Central Lincolnshire Authorities

Central Lincolnshire Local Plan: Climate Change Evidence Base

Draft

Task C - Carbon Reduction Targets

Feb 2021 | Rev D

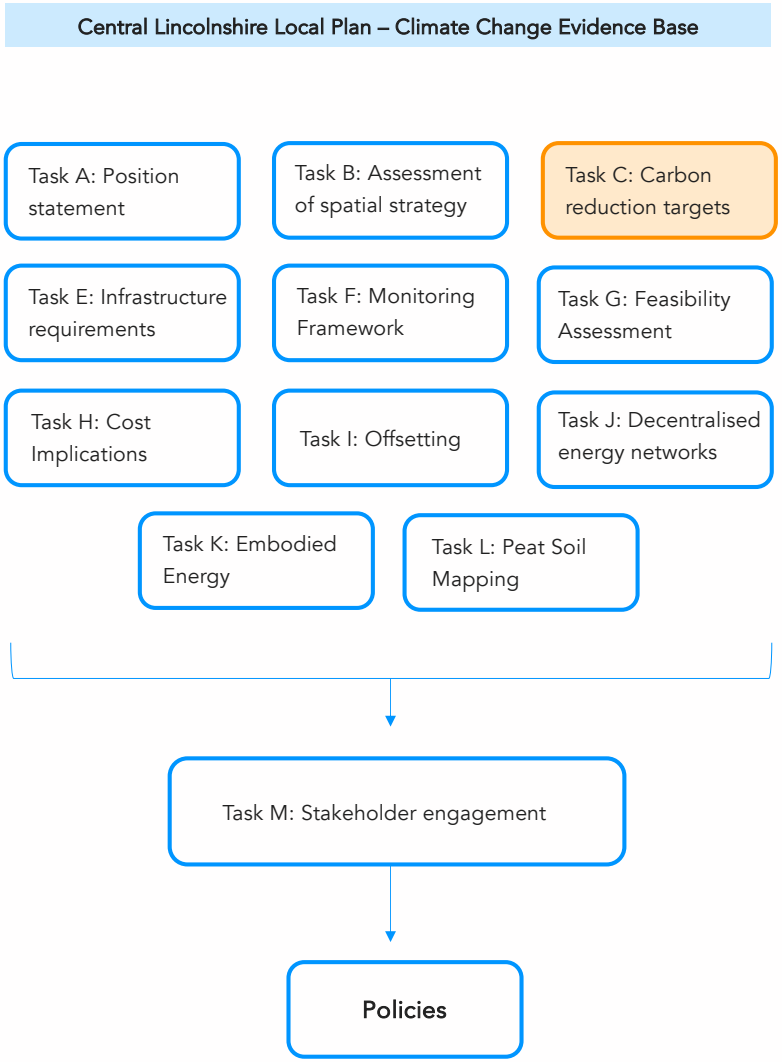
Bioregional Etude Currie & Brown

Task C
Carbon reduction targets

This section assesses the required carbon reduction targets for the built environment in the region by using a **top down approach** based on recommendations from the IPCC, the Committee on Climate Change, the Tyndall Centre and forecast GHG emissions for the region.

We then use a **bottom up analysis** to assess the impact of potential policy measures on meeting these carbon reduction targets.

We look at the role of the local plan in reaching the required targets for different sectors and recommend policies to support them.



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Bioregional Etude Currie & Brown

1.0 Executive summary

Emissions reductions requirements

1.1.1 Our review of existing carbon budgets and models, together with our own analysis for Central Lincolnshire, shows common themes and conclusions emerging to inform the required GHG reduction targets required for the region.

- Central Lincolnshire must reach net zero carbon GHG emissions by **2041** from a science based approach which is aligned with the Paris agreement, or from a purely legal standpoint, by **2050** (Climate Change Act 2008).
- Central Lincolnshire must **emit no more than 9 $MtCO_2$ between 2020 and 2100** (Tyndall Centre Tyndall Centre's Carbon Budgets for Central Lincolnshire) from energy use (excluding aviation and cement production).
- If emissions continue at 2017 levels, the entire carbon budget for the area would be used within **7 years** (from 2020), i.e. by 2027.
- Emissions cuts must average **-13.4**% per year to deliver a Paris aligned carbon budget.
- The sectors of **power generation, buildings and transport should target zero greenhouse gas emissions** and must in order to compensate for those that cannot.
- **A means of removing greenhouse gas from the atmosphere will be required.** The zero carbon pathways we have looked at have shown that there will be residual GHG emissions remaining that cannot be abated. Removal of greenhouse gases from the atmosphere will be required to bring the balance of GHG emissions to net zero.

Maximise renewable energy

1.1.2 Our analysis concludes that Central Lincolnshire should plan to install enough renewable energy to provide for at least 70% of its energy needs through onshore wind, photovoltaics or other forms of renewable energy. This figure reflects Central Lincolnshire's relative ability to generate renewable energy, and has been assessed within the context of the UK's onshore renewable energy generation requirement. The remaining 30% of Central Lincolnshire's renewable energy demands can be imported, while still leaving enough for more energy intense regions and cities.

1.1.3 We recommend that the local plan seeks to identify sites for the installation of on-shore wind and photovoltaic installations. As an indication this should be in the region of 510 MW solar and 340 MW of onshore wind capacity.

Ensure all new buildings are zero carbon

1.1.4 New buildings from 2020 must be designed to be net zero carbon: ultra-low energy (extremely energy efficient with space heating requirements of 15-20 kWh/m^2/yr); heated by low-carbon heat – e.g. heat pumps (no more gas boilers) and; generate renewable energy to match their annual energy demand. To not do this, we are simply adding to the retrofit burden of the future and unnecessarily eating into a very finite carbon budget.

Existing buildings

1.1.5 There are upwards of 130,000 dwellings in Central Lincolnshire, almost all of which will need to undergo deep retrofits to make them zero carbon. The rate at which these need to happen is fast and almost all will need to be undertaken in the 2020s if we are to stay within carbon budgets. We will need to see similar results in the non-domestic sector.

1.1.6 While the local plan does not have a great deal of ability to influence carbon reduction in existing buildings, conservation policies should be reviewed for compatibility with the zero carbon agenda.

Transport

1.1.7 Transport is one of the biggest carbon emitting sectors, and emissions are remaining fairly static. Zero carbon vehicle technology is developing at a very fast pace, with technical issues such as range and battery charging being rapidly addressed by the market. Infrastructure issues, such as places to charge electric vehicles should be addressed in the local plan.

1.1.8 Additionally, the local plan should facilitate a move away from car journeys towards journeys on foot, bicycle or public transport.

Land-use

1.1.9 Carbon sequestration is an imperative element of our zero carbon pathway. The local plan should facilitate land-based carbon sequestration through allocation of land for the planting of diverse species woodland or agroforestry projects, and identification of land for protection – particularly that with carbon rich soils and biodiversity.

Policies

1.1.10 The findings from the analysis within this chapter, and the remaining chapters in this evidence base culminate in suggested policies for the new local plan to include.

The policies are laid out in a separate report forming part of this evidence base – "Recommended policies".

Task C
Emissions reductions targets
2.0 Establishing targets

A look at required emissions reductions targets for Central Lincolnshire, through deriving targets from a global and national standpoint.

2.1 Global Carbon Reduction Targets

There is a climate emergency

2.1.1 There is overwhelming scientific consensus that significant climate change is happening. This is evidenced in the latest assessment of the Intergovernmental Panel on Climate Change (IPCC AR5). The IPCC special report published in 2018 on the impacts of global warming of 1.5 °C above pre-industrial levels. It highlights the **urgency for action** and has generated a high level of interest and concern in society as a whole.

2.2.2 A business-as-usual trajectory would lead to an expected **4 - 5°C** increase in global average temperature above pre-industrial levels by 2100 with more warming expected afterwards.

The Paris Agreement (2015)

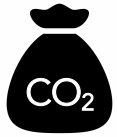
2.2.3 International negotiations on climate change are governed through the United Nations Framework Convention on Climate Change (UNFCCC). The most recent negotiations concluded with the Paris Agreement in December 2015. This Agreement reaffirms global ambition to limit temperature rises to below 2°C and binds every country to produce national plans to reduce emissions. The agreement also contains a further collective aspirational goal to reduce emissions in line with keeping the temperature increase to 1.5°C.

Global carbon budgets

2.2.4 The concept of carbon budgets is an important one. The Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5 °C has estimated the quantity of CO_2 that can be emitted globally and still be consistent with keeping global temperatures well below 2 °C with an outside chance of stabilising at 1.5 °C. The report gives different budgets for different temperature rises and probabilities.

2.2.5 The Tyndall Centre Carbon Budgets reports[30] (which we will refer to throughout this report) has selected from the IPPC report a global budget figure of **900,000 $MtCO_2$** as the basis of their work. This, they indicate, is the maximum allowable budget to stay within an outside chance of staying within a 2C temperature rise. This budget assumes no reliance on carbon removal technologies.

2.2.6 Keeping global warming to below 1.5°C with at least 66% probability corresponds to less than **10-14 years** at current global emissions rates. This increases to 14-18 years for a 50% probability [01].



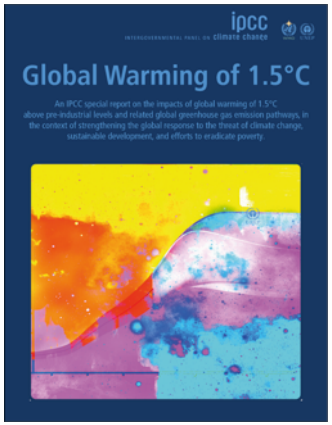
900,000 $MtCO_2$

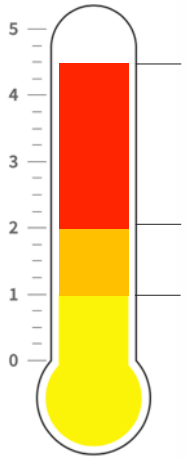
Estimation of **remaining global carbon budget** for staying well below 2C rise.

10-14 years

The number of years it would take to **consume our entire global carbon budget** at current global emissions rates for a good chance of limiting temperature rises to below 2C.

Global level





4-5 C the temperature rise we are likely to see if we continue on a **business as usual** path

1.5-2C The maximum temperature rise above pre-industrial levels the IPCC recommends.

1C The temperature rise already created

2.2 Translating global targets to the national level

National commitment

2.2.1 The UK has binding targets to reduce CO_2 emissions through the Kyoto Protocol and is a signatory of the Paris Agreement.

2.2.2 The UK's national commitment is set through The **Climate Change Act 2008** – which legislates that the UK carbon account for 2050 must be **100% lower than 1990** levels – i.e. the UK must be **net zero carbon by 2050**. Previously requiring an 80% reduction in carbon emissions, the Act was was amended in June 2019 following the publication by the Committee on Climate Change of its 'Net Zero: The UK's Contribution to Stopping Global Warming' in May of the same year. The recommendation was based on the latest scientific evidence presented by the IPCC's Special Report on Global Warming, 2018. The Government adopted the recommendation of this report and the Climate Change Act was amended accordingly.

The Committee on Climate Change

2.2.3 The Committee on Climate Change (CCC) is an independent body formed to advise the UK government on tackling and preparing for Climate Change.

2.2.4 In 2019 the CCC published the report "Net Zero: The UK's contribution to stopping global warming" [01]. In addition to recommending a new emissions target for the UK: net zero greenhouse gases by 2050 (see above) the report also set out an ambitious set of measures required to meet the zero-carbon target.

2.2.5 The Committee on Climate Change also advises government on carbon budgets. The Climate Change Act requires the government to set 5-year carbon budgets. The CCC advises what the carbon budgets should be, and provides progress reports against them (note – these carbon budgets are not comparable to the amount of carbon actually emitted by the UK as they include allowances under the EU Emissions Trading Scheme).

