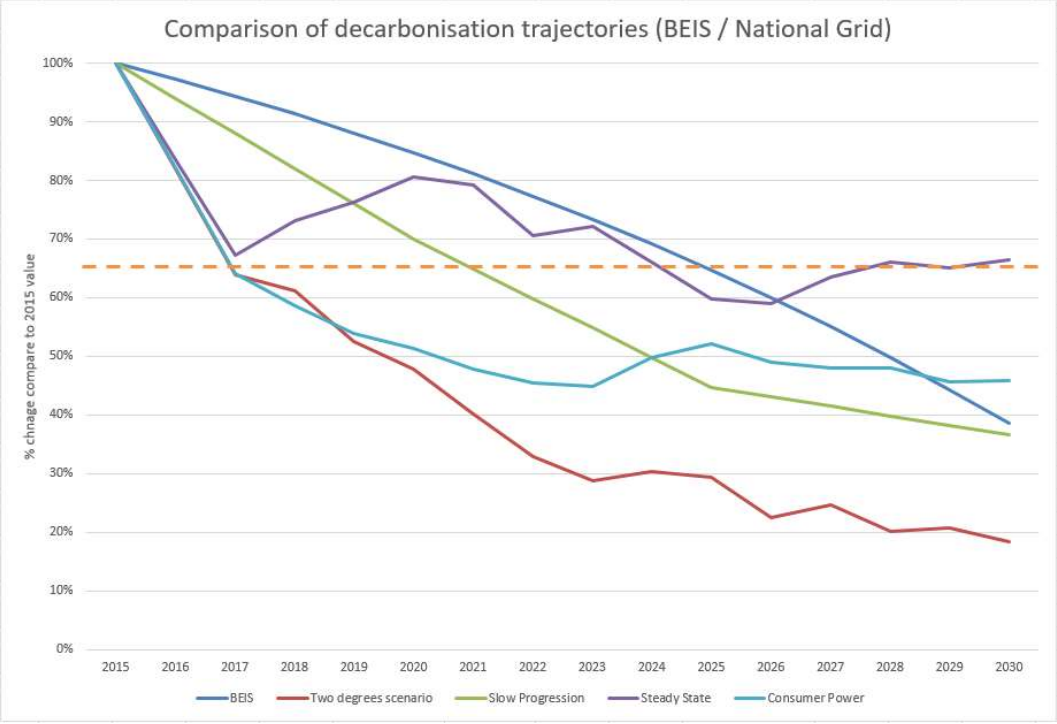

Figure 8 Comparison of decarbonisation trajectories 2015-2030

This provides wider context that the BEIS forecast is within this range, and that three of the National Grid scenarios provide a reduction of at least 50% in CO_2 emissions per kWh.

Taken alongside the BEIS carbon intensity change of -61% between 2015 and 2030 it is considered cautious, but reasonable, to assume that a more moderate assumed reduction in electricity intensity of -35% between 2015 and 2030 is achieved.

This is shown by the orange line in Figure 8, and provides the 2030 estimated decarbonisation to inform projections of CO_2 emissions for the development of Newcastle's future scenario.

[12] Note that the National Grid scenarios are projected from 2016. For the purposes of charting a comparison the decarbonisation rate from 2016 to 2017 has been back-cast linearly to provide a 2015 value.

The assumed decarbonisation of the electricity grid is very significant in understanding the overall trajectory of emissions from the local authority area as it affects emissions from existing buildings/consumption and also impacts on any activity growth in the area. Reducing the intensity of electricity supply provides a (carbon) benefit across all building uses and types. As the use of electric vehicles increases, the grid decarbonisation rate also contributes to reducing emissions from road transport (before allowing for any expansion in overall vehicle usage).

5.4 Transport

Transport demand, energy and emissions will change significantly with several factors affecting overall CO_2 emissions. The main drivers for forecasts in CO_2 are levels of traffic, taken together with assumptions on the fuel efficiency of the vehicle fleet. DfT forecasts for 2015[13] project scenarios where CO_2 falls between 3% and 26% from 2010 to 2040, depending on the level of traffic growth. Fuel efficiency improvements are a driver of this trend, with increased biofuel and fuel efficiency improvements providing much of the downward trend. However, importantly, this modelling predates recent increased focus on the air quality impacts of diesel, and the announcement from car manufacturers of their intent to phase out production of petrol/diesel vehicles.

The National Grid projections consider the uptake of Electric Vehicles, delivering a proportion of new vehicle sales of between 30% (for the least 'green' scenario) to up to 90% for the 'Two Degrees' scenario by 2050 (although the actual fleet mix will lag behind this). Green scenarios also see a shift to natural gas HGVs, to as much as a third of the total HGV fleet. By 2030 PEV/PHEV[14] proportions range from 6% to 30% depending on scenario, although it is noted that this represents a key sensitivity to future CO2 projections, and increased focus on the health impacts of air pollution could lead to increased uptake of electric vehicles.

BEIS produces annual projections of energy and emissions, most recently in 2016[15]. Their 'Reference Scenario' is based on existing and agreed policies, and forecasts CO_2 emissions from Transport reducing from 116 $MtCO_2e$ in 2015 to 104 $MtCO_2e$ in 2030 (a reduction of approximately 10% at a national scale).

5.5 UK Clean Growth Strategy, 2017

The future emissions of the city will also be affected by national policy and strategy on meeting carbon targets. The UK Government released its Clean Growth Strategy (October 2017)[16]. This sets out how the UK will meet the CO_2

[13] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf
[14] Plug-in Electric Vehicles (PEV) can charge from external sources of electricity – e.g. wall sockets – with electricity stored in a rechargeable battery. Within this category are plug-in hybrid vehicles (PHEV) that can be charged from a wall socket, but also include a petrol/diesel engine for longer range and for use when there is insufficient electric charge.
[15] https://www.gov.uk/government/collections/energy-and-emissions-projections
[16] https://www.gov.uk/government/publications/clean-growth-strategy

reductions required within the UK carbon budgets. Headline policies and proposals include:

- **accelerating clean growth** through setting up a Green Finance Taskforce; working with British Standards Institution to develop voluntary green and sustainable finance management standards; funding to support new clean energy technology development; working with mortgage lenders to develop green mortgage products
- **improving business and industry efficiency** with consultations on energy efficiency standards and minimum standards on rented commercial buildings; supporting industrial energy efficiency; developing industrial decarbonisation action plans
- **improving energy efficiency of homes** requiring fuel poor homes to be EPC Band C by 2030, and as many homes as possible EPC C by 2035; improving performance standards of private rented homes; consult on how social housing can meet similar standards;
- **smart metering** uptake to be increased, offering all households the opportunity to have one installed by 2020
- **rollout of low carbon heating** by building heat networks; phasing out off-gas grid high carbon fossil fuel usage; improve standards on new boilers; reform of the Renewable Heat Incentive
- **accelerating the shift to low carbon transport** by ending sale of conventional vehicles by 2040; supporting the purchasing of electric cars; investment in development of vehicle charging networks; supporting uptake of low emissions taxis and buses; announce plans for the public sector to lead in transition to zero carbon vehicles; more walking and cycling; low emission freight strategies;
- **delivering clean, smart, flexible power** to households and businesses; reducing coal generation of electricity; deliver new nuclear; improve the route to market for renewable technologies; invest in smart systems to reduce the cost of electricity storage
- **tighter targets for the public sector** including a target of 30% reduction by 2020-2021
- **Government leadership in driving green growth**

5.6 Implications of a changing energy landscape for local authorities

Given the uncertainty in the UK's future energy strategy, and how quickly or widely uptake of new technologies will take place, Local Authorities will need to be flexible in the projects and areas in which they actively participate. This report sets out what is considered feasible to achieve the magnitude of carbon emissions reductions between 2017 and 2030, but new opportunities may arise from technological, legislative, regulatory or funding changes.

5.6.1 Increased use of local renewable energy sources

Renewable energy sources are set to increase in the UK, although the likely proportion of renewables generation from different sources is not clear. It is likely that installation of renewables in Newcastle will increase – both from large projects, but also at a building or neighbourhood scale.

The city should expect to continue to support medium-large schemes (such as gas CHP and DH, which remains carbon beneficial in the short term and may be able to transition to another heat source) and domestic scale projects (such as solar PV).

5.6.2 Demand side response (DSR) and energy storage

DSR is an approach whereby consumers can opt in to payment tariffs which offer incentives for using energy outside periods of high demand. Smart metering and other technologies then allow for the consumer electrical system in a dwelling/building to switch off demand for electricity during peak periods, and to instead use electricity when demand is low, prices are cheaper, and carbon emissions per kWh are lower.

5.6.3 Overall decarbonisation of electrical supplies

Decarbonisation of electricity (grid electricity and also lower carbon local generation) offers the benefit of reducing existing emissions from electricity consumption across all sectors. Decarbonising electricity also offers a means to decarbonise heat supply (through the use of heat pumps and/or resistive heating) and transport (through the use of electric vehicles). This potentially provides a source of low carbon heat which could be used in an existing heat network, and could form the main space and water heat source at a house-by-house scale.

This may require investment in the electrical distribution network to account for changes in consumption patterns, and also to react to diverse generation sources (as set out above). It remains unclear the degree to which widespread electrification of heat and transport could be carried out without reinforcement of the electrical grid to support the peak demand.

5.6.4 Decarbonisation of gas

Identifying a source of low-carbon gas, which could either be used with current plant, or could be distributed through the existing gas distribution network, could provide a less disruptive transition to lower carbon.

Lower carbon gas supplies could include methane from anaerobic digestion or landfill (green gas) or could include hydrogen (mixed with other gas, or used as the only gas in the network). Hydrogen offers the potential for multiple applications beyond heating (e.g. for powering vehicles) and the ongoing programme of upgrading the gas network offers an opportunity to deliver a hydrogen-ready network. However, at present the main production methods for hydrogen generate CO_2, and so a means of effective CCS is required before this

becomes a low carbon option. The potential for hydrogen for widespread use is not expected before 2030 and therefore does not feature heavily in this strategy.

5.6.5 Heat networks

Heat networks offer an efficient means to distribute lower carbon heat to households and industrial/commercial buildings. Typically heat networks currently use biomass for heat generation, or are attached to a gas-fired combined heat and power (CHP) system and network.

An existing heat network could be used to provide heat to households in the future irrespective of whether the heat source comes from decarbonised grid electricity (e.g. with large scale heat pumps) or combustion of green gas or hydrogen.

5.6.6 Risks and uncertainties

Fabric efficiency is generally considered a low-regret option (as it reduces overall consumption of all energy types), however Newcastle has a large number of domestic properties which would require expensive retrofit measures (e.g. solid wall insulation) to contribute significantly to meeting climate change targets. However, if heat decarbonisation proceeds and a strategy of heat networks is developed then there is a point at which it becomes less cost effective (in purely monetary terms) to carry out energy efficiency measures, and more cost effective to achieve carbon performance through a lower carbon heating system. Whole house retrofit for a significant proportion of Newcastle's housing stock will be highly expensive and disruptive to householders. Counter to the monetary considerations there are also wider fuel poverty arguments for improving building performance through efficiency measures.

Decarbonised gas could offer a means to allow houses and other buildings to continue using individual building boilers, rather than connecting to a heat network. Connecting buildings to a heat network is expensive, and may constitute wasted investment if a decarbonised gas source becomes available that can rely on the existing gas network.

Similarly, the costs involved in upgrading the electricity network to support widespread use of heat pumps (at a building scale, or as a heat source for district heating) is also expensive and may not be required if low carbon heat is available through an existing gas network.

The Energy Path Network project has been carried out by Energy Systems Catapult (ESC) to develop a strategy for transitioning domestic properties in the city over to lower carbon heating technologies. This work provides the most cost-effective strategy for delivering carbon emissions reduction from houses, largely through the use of heat pumps and District Heat systems, in order to meet emissions reductions by 2050. It does not, however, provide an overarching strategy for other key emissions sectors (transport and industrial/commercial). Reports from the EPN work are published alongside this strategy and reflect the ongoing uncertainties in the national energy system evolution.

6 Future emissions for Newcastle

6.1 Overview

Developing an appropriate response to the challenges faced by Newcastle to meet its carbon targets requires an assessment of current performance (see above) but also an estimate of what is expected to change in the future.

Newcastle is a city that expects to increase in population between 2015 and 2030, and an increase in development is associated with this (in line with the Local Plan). New development is expected to lead to an absolute increase in emissions (all other factors being constant) simply due to the additional energy consumed within the local authority area.

However, there are factors which affect the supply of energy (and the efficiency of energy supply) at a national level, which are beyond the control of the city, but which will contribute to delivering a lower carbon intensity of energy use within existing and new buildings.

An estimate has been developed for the city that takes into account:

- planned development within the city
- changes in road traffic demand and changes in the types, numbers and age of vehicles operating in the city
- changes to the carbon intensity of grid electricity supplying the city.

Taken in aggregate these allow us to develop an estimate of emissions in 2030 referred to as **"Local Plan + national trends"**.

6.2 Planned development in the city

The Core Strategy and Urban Core Plan for Gateshead and Newcastle upon Tyne 2010-2030[17] sets out the expected development of domestic and non-domestic buildings over the period.

6.2.1 Domestic

Policy CS10 sets out the following provision of new accommodation for 2010-2030:

	2010-15	2015-20	2020-25	2025-30	Total
Gross provision	2,600	5,100	5,650	5,650	19,000
Forecast losses	1,200	300	250	250	2,000
Net provision	1,400	4,800	5,400	5,400	17,000

[17] https://www.newcastle.gov.uk/sites/default/files/wwwfileroot/planning-and-buildings/planning-policy/planning_for_the_future_core_strategy_and_urban_core_plan_2010-2030.pdf

Section 10.18 of the Local Plan document indicates that these will be split into:

- 1 bedroom 20%
- 2 bedroom 20%
- 3 bedroom 30%
- 4+ bedroom 30%

Section 10.24 of the Local Plan document also suggests a further 2,000 purpose-built student bedrooms in the city.

This new development is needed to respond to increases in the population of the city, and will represent new sources of energy consumption and CO_2 emissions across the city. The impact of new development (in terms of emissions) can be mitigated through various approaches:

- improving the energy performance of new buildings
- ensuring new development makes use of low carbon energy sources through:
  - requiring a proportion of renewable energy per building
  - locating development near to existing low carbon energy systems (e.g. heat networks)
  - ensuring comprehensive feasibility work on new developments to demonstrate what low carbon energy strategies have been considered

To understand the impact of this new development on CO_2 emissions from the local authority, a projection of energy consumption and emissions from new housing has been developed. This is based on taking typical new build energy consumption for different house types/sizes and combining these with estimated unit numbers above.

6.2.2 Non-domestic

The Local Plan 2010-2030 sets out a need to allocate 80ha in Newcastle for new non-domestic development. It also sets out specifically the need for new office space equivalent to 204,000m2 from 2015-2030.

The Employment Land Review for the city takes a typical development ratio of 40% usable floorspace to overall hectares. Based on this future development between 2015 and 2030 is taken to be:

- City Centre office space: 307,200 m^2
- Other development (office, industrial, storage): 240,000m^2

To understand the impact of this new development on CO_2 emissions from the local authority, a projection of energy consumption and emissions has been developed.

6.3 Changes to road transport in the city

Understanding how the emissions from road transport will change in the city is challenging for several reasons.

1. Firstly, the available information on the number of vehicles using roads across the local authority is challenging. While there is good data in specific areas of the city, used to inform transport schemes in the area, there is no comprehensive assessment of road usage across the local authority area as a whole.
2. Emissions from a specific vehicle depend on many variables, including the type and age of the vehicle, driver behaviour, and the conditions in which it is driven (i.e. during period of congestion, when emissions are higher, or during quieter periods).
3. The use of alternative fuel vehicles across the city is not well understood, although it is estimated as being relatively minor at present

The modelling used to develop the estimated road transport emissions for local authorities is based on estimating vehicle flows on different road categories (major roads and minor roads) and then an assessment of the national vehicle fleet and regional variations.

