

Central Lincolnshire Local Plan: Climate Change Evidence Base

Task E: Infrastructure Requirements

Feb 2021 | Rev C



Task E

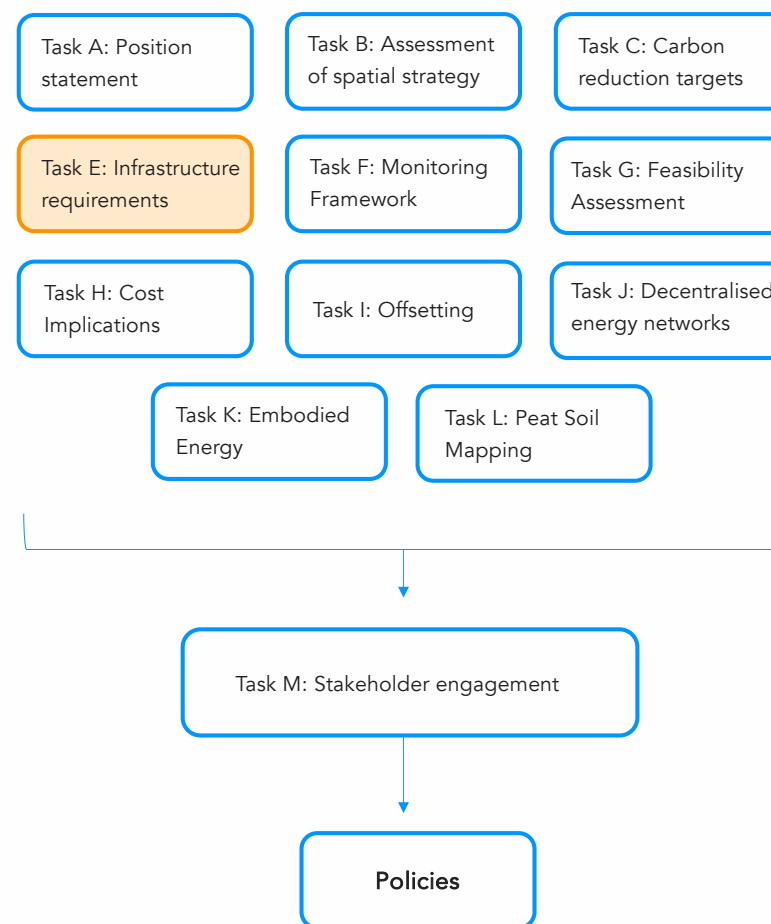
Infrastructure Requirements

This report assesses the required wider infrastructure implications of supporting the carbon reduction targets. We summarise the key possibilities for the future for Central Lincolnshire: the development of a low carbon electricity grid and transport network.

We look at the implications of increasing renewable energy provision, energy storage and 'smart' grids from both a spatial perspective and a technology perspective.

We also consider the development of a low carbon transport network.

Central Lincolnshire Local Plan – Climate Change Evidence Base



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1.1 Introduction

Introduction

1.1.1 Our review of emissions reductions targets in Task C and the implications for different sectors across the economy (buildings, transport, etc) show us clearly that we need to transition away from gas, petrol and diesel towards low carbon alternatives.

1.1.2 This transition is already underway and it needs to gain pace in order that we stay within remaining carbon budgets.

1.1.3 The key implications for infrastructure include:

- Increasing demand for electricity – demand for electrical energy is forecast to increase by 165% in Central Lincolnshire over the next 30 years.
- At least a three-fold increase in the amount of renewable energy generated in the region, including onshore wind and solar farms.
- A growth in small, distributed photovoltaic systems in urban areas.
- The growth of electrified transport

1.1.4 Consequently, the infrastructure, and in particular the electrical infrastructure, in Central Lincolnshire will need to support a different energy demand and supply pattern than has historically been the case.

1.1.5 As we have seen in Task A, the Local Plan has various mechanisms through which it can influence change. It can identify location and timescales for growth and therefore where the demand increases are likely to occur. It can also set targets for the energy performance of new developments. On the supply side, the local plan can shape future energy generation patterns by allocating locations suitable for renewable energy installations. The Local Plan can also require provision of renewable energy as part of new developments.

This Report

1.1.6 This section of the report considers infrastructure under three main categories: electrical grid infrastructure, gas infrastructure; and transport. It considers what impacts the transition to zero carbon will have on each of those in turn. As part of our research we have liaised with Western Power, the dominant District Network Operator in the region.