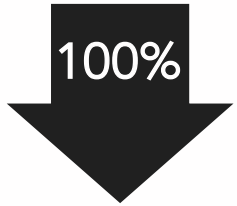
The carbon budget for the UK

2.2.6 To help understand the magnitude and pace of carbon reductions required, the IPCC Special Report 2018 estimates the amount of carbon we can emit globally to stay within certain temperature rises. Following this, the Tyndall Centre Carbon Budgets reports estimate the carbon budget for the UK (allowing for the equity principle from the Paris Agreement) to be **3,757 $MtCO_2$**.

Further Reading

- Accounting for carbon – comparison of methodologies (Task A – Position Statement)

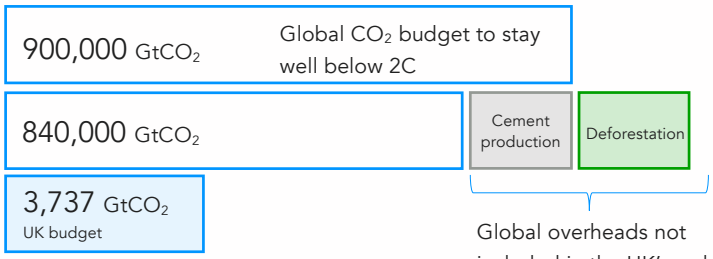
The UK Government has committed in June 2019 to Net Zero emissions by 2050



Reduction in CO_2 emissions the UK government is **legally required** to achieve by 2050 over 1990 levels.

UK level

Global carbon budgets allocation to the UK, Tyndall Centre



UK portion of remaining global carbon budget for staying within 1.5°C temperature rise

Global overheads not included in the UK's carbon budget figure. The budget would need to decrease if there was an increase in global cement production or deforestation

Figure 2.1: Tyndall Centre estimation of remaining UK carbon budget to stay within 2C temperature rise. Aviation and Shipping included in UK budget. Image not to scale.

2.3 Zero Carbon Pathway for the UK: CCC Analysis

Achieving Net Zero Carbon by 2050

2.3.1 The Committee on Climate Change's (CCC) "Net-Zero" report[01] provides an in-depth analysis of what is required of the UK to meet its zero carbon target (legislated by the Climate Change Act). The analysis spans different sectors: buildings; industry; power; transport; aviation & shipping; agriculture & land-use; waste; f-gases and greenhouse gas removals.

The report illustrates the scale of action that is required to achieve the target.

2.3.2 Key measures

- 100% low carbon electricity by 2050.
- Ultra-efficient new homes and non-domestic buildings
- Low carbon heat to all but the most difficult to treat buildings.
- Ambitious programme of retrofit of existing buildings.
- Complete electrification of small vehicles (100% of new sales by 2025).
- Large reduction in waste, zero biodegradable waste to landfill and
- Significant afforestation and restoration of land, including peatland.
- Greenhouse gas removals will be required to achieve net zero carbon.

Compliance with zero carbon target

2.3.3 The CCC analysis of "Further Ambition" scenarios, has identified pathways across different sectors that combined achieve a 89% reduction in GHG emissions by 2050, before greenhouse gas removals.

2.3.4 The report lists some "speculative" measures required which may help to get closer to a 100% reduction.

Compliance with carbon budgets target

2.3.5 The CCC "Net Zero" analysis does not look at cumulative emissions or carbon budgets. However, it is the CCC that sets the recommended levels of the UK government's carbon budgets required by the Climate Change Act. The CCC also reports against the UK's progress in achieving them.

Further Reading

- "Further ambition" measures assumed by CCC for "net-zero". See Appendix 2.2.
- UK carbon budgets – section 2.2.

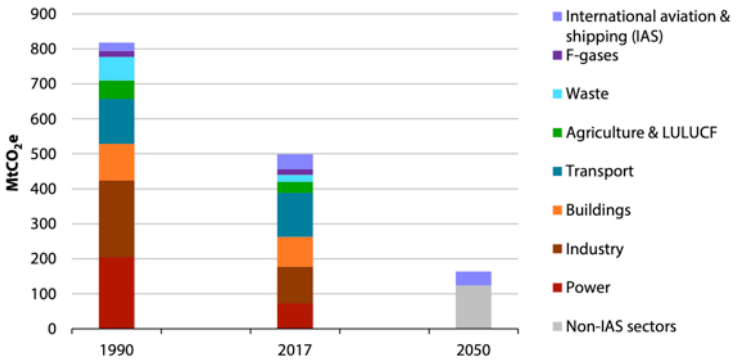


Figure 2.3.1 . Comparison of emissions in 1990, 2017 and what they would need to be based on the original 80% reduction in emissions. CCC. Graph shows the power, industry and waste sectors have already shown big reductions. Aviation emissions have increased. Transport, buildings, F-gases have largely remained constant.

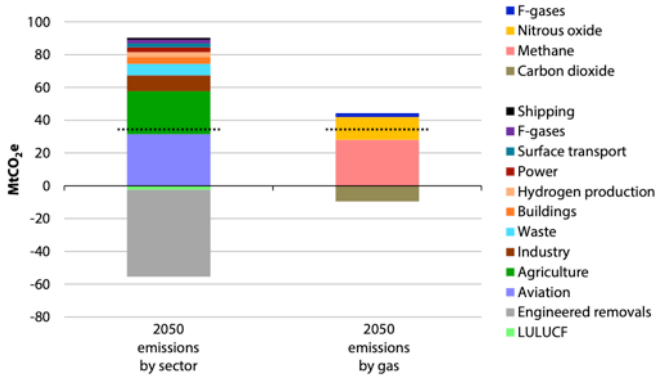


Figure 2.3.2 - Remaining emissions in the "Further Ambition" scenario by sector and by gas, Committee on Climate Change. Graph shows aviation and agriculture are likely to be the dominant GHG emitters in 2020.

UK level

CCC analysis

Scale:

Whole of UK

GHG emissions included

CO_2 NOx NH4 F-gases

Emissions sources Included

- ✓ Power
- ✓ Buildings
- ✓ Transport
- ✓ Waste
- ✓ Industry
- ✓ Cement production
- ✓ Forestry & Land-Use
- ✗ Peatlands
- ✓ Aviation and Shipping

2.4 Translating national targets to the local level

Tyndall Carbon Budget Reports

2.4.1 Tyndall Carbon Budget Reports [30] provide UK local authority areas with budgets for energy related CO_2 emissions from 2020-2100. Aligned with the Paris Agreement, they are informed by the latest science on climate change and carbon budget setting.

2.4.2 Figure 2.4.1 illustrates how the carbon budget for Central Lincolnshire has been derived from the global carbon budget. The UK's carbon budget has been derived using the equity principle – developed countries have been given a smaller portion of the budget compared with developing countries (this is in line with the Paris Agreement).

2.4.3 The carbon budget and required reduction pathway for Central Lincolnshire is illustrated in Figure 2.42. In summary, the report recommends:

- Central Lincolnshire stays within a maximum cumulative CO_2 emissions budget of **9 million tonnes ($MtCO_2$)** for the period 2020-2100.
- If emissions continue at 2017 levels, the entire carbon budget for the area would be used within **7 years** (from 2020), i.e. by 2027.
- Emissions cuts must average **-13.4**% per year to deliver a Paris aligned carbon budget.
- Reach net zero no later than **2041**, at which point 5% of the budget remains.
- Meeting the budget **must not** rely on carbon offsets.

Comparison with UK carbon budgets

2.4.4 The Tyndall Centre's carbon budgets are not comparable with the official UK governments carbon budgets for a number of different reasons: the UK carbon budgets do no apply the equity principle (integral to the Paris Agreement); they include allowances from the EU emissions trading scheme (and therefore do not reflect actual carbon emitted by the UK); budgets until 2032 were set on the basis of an 80% reduction in GHG emissions (not 100% as now required). They also include other GHG emissions.

2.4.5 This report uses the Tyndall Centre carbon budgets for setting targets for Central Lincolnshire, as they are a truer reflection of emitted CO_2 and BEIS figures can be used to directly assess progress. Crucially, the official UK carbon budgets may be too large by a factor of at least two to be consistent with a 1.5C temperature rise[04].

Further Reading

- A look at greenhouse gas emissions – Appendix 1.
- UK Carbon budgets – Section 2.2.

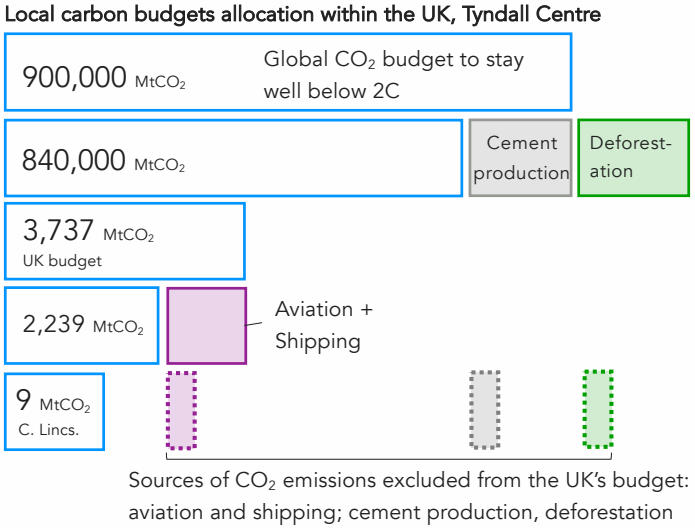


Figure 2.4.1: Tyndall Centre estimation of remaining carbon budget for Central Lincolnshire to stay within 2C temperature rise. Image not to scale.

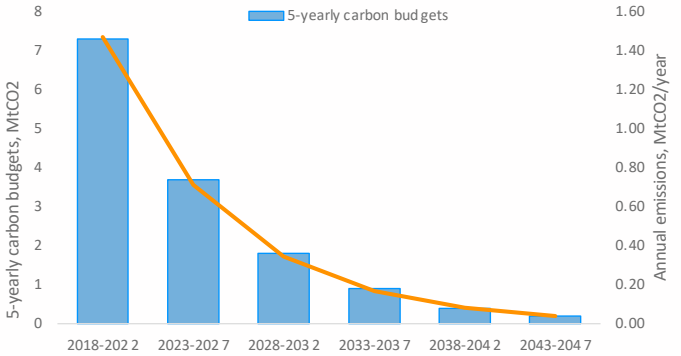


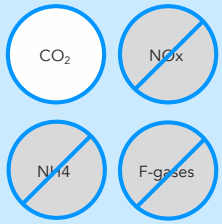
Figure 2.4.2: 5-yearly carbon budgets, annual CO_2 emissions and total remaining carbon budget for Central Lincolnshire's contribution to staying within a 1.5C temperature rise. Data source: Tyndall Centre Carbon budgets report.

Tyndall Centre Carbon Budgets

Scale:

Central Lincs

GHG emissions included



Emissions sources Included

- ✓ Power
- ✓ Buildings
- ✓ Transport
- ✗ Waste
- ✓ Industry
- ✗ Cement production
- ✗ Forestry & Land-Use
- ✗ Peatlands
- ✗ Aviation and Shipping

2.5 Zero Carbon Pathway for Central Lincolnshire: SCATTER Analysis

SCATTER

2.5.1 SCATTER (Setting City Area Targets and Trajectories for Emissions Reduction) is a local authority focussed GHG emissions tool capable of both creating GHG emissions inventories (a point-in-time summary of the GHG emissions apportioned to the local authority area), and the creation of decarbonisation pathways to 2050. The tool can be used by all local authorities, not just cities.

2.5.2 Trajectories to zero carbon can be modelled for different sectors: domestic, transport, industry & commercial agriculture and land-use. It is possible to test varying levels of ambition across 32 different action areas.

