



A Route to Net Zero in Leiston

TECHNICAL REPORT

A project designed to understand practical steps for getting a small town to Net Zero carbon emissions.

COMMUNITY POWER

NET
ZERO
LEISTON

FOREWORD

Leiston-cum-Sizewell Town Council has long recognised the importance of climate change on our everyday lives and our futures. We are very pleased, through Net Zero Leiston, to get involved and do our bit to fight global warming in the best way we can, which is to pursue Net Zero carbon emissions in the parish by around 2030.

We launched the Net Zero Leiston project through Leiston Together in the summer of 2020. Since then, a huge amount of work has been undertaken to create the Route Map for Leiston to reach Net Zero. We are very pleased to be able to share this work with the Leiston community and other communities. We hope this technical manual inspires and supports towns similar to Leiston to reach Net Zero.

This project has demonstrated that reaching Net Zero is not straightforward, and that communities

need all the support available to help them work towards the Government's ambition of Net Zero by 2050. This project has required the talented, committed and professional collection of partners who have the expertise and global knowledge to make this all possible. We hope that by using their experience, and by developing this Technical Manual, we can help fellow communities move a few steps further along their own Net Zero journey.

We invite Leiston residents and businesses to become the drivers of this project to help us implement the plan outlined in the Route Map. Please do help the Town Council get the message out there and bring everyone on board to achieve the aim. Contact us via the Net Zero Leiston website (www.netzeroleiston.info) if you have any questions or want to offer your support.



MRS CAROLINE RINDER



MR JOHN LAST BEM

EXECUTIVE SUMMARY

NET
ZERO
LEISTON

BACKGROUND

Climate change is the single greatest threat facing the planet. If we don't act now, rising temperatures will see the increased probability of droughts, wildfires, and flooding. Moreover, melting glaciers will lead to sea levels rising, which will have a devastating impact on coastal habitats, including soil contamination and lost habitat for fish, birds and plants.

That's why much of the world came together to sign The Paris Agreement of 2015, a legally binding treaty on climate change that sets targets to keep global temperature rises under control. The targets require that global temperatures should not rise above 2°C from pre-industrial levels by 2100, and that efforts are undertaken to limit the temperature increase to 1.5°C .

In response to the Paris Agreement, the UK statutory target for reducing greenhouse gas emissions was strengthened in May 2019 to include a legal commitment to reach Net Zero in the UK by 2050.

This is an unprecedented challenge for the UK and will require major investment into infrastructure, as well as a step change in how people behave, to reach the target.

DEFINING NET ZERO

Net Zero is the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere. Net Zero is achieved when the amount of greenhouse gas we produce is no more than the amount removed.

Given the likely difficulty in entirely eliminating emissions from some sectors , carbon removals (where carbon is taken out of the atmosphere) are important to achieve Net Zero.

THE NET ZERO LEISTON PROJECT

Town, District and City Councils across the UK have declared climate emergencies, along with ambitions to reach Net Zero. At its heart, the Net Zero Leiston project (NZL) aims to provide a robust plan to achieve these ambitions.

Developed through joint discussions between the Sizewell C project, EDF in the UK, and local Leiston and wider Suffolk representatives, the Net Zero Leiston project has considered how Leiston could become the UK's first Net Zero town.

An expert low carbon working group was formed to develop a replicable and socially acceptable Route Map, detailing how to achieve Net Zero in a small town like Leiston by 2030. The ambitions for Leiston set out in this Route Map are forward-thinking and will likely need to be replicated across the country for the UK to achieve the environmental climate objectives mandated by law. [Chapter 7](#)

WHY LEISTON?

As a town with a rich industrial heritage, and situated on Suffolk's 'Clean Energy Coast', Leiston is in an ideal location to be at the heart of a new green revolution.

Leiston is also a town that urgently needs to act if it is to reach Net Zero. To achieve the Paris Climate agreement targets, each country has an apportioned 'carbon budget'. The methodology was to apportion the international carbon budgets to the UK, then regionally and then to a parish level. The NZL Route Map has assessed the apportioned carbon budget for Leiston of 95,000 tonnes of CO₂, until 2100. The current net carbon emissions in Leiston are 12,000 tonnes of CO₂ per year, which has been calculated after a detailed analysis of emissions within the study boundary.

This means that at the current rate of emissions, Leiston's entire carbon budget until 2100 would be exhausted in under eight years. [Chapter 1](#)

THE NZL PROJECT’S BOUNDARIES

The scope of carbon emissions considered by NZL extends to the boundary set out in the Leiston Neighbourhood Plan.

This follows the parish boundary of Leiston town, including domestic, commercial, and agricultural land use. The boundary excludes the Sizewell sites and the transmission scale electricity sub-stations that serve the incoming feeds from offshore wind turbines to maintain project replicability ^{Chapter 2}. Annotated maps of the full data set, including infrastructure and utilities, were also used in evaluating the boundary area. ^{Chapter 6}.

THE NZL ROUTE MAP

The NZL Route Map is an achievable, although challenging, plan for Leiston to reach Net Zero by around 2030 through a phased implementation of credible, robust and available techniques. ^{Chapter 7}

In practice, the precise implementation of the Route Map will be more fluid as different technologies and policies are developed, but it nonetheless offers a clear and reachable plan. The community itself will determine the most appropriate measures to adopt in the journey to Net Zero.

The NZL Route Map also demonstrates the challenge facing communities similar to Leiston. While the measures highlighted are themselves not first of a kind, the scale and ambition of uptake from the residents and businesses of Leiston may be considered revolutionary.

The uptake figures require a step-change in behaviour and understanding that will be complemented, and steered by, community engagement and education. Collaborative resources will be necessary to assist the population of Leiston to achieve such a testing target in the time frame.

KEY AREAS OF FOCUS

Baseline emissions have been calculated for the agreed Leiston boundary area and broken down into three key areas: ^{Chapter 4}

- » Buildings: 11,608 tonnes of CO₂ eq. per year ^{Chapter 16}
- » Transport: 3,830 tonnes of CO₂ eq. per year ^{Chapter 17}
- » Agriculture: 300 tonnes of CO₂ eq. per year ^{Chapter 4}

Utilising current and developing technologies, carbon calculations were carried out and modelled across each year to project the emission reductions required in the key areas identified. ^{Chapter 3}

In each area, the cumulative effect was calculated up until 2030. Sequestration was also evaluated, looking at options to remove CO₂ from the atmosphere. ^{Chapter 18}

The various technologies and initiatives were then evaluated based on their effectiveness for reducing carbon emissions over time. The current most viable options were then shortlisted and applied to the Route Map.

For Leiston to achieve Net Zero by 2030, the uptake of a variety of technologies will be required to reduce and remove emissions, including:

- » Household insulation (1,241 tCO₂ pa emission saving)
- » Replacement of boilers to air source heat pumps (7,148 tCO₂ pa emission saving)
- » Agricultural initiatives to increase CO₂ removal, such as tree planting and rewilding (3,735 tCO₂ pa removal).

Of the three sections, buildings were identified as the biggest opportunity for emission reduction in Leiston. The result of applying these technologies, along with others noted in the Route Map, would contribute to an 85% reduction from the calculated baseline.

WHAT EMISSIONS WERE EXCLUDED?

The NZL Route Map sets a budget for CO2 fossil fuel emissions [Chapter 1, Chapter 4 & 5](#) and a target for CO2 removal [Chapter 4 & 5](#).

No target was set for non-CO₂ emissions reduction within the Leiston parish boundary [Chapter 19](#) as they were considered negligible. For NZL, CO₂ emissions come from two sources: fossil fuels **Chapter 1** and biomass [Chapter 4 & 5](#).

For businesses, carbon emissions are generally categorised into three areas: Scope 1, 2 and 3 [Chapter 1](#) according to the Greenhouse Gas Protocol. Excluded from the NZL emission calculations are.

- » Embodied emissions (e.g. from the extraction and production of materials)
- » Supply chain emissions

NZL AS PART OF THE WIDER NET ZERO LANDSCAPE

NZL includes an exploration of relevant local, national and international policy and how the project is delivering against these areas. The NZL Route Map also highlights challenges and possible opportunities to consider in any future policy landscape.

The delivery and implementation of NZL and its interaction with local, national and international policy would need to form part of any business case for funding or investment. [Chapter 13](#)

The NZL project also provides a welcome opportunity to develop solutions that work in rural areas. Currently, many locations that are pioneering Net Zero initiatives, like low carbon heating and electrification, are primarily established in urban communities with different population profiles, economies, social drivers and ambitions.

In this way, NZL – which has engaged with the community at all stages through surveys, pilots, focus groups and ESC interviews – can stand as a demonstrator nationally and possibly internationally in showing how to create a repeatable and fully engineered route to decarbonisation. [Chapter 15](#)

DATA-DRIVEN APPROACH

NZL has taken a data-driven approach to developing the Route Map, allowing the project to make informed choices on which technologies are appropriate for, and likely to be adopted by, the local community.

There are currently around 5,500 residents who live within the Leiston boundary area. Around 39% of the population is 60 or older, with 21% being retired. Occupational data shows that around 1,000 residents are skilled/manual workers and that the most common income bracket is 10-20k. 65% of the population own their houses. [Chapter 11](#)

The age of the local population will inform the communication and engagement strategy with the local residents. The income data highlights the need for cost efficient emission reduction measures to ensure adoption. High home ownership is helpful as residents will have more autonomy to make changes to their own homes, rather than requesting permission from the landlord.

COMMUNITY ENGAGEMENT

To complement its data-driven and engineering approach, NZL has developed a community engagement strategy to ensure the Route Map is socially acceptable and fair.

This engagement includes:

- » Three low carbon technology pilots in the community [Chapter 9](#)
- » Surveys and focus groups facilitated by University of Suffolk
- » Interviews and a standalone report from Energy Systems Catapult to understand the needs of vulnerable households in Leiston [Chapter 10](#)
- » Interviews with other Net Zero initiatives across the UK, Ireland and mainland Europe [Chapter 14](#)

THE COST OF IMPLEMENTING THE ROUTE MAP

The NZL Route Map estimates a total CAPEX of £210m for the implementation of all measures for Leiston. This will be further evaluated against available funding mechanisms, as well as proposed forecast funding mechanisms. ^{Chapter 7}

NEXT STEPS

The development of the NZL Route Map is the first stage in Leiston's journey to Net Zero. Following the publication of the Route Map, the project's next phase is to implement and find ways to finance the proposed changes.

There is also an important role for the community to play in changes to their behaviours, alongside changes to buildings, transport and agriculture.

NOVEMBER 2021 ADDENDUM: HMG PUBLISHES NET ZERO STRATEGY

This technical manual is the culmination of more than 18 months of research and development into how Leiston can reach Net Zero carbon emissions. Over this period, the technical manual has been updated to reflect policy changes and developments in the Net Zero landscape in the UK.

However, as this report was being finalised, the UK government published its Net Zero Strategy: Build Back Greener.¹ This strategy builds upon several of the ambitions outlined in the "10-point plan for a green industrial revolution" in November 2020.² This November 2021 addendum has been provided to highlight the clear links between the direction of Net Zero Leiston and HMG's Net Zero Strategy. This addendum sets out themes of this technical manual which align to the Net Zero Strategy and highlights the key statements in the Net Zero Strategy which relate to Net Zero Leiston.

NET ZERO STRATEGY: BUILD BACK GREENER

The following sub-paragraphs set out sections in this technical manual that link to key elements of the Net Zero Strategy.

JUST TRANSITION

This technical manual highlights the need for a just transition to Net Zero (**Chapter 10**). The Net Zero Leiston project principles include having sustainable and affordable business models and providing social mobility for a responsible transition. This principle was reflected in the pilot schemes undertaken by the project (**Chapter 9**). The government strategy clearly recognises this, and highlights ways in which technologies need to support consumers financially.

» *"In the Ten Point Plan, we committed to deliver greener buildings. Since then, we have announced £60 million to support decarbonisation of Social Housing and have allocated over £1 billion from the Public Sector Decarbonisation Scheme, in doing so, supporting up to 30,000 jobs."*

» *"Technologies such as electric vehicles and smart appliances can be automatically programmed to take advantage of cheaper rates, cost-effectively integrating them with renewable energy sources and saving consumers money."*

¹ <https://www.gov.uk/government/publications/net-zero-strategy>

² <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

BEHAVIOURAL CHANGE AND EDUCATION

This technical manual recognises the need for some behavioural change to support energy reduction, and climate positive choices. An example of this was tested with an early Net Zero Leiston pilot scheme, offering an exclusive energy tariff which was backed by low carbon power, saving the consumer money and educating them. This is something which is also reflected in the Government's Net Zero Strategy.

- » *“To support these choices, consumers should receive accurate information about the carbon content of their energy products, and we will consider the case for reforming the framework which underpins green electricity tariffs and wider environmental carbon accounting schemes.”*

The project aims to track its progress against the carbon emissions baseline and measure the emissions reduction. By communicating this progress to the community, the hope is that more will be engaged in the vision and will understand what it takes to reach Net Zero. Similarly, the Net Zero Strategy has a commitment to skills and education for meeting Net Zero.

- » *“Reform the skills system so that training providers, employers and learners are incentivised and equipped to play their part in delivering the transition to net zero – including by legislating for skills required for jobs that support action on climate change and other environmental goals to be considered in the development of new local skills improvement plans.”*

GOVERNMENT’S COMMITMENT TO SUPPORTING PROJECTS LIKE NET ZERO LEISTON

Projects like Net Zero Leiston are well supported in the Government strategy. It outlines how it is committed to working with local communities.

- » *“To ensure that all parts of the UK benefit from the transition to net zero we also want local communities to take bold action that supports the transition. Local communities benefit from strong relationships and ties to their areas and their local authorities; these can be key to reducing emissions across the economy and making sure people stay engaged in the process. Where local authorities and communities work together effectively, we have already seen significant improvements in both delivery and in wider public engagement.”*

- » *“Some very ambitious campaigns on food, recycling, water, and other areas critical to climate action, have been launched and run by pioneering local communities and activists. Community projects can also act as a catalyst for raising public awareness and promoting green choices.”*
- » *“Community groups can bring together people, finance, and ideas to have a real impact on the behaviours, infrastructure, and attitudes locally. Community cohesion and grassroots initiatives are also central to locally based resilience to climate change risks, such as flooding and heatwaves.”*

POLICIES TO SUPPORT DECARBONISATION OF VARIOUS SECTORS

To reach Net Zero, a UK-wide approach is required. The UK Government are committed to working to deliver coordinated policy to meet emissions reduction targets across the UK. The following specific policy announcements align to the decarbonisation solutions in this technical manual and could be taken advantage of to achieve Net Zero in Leiston. (HYPERLINK TO SECTION 4)

TRANSPORT

- » *“Building on the £1.9 billion from Spending Review 2020, the Government has committed an additional £620 million to support the transition to electric vehicles. The funding will support the rollout of charging infrastructure, with a particular focus on local on-street residential charging, and targeted plug-in vehicle grants.”*
- » *“Invest £2 billion in cycling and walking, building first hundreds, then thousands of miles of segregated cycle lane and more low-traffic neighbourhoods with the aim that half of all journeys in towns and cities will be cycled or walked by 2030”*
- » *“Invest £3 billion in the National Bus Strategy, creating integrated networks, more frequent services, and bus lanes to speed journeys, and support delivery of 4,000 new zero emission buses and the infrastructure needed to support them.”*

BUILDINGS

- » “We are investing in technology now, in trialling hydrogen ahead of strategic decisions on the role of hydrogen for heating in 2026”
- » “£60 million in heat pump innovation – making them beautiful, smaller and easier to install.”
- » “Supporting households in making this transition with a new £450 million Boiler Upgrade Scheme providing £5,000 capital grants and a new market-based incentive for heating system manufacturers, whilst investing £60 million in heat pump innovation”
- » “We will build on our 2020 consultation on strengthening the Minimum Energy Efficiency Standards to EPC band C by 2028 to set long term minimum regulatory standards consistent with our net zero commitment for private rental sector”

AGRICULTURE

- » “We will support farmers to adopt low carbon farming practices, and increase the carbon stored on their farms, helping to improve business productivity and profitability gains.”
- » “Schemes that support environmental land management will help drive this change and will also help compensate for residual emissions that are harder to reduce, such as from livestock.”
- » “The Farming Investment Fund will offer funding for equipment, technology, and infrastructure that improves farm productivity and benefits the environment.”

NATURE

- » “We will boost the existing £640 million Nature for Climate Fund with a further £124 million of new money, ensuring total spend of more than £750 million by 2025 on peat restoration, woodland creation and management. This will enable more opportunities for farmers and landowners to support net zero through land use change.”

- » “Private finance for tree planting and management is being generated via the Woodland Carbon Code with the support of government’s Woodland Carbon Guarantee.”
- » “Government has also launched a new England Woodland Creation Offer to fund woodland creation in England and will establish new Woodland Creation Partnerships in key areas, bringing together government, NGOs, and the private sector to develop bespoke offers to encourage woodland creation.”

FINANCE SUPPORT

The Financing chapter of this technical manual (**Chapter 8**) highlights the importance of ensuring long-term investment and business models which ensure that finance is available to pay for the journey to Net Zero. This point is also reflected in the Net Zero Strategy

- » “Government has an important role to play in ensuring a comprehensive financing offer, long-term investment signalling and fit-for-purpose business models coupled with investment from numerous private sources. We will work to create an attractive environment to secure the right investment in UK projects, with benefits to UK business and communities. By building on our strengths, including potential for rapid scale up across the domestic value chain, and coupling this with a strategic approach from government on policy and investment, we can create the right conditions to unlock the significant scale of private investment that will be needed.”

It is recognised that getting to Net Zero requires action by multiple parties across the public and private sectors, delivery at pace, and management of large uncertainties.

- » “HMG has mobilised £26 billion of government capital investment for the green industrial revolution. Along with regulations, this will support up to 190,000 jobs by 2025, and up to 440,000 jobs by 2030 and leverage up to £90 billion of private investment by 2030.”

Like Net Zero Leiston, the Net Zero Strategy recognises that the exact route to Net Zero will depend on the availability and deployment of key technologies and user behaviour. **Chapter 7**

- » “The exact route to net zero will depend on the availability and deployment of key technologies, supported by long-term market growth,

as well as the extent to which individuals and businesses adopt green choices... The exact technology and energy mix in 2050 cannot be known now, and our path to net zero will respond to the innovation and adoption of new technologies over time. However, the government has reinforced the idea, that the UK will rely on the following key green technologies and energy carriers”

Both the Net Zero Leiston and The Government's approaches to setting decarbonisation pathways are aligned to the carbon budgets for the UK. This technical manual highlights the urgent need for action in Leiston, which will use up an apportioned carbon budget within 8 years at the current rate of consumption. **Chapter 1**

» “Drawing on the insights from our illustrative 2050 scenarios, we have developed a delivery pathway: an indicative trajectory of emissions reductions which meets our targets up to the sixth carbon budget ending in 2037... It is designed only to provide an indicative basis on which to make policy and plan to deliver on our whole-economy emissions targets.”

(COMMUNITY POWER)

PROUD TO BE WORKING TOGETHER TO TAKE LEISTON TO NET ZERO



(WWW.NETZEROLEISTON.INFO)

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A ROUTE TO NET ZERO





CHAPTER 1

DEFINING NET ZERO

Authored by



MARCH 2020

INTRODUCTION

The purpose of this Chapter is to describe the importance of Net Zero targets and the implications a Net Zero target may have for a local authority in general, and for Leiston in particular. Some background information on the UK's Net Zero target is provided, as well as a definition of Net Zero and what this means for Leiston, followed by a discussion of high-level processes to practically achieve this, and finally consideration of what this means for Leiston specifically in terms of a carbon budget.

This study encompasses the carbon emissions from the boundary set out in the Leiston Neighbourhood Plan, which follows the parish boundary of Leiston town, excluding the Sizewell sites and the transmission scale electricity sub-stations serving the incoming feeds from offshore wind turbine installations¹. This chosen boundary is explained in further detail in **Chapter 2** - NZL Boundary.