Assessment of the levels of road usage, and the usage of alternative fuels, varies across different sources of information.

The National Transport Model (NTM) provides the means by which the Department for Transport (DfT) forecasts the impacts of changes in policy. DfT provides road traffic forecasts for the UK[18]. The forecasts explain in some detail the complexities around forecasting how traffic levels will change, and the uncertainties around estimating future traffic. The traffic forecasts take a scenario approach and provide a range of potential outcomes on traffic and emissions levels. The supporting tables also highlight the uncertainty around the forecasts, and note that they provide projections that "should be treated as indicative, illustrating trends and broad orders of magnitude"[19].

The NTM provides modelling results for the North East Large Urban area type which, under their Scenario 1[20], indicates an increasing trend in vehicle distances as shown:

Parameter	2015	2020	2025	2030
Total miles (bn)	6.13	6.64	7.00	7.38
Total CO_2 (kt)	1,789	1,605	1,494	1,463

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf
[19] DfT Notes on Regional Traffic Forecasts contained within spreadsheets located at https://www.gov.uk/government/publications/road-traffic-forecasts-2015
[20] Road Traffic Forecasts are developed under various Scenarios. Scenario 1 assumes future trip numbers reflect historical averages and that incomes/cost affects travel choices in the same was as has been previously modelled. Other scenarios make different assumption on these, and other, factors.

The supporting notes state that as the modelling cannot represent speeding, congestion or stop/start conditions. It is unclear what proportion of the change in CO_2 emissions between 2015 and 2030 arise from considerations of improved vehicle efficiency and how much from other influences. However, a useful trend to appreciate is the increase in vehicle mileages of around 20% between 2015 and 2030.

An additional source to inform the understanding of traffic trends is the UK energy and emissions projections[21], published in March 2017. The supporting tables provide estimates of CO_2 emissions by source under a Reference Scenario (based on central estimates of economic growth and fossil fuel prices) and 4 other scenarios. Emissions from road transport (in $MtCO_2$) are provided as follows:

Scenario	Emissions ($MtCO_2$)				Change 2015-2030
	2015	2020	2025	2030	
Reference	108	101	97	95	-12%
Low Prices	108	104	100	97	-10%
High Prices	108	99	95	92	-15%
Low Growth	108	101	97	94	-13%
High Growth	108	102	98	96	-11%

The supporting report notes that road transport projections show a decline out to 2030 due to improvements in road vehicle fuel efficiencies, and to a lesser extent the inclusion of biofuels in road transport fuels and increased use of electric vehicles.

6.4 Magnitude of effects of decarbonisation and changes to transport emissions

As noted in Section 5.3 the ongoing reduction in carbon intensity of the national electricity grid (predominantly to increased use of renewables at a national scale) has contributed significantly to the reduction in CO_2 emissions attributable to buildings, particularly in the years 2013-2015.

The potential future trajectories for grid intensity have a direct impact on the outturn emissions in 2030:

- They will guide the city over the magnitude of interventions that are required to meet targets
- The city may also need to help facilitate the achievement of the intensity reduction, through some of the projects delivered in the city

For the purposes of this strategy document a moderate assumption for the decarbonisation rate has been assumed. This is that emissions from grid electricity

21 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/599539/Updated_energy_and_emissions_projections_2016.pdf

will reduce by 35% between 2015 and 2030, and that the benefit of this will accrue to all existing users of electricity in the city.

The position on transport emissions is similarly challenging, although sources indicate that improved efficiency of engines up to 2030 will deliver a net reduction in emissions from the road network. Some caution is required around this assumption however:

- Efficiency improvements attributed to diesel vehicles may now not be realised given recent policy changes around diesel vehicles and air quality
- Road transport projections for the UK are across all road types, whereas the metrics produced by BEIS to monitor local authority emissions exclude motorways (which may be responsible for a larger or smaller proportion of the efficiency improvements)
- National policy may favour increased uptake of electric vehicles.

For the purposes of developing a 2030 scenario to inform this strategy it is assumed that various trends and drivers combine to **reduce overall emissions from road transport by 10% between 2015 and 2030.**

6.5 How are Newcastle's CO_2 emissions projected to change?

An estimate of emissions in 2030 has been developed as set out in Section 6.1 The projected emissions from different sources are shown below.

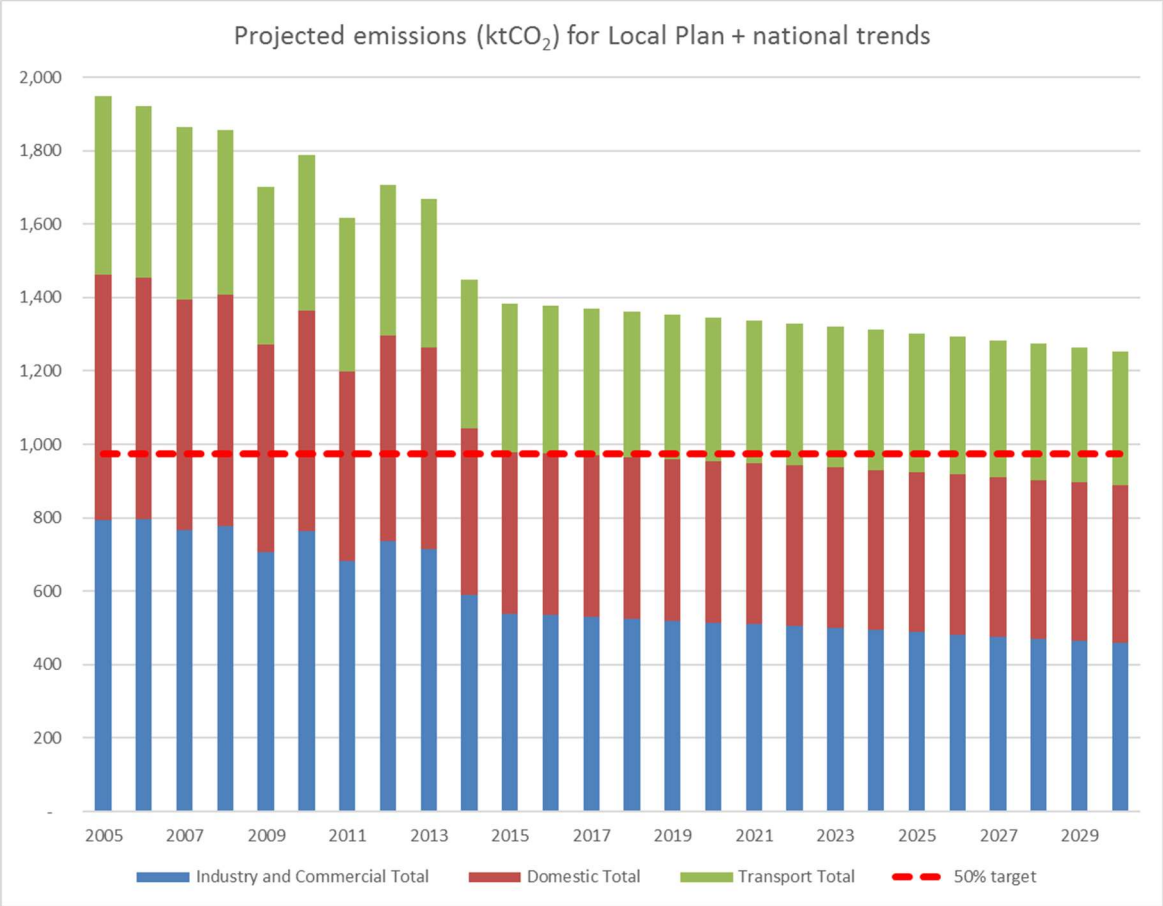

Figure 9 Projected emission for Local Plan + national trends

A fuller breakdown of the contributing emissions is included in Appendix B.

Based on a 50% reduction target against 2005 baseline (equating to a target of **973.8 ktCO₂**) there is a shortfall in meeting the target of **279.7 ktCO₂** which would need to be met through other local measures.

The following sections set out a range of projects and programmes across different sectors to meet this shortfall.

7 Domestic buildings strategy

7.1 Strategic objectives for the domestic sector

Emissions from domestic housing have reduced significantly since the SEAP produced in 2010, and the sector will play a key role in further reductions out to 2030 and beyond.

The objectives for CO_2 reductions within this sector are:

Support small scale domestic energy efficiency improvements and behaviour change across 25% of the households in the city	24 ktCO2
Support loft and cavity wall insulation projects for remaining un-insulated homes	7.2 ktCO2
Through social housing providers deliver improvements to social housing stock to achieve 100% EPC Band C by 2030	18.8 ktCO2
Instigate a hard-to-treat programme to address households for which simple insulation opportunities are not applicable.	41.1 ktCO2
Develop a vehicle to support further uptake of domestic scale renewables and storage across 20,000 households	19.1 ktCO2
Committing to an energy strategy which transitions houses to new heating technologies in line with the findings from the Energy Systems Catapult and ETI Smart Systems and Heat Programme	30 ktCO2
Planning guidance to support Local Plan Policy CS16 to improve standards of new build homes	3.7 ktCO2

7.2 Overview

There are approximately 130,000 occupied households in Newcastle upon Tyne. The tenure of these is[22]:

- Private rented 19.1%
- Owner occupied 49.5%
- Local authority 23.3%
- Housing association 6.4%

There are approximately 4,700 unoccupied houses.

The proportion of social housing (29.7%) is significantly higher than the average across England of <18%. The proportion of private rented is slightly higher than the English average of around 17%.

The housing sector is polarised in Newcastle, with significant pockets of deprivation in some areas.

[22] https://www.newcastle.gov.uk/housing/housing-policy-plans-and-performance/housing-statement

There are several housing associations with properties in the city. The largest social housing provider is Your Homes Newcastle (YHN), which is an Arms-length Management Organisation (ALMO) administering 26,700 council homes on behalf of Newcastle City Council, and over 400 homes on behalf of Leazes Homes Housing Association. In total YHN administer almost one quarter of all homes in Newcastle.

An estimated 10% of Newcastle's private housing stock is classified as having a hazard which impacts on health. This is below the national average and due largely to past improvement programmes. However, the Housing Statement notes that "a greater proportion of Newcastle's housing stock is predicted to be in 'fuel poverty' than the national average. This can be attributed to the high proportion of low income households in the City.[23]"

Newcastle has made significant process in the targeting of energy efficiency measures across the city, and in overall terms the average energy efficiency of homes is above the national average. This work has been supported by other Council initiatives around provision of energy management advice. The majority of remaining houses needing energy efficiency improvements are 'hard to treat' homes – for example those with solid walls, electrical heating, or of non-traditional construction.

The housing stock in Newcastle is predominantly pre-1980s, with around 20% being late Victorian/Edwardian, and over 20% constructed between the World Wars. Many homes in these two categories are classed as "hard to treat" – either because they lack cavity walls (pre-first World War) or they have cavities that are hard to insulate (e.g. tall buildings, narrow cavities, or requiring non-standard insulation). It is estimated that these categories represent approximately 46,000 homes across Newcastle.

13% of Newcastle households are estimated to be in fuel poverty, concentrated in Wingrove, North Jesmond, South Jesmond, and South Heaton.

Gas is the primary heating fuel for homes in Newcastle, accounting for 92% of energy consumption for this purpose.

7.3 Reducing emissions from the domestic stock

Domestic housing has been a key area for addressing CO_2 emissions over the last decade. The cost of energy for households is also a key issue in areas of poverty and deprivation.

[23] https://www.newcastle.gov.uk/housing/housing-policy-plans-and-performance/housing-statement Page 11

7.3.1 Energy sources for different applications

Improving the energy performance of households can be effected through a range of techniques and interventions that follow the energy hierarchy. Energy sources for different applications in dwellings vary – the main energy sources/applications are summarised below:

	Application	Typical energy sources
Regulated energy[24]	Space heating	Natural gas fired boilers Electric heating (e.g. storage heaters) Oil fired boilers/heaters (for properties not connected to the national gas grid) District heating systems
	Hot water	Natural gas fired boilers Electric heating (e.g. immersion heaters) Oil fired boilers/heaters (for properties not connected to the national gas grid)
	Lighting	Electricity
Unregulated energy	Cooking	Electricity Natural gas
	Plug-in appliances	Electricity

[24] 'Regulated energy' refers to consumption that is considered in Part L of the Building Regulations, which requires a certain level of modelled energy performance for development. Regulated energy includes heating, hot water and lighting and therefore reflects the majority of domestic energy consumption.

7.3.2 Energy hierarchy in housing

The energy hierarchy provides a basis for prioritisation of measures and projects which can be used to manage energy consumption. The table below provides an overview of the main types of measures that can be used for different applications in a household to achieve reductions in CO_2 emissions:

Energy hierarchy level	Typical interventions
Energy saving	Better controls on lighting and heating systems to avoid unnecessary use, including: • Use of thermostatic valves and room thermostats to ensure comfort levels are met with minimal energy usage • Use of timers to switch heating on and off to avoid heating spaces or water unnecessarily • Lighting controlled by timer or presence detecting • Smart heating controls Changes in occupant behaviour (e.g. reducing thermostat set points; utilising TRVs effectively; turning off standby modes; reduced washing machine temperatures etc) Improved thermal performance of a building: • Double / Triple glazing • Loft insulation • Floor insulation • Cavity wall insulation • Solid wall insulation – internal or external Insulation of water tanks Draught proofing
Energy efficiency	More efficient boilers More efficient domestic appliances More efficient lighting (i.e. lights which produce the same amount of light using less power)
Renewables	Solar thermal Solar photovoltaic Wind Storage
Low emission energy sources / low carbon energy generation (building scale and/or heat network scale)	Ground source heat pumps Air source heat pumps Air source / gas hybrid boilers Biomass boilers / heaters

7.3.3 Changes in energy consumption in households since the last SEAP

Recent years have seen a reduction in the carbon emissions associated with the generation of grid electricity, which means that the emissions from existing buildings (assuming no change in consumption) have reduced simply through using less carbon-intensive electricity, rather than by implementing specific measures in the building. However overall consumption of domestic electricity has also fallen - from 490.7 GWh in 2005 to 428.2 GWh in 2015 (a drop of 13%).

This suggests that reductions in overall emissions from electricity usage in households in Newcastle is not limited to just decarbonisation effects – but that an overall reduction in electricity consumption, likely in excess of the national trend, has taken place. This may be due to changes in user behaviour, or through the uptake of energy efficient equipment etc.

At a national scale the consumption of natural gas has reduced by 22% over the 2005-2015 period. Emissions from gas consumption in Newcastle (which are not subject to a decarbonisation mechanism in the same way as electricity) have fallen by 29% in the same period. This may be due to user behaviour change, because the thermal performance of houses has improved, because more efficient heating systems are being used, or because of increasing gas prices.

7.4 Measures to reduce emissions from domestic buildings

7.4.1 Improvements to the performance of housing stock

Recent years have seen programmes of improvements to large amounts of the housing stock in Newcastle.

As stated above, in general terms the condition of Newcastle's housing stock is above national average. A large proportion of the stock sits within YHN or housing associations, and generally this building stock will be in better condition than equivalent properties in private ownership.

A full assessment of the existing Newcastle housing stock is not available, but the English Housing Survey provides some broad context for understanding the condition of housing outside YHN or Housing Association control. The report on potential stock improvements[25] provides the following headline indicators of condition:

- In general, the energy efficiency of homes has improved in the last two decades
- The Private rented sector has the largest proportion of dwellings failing Decent Homes standards on the basis of thermal comfort

25 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/627688/Potential_stock_improvements_Report_2015-16.pdf

- Nationally, 23% of the total housing stock had uninsulated cavity walls and could possibly have cavity wall insulation installed. Of these 56% were considered 'relatively easier to treat' after applying criteria in line with the energy company obligations (ECO). Harder to treat cavity walls are predominantly urban dwellings and include a higher proportion of purpose built flats.
- Nationally around 8 million homes could have some form of (internal or external) solid wall insulation installed. Barriers to solid wall insulation include:
    - Masonry walls with projections (e.g. conservatories) which add complexity and expense to installation;
    - Walls with a rendered finish which would require removal and potential repair/treatment
    - Walls with a predominantly non-masonry finish (stone cladding, tile, timber etc)
    - Flats – where challenges of multiple leaseholders and the nature of high-rise buildings[26]
- Nationally, 36% of dwellings could benefit from loft insulation installation or upgrade. For around 56% of these homes installation/upgrade is considered less problematic.