2.5.3 Key conclusions

- Emissions in Central Lincolnshire were 0.5 $MtCO_2eq$ in 2018.
- A pathway modelling the maximum level of ambition (within the tool options) has been selected. In this scenario, 23% of GHG emissions remain in 2050.
- Industrial and commercial emissions, and land-use and agriculture emissions are shown to be difficult to abate.
- This makes it **imperative** that housing, transport and waste sectors achieve maximum possible reductions.
- Large scale wind, solar and small scale solar will all need to increase.
- All new housing to be PassivHaus from 2021.
- All buildings heated by low carbon electricity and heat pumps by 2050.
- 25% reduction in journeys taken

Compliance with zero carbon target

2.5.4 The SCATTER tool has identified pathways across different sectors that combined achieve a 77% reduction in CO_2 emissions by 2050.

Compliance with carbon budgets target

2.5.5 It is understood that SCATTER is developing a functionality which will allow local authorities to assess decarbonisation pathways for compliance which compare emissions pathways with the Tyndall Centre's Carbon budgets. However, comparison is not possible at this time.

Further reading

- Appendix 2.1 - Pathways assumptions comparison by sector.

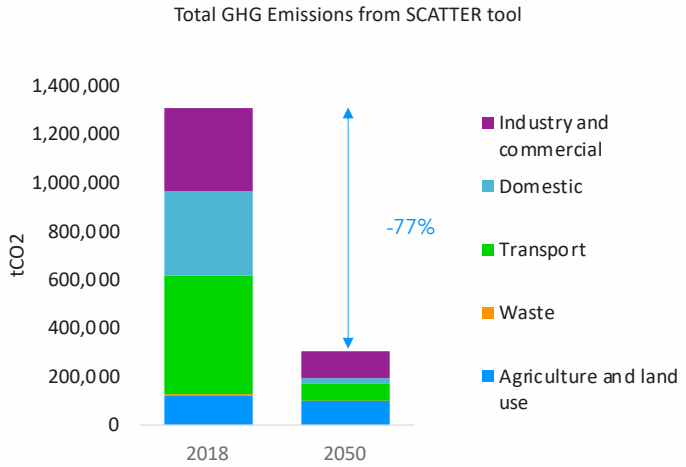


Figure X: SCATTER's maximum level of ambition leads to a predicted 77% reduction in GHG emissions. Remaining emissions from transport, domestic and waste are 14%, 7% and 11% respectively.

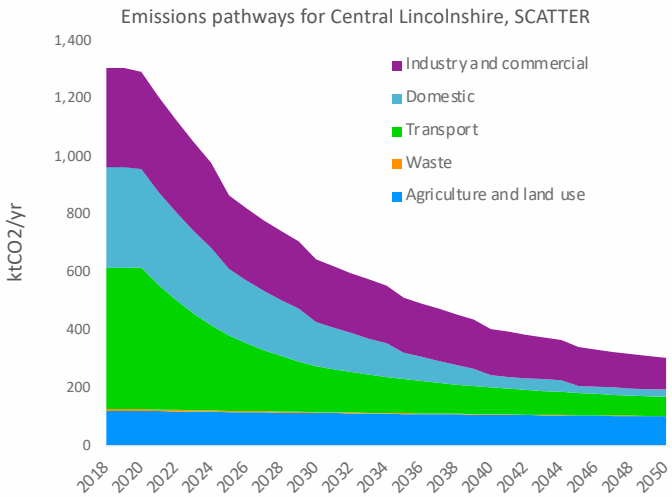


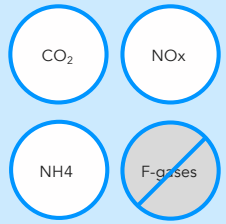
Figure X: GHG emissions pathway for Central Lincolnshire, following maximum ambition across all sectors (Source: SCATTER)

SCATTER analysis

Scale:

Central Lincolnshire

GHG emissions included



Emissions sources Included

- ✓ Power
- ✓ Buildings
- ✓ Transport
- ✓ Waste
- ✓ Industry
- ✓ Cement production
- ✓ Forestry & Land-Use
- ✗ Peatlands
- ✓ Aviation and Shipping

2.6 Zero Carbon Pathway for Central Lincolnshire: Etude Analysis

Achieving Net Zero Carbon by 2050

2.6.1 We have carried out an in-house analysis to estimate current and future CO_2 emissions in Central Lincolnshire. Our approach differs from other approaches in that it looks at CO_2 only and compares forecast cumulative emissions to Central Lincolnshire's carbon budget (section 2.4).

Key conclusions

2.6.2 Like other pathways in this analysis, the Etude pathway illustrates that radical changes to all sectors are required to move towards net zero carbon.

2.6.3 This includes:

- net Zero Carbon new buildings as soon as possible.
- existing building stock energy efficiency retrofits by 2032.
- switch from gas heating to low carbon heat by 2032.
- the electrification of all transport by 2032.

Compliance with Zero Carbon Target

2.6.4 The cumulative emission reductions demonstrate that near zero carbon emissions are possible by 2050 provided all combustion of gas and oil are ceased.

Compliance with Carbon Budgets Target

2.6.5 The analysis shows that compliance with carbon budgets target is only possible if the vast majority of decarbonisation in the districts is carried out in the 2020s and early 2030s. Any delay beyond 2022 exponentially increases the scale of the challenge.

Further Reading

- Etude forecast model methodology and assumptions.

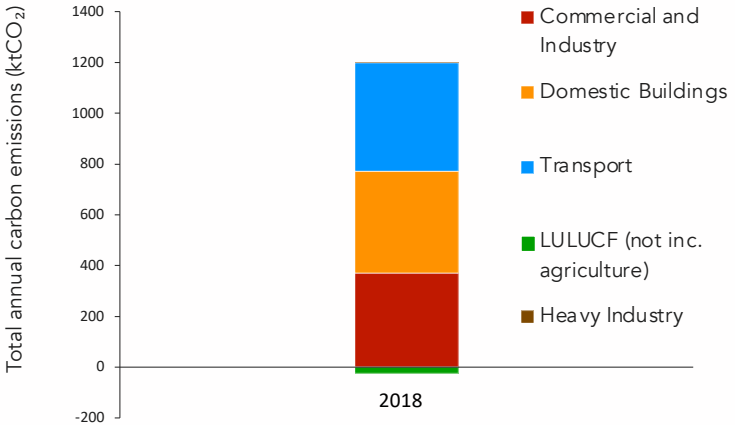


Figure 2.6.1: Latest reported CO_2 emissions (2018) for Central Lincolnshire.

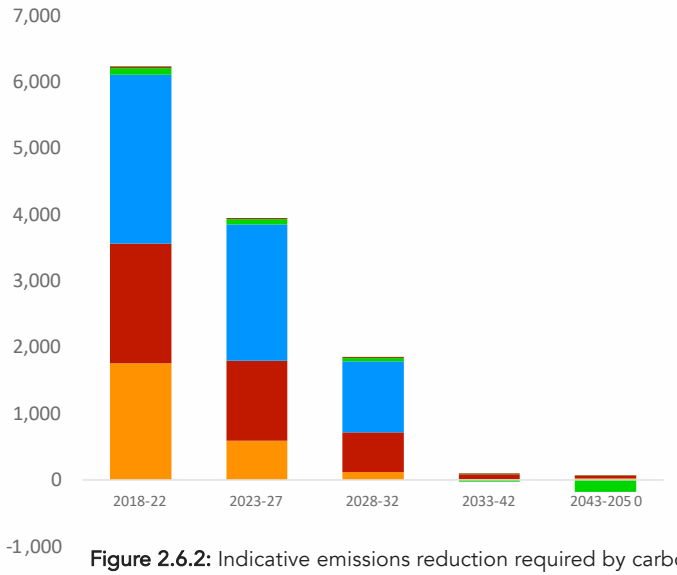
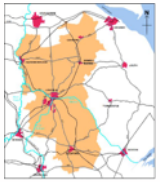


Figure 2.6.2: Indicative emissions reduction required by carbon budget period in order to stay within carbon budget.

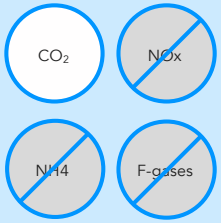


Etude analysis

Scale:

Central Lincolnshire

GHG emissions included



Emissions sources Included

✓ Power
✓ Buildings
✓ Transport
✗ Waste
✓ Industry
✗ Cement production
✓ Forestry & Land-Use
✗ Peatlands
✗ Aviation and Shipping

2.7 Summary of emissions targets required

Required targets

2.7.1 Our review of existing carbon budgets and models, together with our own analysis for Central Lincolnshire, shows common themes and conclusions emerging to inform the required GHG reduction targets required for the region.

- Central Lincolnshire must reach **net zero carbon GHG emissions by 2050** (Climate Change Act 2008)
- Central Lincolnshire must **emit no more than 9 $MtCO_2$ between 2020 and 2100** (Tyndall Centre Tyndall Centre's Carbon Budgets for Central Lincolnshire) from energy use (excluding aviation and cement production).
- The sectors of **power generation, buildings and transport should target zero greenhouse gas emissions** and must in order to compensate for those that cannot.
- **A means of removing greenhouse gas from the atmosphere will be required.** The zero carbon pathways we have looked at have shown that there will be residual GHG emissions remaining that cannot be abated. Removal of greenhouse gases from the atmosphere will be required to bring the balance of GHG emissions to net zero. Examples within the power of the local plan are discussed in section 3.11).

Section 3.0 looks at how the local plan can facilitate the above emissions reductions targets being achieved.

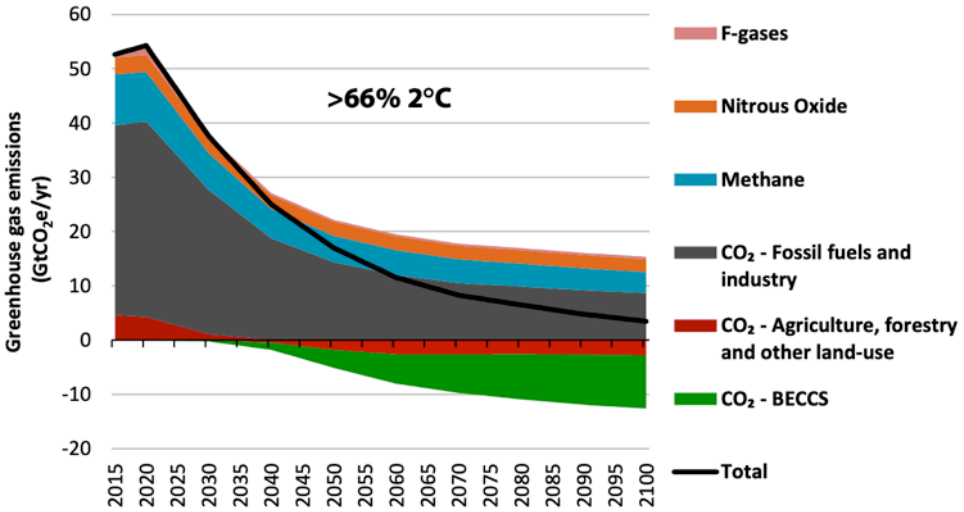


Figure 2.7.1: Graph shows different GHG emissions and how they reduce over time. CO_2 from fossil fuels and industry is the only GHG that is likely to see a large reduction. Other GHGs, including methane and nitrous oxide and difficult to abate, and reduce by a small amount. Residual emissions remain for all GHG gases, and are partially offset by greenhouse gas removals. Source: Committee on Climate Change Net Zero: The UK's Contribution to Climate Change.

Task C

Emissions reductions targets

3.0 Implications for the local plan

A sector by sector look at what the local plan can do to help achieve the emissions reductions required for the region.

3.1 Implications for the local plan

Translating targets to the local plan

3.1.1 The following pages take a closer look at the sources of greenhouse gas emissions in Central Lincolnshire, by sector - the chart on the rights shows the relative emissions of each sector. We seek to understand:

- what is required within Central Lincolnshire to make each sector zero carbon
- how quickly it needs to happen
- how the local plan may facilitate this transition.

The sectors considered are aligned with the categories used by the Committee on Climate Change.

Existing emissions vs new emissions

3.1.2 The local plan is concerned mainly with guiding new development. Therefore it has a very strong ability to influence future emissions associated with new development – particularly emissions from new buildings. It also has the ability to influence the delivery of infrastructure required for a zero carbon future, land-use, and future transport emissions.