This methodology and definition of Net Zero will be adopted for the purposes of carrying out the study and creation of the Leiston Net Zero Route Map.

The potential lifecycle carbon emissions associated with the Sizewell C site are being considered by the Sizewell C team and is outside the scope of this Route Map. This will be published once complete. Each year Sizewell B calculates the emissions it saves by generating nuclear power (in comparison to combined cycle gas turbines). Analysis of the Sizewell B site lifecycle emissions have also been calculated by EDF Energy which is also publicly available. The Sizewell A site is owned by the NDA and is being decommissioned.

NET ZERO TARGET

Responding to the threat of catastrophic climate change requires coordinated action to reduce greenhouse gas (GHG) emissions in order to meet targets set out in the Paris Agreement of 2015. The aim of this agreement is to keep global temperature rise this century below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C². In response, the UK statutory target for reducing GHG emissions was strengthened in May 2019 to Net Zero by 2050³.

According to the Committee on Climate Change (CCC) definition, 'Net Zero' emissions means that the "total of active removals from the atmosphere offsets any remaining emissions from the rest of the economy. The removals are expected to be important given the difficulty in entirely eliminating emissions from some sectors"⁴.

¹ The electricity and sub-stations are assumed to transmit power wider than just the district of Leiston, hence excluded.

² <https://www.ipcc.ch/sr15/>

³ <http://www.legislation.gov.uk/ukdsi/2019/9780111187654>

⁴ <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>



There are seven main GHGs that contribute to climate change, as covered by the Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃). Carbon dioxide is the primary greenhouse gas representing about 75% of all GHG emissions. Amounts of other gases are converted to the equivalent amount of carbon dioxide, so Net Zero often refers to carbon dioxide equivalent (CO₂e) emissions. CO₂e is the universal unit of measurement to indicate the global warming potential (GWP) of GHGs, expressed in terms of the GWP of one unit of carbon dioxide.

The CCC Net Zero Technical Report May 2019⁵ (which informed the strengthening of the UK statutory target) identifies the various sectors of the economy with a key role in reaching Net Zero emissions by 2050 (in England), namely: power and hydrogen production; buildings; industry; transport; aviation and shipping; agriculture and land use, land-use change and forestry (LULUCF). The latter sector also has an important role of carbon sequestration. However, it is up to individual local authorities to understand the emission baseline arising from their area and develop their own methodology and action plan to achieve their Net Zero aspirations.



Committee on Climate Change (CCC) Net Zero Advice and accompanying Net Zero Technical Reports (May 2019)

In March 2019, Suffolk County Council declared a Climate Emergency⁶ and pledged to work towards becoming Net Zero by 2030. In July 2019, East Suffolk District Council (noting that on 1st April 2019, East Suffolk Council was created, covering the former districts of Suffolk Coastal District Council and Waveney District Council) also declared a Climate Emergency⁷ and is working towards the aspiration to make the county of Suffolk carbon neutral by 2030. It is noted that Leiston is a small town within the boundaries of East Suffolk District Council.

All local authorities within Suffolk are part of the Suffolk Climate Change Partnership (SCCP)⁸ which is a group organised to work with the Environment Agency and other organisations locally including Groundwork Suffolk and the University of Suffolk, towards achieving Net Zero by 2030.

Sizewell C's proposition to make Leiston Net Zero is fully aligned with and supportive of the carbon neutrality aspirations of local government in the area. Although the Net Zero target for England is 2050, setting a target of circa 2030 would dovetail with local government timeframes. This earlier target date would also align with the construction period of Sizewell C which could be a high-tech energy hub for zero carbon technologies (including nuclear) once completed. The next section of the chapter outlines why a target date earlier than 2050 is likely to be necessary owing to the finite Carbon Budget for the district.

The Net Zero Leiston project could go one step further than Net Zero and aim for Leiston to be 'Carbon Negative'. Being Carbon Negative would require Leiston to remove more carbon from the atmosphere than it will emit, once all carbon reduction measures have been applied. This could be achieved through additional carbon sequestration (e.g. planting trees that absorb CO₂ from the atmosphere). As an example, Microsoft has pledged to be Carbon Negative by 2030⁹, and plans to remove all lifetime carbon the company has emitted directly or indirectly through electricity consumption by 2050. Microsoft states it will do this using a range of carbon capture and storage technologies.

However, for the purposes of this study, it is recommended that Net Zero, rather than Carbon Negative, is targeted for Leiston, aligning with the existing local and UK targets described above and that carbon sequestration of residual emissions, rather carbon capture and storage technologies, will be the main form of achieving Net Zero.

OVERVIEW OF EMISSIONS

For the purposes of the overall study, we will consider the following 3 areas:

1. CO₂ fossil fuel emissions (Chapter 4)
2. CO₂ removal (Chapter 4, 5 and 18)
3. Non-CO₂ emissions (Chapter 19)

⁶ <https://www.suffolk.gov.uk/planning-waste-and-environment/pledge-to-climate-emergency-declaration/>

⁷ <https://www.eastsuffolk.gov.uk/environment/climate-change/our-climate-commitment/>

⁸ <http://www.greensuffolk.org/about/suffolk-climate-change-partnership/>

⁹ <https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/>

One budget will be set for CO₂ fossil fuel emissions; one target set for CO₂ removal. No target will be set for non-CO₂ emissions reduction.

This chapter and subsequent more in-depth chapters (i.e. Atkins assessments) cover items 1 and 2 above. A separate assessment and report will be provided by the consultant Carbone4 (working on behalf of Sizewell C) for item 3.

These areas are discussed further in subsequent sections below.

CO₂: FOSSIL FUEL EMISSIONS BUDGET

The scale of the challenge for Leiston is made clear when introducing the concept of a territorial Carbon Budget.

As a result of the targets set out in the United Nations Paris Agreement, the Intergovernmental Panel on Climate Change (IPCC) has calculated a global carbon budget. It is predicted adhering to this budget should stop the world from exceeding the global temperature increase limit. It is noted that the IPCC global carbon budget is based on CO₂-only emissions.

CO₂ emissions ultimately come from two sources: fossil fuels and biomass (Land Use Land Use Change and Forestry or LULUCF). This Chapter covers emissions from fossil fuels. Refer to **Chapter 5** for review and assessment of LULUCF emissions/removal.

The Tyndall Centre for Climate Change Research has developed a methodology to apportion this global budget to the UK. However, this UK budget needs to be further broken down for districts and individual local authorities. Atkins has developed a tool which allows for the calculation of such budgets using the methodology from the Tyndall Centre to apportion IPCC global carbon budgets (cumulative quantity of CO₂ emissions from all anthropogenic sources to maintain warming well below 2oC) to local authorities for the period 2018-2100.

The carbon budget for the Suffolk Coastal District Council (now part of East Suffolk Council) is then prorated for the town of Leiston based on population numbers (see **Table 1** for numerical figures). Note that aviation, shipping and military transport has been deducted from the local authority budget below. These emissions will not be included in this study.

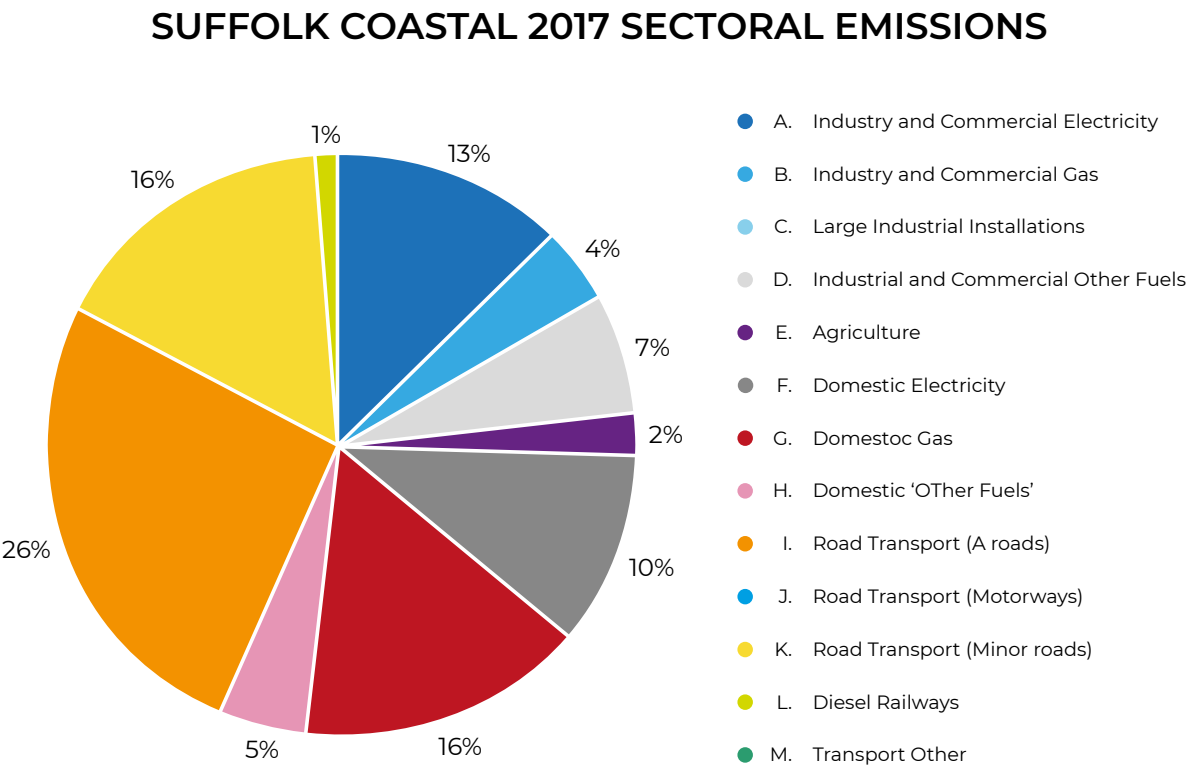
Table 1 – Suffolk Coastal District Council carbon budget calculation (2017)

District Emissions Budget Summary

APPORTIONMENT REGIME (BRACKET TERM IS THE DISTRICT'S PROPORTION OF THE UK)	PROPORTION (SUFFOLK COASTAL SPECIFIC)	%	UK MID- VALUE BUDGET (MTCO ₂)	DISTRICT MID VAULE BUDGET (MTCO ₂)
Grandfathered to district from UK (UK CO ₂ based on population split of OECD). GF-Pop	0.0014	0.14	2463	3.50
Population split to district from UK (UK CO ₂ based on population split of OECD Pop-Pop	0.0020	0.20	2463	4.82
GVA split to district from UK (UK CO ₂ based on population split of OECD) GVA-Pop	0.0018	0.18	2463	4.42
Grandfathered to district from UK (UK CO ₂ grandfathered from OECD) GF-GF	0.0014	0.14	1350	1.92
Population split to district from UK (UK CO ₂ grandfathered from OECD) Pop-GF	0.0020	0.20	1350	2.64
GVA split to district from UK (UK CO ₂ grandfathered from OECD) GVA-GF	0.0018	0.18	1350	2.42
Recommended carbon budget for district (MtCO₂)				3.29

Our calculation indicates that the recommended carbon budget (calculated as an average of the district mid value budgets) for Suffolk Coastal District Council is around 3.3 MtCO₂.

In 2017 (note that these are the latest government statistics available), Suffolk Coastal local authority generated 660 ktCO₂ (around 0.2% of the total annual UK CO₂ emissions)¹³ with the following breakdown:



At the 2017 rate of emissions, it is expected that Suffolk Coastal will use its entire budget within 3 - 7 years (from 2017). This excludes LULUCF emissions. The knowledge of this figure is important to inform the combination of actions that are necessary to achieve the Net Zero target for Leiston, and the potential timeframe for doing so.

To account of the emissions that have already occurred for the two complete years that have passed since 2017, a simple assumption has been made that Suffolk Coastal local authority created roughly the same volume of CO₂ emissions in 2018 and 2019, as it produced in 2017. The total net CO₂ emissions for the two last years have therefore been subtracted from the Suffolk Coastal Carbon budget of 3.3 MtCO₂, to create an approximately up-to-date carbon budget, valid from 2020 (Table 2).

Table 2 - Suffolk Coastal carbon budget correction 2019/20

REGION TOTAL NET EMISSIONS - 2017 (KT CO ₂)	REGION TOTAL EMISSIONS - 2017 (MTCO ₂)	NUMBER OF YEARS FOLLOWING YEAR OF BUDGET CALCULATION STATISTICS (2017)	REVISED CARBON BUDGET BASED ON YEARS OF EMISSIONS SINCE BUDGET CALCULATION STATISTICS (MTCO ₂)
582.7	0.58	2	2.14

Based on a simple indicative exercise of prorating the Suffolk Coastal carbon budget (corrected to 2020) to Leiston based on population totals¹⁴, the carbon budget for Leiston is around **95 KtCO₂**, as per **Table 3**. **This means that Leiston needs to hold cumulative emissions at under 95 KtCO₂ from 2020 onwards to 2100.**

Table 3 - Carbon Budget and Current Emissions

	LEISTON TOWN (STUDY AREA)	SUFFOLK COASTAL (LOCAL AUTHORITY)
Population (number of people)	5,508	124,620
Carbon Budget 2018 - 2100 (ktCO ₂) - mean value	95	2140

At 2020, baseline calculated emissions for Leiston are c. 12.6 ktCO₂¹⁵, this means that, at the current rate without intervention, the total Leiston recommended budget of 95 ktCO₂ would be used in 7.6 years¹⁶.

Quantified, measurable actions and targets to reduce emissions across sectors in Leiston will therefore need to be identified. Typically, this is in the form of emissions trajectories, broken down by key sectors as set out above from the CCC Net Zero Technical Report.

LULUCF: CO₂ REMOVAL TARGET

In this chapter we consider emissions/ removals from Land Use Land Use Change and Forestry (LULUCF). In the UK, the LULUCF emissions are net negative. Therefore the LULUCF sector is an emission sink. In 2018, the CO₂ removals of the sector for the UK were -11.7 MtCO₂ (net negative), while non-CO₂ emissions were relatively negligible. Non-CO₂ emissions from LULUCF are not included in this chapter, and will be dealt with in the “Non-CO₂ emissions” chapter.

¹⁵ Note this figure will be further refined in subsequent detailed assessment as the study progresses and is subject to change (up or down)

¹⁶ Atkins own carbon budget calculations Revised in Rev06

¹³ <https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics>

¹⁴ Census 2011 population Wiltshire=470,981; Chippenham=45,337

In 2017, 77.8 ktCO₂ were sequestered in the Suffolk Coastal district, which equates to a 13% removal of emissions if LULUCF is included in the fossil fuels emissions discussed in **Chapter 5**. The annual LULUCF CO₂ emissions within Suffolk Coast boundary are therefore net negative.

The carbon budgeting method developed by the Tyndall Centre for Climate Change for the LULUCF sector will be applied to ensure that across the century any early emissions from the sector will be fully compensated by later carbon sequestration. The method will enable LULUCF emissions to reach zero by 2030, so as to align with Leiston's zero-emission commitment. Finally, post 2030, sequestration by LULUCF is set to compensate, at least partly, for Leiston's unavoidable non-CO₂ greenhouse gas emissions. Therefore, Leiston's emissions from LULUCF will achieve zero cumulative CO₂ emissions for the period 2018 to 2100.

NON-CO₂: EMISSIONS REDUCTION TARGET

In parallel to CO₂ emissions (see earlier section), non-CO₂ emissions covered by the Kyoto Protocol include: methane (CH₄), nitrous oxide (N₂O) and fluorinated gases (HFCs, PFCs, SF₆, NF₃).

The assessment of non-CO₂ emissions and an associated reduction target are provided by Carbone4. Refer to **Chapter 20** – Non-CO₂ Emissions.

CARBON BUDGET EMISSIONS BOUNDARIES

- » At an organisational level (e.g. for a business), carbon emissions are generally considered by categorising them into three areas: **Scope 1, 2 and 3** according to the Greenhouse Gas Protocol¹⁷:
- » **Scope 1 emissions** are direct emissions i.e. from an activity that produced emissions on site,
- » **Scope 2 emissions** are indirect emissions, i.e. emissions generated offsite from imported heat or electricity,
- » **Scope 3 emissions** are any remaining indirect emissions in the value chain.

As per the Tyndall Centre approach to calculating carbon budgets, the emissions included within the boundaries of the carbon budget are aligned with the UK Government Emissions Estimates Statistics (2005-2017)¹⁸. The emissions included within these statistics are split by the following sectors:

- » A. Industry and Commercial Electricity
- » B. Industry and Commercial Gas
- » C. Large Industrial Installations
- » D. Industrial and Commercial Other Fuels
- » E. Agriculture
- » F. Domestic Electricity
- » G. Domestic Gas
- » H. Domestic 'Other Fuels'
- » I. Road Transport (A roads)
- » J. Road Transport (Motorways)
- » K. Road Transport (Minor roads)
- » L. Diesel Railways
- » M. Transport Other
- » N. LULUCF Net Emissions

Excluded from the boundaries of the emissions statistics are:

- » Embodied emissions (e.g. from the extraction and production of materials); and,
- » Supply chain emissions.

These excluded emissions (i.e. Scope 3) are accounted for elsewhere in the territories where they occur, and are not under direct control of the local council.

The calculated 95 ktCO₂ carbon budget encompasses Leiston's direct CO₂ emissions from the above statistical sectors, excluding LULUCF and associated CO₂ removals.

¹⁷ <https://ghgprotocol.org/>

¹⁸ <https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017>



Separate targets will be set for such carbon removals and sequestration for each budget period, according to:

- » The emissions remaining, beyond the 95 ktCO₂ carbon budget, following all achievable carbon reductions;
- » The national effort to be made on carbon removals, to ensure that Leiston does its “fair share”.

BASELINE EMISSIONS

The carbon budget for the purposes of this study will include direct GHG emissions of Leiston town and the surrounding rural/ agricultural areas that make up the overall study boundary area.

As described within **Chapter 2** - NZL Boundry, the Sizewell sites are excluded from the assessment. Primarily, this is because:

1. The inclusion of a major energy production station is not typical of other UK districts and therefore inflates the energy use and carbon emissions for the study area. This means the outcomes of the Net Zero Leiston Route Map are not easily compared to other districts around the UK when considering Net Zero strategies and outcomes; and
2. The Sizewell sites are operated under nuclear site licence and therefore the energy use and emissions associated with the facilities cannot be directly controlled, or reduced, by the local council or other stakeholders. Inclusion of these sites therefore impacts the district’s ability to determine a deliverable Net Zero Route Map.

The first step in the methodology above sets out that baseline emissions in the Leiston study area must be identified.

The 2017 Government national carbon statistics for Suffolk Coast are a starting point for baseline emissions but there is a need to further develop this territorial baseline for the Leiston area so that progress to Net Zero can be accurately tracked and to enable a starting point to compare results to. The carbon baselining will be done for the area of the study, by calculating all current emissions and removals from the following key sectors/ areas:

1. Buildings
2. Grid Energy

3. Transport (noting assessment strategy for SZC construction traffic to be confirmed)
4. Agriculture
5. LULUCF

This will be done by gathering all relevant available datasets for the study area. Where datasets are not available, benchmarking will be used to assign carbon emissions to the various sectors.

IPCC guidelines and the methodology used in the UK National GHG Inventory will be applied for LULUCF emissions and removals, quantification of carbon storage, sequestration and releases from a land-use baseline inside the geographic study area.

As the carbon budget has been calculated based on the baseline year of 2017, we propose that this should be our baseline year to provide an accurate comparison.