1.1.7 Key recommendations in each category are summarised at the end.

1.1.8 This document draws upon parallel research and analysis for other sections of this evidence base: Tasks A Position Statement, Task C Emissions Reductions Requirements, and Task G Technical Feasibility.



2.1 Electricity and grid infrastructure: the grid

The Electricity Grid

2.1.1 The electricity grid across the UK will need to adapt and be reinforced to be able to cope with increasing demand for electricity, and increasing renewable energy generation at both large and small scales.

2.1.2 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) in the development of a clean energy future through supporting the development of smart grids. The report states “Strategic, whole system, energy planning is a process that engages local stakeholders in discussion of the challenges of the energy transition...”. 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.

2.1.3 We have liaised with one of the local District Network Operators (DNO), Western Power, to understand how the local plan can support them in adapting the local electricity grid in Central Lincolnshire, the key message that emerged was that they need a clear and detailed plan upon which to base their investment strategy for the next 5 years and beyond because they will be penalised by Ofgem if they make investment choices that are not supported by evidence of need. Both Western Power Distribution and Northern Powergrid are currently seeking engagement with stakeholders on a number of different issues, including digitalisation, Community Energy Schemes and their future investment plans.

2.1.4 The key document which facilitates engagement with local stakeholders will be the draft Infrastructure Development Plan (IDP), which will form a significant part of the evidence base relied upon by the DNOs when formulating their business investment plans for the next few years. It is crucial that the Infrastructure Development Plan reflects the outcomes of this Net Zero Carbon evidence base and the emerging Local Plan. The DNOs nationally are required by the regulator, Ofgem, to submit business plans for 5 year periods. Currently the local DNOs, Northern PowerGrid and Western Power Distribution, are both seeking contributions from interested parties to inform their 2023-2028 business plans, which must be submitted to Ofgem in 2021².

2.1.5 The District Network Operators can then use both the demand and supply information to formulate their plans for future investment in the area, to meet the needs and the ambitions for achieving Net Zero Carbon in Central Lincolnshire.



Figure 2.1: An aerial view of housing in Lincoln: changing to electric heating, increasing PV installations and providing Electric Vehicle charging points all require a substantial change in the existing infrastructure for power and for transport.

2.2 Electricity and grid infrastructure: renewable energy

Renewable Energy

2.2.1 The requirements for new renewable energy installations (set out in Section 3.3 of “Task C – Carbon Reduction Requirements”) are predominantly a mix of onshore wind and solar PV. In the case of onshore wind, the generation will invariably be located away from urban centres. For PV, there is expected to be a mix of roof mounted PV which will be concentrated in towns, especially on large new developments, and field mounted ‘solar farms’, which will be in more rural areas.

2.2.2 The disposition of the generation is an important factor for the DNOs to consider in their investment strategies. The historic development of the Grid assumed that power would be generated centrally and distributed out, so farms, for example, are at the ‘end of the line’. Roof mounted PV in urban centres can be managed by the DNOs as part of the general development of the network. Large sites with a high number of new PV installations can be addressed as part of the energy strategy for the masterplan as a whole.

2.3.3 Potential locations for field based ‘solar farms’ and also onshore wind farms are the most critical to identify in the Local Plan. For power to be generated in a more dispersed way, the capacity of the system at remote locations, where demand has historically been low, needs to be substantially uprated. The physical works required can be carried out reasonably expeditiously but permissions and land access agreements take longer. For example, recent works to uprate the network within Lincoln took around 1 year but the planning process for the work took more than 10 years. Therefore a clear spatial strategy and, ideally, allocation of sites is of great importance within the Local Plan, to allow the work to facilitate those installations to be carried out in good time.

2.4.4 In our discussions with Western Power, they identified some barriers to their upgrade works, some of which may potentially be addressed by either the Local Plan or by other Council agencies. For example, they suggested that new roadways built as part of new large developments and especially new bridges crossing water courses or railways should be built with ductways incorporated to allow new cables to be laid quickly with minimal disruption at a later time.

Recommended target



	Methodology 1: generation as a proportion of consumption	Methodology 2: Generation as a proportion of land area	Methodology 3: Generation as a proportion of rural land area
 Solar PV arrays	230 MW	440 MW	510 MW
 Wind turbines	150 MW	290 MW	340 MW

Figure 2.2.1 How much renewable energy? The different possible allocations of Central Lincolnshire’s contribution to national and local renewable energy generation are described in detail in the report “Task C – Carbon Reductions Requirements”.