These figures are national, and do not necessarily reflect the picture in Newcastle, but they provide an indication of the magnitude of potential gains to be made through improvements.

7.4.2 Achieving further reductions from domestic properties

There is a range of potential projects which could be taken forward to achieve reductions in CO_2 emissions. The delivery approach to achieving reductions will depend on the building type, location and tenure.

7.4.3 Energy reduction through behaviour change and more energy efficient equipment

Changes in the behaviour of the occupants of housing provide a means of delivering reductions in energy use and reduced carbon emissions. Replacing older and less efficient equipment can also offer benefits.

Typically, energy reduction would include:

- Water heating and hot water use behaviours

[26] The implications of the Grenfell Fire in 2017 on fabric improvements to flats and tower blocks are not yet known, but will likely include information on the use of cladding materials on tower blocks to improve thermal performance. It is reasonable to expect that improvements to the thermal performance of tower blocks will be brought forward at a much reduced pace until the Inquiry into the Grenfell Tower fire has reported on the implications of over cladding materials.

- Thermostat set points, for room thermostats and radiators with TRVs
- Household appliances: washing temperatures; standby mode etc
- Timer switches for lights
- Replacement of older domestic appliances with A++ rated appliances
- Replacement of halogen and incandescent bulbs with LEDs

Advantages	Disadvantages
• can be delivered at a range of scales and extent of intervention • financial benefit of measures accrues to the occupant (except for tenures where energy costs form part of fixed charges) • not technically complex • may be constrained by current heating system and controls • offers benefits across fuel poverty and other agendas for change	• reductions per household are relatively small • initial changes in behaviour may not remain permanent • hard to quantify the impact of programmes to change behaviour • national campaigns may already have delivered some of the benefit • some interventions will have up-front costs for householders

By 2030:

Delivering a campaign to reduce thermostat set points could save 2,000 kWh per household. Applied across approximately 25% of the city (around 26,000 households) would yield a reduction **of 12 ktCO$_2$**. Some of these emissions would relate to electricity use, and some to gas consumption.

Also undertaking a programme of improved controls in households (thermostats, TRVs etc) across 20% of households could deliver an additional **12 ktCO$_2$.**

7.4.4 Energy reduction through fabric efficiency measures

7.4.4.1 Efficiency projects for 'simpler' buildings

As noted above, there have been several programmes offering loft insulation and cavity wall insulation over the last 10-15 years, and many properties in the city will already have made use of these. There will be the potential to carry out 'simple' fabric efficiency measures on a small number of units.

The scenario developed by the ESC includes a deployment project that would see targeted at up to 7,800 homes in the city. Based on the English Home Survey approximately 12-13% of houses with cavities are in the 'relatively easier to treat' category. A conservative estimate of 5% in this category in Newcastle would equate to 5,850 households. Based on this the ESC assumption appears reasonable.

Energy savings trust provides the following estimates of financial savings and CO_2 savings from cavity wall insulation[27]:

	Detached	Semi detached	Mid terrace	Bungalow	Flat
Fuel bill savings (£/yr)	£225	£150	£95	£105	£70
Typical installation cost	£720	£475	£370	£430	£330

Costs have been converted into kWh (estimated as 2,500 kWh reduction for both of loft and cavity wall insulation).

Assuming an average carbon reduction of 900 $kgCO_2$, delivered across 7,800 households, would reduce carbon emissions by **7.2 $ktCO_2$.**

7.4.4.2 Delivering improved performance in social housing

Social housing accounts for just less than 30% of dwellings in Newcastle, over 34,000 households (the majority – 25,700 – managed by YHN). Social housing is in generally good condition, with YHN stock having an average EPC rating of 68, which is at the top end of the 'D' band. The actual energy consumption, and CO_2 emissions, from properties will vary depending on the type and nature of the property being assessed.

YHN have set out targets to deliver the following:

- All stock EPC D by 2025
- All stock EPC C by 2030
- All stock EPC B by 2050

Estimating the carbon emissions from buildings in different EPC bands is challenging for several reasons:

- EPC rating is normalised from the size of the house – and so estimating emissions without details of the property size is challenging
- EPC ratings only apply to regulated energy consumption (see Section 0) and do not account for other energy consumption.
- the performance gap between EPC data and actual building consumption is widely acknowledged – meaning that actual in-use consumption can be significantly higher or lower than the modelled consumption
- Examination of lodged EPC certificates demonstrates that there are extremes across all bands and property types that can skew a regional or city subset of data

A preliminary assessment of EPC data for Bands B/C/D in Newcastle provided the following average CO2 emissions per m2 of floor area:

[27] http://www.energysavingtrust.org.uk/home-insulation/cavity-wall

Band	Average annual CO2 emission per m2 (kg)
B	44.2
C	51.5
D	75.2

- a property moving from Band D to Band B would have reduced emissions totalling approximately 31 $kgCO_2/m^2$
  - for a $100m^2$ property this equates to a reduction of 3,100 $kgCO_2$
  - for a smaller $50m^2$ property this equates to a reduction of 1,550 $kgCO_2$

The Government's Clean Growth Strategy does not provide an analysis of emissions within EPC bands, but it does provide an estimate of financial savings from improving EPC bands. Moving from a Band D to a Band C is estimated to save £270. Moving from a lower band will saving a greater amount.

- the UK Governments estimated gas prices for domestic users[28] estimate a cost of £650 for 18,000 kWh, equivalent to 3.6p per kWh
- a saving of £270 is equivalent to 7,500 kWh

Based on the above it is estimated that on average improving from Band C to Band B would save (per household) approximately:

- 7,800 kWh of gas
- 1,000 kWh of electricity

Delivering 8,800 kWh energy reduction across approximately 750 households per year for 15 years would reduce CO_2 emissions by **18.8 ktCO_2**

[28] https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics

7.4.4.3 Delivering improved performance in other tenures and hard-to-treat buildings

A much more challenging sector in which to improve performance is the owner-occupied, and private rental sectors.

Barriers to improvement in this area include:

- Long payback periods for investment in energy efficiency measures
- Capital cost required at outset
- Poor engagement from householders
- Poor engagement from private landlords
- Intrusiveness of some measures – through disruption to the house, or potential disruption of rental periods
- Technical challenges
- Planning requirements
- Poor quality workmanship
- Paybacks lower than expected
- Uncertainty over technical requirements

Delivering efficiency improvements across other tenures in the city, especially in those houses that are hard-to-treat, will be extremely challenging. Measures such as loft and cavity wall insulation are technically straightforward – however, large parts of the Newcastle housing stock have solid walls, and CWI is not appropriate. Uptake of solid wall insulation (internal or external) has typically been less popular due to the expense and technical challenges of installation.

The Government's recent Clean Growth Strategy, however, has set out a clear policy direction on improving the existing domestic stock. It sets out objectives to:

- improve fuel poor homes to be EPC Band C by 2030
- improve as many homes as possible to EPC C by 2035

The nature of housing in Newcastle (and nationally) is that much of the worst performing stock is in either the private rental sector, or is occupied by households in fuel poverty. Following the statement of policy in the Clean Growth Strategy the improvement of some hard to treat households will be necessary by 2030.

The English Housing Survey estimates that nationally around 8m homes could possibly have some form of external or internal insulation, and around 15% of these would be considered 'easier to treat'. The figures for Newcastle are not known, but a proportioning approach would estimate:

- approximately 40,000 households (34%) could possibly have some internal/external insulation

- approximately 6,000 households (5%) would be 'easier to treat' within this subset

Anecdotally these estimates appear high given that the general condition of housing in Newcastle is higher than the national average.

Unlocking the delivery mechanisms to achieve delivery of improvements to hard-to-treat homes will be challenging, and will combine both local and national strategies and initiatives. The challenges around different tenure and ownership of adjoining properties will contribute to this.

The potential to bring houses from existing EPC levels up to Band C delivers the same quantity of CO_2 reduction as seen under the previous initiative, but could potentially be deployed at a wider scale across the city.

Delivering solid wall insulation to hard-to-treat existing building stock to improve thermal performance, delivering 2 tCO_2 reduction across approximately 20,000 households would reduce CO_2 emissions by **41.1 $ktCO_2$**

7.4.4.4 Programme of renewable energy at domestic scale

The last decade has seen an increase in the deployment of dwelling-scale renewable energy systems – mainly solar photovoltaics, and also some other technologies such as heat pumps. However, changes to the rates of Feed in Tariffs (FiTs) by the UK Government quite suddenly reduced the rate at which solar PV was being deployed on houses.

There is still scope for the deployment of renewables at household or (small) community scale. As the prices of renewable energy technologies fall further then there is more scope for their deployment in houses – and coupled with emerging storage technologies can provide a means to reduce reliance on the electricity grid (in the case of solar PV) or thermal energy (in the case of solar thermal). Other technologies such as GSHP may also be viable for households. A typical 4 kW domestic PV installation can reduce CO_2 emissions by 1.5 tCO_2/yr[29] (although this benefit reduces over time when compared against a decarbonising national grid).

Delivering or supporting a programme of domestic solar PV deployment across 20,000 households could deliver **19.1 $ktCO_2$**

[29] http://www.energysavingtrust.org.uk/renewable-energy/electricity/solar-panels

7.4.5 Changing the energy supply strategy for households at a large scale

Recent years have seen significant progress in reducing the carbon intensity of electricity, and this is forecast to continue in the next decade. However, national policy now acknowledges that the key challenge to meeting national carbon targets is to decarbonise the generation of heat in buildings. At present most dwelling use natural gas to provide space and water heating. A smaller number use electricity in the form of storage heaters and immersion heaters.

The work being undertaken by the Energy Systems Catapult (ESC) to develop the Local Area Energy Strategy has looked in detail at the technologies that would allow dwellings to shift to lower carbon sources of heat for space heating and hot water. The research uses GIS/spatial analysis to identify the optimal cost strategy to achieve the magnitude of CO_2 reductions required to achieve carbon targets in the city for 2050.

The research involves the running of different economic scenarios to understand what technologies are preferred for different areas of the city. At present most houses use gas combi boilers for space and water heating. Under the scenarios developed by ESC households would generally move to using:

- Air source, and hybrid, heat pumps (high temperature / low temperature)
- District heating – powered through large scale heat pumps or other heat sources to be confirmed

The transition to widespread use of these technologies would be extremely challenging, with two main considerations being:

- The implications of significantly increased electricity demand on the existing electricity infrastructure, and the phasing of grid reinforcement
- The process of transferring householders to new technology, in some cases using more than one technology change in the period to 2050.

Outside of the work carried out by ESC there are also research projects into the potential for alternative fuels to replace natural gas, which would provide heating at a lower carbon intensity than current systems.

- Hydrogen offers the potential to replace (in full, or in part) natural gas. However, generation of hydrogen requires the capture and storage of CO_2 at a large scale to allow for this to be a significant element of heat generation
- Other low carbon sources of gas include biogas and methane from anaerobic digestion.

The work undertaken by the Energy Systems Catapult has looked at how the city can transition away from (largely) gas boilers for domestic space/water heating, and towards a system of lower carbon heat pumps for some houses, and district heating for others, depending on the characteristics of the neighbourhood.

The technical analysis behind this work is complex, but it has developed a strategy for transitioning to these systems by 2050. Committing to, and delivering,

the infrastructure upgrades and the equipment changeover would yield some benefit by 2030 (although the main benefit would be delivered in the period 2030-2050).

Committing to the strategy set out by ESC, and beginning the transition over to new heating systems for neighbourhoods, would see 29,000 homes connected to district heating schemes, and over 17,000 households transitioned to heat pumps (of various types).

By 2030 this transition process will be reducing emissions by **30 $ktCO_2$**.

7.4.6 Planning guidance to support Local Plan Policy CS16

The Local Plan includes a policy (CS16 Climate Change) that requires development to use a good standard of building fabric, and to reduce its whole life emissions impact.

The council is currently considering additional guidance on this policy which would set a minimum Fabric Energy efficiency for new buildings. This would have the effect of reducing the energy consumption of new buildings across the council area. The requirements may be extended to both new domestic and non-domestic buildings.

A conservative estimate is that **3.7 $ktCO_2$** of forecast energy consumption arising from 19,000 new dwellings could be avoided through implementation of additional guidance on CS16 to domestic properties

7.5 Aggregated savings across housing

In aggregate these initiatives provide a potential reduction of **143.8 $ktCO_2$** (allowing for some rounding variation)**.**

8 Industrial and commercial sector strategy

8.1 Strategic objectives for the industrial and commercial sector

Emissions from industrial and commercial sectors have reduced significantly since the SEAP produced in 2010, and the sector will play a key role in further reductions out to 2030 and beyond.

The objectives for this sector are:

Work closely with corporate bodies in the city to understand their emissions, forward plans, and progression towards their own corporate targets	36.5 $ktCO_2$
Investigate potential low carbon heat projects – such as heat from sewage, heat from the Tyne, large GSHP – and support delivery of one or more projects	19.3 $ktCO_2$
Deliver an SME energy awareness service/project in the city (and/or wider area)	0.6 $ktCO_2$
Facilitate delivery of a commercial PV programme to achieve widespread rollout across the city	17.9 $ktCO_2$
Facilitate delivery of a major industrial energy efficiency programme in line with the UK Clean Growth Strategy	28.9 $ktCO_2$

8.2 Overview of non-domestic sector

There are approximately 18,800 non-domestic buildings in Newcastle[30].

At present there is no complete emissions inventory for the city, and the contributions of different institutions/organisations to the footprint are not known. However, based on a review of publicly available documents covering the period around 2015 (the closest temporal period to the calendar year has been chosen where financial/reporting years do not align) the following approximate emissions have been identified for key institutions (based on energy consumption only where this is specified):

Organisation	Period (if known)	Total CO_2/CO_2e emissions
Newcastle City Council	2015 – 2016	62,566 tCO_2e
Newcastle upon Tyne Hospitals NHS Trust	2015 – 2016	65,995 tCO_2e
Newcastle University	2014 – 2015	40,438 tCO_2e
Northumbria University	2014 – 2015	19,248 tCO_2e
Newcastle Airport (from CRC Return)	2014 – 2015	8,542 tCO_2e
Newcastle College	2014 – 2015	6,780 tCO_2e

In total these organisations/institutions account for approximately 193 $ktCO_2$ per year, which is equivalent to around 36% of the total CO_2 emissions from the Industrial and Commercial sector, and around 14% of the overall city carbon emissions. There will be some error with this estimate as many organisations report CO_2e rather than CO_2 (the units used for reporting by the local authority)

[30] Catapult Energy Systems – Local Area Energy Strategy, 2017

however this is relatively minor in the context of gaining a wider understanding of where emissions are generated[31].

Further information on emissions from institutions is provided in Appendix B.

The emissions from the council's own operations are discussed separately in Section 9.

The wider set of organisation types and scales across the city has not been fully investigated as part of this study. Some preliminary work undertaken by the Energy Systems Catapult has begun to characterise this wider set of non-domestic building archetypes. However, the data to understand what levels of energy consumption does not yet exist. The absence of a strong evidence base to inform the development of industrial and commercial strategies for the city is a key barrier to developing a strategy in this area, and the council will look to prioritise the development of an improved set of data to address this.

8.3 Industrial emissions interventions

There is a wide range of potential measures which can contribute to reducing emission from this sector, although many of the significant benefits will be gained from activity in a relatively small number of industrial operations. Further work is recommended to understand what industrial activities are undertaken where in the city, to inform the best focus for future support on energy efficiency and low carbon energy sources.