STRATEGIES TO ACHIEVE NET ZERO

The purpose of the study is to consider options that would achieve Net Zero for the Leiston study boundary area. As already defined, this means balancing the amount of emitted GHG with the equivalent emissions that are sequestered, such as the sequestration of residual carbon emissions by trees and other types of vegetation within the study area boundary. Such removal strategies would be consistent with wider UK strategy; this includes the CCC indicating that 30,000ha of trees need to be planted per year in the UK between now and 2050 to meet Net Zero targets, amounting to nearly a million hectares of new forest and woodland. These strategies, and others, will be further reviewed and considered as the Route Map develops.





CHAPTER 2

NZL BOUNDARY

Authored by

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Member of the SNC-Lavalin Group

APRIL 2020

INTRODUCTION

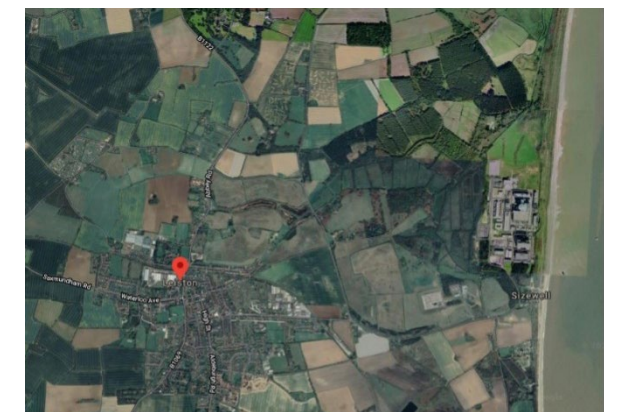
Having set out how we will define Net Zero (**Chapter 1 – Defining Net Zero**), the next task is to define the study boundary area over which we will create the Route Map to achieve Net Zero. In setting the boundary there are several key criteria:

1. Alignment with the Net Zero Leiston project principles, and in particular ensuring local stakeholders are at the heart of the project,
2. Ensuring the study area is of a suitable scale i.e. small enough to allow reasonable granularity of solutions within the Route Map, but large enough to ensure the learning can be more widely used to inform similar projects across the UK,
3. Providing a wide diversity of end-use types, sectors and stakeholders, over and above domestic,
4. Alignment with existing pre-defined boundaries or areas, such that the outputs of the Net Zero study can be easily dovetailed with other initiatives e.g. Suffolk Climate Emergency Plan by the Suffolk Climate Change Partnership.

The agreed boundary will then form the basis for the remainder of the study and creation of the Route Map.

CONTEXT

Leiston is a small town in the East Suffolk non-metropolitan district of Suffolk, near Saxmundham and Aldeburgh. The town lies about 2 miles from the North Sea coast, 21 miles north-east of Ipswich and 90 miles north-east of London. Leiston had a population of 5,508 at the 2011 Census.



BOUNDARY OPTIONS

A number of initial boundary options were considered;

OPTION	BOUNDARY AREA	ADVANTAGES	DISADVANTAGES
1	Leiston town only	- Smaller geographical area - Key focus on town and local stakeholders	- Reduces sectors, end-use types and stakeholders considered - Limits wider learning from UK wider perspective
2	Leiston town + Sizewell sites	- Bigger study area - Presents greater range of options associated with utilising the potential Sizewell energy hub as part of Route Map (e.g. use of heat from facility to serve Leiston)	- Increases end-use types, but still excludes wider areas such as agricultural land and non-urban stakeholders
3	Leiston town + Sizewell sites + surrounding rural areas	- Largest of all boundary area options; therefore gives study some real scale - Takes in widest range of use-types and stakeholders e.g. includes agricultural sector - Scale also provides best opportunity to add value through learning from wider UK perspective	- Increases boundary size, with some potential for this reducing granularity of solutions that can be considered within the Route Map - Sizewell site is operated under nuclear licence and therefore energy use and emissions cannot be directly influenced by local council or other stakeholders w.r.t Net Zero strategies
4	Leiston town + surrounding rural areas (i.e. excluding Sizewell sites)	- As Option 3, but makes the energy use and emissions more comparable to other UK districts i.e. Sizewell doesn't inflate these figures	- Sizewell emissions should still be assessed, so this study will be undertaken by others separately

(Note: all options exclude the transmission scale electricity sub-stations located within the district that serve the incoming feeds from offshore wind turbine installations, as these are assumed to transmit power wider than just the district of Leiston).

PREFERRED STUDY BOUNDARY

Having reviewed the options presented above, we conclude, with agreement of the NZL steering group the benefits of adopting the larger study area (Options 3 and 4) are advantageous to the study. Consideration of a wide range of use-types, engagement with additional stakeholders and the additional learning that can be gleaned from a wider Route Map, combine to make this the optimal choice.

We consider the inclusion of the Sizewell sites would be detrimental to the study for the reasons outlined in the table. We therefore propose the Sizewell sites are excluded.

This leaves **Option 4** as the preferred choice.

Having selected this option, we have considered how this can be aligned with any existing or pre-defined geographical or political boundaries within this area. **The Leiston Neighbourhood Plan**¹ (2017) was prepared by Leiston Town Council and sets out its vision for development through to 2029. The plan adopts the same boundary area as the administrative boundary of Leiston Parish, defined as the 'Leiston Neighbourhood Plan Boundary', as reproduced on the following page². Use of an existing Council defined area should also help align any datasets that feed into the study, and also the general availability of data itself.

This pre-defined area is an obvious choice for our Net Zero study boundary and will be adopted for the study, as it meets all of the 4 criteria established earlier in this chapter, namely:~

1. Alignment with the Net Zero Leiston project principles, and in particular ensuring local stakeholders are at the heart of the project,
2. Ensuring the study area is of a suitable scale i.e. small enough to allow reasonable granularity of solutions within the Route Map, but large enough to ensure the learning can be more widely used to inform similar projects across the UK,
3. Providing a wide diversity of end-use types, sectors and stakeholders, over and above domestic,
4. Alignment with existing pre-defined boundaries or areas, such that the outputs of the Net Zero study can be easily dovetailed with other initiatives e.g. Suffolk Climate Emergency Plan by the Suffolk Climate Change Partnership³,

Note all Sizewell emissions will be excluded from the assessment, even though these sit geographically within the boundary.

¹ <https://www.eastsuffolk.gov.uk/assets/Planning/Neighbourhood-Planning/Designated-Neighbourhood-Areas/Leiston/Leiston-NP-Made-Version-March-2017.pdf>

² Boundary map image reproduced from Leiston Neighbourhood Plan, as above weblink

³ <https://www.greensuffolk.org/about/suffolk-climate-change-partnership/>

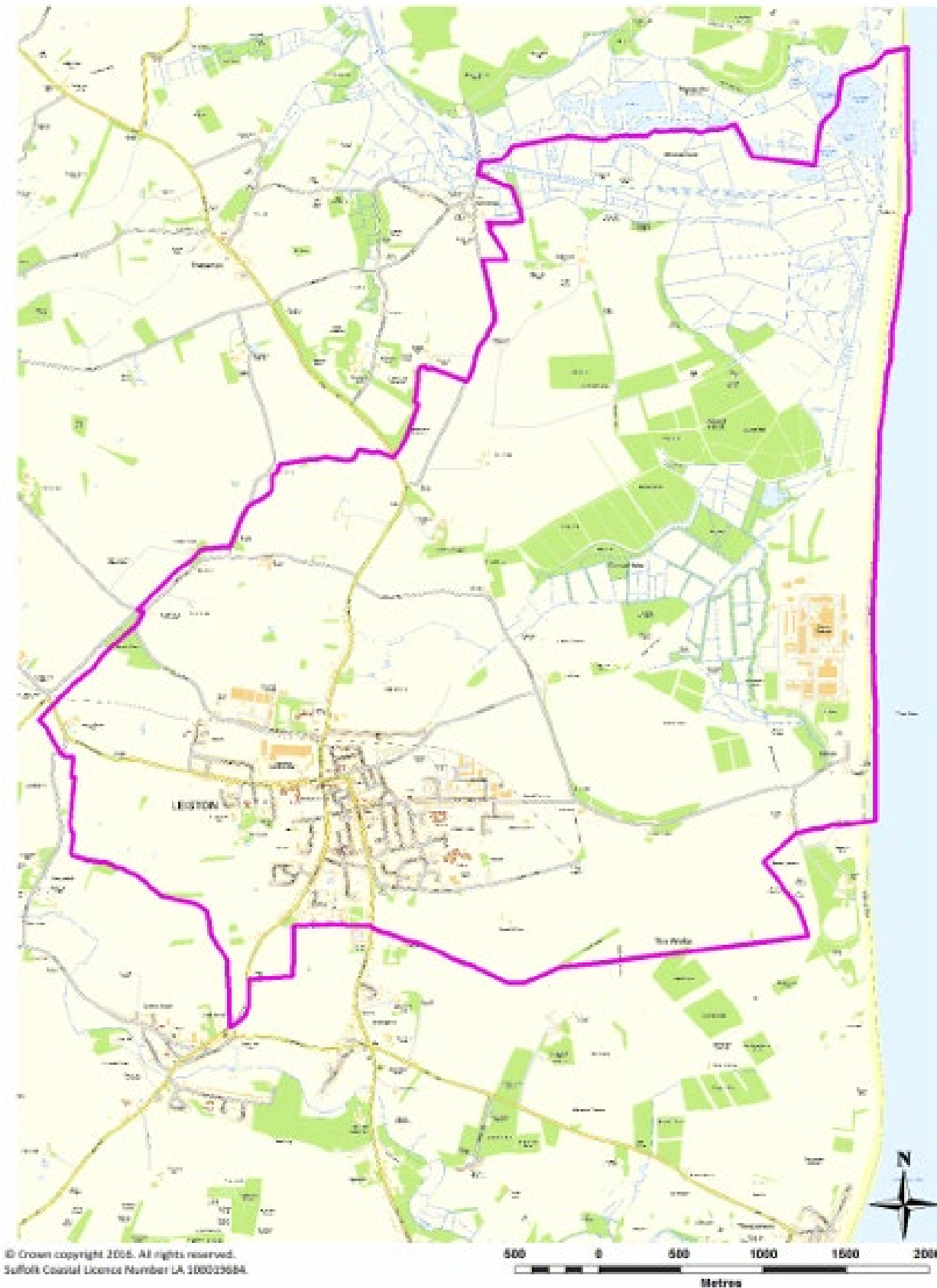


BOUNDARY OPTIONS

Having selected a suitable study area, it is important to note this boundary is virtual, not physical. This area is connected to a large network of wider energy uses, transport routes, environmental features and carbon emissions.

As the Route Map is developed consideration will be given to how the Leiston study boundary interacts with the wider regional and national energy system as a whole, including:

- » Decarbonisation of the electricity grid,
- » Green transport, including electric vehicles (EV) and freight (e.g. where vehicles cross the boundary area coming into or leaving Leiston),
- » Goods or services moving to/ from Leiston across the boundary,
- » Heat decarbonisation for both domestic and non-domestic sectors.





CHAPTER 3

ROUTE MAP ASSESSMENT PROCESS

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MAY 2020

INTRODUCTION

The purpose of this chapter is to capture the process by which we will develop the Net Zero Leiston (NZL) Route Map, such that a broad range of sectors and solutions can be considered, to ensure a well-rounded outcome that addresses the project principles.

Clearly heat, power and transport sectors will be key to developing the strategy – and are likely to account for the majority of carbon emissions reduction – however wider Environmental sectors (such as biodiversity, agriculture, water etc) should also be included. This is particularly relevant for the purposes of carbon sequestration (i.e. removal and capture of carbon dioxide from the atmosphere), should this form part of the Route Map strategy during a transition phase, or over the longer term.

ASSESSMENT PROCESS

The advent of **Net Zero**¹ is relatively recent and as such the tools, processes and thinking behind developing a Net Zero strategy or Route Map are immature.

When we consider the construction/ infrastructure/ energy sectors in the UK, there is a wide range of legislation, codes, standards and Planning processes that provide a defined path to developing a programme or project. This includes requirements such as Strategic Environmental Assessment² (SEA) and Environmental Impact Assessment³ (EIA). Although a SEA is not appropriate (or mandatory) at this stage of the NZL project, the key topics within the SEA are useful to help us frame the assessment.

Taking this into account, we therefore propose the following assessment process as the underlying methodology to develop the NZL Route Map. It is important to note that whilst this is presented as a sequential set of activities, it is intended to be iterative and therefore no sector solution will be prioritised over another (e.g. Environmental).

¹ “**Net Zero**” refers to achieving an overall balance between emissions produced and emissions taken out of the atmosphere. The target for England & Wales is to achieve Net Zero by 2050. Refer to Atkins **Chapter 1** – ‘Defining Net Zero’ for further details.

² **SEA** is a systematic decision support process, aiming to ensure that environmental and other sustainability aspects are considered effectively in policy, plan and programme making. The SEA process sits at a programme level and therefore comes prior to any EIA, which is undertaken at a project level.

³ **EIA** is the assessment of the environmental consequences (positive and negative) of a project prior to being implemented.



STEP 1: BASELINE CARBON EMISSIONS

Review and calculate the current baseline emissions within the study boundary area i.e. Leiston town and surrounding agriculture/ rural areas.



STEP 2: ASSESS HEAT, POWER, & TRANSPORT SOLUTIONS

- Review and assess the heat, power & transport strategies that are feasible for the study area.
- Calculate the carbon emissions reduction associated with these solutions and what portion of the baseline carbon emissions can be reduced.
- Note the carbon budget allowance for Leiston district is likely to mean Net Zero has to be achieved before 2030. It is unlikely all projects can be implemented in this time frame and hence carbon sequestration initiatives are likely to be required during a transitional phase (e.g.Environmental solutions) to meet the overall target.



STEP 3: ASSESS ENVIRONMENTAL SOLUTIONS

- Review environmental (or 'nature based') solutions that could be used to provide further carbon emissions reduction to meet the Net Zero target and to ensure the best overall strategy for the Route Map.
- The assessment will generally consider the key topics within the SEA framework.



STEP 4: CREATE OPTIMUM NZL ROUTE MAP

Iteratively review Steps 2 and 3 to generate the optimum blend of solutions to hit the range of project principles, supported by analysis (e.g. technical, social, community, environmental etc) and produce output NZL Route Map.



CHAPTER 4

CARBON BASELINING

Authored by



FEBRUARY 2021

INTRODUCTION

When considering a Route Map to achieve Net Zero carbon in the study boundary area (**Chapter 2 - NZL Boundry**), the first step is to baseline the current and predicted future carbon emissions of the area as if no external intervention was taken i.e. the business-as-usual scenario (BAU). This allows for an accurate comparison and carbon reductions to be calculated. The BAU scenario shall include carbon emissions across the following three sectors that make up the in-scope emissions:

1. Buildings/Energy Consumption
2. Transportation
3. Agricultural

This chapter calculates the existing carbon emissions across the first 2 of these sectors (buildings and Transportation). The existing Carbon emissions associated with Agriculture are reported by University of East Anglia¹.

The emissions will be calculated for the start year and estimated up to 2050. The start year is 2020, as this is the year the carbon budget² was calculated.

Due to the large volume of data involved, much of this analysis was completed in GIS software. This will allow the results to be presented graphically over a web-based system at a later stage. This will be particularly useful in reviewing change over time.

The sections below outline the method used and the results from each sector, with a final section outlining the total baseline carbon emissions by summing the three sectors under the BAU scenario, with input from University of East Anglia.

1. BUILDING CARBON ANALYSIS

This section calculates the carbon emissions from energy use in all buildings within the Leiston study area.

To calculate the carbon emissions, we first establish an energy demand for each defined building within the study area, and then business-as-usual fuel type(s) for each building. Where possible, this data will

¹ "University of East Anglia, Net Zero Leiston: Agriculture Baseline, 2020

² As a result of the targets set out in the United Nations Paris Agreement, the Intergovernmental Panel on Climate Change (IPCC) has calculated a global carbon budget. It is predicted adhering to this budget should stop the world from exceeding the global temperature increase limit. The Tyndall Centre for Climate Change Research has developed a methodology to apportion this global budget to the UK. However, this UK budget needs to be further broken down for districts and individual local authorities. Atkins has developed a tool which allows for the calculation of such budgets using the methodology from the Tyndall Centre to apportion IPCC global carbon budgets to local authorities for the period 2018-2100.



come from one of our collected datasets, as noted below. As a fall-back position, and to ensure that datasets are not carrying large errors, benchmark energy use will be derived for each building type. These will be based on the nature of the building and the floor area. For future analysis in developing the Route Map, further information such as current insulation levels, building age and construction type will be needed. This data must also be collected at this point.

This analysis will assume that building energy consumption will remain broadly constant without intervention in the future.

There are **3,173 buildings** in the study area, that have been identified as having an energy demand. **2,828** (89%) are domestic, with the remaining 11% non-domestic. See Figure 1 for a map of building locations across the study area.

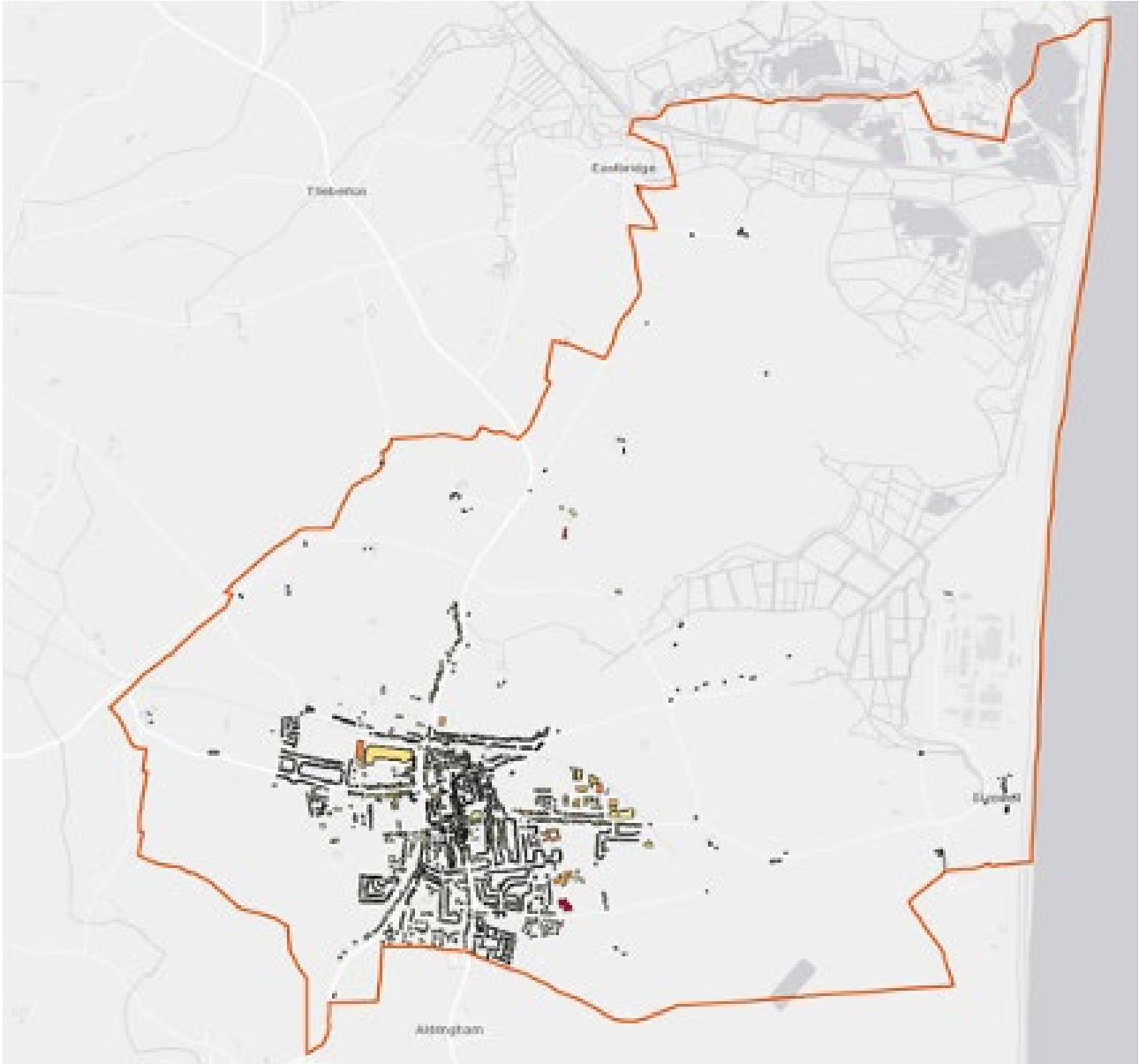


Figure 1 - Buildings in Study Area

1.1 DATA SETS USED

There is limited accurate information available at a building level across England. All data sources used in the dataset are publicly available.