Figure 2.2.2 - Field mounted solar farms are potentially more difficult to incorporate into existing infrastructure than roof mounted PV in urban areas. Identification of future rural renewable power generation sites will be key to maintaining steady progress towards overall renewable energy generation targets

2.3 Electricity and grid infrastructure: supply and demand

Energy Storage

2.3.1 One consequence of a substantial shift from centralised fossil fuel based electricity generation to a more dispersed and renewable energy based generation pattern is that the Grid will have to perform a far greater role in balancing the supplies and demands than has historically been necessary. The intermittent and seasonal nature of most renewable energy sources (weather dependency) needs to be managed to maximise the use of the renewable power. Energy storage allows rapid response to demand fluctuations and storage of energy generated to discharge when it is needed. Energy storage is most often in the form of batteries; thermal storage is usually either hot water or ice stores. All of these are relatively bulky, requiring space in close proximity to either the source or the demand. The Local Plan should include policies to ensure that storage is incorporated into the networks, either close to existing sub-stations, or as part of the master-planning of new developments.

2.3.2 The RTPI report “Planning for a Smart Energy Future”^[10] advises “the pace of technological innovation suggests planning strategies should avoid prescribing technologies, so as to avoid limiting the use of emerging and future technologies that best fit local need, opportunity and economic viability.” The policy therefore needs to be based around energy strategy requirements, which should address demand and also supply arrangements, to ensure that adequate space is incorporated into master-plans to accommodate current proposals and future phases in a coherent overall plan for infrastructure.

Demand Side Response

2.3.3 Demand Side Response (DSR) technologies reduce the demand when the supply is diminished or when peaks in one demand type occur. For example when a high profile sports event creates a peak demand for domestic power, retail and industrial users may be able to reduce their demand temporarily to flatten the peak and avoid the need to increase the overall grid capacity. DSR technologies are generally digital and don’t require any particular space provision in Planning terms.

‘Smart Grids’

2.3.4 To make best use of energy storage and to manage the DSR strategies, the Grid has to be digitalised at both supply and demand points in order to keep the loads balanced to the finest possible margins. Avoiding failures and black outs is critical, and avoiding overcapacity is an essential component of decarbonisation. There are various systems, such as micro-grids and mini-grids which are used by the DNOs to control the network and can be used by owners of large sites to manage demands and therefore costs. These all rely on the use of smart meters and the two-way flow of data between consumers and suppliers. In planning terms, none of these systems and strategies have spatial impacts.



Figure 2.3.1 - Battery storage at Breach Farm in Derbyshire (Anesco)

Time-shift benefits of energy storage

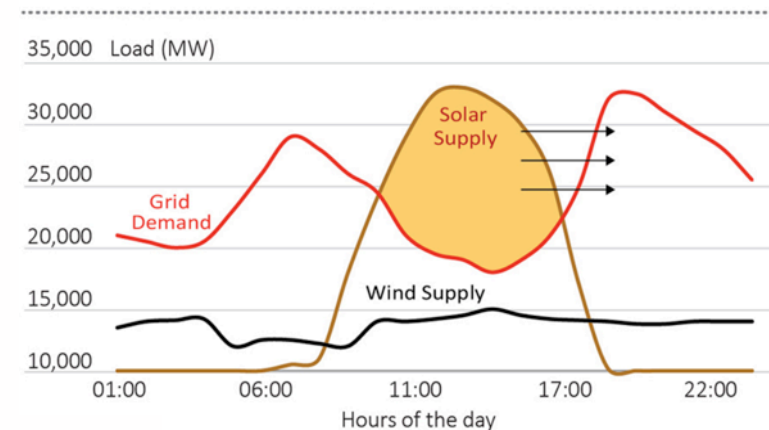


Figure 2.3.2 - Notional graph of renewable energy supply vs energy demand

3.1 The gas network

The Future of the Gas Network

3.1.1 Natural gas currently supplies around 65% of homes in West Lindsey and North Kesteven and 75% of homes in Lincoln City^[03].

3.1.2 Ofgem, the energy regulator, have been mandating the DNOs to connect new customers to the gas grid and penalising any that did not meet new connection targets^[04]. The driver for this initiative has been fuel poverty – natural gas is relatively cheap in the UK. However, as natural gas is a fossil fuel, it must be phased out as a fuel, with relative urgency, as evidenced in the report “Task C – Carbon Reduction Requirements”.