3.1.3 The local plan's influence over existing emissions is more limited, or indirect. The biggest impact the local plan can have on existing emissions is facilitating new renewable energy generation – as this will help to bring down emissions in all sectors where electricity is used.

Recommendations and policy

3.1.4 In order to ensure that the recommended policies are comprehensive and fully consistent with a zero carbon future, all emissions within the boundary of Central Lincolnshire are considered before making recommendations on how the local plan may facilitate their reduction.

3.1.5 The recommended policies that fall out of this analysis form a separate document forming this evidence base, "Recommended Policies".

Further reading

- Task A - Position Statement, which expands further on the powers of the local plan.
- "Recommended policies" report which forms part of this evidence base.

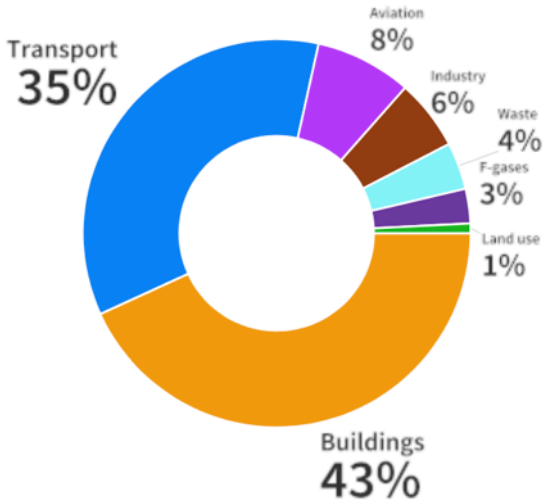


Figure 3.1.1 - Greenhouse gas emissions from Central Lincolnshire, 2018: The majority of emissions currently come from buildings and transport. Emissions from the power sector are included in the sectors in which electricity is consumed.

3.2 Implications for the local Plan: The future of electricity generation

The future of electricity generation

3.2.1 The UK's electricity generation mix has rapidly decarbonised as coal power stations have been retired and use of wind and solar power has increased. The future electricity generation mix is investigated by the National Grid each year through the development of different future energy scenarios (FES), to give an idea of how the future energy mix may look like. In FES 2020[28] there are four scenarios, three of which are compliant with the 2050 zero carbon target: Consumer Transformation, System Transformation and Leading the Way. We have selected the scenario with the most local energy generation (Consumer Transformation) to understand what this might mean for Central Lincolnshire. The main difference between the scenarios is the technology through which low carbon heat is delivered: predominantly electric heat pumps (Consumer Transformation), predominantly hydrogen boilers (System Transformation) and a hybrid of the two (Leading the Way).

3.2.2 The Consumer Transformation scenario relies on the continued deployment of proven technologies with competitive costs such as offshore wind, onshore wind, and solar photovoltaics. System Transformation relies heavily on a hydrogen economy – largely unproven in technical feasibility, cost effectiveness or sustainability[29].

3.2.3 By 2050, electricity demand in the 'Consumer Transformation ' scenario increases by 60% due to electrification of heat and transport. This scenario also tells us that approximately 1/3 of electricity generated in 2050 will need to come from a mixture of both onshore wind and solar photovoltaics. The remaining 70% of electricity is likely to come from sources outside the region – such as off-shore wind, perhaps some nuclear, and other sources.

Current Renewable Energy Capacity in Central Lincolnshire

3.2.4 The Renewable Energy Planning Database and Sub-National Feed in Tariff Register indicate an installed capacity of 149MW of solar photovoltaic technology in Central Lincolnshire in 2020 – this contributes 147 GWh of electricity, or 11.7% of Central Lincolnshire's energy demand, well above the current national average of 3.75% for solar. No onshore wind capacity is recorded in these databases although it is understood that a small amount exists. Nationally, onshore wind contributes 10% of energy demand. Central Lincolnshire also has 9.5 GW of anaerobic digestion, contributing approximately 4% of electricity demand.

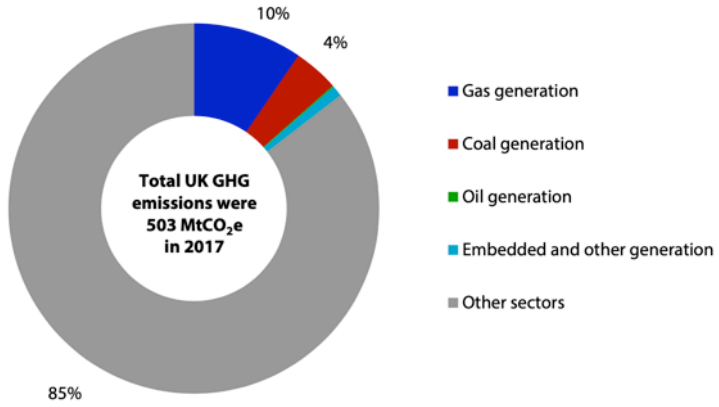


Figure 3.2.1 Greenhouse gas emissions from UK electricity, 2017: In 2017 15% of all UK GHG emissions were from electricity generation via the combustion of fossil fuels. (© CCC, 2019)

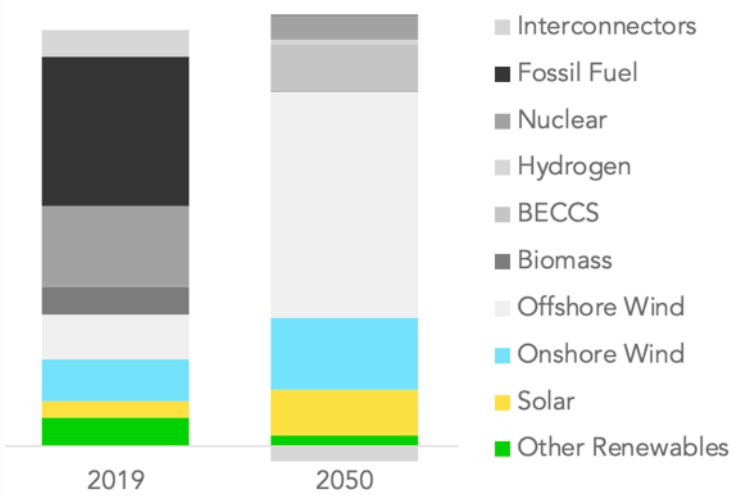


Figure 3.2.2 The UK electricity generation mix, 2019 and 2050: Projected to 2050 using the National Grid's 'Consumer Transformation' scenario, which currently appears to be the most technically plausible way to a two degree compliant electricity supply. Generation technologies most relevant to the local plan (onshore wind, solar and other renewables) will likely represent 30% of the UK energy mix in 2050.

3.3 Implications for the local Plan: How much renewable energy?

The future of renewable energy in Central Lincolnshire

3.3.1 Using the National Grid's Future Energy Scenarios 2020 [28] 'Consumer Transformation' scenario as a basis we have sought to give an indication of how much renewable energy should be generated within the boundaries of Central Lincolnshire. We have utilised three simple methodologies and compared the results:

1) **Projected energy demand in 2050**: Installed solar and wind capacity is apportioned to Central Lincolnshire based on how much energy Central Lincolnshire is likely to use.
2) **Area relative to the total UK area:** this approach considers the area of land within Central Lincolnshire relative to the total generation required.
3) **Area relative to the area of UK with low population density (and hence more ability to host large scale renewables)**: this approach discounts urban areas unable to host large scale renewables, and divides renewable energy generation amongst rural areas.

3.3.2 The results are illustrated in figures 3.3.1 and 3.3.2. Methodologies 1 and 2 do not take into account the relative ability to host large scale renewable energy installations, which dense urban areas are not suitable for. Rural areas will likely need to generate are greater portion of renewable energy within their boundaries than dense urban areas which don't have the means. We would therefore recommend that approach 3 is the fairest and necessary capacity likely to be required, and hence should be used as a guide for allocating sufficient sites. Approach 3 equates to Central Lincolnshire producing approximately 70% of its energy requirements within its boundaries, and it enables cities to use a greater portion of nationally produced generation (e.g. off-shore wind). However, since urban areas are suited to rooftop solar photovoltaics, and off-shore wind provision may well increase, there is still much uncertainty and these figures should be used as a guide only.

3.3.3 These methods give us an indication of renewable energy capacity required, but a detailed local renewable energy strategy is required to better inform this. In 2011, Central Lincolnshire authorities commissioned AECOM to produce a "Renewable and Low Carbon Energy Study for Central Lincolnshire" [20]. The report confirms that the majority of Central Lincolnshire is favourable for wind, and that North Kesteven and West Lindsey have some of the highest potential in the East Midlands region. The presence today of large scale solar photovoltaic farms, with more in the pipeline, demonstrate that the region is also favourable for this technology. The AECOM analysis refers to the "East Midlands Low Carbon Energy Study" which looked at detailed feasibility aspects of large scale onshore wind, which stated a capacity for large scale onshore wind of 1,500 MW within Central Lincolnshire. This is in the region of 4x the capacity required according to our estimate.

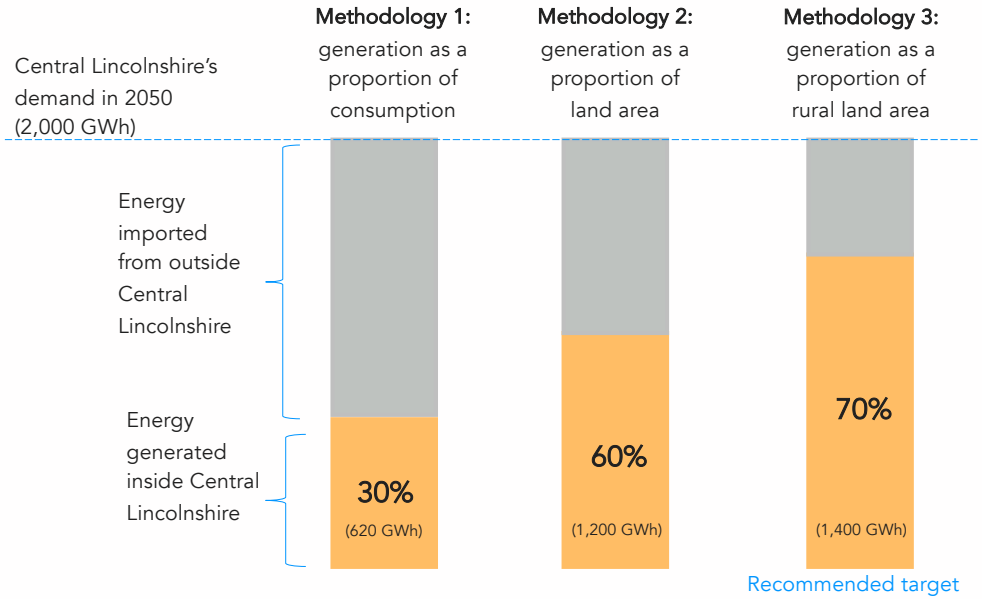


Figure 3.3.1 How much energy should Central Lincolnshire generate within its boundaries? We used three different methodologies to understand how much renewable energy generation Central Lincolnshire should aim to generate. Projected 2050 figures from the National Grid's Future Energy Scenarios 2020 "Consumer Transformation" scenario have been used to compare generation levels on i) consumption; ii) available land area; iii) approximate available area suitable for large scale renewable energy generation.

Recommended target

	Methodology 1:	Methodology 2:	Methodology 3:
Solar PV arrays	230 MW	440 MW	510 MW
Wind turbines	150 MW	290 MW	340 MW

Figure 3.3.2 How much solar PV and wind should we plan for? Taking the generation requirements in Figure 3.3.1, and using the same relative split between solar and wind used in FES 2020 "Consumer Transformation" scenario, we have suggested the required solar and wind capacities that should be targeted in Central Lincolnshire. In reality the proportion of each could vary slightly but a combination is important for diversity.