BEIS were contacted for more granular information than is available online i.e. building level rather than data zone. No response has been received to date. While these datasets would be informative, they are not critical. In the past, BEIS provided a National Heat Map which would have been a useful start for this exercise. This was de-commissioned in 2018 and, as yet, has not been replaced³.

The following data sources were used in the dataset⁴:

1	AddressBasePlus is an Ordnance Survey paid product listing addresses, including residential, non-residential, and non-traditional buildings such as tanks. The data is delivered in Point format, with one point potentially representing multiple buildings, for example a school with several teaching blocks. » AddressBase Plus, Ordnance Survey, Accessed May 2020
2	Ordnance Survey Open Map Local is an open data product which includes polygon data on buildings, somewhat simplified. » Open Map Local, Ordnance Survey, Accessed May 2020
3	Off-gas postcodes were produced by the Centre for Sustainable Energy based on data collected in 2017. Postcodes are only included where every property is outside the main gas network; where even one property is connected the whole postcode is excluded from the list. » Off Gas Postcodes, Centre for Sustainable Energy, Accessed May 2020
4	Energy Performance Certificate (EPC) and Display Energy Certificate (DEC) data are released by the Ministry of Housing, Communities, & Local Government. The dataset only includes properties which have had an EPC issued post-2008, and therefore does not include every property. » Energy Performance Certificate & Display Energy Certificates, Ministry of Housing, Communities & Local Government, Accessed May 2020.

³ <https://www.cse.org.uk/projects/view/1183>
⁴ This report is prepared based on Open data and proprietary data, issued by Ordnance Survey, Centre for Sustainable Energy, and Ministry of Housing, Communities & Local Government. The following attribution statements apply: Contains public sector information licensed under the Open Government Licence v3.0. Ordnance Survey data is used under © Crown copyright and database rights [2020] OS [609497] © Local Government Information House Limited copyright and database rights [2020] [609497] Contains Royal Mail data © Royal Mail copyright and Database right [2020]

Further data sets have been requested in relation to:

- » Building Age
- » Conservation Areas
- » Section 106 Agreements (Land Use)
- » Leiston Neighbourhood Plan
- » Tree Preservation Map
- » East Suffolk Council Ownership

1.2 GENERATION SOURCES

From the data sources reviewed, no local generation sources are identified as being within the study area boundary⁵.

While there are local substations receiving electricity from offshore windfarms, these have been excluded from this study as it is not possible to disaggregate the electricity from these that would be used within the bounds of the study area compared to that shared to the remainder of the National Grid⁶.

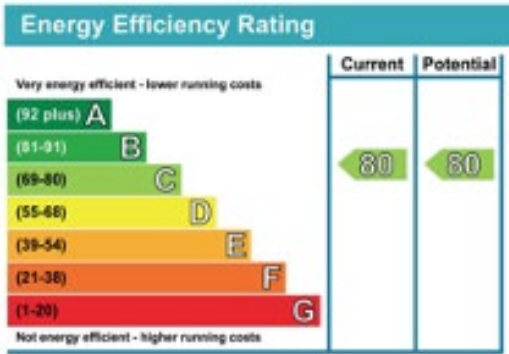
The same logic pertains to Sizewell's generation itself. Its low carbon power is intrinsic to the calculated grid emissions factor that is used for the grid average, and thus for all the buildings in the study area. Only energy that can be disaggregated from the grid supply (whether directly or indirectly) will be considered.

There is a wastewater treatment works in the study area. This is a potential heat source and will be explored in further detail in future analysis. For this stage, the energy consumption associated with the wastewater treatment works has been accounted for, see Benchmarks section below.

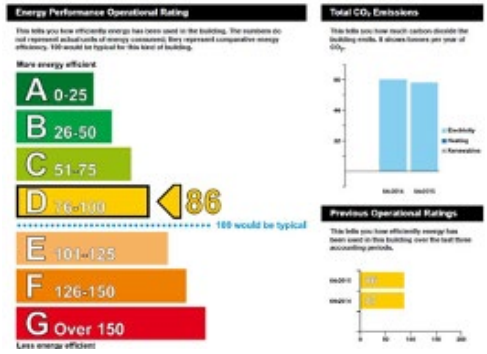
1.3 GIS METHODOLOGY

After all data sets were “clipped” to the local authority boundary for Leiston Ward, EPC data was first processed to retain only the most recent EPC for each property. Following this, AddressBasePlus (ABP) data were joined with EPC and DEC data by using the full PAO text⁷ as the common factor. This required some manual processing to ensure address formats were identical. Around 50% of addresses were present in the EPC data, offering a good coverage of Leiston. This EPC data supplied factors including floor area, fuel type and energy consumption.

What is an EPC and how does it differ from a DEC?



The Energy Efficiency Rating scale ranges from A (92 plus) to G (1-20). The 'Current' rating is 80 and the 'Potential' rating is 80.



The Energy Performance Operational Rating scale ranges from A (0-25) to G (Over 150). The bar chart shows a score of 86, which is between D and E.

An **Energy Performance Certificate (EPC)** is a certificate that shows how energy-efficient a domestic property is. The document includes estimated energy costs, as well as a summary of the home's energy performance-related features.

Display Energy Certificates (DEC) show the energy performance of non-domestic buildings based on actual energy consumption.

In order to classify the remaining addresses and calculate a baseline, OpenMapLocal polygons were imported and spatially joined to ABP data using a one-to-many operation. This allowed a count of addresses to be assigned to each building polygon i.e. in the case of a block of flats. ABP data also includes a four-level building classification, allowing residential and non-domestic building types to be assigned, for example whether a residence was terraced, detached, or semi-detached. To determine the number of storeys of each building, a manual visual check of Google Streetview was conducted. Floor area per property was then calculated using the polygon geometry multiplied by the number of storeys, then divided by the number of ABP points present within each building.

Off-Gas Postcodes were then joined to the resultant dataset to indicate whether gas was not a primary energy type for the property; this data was used in conjunction with EPC data.

⁵ Embedded generation is electricity generation which is connected to the Distribution network rather than to the high voltage National Grid. Embedded generation is typically smaller generation such as Combined Heat and Power (CHP) or renewable generation: small hydro, wind or solar power

⁶ Note the transmission network moves electricity from a power plant or power station to various substations whereas the distribution network carries electricity from the substation to the consumer's end. i.e, to the residential and commercial customers

⁷ This is the Primary Addressable Object Name as text – e.g. building name or street number.

1.4 GENERATION SOURCES

The data come with a series of recognised limitations. Most of these are inherent for any such analysis which cannot rely on a pre-populated data set, and are not unique to our project:

- » EPC data was the main source for domestic properties, this is based on a modelled energy demand for the building rather than actual building demand. This allows difference in say insulations levels to be accounted for, but not actual consumption. This is the best quality data available, so this is what was used. This demand is for regulated energy only, so a benchmark allowance for non-regulated energy (i.e. domestic appliances, plug loads etc) has been added.
- » DEC data was used for non-domestic buildings where available. This was the case for a small selection of buildings in the area for which there is real data for each building. The buildings with DEC data are:
 - The Surgery, Main Street
 - Leiston Sports Centre
 - Leiston Primary School⁸
 - Leiston High School
- » It is widely recognised that there are little available datasets for non-domestic building energy consumption, outside of main public buildings. In the absence of the afore-mentioned National Heat Map, we have used benchmarks to assign a heat and power demand where building attribute is provided.
- » The visual check of buildings using Google Streetview is constrained by using only an outside view of houses, from the road, therefore buildings which have concealed storeys, for example attic extensions visible to the rear, will have their floor area underrepresented.
- » Postcodes off-gas is a 2017 dataset and therefore some properties may have subsequently been connected to the main gas network. Due to the whole-postcode nature of the dataset, there is likely to be other properties which are not connected to the gas network which are not included within this dataset, as others in their postcode may have been gas connected

and therefore excluded the whole postcode from inclusion. This effect is mitigated where an EPC exists and allows a “check” on this data node.

- » EPC data does not reflect any changes in a property during tenure and is generally conducted only upon sale or rental of a property. Actual energy ratings may therefore have changed since the EPC was issued, i.e. if an owner installed photo-voltaic panels.
- » OpenMapLocal presents a simplified building shape; building areas that rely on this dataset will be somewhat approximate.

1.5 BENCHMARKS

Benchmarks were used for buildings where data was unavailable to provide a heating demand and a power demand.

For domestic buildings, this was an average annual demand based on house type, for non-domestic this was based on a kWh/m²/annum usage per building type.

Domestic Buildings

For domestic buildings the following benchmarks were used:

PROPERTY TYPE	AVERAGE ANNUAL HEAT DEMAND (KWH) ⁹	AVERAGE ANNUAL ELECTRICITY DEMAND (KWH) ¹⁰
All Dwellings	10,800	2,900
Houses	11,440	2,900
Detached	14,960	2,900
Semi-Detached	11,360	2,900
End Terraced	10,240	2,900
Mid Terraced	9,600	2,900
Bungalow	11,040	2,900
Flats	6,640	2,900
Converted Flat	8,880	2,900
Purpose Built Flat	6,080	2,900

⁹ Gas Consumption by Dwelling Type, National Energy Efficiency Data Framework, 2019. Converted to Heat demand by applying 80% efficiency.

¹⁰ Typical Domestic Energy Consumption Values (TDCV), Ofgem, 2020



⁸ It is noted on the DEC that Leiston Primary School has existing renewable electricity generation, serving 46.6% of electrical demand.



Clearly the dataset is utilised to identify the most appropriate dwelling type, but if data is lacking, it will default to the more generic “house” or “all dwellings”.

Non-Domestic Buildings

For non-domestic buildings, CIBSE TM46 data was used. See heat and power benchmarks below. The heat benchmark comes from the fossil fuel benchmark with a boiler efficiency of 80% applied.

TM46 TYPE	HEAT BENCHMARK (KMH/M²)	POWER BENCHMARK ¹¹ (KWH/M²)
General Office	96	95
High Street Agency	56	84
General Retail	49.5	115.5
Large non-food shop	136	70
Small Food Store	93	217
Large Food Store	84	400
Restaurant	296	90
Bar, pub or licensed club	280	130
Hotel	264	105
Cultural Activities	160	70
Entertainment halls	336	150
Swimming pool centre	904	245
Fitness and Health Centre	352	160
Dry Sports and Leisure facility	264	95
Covered Car Park	0	20
Public Buildings with Light Usage	84	20
Schools and Seasonal Public Buildings	120	40
University Campus	192	80
Clinic	160	70
Hospital (clinical and research)	336	90
Long term residential	336	65



¹¹ Electricity used for heat taken from TM46 percentage of electricity benchmark pro-rated to degree days - assumption made that the degree days is applied to 50% of the heat proportion. E.g. 15% electricity benchmark to degree days results in 30% of the electricity in total being assumed heat usage.

TM46 TYPE	HEAT BENCHMARK (KMH/M²)	POWER BENCHMARK ¹¹ (KWH/M²)
General Accommodation	240	60
Emergency Services	312	70
Laboratory or Operating Theatre	128	160
Public Waiting or Circulation	96	30
Terminal	160	75
Workshop	144	35
Storage Facility	128	35
Cold Storage	64	145

The TM46 categories were assigned to the ABP categories provided by the dataset to determine the appropriate benchmark to be assigned to the property. Buildings assigned the workshop category were individually considered, due to the varying nature of uses of this building type. Where appropriate, the benchmark was altered to a more suitable estimation.

Specific manual changes of benchmark energy usage were applied to the following buildings:

- » **Applefields Caravan and Camping Park** – this has an office for check in to the park and has twenty electrical hook-ups. Assuming the site is busy for 16 weeks of the year, using a benchmark for a single occupancy domestic building electrical only and multiplying this by 20 pitches and the number of weeks, gives 35,600 kWh/annum. The Office is 150m² so using the benchmarks above, this gives a total electrical demand for the office of 28,650 kWh/annum, so 64,250 kWh/annum total.
- » **Wastewater Treatment Works on Valley Road** – this will have an electricity demand only. From google maps, there appears to be no digester. Using a benchmark of 45 kWh/Population Equivalent¹², and assuming an average local area population of 5,000 people, gives and annual demand of 225,000 kWh.
- » **Data Centre at Eastlands Industrial Estate** – data centres have a high electrical demand, benchmark of 400 kWh/m² used.
- » **Leiston Recycling Centre** – has a portacabin onsite that will have an electrical demand, therefore General Office benchmark assumed.

¹² <https://www.huber.co.uk/solutions/energy-efficiency/general/wastewater-treatment-plants.html>



1.6 ASSIGNING A HEAT AND POWER DEMAND

EPC data was used where available as the primary source of truth, i.e. it is known that the building has been surveyed by a registered energy assessor. While this is no guarantee of accuracy, it is the best available data set for such an exercise.

In the EPC data set, the key indicator is the “primary energy consumption” based on the SAP 2012 method of assigning energy to the fuel type¹³. This is a comparative value and is not an actual measure of energy use in that building’s boundary, nor its nature. The following method was used to split the primary energy use into a more useful heat and power demand:

1. Benchmark electricity demand converted to electricity primary energy using factors in Table 1;
2. Electricity primary energy subtracted from building primary energy demand to fuel primary energy demand; and
3. Fuel primary energy demand converted to fuel demand using primary energy factor, then converted to a heat demand using assumed efficiency, Table 1.

Table 1 - Primary Energy Factors and Assumed Efficiency

PRIMARY FUEL TYPE	PRIMARY ENERGY FACTOR ¹⁴	ASSUMED EFFICIENCY
Mains Gas	1.22	85%
Electricity	3.07	100%
Dual Fuel appliance (mineral + Wood)	1.02	75%
Wood Logs	1.04	80%
Bulk LPG	1.09	85%
Heating Oil	1.1	85%

Where EPC data was available for a building, this was used in favour of a benchmark value. While it could be argued that EPC data is also a benchmark of sorts, as it is based on a modelled building rather than actual data, in theory it should take into account varying insulation levels across buildings.

¹³ Primary Energy is energy that has not undergone any conversion or transportation process, as defined by SAP2012. This takes into account the energy used to produce this fuel – so for example, all fuels involved in the production of electricity will be accounted for based on the Government projections of the electricity grid mix. For this analysis, we are concerned with the fuel that is used in the property, not the chain of energy to get the fuel to the property as this is accounted for at the generation source. For this analysis, the Primary Energy Consumption must be divided by the associated Primary Energy Factor to give the real fuel used at the property. Derivation and Use of Primary Energy Factors in SAP, 2019: <https://www.bregroup.com/wp-content/uploads/2019/10/Briefing-note-on-derivation-of-PE-factors-V1.3-01-10-2019.pdf>

¹⁴ SAP 2012, Table 12: https://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf

Where there was no EPC data available for domestic buildings (1,328 properties), the benchmarks identified in the section above were applied to the corresponding property type. Where domestic property type information was not available from any data set, the benchmark for “All Dwellings” was used.

Where there was no demand information for non-domestic buildings (349 properties), the non-domestic benchmarks were used to assign a heating and power demand. A benchmark could only be applied where a type and floor area were available. Where a building type and floor area were not available, analysis could not be undertaken. This was the case for 34 properties.

Fuel type was determined through EPC information provided and the gas grid data set applied. Where no information was provided about fuel type on the EPC, connection to gas grid was looked for first. If connected to the gas grid, the heating fuel is assumed to be gas. Otherwise, heating fuel is assumed to be electricity. Out of all the buildings with EPC and DEC data, 3.6% of the buildings had a fuel type of Oil, Wood Logs, Dual Fuel or LPG. With this being such a small portion and with no way of assessing whether a property uses these fuel types, it was assumed that all properties not on the gas network were electricity. Figure 2 identifies the fuel types across Leiston.



Figure 2 - Fuel Type Leiston

The majority of the demand in the area comes from the number of domestic dwellings in Leiston. However, the largest energy load is the Leiston Sports Centre, the only building to have an annual energy demand of more than 1,000 MWhs. See Figure 3 for the heat demands of buildings across the study area, the sports centre is the building in red towards the bottom right.



Figure 3 - Heat Demand Across Leiston Town Centre - (Red shows highest heat demand, yellow is lowest)

1.7 CARBON FACTORS

Three sources of carbon factors were used for this assessment, see Table 2. For fossil fuel, it is assumed that the factor does not change year on year, however, the carbon factors for electricity take into account the predicted decarbonisation of the electricity grid, a list of factors used can be found in Appendix A: Electricity Carbon Factors. The carbon factors were multiplied by the corresponding fuel and power demand for each building. The heating demand must be converted to a fuel demand, using efficiencies previously presented in Table 1.

Grid average electricity carbon emission factors were used to establish the baseline in a carbon foot printing exercise and based on current usage not changing. When measure changes are taken into account, long run marginal factors will be used as this will take into account the potential change in future energy mix as a result of any demand changes.

Table 2 - Carbon Factors

FUEL	FACTOR (K _G CO ₂ /KWH)	CARBON FACTOR SOURCE
Gas	0.184	BEIS Green House Gas reporting carbon conversion factors 2019 ¹⁵
Oil	0.267	BEIS Green House Gas reporting carbon conversion factors 2019
LPG	0.214	BEIS Green House Gas reporting carbon conversion factors 2019
Wood Logs	0.019	BEIS Green House Gas reporting carbon conversion factors 2019
Dual Fuel (Mineral and Wood)	0.226	SAP2012 Carbon Emissions Factor ¹⁶
Electricity	Domestic (2020) » 0.141	Green Book Greenhouse Gas Emissions- Grid-Average Domestic and Commercial/ Public Sector ¹⁷
	Commercial/Public Sector (2020) » 0.138	

¹⁵ <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019>

¹⁶ https://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf

¹⁷ Carbon Factors show predicted decrease in carbon emissions from the electricity grid. <https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>

1.8 BUILDINGS RESULTS

The BAU building carbon emissions are shown in Table 3 below. Current year emissions are shown under 2020, with the annual emissions up to 2050 displayed as well. Without any intervention, carbon emissions from buildings are expected to reduce by 20% by 2050. The decrease in carbon emissions overtime is due to the projected decarbonisation of the electricity grid¹⁸.

Table 3 - Estimated buildings carbon emissions (t Co2) for 2020 and evolution to 2050

TYPE OF BUILDING	2020 (BASELINE YEAR)	2025	2030	2035	2040	2045	2050
Domestic	7,837	7,468	7,232	6,792	6,792	6,723	6,653
Non-Domestic	3,770	3,433	3,216	2,814	2,814	2,751	2,687
Total	11,608	10,901	10,448	9,607	9,607	9,473	9,340

The results above assume that all properties are occupied. In theory this will not be the case, however measures will need to be applied to all properties as it is likely that different properties will be vacant at different times over the analysis period. This analysis also assumes that property energy demands remain constant over this time period.

To sense check the domestic carbon emissions above, the CO₂ emissions from domestic electricity, gas and other fuels for Suffolk Coastal for 2017 were pro-rated for the population of the study area. This value (8,700tCO₂) was found to be approx. 11% more than the calculation completed above. see Table 4 (equivalent figure of 7,837tCO₂ for 2020), which is a reasonable correlation. We also note a period of 3 years between these figures (2017 and 2020), which will also account for some of the difference.