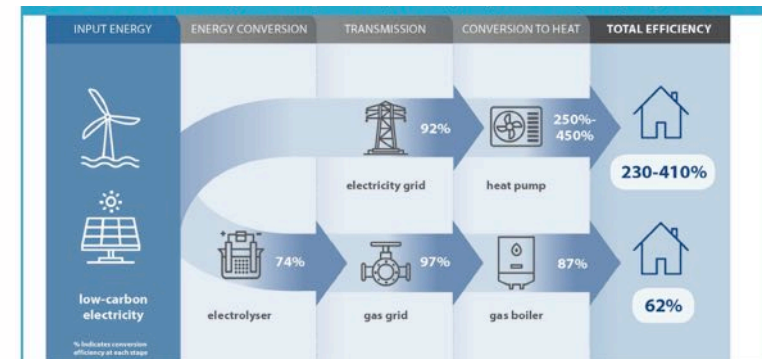
Hydrogen as a substitute for Natural Gas

3.1.3 The Committee on Climate Change’s ‘Hydrogen in a Low Carbon Economy’ Report^[05] considers whether the existing gas grid can be reused to provide hydrogen and concludes that this may be possible for some parts of the network, stating that “[Hydrogen] could replace natural gas in parts of the energy system, where electrification is not feasible or is prohibitively expensive, for example in providing heat on colder winter days, industrial heat processes and back-up power generation”. But that report also concludes that hydrogen, whilst it may provide a part solution to lower carbon heating, is currently not a zero carbon energy source, is expensive to produce and is unlikely to ever be able to entirely replace natural gas in all its current applications. There will be some applications where hydrogen may have role in the medium term at least but for new homes, electrification of heating is at least as cost effective and significantly, given the carbon budget time constraints, possible now with current technology.

3.1.4 For heating in buildings, the CCC’s analysis shows that electricity is more energy efficient – between four and seven times more efficient – than using a hydrogen boiler (see figure 6). Reliance on hydrogen for heating would necessitate substantially more solar and wind powered generation than using the renewable energy as electricity for heating.

3.1.5 The CCC report recommends that the gas network is not expanded beyond its current extent (see figure 3.1.2).

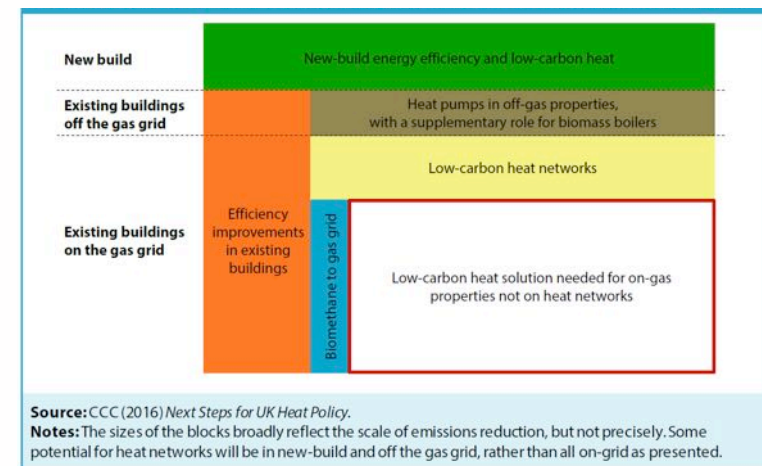
3.1.6 For the Local Plan, the new build strategy is clear – these should not be connected to the gas grid.



Source: CCC analysis.

Notes: The diagram shows the indicative efficiency of using a given amount of zero-carbon electricity in delivering heat for buildings. Whilst in practice each of the efficiency numbers could vary, this would not be sufficient to change the conclusion that heat pumps provide a much more efficient solution for providing heat from zero-carbon electricity than use of electrolytic hydrogen in a boiler.

Figure 3.1.1 - Extract from the Committee on Climate Change report on the role of hydrogen in a Net Zero Carbon UK: Relative efficiency of heating: electricity in heat pumps vs electrolytic hydrogen in boilers



Source: CCC (2016) Next Steps for UK Heat Policy.