Work carried out for the City of Bristol[32] identified a long list of industrial and commercial intervention for buildings which can contribute to reducing emissions:

Industrial low carbon measures

- Boilers and steam piping
- Furnaces
- Refrigeration
- Pumps
- Fans
- Compressed air systems

Commercial

- Improved efficiency lighting and controls
- Higher efficiency boilers and improved controls

[31] In the most recent set of emissions factors produced by UK Government for corporate reporting CO_2 emissions as a percentage of CO2e emissions are 99.3% for electricity, and 99.8% for natural gas consumption (https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016)
[32] http://bristol.ac.uk/cabot/media/documents/bristol-low-carbon-cities-report.pdf

- Power factor correction
- Variable speed pumps
- Air tightness and other fabric improvements
- Solar thermal and solar PV systems
- Heat pumps
- Heat recovery in buildings
- Cooling systems and chilled beams

8.4 Barriers to delivering improvements

While the industrial and commercial sectors are being grouped together, the strategies required to deliver improvements in each sector are different, and respond to different challenges and barriers.

In the industrial sector the main challenge is expected to be the industry-specific nature of improvements. As the opportunities for energy efficiency improvements will be linked closely to the equipment and systems particular to that industry, then the investment and support required to understand, assess and implement measures will be considerable. Many larger industrial partners will have already investigated the potential for improving their systems in order to reduce energy costs.

However, a fuller understanding of the energy consumption and operational emissions from the industrial sector across the city would assist in identifying the organisations with the greatest potential to reduce energy consumption.

Within the commercial sector the main challenge is around the ownership and leasing of buildings. The majority of commercial organisations in the city lease their premises – and energy costs typically represent only a small portion of occupation costs. This is compounded by the majority of leases being quite short – typically <4 years – which further reduces the overall consideration of energy costs in the overall costs of occupying a property.

A small proportion of larger corporate bodies will be actively interested in the energy consumption of their facilities (through Corporate Social Responsibility requirements) but these will tend to be organisations which will occupy higher grade office properties – which will tend to perform better in energy terms.

The Minimum Energy Efficiency Standards (MEES) for commercial properties are not expected to deliver large improvements in overall energy consumption within the city. The system provides for some building owners to obtain exemptions from the requirements based on the payback period of measures or the potential for impact on the market value of their building. Also many poorly performing office buildings – such as those in the centre of the city – will be exempt based on their listed status.

Notably the recent Clean Growth Strategy produced by the UK Government notes the need for industrial and commercial buildings to improve, and has indicated the introduction of innovation programmes aimed at this sector.

8.5 Measures to reduce emissions from industrial and commercial buildings

8.5.1 Close working with corporate bodies across the city

As noted above, a small number of organisations within the city contribute a large proportion of the overall emissions within the city. The council, the two universities, the NHS, the airport and the college represent **14% of the overall CO_2 emissions from the city.**

These organisations clearly have an important role to play in delivering carbon reductions across the city, and will be facing their own organisational challenges in meeting their corporate carbon targets. This is especially the case as many of them are seeking to reduce overall emissions against a strategic aim to expand their operational estate.

It is essential that the council effectively engages with these bodies in order to understand:

- How they expect to meet their carbon targets, and how well are they proceeding towards achieving them
- Where sites are located in close proximity (specifically the civic quarter at the north of the city centre) are the opportunities for the city to facilitate, or commit to, partnering in projects which will contribute to all organisations meeting their carbon targets

Across the large organisations in the city, excluding the council, it is expected that an overall contribution of **36.5 ktCO_2** is a realistic, and cautious, basis on which to proceed. The full extent of how institutions will deliver this is unclear at this stage, and it is unclear to what extent national decarbonisation trends will provide these reductions. The institutional targets used to inform this value are projected to be met by 2020.

It is expected that further CO_2 commitments will lead to lower emissions beyond 2020 as institutions continue to support GHG reductions in line with the Climate Change Act but no further reduction is included in the modelling for citywide emissions beyond these 2020 commitments.

The Council must be clear in understanding progression towards this across other organisations, and what can be done to assist in ensuring delivery of this quantum of carbon reduction.

8.5.2 Investigate low carbon heat projects

There is a need for the city to work to investigate and identify potential sources of low carbon heat across the city, and to support the exploitation of these. Heat sources have not been identified, but potential opportunities could include:

- Water source heat pumps on the River Tyne
- Ground source heat pumps from the Town Moor or other open areas in the city
- Heat from sewage
- Heat derived from Energy from Waste (EfW) plant

The need to identify sources of low carbon heat also feed into the wider, and longer term, need to decarbonise heat supplies in the city (also referenced under the Smart Systems and Heat opportunity in Section 0).

Delivering an estimate for the potential energy from heat projects is challenging as no citywide study on the potential has been carried out. The scale of heat output from different projects will vary widely.

A conservative estimate of **19.3ktCO_2** has been adopted. This would represent approximately 10 medium scale projects implemented across the city. A larger scale project (such as EfW) may produce significantly larger amounts of heat to offset other energy use.

8.5.3 SME Advise and awareness raising

The barriers to delivering energy efficiency projects in the SME sector are significant, with the barriers arising from the leasing of buildings as set out above.

One opportunity for intervention in this area supported by the local authority is through the provision of energy efficiency and reduction advice. A project providing this support has been established in Durham, using ERDF funding, and there is a potential funding stream for a similar project in Newcastle, or serving a wider set of local authorities within the area covered by the North East LEP.

Reductions in emission are expected to be quite moderate.

An estimated **0.6 ktCO_2** could be delivered through energy efficiency and advice to SMEs

8.5.4 Other action areas

One area which has not been explored further, but which may offer potential for significant energy reduction, is through achieving energy efficiency improvements across industrial activities. However, at present there is insufficient data at the local authority level to determine what the emissions are at present from this sector. This should form part of a wider emissions inventory exercise.

8.5.5 Facilitate delivery of a commercial PV programme to achieve widespread rollout across the city

There is significant potential in the city for a widespread rollout of a commercial PV programme – using the roofs and facades of existing building to install solar voltaic panels to either generate supply for the building itself, or to supply the national grid. As prices for installing PV continue to fall, combined with improvement in battery storage technology and other techniques for dealing with fluctuating demand, there is potential for significant uptake.

The city would like to see the widespread uptake of solar PV panels on commercial buildings either directly implemented by building owners, or through innovative schemes whereby roof space is effectively rented by solar power generating firms.

A widespread rollout of solar PV across the city's non-domestic buildings, achieving approximately 20,000 domestic installations, could generate sufficient electricity to reduce overall emissions by **17.9 ktCO2**.

8.5.6 Facilitate delivery of a major industrial energy efficiency programme in line with the UK Clean Growth Strategy

The UK Clean Growth Strategy has highlighted the potential for industrial energy consumers to achieve significant energy consumption savings through a range of measures (new equipment, new controls, more efficient boilers, lighting etc). The work undertaken by the University of Leeds in the 'Can-do cities' project estimates that Newcastle industrial companies could save £7m of fuel costs per year from their running costs.

Converting this value to a gas consumption provides an indicative quantity of CO_2 achievable from this sector.

Saving £7m of energy consumption, across 15 years, could generate aggregated carbon savings of around **28.9 ktCO$_2$.**

8.6 Aggregated savings across non domestic buildings

In total these initiatives provide a potential reduction of **103.2 ktCO$_2$** although almost all of this is from close working with the large organisations in the city responsible for significant proportions of emissions from buildings.

9 Council operations strategy

9.1 Strategic objectives for addressing emissions from council operations

The Council needs to achieve carbon reductions from its operations as part of its overall commitments, but also to demonstrate leadership across the city.

The objectives for the Council are to:

Accelerate the delivery of energy efficiency projects across the Council estate	1 $ktCO_2$
Implement measures to improve the performance of council-owned properties let to other bodies/companies	0.6 $ktCO_2$
Deliver the Science Central CHP system, and Civic Quarter heat network, and investigate and deliver other CHP or district heating projects which can contribute to council operational buildings	13.5 $ktCO_2$
Carry out the streetlighting replacement programme	3.7 $ktCO_2$
Council fleet replacement	1.5 $ktCO_2$

9.2 Overview

Newcastle City Council is one of the largest organisations in the city, with operational buildings and equipment consuming energy and power within the city representing the majority of corporate emissions.

In 2015 the city reported its Scope 1 and 2 emissions (electricity and gas) as 62.5 $ktCO_2$. **This represents around 4.5% of the overall CO_2 emissions for the local authority area.** It does not include emissions from social housing.

The actions of the council in addressing its own carbon footprint are therefore significant, both in terms of contributing to reductions in overall emissions from the city, but also to demonstrate clear leadership to other corporate organisations within the city.

9.3 Operational buildings

The council operates a range of buildings across the city, including offices for council staff, schools, depots, and care homes. The council also operates streetlighting and traffic signals. As with any organisation the council also has a large element of 'Scope 3' emissions (from travel, water treatment, waste management etc) although these are not considered further as they are a relatively small portion of the emissions within the city boundary.

For 2015/16 the headline operational consumption for the council was:

- 72.2 million kWh of electricity
- 158.2 million kWh of gas

9.4 Operational vehicles

The council operates a fleet comprising approximately 800 vehicles[33] all of which are owned by Newcastle City Council. This fleet includes:

- Over 400 vans of varying types and sizes
- 55 Refuse collection vehicles
- Over 85 welfare and minibuses
- Approximately 70 cars, of which a fifth are electric vehicles

Fuel consumption in 2015 for the council's vehicle fleet was:

- 1.6m litres of diesel
- 30,000 litres of petrol
- 175,000 litres of gas oil

This fuel consumption results in emissions of around 4.8 $ktCO_2$.

9.5 Measures to reduce emissions from Council operations

9.5.1 Energy efficiency projects across the Council estate

Salix funding has provided a mechanism for the Council to carry out energy efficiency improvements across its own operational buildings. These projects take in a wide range of improvements to buildings, including:

- Upgrades to lighting and controls
- Boiler and heating controls
- Building Management System improvements
- Insulation and draft proofing

Since 2009 approximately £1m has been secured through Salix funding and delivered annual cost savings of over £230,000, and lifetime savings approaching £4m. the annual CO_2 savings from these projects total over 1 $ktCO_2$.

There exists a further list of around 650 uncosted projects. It is expected that continued rollout of this type of efficiency project could deliver substantial further CO_2 reductions.

A conservative estimate of **1 $ktCO_2$** is ascribed to additional energy efficiency measures across the council operational buildings. The potential benefit could be significantly higher if rolled out to the full extent.

[33] Data supplied by NCC for March 2017

9.5.2 Minimum energy efficiency standards in council-owned buildings

The Minimum Energy Efficiency Standards (MEES) Regulations make it unlawful to let commercial properties with an Energy Performance Certificate rating of F or G. Newcastle City Council owns a number of buildings which are not used for the council's operational activities, but are instead let to other companies/organisations.

In line with MEES the council has adopted a commitment to improve this stock to meet the minimum standards by the April 2018 deadline.

Improvements to the buildings will comprise energy efficiency measures and improvements to building fabric.

A full quantification of the energy and carbon impact of these measures has not been carried out, but it is expected to result in improvements to around 75 buildings/properties.

A conservative estimate of **0.6 $ktCO_2$** has been assumed through improvements to these buildings, although it could be significantly more depending on the number, size and improvement to individual buildings.

9.5.3 Target reductions in emissions from the council fleet

The council's vehicle fleet was responsible for 4.8 $ktCO_2$ in 2015 and offers the potential for significant reductions where alternative lower emitting vehicles can be identified. This will face operational challenges, some of which have been identified through previous trials in the council. However, technology continues to improve and alternative vehicle options may increase between 2015 and 2030.

Moving half of the vehicle fleet to low carbon fuels could reduce emissions by **1.5 $ktCO_2$.**

9.5.4 Delivery of CHP and/or district heating schemes

The council has previously undertaken studies to understand the potential to deliver district heating schemes with the primary initial aim of supplying heat to council operational buildings (council offices, schools, nurseries etc) and also areas of social housing. In 2013 the Re-Generate Newcastle identified and prioritised schemes from an identified list of 20 clusters of heat demand across the city. These were quantified in terms of carbon and energy centre/network costs.

Since this time the proposals for a gas fired CHP system at Science Central have been progressed, and a new energy centre and heat network is expected to be delivered at the site. The forming a partnership between Newcastle City Council and energy company Engie will underpin the progression of this project, and others, across the city.

Based on the historic work carried out for the Re-Generate study the likely contributions of projects to reducing CO_2 emissions are:

- Science Central 748 tCO_2/yr
- Civic Quarter West 6,860 tCO_2/yr
- Other projects >5,000 tCO_2/yr

A reappraisal of the projects included in the Re-Generate study has not been carried out, and the viability of these has not be reassessed.

Delivery of CHP and/or heat network projects at Science Central and Civic Quarter West estimated to provide **7.6 $ktCO_2$** of low carbon heat.

Additional projects in the rest of the city are estimated to save **5.9 ktCO2**.

9.5.5 Carry out the streetlighting replacement programme

As technology for streetlighting improves, the potential gains from replacing the existing streetlighting equipment increase. Benefits of replacing streetlighting come from multiple aspects:

- The replacement of lamps which provide lighting at a lower energy consumption than previous fittings
- Better controls to allow for the dimming of light output levels (and associated energy consumption)
- Better controls to allow for the timed trimming of lighting periods (more selective operation of subsets of streetlights)
- less maintenance is required due to better understanding of operating conditions.

Proposals for the replacement of streetlighting across the city have been developed, and can be justified in terms of energy cost reductions and savings on whole life maintenance costs. It is understood that the city-wide replacement programme will be carried out.

An estimated **3.7 $ktCO_2$** reduction in emissions will be delivered through the streetlighting replacement programme

9.6 Aggregated savings across Council operations

In aggregate these initiatives provide a potential reduction of **20.3 $ktCO_2$** across Council operations could be possible.

10 Emissions from road transport strategy

10.1 Strategic objectives for carbon emissions from road transport

Road transport is the area that has seen the slowest rate of emissions reduction over the last decade. Transport is highlighted as a key area that must deliver carbon reductions if the UK is to meet its carbon emissions commitments.

This translates into a requirement for Newcastle to address the emissions from vehicles within the local authority boundary, but also to identify opportunities to facilitate the shift to lower carbon forms of transport and freight.

The issues around CO_2 emissions from transport are also closely linked to issues of local air quality, which are currently receiving increased public scrutiny. Alongside challenging carbon targets Newcastle also has areas identified as being expected to fail to meet air quality requirements.

The objectives for this sector are:

Deliver a range of low carbon transport projects to encourage greater walking and cycling	1.5 $ktCO_2$
Deliver a range of low carbon transport and freight projects, developed to achieve quantified CO_2 reductions by 2030	15 $ktCO_2$

10.2 Overview

Emissions from road transport have reduced at a slower rate than for buildings – not benefitting from the decarbonisation contribution that the grid provides.

Large changes are expected in the carbon intensity of transport in order to meet the UK's climate change targets, and will be based on some or all of:

- Improving vehicle efficiency
- Ending the sale of conventional petrol/diesel vehicles
- Transitioning to lower carbon energy systems for vehicles (biofuel, hydrogen, electric etc)
- Improved electric vehicle charging networks
- Encouraging uptake of low emission taxis and buses
- Innovation in battery storage technology

10.3 Measures to reduce emissions from road transport

10.3.1 Opportunities for walking and cycling

Newcastle has an ongoing programme of investing in cycling infrastructure across the city, and has recently rolled out a bikeshare scheme in the city to further encourage cycling of short journeys.