Table 4 - Local Authority Carbon Comparison

AREA	POPULATION	DOMESTIC GAS, ELECTRICITY AND OTHER FUELS CO ₂ EMISSIONS ¹⁹ (T CO ₂)
Suffolk Coastal	129,01619	204.5
Leiston Study Area	5,508	8,700

2. TRANSPORTATION CARBON ANALYSIS

The transport carbon baseline for Leiston was calculated in line with guidance from the Department for Transport's (DfT) Transport Appraisal Guidance (TAG), using the following key inputs:

- » Traffic volume, speed and composition (in terms of Cars, LGVs, HGVs and buses) data from the Leiston area VISUM model²⁰ for the years 2015 and 2034 and for each of 7 modelled hours (06.00 to 09.00 and 15.00 to 19.00);
- » Fleet composition assumptions from the DfT's TAG databook;
- » Fuel consumption assumptions by vehicle type from the DfT's TAG databook (accounting for improvements and fleet composition change through time);
- » Carbon intensity factors (kg CO₂e/ litre of fuel) from the DfT's TAG databook and kg CO₂e/ per kWh of electricity from the BEIS dataset (using domestic grid average intensity for the baseline rather than marginal intensity which is recommended in the TAG databook to appraise changes in energy use); and
- » Traffic demand growth forecasts from the VISUM model and from the DfT's National Traffic Forecasts 2018 for the East of England.

2.1 TRANSPORTATION CARBON ANALYSIS

The calculations involved the following steps:

1. For the modelled years of 2015 and 2034 and for each time period, calculation of fuel consumption /electricity use for traffic on each modelled road link within the Leiston area. Calculations included all traffic apart from any traffic to and from Sizewell C²¹, and used the TAG fuel consumption formulae which link fuel consumption to vehicle type, fuel type, speed, year and distance of travel. See Figure 4 for an image of the modelled road links.
2. Summation across all modelled road links of estimated fuel consumption/ electricity use by vehicle type (car, LGV, HGV and bus), time period and fuel type for the modelled years of 2015 and 2034.

²⁰ Transport model provided by Sizewell C. This was used as the base for the modelling scenarios.

²¹ Note that traffic to and from Sizewell B and A are included Sizewell C traffic, for construction, are excluded from the boundary for replicability purposes. Sizewell C emissions have not impact on the 2015 baseline, but are estimated to increase the 2034 baseline emissions by around 10% if included.



¹⁸ BEIS UK Local Authority and Regional Carbon Dioxide Emissions National Statistics 2017

¹⁹ Mid-Year Estimate



3. Application of an uplift of 15% (based on road coverage) to allow for traffic on minor roads that are not captured in the model.
4. Interpolation and extrapolation to produce estimates of fuel and electricity use for each vehicle type in each time period in each year between 2020 to 2050. This process drew on:
 - a. DfT National Traffic Forecasts for the East of England (by vehicle type):
 - i. To distribute the VISUM modelled demand growth to the years between 2015 and 2034 (modelled years); and
 - ii. To estimate additional traffic growth beyond 2034 (assumed to be equivalent to the East of England average).
 - b. DfT TAG estimates of improvements in fuel consumption through time by vehicle type and fuel type (accounting for fleet composition change)
5. Conversion of fuel/ electricity consumption estimates in litres and kWh for modelled hours to represent:
 - a. Full weeks - using expansion factors based on DfT statistics on the relative levels of travel by time of day
 - b. Full years - on the assumption of 253 working days per year and the remainder weekend or bank holidays.
6. Conversion of fuel and electricity consumption estimates to estimated emissions impacts by year using the DfT and BEIS carbon intensity factors by year.



Figure 4 - Transportation Model - Modelled Road Links

2.2 TRANSPORTATION RESULTS

The summary results are presented below by 5-year intervals for the BAU scenario without Sizewell. Emissions associated with electric vehicle use are presented separately to those from petrol and diesel vehicle use as they are not usually considered part of transport sector emissions.

Table 5 - Estimated transport carbon emissions (t CO₂e) for 2020 baseline and evolution to 2050

ENERGY SOURCE	2020 (BASELINE YEAR)	2025	2030	2035	2040	2045	2050
Petrol/ Diesel	3,820	3,860	3,750	3,620	3,370	3,160	2,960
Electricity	10	20	60	50	70	70	70
Total	3,830	3,880	3,810	3,670	3,440	3,230	3,030

A sense check was undertaken, comparing the 2017 estimate against the BEIS local authority road vehicle emissions for the Suffolk Coastal district for 2017. The calculated emissions figure for Leiston was just over 1.5% of the Suffolk Coastal total. This compares to the population accounting for approximately 4.2% of the total.

This difference largely reflects the fact that there are no A roads passing through the Leiston study area. Traffic on A roads was attributed 60% of emissions in the BEIS statistics as the high traffic flows and high good vehicles proportions (for instance to and from Felixstowe) contribute disproportionately to emissions totals.

3. TOTAL CARBON ANALYSIS RESULTS

Combining the results of sections 2.0, 3.0 and the supporting note from University of East Anglia (buildings, transportation and agriculture) gives the total current carbon emissions for the study area as:

» 15,738 t CO₂/annum

This is the gross level of emissions in the Leiston parish boundary. The area benefits from existing green space which naturally removes carbon from the environment. The existing carbon sequestration from the boundary area is estimated at:

» -3,725 t CO₂/annum

Detailed methodology for calculating this will be published later this year.

This provides the net total current carbon emissions for the area of:

» 12,013 t CO₂/annum

Comparing these net values to the CO₂ budget of the study area, 95 kt CO₂ up to the year 2100, if business as usual were to carry on, the carbon budget of the study area would be emitted (i.e. used up) in just under eight years. **Essentially, this defines the scale of the carbon challenge required to make Leiston Net Zero and sets the baseline for defining the Route Map.**

Table 12 below shows the annual carbon emissions up to 2050. Almost 70% of the carbon emissions can be attributed to building energy consumption.

Looking at this over the period from 2020 – 2050, the overall carbon emissions are reducing. This is due to the baseline predicted increase in electric vehicle usage combined with the projected decarbonisation of the electricity grid.

Table 12 - Total Estimated Emissions (t CO₂) for the Study Area

SECTOR	2020 (BASELINE YEAR)	2025	2030	2035	2040	2045	2050
Buildings	11,608	10,901	10,448	9,607	9,607	9,473	9,340
Transport	3,830	3,880	3,810	3,670	3,440	3,230	3,030
Agricultural ¹	300	300	300	300	300	300	300
Total	15,738	15,081	14,558	13,577	13,347	13,003	12,670

Note: An assessment into the changes between now and 2050 emissions forecast as a result of changes in land use area or agricultural equipment efficiency has been undertaken.

The assessment identified that agricultural land use area in Leiston has not undergone any particular change over the last 15-year period (further detail will be published in a separate Land Use, Land Use Change and Forestry (LULUCF) chapter). It is therefore, assumed that land use area will not undergo significant changes between now and 2050.

Furthermore, the DfT's TAG forecast statistics do not forecast any changes in fuel efficiency of diesel HGV's between 2020 - 2050, which are of a similar engine size to agricultural vehicles. Equally, the DfT's TAG forecast statistics do not forecast any changes in carbon emissions from diesel fuel burnt between 2020 - 2050. It is therefore assumed that there will similarly be no changes in the efficiency of diesel agricultural vehicles nor changes in carbon emissions from diesel fuel burnt for agricultural equipment.

It is therefore assumed that the baseline agricultural emissions calculated for 2020 will be constant 300 t CO₂ for each year from 2020 – 2050.

APPENDIX A: ELECTRICITY CARBON FACTORS

Carbon Emission Factors

YEAR	GRID AVERAGE (KGCO ₂ E/KWH)			
	CONSUMPTION-BASED			GENERATION-BASED
	DOMESTIC	COMMERCIAL/ PUBLIC SECTOR	INDUSTRIAL	
2020	0.141	0.138	0.135	0.128
2021	0.115	0.113	0.111	0.105
2022	0.107	0.105	0.103	0.098
2023	0.112	0.110	0.108	0.102
2024	0.104	0.102	0.100	0.095
2025	0.105	0.103	0.101	0.096
2026	0.099	0.097	0.095	0.090
2027	0.105	0.103	0.101	0.096
2028	0.100	0.098	0.096	0.091
2029	0.092	0.090	0.088	0.084
2030	0.083	0.081	0.080	0.076
2031	0.073	0.072	0.070	0.067
2032	0.061	0.060	0.059	0.056
2033	0.057	0.056	0.055	0.052
2034	0.049	0.048	0.048	0.045
2035	0.041	0.040	0.039	0.037
2036	0.041	0.040	0.039	0.037
2037	0.041	0.040	0.039	0.037
2038	0.041	0.040	0.039	0.037

YEAR	GRID AVERAGE (KGCO ₂ E/KWH)			
	CONSUMPTION-BASED			GENERATION-BASED
	DOMESTIC	COMMERCIAL/ PUBLIC SECTOR	INDUSTRIAL	
2039	0.041	0.040	0.039	0.037
2040	0.041	0.040	0.039	0.037
2041	0.040	0.039	0.038	0.036
2042	0.038	0.038	0.037	0.035
2043	0.037	0.036	0.036	0.034
2044	0.036	0.035	0.034	0.032
2045	0.034	0.034	0.033	0.031
2046	0.033	0.032	0.032	0.030
2047	0.032	0.031	0.030	0.029
2048	0.030	0.030	0.029	0.028
2049	0.029	0.028	0.028	0.026
2050	0.028	0.027	0.027	0.025

NET ZERO: AGRICULTURE

This document discusses a number of issues regarding agriculture and the Net Zero Leiston (NZL) project. It begins with some background information on agricultural activities and then provides responses to a number of key questions.

Agricultural Background

The most recent data from the Agriculture in the United Kingdom publication indicate that in 2018 agriculture was responsible for 10.1% of total UK greenhouse gas (GHG) emissions (Defra, 2020). However, this share varied appreciably between GHGs, with agriculture being the source of 49.3% of Methane, 69.8% of Nitrous Oxide and only 1.6% of Carbon Dioxide (CO₂) emissions. Most agricultural Methane emissions arise from digestive processes in ruminating animals and those of Nitrous Oxides from nitrogen fertiliser or manure applications to soils. The main sources of Carbon Dioxide are combustion, vehicle emissions



and releases from soil during cultivations. This document focuses on CO₂, though it is important to keep in mind that they are only a small proportion of agricultural GHG emissions. **Chapter 20** further explains the exclusion and concludes that no large non-CO2 emitters are found within the NZL boundary, and Leiston's non-CO2 emissions are expected to be negligible.

An insight into the composition of agricultural activities in the NZL project area can be obtained from the Crop Map of England (CROME) dataset (Rural Payments Agency, 2020). Figure 1 and Table 1 below summarise the most recent data from 2019 for the project area.

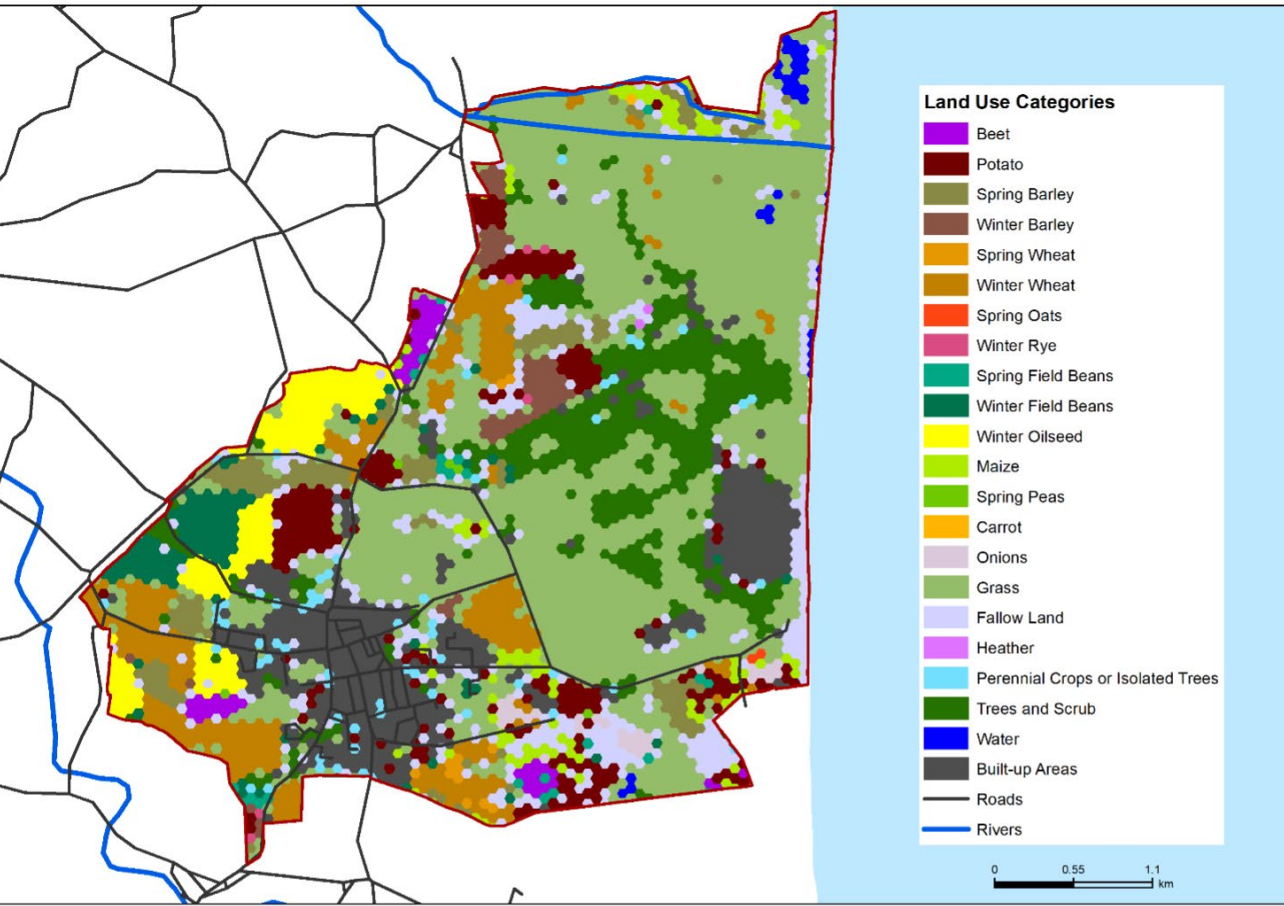


Figure 1: Crop and other land use information from CROME 2019 for the NZL project area.

Table 1: CROME 2019 crop and other land cover totals for the NZL project area.

Category	Hectares	Category	Hectares
Winter Wheat	139.0	Carrot	0.4
Spring Wheat	5.0	Onions	12.9
Winter Barley	27.6	Potato	96.7

Category	Hectares	Category	Hectares
Spring Barley	69.2	Maize	39.9
Winter Rye	2.5	Fallow Land	147.9
Spring Oats	0.8	Grass	697.1
Winter Oilseed	71.5	Heather	0.8
Winter Field Beans	44.6	Trees, Shrubs, Hedgerows	182.4
Spring Field Beans	8.8	Perennial Crops, Isolated Trees	26.2
Spring Peas	2.1	Built-Up or Sparsely Vegetated Land	193.7
Beet	21.0	Water	11.8

Most of the agricultural activity is associated with arable farming, primarily cereals, other combinable crops, potatoes, and other vegetables. A check using aerial imagery indicates that there are some areas of grass pasture, but no obvious evidence of large-scale poultry or pig sheds. This means that initiatives to reduce CO₂ emissions need to focus primarily on arable farming.

Assessing Current Agricultural CO₂ Emissions in the NZL Project Area

Carbon dioxide emissions estimates by local authority are published on an annual basis. Table 2 summarises data for the East Suffolk district for a number of years through to 2018. Several important points can be made from this table.

- » Overall and per capita CO₂ emissions have declined over time.
- » The decline in emissions has been particularly pronounced in the Industrial, Commercial and Domestic sectors.
- » The contribution from Transport has been relatively stable and so has become proportionally more important over time.
- » Emissions associated with Land Use, Land-Use Change and Forestry (LULUCF) can be positive or negative. On average, land uses such as Forestry and Grassland tend to sequester carbon, so reducing emissions, while Croplands are associated with an increase, though this depends on factors such as soil types and cultivation methods.

» Combining the Agriculture (E) and Cropland (O) categories in Table 2 represents 44.8 kt CO₂ in 2018, some 4.2% of the East Suffolk total. If, say, a third of the grassland is attributed to agricultural activity then the net contribution would be closer to 3%.

East Suffolk is obviously much larger than the NZL project area, but the data in Table 2 provide useful context for estimating the importance of agriculture in this smaller area. The local authority summaries draw upon gridded datasets (1 km² resolution) which are available from the National Atmospheric Emissions Inventory (NAEI) website (<https://naei.beis.gov.uk/data/map-uk-das>) and details for Carbon Dioxide have been downloaded and a map of total emissions for 2018 is shown in Figure 3. The map highlights that grid cells with higher levels of CO₂ emissions are associated with larger urban centres or main roads. Few grid cells around Leiston have higher emissions on a district scale but using GIS software it is possible to extract and summarise the available data layers for 20 1 km² cells intersecting the boundary of the NZL project area. These details are shown in Table 3.