3.4 Implications for the local Plan: The electricity grid

Grid Infrastructure

3.4.1 The Royal Town Planning Institute (RTPI) published the report "Planning for a Smart Energy Future" in July 2019. The report looks at the role of planning policy (both local and national scale) can support the development of a clean energy future through supporting the development of smart grids. The report states that local planning authorities should ensure that their policies and implementation support smart energy, and that smart energy should be central to planning for new homes, jobs, transport and infrastructure.

3.4.2 A key recommendation relating to grid infrastructure to come out of the report is that Local Authorities should work with the local Distribution Network Operator (DNO), National Grid and the storage industry to identify potential areas for allocation of energy storage uses and consider safeguarding or allocating such sites through the local plan process.

Battery Storage + Interconnectors

3.4.3 As wind and solar energy are intermittent, and demand for electricity constantly varies, it is necessary to have mechanisms to balance power in the electricity network. The main options are: demand side management; battery storage and importing/exporting power through interconnectors with other countries.

3.4.4 The National Grid's "community renewables" scenario shows a steep rise in the need for battery storage capacity. The UK currently has a pipeline of over 14GW of battery storage projects, many of which are being co-located with wind and solar generation. However, projections estimate we will need twice that. Local Plans will provide a crucial role in enabling these projects.

3.4.5 It is not yet clear how much storage capacity will be deployed at a utility scale, versus smaller systems within buildings, however larger systems can achieve significant economies of scale and their growth may render the need for building-level storage less important.

Figure 3.4.1 Utility scale battery storage: Large scale battery storage projects such as this are likely to be deployed rapidly in the coming years. They offer significant economies of scale. (© Energy Saving Trust, 2020)

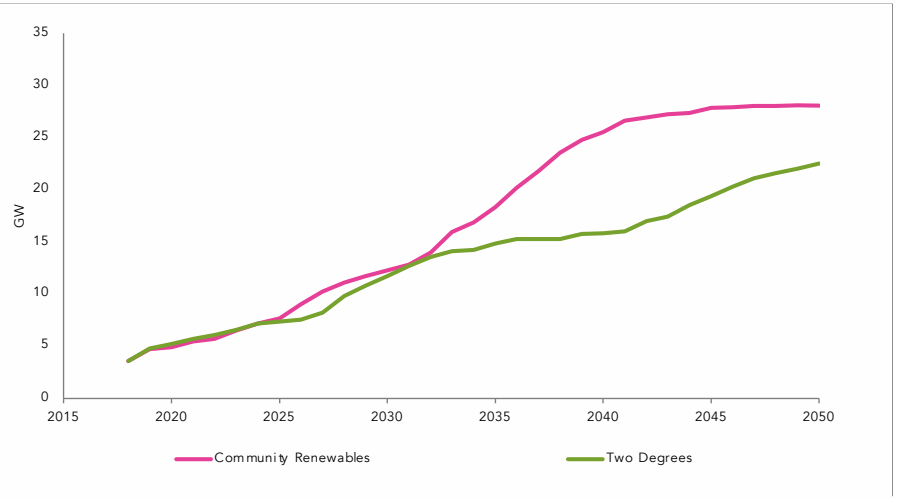


Figure 3.4.2 Battery storage capacity: Battery storage capacity is likely to increase in both of the National Grid's two degree compliant scenarios. Will this be at a utility scale, or within buildings? (© National Grid, 2019)

3.5 Implications for the local Plan: Managing demand

Agile Tariffs

3.5.1 Agile electricity tariffs vary in response to wholesale electricity pricing. They are likely to play a core role in the future electricity supplies by offering a mechanism to incentivise consumers to use renewable energy when it is being generated. This could significantly reduce a household's electricity costs, while increasing use of clean renewable electricity. Local policy could promote measures that increase the potential for participation, discussed below.

Demand Side Management

3.5.2 There are three core opportunities for demand side management: electric vehicle charging, space heating, and hot water heating. For most households these will represent the three largest end uses of electricity over which some degree of time-control is possible and desirable.

3.5.3 Smart charging for electric vehicles is already mandated by the UK government. Smart heating and hot water controllers are already on the market, though require an electric heating system with hot water storage to work. They work by receiving pricing signals from a power company and then acting on that signal, for example by turning down the heating when electricity is expensive.

3.5.4 Excellent levels of building fabric efficiency are useful in unlocking the benefits of smart heating controls as this decouples the need for heat with external temperature variations. This means that homeowners can allow their thermostat to turn off heat sources for many hours without the house perceptibly cooling. Hot water storage is also important in the form of well insulated hot water tanks, rather than instantaneous hot water sources.

3.5.5 Recommended policies for power and infrastructure

- The local plan should facilitate expansion of renewable energy in the districts as far as possible.
- To ensure on-shore wind and solar photovoltaic energy is delivered in appropriate locations, the local plan should seek to allocate sites for installation.
- Provision of renewable energy Supplementary Planning Documents (SPDs) covering large scale on-shore wind, large scale solar photovoltaic and other appropriate low carbon energy sources.

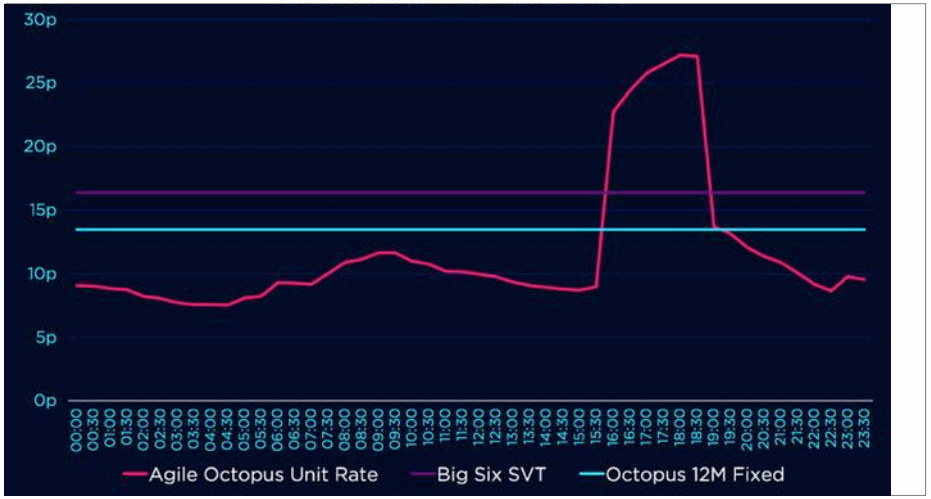


Figure 3.5.1 Flexible electricity tariffs: Net zero carbon buildings with high levels of fabric efficiency and heat pumps can be well positioned to take advantage of "agile" tariffs, which offer cheaper electricity at times of the day where demand is low relative to generation.

Figure 3.5.2 Smart thermostats: Smart thermostats are a way of unlocking the power of "agile" tariffs and demand side management to provide affordable low carbon heating. Used in combination with services such as If This Then That (IFTTT) they empower users to access cheap low carbon electricity.

3.6 Implications for local plan: Existing Buildings

The future for existing buildings

3.6.1 Our analysis shows that existing buildings currently account for 43% of GHG emissions in Central Lincolnshire. If we allocate existing buildings a share of Central Lincolnshire's carbon budget, they would consume their budget within 7 years. It is clear therefore that tackling carbon emissions from existing buildings is of paramount and urgent importance. There are 130,000 homes in Central Lincolnshire to stay within their carbon budget gas boilers would need to be removed in the 2020s peaking at around 20,000 replacements per year – any slower pace could not stay within carbon budgets.

3.6.2 The CCC concluded that at least 90% of existing buildings should have energy efficient retrofits for the UK to meet its zero carbon targets. SCATTER and our own analysis concluded similar results.

Buildings in Central Lincolnshire

3.6.3 Existing buildings in Central Lincolnshire should be made zero carbon where possible. This must be achieved through: i) Energy efficient retrofits for the majority of buildings; ii) replacement of fossil fuel heating with low carbon heating sources; iii) zero carbon electricity (through either on-site renewables or through off-site renewables).

3.6.4 Policy should be reviewed in a pragmatic manner with regards to listed buildings and conservation areas. The question of whether their heritage asset value truly warrants 'absolute' preservation will need consideration. For example, by the addition of solar panels or upgrading of windows. Consideration could also be given to whether some buildings can be re-purposed to house functions more suitable to their energy profile.

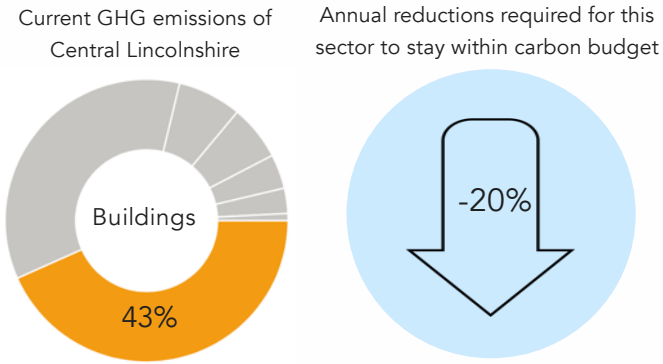
What the local plan should do

3.6.5 The ability of the local plan to influence the carbon emissions of existing buildings is limited. However, there are areas in which policy can impact existing buildings: listed buildings; buildings in conservation areas; buildings which are undergoing a "change-of-use".

3.6.6 Mechanisms such as Supplementary Planning Guidance, supportive policies and Local Development Orders could be considered to facilitate emissions reductions from existing buildings.

Further reading

- Key recommended policies are listed in the "Recommended Policies" report.
- Chapter on Infrastructure (Task E).



Case study: New Court, Trinity College

Grade I listed building

88% reduction in carbon emissions

75% reduction in energy demand

Internal wall insulation

Low temperature underfloor heating

New mechanical ventilation with heat recovery system

Figure 3.6.1: Trinity College New Court is a Grade I listed building that successfully underwent a energy efficient retrofit

3.7 Implications for local plan: New Buildings

The future of buildings in Central Lincolnshire

3.7.1 Our analysis of different zero carbon pathways for Central Lincolnshire shows that buildings are one of the sectors which must target zero emissions. The CCC, SCATTER and our own analysis all concur that:

- New buildings from 2020 must be designed to be **net zero carbon.**
- New buildings built from 2020 must be **ultra-low energy** (extremely energy efficient)
- New buildings must be heated by **low-carbon heat** – e.g. heat pumps. There should be no gas boilers installed in new homes from 2020.

3.7.2 The Committee on Climate Change has published a report in 2019 named 'UK housing – fit for the future?'. The report highlights the need to build new buildings with 'ultra-low' levels of energy use. It also makes a specific reference to space heating demand and recommends a maximum of 15-20 kWh/m²/yr for new dwellings. For reference, Passivhaus requires 15 kWh/m²/yr, and most new domestic buildings have a heating demand of 40-80 kWh/m²/yr.

3.7.3 The Department for Business, Energy & Industrial Strategy (BEIS) asked the Green Construction Board to respond to the 2030 Buildings Energy Mission. The background report published as part of this response reviewed the evidence from new buildings which have already achieved a 50% reduction in energy use, compared with typical benchmarks. There is a lot which can be learnt from these buildings as there are recurring approaches, techniques and systems that are responsible for their excellent energy efficiency.

Targets

3.7.4 We conclude that future development in the region should be designed and built to be zero carbon without delay. Central Lincolnshire expects to build 1,325 new homes every year. To continue to design new developments with net positive carbon emissions simply adds to the already significant retrofit challenge of the future. It is possible to build net zero carbon homes and buildings today – see technical and cost feasibility chapters.