Quantifying the potential benefit of these types of measures is challenging, however an order of magnitude can be established:

- a car journey of 3.5 miles would be expected to emit approximately 1kgCO_2
- achieving a contribution of 1.5 ktCO_2 would require 1.5m journeys of this type to be transferred to low carbon transport mode
- focusing on commuters, changing behaviour to cycling 8 times per week to and from work, across 9 months of the year would, require over 5,000 commuters to change behaviour to achieve this magnitude of carbon reduction

this is clearly a challenging aspiration to achieve across the city, but establishes the quantum of behaviour change required to deliver CO_2 reductions through this route.

Deliver walking and cycling infrastructure, supported by local campaigning, to target **1.5 ktCO_2** reduction through avoided car use

10.3.2 Delivering wider CO_2 transport reductions

As noted, there is a need for road transport to contribute to reducing CO_2 emissions across the city.

At present the understanding of what elements contribute to the road transport emissions are incomplete. Most transport-related data in the city has been collected/developed to assist in transport management and air quality. While these overlap in some areas as strategic drivers, the measures adopted to address each area will not necessarily contribute to a reduction in CO_2 emissions (although many initiatives will).

In order to deliver reductions in CO_2 emissions over and above the assumed changes in the wider transport context (already built into the 2030 projection scenario) the council will need to develop and adopt strategies which reduce vehicle use, and which reduce emissions of CO_2.

A wide range of potential measures could be considered to deliver this:

- increased public transport prioritisation
- increased use of Park and Ride
- smart/single ticketing regimes

- school and workplace travel planning
- key institution modal shift plans
- revenue generation from congestion charging or private vehicle levy (such as has been undertaken with the Nottingham Work Place Levy)
- expanded EV infrastructure
- parking strategy
- expanded car club
- city logistics strategy
- support for alternative fuel taxis and buses
- development of freight strategy to reduce vehicle movements and congestion – consolidation or last-mile strategy

To achieve this quantity of CO_2 savings will require action across many different initiatives, and the aggregated savings will be a function of the interplay between different initiatives in what is a complex and inter-related transport system. To provide an indication of the magnitude of changes required the following changes in vehicle use represent a reduction in CO_2 emissions of 15 $ktCO_2$:

- approximately 50m avoided car miles travelled per year (based on a simple CO_2 emissions value per mile)
- approximately 18m avoided HGV miles travelled per year (based on a simple CO_2 emissions value per mile)
- moving an estimated 10,000 vehicles (travelling an estimated 5,000 miles/yr within the city) from fossil fuel to low carbon electricity

In practice the reduction in CO_2 emissions can also be helped by reducing congestion in the city, however the interplay between different CO_2 reductions by intervention are highly complex.

Deliver a suite of measures to target **15 $ktCO_2$** reduction in road transport emissions over and above background trends

10.4 Aggregated savings across road transport

Delivering projects of this scale would reduce emissions by **16.5 $ktCO_2$** although it is expected that a suitable informed evidence base, and an understanding of proposals in the city to address air quality issues, this estimated total contribution could be significantly larger.

11 Aggregated emissions reductions for 2030

Based on the suite of projects set out above, the following emissions reductions are projected:

Sector	CO_2 reduction ($ktCO_2$)
Domestic	- 143.8
Non-domestic (excluding Council)	- 103.2
Council operations	- 20.3
Transport	- 16.5
Total potential reduction	**- 283.8**

This exceeds the gap-to-target of 279.7 $ktCO_2$ by a small amount. This is shown in the chart on the following page.

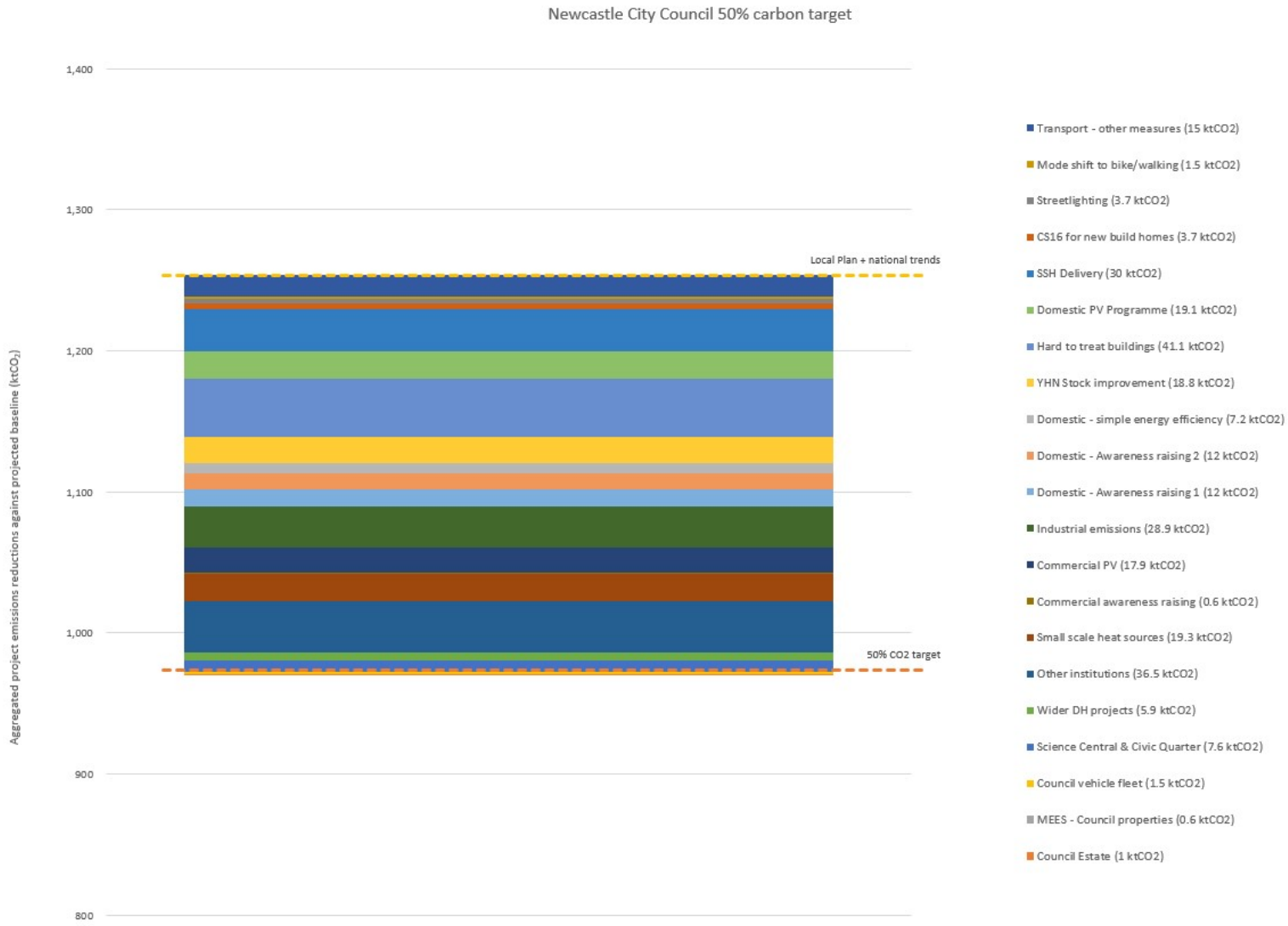

Figure 10 Projects/programmes to meet the 2030 CO_2 target of 973.8 $ktCO_2$

Table 6 List of programmes/projects and associated CO_2 reductions

Project		**CO2 savings (ktCO2)**
Municipal	Improvement to the Council operational estate	1.0
	Application of Minimum Energy Efficiency Standards to council buildings which are not used for operational (i.e. let to other parties)	0.6
	Council fleet replacement	1.5
	Delivery of Science Central and Civic Quarter West DH projects	7.6
	Delivery of remaining projects identified in the PB Report	5.9
Industrial and commercial	Working with other institutions	36.5
	Identify and exploit low carbon heat opportunities across the city - SMALL	19.3
	Awareness raising and behaviour change support	0.6
	Commercial PV Programme	17.9
	Interventions on industrial emissions	28.9
Domestic	Awareness raising and behaviour change campaign	12.0
	Awareness raising and behaviour change campaign	12.0
	Improved efficiency of houses	7.2
	Improvements to energy performance of YHN stock.	18.8
	Improved thermal performance in Hard to Treat (OO / Private) houses	41.1
	Renewable energy at domestic scale - support for PV	19.1
	SSH - commitment and delivery	30.0
	Tighter performance requirements on new build domestic	3.7
Lighting	Streetlighting replacement	3.7
Transport	Mode shift from car to bike/walking for c. 5000 people	1.5
	Suite of measures to be determined (see Section 10)	15.0
TOTAL		**283.8**

12 Other initiatives to support the transition to a low carbon economy

In addition to the sector-specific programmes set out above there is a range of other initiatives and/or research which the city could undertake. These are briefly described below.

12.1 Research and innovation projects identified through the Smart Systems and Heat project

The SSH work has identified areas where further research and innovation is required.

Delivering heat networks to low rise residential properties

One of the key challenges around a transition to wider use of district heating is how to implement heat networks in the existing building stock, predominantly in those areas of owner occupied or privately rented homes.

Heat pump demonstrator project

Establishing how low carbon electric heating systems could be implemented in homes across the city, and how this would then link into commercial arrangements for supply of power, and upgrades to the supply network to support this.

Fitting biomass to off-gas-grid properties

Investigating and developing mechanisms for provision and installation of biomass boilers to the rural fringe of the city.

12.2 Other supporting initiatives

Robust non-commercial emissions dataset

The city does not currently understand in full where emissions arise from for the non-domestic sector. This work has identified that a small number of organisations contribute a significant proportion of CO_2 emissions for the city. However, a fuller analysis of commercial and industrial energy consumers, and their locations in the city, would help to inform future interventions and activities to support CO_2 reductions.

Development of local emissions inventory

Linked to the objective above would be to develop a more complete emissions inventory for the city, bringing together the BEIS data on consumption and reconciling this with other local data on energy consumption to understand spatially where this takes place. Mapping work carried out prior to the previous Climate Change Strategy and Action Plan included:

- Thermal photographic flight over Newcastle to identify buildings emitting large amounts of heat
- Average electricity, gas and heat consumption data by ward (aggregated for 2008)
- Domestic heat density at Lower Layer Super Output Area (LLSOA)

As an initial task the full suite of available data from BEIS should be mapped to the city to provide an understanding of what has changed since the previous SEAP work.

The question of how transport feeds into the city's emissions is also unclear, as presently there is no clear data set which reports on vehicle numbers, congestion, fleet, and public transport in the city. If the city strategy is to move from focusing on domestic buildings onto industrial, commercial and transport emissions (as set out in the UK Clean Growth Strategy) then there will be a need for a more comprehensive understanding of emissions across the city.

There would also be benefit in bringing together available data on the renewable energy installations across the city to understand the contribution that these make to local energy consumption.

Real time energy monitoring

To support the local emissions' inventory one area of future research would be to develop real time energy measurement across the city. This would also offer a platform for understanding peaks in demand, which will support a move to new models of energy and comfort contracting.

Future models for energy transactions

The expectation is that new models of energy transactions will start to be implemented, supported by the installation of smart metering in buildings. Energy contracting offers one mechanism which ties into energy efficiency improvements, where a supplier guarantees the future costs of energy for a consumer.

Energy storage

Storage of energy – either battery storage of electrical power, or thermal storage of locally generated heat – will form an important element in delivering the benefits that can be accrued from the mechanisms above – new forms of energy transactions, local renewables, and demand side management.

13 Financing and delivery models

Delivering the range of interventions and programmes set out above will require a range of different funding, organisational and advice systems to be established.

Recent years have seen significant reductions in the capacity of local authorities in the UK to directly fund and/or support energy and climate change projects – both through the availability of funding for projects, but also through the capacity within local authorities (in terms of staff time) to address the complex and multi-stakeholder engagement that energy projects require.

Delivery of the range and scale of programmes set out above will rely substantially on identifying mechanisms to secure funding investment, but also relies on establishing systems to address the multifarious barriers and challenges that are present across different project types, sectors and timescales.

The changes that are forecast across the way energy is generated and supplied in the UK – both for buildings and for vehicles – will evolve in parallel with new commercial and funding arrangements. The UK is expected to move away from large scale centralised energy generation and towards more distributed and widespread generation. This will require changes to the way in which energy is bought and sold to consumers, and with the advent of smart metering across the UK will open the potential to innovative charging mechanisms.

13.1 Funding and financing options

Funding sources for local authorities have changed in recent years. Future sources of funding from European bodies (which has historically been used on many innovative energy/transport projects in the North East) will become restricted as the UK moves closer to exiting the EU.

At a local level the wider economic constraints on councils restricts their autonomy to spend beyond statutory requirements, and also means that some sources of funding may be politically unpalatable. Typical funding mechanisms used previously are set out below.

Funding Mechanism	Type of Funding	Description
User Fee/ Toll Collection	Revenue	A charge to the users of a facility, such as a road, bridge, tunnel, congestion charging, tram fares. Future User Fee charges may link closely to fuel use such as charges for diesel engines in areas with air quality issues.
Community Infrastructure Levy (CIL)	Capital	CIL is a charging mechanism that local planning authorities can levy upon new development as a condition of granting planning consent. CIL allows Local Authorities to raise funds from developers undertaking new building projects, with this then being used to fund a wide range of strategic infrastructure.
Business Rate Supplement (BRS)	Revenue	A BRS is a compulsory charge added to all National Non-Domestic Rates (NNDR) that are levied on qualifying properties within a given local authority area.

Funding Mechanism	Type of Funding	Description
		Under the terms of the Business Rates Supplement Act 2009, a BRS can be levied up to a maximum of 2p in the pound of rateable value, increasing the total NNDR multiplier to a maximum of 50.2p in the pound with a rateable value threshold of £50,000 (2014).
Council tax precept	Revenue	An addition to council tax which could be levied for either a specific project or an infrastructure investment programme as a whole.
Crowdfunding	Capital/ revenue	A form of third party contributions, whereby more often a small amount of money is drawn from a large volume of donors, often coupled with a public advocacy campaign and local support and events.
Workplace Parking Levy (WPL)	Revenue	Under the Transport Act 2000 local traffic authorities in England and Wales, outside London, may introduce a WPL to help tackle congestion in towns and cities. A levy on employers for providing workplace parking with the aim of reducing private car commuting to work and encouraging a shift towards public transport
Special purpose local taxes, e.g. Stamp Duty Land Value Taxation	Revenue	Specific fund-raising measure such as tax levied on the purchase of consumer goods made in the local area or a tax levied on tourism (such as hotel tax), an annual charge based on the rental value of land (Land Value Tax), etc. There are, of course, a range of other possible taxes which could in theory provide additional funding, though these may pose wider challenges in terms of practicality, fairness and competitiveness.
Tax Increment Financing (TIF)	Revenue	TIF is a mechanism used by a Local Authority to promote economic development. It is designed to use the incremental business rates generated by a development project to leverage upfront borrowing to deliver the project.
EU grants	Grant	EU Structural Funds including: • European Regional Development Fund (ERDF) and the European Social Fund (ESF). • ERDF promotes: o Innovation and research o The digital agenda o Support for Small and Medium-Sized Enterprises (SMEs), and o Low-carbon economy • ESF promotes: o Growth through job creation o Sustainable development o Social innovations Also other EU grant sources where applicable, e.g. EU Trans-European Transport Networks (TEN-T).
Central government LEP funding	Grant	LEP funding comes from a number of grant sources. Some of these currently include: • Regional Growth Fund (no further rounds announced and LEPs were barred from the last two round (i.e., Rounds 5 and 6));

Funding Mechanism	Type of Funding	Description
		• Growing Places Fund (no further rounds announce) to be spent on infrastructure; • Responsibility for delivering part of the EU Structural Investment Funds for 2014 - 2020 • Single Local Growth Fund (LEPs eligible to apply to a pot of £10bn from 2015-16 covering housing and transport); and • LEPs also have responsibility for delivering part of the EU Structural and Investment Funds for 2014-2020.
Business rates	Revenue	National Non-Domestic Rates, or Business Rates, collected by Local Authorities are the way that those who occupy non-domestic property contribute towards the cost of local services. Currently business rates are currently distributed 50% to the Local Authorities and 50% to central government (which is then redistributed nationally, partly through Revenue Support Grant) The UK Government is proposing a significant reform to local government financing that will see a system of 100% local business rate retention rather than central government collection and redistribution.
Council tax	Revenue	Council taxes collected by Local Authorities are the way that those who occupy domestic property contribute towards the cost of local services. There is a 2% p.a. cap (imposed by Government) on any increases subject to a referendum.
Section 106	Capital	Planning obligations under Section 106 of the Town and Country Planning Act 1990 (as amended), commonly known as S106 agreements, are a mechanism which make a development proposal acceptable in planning terms, that would not otherwise be acceptable. They are focused on site specific mitigation of the impact of development. S106 agreements are often referred to as 'developer contributions' along with highway contributions and the Community Infrastructure Levy. Planning obligations are used in order to: • Prescribe the nature of development to comply with policy • Compensate for loss or damage (such as loss of open space) created by a development • Mitigate impact from a development
Third party contributions	Capital	Voluntary or negotiated contributions to infrastructure costs.
Revenue generating assets (Charging)	Revenue	Some Local Authority services are discretionary and there is a general power to charge for these services provided they are not prevented by law and the council does not make a profit. Charging for discretionary services, e.g. car parks, leisure centres, licensing, planning, environmental health, etc. is widespread.
Revenue generating assets (Trading)	Revenue	Some Local Authorities have established a commercial Local Authority Trading Company (LATC) primarily to make profits.