Table 2: Territorial CO₂ emissions estimates for East Suffolk 2005-2018 (kt CO₂)

Sector	2005	2010	2015	2017	2018	2018%
A. Industry and Commercial Electricity	384.8	331.8	229.2	163.6	149.1	14.1%
B. Industry and Commercial Gas	92.5	63.6	67.9	66.7	75.6	7.1%
C. Large Industrial Installations	0.1	0.0	0.0	0.0	0.0	0.0%
D. Industrial and Commercial Other Fuels	114.4	139.3	134.0	118.2	105.1	9.9%
E. Agriculture	27.5	22.6	21.9	22.5	22.4	2.1%
Industry and Commercial Total	619.3	557.3	453.0	370.9	352.2	33.3%
F. Domestic Electricity	289.8	262.8	171.8	122.3	110.4	10.4%
G. Domestic Gas	258.4	250.4	205.3	209.8	211.8	20.0%
H. Domestic 'Other Fuels'	62.4	66.3	49.2	48.5	48.5	4.6%
Domestic Total	610.5	579.5	426.3	380.7	370.7	35.0%
I. Road Transport (A roads)	250.8	217.6	226.6	239.5	236.0	22.3%

Sector	2005	2010	2015	2017	2018	2018%
J. Road Transport (Motorways)	0.0	0.0	0.0	0.0	0.0	0.0%
K. Road Transport (Minor roads)	158.9	159.3	156.0	174.3	172.3	16.3%
L. Diesel Railways	7.2	7.2	7.5	7.1	5.9	0.6%
M. Transport Other	9.0	10.2	10.8	11.6	11.8	1.1%
Transport Total	425.8	394.3	400.8	432.5	426.0	40.3%
N. LULUCF Net Emissions: Forest	-106.1	-106.9	-102.2	-102.0	-101.3	-9.6%
O. LULUCF Net Emissions: Cropland	24.8	24.3	22.6	23.2	22.4	2.1%
P. LULUCF Net Emissions: Grassland	-21.0	-24.8	-29.1	-30.7	-31.3	-3.0%
Q. LULUCF Net Emissions: Wetlands	0.0	0.0	0.0	0.0	0.0	0.0%
R. LULUCF Net Emissions: Settlements	21.2	20.3	19.4	19.8	19.7	1.9%
S. LULUCF Net Emissions: Harvested Wood	0.0	0.0	0.0	0.0	0.0	0.0%
LULUCF Net Emissions	-81.2	-87.1	-89.3	-89.7	-90.5	-8.6%
Grand Total	1,574.5	1,444.0	1,190.8	1,094.4	1,058.4	100.0%
Population ('000s, mid-year estimate)	235.7	239.9	243.3	246.9	248.2	
Per Capita Emissions (t)	6.68	6.02	4.89	4.43	4.26	
Area (km ²)	1,294.8	1,294.8	1,294.8	1,294.8	1,294.8	
Emissions per km ² (kt)	1.22	1.12	0.92	0.85	0.82	

Source: <https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas>

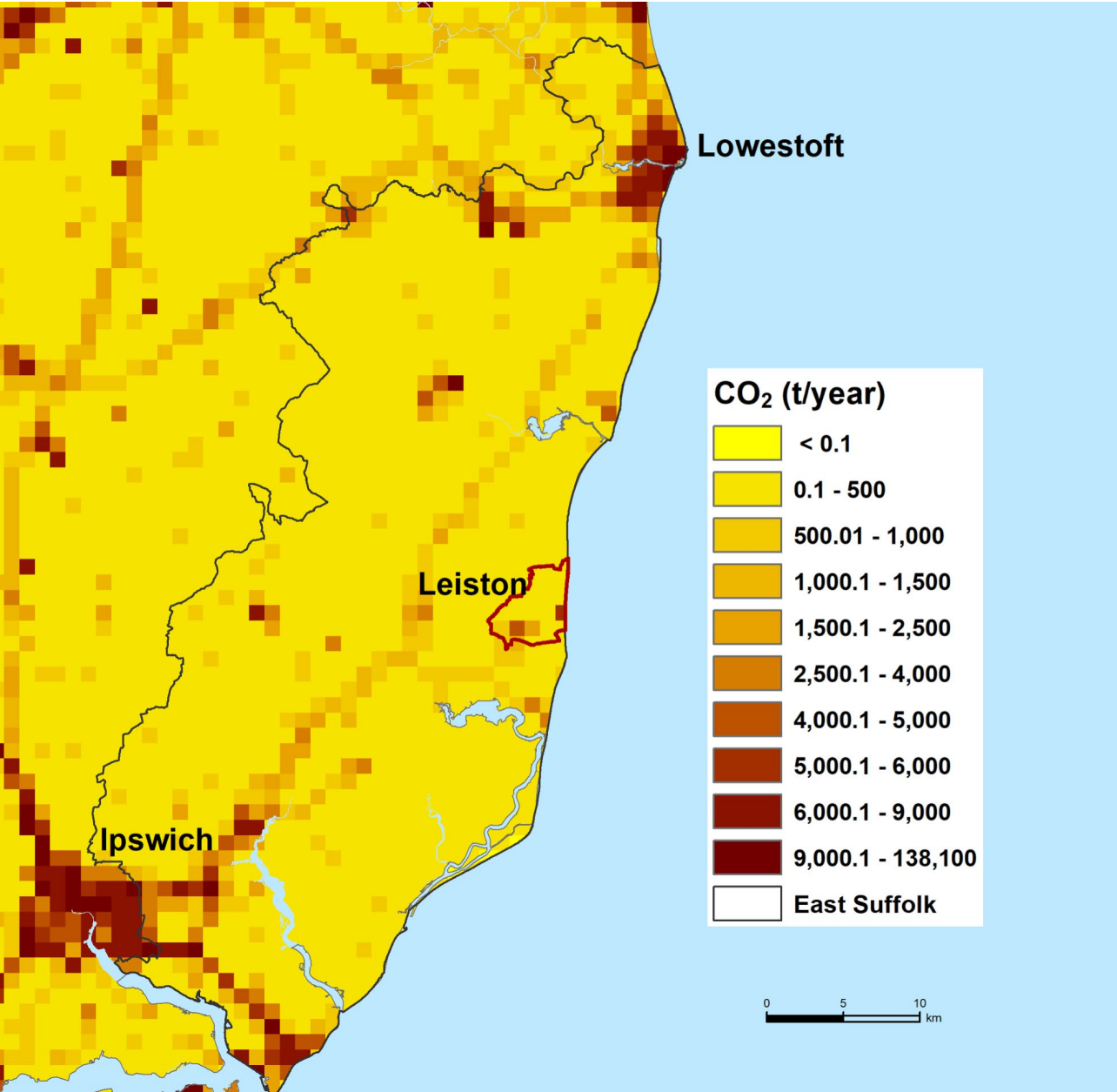


Figure 2: Estimated total CO₂ emissions in tonnes (area and point sources) in 2018 from NAEI gridded data.

The NAEI data units are tonnes of Carbon Dioxide as Carbon and have been converted to tonnes of CO₂ for presentation in Figure 2 and Table 3. They are also presented for CORINAIR sectors which, unfortunately, are not directly comparable with the categories used in the local authority estimates. It is also important to note that the grid cell format introduces an element of approximation in calculating totals for smaller geographical areas and, for instance, summing the values in Figure 2 within the East Suffolk boundary produces a total which is 15% less than that in the local authority statistics. At least some of this discrepancy is likely to be due to boundary effects around Ipswich.

Table 3 shows the results of the calculations for the NZL project area, with an estimate of 15,273 t CO₂ from all sources and 12,652 t CO₂ if point sources are excluded. Agricultural activities are split across two categories where, unfortunately, they are combined with other sources. However, based on the district proportions and totals in Table 2 it seems unlikely that agriculture could account for more than 300 t CO₂ of this total (2.5% of area sources or 2% of total emissions) and a figure close to 250 t CO₂ might be more realistic. In any respect, it is clear that the current net contribution of agriculture is very small compared to domestic or transport sources.

Table 3: Estimates of CO₂ emissions for the NZL project area using NAEI gridded data.

CORINAIR Sector	CO ₂ (t)	% of Total
Combustion in Commercial, Residential and Agriculture	6,344.4	41.5%
Combustion in Industry	1,938.9	12.7%
Road Transport	2,310.0	15.1%
Agriculture, Forestry and Land-Use Change	48.7	0.3%
Nature	27.1	0.2%
Total Area Sources (Sum of all Sectors)	12,652.4	82.8%
Total Emissions (Including Point Sources)	15,272.7	100.0%

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CHAPTER 5

LAND USE, LANDUSE CHANGE AND FORESTRY (LULUCF)

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1. INTRODUCTION

1.1 THE AFOLU SECTOR

The agriculture, forestry and other land use (AFOLU) sector considers the impact of land use and management on ecosystems processes which affect greenhouse gas fluxes. This sector is subdivided into land use, land use change and forestry (LULUCF), and agricultural emissions. Greenhouse gases such as carbon dioxide (CO₂) exchange between the atmosphere and terrestrial biosphere, through biological and physical processes such as photosynthesis, respiration, decomposition, nitrification/denitrification, enteric fermentation, and combustion (Figure 1).

Agriculture is responsible for around 10% of UK greenhouse gas emissions. Conversely, the biosphere is an important reservoir of carbon, and LULUCF processes are a net carbon sink in the UK. Human activities influence the flux of greenhouse gases from land uses. This impact may cause a pool to increase or decrease, creating sinks and sources, for example where forests or peatland are removed to make way for agriculture, or infrastructure. Creating new carbon sinks can be an important climate change mitigation activity, leading to enhanced removal of greenhouse gases from the atmosphere, for example through forestation and regeneration programmes.



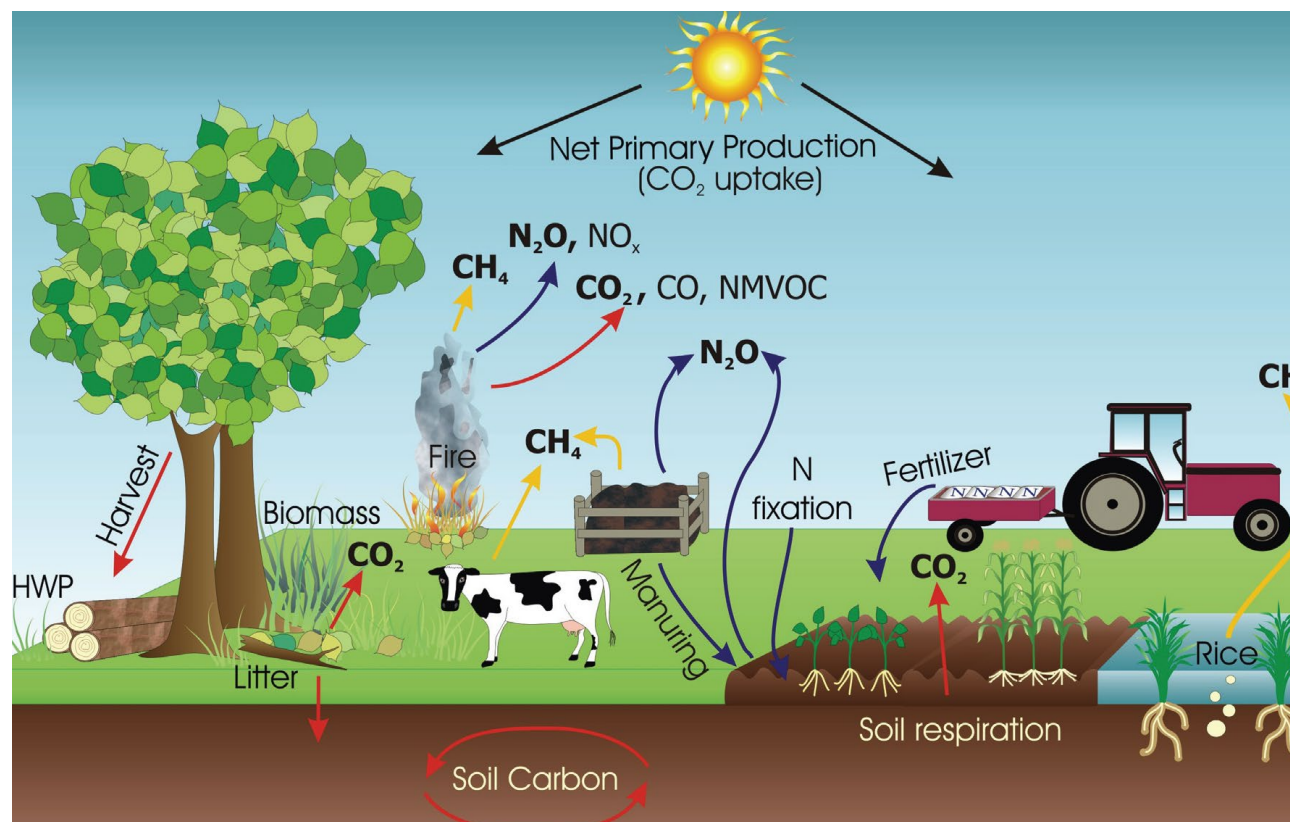


Figure 1 - The main greenhouse gas emissions sources / removals and processes in managed ecosystems (IPCC, 2006)

The UK Government's '25-Year Plan to Improve the Environment' contains key policy elements around encouraging land management practices which store carbon, including protecting peatlands, promoting woodland creation, restoring landscapes and increasing green infrastructure in urban areas. The report by the Committee on Climate Change (CCC)'s 'Land use: Reducing emissions and preparing for climate change', published in 2018, identifies areas where land-use and land management changes can enable land-owners to deliver climate change mitigation and adaptation objectives. The report also provides examples on how land can be used to deliver higher emissions reductions, covering greater use of low-carbon intensive farming practices and releasing agricultural land for carbon reduction by converting them to alternative uses.

A further report, 'Land use: Policies for a Net Zero UK' published in 2020 presents the CCC's first ever in-depth advice on UK agricultural and land use policies. It identifies that a transformation of the way we use our land will be required to achieve Net Zero. Key recommendations include tree planting, low-carbon farming practices, restoration of peatlands, growth of bioenergy crops, and a reduction in carbon-intensive food production. This is supported by document 'The Path to Sustainable Farming: An Agricultural Transition Plan 2021 to 2024' which works to provide practical options to deliver improvements to our natural environment via agriculture.¹

1.2 SCOPE

This chapter presents the LULUCF baseline for the Leiston area, including:

- » Estimated LULUCF carbon storage and
- » Estimated annual LULUCF carbon emissions and removals.

Whilst non-CO₂ greenhouse gases such as methane (CH₄) and nitrous oxide (N₂O) also exchange between biosphere and atmosphere, in the UK context CO₂ is the predominant gas of concern², and the one considered in detail in the UK national inventory. This baseline considers only stocks of carbon and emissions and removals of CO₂. This exclusion is further explained in **Chapter 20**.

Note that estimated emissions from agricultural processes are considered and calculated in **Chapter 4**.

2. METHODOLOGY

2.1 LULUCF

2.1.1 INTRODUCTION

At its simplest, the methodology for estimating carbon stocks is based on the principle of dividing the total land area into its different land-use categories and multiplying these areas by emission factors.

The key source of methodological guidance has been the IPCC's 2006 guidelines³. These provide a comprehensive and detailed approach to preparing national greenhouse gas inventories in the Agriculture, Forestry and Other Land Uses (AFOLU) sector. Much of the technical content of the guidelines – such as classifying land-uses and the calculations for estimation – can be readily applied at a regional or local level.

This methodology has also been adapted by DEFRA to the UK context, and is used in the UK National GHG Inventory for its LULUCF emissions and removals. Applying this methodology allows EDF to make use of publicly available data, as well as peer-reviewed and technically rigorous calculation equations.

2.1.2 SETTING STUDY BOUNDARIES AND ASSESSMENT SCOPE

Spatial and temporal scope

The scope of the baseline assessment was established. The geographic study area has been set to include all areas within the parish of Leiston, an area of 1,799 hectares (ha). The temporal scope is a single 'snapshot' of carbon stocks and emission / removals rates within a year; the baseline does not attempt to project past or future land-use changes. This is an important point, as emission and removal rates associated with land use changes very depending on the previous land use as well as the post-conversion land use.

Carbon stocks

A carbon 'pool' is a reservoir with the capacity to store, capture and release carbon. The quantity of carbon within a pool is referred to as the carbon 'stock'. Within each land-use area, there are carbon stocks within the following three aggregate carbon pools:

- » Biomass (above and below ground);
- » Dead organic matter 'DOM' (dead wood and litter); and
- » Soils (soil organic matter in mineral and in organic soils).

The carbon content per carbon pool differs from one land-use to another and within the sub-categories of a land-use. For example, in Grassland most of the carbon is within soil, whereas Forest Land has significant above-ground biomass present. The baseline includes estimates of carbon stocks in all pools within each identified land use.

Emissions and removals

Emission and removal rates associated with land uses vary depending on its level of establishment. Once a land-use conversion or change in management practices has taken place, it takes by default up to 20 years for the new land-use to reach equilibrium status (a timescale specified in the IPCC guidelines).

Information has not been made available on the age of the land uses within the Leiston study area or any previous land uses, which will reduce the accuracy of emissions and sequestration estimates. When selecting emission and removal factors, these were chosen to represent land uses which are being maintained, not having undergone land use change in the recent past, and not being managed intensively.

2.1.3. GENERATING LAND USE MAPPING AND CALCULATING AREAS

All land within the study area has been categorised as one of six broad land-use categories: Forest Land; Cropland; Grassland; Wetlands; Settlements; and Other Land. The categories used were developed by the IPCC to be robust, comprehensive and implementable in any setting. They form the basis of all land representation for LULUCF emissions and removals estimations, internationally. The definitions of different land-use types are provided in Table 2. These are sourced from the IPCC guidelines, with specifics around the definition of forest in the UK sourced from Annex II of Regulation 2018/841⁴.

The more precisely land can be stratified and described, the more accurate resulting carbon stock estimates will be. Therefore, each overall land use category has been subdivided further into high-level subcategories. The subcategories used were selected based on two key factors:

- » Availability of spatial data in GIS format to enable areas in hectares to be calculated; and
- » Availability of published emission factors for that subcategory, to enable calculations.

The sources of spatial data in GIS format used for the preparation of the land use map in Figure 1 are set out in Table 1.

Table 1 - Land use categories and sources of spatial data

Categories	Subcategories	Source
Forest Land (broad-leaved woodland, semi-natural)	» Deciduous woodland	Forestry Commission
	» Ancient woodland	http://data-forestry.opendata.arcgis.com/search?tags=England
	» Assumed woodland	
	» Forestry Commission 2015	Working with Natural Processes (WWNP) Woodland Constraints https://data.gov.uk/dataset/8e5fc315-a3cc-4659-b444-44bc72f4d6f7/wwnp-woodland-constraints
Cropland (annual)	» Arable_digitised	Digitisation from aerial mapping

⁴ <http://www.legislation.gov.uk/eur/2018/841/2018-05-30>

Categories	Subcategories	Source
Cropland (perennial)	» Traditional orchards	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england
Grassland (meadows & pasture)	» Pastoral_digitised » Lowland dry acid grassland » Lowland Mire Grassland and Rush Pasture » Coastal and floodplain grazing marsh » Saline lagoons » 'The Distribution of Lowland Wet Grassland in England'	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england Digitisation from aerial mapping
Grassland (shrub & scrub)	» Lowland heathland » 'Lowland health: lowland dry acid grassland' » Lowland heath	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england
Wetland (fen)	» Lowland fens » Floodplain fen	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england

Categories	Subcategories	Source
Wetland (reedbed)	» Reedbeds » 'Inventory of British Reedbeds: Floodplain fen: Reedbeds' » 'Reedbeds: Floodplain fen'	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england
Wetland (sand dunes and shingle)	» Coastal sand dunes » Coastal vegetated shingle » Perennial Vegetation of Stony Banks » Sand_dune_digitised	Priority Habitat Inventory https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england Digitisation from aerial mapping
Wetland (water mass)	» OS Waterbodies » Open water » Waterbody_digitised	Priority Habitat Inventory https://data.gov.uk/dataset/8e5fc315-a3cc-4659-b444-44bc72f4d6f7/wwnp-woodland-constraints Working with Natural Processes (WWNP) Woodland Constraints https://data.gov.uk/dataset/8e5fc315-a3cc-4659-b444-44bc72f4d6f7/wwnp-woodland-constraints Digitisation from aerial mapping

Categories	Subcategories	Source
Settlement (built environment)	» CORINE2012 Urban » OS Roads » Settlement_digitised	Working with Natural Processes (WWNP) Woodland Constraints https://data.gov.uk/dataset/8e5fc315-a3cc-4659-b444-44bc72f4d6f7/wwnp-woodland-constraints Digitisation from aerial mapping
Settlement (green space)	» OS Open Greenspace » Greenspace_digitised	Ordnance Survey https://www.ordnancesurvey.co.uk/business-government/products/open-map-greenspace
Other Land	» Bare area (National Forest Inventory Maritime cliff and slope)	Priority Habitat Inventory https://data.gov.uk/dataset/8e5fc315-a3cc-4659-b444-44bc72f4d6f7/wwnp-woodland-constraints

There are minor limitations with the method used for some land use categories, as in a few cases a ‘high level’ manual digitisation exercise has been undertaken to supplement existing data sources. In these instances, there was a reliance on aerial maps from which there are inherent limitations (e.g. how up to date they are). There is also a higher level of uncertainty, particularly with small land plots, when categorising digitised land plots. It is noted that 100% accuracy would likely only be achieved/validated through a ground truthing exercise or similar.

The categories and subcategories considered, the sources of spatial data and the corresponding area for each subcategory are shown in Table 2.