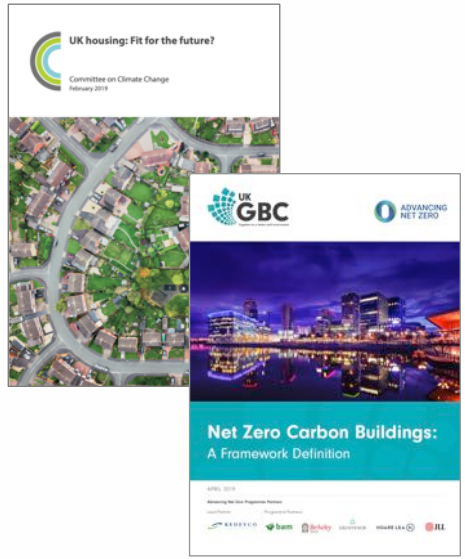
To build net-zero carbon homes and buildings with immediate effect is consistent with a fair contribution towards the Paris agreement target and the Climate Change Act 2008.

Further reading

- Report "Task A - Position Statement"
- The reports 'Task D - Technical Feasibility' and 'Task E - Cost Implications' (Task E) take an in depth look at delivering zero carbon new buildings.

"We will not meet our targets for emissions reduction without near complete decarbonisation of the housing stock"

Committee on Climate Change, UK Housing: Fit for the Future?



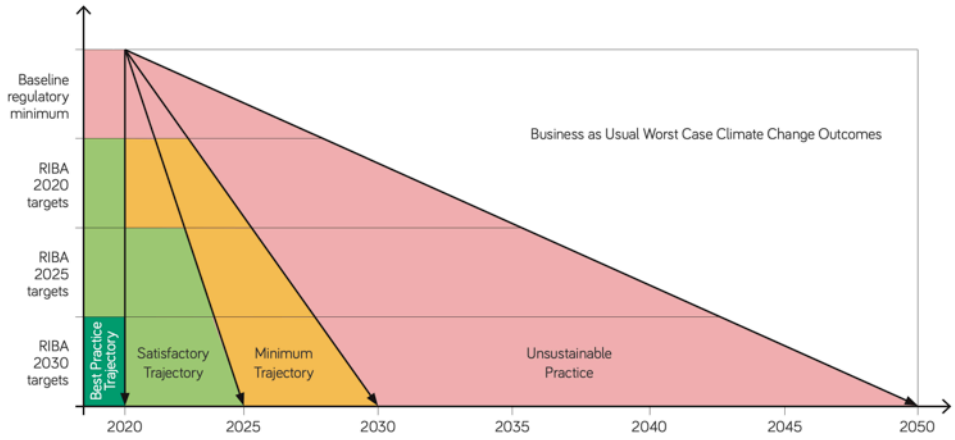


Figure 3.7.1: RIBA 2030 Climate Challenge Trajectories

3.8 Implications for the local plan: Overheating in buildings

Overheating risk in buildings

3.8.1 Average monthly temperatures are increasing across the UK due to climate change. Compared with the rest of the UK, external temperature and solar radiation in Central Lincolnshire are in the middle of the range, and represent a moderate risk to overheating. However, there are many other factors that contribute to overheating. These include orientation, proportion of glazing, the ability to open windows, presence of community heating and amount of surrounding green space[15] .

3.8.2 If overheating risk is not mitigated, there is the risk that some dwellings and buildings will overheat even on average summer days. This is not only a matter of discomfort – overheating can have serious health impacts, including death. During the heat wave of 2003, a total of 2,091 excess deaths were recorded in England and Wales[14] .

3.8.3 Without care and attention at the design stage, overheating in buildings will lead to an increase in the use of cooling systems, generating increased demand for electricity, increasing running costs of dwellings.

Building Regulations alone is insufficient to mitigate risk

3.8.4 The checks to assess the potential risk of overheating / excessive solar gains in building regulations are rudimentary. There are sophisticated modelling methodologies available – e.g. CIBSE TM52 and TM59 (for non-residential and residential heating checks respectively) but these are not mandatory.

Good Homes Alliance Overheating Tool

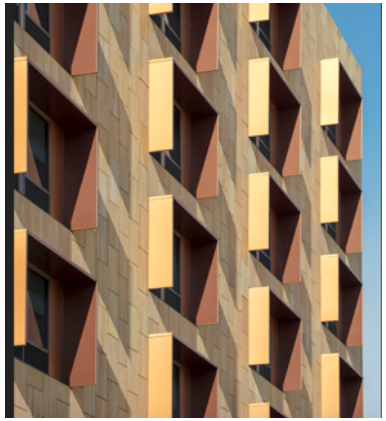
3.8.5 The Good Homes Alliance (GHA) have developed guidance and a tool[15] for use on residential developments at the pre-planning stage. The tool helps to identify key factors contributing to overheating risk and provides possible design measures to mitigate this risk. It has been designed to provide practical design guidance without the need for detailed modelling to be undertaken.

3.8.6 The new London Plan (2020) will require all new residential developments to undertake an overheating risk assessment at planning stage using the GHA tool[17] .

What the local plan can do

3.8.7 We recommend that the local plan contains policies that require early stage overheating checks using the Good Homes Alliance "Overheating in New Homes" tool demonstrating that the design is at "low" risk of overheating. Where there is a potential risk of overheating, detailed TM52 / TM59 analysis should also be undertaken to demonstrate the risk has been mitigated sufficiently.

Figure 3.8.1: The above documents and guides provide guidance on mitigating overheating risks in residential buildings [15], [14], [16].



Tooker House - Solomon Cordwell Buenz's (SCB)

Sulgrave gardens: Cartwright Pickard Architects

Figure 3.8.2: Overheating mitigation measures could include adding external shading (either building mounted or trees), the colour of surfaces, the presence of thermal mass and the ability to take advantage of secure night cooling.

3.9 Implications for local plan: Transport

The future of transport in Central Lincolnshire

3.9.1 Of the pathways to zero carbon that we have reviewed, all show that transport has to date been static or increasing in its emissions, but that it has the potential to become a zero carbon sector. Indeed, our analysis shows that it is essential for it to do so.

3.9.2 Currently, transport represents approximately 35% of Central Lincolnshire's GHG emissions through the combustion of petrol and diesel. To be consistent with a 1.5-2C pathway, Central Lincolnshire should reduce transport emissions by at least 13.5% per year – ideally targeting 20% per year.

3.9.3 The UK government has announced the intention to ban the sale of new petrol and diesel cars from 2030 and require all new cars and vans to be zero emissions from 2035 [13]. Options for low emissions vehicles include hybrid petrol/electric (still a source of CO_2), full electric, biofuel (still a source of CO_2) and hydrogen. The market appears to be responding at pace to electric vehicles, especially cars and light vehicles. There are also electrification options for freight vehicles and public transport, however hydrogen is another contender in this domain.

3.9.4 Electric and hybrid electric cars currently represent less than 2% of total cars registered in the UK, however, uptake is increasing exponentially. Pure electric car sales increased 184% from September 2019 to September 2020 [11]. This actually exceeds the National Grid Future Energy Scenarios 2020 best case forecast .

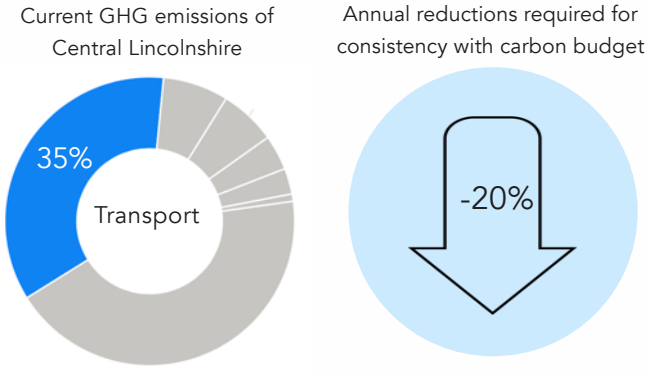
3.9.5 Barriers to uptake include battery capacity, lack of charging points and the high costs of EVs (however cost parity is expected by mid-2020s [10]). Ongoing research into batteries will help to address range and sustainability issues. There are ambitious plans to roll out additional charging points across the UK.

3.9.6 In tandem with the transition to zero emission vehicles, the Committee on Climate Change recommends that we need to realise a reduction in total car journeys of at least 10% by 2050. This will necessitate a move towards greater use of walking, cycling and public transport.

What the local plan should do

3.9.7 The Local Plan will play mostly a facilitatory role in reducing emissions from transport (Task A). It should use all available mechanisms to ensure adequate charging points are made across new developments, land is safeguarded for the expansion of public transport and walking/cycling routes, and new development is focused in locations that are already (or can be) well connected to local amenities and existing public transport systems.

See the "Recommended Policies" report in this evidence base for more detail.



3.10 Implications for local plan: Land-use

The role of the land

3.10.1 Land can be both a source and a sink of GHG emissions, depending on land-use practices.

3.10.2 Carbon and methane is stored below ground in soils and peatland, and above ground in trees and plants. The land will therefore play an important role in carbon sequestration – mopping up CO_2 already emitted into the atmosphere.

3.10.3 The Committee on Climate Change (CCC) report, "Land Use: Policies for a Net Zero UK" (Jan 2020) issues a number of recommendations relating to the key objectives of delivering low-carbon farming practices and changing the use of land to reduce emissions and increase sequestration. See table on the right which lists the key recommendations and how the local plan can support them.

Limiting emissions from the land

3.10.4 The land naturally emits some greenhouse gas emissions through natural cycles and processes. But if these become out of balance, they can become a problem. For example, the draining of peatland soils for agriculture or development can lead to huge amounts of stored carbon being released into the atmosphere.

3.10.5 The biggest impact the local plan can have on limiting emissions from the land is through how land is allocated for development and the protection of carbon-rich soils. Using the land as a carbon sink is discussed on the next page.

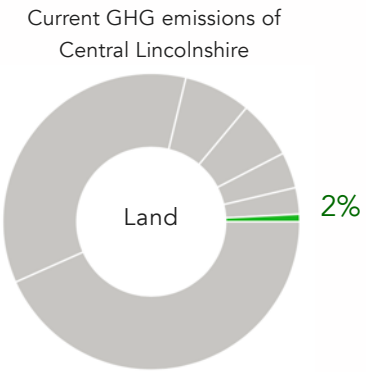
Allocating land for development

3.10.6 Carbon-rich soils should be protected from development, where possible. It is therefore recommended that sites should be assessed for their ability to release or store GHG emissions prior to permission being granted for development.

Protection of carbon-rich soils

3.10.7 The creation, preservation and management of habitats that are known to be beneficial in terms of storing carbon (such as woodland, grassland, wetlands, peatlands and agricultural land), can also effect many other benefits, including increasing biodiversity, improving resilience to the effects of climate change and providing amenity for the local community.

The report "Task A – Position Statement" includes more information on carbon sequestration and peatlands.



CCC Recommendation	Can the local plan influence?
Low carbon farming practices	No
Afforestation, agro-forestry, hedge creation and broadleaf management	Yes. Through allocation of land for projects.
Upland peat restoration	N/A
Lowland peat restoration and management	Yes. Through allocation for restoration and protection.
Energy crops	Indirectly through being supportive of appropriate new bioenergy applications.
Enabling measures	No. However wider council policies and measures can support.
Diet change	No. However wider council policies and measures can support.
Food waste reduction	No. However wider council policies and measures can support.
Trade policies	No. However wider council policies and measures can support.
Wider government agricultural strategy	No.
Monitoring, reporting and verification	No.

3.11 Implications for local plan: Forestry and agriculture

The need to take carbon dioxide out of the atmosphere

3.11.1 Almost all sectors will likely have residual, hard-to-eliminate emissions as – for example, industrial processes for which suitable fossil fuel alternatives have not been found. To achieve carbon neutrality and ensure we do not overspend our carbon budget, we need to compensate for those ongoing emissions through removal of at least an equal amount from the atmosphere. The land has a key role to play here.

3.11.2 In addition to the Committee on Climate Change's Land-Use report[21], the Royal Society and Royal Academy of Engineering have recently published a report "Greenhouse Gas Removals"[22] which list recommendations for carbon sequestration in the UK. A summary is given in Figure 3.11.1, where we have highlighted in orange those removal methods that the local plan can influence. The study also assessed the potential of each method to store carbon and its readiness for implementation (figure 3.11.2). The local plan can help facilitate three of the four methods that are proven and ready for deployment: forestation; habitat restoration and building materials.