Funding Mechanism	Type of Funding	Description
Surplus asset sales / development	Capital	Asset sales and development may include: Sale of surplus assets to realise a capital receipt; Sale of land and property temporarily claimed to deliver new infrastructure; and Investment in enhancing surplus land to prepare it for development to generate an uplift prior to disposal.

13.2 Innovative financing models

Several innovative financing models have emerged in the last decade to provide financing for large -scale energy efficiency initiatives. The ongoing project Citynvest (http://www.citynvest.eu/content/project-description) has researched and documented a range of innovative models for such projects.

Innovative funding models include:

- **Energy performance contracting** where an Energy Service Company (ESCO) implements a project to deliver energy efficiency, or renewable energy, and uses the income stream from cost savings or revenue generation to repay the costs of the project (and the investment)
- **Third party financing** such as projects where a third party shares the purchase and installation costs of a system and receives payment for outputs (e.g. from the Renewable Heat Incentive scheme)
- **Power Purchase Agreements** where a third party owns, operates and maintains a renewable energy system and a host customer agrees to site the system on its property and purchase the system's output for a predetermined period
- **Revolving funds** where a source fund is used to provide loans for scheme/systems, and the loan repayment is then used to refill the central fund for future projects
- **Cooperative models** are ownership models where community groups invest in the production of renewable energy to both supply to the community and to generate returns on investment
- **Crowdfunding** offers an alternative source of funding, via open calls to the public to finance a project through donations, monetary contributions in exchange for a reward, or for lending
- **Green bonds** are a financing option whereby local government issues a bond for borrowed funds, repaying the loan after a defined period of time at a fixed interest rate

Work carried out by Arup in 2014 looked at case studies of three main delivery models for retrofit projects:

- **Public-sector-led models** which tend to be focused on social housing

- **Innovative community-led models** which use a mix of public sector finance and bespoke financing tools (share issues etc)
- **Market based models** using on-bill financing, and public sector extension of credit lines to retail banks / revolving funds

The research identified that there is no single approach which addresses the challenges across different asset types and tenures, and that local work is required to identify the types of programme that will work in a given situation and context.

The work also identified that the public sector has to act as the first-mover, often subsidising or incentivising retrofit projects but involving the private sector in financing projects.

Stakeholder engagement was identified as being key to success, identifying that a wide range of partners including tenant groups, social housing, government organisations and NGAs need to be included.

It was identified that the main driver for retrofit is not financial (through energy savings – but that comfort and sustained asset values are more important to householders.

Delivery models and funding mechanisms that incorporate capital improvements and housing modernisation into energy efficiency schemes are more successful, because uptake is greater where a wider set of benefits is available to householders.

The differences between modelled benefits and actual in-use performance is a significant barrier to both convincing householders to undertake measure, but also to securing private investment.

Local supply chains are key – deploying a programme of retrofit will be constrained by the skills and capacity of local companies.

Financing (as picked up in the Government's Clean Growth Strategy) needs to be well aligned with mortgage financing. This issue was reflected in the failure of the Green Deal which offered loans at interest rates significantly above those which were applied to mortgages at the time.

13.3 New commercial opportunities and trends

New commercial vehicles providing the finance to carry out energy, transport and retrofit projects are expected to emerge over the next decade ("smart energy") – largely informed by greater granularity of city-wide data on energy and transport use. However, given technology and market uncertainty the ways in which commercial opportunities will develop is challenging to forecast.

Energy companies will occupy a range of different roles in the value system – from generation and transmission (focusing more on the assets underpinning the energy systems) to customer-focused models which will capitalise on the flexibility of energy generation to provide contracts tailored more closely to the different needs of user groups.

Customer-focused models will rely on new metering technologies to provide real-time consumption data to both users and suppliers, and the introduction of price tariffs which can capitalise on different emissions intensities for power at different times of day will emerge.

14 Delivering the projects

14.1 Introduction

The suite of measures assembled to achieve the CO_2 targets vary in scale, technology, ease of delivery, cost, and timescales. There is no single delivery mechanism that suits all project/programme types, and the challenges within each will differ. Many projects will be delivered by Newcastle City Council, but many others will have a much reduced input from NCC. However, the council must remain actively engaged in the process of the projects being brought forward – as a minimum to understand what impact their success (or otherwise) will have on the overall emissions for the local authority.

This document does not prescribe the delivery vehicle for projects. Some project types (particularly those which are challenging to deliver and costly) may emerge from changes in national policy, through innovation in commercial models, or through technological innovation. However, based on a review of existing and innovative delivery methods some potential routes are identified.

14.2 Developing capacity within Newcastle City Council

All the projects listed will require capacity from within the City Council, and some will require concentrated time and effort to progress – often in a coordinating role between different partners where the council is best placed to act as an intermediary.

The council will need to establish a governance structure that supports programmes to deliver projects, and which can bring together different parties within the council where there is an overlap in objectives. A suggested structure for delivering programmes is set out below, which features:

- a **delivery executive** of senior City Council directors with the remit and authority to support long term programmes of project delivery;
- five **low carbon task groups** which are largely driven by the split across different building types and tenures, and across a low carbon transport task group. These groups will drive the identification and business case development for delivering projects;
- within each task group a set of **project areas** which reflect the specific opportunities to delivery CO_2 savings across the city (some grouping of projects has taken place to produce the project areas);
- four **cross-sector technology groups** which are arranged across multiple task groups where collaboration on a technical intervention type is likely to support activity and delivery.

Taking a multi-dimensional approach to the delivery of projects is important:

- By working on multiple projects within the sector the delivery of projects can be combined – e.g. delivering domestic PV and thermal energy efficiency measures as part of single phase of delivery (minimising disruption to householders and potentially reducing costs)

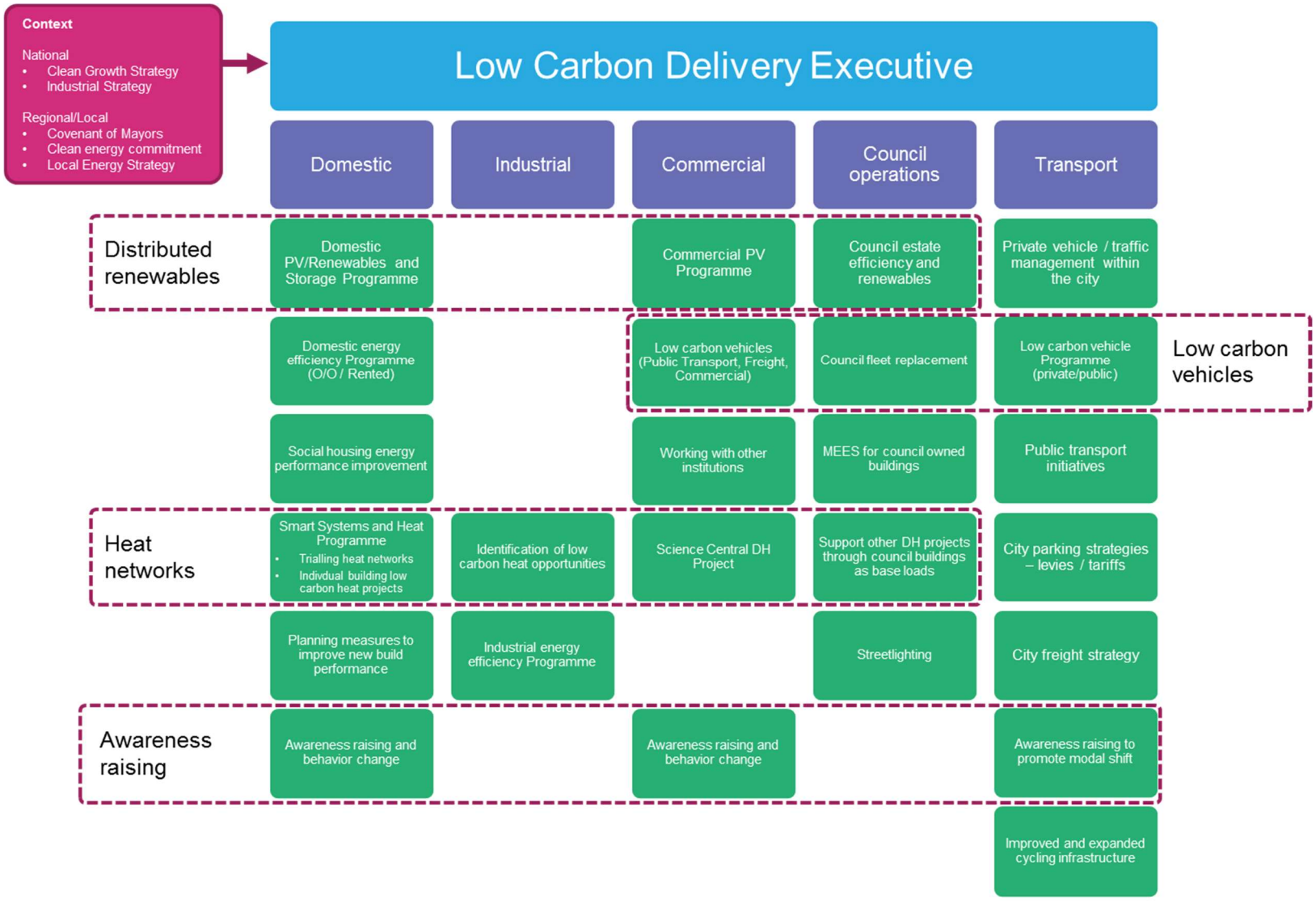

Figure 11 Proposed delivery structure

- Delivering on multiple projects within a task group may provide increased access to funding sources to deliver a holistic suite of improvements
- Bringing together different project types within a task group may unlock new commercial mechanisms for delivering multiple interventions within a property or cluster of properties

Similarly, for four areas of project type there are commonalities across the task groups:

- **Distributed renewables** is expected to focus heavily on solar PV. Delivering many projects using the same technology across different sectors may offer opportunities for cross-subsidy of projects across different building types/tenures. The delivery vehicle for a technology may also be shared (e.g. a local energy company that delivers PV programmes irrespective of the roof/land ownership/tenure)
- **Heat network delivery** is included in programmes across all building types (domestic, industrial, commercial and council-owned). The Local Area Energy Strategy developed by the Energy Systems Catapult focuses on domestic heat networks (although which also makes use of building-scale heat pumps), and heat networks also form the basis of the Science Central project and many other projects supplying public sector buildings and large heat consumers in the city
- **Awareness raising** may offer a potential area for cross-task-group working (although the different practicalities of delivering this type of projects in commercial and domestic buildings must be noted – e.g. engagement techniques, types of efficiency measure)
- **Low carbon vehicles** offer potential for citywide reductions in CO_2 emission, but also form part of the suite of measures to reduce emissions from the council's own operations.

14.3 Capacity and capability within the council

Delivering the programme of projects will require investment both in the capital measures themselves, but also in the provision of delivery capacity within the council to ensure projects are taken forward, that the business cases are developed, and that delivery takes place.

- Delivering the projects will require Director level input to the Low Carbon Delivery Executive, expected to require a regular programme of meetings to support and monitor delivery across the task groups and to report to elected members on progress against commitments.
- Underneath the executive will be a set of senior officers with responsibility for bringing forward projects within each task area and co-ordinating activity across task groups. The resources required for this are estimate to equate to a minimum of:
    - 0.5x FTE for the domestic sector

- 0.5x FTE covering industrial and commercial sectors combined
- 0.25x FTE covering council operations
- 0.5x FTE for transport programme

It is expected that significant individual projects within each task group will then require dedicated staff to manage and oversee delivery. Additional resource expectation is set later against specific projects.

14.4 Low carbon delivery executive

The overarching purpose of the Low Carbon Delivery Executive will be to offer a structure for strategic decision making and prioritisation on projects that feed into the city's carbon mitigation targets, and to provide a basis for collaboration between different groups across the Council's delivery vehicles. This is particularly important in terms of the key linkages that exist between different strategic objectives, e.g.:

- Public health ↔ Fuel poverty ↔ Energy efficiency
- Retrofit programmes ↔ Economic development ↔ Skills development
- Local energy projects ↔ Regeneration ↔ Community energy companies

A key early action for the Delivery Executive will be to produce, within a fixed time period (suggested as six months), a clear restatement of the priority areas being taken forward by the council, in what timescales, and with a more detailed set of co-ordinated actions to deliver a step change in the rate in which buildings and transport are decarbonised. This will build on the outline Action Plans set out in the following section.

15 Action plans for delivery

The delivery structure features 5 main action plan areas. Within each action plan area there will be a common set of tasks to establish the baseline and data for the city and to develop the outline business cases for bringing forward specific projects.

An indication of the expected resource for specific projects has been provided – although the timing and delivery period of these may change significantly depending on the delivery model adopted.

15.1 Domestic

Knowledge and dissemination	
Improving the baseline	Develop robust dataset on domestic building typologies and condition across the city to inform baseline and strategy development. Also identify house types which will benefit from 'easier to treat' measures such as loft/cavity wall insulation.
Supporting solution delivery	Carry out a review of previous innovation projects for households in the area (local or regional) to understand relative benefits and performance. Develop cost/saving estimates for standard suite of interventions for common dwelling typologies
Developing projects and delivery models	
Funding review	Comprehensive review of existing funding sources for different measures, tenures etc. This should extend to funding from sectors/funds where additional benefits accrue from retrofit (e.g. health funding).
Engagement with householders	Develop engagement network and strategy for different housing tenures focusing on the priorities of both occupants and property owners (in the case of private rented sector), and on occupant age/family status, and on how to incentivise residents/owners to engage in improving energy performance of buildings. Lessons from other projects and studies indicate that a strong case for investments does not succeed on only consideration of energy savings, but must be based around the wider benefits to occupants arising from improvements to the building, and an effective delivery vehicle may be through integration of energy efficiency with other house improvements.
Supporting new financial routes - Quality	Consider a contractor assurance system to deliver confidence in quality of installations and to address risks in customer experience during works (may be supported by national programme – but typically contractors differ in size for energy company funded installation of energy efficiency measures (large) and for typical house improvement work (small) – there may be a need for a wider pool of accredited installers)
Supporting new financial routes – Metrics	Pilot retrofit projects at a cluster/community scale to provide better and consistent data on in-use energy efficiency benefits arising from suites of measures

Supporting new financial routes – Aggregation	Develop a pilot study for community-scale retrofit, which can bring together the Quality and Metrics issues and provide a basis for retrofit at a multi-property scale that is of significant financial size to attract private sector funding
Supporting solution delivery	Investigate potential for standardised design-book and guidance on retrofit techniques to provide clarity on locally appropriate techniques (e.g. challenges around visual changes from over-cladding; extension beyond front façade of properties and other identified barriers to retrofit)
Supporting solution delivery	Assess and quantify wider benefits from a community-based approach to retrofit. A study in this area would seek to quantify whether a holistic retrofit of an area (considering other opportunities beyond just building performance – e.g. facilities, streets, open spaces) and quantification of social benefits in addition to energy/carbon benefits.