Table 2 - Land use categories, subcategories and total areas in Leiston

Land Use Category	IPCC 2006 Definition	Subcategory	Total Area (ha)
Forest Land	In the UK, a wood or forest is defined as an area of trees 0.1 hectares or greater, with a canopy cover of 20% and a height of 2m. Areas of less than 0.5 hectares of open space within a woodland are included within the woodland area. However, open spaces of greater than 0.5 ha within a woodland are excluded.	Broad-leaved woodland	268
Cropland	Cropland includes arable and tillable land, and agroforestry systems which do not meet the definition of Forest Land. Annual and perennial crops are included, as are herbaceous or woody crops. Land which is temporarily fallow is also included, as is land which is normally used for the cultivation of crops but is temporarily used for grazing as part of an annual crop-pasture rotation.	Annual cropland	722
		Perennial cropland	0.46
Grassland	Grassland is non-forested land where crops are not grown. This includes continuous pasture, hay land, moorland and areas of scrub and trees not reaching the threshold required for ‘Forest Land’.	Meadow / pasture	308
		Shrub / scrub	57
Settlements	This includes all developed land; residential, commercial, manufacturing, and transportation, or land which is functionally or administratively associated with public or private land in cities, towns or villages. It incorporates infrastructure of any size. Settlements can include soils, trees, grass, golf courses and parks (typically referred to as ‘green areas’).	Built environment	260
		Green space	26

Land Use Category	IPCC 2006 Definition	Subcategory	Total Area (ha)
Wetland	This category includes areas of peat extraction and land that is covered or saturated by water for all or parts of the year (which does not fall into the Forest Land, Cropland, Grassland or Settlements categories). It includes peat bogs and marshes, as well as reservoirs and natural rivers and lakes.	Fen	14
		Reedbed	28
		Sand dunes / shingle	51
		Water mass	54
Other Land	This includes bare soil, rock, ice and all land areas which do not fall into any of the other five categories	n/a	11

2.1.4 ESTIMATING SOIL CARBON STOCKS

Information on the carbon content of soils was sourced from the UK Soil Observatory (UKSO)⁵, which presents the topsoil (0-15 cm depth) carbon density as reported in the Countryside Survey. The majority of the study area falls into the category of 0-50 t ha⁻¹. LULUCF calculations require the inclusion of soil carbon to a default of 30 cm depth, so the carbon density from 0-15 cm has been doubled to provide an estimate for the 30 cm profile. An assumed soil carbon stock of 100 t ha⁻¹ has been used for the whole study area, with the exception of:

- » Settlement land – here, the IPCC assumption that conversion to settlements leads to the loss of 20% soil carbon has been applied, and a figure of 80 t ha⁻¹ has been used.
- » Wetland (fen) – the National Soils Map⁶ identifies this area as being ‘fen peat soils’ with a medium-high carbon content. Extrapolating from Natural England’s report ‘England’s peatlands: carbon storage and greenhouse gases’⁷. A value of 1,000 t ha⁻¹ has been used.
- » Wetland (sand dunes / shingle) – use of the National Soils Map suggests

that the carbon content of this type of soil is low. A value of 0 t ha⁻¹ has been used.

2.1.5 SELECTING APPROPRIATE CARBON FACTORS

Carbon densities and emission factors, for each pool within each land use type, were taken from two key sources (shown in Table 3), based on the suitability of the available data:

- » IPCC ‘Guidelines for National Greenhouse Gas’ Inventories, Volume IV: Agriculture, Forestry and Other Land use’⁸; and
- » Natural England Research Report ‘Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources’ (NERR043)⁹ (and sources therein).

It should be noted that land quality, age and management practices can cause emissions and removal rates to vary dramatically, turning sinks into sources and vice versa. The factors chosen are believed to be representative, however much more detailed information would be required to provide more accurate factors.

Forest land is one category that would particularly benefit from more detailed information. Whilst the emissions factor listed below (11 tonnes CO₂ ha⁻¹) from Natural England is a reasonable assumption, it may be high when compared to the UK average removal factor for UK forest. UK woodlands remove c. 15 Mt CO₂ yr⁻¹ ¹⁰, across 3.19 million hectares¹¹, which would give an average removal factor of 4.7 tonnes CO₂ ha⁻¹. However, as mentioned above, without further, more detailed, information around other factors such as forestry management approach or forest age, it is difficult to come to any reasonable conclusion. In the future this assumption could be reviewed to get more accurate results, based on more detailed knowledge

⁸ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html>

⁹ <http://publications.naturalengland.org.uk/publication/1412347>

¹⁰ <http://publications.naturalengland.org.uk/publication/1412347>

¹¹ <https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2019/woodland-area-and-planting/>

of the forest characteristics and management approach in the area.

Where stocks in a particular pool are noted to be zero, this assumption is based on guidance in the 2006 IPCC guidelines. Dead organic matter pools are assumed to be zero for land uses where this pool is likely to be ephemeral and degraded within a year period.

Table 3- Carbon density and emission / removal data

Land Use Category	Subcategory	Carbon Pool	Carbon Density (tonnes C ha ⁻¹)	Source	Emission (+) or removal (-) factor (tonnes CO ₂ ha ⁻¹)	Source
Forest Land	Broad-leaved woodland	Biomass	71.4	IPCC 2006, tables 4.3, 4.4 and 4.7	-11	NERR043, table 3
		Dead organic matter	16.0	IPCC 2006, tables 2.2		
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		
Cropland	Annual cropland	Biomass	5.0	IPCC 2006, table 5.9	+0.09	Warner (2008)
		Dead organic matter	0.0	IPCC 2006		
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		

Land Use Category	Subcategory	Carbon Pool	Carbon Density (tonnes C ha ⁻¹)	Source	Emission (+) or removal (-) factor (tonnes CO ₂ ha ⁻¹)	Source
	Perennial cropland (traditional orchards)	Biomass	21.4	NERR043 'Orchards: trees aboveground + root'	-0.1	Robertson et al. (2012)
		Dead organic matter	0.0	IPCC 2006		
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		
Grassland	Meadow / pasture	Biomass	1.0	NERR043, table 7	-2.2	De Deyn et al. (2010)
		Dead organic matter	0.0	IPCC 2006		
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		
	Shrub / scrub	Biomass	2.0	NERR043, table 7	+0.07	Warner (2008)
		Dead organic matter	0.0	'lowland heathland, degraded – litter and deadwood'		

Land Use Category	Subcategory	Carbon Pool	Carbon Density (tonnes C ha ⁻¹)	Source	Emission (+) or removal (-) factor (tonnes CO ₂ ha ⁻¹)	Source
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		
Settlements	Built environment	Biomass	0.0	IPCC 2006	0.0	IPCC 2006
		Dead organic matter	0.0	IPCC 2006		
		Soil	80.0	UKSO 'CS Top Soil Carbon – Carbon density'		
	Green Space	Biomass	0.0 ¹²	IPCC 2006	0.0	IPCC 2006
		Dead organic matter	0.0	IPCC 2006		
		Soil	80.0	UKSO 'CS Top Soil Carbon – Carbon density'		
Wetland	Fen	Biomass	1.0	Assumed similar to Grassland	-1.43	Evans et al (2017), table 6.1 ¹³
		Dead organic matter	0.0	Assumed similar to Grassland		
		Soil	500	National Soils Map		

Land Use Category	Subcategory	Carbon Pool	Carbon Density (tonnes C ha ⁻¹)	Source	Emission (+) or removal (-) factor (tonnes CO ₂ ha ⁻¹)	Source
	Reedbed	Biomass	1.0	Assumed similar to Grassland	-1.43	Evans et al (2017), table 6.1
		Dead organic matter	0.0	Assumed similar to Grassland		
		Soil	100.0	UKSO 'CS Top Soil Carbon – Carbon density'		
	Sand dunes / shingle	Biomass	1.0	Assumed similar to Grassland	-2.13	Jones and others (2008)
		Dead organic matter	0.0	Assumed similar to Grassland		
		Soil	0	National Soils Map		
	Water mass	n/a	0.0	IPCC 2006	0.0	IPCC 2006
Other Land	n/a	n/a	0.0	IPCC 2006	0.0	IPCC 2006

2.1.6 CARBON TONNAGE CALCULATIONS

The total areas of the different land use subcategories were multiplied by the identified carbon factors to give a total carbon tonnage (see Table 4). To give an indication of the potential scale of potential emissions and removals associated with land use changes, carbon stocks were converted to tonnes of CO₂ by multiplying by 44/12, based on molecular weight ratios.

3. FINDINGS

3.1 LAND USES WITHIN STUDY AREA

Land uses identified within the Leiston study area are shown below in Figure 2.

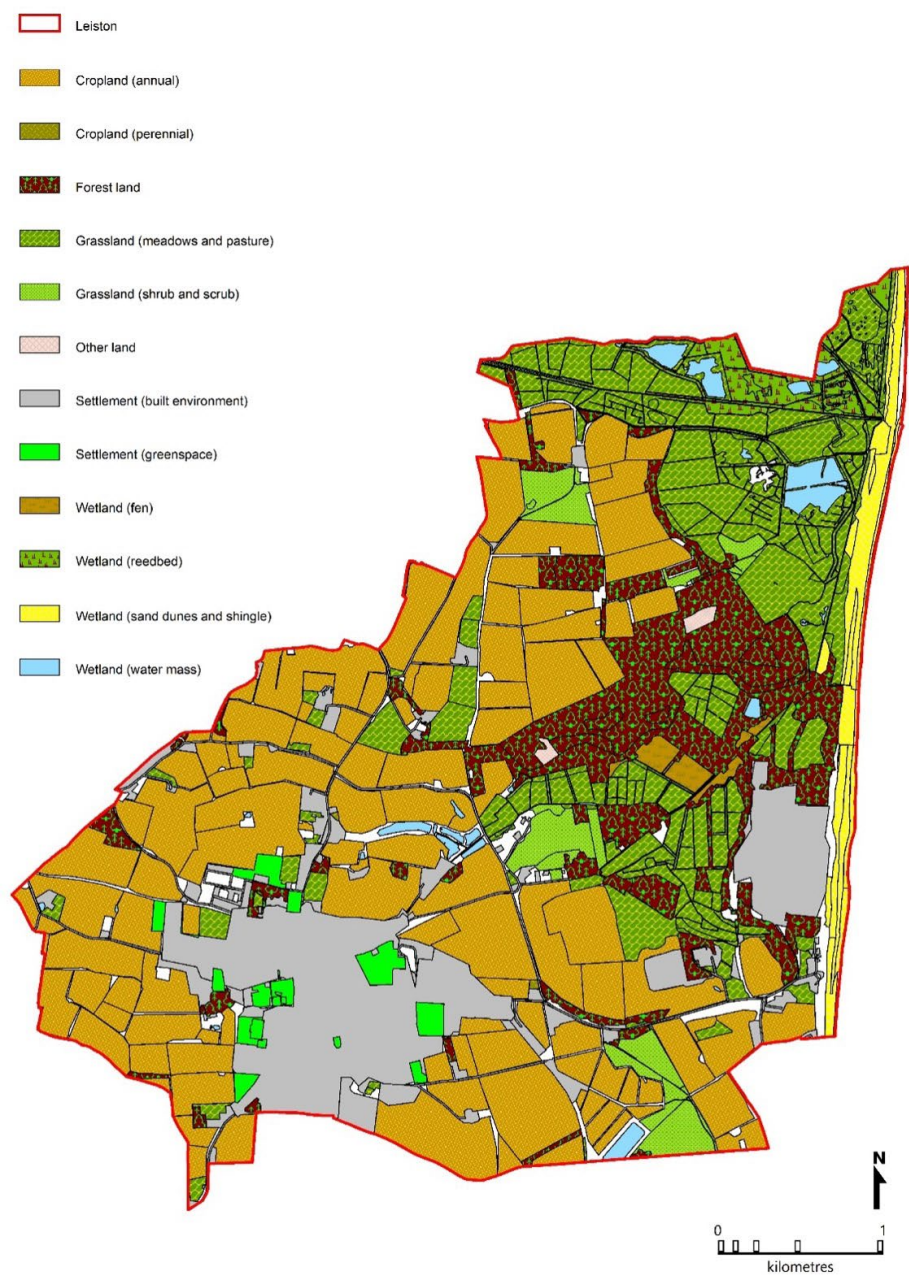


Figure 2 - Lesiton land use map

3.2 LULUCF BASELINE EMISSIONS

Table 4 shows the total areas of the different land use subcategories, presents the estimated carbon stock in each, and highlights potential emission and removal rates for each.

The total estimated baseline carbon stock is approximately 195,784 tonnes C. This is the equivalent of 717,875 tonnes of CO₂, should it be released. Important land uses for carbon storage in the study area are Forest Land (which holds around a quarter of total carbon despite making up only 15% of the geographic area) and Cropland (39% of the carbon and 40% of the land area). The built environment also appears to store a considerable amount of carbon (13%), though it should be noted that this is held within soils and is due to the relatively large area of settlement (15%).

In terms of annual removals, these may be in the region of 3,725 t CO₂ yr⁻¹ (c. 2 tCO₂ ha⁻¹ yr⁻¹). The only land use which is likely to be a net source is the arable cropland, which may emit around 65 t CO₂ yr⁻¹. This is an important factor, considering that cropland may hold up to 40% of the area's carbon storage.

Particularly beneficial land uses are likely to be the Forest Land, which may sequester c. 3,000 t CO₂ yr⁻¹. However, it should be noted that all land use types may be sources or sinks, depending on their age, quality and the management practices used. These figures should be taken as a guide only – further detail on the land uses would be required to give a more accurate view.

Table 4 - Leiston estimated land use carbon stock and AFOLU emissions and removals

Land Use Category	Subcategory	Total area (ha)	Estimated carbon stock (t C)	Estimated annual emissions (+) and removals (-) (t CO ₂ yr ⁻¹)
Forest Land	Broad-leaved woodland	268	50,223	-2,948
Cropland	Annual cropland	722	75,810	+65
	Perennial cropland	0.46	56	- 0.05
Grassland	Meadow / pasture	308	31,108	-678
	Shrub / scrub	57	5,814	+4

Land Use Category	Subcategory	Total area (ha)	Estimated carbon stock (t C)	Estimated annual emissions (+) and removals (-) (t CO ₂ yr ⁻¹)
Wetland	Fen	14	7,014	-20
	Reedbed	28	2,828	-40
	Sand dunes / shingle	51	51	-108
	Water mass	54	0	0
Settlements	Built environment	260	20,800	0
	Green space	26	2,080	0
Other Land	n/a	11	0	0
Total			195,784	-3,725

3.3 LULUCF RESULTS

It has been estimated that the LULUCF sector is responsible for an overall removal of CO₂ from the atmosphere in the order of -3,725 tonnes per year based on the analysis of the most recent available spatial data.

A sense check was undertaken comparing the estimate against the BEIS local authority LULUCF emissions/ removals for the Suffolk Coastal district which is -77.8 kt CO₂. This value was pro-rated down to estimate Leiston's 2017 LULUCF emissions using the ratio of Leiston's 2011 population statistics (5,508) compared to Suffolk Coastal's 2011 population statistics (124,590). The calculated ratio is 0.0442, and the resulting pro-rated 2017 LULUCF emissions for Leiston is -3.44 kt CO₂ or -3,440 tonnes, a value remarkably close to the bottom up estimate of -3,725 tonnes.

Historic satellite imagery of the area, for the years 2007, 2011, 2014 and 2019, was also examined (Figure 3). No visible land use changes appear to have occurred during that time, and it is assumed that the annual rate of CO₂ removal associated with LULUCF has remained relatively constant during this period.

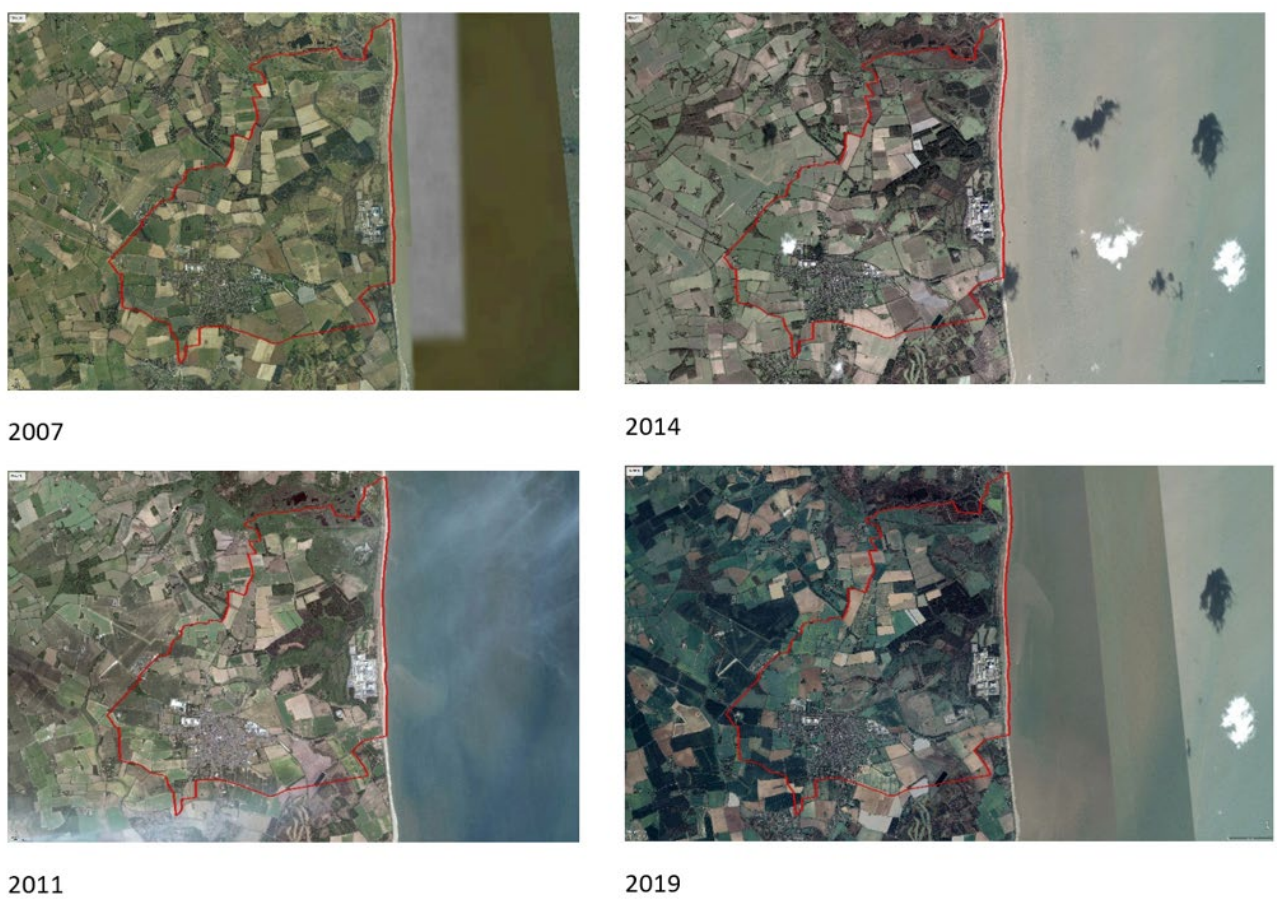


Figure 3 - Historic satellite imagery for Leiston area

Source: Google Maps

As no land use changes are underway and there is no recent history of land use change, the Business as Usual (BAU) case is taken to be a continuation of the use of the land in the same manner as since 2007, with the same yearly CO₂ removal rates of -3,725 tonnes continuing until 2050.



CHAPTER 6

UNDERLYING MAPPING

Authored by



JUNE 2020

SUMMARY

The purpose of this Chapter is summarise the approach Atkins has taken to produce the 'Base Case' deliverable for the Net Zero Leiston project.

The purpose of the Base Case is to capture the current situation within the study boundary area with respect to energy, infrastructure and related information (e.g. local development plans). Essentially this collates all datasets we have into one central place and forms the basis for future analysis as we develop the Route Map options and solutions.

APPROACH

Our overarching approach to the NZL study is Geographic Information System (GIS) based. This allows us to gather, display and assess large quantities of data in a user friendly interface.

Accordingly, the Base Case has been developed in GIS. To enable this, the team has gathered a wide range of data from various sources, including:

- » Council data (e.g. green spaces, development sites, fuel poverty etc)
- » Central data (e.g. BEIS)
- » Energy use data (gas, electric)
- » Utility infrastructure data (gas, electricity, water, sewerage)

These datasets are supplemented by preliminary outputs from Atkins analysis during the study, such as carbon emissions data for buildings and transportation. Refer to **Chapter 4** for further details of the emissions data assessment.