Afforestation

3.11.3 Sites are needed across the UK for reforestation. The CCC recommends the UK needs to increase forest cover to 19% [01]. Central Lincolnshire is a predominantly agricultural area, with a low forest area (less than 10%) [08]. Therefore, Central Lincolnshire should seek to understand the potential of targeting a similar increase and sites should be allocated for creation of new multi-species woodlands. Multi-species woodlands store more carbon, increase biodiversity and are more resilient to disease than mono-culture forests. Potential for working with farmers to combine afforestation with food production should be explored.

Habitat restoration

3.11.4 Woodlands and forests are not the only habitats that can store carbon. Peatlands[25], wetlands[26], grasslands[24] and others can store significant amounts of carbon. Restoration of these habitats can turn degraded habitats into carbon sinks.

Building with biomass and low carbon concrete

3.11.5 Timber and low-carbon concrete can lock up carbon indefinitely. Through encouraging the utilisation of wood and and low-carbon concrete, buildings can become effective carbon sinks.

Further reading

- Chapter on Peatlands (Task A), and Offsetting report (Task I).

Storage location	Greenhouse gas removal method: Increased biological uptake	Natural inorganic reactions	Engineered removal
Land vegetation (living)	Afforestation, reforestation and forest management; Habitat restoration;		
Soils and land vegetation (dead)	Soil carbon sequestration; Biochar	Enhanced terrestrial weathering	
Geological	BECCS	Mineral carbonation at surface	DAC + geological storage DAC + sub-surface mineral carbonation
Oceans	Ocean fertilisation	Ocean alkalinity	DAC + deep ocean storage
Built environment	Building with biomass		Low-carbon concrete

Figure 3.11.1 Greenhouse gas removal methods by storage location (from "Greenhouse Gas Removals", RS and RAE[22]. The local plan can have a direct influence on those highlighted in orange.

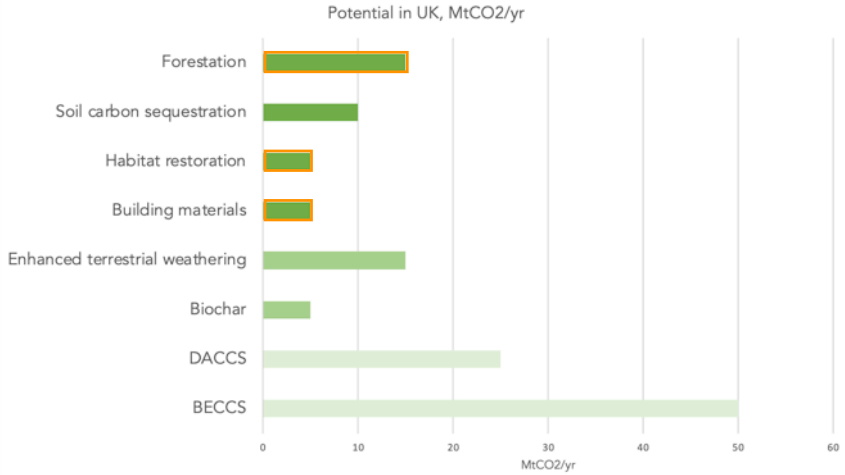


Figure 3.11.2 - Potential of greenhouse gas removal methods in the UK. Dark green = ready for deployment. Mid-green / light-green = yet to be demonstrated at scale. Light-green methods are unproven and theoretical (direct air carbon capture and storage, DACCS, and bioenergy with carbon capture and storage, BECCS).

3.12 Implications for local plan: F-gases

F-gases

3.12.1 F-gases, while a small proportion of Central Lincolnshire's current GHG emissions (around 3%), are a potent greenhouse gas. There are four F–gases included in the UK's GHG inventory, however 94% are from one group: HFCs. HFCs are used in refrigeration and air conditioning systems, aerosols, medical inhalers, and fire equipment. The other F-gases are mainly used in industry and electricity distribution.

3.12.2 The use of HFCs in particular is set to increase rapidly due to heat pumps being a good solution for low carbon heat for buildings, and as air conditioning systems become more widely used as summer temperatures increase.

3.12.3 Industry is reacting to the need for refrigerants with low GWP, driven largely by the European F-gas regulations and the Kigali amendment, which will phase out some refrigerants with high GWP in 2022 and continue to reduce the total amount of refrigerant available for sale, further incentivizing the use of low GWP refrigerants. It is essential that the UK either continues participating in this regulation or it develops and enforces a regulatory regime that is at least as strong.

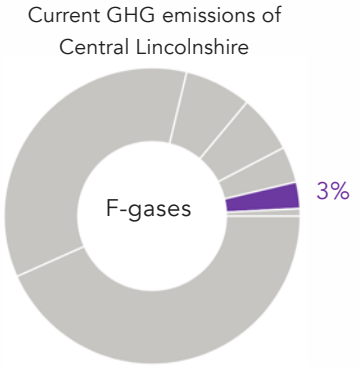
3.12.4 It is imperative that policies and regulations are developed that foster responsible specification, management and disposal of refrigerants. The greatest risk in leaks is at end-of-life, however it is possible for refrigerants to be recovered and re-used.

What the local plan should do

3.12.5 We recommend policies are put in place that encourage the need for refrigerant systems to be reduced through passive design, use of low GWP refrigerants where possible, minimize refrigerant charge (the amount of refrigerant in the system), mitigate refrigerant leakage through leak detection and high-quality sensors, and enhanced refrigerant recovery at the end of life.

Further reading

- Technical Feasibility, Task D



3.13 Implications for local plan: Other sectors

Waste

3.13.1 The Committee on Climate Change have recommended a target recycling rate of 70% by 2030 at the latest with an immediate ban on biodegradable waste going to landfill. New housing will have to have the space to allow segregation of waste and constrained collection to encourage reuse.

3.13.2 For commercial waste and in the context of the local plan, particularly construction waste, strict limits should be set for all construction sites on recycling rates, waste to landfill and total quantities of waste.

3.13.3 The County Council's minerals and waste plans will also have a role in allocating potential sites for additional waste processing facilities that may be required in response to increased recycling rates and diversion from landfill. These could also include sites for large scale anaerobic digestion to process agricultural waste into biogas for energy generation.

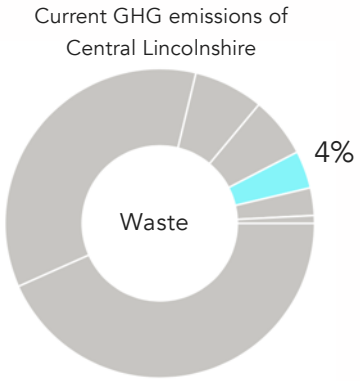
Water

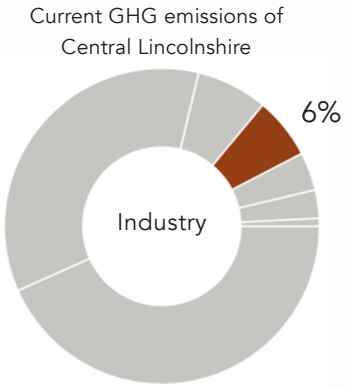
3.13.4 Management of water resources in Central Lincolnshire is a significant challenge. Both excess (flooding) and deficit (drought) are increasing in frequency as weather patterns have changed due to Climate Change. The attenuation of rainfall run off into the river network, both urban and rural, is a critical factor in levelling out the increasingly extreme peaks and troughs of weather events. However, surface water run-off and other mitigation measures are beyond the remit of this evidence base.

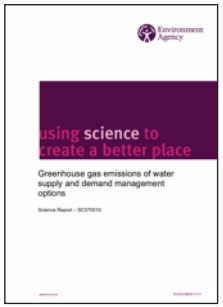
3.13.5 Of carbon emissions associated with water, 89% are from water heated in the home, and 11% are from water supply and treatment[27]. The local plan can support GHG emissions associated with water use through requiring water efficiency standards in buildings. By doing so, demand for water will be reduced, less energy will be required for hot water heating, and demands on water treatment facilities will be less.

Industry

3.13.6 Industrial processes within Central Lincolnshire will likely represent a significant portion of emissions in 2050 since they are more difficult to abate than emissions from other sectors. While the local plan doesn't have a large scope to influence emissions, it would be worthwhile considering the potential of co-location of different industries in order that inputs/outputs can be shared, and efficiency increased, for example food-manufacturing directly adjacent to bioenergy plant[28]. It would also be reasonable to request a requirement deliver a certain amount of renewable energy for any applications for new industrial sites.







4.0 Conclusion

The pace and scale of emissions reductions required

4.1.1 Central Lincolnshire's remaining carbon budget for a fair contribution to the national and global effort to stay withing a 1.5-2C temperature rise is 9 $MtCO_2$. If we continue to emit emissions at the rate they were in 2017, this entire carbon budget would be used within 7 years (by 2027).

4.1.2 Some methods and means of carbon reduction are developed, tried and tested. Others are theoretical. Even with optimistic scenarios, there will likely be remaining, unavoidable emissions in 2050 from hard-to-treat sources. These emissions will need to be offset, but the means of offsetting all these residual emissions do not yet exist at scale. We must therefore not be complacent in dealing with emissions which we have the technological means to eliminate, such as those from buildings and transport. The local plan should take every opportunity to reduce emissions across all sectors where possible.

The power of the local plan

4.1.3 The new local plan can have varying levels of impact on different emissions.

1. Facilitate the expansion of renewable energy generation in order that current, existing emissions can be reduced throughout all sectors.
2. Minimise emissions from new buildings – zero carbon buildings policies
3. Minimise emissions from transport by supporting and facilitating low carbon transport.
4. Facilitate the decarbonisation of heat of existing buildings through targeted use of planning powers.

Policies

4.1.4 The findings from the analysis within this chapter, and the remaining chapters in this evidence base culminate in suggested policies for the new local plan to include.

The policies are laid out in a separate report forming part of this evidence base – "Recommended policies".

Step 1

The local plan's greatest ability to influence emissions reductions across all sectors, include existing emissions, is through facilitating the decarbonisation of the electricity grid through renewable energy provision.

Step 2

The local plan should also be responsible for ensuring new development does not unnecessarily increase overall emissions within Central Lincolnshire

Step 3

The local plan should exercise its powers where possible to decarbonise transport. This should be through a mixture of encouraging active transport, expansion of public transport services, and provision of infrastructure for low-carbon transport (e.g. electric car charging networks).

Step 4

The local plan should facilitate the transition to low carbon heat in buildings through use of planning powers such as local development orders, permissive policies and a review of conservation policies. And, where appropriate, consideration of low carbon heat networks.

References

[01] "Net Zero: The UK's Contribution to Climate Change", Committee on Climate Change

[02] (above technical report)

[03] "Climate Metrics Under Ambitious Mitigation", Oxford Martin School, University of Oxford, Briefing Note, November 2017.

[04] Kevin Anderson, John F. Broderick & Isak Stoddard (2020): A factor of two: how the mitigation plans of 'climate progressive' nations fall far short of Paris-compliant pathways, Climate Policy, DOI: 10.1080/14693062.2020.1728209

[05] "Net Zero Cambridgeshire", CUSPE, October 2019.

[06] Transport emissions from NAEI data for 2017 (BEIS emissions records) - https://naei.beis.gov.uk/laco2app/

[07] DfT published data for 2017/18 CW0301

[08] NAEI (BEIS) report Mapping Carbon Emissions & Removals for the Land Use, Land Use Change & Forestry Sector (up to 2017)

[09] IPCC 5th Assessment Report (AR5), Climate Change 2014, Synthesis Report, Summary for Policy makers.

[10] Electric Vehicles and Infrastructure, Briefing Paper 7480, House of Commons, March 2020.

[11] Driving Electric, https://www.drivingelectric.com/news/678/electric-car-sales-uk-near-7-market-share-september-2020 , October 2020.

[12] National Grid ESO, Future Energy Scenarios 2020, Data Workbook.