Notes: The sizes of the blocks broadly reflect the scale of emissions reduction, but not precisely. Some potential for heat networks will be in new-build and off the gas grid, rather than all on-grid as presented.

Figure 3.1.2 - Extract from the Committee on Climate Change report on the role of hydrogen in a Net Zero Carbon UK: recommended hierarchy of measures for various building categories – new builds should not be connected to the gas grid.

4.1 Transport

Electric vehicles.

4.1.1 The switch to Electric vehicles (EVs) required to decarbonise transport requires significant infrastructure investment and support if it is to be as rapid and comprehensive as is needed. In new developments, EV charging points will certainly be required to allow residents to charge EVs overnight, at home. In older homes and particularly in urban areas where on street parking is the norm, new infrastructure will be needed to provide fair access to charging points for residents' cars and vans.

4.1.2 The Local Plan should respond to the particular constraints of different environments – new and existing neighbourhoods, urban, suburban and rural areas - to ensure uniformity of access to cost effective charge points right across the District and thereby encourage people to change to EVs from fossil fuel vehicles.

Encouraging active transport.

4.1.3 Whilst the switch to EVs is essential, this alone may not achieve the rapid decarbonisation of transport needed to meet the Tyndall Centre Budgets (section 2.4 Task C report) and it is likely that a significant reduction in private vehicle journeys will also be required, so the Local Plan should support active travel – walking and cycling – as far as possible.

4.1.4 The draft IDP includes outline plans and some specific measures to improve cycle and pedestrian routes and connectivity between new urban extension sites and town or city centres. The masterplans for new development sites should be required to include detailed proposals for enhancement of active travel routes and facilities, linked to the green infrastructure plans and integrated with new and existing public transport hubs, even where those routes continue beyond the boundaries of the development site.

4.1.5 A wider district plan to link the major centres with longer distance cycle routes should also form part of the green infrastructure plan in order to protect those routes from 'blocking' by new development that could restrict access and from interruption by busy roads with restricted crossing points.

Hydrogen

4.1.6 The Committee on Climate Change⁵ acknowledge the need for some use of hydrogen for larger vehicles, particularly HGV and PSV vehicles, but the scale of hydrogen production required, and the technological development needed to allow that manufacture to be zero carbon is substantial. For domestic vehicles, hydrogen is not expected to be a major component. So although some hydrogen infrastructure may be needed to replace petroleum to some extent, this will be a future development and not part of the emerging Local Plan.



Figure 5.1.1 - Lincoln visitor attraction EV charging point



Figure 5.1.2 - Hydrogen powered vehicles are currently possible but not expected to form a major component of mass travel in the near to medium term

5.1 Implications for the local Plan: Recommendations

Recommendations

5.1.1 Our key recommendations for the Local Plan in relation to infrastructure are:

- In principle, the energy suppliers, National Grid and the local District Network Operators, have responded to the National objectives but more detail is needed for them to be able to address the particular ambitions of the region and the specific needs of the different districts.
- The Infrastructure Delivery Plan (IDP) should reflect the findings of the climate change evidence base.
- Large new developments should be required to submit an energy strategy for the whole masterplan and to agree that with the relevant District Network Operator prior to planning consent to ensure adequate space is included for infrastructure works required.
- Sites should be identified close to existing substations and within new developments for energy storage.
- The Local Plan should avoid being prescriptive about specific energy distribution and management technologies that should or should not be adopted.
- Sites should be allocated for the required capacity of onshore wind and field mounted PV arrays in order to allow grid and network reinforcement/restructure to be planned in good time.
- New buildings should not be connected to the gas grid.
- Each district should develop a strategy for providing Electric Vehicle (EV) charging points for existing homes, for example with charging points integrated into street lighting or 'Mobility Hubs' (as set out in the current IDP) in urban areas. New homes should all have EV charging provision.
- Integrated plans for active transport routes should form part of all new developments.
- A strategy to connect urban centres with active transport links should form part of the Local Plan and potential routes should be protected from possible 'blocking' development, such as new roads or private land with restricted access.



From the Sustrans website

- [01] Planning for a Smart Energy Future – Royal Town Planning Institute Research Paper 2019
- [02] RIIO-ED2 Consultation (Ofgem)
- [03] Nongasmap.org.uk data
- [04] RIIO Gas Network (Ofgem) Fuel Poor Network Extension Scheme 2008 to 2021
- [05] Hydrogen in a Low Carbon Economy – The Committee on Climate Change 2018