Project	Description	Primary delivery lead	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
Awareness raising campaigns (zero cost)	Small behaviour changes across many households, not requiring expenditure on equipment/ installations (e.g. turn down thermostats; turn off lights; use existing controls properly)	Householders	NCC could act as lead in delivery of awareness raising programme.	Zero capital cost	Council led initiative	NCC could act as lead in delivery of awareness raising programme. NCC could also provide direction to technical resources for householders and recommended measure for different household interventions. Depending on delivery mechanism NCC could also act as a source of advice for funding.	Staff time / materials / delivery / follow up support.	1xFTE ongoing for a period of 3-5 years.
Awareness raising campaigns	Large scale interventions to improve controls in houses – to install thermostats/timers to manage heating systems; TRVs on radiators; energy efficient light	Householders	NCC could act as lead in delivery of awareness raising programme.	£1.5m	Council led initiative			

Project	Description	Primary delivery lead	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
	bulbs; improved efficiency appliances; presence detection / timers on lighting							
Simpler energy efficiency measures (loft / CWI)	Reaching the small number of households for whom cheaper energy efficiency measures have not been installed (loft insulation / top up; cavity wall insulation)	Householders	Identification of target households and engagement with occupiers.	£5.5m	• Programme managed by NCC • ESCo	There is a role for NCC to identify and directly engage with remaining householders suitable for simple energy efficiency measures. NCC could act as lead in delivery of awareness raising programme. NCC could also provide direction to technical resources for householders and recommended measure for different household interventions. Depending on delivery mechanism NCC could also act as a source of advice for funding.	Engagement with householders for targeted properties where measures have not been implemented. Identifying projects will be challenging and time consuming unless sufficient householder 'pull' is generated.	Analysis period 1xFTE for 6 months Delivery support 0.25xFTE ongoing for 1-2 years.
Improvement to YHN housing stock to meet EPC C across whole stock	Improvement to energy efficiency across the social housing stock under the control of YHN to deliver an overall	Your Homes Newcastle	Governance and funding support plus wider activities/interventions required to facilitate the scale of delivery.	£500m	Delivery model will be developed by YHN	Expected that the main delivery will be undertaken through YHN although this requires a significant scale of delivery for which local	Effective delivery would require robust engagement and support through programme of measures. Previous case studies have identified that support during all project phases (planning, delivery, operation)	5xFTE ongoing (within YHN) expected for the majority of

Project	Description	Primary delivery lead	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
	improvement in EPC Band. Will require deep retrofit for some properties (fabric + renewables).					skills/supply chains may not be adequate. NCC therefore may have a broader role in helping to develop the wider framework in which this programme will sit – which will draw in technical capacity but also the identification of a funding mechanism (which could include identifying means to access private sector funding)	is essential to capitalise on benefits from this housing stock. Resource estimate: expected to sit within YHN. Planning/feasibility work will require 5xFTE/yr. Delivery will require significant project development and management personnel.	the period up to 2030.
Improved performance in hard-to-treat buildings	Programme to deliver energy efficiency improvements to hard-to-treat buildings, particularly focusing on owner-occupied and private rented housing sectors. Will be challenging due to tenure differences, and technical	Owners / landlords	Financing support plus wider activities/interventions required to facilitate the scale of delivery.	£50m	• Performance contracting for householders • Community ESCo	Likely to be one of the most challenging sectors in which to deliver CO_2 reductions NCC will have a critical role across this area including: • Ensuring an understanding of the housing condition and neighbourhoods where different interventions and	Effective delivery would require robust engagement and support through programme of measures. Resource estimate: this is a challenging priority area that will require ongoing sustained support from the local authority in order to deliver full potential. Specialised delivery team will be required to address technical aspects, stakeholder engagement and liaison, and support during planning/installation/operation.	Expected to be a team of 6-10 FTE, supported by technical and other specialists. Expected that this programme will require support for the majority of

Project	Description	Primary delivery lead	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
	difficulties in the housing stock.					measures will be appropriate • Active engagement with O/O and private landlords through various methods/interfaces to facilitate uptake • Coordination of clusters of retrofit – there is potential for a community-scale retrofit programme to offer efficiencies of scale and also a broader justification for investment leading to a more robust economic/social argument for undertaking retrofit projects		the period up to 2030.
Renewable energy at domestic scale – e.g. PV	Deliver a programme of PV installation on domestic properties (which	Owners / landlords	Could be delivered entirely by private sector, or could be delivered through a	£75m	• Community ESCo	As PV costs continue to fall then a business model allowing greater uptake of PV from householders may	Identification of appropriate households/tenures and engagement costs with householders/owners.	1xFTE ongoing for the period up to 2030 –

Project	Description	Primary delivery lead	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
	will need to have sufficient focus on owner occupiers and private rented properties)		community/city based energy company			emerge. But there may also be scope for NCC to act as an enabler, if a new model for funding and recouping spend on PV installations could be developed.	Resource estimate: this will require an ongoing process identifying and maintaining a robust funding/support mechanism for delivering at scale. Work to understanding optimal locations and maximum potential capacity will be required at an early stage. Following this will be a need for resources to develop packages of measures to then be marketed and delivered to householders.	although this may be reduced depending on the form of delivery vehicle and what is provided by the private sector as part of the delivery vehicle.
SSH Delivery	Delivery of the energy strategy for the city as set out in the Local Area Energy Strategy Main Report	City led – but with multiple parties involved in delivery (across local government / householders / utilities)	NCC will be integral to the delivery of the strategy	Capital costs cannot be estimated at this stage.	Potential delivery vehicles are being researched by Energy Catapult	N/A	N/A	N/A
CS16 for new build homes	Policy guidance for new development to deliver better thermal performance of buildings	Developers	NCC will develop the policy guidance which is then applicable to new development in the Local Authority area	£0	N/A	N/A	N/A	N/A

15.2 Industrial

Theme: Knowledge and dissemination	
Low carbon heat projects	Undertake a scoping study to identify the range of type and scale of heat source available to support future heat network projects across the city
Low carbon heat projects	Carry out feasibility studies to identify potential collaboration projects with private sector, and to understand likely costs and benefits from collaboration. Also identify where projects support other research and/or delivery projects (e.g. SSH)

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
Small scale heat sources	Identification of heat sources which could provide low carbon heat to buildings	Private sector / NCC	Further feasibility work required to identify heat sources and to identify potential consumers who could partner on projects.	£4m	• Private sector led – targeted at specific developments • Council-led for own buildings • ESCo	Delivery of actual projects will depend on the type of building/facility that will benefit from them.	NCC may commission further city-wide assessment of potential heat sources.	1xFTE for a period of 1 year.
Industrial emissions	Widespread programme of energy efficiency interventions for industrial buildings across the city	Private sector	Delivery expected to be largely through private sector directly – although local authority involvement could be involved to support identification of opportunities and support to industry	£100m	N/A	Delivery and funding will be largely through private sector project identification and investment. The Local Authority role will be one of facilitation.	NCC may develop a role/team as a facilitator to help industrial operators identify potential projects. However much of the feasibility work will be undertaken by industrial partners themselves.	0.5xFTE for the majority of the period up to 2030.

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
			on types/scale of measures that could be implemented. Planning authority may also be able to facilitate delivery through clear guidance if this is a barrier to uptake.					

15.3 Commercial

Partnering, knowledge and dissemination	
Working with other organisations in the city	Reinvigorate a platform for sharing strategic objectives and progress, and to provide opportunities to identify and develop potential collaborative energy projects
SME Support	Based on a more informed commercial/industrial baseline dataset, identify priority building types/areas/occupants and develop support/advice project
Support to commercial building operators	Develop a locally delivered education programme to support building owners and investors to understand risks arising from poor performance and environment within their buildings, and a robust business case for delivering improvements to building performance.

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
Commercial awareness raising	Energy efficiency advice for SMEs to deliver savings on energy consumption, largely through changes to fit-out or equipment in office space. Not expected to include fabric improvements to buildings (which will predominantly be rented properties)	Private sector (SMEs)	Support and advice services provided by NCC to SMEs.	Zero capital cost	• Council-led through national/local funding	Likely to be supported by a small team out of Newcastle City Council – but funding for projects will come from either SMEs themselves or from other funding sources outside the council.	Will require regular programmes of support and provision of engagement/advice delivery	1 x FTE for a period of 3-5 years
Commercial PV	Widespread deployment of solar PV on commercial roof spaces across	Private sector – either building owners, or standalone PV	Delivery expected to be largely through private sector directly – although local authority	£25m	• Private sector direct delivery	Local Authority will not necessarily be significantly involved in	Will depend on approach taken to delivery, and degree of coordination with other renewables	0.5xFTE ongoing for the period up to 2030

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
	the city. Electricity generated expected to be used by building occupants or exported to National Grid.	scheme developer	involvement could be required to support delivery structures/mechanisms. Planning authority may also be able to facilitate delivery through clear guidance if this is a barrier to uptake.			delivery unless a co-ordinate delivery vehicle is established across both commercial and domestic sectors.	delivery projects across the city	– although this may be reduced depending on the form of delivery vehicle and what is provided by the private sector as part of the delivery vehicle.
Other institutions	Large institutions within the city delivering on their CO_2 mitigation commitments	Other institutions within the city (NHS, Universities)	Not expected to be significant to assist in delivery of this carbon benefit – but close working relationship required with institutions to monitor progress towards their targets (and the benefit for LA-wide CO2 emissions targets)	Costs to institutions not known	• Delivered by institutions themselves	Requires an ongoing engagement role.	Minor.	0.1 x FTE for the majority of the period up to 2030.

15.4 Council operations

Theme: Developing projects and delivery models	
Energy efficiency on council estate	Continue to identify and update information on potential energy efficiency projects across the estate.
Council fleet transformation	Understand what vehicles are currently appropriate for switch to lower emission types. Understand and challenge operational teams around appropriateness of new technology. Continue to monitor availability of vehicles for different applications and identify replacement cycles for switching over to EVs or other technologies.
Ongoing heat network project feasibility work	Review and update existing information on potential heat network projects supporting council estate, and identify links into other initiatives (SSH)

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
Accelerate delivery of energy efficiency measures on Council operational estate	Energy efficiency measures across council operational estate, and building-scale renewable projects (largely solar PV)	Newcastle City Council	N/A	£1m	• Council-led through Salix funding • Building performance contracting	Delivered directly by council, although other procurement routes might be available.	Project identification, feasibility, costing and delivery.	0.5 x FTE for the majority of the period up to 2030
Implement MEES for council owned properties	Council carrying out improvements to the buildings that it owns, but rents to other parties, to meet minimum energy efficiency standards	Newcastle City Council	N/A	£750k	• Council-led directly funded	Delivered directly by council, although other procurement routes might be available.	Project identification, feasibility, costing and delivery.	0.2 x FTE for a period of 1-2 years.

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
Council vehicle fleet replacement	Changeover of the existing fleet of vehicles (cars, vans, refuse collection vehicles) to alternative low-carbon fuel or EVs	Newcastle City Council	N/A	£12m	• Council-led directly funded	Delivered directly by council, although other procurement routes might be available. Leasing schemes may be available to avoid large capital investment.	Project identification, feasibility, costing and delivery.	0.1 x FTE for period up to 2030
Science Central & Civic Quarter	Delivery of 2 district heating schemes	Newcastle City Council / Engie / Private sector	NCC is responsible for finalising the legal partnership with Engie.	£27m	• ESCo development • Private developer led scheme • Council-led through JV with main energy consumers	Understood that Engie are providing the technical support for scheme development and delivery – but that ultimately funding for projects will come from NCC and supported by other institutions/organisations who will benefit from the scheme. Operating structure for Science Central is not clear – JV/Esco?	Project identification, feasibility, costing and delivery.	0.5 x FTE for a period of 1-2 years (although may be delivered differently through Engie JV)
Wider DH projects	Delivery of longer list of district heating schemes mainly providing energy to local authority buildings, schools, nurseries and care homes	Newcastle City Council / Engie / Private sector	NCC is responsible for finalising the legal partnership with Engie.	£90m	• ESCo development • Private developer led scheme • Council-led through JV with	Mechanisms for delivery of the multiple projects is unclear – they are largely structured around supplying heat to council properties and other public sector buildings.	Project identification, feasibility, costing and delivery.	0.5 x FTE for a period of 1-2 years (although may be delivered differently through Engie JV)

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle	Notes on delivery	NCC Costs to facilitate delivery	Resources estimate
					main energy consumers			
Streetlighting replacement programme	Replacement of existing streetlighting to more energy efficient fittings, with control systems which allow for more targeted and less costly maintenance.	Newcastle City Council	N/A	TBC	• Direct council delivery	Understood that feasibility has already been carried out and project can be progressed	Already covered within existing resources for the relevant department	N/A

15.5 Transport

Theme: Knowledge and dissemination	
Improving baseline	Understand the citywide CO_2 emissions from road transport to better understand what vehicles are resulting in emissions in which areas
CO_2 based evaluation of measures	Carry out CO_2 assessment of strategic transport policies to identify expected impact as these are brought forward
Integrate with other priorities	Consider what opportunities to mitigate CO_2 emissions from vehicles can be brought forward in parallel with measures to manage Air Quality hotspots
Integrate with other priorities	Understand and quantify the full extent of potential benefits of measures to limit traffic flow in the city centre, to include CO_2 impacts

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle
Private vehicles	Develop a strategy for citywide charging infrastructure, understanding how to increase the distribution of charging points and also to address blocking of EV charging points throughout the day by single vehicles	NCC	N/A	TBC	Delivery of measures will vary across different types, but will need to be integrated with wider transport projects/programmes across the city. Much of the resourcing behind projects will be integrated with the wider, ongoing work from the Transport team within Newcastle City Council.
Private vehicles	Consider the expansion of City Car Club systems – through an evaluation of the success of the existing scheme and an understanding of barriers to further uptake	NCC / Car club schemes	N/A	Low	
Public Transport	Working with public transport providers to develop strategies for increasing PT usage across the city as a means of removing private vehicles from the urban core	Public transport providers	N/A	TBC	
Public Transport	Consider the expansion of Park and Ride facilities in the city to reduce traffic levels in the city centre, combined with appropriate bus lane prioritisation	NCC	N/A	TBC	
Public Transport	Continue to review and support development of increased ticketing flexibility across the city and wider region to support the usage of Public Transport	NCC / Nexus / Bus companies	N/A	TBC	
Public Transport	Assess the impacts and transition process to a requirement for all buses and taxis in the city to be low emission vehicles	NCC	N/A	TBC	
Parking	Assess the feasibility and impacts of a Workplace Parking Levy as a revenue generation source to invest in measures targeting CO_2 reduction	NCC	N/A	TBC	

Project	Description	Primary delivery responsibility	Support from NCC	Est capital costs	Potential delivery vehicle
Parking	Review citywide parking strategy to understand CO_2 impacts of differential pricing for parking in the city (e.g. Alive after Five)	NCC / car park providers	N/A	TBC	
Freight	Assess the impact of freight and deliveries on CO_2 emissions across the city	NCC	N/A	TBC	
Freight	Develop a freight and logistic strategy to reduce vehicle movements in the city and to ease congestion and reduce impacts from last-mile deliveries	NCC	N/A	TBC	

Appendix A

Historic carbon emissions data for Newcastle

A1 UK local authority carbon dioxide emissions national statistics for Newcastle upon Tyne

Year	A. Industry and Commercial Electricity	B. Industry and Commercial Gas	C. Large Industrial Installations	D. Industrial and Commercial Other Fuels	E. Agriculture	Industry and Commercial Total	F. Domestic Electricity	G. Domestic Gas	H. Domestic 'Other Fuels'	Domestic Total	I. Road Transport (A roads)	K. Road Transport (Minor roads)	M. Transport Other	Transport Total	Grand Total	Population ('000s, mid-year estimate)	Per Capita Emissions (t)
2005	492	266	-	36	1	**795**	256	401	11	**668**	225.908	246.045	13.144	**485**	1,948	269.608	7.2
2006	520	243	-	34	1	**797**	267	380	10	**657**	218.333	233.708	13.346	**465**	1,920	270.258	7.1
2007	502	228	-	34	1	**766**	263	356	9	**628**	218.895	237.401	13.534	**470**	1,864	271.577	6.9
2008	505	242	-	30	1	**778**	251	368	10	**630**	207.334	227.259	13.329	**448**	1,855	271.649	6.8
2009	445	238	-	24	1	**708**	228	327	9	**564**	195.245	221.067	12.469	**429**	1,700	273.422	6.2
2010	472	268	-	24	1	**765**	232	357	9	**598**	197.238	216.487	12.155	**426**	1,789	276.681	6.5
2011	441	219	-	21	1	**682**	220	288	9	**517**	194.405	210.821	12.438	**418**	1,616	279.092	5.8
2012	463	248	-	23	1	**736**	234	320	8	**562**	190.871	206.978	12.360	**410**	1,708	282.442	6.0
2013	440	256	-	19	1	**716**	213	326	10	**549**	187.586	202.711	12.725	**403**	1,668	286.821	5.8
2014	368	200	-	21	1	**589**	177	268	9	**454**	185.616	205.952	13.098	**405**	1,448	289.835	5.0
2015	304	213	-	21	1	**539**	148	283	9	**440**	190.522	201.272	13.671	**405**	1,384	292.883	4.7

https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics

Appendix B

Summary of CO_2 emissions data for other institutions

B1 CO_2 emissions from other institutions in the city

A review was carried out of publicly available data on the CO_2/CO_2e emissions from large organisations within Newcastle upon Tyne. Summary information for each is shown below.