[13] " Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030", Gov.uk, https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030

[14] "Impacts of overheating in homes", Zero Carbon Hub

[15] "Overheating in new homes", Good Homes Alliance, July 2019.

[16] "Acoustics, Ventilation and Overheating: Residential Design Guide", Association of Noise Consultants, Janurary 2020 [20] "Renewable and Low Carbon Energy Study for Central Lincolnshire", AECOM, 2011.

[17] "Energy assessment guidance: GLA guidance on preparing energy assessments as part of planning applications", Greater London Authority, April 2020.

[18] "UK Housing: Fit for the Future?", The Committee on Climate Change, February 2019.

[19] "The cost of poor housing to the NHS", S.Nicol, Mike Roys, Helen Garrett, BRE, 2015.

[20] "Renewable and Low Carbon Energy Study for Central Lincolnshire", AECOM, 2011.

[21] "Land-use policies for a net-zero UK", Committee on Climate Change, January 2020.

[22] "Greenhouse Gas Removal", The Royal Society and The Royal Academy of Engineering, September 2018.

[23] "Tree species richness increases ecosystem carbon storage in subtropical forests", Liu, Trogisch, He, August 2018. - https://royalsocietypublishing.org/doi/10.1098/rspb.2018.1240

[24] "Nature's Tapestry", The Grasslands Trust, 2011. http://www.magnificentmeadows.org.uk/assets/pdfs/Natures_Tapestry.pdf

[25] International Union for the Conservation of Nature, https://www.iucn.org/resources/issues-briefs/peatlands-and-climate-change

[26] "Carbon sequestration by wetlands: A critical review enhancement measures for climate change mitigation", Were, Kansiime, Fetahi. April 2019.

[27] "Using science to create a better place: greenhouse gas emissions of water supply and demand management options.", Environment Agency, July 2008.

[28] "Future Energy Scenarios", National Grid ESO, July 2020 (https://www.nationalgrideso.com/document/174541/download)

[29] "Heating in Great Britain: An incumbent discourse coalition resists and electrifying future", R Lowes, B Woodman, J Speirs, August 2020 (Journal of Environmental Innovation and Societal Transitions).

[30] The Tyndall Centre carbon budgets reports, downloadable from https://carbonbudget.manchester.ac.uk

Task C
Emissions reductions targets
Appendices

Appendix A - A look at Greenhouse Gas Emissions

What are GHG emissions?

Greenhouse Gas (GHG) emissions are gases which contribute to warming global temperatures by trapping heat from the sun within our atmosphere.

The Kyoto Protocol's "basket" of GHG emissions include: carbon dioxide (CO_2), methane (NH_4), nitrous oxides (NO_x) and three different fluorinated gases (HFCs, PFCs and SF_6).

Reducing greenhouse gas emissions

The sources of greenhouse gas emissions show that three main overarching actions will address emissions:

1. End combustion of fossil fuels
2. Change agricultural and land-use practices to utilise land as a carbon sink
3. Use F-gases responsibly.

How does each GHG impact climate change?

Not all greenhouse gases have the same impact on climate change. The three main properties to consider are:

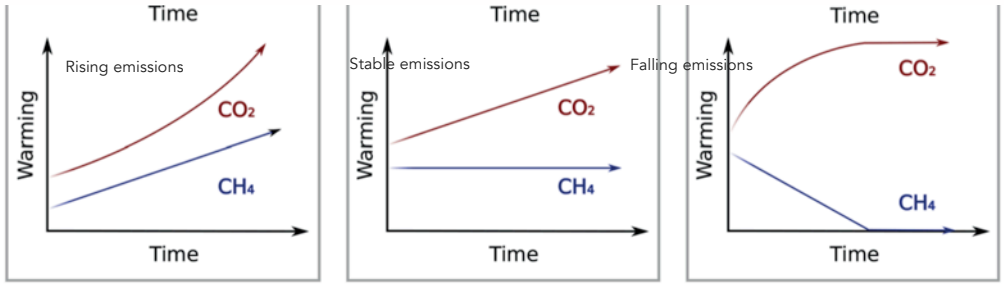
- **How much** of the gas exists in the atmosphere?
- **How long** does the gas persist in the atmosphere once emitted?
- **How strongly** does it act as an insulating "blanket"? Measured as Global Warming Potential (GWP).

*A note on Global Warming Potential

Global warming potential is a measure of how effective a gas is at trapping heat in the atmosphere. The standard agreed metric is GWP100 – (global warming potential over 100 years). However, it is acknowledged [1, 3], that GWP has scientific limitations. It overstates the warming impacts of short-lived greenhouse gases, and underplays the effects of long-lived greenhouse gases such as CO_2. It is therefore important to bear in mind not only a GHG's strength (GWP) but also its lifetime. CO_2 persists in the atmosphere long after it is emitted and continues to create a warming effect. Stabilised CO_2 emissions will lead to increasing temperatures because the CO_2 would still accumulated. Methane (NH_4) acts differently. Stabilised methane emissions will not lead to increasing temperatures as it does not readily accumulate in the atmosphere. It is not necessary that methane emissions reach zero, provided emissions levels are stabilised.

Greenhouse gas emissions: properties, source and sinks

				F-gases		
	CO_2	NH_4	NO_x	HFCs	PFCs	HF_6
% in the atmosphere	tbc	tbc	tbc	tbc	tbc	tbc
Lifetime	tbc	tbc	tbc	tbc	tbc	tbc
Strength (GWP)*	tbc	tbc	tbc	tbc	tbc	tbc
Sources						
Fossil fuel combustion	✓	✓	✓			
Biomass combustion	✓	✓	✓			
Agricultural practices		✓	✓			
Land-use change	✓	✓				
Organic waste + sewerage		✓				
Heat pumps				✓		
Industry				✓	✓	✓
Sinks						
Agricultural practices	✓					
Land-use change	✓					



Schematic illustration of how global mean temperatures respond to different emissions trends in carbon dioxide (CO2) and methane (CH4). Source: Briefing paper, "Climate metrics under ambitious mitigation".

Appendix B.1 - Pathways assumptions comparison by sector

Sector	Committee on Climate Change	SCATTER	*Etude*
Power	The CCC identified a "Further Ambition" scenario that reached a 96% GHG reduction by 2050. 375TWh of renewables. Additional 250TWh power generation from nuclear, Bioenergy Carbon Capture and Storage (BECCS) and Gas Carbon Capture and Storage (Gas CCS). Hydrogen plays a role for some high energy intensity processes (industrial) and peak heating in some buildings.	Grid carbon factor projections taken from BEIS Treasury Green Book. Solid biomass generation quadruples in 2025, dropping off after that. ; Coal phase-out follows trajectories from the National Grid's Two Degrees scenario. Hydroelectric power generation grows to 34 MWh per hectare inland water in 2030; 41 in 2050. Large-scale onshore wind generation grows to 4.8 MWh per hectare in 2030; 6.9 MWh in 2050. Large-scale onshore wind generation grows to 1.9 MWh per hectare in 2030; 2.2 MWh in 2050. Small-scale wind grows to 2.8 MWh per hectare in 2030; 3.3 in 2050 (from a baseline of 1.2 MWh per hectare.) Large-scale solar generation grows to 200 kWh per hectare in 2030; 400 in 2050 (from a baseline of 50 kWh per hectare.) Local solar capacity grows, generating equivalent to 2500 kWh per household in 2030; 5200 in 2050 (from a baseline of 400 kWh per household.) For areas with wave / tidal power, 320-fold increase by 2030, 1300-fold increase by 2050.	Carbon content of electricity falls rapidly in line with National Grid Future Energy Scenarios 2020 projections.
Buildings: New	Ultra-high levels of energy efficiency 100% new homes on low carbon heating from 2021.	From 2021, 100% new-build properties are built to passivhaus standard.	New homes achieve space heating demands of 15kWh/m^2/yr from 2022. No new homes on gas grid after 2022. New homes heated by heat pump or other low carbon heating.
Buildings: Existing	Most existing buildings (including listed buildings and those in conservation areas receive energy efficiency retrofits and low carbon heating. 90% of existing homes on low carbon heating by 2050. All building heating is provided by a heat pump, or an equivalent low carbon technology (for example hydrogen fuel cell, or waste industrial heat). No buildings are heated by on-site combustion.	By 2050, 10% of current stock is retrofitted to a medium level; 80% deep retrofit. By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating By 2050, domestic lighting and appliance total energy demand has dropped to 27% of current levels. Small reductions in efficiency of domestic cooking. Proportion of cooking which is electric increases to 100% in 2050. Hot water demand per household reduces by 8% every 5 years **Commercial** In 2050, commercial heating, cooling and hot water demand is 60% of today's levels By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating Commercial lighting & appliance energy demand decreases 25% by 2050. By 2050, 100% of commercial cooking is electrified.	30% of existing homes have a complete low energy retrofit and electrified heat, by 2022 and achieve an average heating energy demand of 40kWh/m^2/yr. 70% by 2027 and 100% by 2032.

Appendix B.2 - Pathways assumptions comparison by sector

Category	Committee on Climate Change	SCATTER	*Etude*
Transport	Cars and vans go electric – 100% of sales by 2035. Car use reduction of 10% HGVs transition to zero carbon. Reduction in HGV journeys of 10%. Rail electrification.	By 2050, 22% decrease in distance travelled by road freight; 75% increase in efficiency. In waterborne transportation, 28% increase in use of waterborne transport. 25% reduction in total distance travelled per individual per year by 2030. Average modal share of cars, vans and motorbikes decreases from current national average 74% total miles to 38% in 2050. Cars and buses are 100% electric by 2035, rail is 100% electric by 2030. Average occupancies increase to 18 people per bus km (from 12), 1.65 people per car-km (up from 1.56), and 0.42 people per rail-km (from 0.32).	5% reduction in in car use through switch to walking and cycling. 10% of domestic and light goods mileage completed by electric vehicles or equivalent by 2022. 100% by 2032. 100% of HGVs are electric by 2032.
Reducing waste	20% reduction in food waste by 2025 Zero biodegradable waste to landfill by 2025. 70% recycling rates by 2025. 20% reduction in waste water emissions by 2050.	65% recycling, 10% landfill, 25% incineration achieved by 2035, recycling rates increasing to 85% by 2050 Total volume of waste is 61% of 2017 levels by 2040.	N/A
Industrial efficiency	Move to electric, hydrogen and bioenergy with carbon carbon and storage (BECCS). Energy efficiency Carbon capture and storage (CCS) Resource efficiency.	Industrial electricity consumption is 50% of total energy consumption by 2035; 65% by 2050. Output falls by 2% every year for non-heavy industry. Reductions in process emissions from all industry: general industry reduces process emissions at a rate of 4.5% per year. Chemicals emissions reduce 1% per year; metals 0.7% per year, and minerals 0.8% per year.	80% reduction in industrial emissions through efficiency or changes in the sector. This is comparable to the 'Further ambition' recommendations by CCC[1].
Aviation	Demand reduction Improvements in technology, operations and alternative fuels.	Department for Transport "Low" forecast for aviation. The "Low" forecast encapsulates 'lower economic growth worldwide with restricted trade, coupled with higher oil prices and failure to agree a global carbon emissions trading scheme. For reference see Pathways Methodology. By 2050, 28% decrease in fuel use at UK ports.	N/A
Forestry & land use	Afforestation Improved forestry management and productivity Energy crops Peatland restoration and management Improved fertiliser efficiency Low carbon farming practices and soil management. Changes in livestock measures (improving feed, genetic selection). Improved manure practices. Agricultural vehicles and machinery to electrify or use hydrogen. Reduction in meat consumption.	24% increase in forest cover by 2030. 7% decrease in grassland. 0.5% annual reduction in livestock numbers Tree-planting to increase current coverage by 30% by 2030; from 2030-2050 further increase of 20%.	Significant tree planting in the borough has a very small but important impact. Central Lincs would need further reductions in emissions from forestry in other local authorities, potentially through a future national trading scheme.
F-gases	The UK maintains a regulatory framework at least as strong as the EU F-Gas Regulation.		N/A