Organisation	Source document	Notes on historic emissions and projected reductions
Newcastle upon Tyne Hospitals NHS Trust	**Sustainable Healthcare Strategy** http://www.newcastle-hospitals.org.uk/downloads/ About%20us%20pages/Sustainability_Strategy.pdf	• This document provides (Page 8) a summary of CO2e emissions for 2015-16 of 65,995 tCO2e • On Page 7 it notes a 28% reduction against the 2013 baseline (across energy/waste/water) is required. Taking 2013 emissions as 68,082 tCO2e (for energy only) would mean hitting a target of 49,019tCO2e – a reduction from 2015-16 of 16,976 tCO2e. This analysis excludes emissions from waste and water, although they are small compared to emissions from water. There is potential for double counting in forward projection as the modelled scenario assumes a degree of decarbonisation across all commercial/industrial buildings in the city. Therefore, it is assumed that only a portion of this reduction is achieve, through low carbon heat projects.
Newcastle University	**Carbon Management Plan 2016** http://www.ncl.ac.uk/sustainable-campus/assets/documents/NewcastleUniversityCMP_2016_V1.pdf	• Page 5 notes emissions from Scope 1 and 2 were 41,187 tCO2 in 2005/06 • Page 4 restates the University's commitment to reduce emissions by 43% by 2020 (equivalent to hitting 24,712 tCO_2) but notes that this is reliant on the UK decarbonising electricity supply • Table 2 provides a breakdown of 2014/15 emissions, and states total Scope 1 and 2 emissions (for Residential and Academic) as 40,438 tCO_2 • Achieving the 43% reduction between 2014/15 and 2020 would be equivalent to a reduction from 40,438 tCO2 to 24,712 tCO2 – a reduction of 15,726 tCO2 The University notes in its CMP that meeting its target will be achieved in part through grid decarbonisation (quoting a scale of reduction of 40% by 2020). There is potential for double counting in forward projection as the modelled scenario assumes a degree of decarbonisation across all commercial/industrial buildings in the city. Therefore, it is assumed that only a portion of this reduction is achieve, through low carbon heat projects.

Organisation	Source document	Notes on historic emissions and projected reductions
Northumbria University	**Carbon Management Plan 2010-2020** https://www.northumbria.ac.uk/about-us/environmental-sustainability/energy-water/-/media/corporate-website/documents/campus-services/sustainability/carbon-management-plan-2010.ashx **Carbon Management Plan Update (2015)** https://www.northumbria.ac.uk/about-us/environmental-sustainability/energy-water/-/media/corporate-website/documents/campus-services/sustainability/carbon-management-plan-update-2015.ashx	• CMP states baseline year emissions of 16,804 tCO2 • CMP Update does not explicitly provide a 2015 value. It states that a target of 11,500 tCO2 is the 2020 target, and that this now requires a reduction of 42% • This magnitude of reduction by 2020 implies that 2015 emissions were in the region of 19,827 tCO2 • Meeting the 2020 target would therefore require a reduction of 8,327 tCO2 There is potential for double counting in forward projection as the modelled scenario assumes a degree of decarbonisation across all commercial/industrial buildings in the city. Therefore, it is assumed that only a portion of this reduction is achieve, through low carbon heat projects.
Newcastle Airport	Carbon Reduction Commitment returns https://www.gov.uk/government/publications/crc-annual-report-publication-201415-and-201516	CRC return for Newcastle Airport states emissions in 2015/16 for CRC were 8,542 tCO2. These relate only to operational emissions from the airport itself, and do not reflect aviation emissions.
Newcastle College	No publicly available source. Information gathered during a phone discussion with Estates team at Newcastle College.	In discussion with Newcastle College it was established that Scope 1 and 2 emissions for 2014/15 were approximately 6,780 tCO_2e.

Appendix C

Modelled outturn emissions for 2030

C1 "Local Plan + national trends"

The table below shows the estimated emissions for 2030 based on Local Plan development, a degree of grid decarbonisation, and a degree of reduced emissions from road transport.

Emissions source / influence	CO_2 emissions/impact ($ktCO_2$)
Interim baseline emissions	
2015 Domestic emissions	440.1
2015 Industrial/commercial emissions	538.9
2015 Transport emissions	405.5
2015 TOTAL	**1,384.5**
Decarbonisation effects on existing buildings	
Domestic	- 51.8
Industrial / commercial	- 106.4
Improvements to vehicle efficiency and other national trends	
Transport	- 40.6
New development (with decarbonisation effect by 2030)	
Domestic	+ 41.6
Industrial / commercial	+ 26.1
Projected emissions in 2030	**1,253.5 $ktCO_2$**

Small variations in rounding result in a difference between the summed total in the above table, and actual calculated total.

Appendix D

Covenant of Mayors annex

D1 Covenant of Mayors annex

Overview

Newcastle upon Tyne is committing to meeting a target reduction for 2030 emissions in line with the reporting mechanisms for the Covenant of Mayors.

The CoM is a group of regional and local authorities publicly committing to delivery of a range of local projects and programmes to deliver energy reduction within the area of jurisdiction, also delivering associated reductions in CO_2 emissions.

Methodology

However, the methodology adopted for reporting CO_2 emissions for the CoM differs from that used for the rest of this report. Most importantly is that it relies on retaining a consistent set of CO_2 emissions factors between the baseline year (2005 for Newcastle) and the target year of 2030. The justification for this is precisely to dissuade signatories from relying on national trends in decarbonisation, and instead to increase focus on local initiatives and programmes around consumption reduction and local renewables.

This approach raises a number of challenges to accurate accounting and modelling of projects.

1. Removing the influence of a decarbonising electricity supply

- The actual carbon intensity of grid electricity has reduced significantly between 2005 and 2015, however this is not reflected in the calculators used for CoM which will use a consistent carbon factor ($kgCO_2/kWh$) for the full period up to 2030.
- Furthermore, the grid intensity of grid electricity is forecast to reduce significantly further between 2015 and 2030, which will reduce the CO_2 emissions from building energy usage for all existing buildings, and (over time) for future development

Removing these two influences from the projected CO_2 emissions for the city leads to a significantly different 2030 projection:

- Under the CoM the 2030 projection is **1,783 $ktCO_2$**
- Under the projection used for the broader strategy (which includes decarbonisation of grid electricity) the 2030 projection is **1,253.5 $ktCO_2$**

2. Artificially inflating the impact of measures which reduce electricity consumption

As progress has been made on reducing the carbon intensity of grid electricity it is more broadly accepted that:

- Further carbon reductions in the future will need to be achieved by addressing the use of fossil fuels for space/water heating (i.e. moving from natural gas to low carbon electricity)
- Moving from natural gas to electrical space/water heating will (in time) provide a net CO_2 benefit to individual buildings/projects
- Moving from fossil fuelled vehicles to electric vehicles will offer a carbon benefit if the grid intensity of electricity continues to fall

However, by using electricity factors that are from 2005 the identification of projects to meet the CoM target will favour those which reduce electricity consumption – even though the need for increased focus on the decarbonisation of heat is a key element of a low carbon energy strategy for the UK.

Targets

The CoM requires adoption of a carbon target that is a 40% reduction against baseline (taken as 2005 for Newcastle upon Tyne). However, the CoM allows for this to be either an absolute 40% target, or a per-capita 40% target.

Newcastle has opted to pursue a per-capita target, which is developed based on a projected 2030 population of 312,000.

Year	Population	tCO2/capita
2005	269,608	7.471
2015	292,883	5.806
2030	312,000 *	4.482 *

* projected

Per capita emissions of 4.482 tCO_2 for a population of 312,000 would equate to total 2030 emissions of **1,398.5 $ktCO_2$**.

The projection for 2030 (based on new development on top of existing emissions) is 1,783.1 $ktCO_2$. This means there is a target shortfall of **384.5 $ktCO_2$** to be met through other programmes/projects.

Projects to meet the shortfall

The projects adopted to demonstrate compliance with the CoM target are the same projects as set out in the overarching carbon mitigation strategy. However, the CO_2 impact of these projects is calculated because the CO_2 emissions per kWh of electricity are significantly different for 2005 from 2015, and from what is projected for 2030.

The full list of projects and associated carbon savings is shown on the following pages.

Further information on the factors used to calculate these emission estimates can be found in the CoM submission and the technical guidance provided by the CoM.

Project		**CO2 savings (ktCO2)**
Municipal	Improvement to the Council operational estate	1.90
	Application of Minimum Energy Efficiency Standards to council buildings which are not used for operational (i.e. let to other parties)	0.70
	Council fleet replacement	1.50
	Delivery of Science Central and Civic Quarter West DH projects	7.60
	Delivery of remaining projects identified in the PB Report	5.90
Industrial and commercial	Working with other institutions	46.50
	Identify and exploit low carbon heat opportunities across the city - SMALL	21.2
	Awareness raising and behaviour change support	1.40
	Commercial PV Programme	42.7
	Interventions on industrial emissions	47.00
Domestic	Awareness raising and behaviour change campaign	13.10
	Awareness raising and behaviour change campaign	13.10
	Improved efficiency of houses	7.90
	Improvements to energy performance of YHN stock.	24.10
	Improved thermal performance in Hard to Treat (OO / Private) houses	52.40
	Renewable energy at domestic scale - support for PV	45.4
	SSH - commitment and delivery	30.00
	Tighter performance requirements on new build domestic	4.10
Lighting	Streetlighting replacement	8.7
Transport	Mode shift from car to bike/walking for c. 5000 people	1.5
	Suite of measures to be determined	15.0
TOTAL		**391.9**

This demonstrates that projects are identified to deliver CO_2 reductions totalling **391.9 ktCO2**, versus a gap between projected emissions and the CoM target of **384.5 ktCO2.**

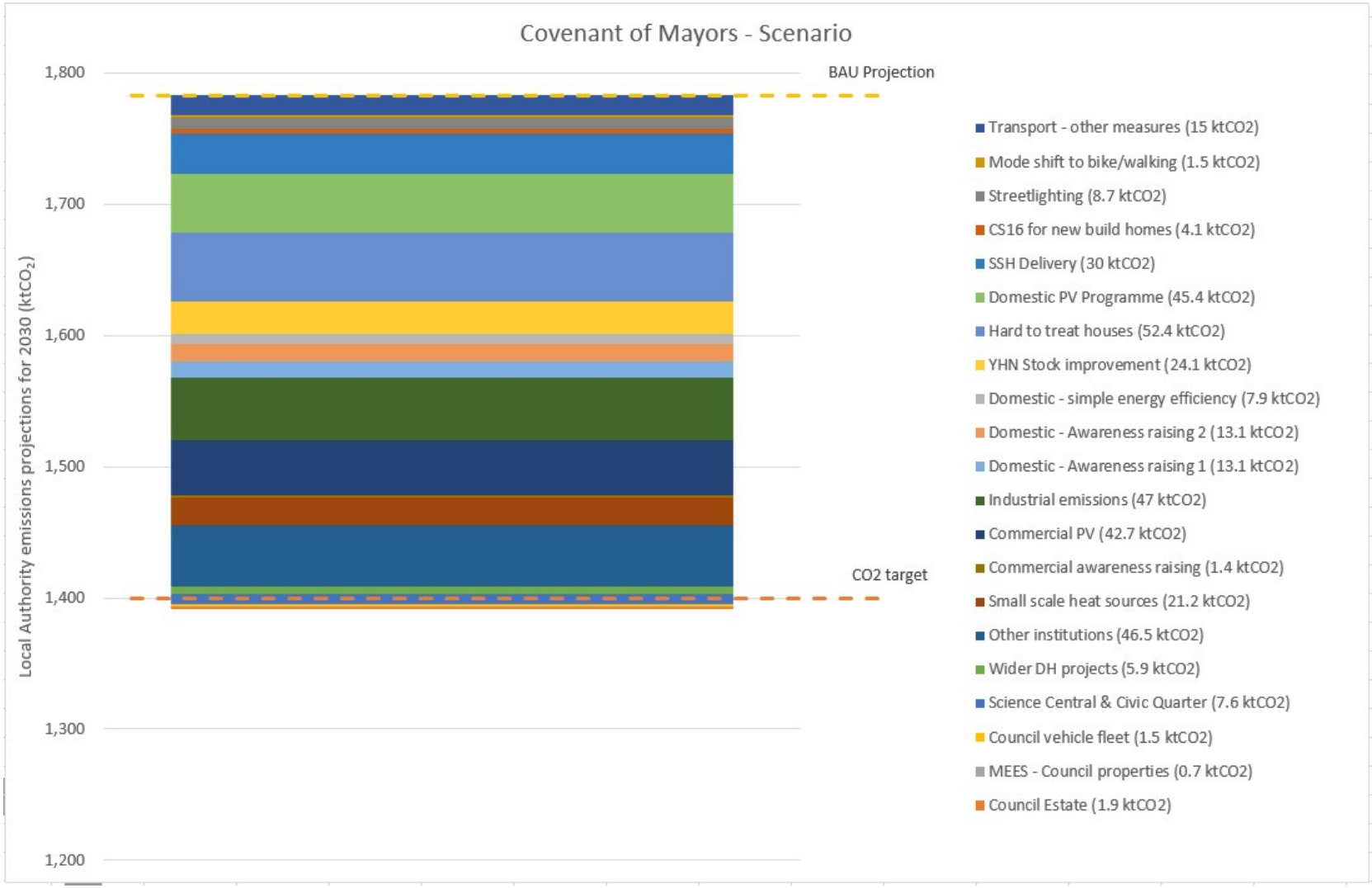

Figure 12 List of projects to meet CoM per-capita target (based on 2005 carbon intensities for electricity/gas)