OUTPUT

The GIS output is contained within software and is not readily available to export for review. A selection of typical screenshots are provided below and the model will be further shared with the team via screenshare.



Wide view of Leiston showing all datasets overlaid



More detailed view for part of Leiston – showing utility data plus heat demands (darker shading = higher demand)



More detailed view for part of Leiston – showing granularity of just utility data



View of Leiston showing green spaces and town growth region areas (Local Development Plan)



CHAPTER 7

CARBON REDUCTION SCENARIOS

Authored by



SEPTEMBER 2020

INTRODUCTION

The results from the building, transportation, agriculture, and sequestration measures assessment have been combined to create a Route Map in order to achieve the Net Zero Leiston project objectives:

1. Net Zero direct emissions (scope 1) and indirect emissions (scope 2) by 2030, from a 2020 annual baseline of 12,013 t CO₂, whilst,
2. Not exceeding the 2100 Carbon budget of 95,000 t CO₂

Each sector assessment has reviewed the measures shortlisted against:

- » Carbon Saving
- » CAPEX
- » Feasibility
- » Timescale for implementation
- » Expertise required to implement

ASSESSMENT SCENARIOS

With the results from the assessment of each measure, an iterative process was undertaken in which a number of scenarios were stress tested. Three final scenarios were considered to inform the level of uptake and impact of measures to achieve the project objectives; these cases were Maximum, Reasonable Maximum and Carbon Budget Aligned with 2030.

	Buildings	Transportation	Agriculture	Carbon Sequestration
Maximum	100% uptake (Domestic) 100% uptake (Non-Domestic)	High Case (uptake acceleration aligned to DfT ¹ 2040 scenario)	50% uptake as per UEA ² recommendation	Lowest Requirement



	Buildings	Transportation	Agriculture	Carbon Sequestration
Reasonable Maximum	80% uptake (Domestic) 80% Uptake (Non-Domestic)	High Case (uptake acceleration aligned to DfT 2040 scenario)	50% uptake as per UEA recommendation	Requirement lower than Maximum sequestration according to CCC ³ ambitious speculative case.
Alignment with Carbon budget/ Maximum sequestration	75% uptake (Domestic) 75% Uptake (Non-Domestic)	Medium Case (uptake acceleration aligned to DfT 2035 scenario)	50% uptake as per UEA recommendation	Requirement lowest and less than maximum sequestration according to CCC ambitious speculative case.

Chapter 18 - Carbon Removal Solutions, identifies additional opportunity for carbon sequestration measures in addition to the BAU case. Understanding the reasonable maximum carbon sequestration is vital in order to remove the net emissions remaining after the application of measures. The reasonable maximum additional sequestration measures identified that an additional 3,936 t CO₂ can be sequestered. This value does not include Direct Air Capture. The reasonable maximum scenario accounts for:

- » Tree planting increase from 15% to 30% per CCC ambitious speculative scenario
- » Biochar application at 1 tonne per hectare on all arable lands per Environment Agency’s Low Risk waste position statement.

Direct Air Capture has been assessed in **Chapter 18** the technology is immature, however as a mechanical carbon sequestration measure, the scaling of technology if available is not limiting.

IMPLEMENTATION PHASING

A phased implementation programme was developed to inform the uptake of each measure in any specified period. The decade between 2020 and 2030 was separated into phases which have been selected to demonstrate quick wins, medium term achievable measures, long term achievable measures and long-term. strategic measures. This final category is unlikely to be influenceable by the Net Zero Leiston project, as measure assessments and implementation will likely be linked to major infrastructure and policy adjustments in the geographic region, local authority and UK.

For the purpose of the road map, the following designation of time periods have been used;

Phase 0	0 – 2 years	Quick Wins
Phase 1	2 – 5 years	Medium term achievable
Phase 2	5- 10 years	Long term achievable
Phase 3	10+ years	Long term strategic

SCENARIO SELECTION

Appendix A shows the percentage uptake figures allotted to each of the measures in the three final scenarios.

Uptake figures were applied across carbon saving measures at rates according to those identified in the assessment scenarios.

The remaining carbon saving required to achieve Net Zero was noted as per the Table 1 as “carbon sequestration required”. For all cases the remaining carbon reduction was lower than that identified in **ww** as max reasonable maximum carbon sequestration. Therefore, validating the uptake scenario.

The assessment also considered the cumulative reduction of emissions compared to the allocation of 2100 carbon budget. The table below also demonstrates the carbon budget remaining in 2030 after the measures have been implemented at uptakes identified in Appendix A. Again, a second validation that the 2100 carbon budget is not exhausted before 2030.

In theory, by aligning these scenarios Leiston would boast Net Zero status by 2030 and hold contingent carbon budget from 2030 to 2100.

Table 1 – Scenarios Considered

	Maximum Case	Reasonable Maximum	Aligned with Carbon Budget
Carbon Sequestration Required	713 t CO ₂ (6%)	1,589 t CO ₂ (13%)	3,548 t CO ₂ (30%)
Remaining Carbon Budget in 2030 (Excluding additional sequestration)	15,594t t CO ₂ (16%)	11,820 t CO ₂ (12%)	0 t CO ₂ (0%)

It should be noted that with additional carbon sequestration measures, the net annual carbon emission reduction is reduced further, resulting in additional availability of carbon budget. In the Reasonable Maximum scenario at 2030 the Leiston Carbon budget including additional carbon sequestration measures to achieve Net Zero is 17,488 t CO₂, or 18% of the 2020 carbon budget.

The Route Map has selected the Reasonable Maximum case. The uptake of measures shows an ambitious but achievable requirement for Leiston to reach Net Zero by 2030 and avoid exceeding its 2100 carbon budget.

NET ZERO SCENARIO

The Route Map to take Leiston to Net Zero emissions by 2030 and avoid exceeding it’s 2100 carbon budget is summarised in this section.

Table 2 shows a summary by sector of the annual baseline emissions and subsequent annual carbon reduction from the reasonable maximum scenario application of measures. Net Zero is reached in 2030 with modest application of additional sequestration measures, giving some flexibility in uptake assumptions where further Carbon sequestration measures could be considered a missed uptake target.

The 2100 carbon budget is demonstrated not to be exceeded and should in theory remain at 17,488 t CO₂ from 2030 to 2100.

Table 2 – Annual emissions summary by sector before and post measures implementation

		2020	2021	2022	2023	2024	2025	2526	2027	2028	2029	2030
Baseline Emissions (tCO ₂)	Buildings Domestic	7,837	7,572	7,486	7,537	7,457	7,468	7,398	7,467	7,409	7,326	7,232
	Buildings Non-Domestic	3,770	3,528	3,449	3,496	3,423	3,433	3,369	3,432	3,378	3,303	3,216
	Transportation	3,830	3,840	3,850	3,860	3,880	3,880	3,870	3,860	3,840	3,820	3,810
	Agricultural	300	300	300	300	300	300	300	300	300	300	300
	Sequestration	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725
	Annual Emission Baseline	12,013	11,514	11,360	11,468	11,335	11,356	11,212	11,334	11,202	11,024	10,833
Post Measure Emissions (tCO ₂)	Buildings Domestic	7,837	7,505	6,959	6,418	5,885	5,358	4,492	3,643	2,812	2,001	1,210
	Buildings Non-Domestic	3,770	3,528	3,337	3,147	2,957	2,769	2,300	1,845	1,402	975	563
	Transportation	3,830	3,820	3,810	3,800	3,800	3,760	3,710	3,640	3,560	3,470	3,390
	Agricultural	300	300	300	300	300	300	270	240	210	180	150
	Sequestration	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725	-3,725
	GGR & Sequestration (additional)	0	0	0	0	0	0	-1,020	-1,020	-1,020	-1,020	-1,589
	Annual Emission after Measures	12,013	11,428	10,680	9,940	9,217	8,463	6,027	4,623	3,240	1,881	0
Carbon Budget		95,000	82,987	71,560	60,879	50,939	41,722	33,259	27,232	22,609	19,369	17,488

Table 3 shows the measures uptake in each phase under the reasonable maximum scenario until 2030, the subsequent carbon emission reduction and the associated estimated costs⁴.

Table 3 - Reasonable Maximum - Required Measures and Estimated CAPEX

	Phase/ Year	Reasonable Maximum				Baseline (tCO ₂)	Carbon emissions after measures implementation 2030 (tCO ₂)	CAPEX
		Phase 0	Phase 1	Phase 2	Phase 3			
		0 to 2	2 to 5	5 to 10	10+			
Agriculture	Agricultural			50%		300	150	TBC
Sequestration	Sequestration	Medium Case				-3,725	-5,314	£2m
Transportation	UV Uptake	High Case				3,830	3,390	£20m-35m
	Electrifying Transport	High Case						
Buildings	Domestic Insulation	5%	55%	30%		11,608	1,774	£173m
	Domestic Heat Fumes		20%	60%				
	Non-Domestic Heat Pumps		10%	70%				
	Wind			100%				
	Non-Domestic Solar PV		10%	70%				
	Domestic PV		20%	60%				
	Solar Canopy Parking		25%	75%				
	Smart Meters & Smart Thermostat (SHS)	50%	50%					
	Non-Domestic Insulation		60%	20%				
Community Measures	Community Measures	100%				0	0	TBC
						12,053	0	£210m
Carbon Sequestration Required		1,588t CO ₂ (1.3%)						
Remaining Carbon Budget in 2030		17,488t CO ₂ (12%)						

Reasonable Maximum Carbon Sequestration, excluding DAC (Based on CCC max scenario): 3936 tCO2

The reasonable maximum scenario used to create the Route Map is ambitious and requires support from all levels of stakeholders involved in Net Zero Leiston. The local residents, workers, councillors, policy makers, engineers and funders are required to work together to enable the successful and just transition to Net Zero.

QUICK WINS

These are measures that have been carried forward that are considered quick wins or no-regrets options. These are either relatively simple to implement or the expertise is available in-house at NZL so should be able to be mobilised quickly. These include, Smart Meters, where no carbon saving is given but acts as an enabler to encourage resident's participation understanding of energy use, and energy efficient public lighting, where EDF will need to engage with the local council to support acceleration on a current programme and some domestic insulation.

At this stage, trees will need to be planted in order for the sequestration benefits to be seen by 2030.

MEDIUM TERM ACHIEVABLE

Measures in this phase are achievable but will take some planning before they can be implemented, they are mainly physical changes to reduce carbon demand.

These measures require full stakeholder buy-in, have a higher CAPEX and begin to deliver higher carbon savings.

The measures may be more disruptive to normal life, i.e. insulation upgrades, new heating systems and encouraging new transportation styles. There will also need to be a significant amount of electricity network upgrade in the medium and long term.

LONG TERM ACHIEVABLE

When considering measures at this stage, they are almost so far into the future they are beyond the control of this Route Map, however, they build upon uptake of measures implemented in the medium term. Further energy efficiency upgrades, switch over to heat pumps, and encouraging an accelerated uptake in EVs. There is also the consideration of small-scale wind turbines, pushed to this phase to allow time to achieve planning permission.

NZL will need to re-evaluate the Route Map at this stage, considering any changes in policy or local area to confirm that this is still the best route to take.

At this stage, further sequestration measures will need to be considered, i.e. DAC plant and Biochar.

LONG TERM STRATEGIC

Past the 10-year mark it is increasingly difficult to predict the energy landscape, due to the ever-evolving technology advancements and policy decisions at a national level.

These will be measures that are influenced outside of the study area’s control, e.g. the move toward hydrogen in the gas grid as a method of decarbonisation.

NZL will need to regroup mid-way through this Route Map to identify if there have been any decisions that would influence remaining Route Map installs.

Figure 1 shows the decrease in carbon emissions and cumulative decrease in carbon budget.

Figure 2 shows a graphical quantitative route

Figure 1 - Reasonable Maximum - Carbon Emissions

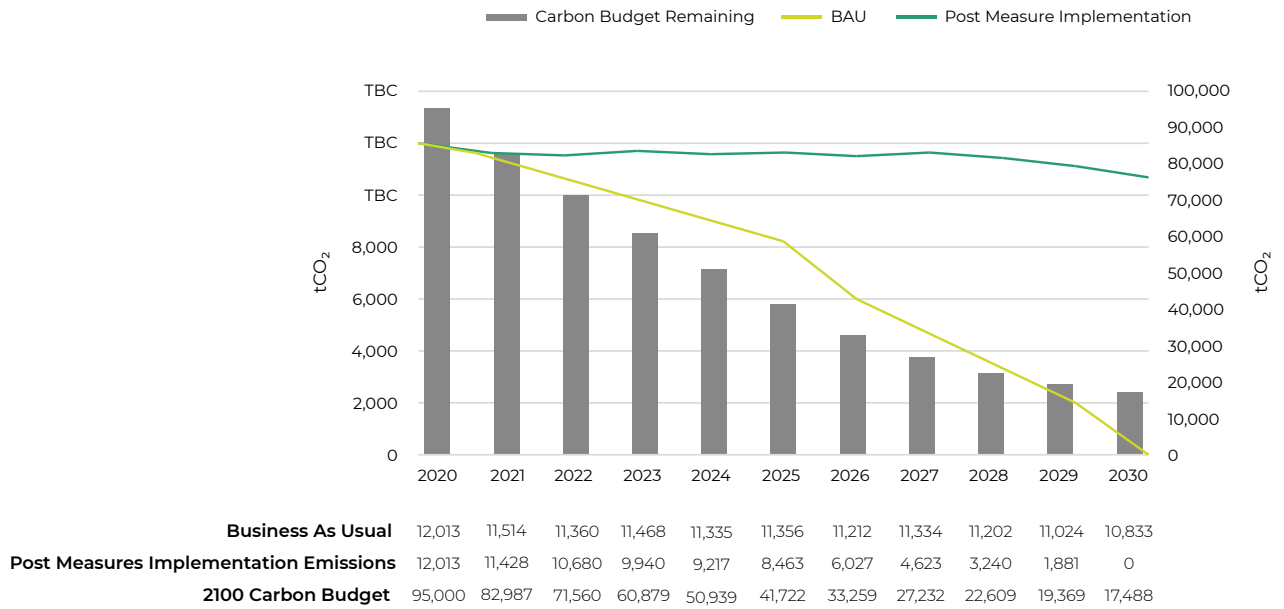
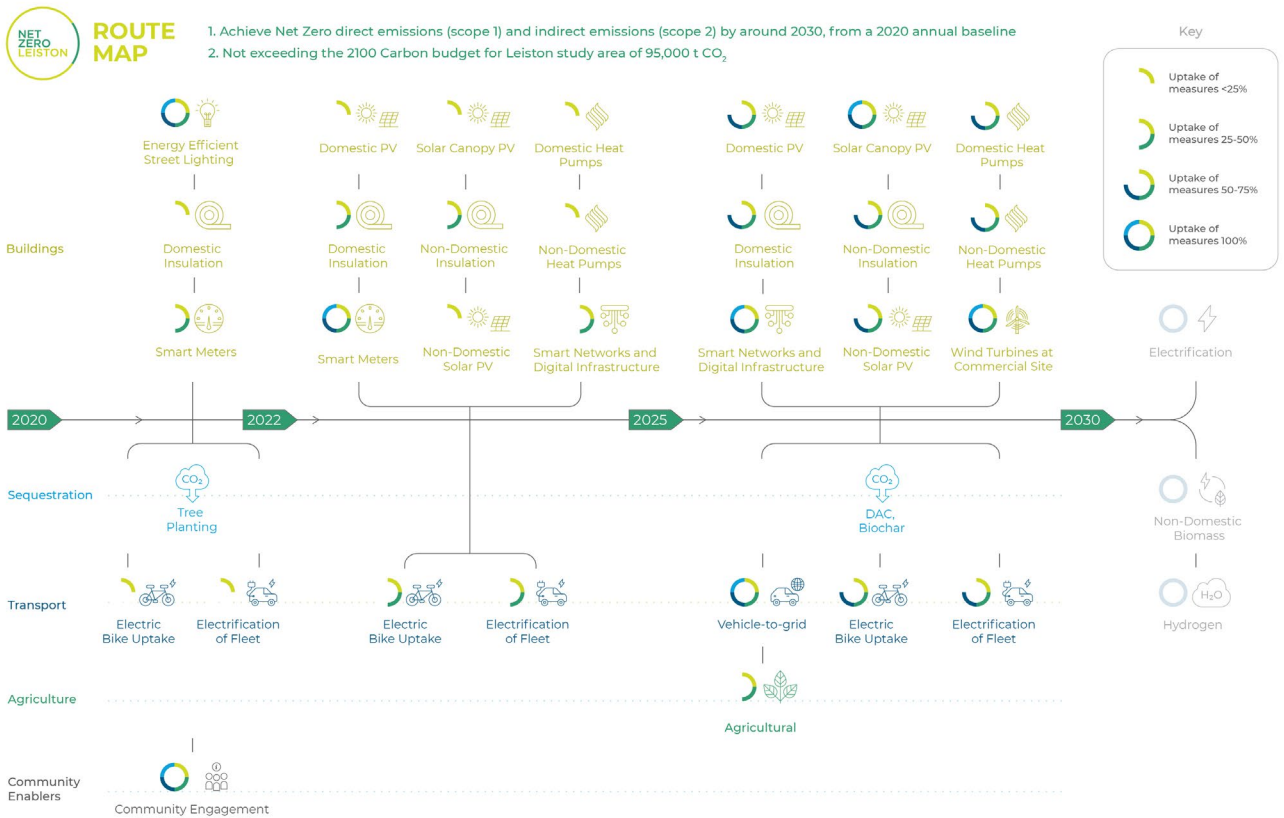


Figure 2 - Route Map



CONCLUSION

The Route Map to Net Zero is achievable, although challenging. Reaching Net Zero t CO₂ by 2030 whilst not exceeding the 2100 carbon budget is achieved through the a phased implementation of a number of credible, robust and available techniques.

The study demonstrates the challenge facing an extremely high number of similar locales in the UK, and whilst the measures highlighted are anything but first of a kind, the scale and ambition of uptake from the residents and businesses of Leiston may be considered revolutionary. The ambitious uptake figures require a step change in behaviour and understanding that will be complimented and steered through community engagement and education, where collaborative resources must assist the population of Leiston to achieve such a target in the timeframe.

The estimated total CAPEX of £210m for implementation of all measures should be further evaluated against available funding mechanisms, as well as proposed forecast funding mechanisms.

Leiston is not a unique geography, where this study highlights the required scale of implementation including financial, fabric, infrastructure and behavioural change for any similar location. The ambitions required by Leiston are forward thinking and must be replicated across similar locations to achieve the environmental climate objectives that are mandated and required as part of our social responsibility.

APPENDIX A. SCENARIO DEFINITION

Measure Type	Phase/ Year	Maximum Case				Reasonable Maximum				Aligned with Carbon Budget			
		Phase 0	Phase 1	Phase 2	Phase 3	Phase 0	Phase 1	Phase 2	Phase 3	Phase 0	Phase 1	Phase 2	Phase 3
		0 to 2	2 to 5	5 to 10	10+	0 to 2	2 to 5	5 to 10	10+	0 to 2	2 to 5	5 to 10	10+
Agriculture	Agricultural			50%				0%				50%	
Sequestration	Sequestration	Lowest Case				Medium Case				Maximum Case			
Transportation	EV Update	High Case				High Case				Medium Case			
	Electrifying Transport	High Case				High Case				Medium Case			
Buildings	Domestic Insulation		75%	25%		5%	55%	20%			55%	20%	
	Domestic Heat Pumps		25%	75%			20%	60%			20%	55%	
	Non-Domestic Heat Pumps		10%	90%			10%	70%			10%	60%	
	Wind			100%				100%				100%	
	Non-Domestic Solar PV		10%	90%			10%	70%			10%	60%	
	Domestic PV		25%	75%			20%	60%			20%	55%	
	Solar Canopy Parking		25%	75%			25%	75%			25%	75%	
	Smart Meters & Smart Thermostat (SHS)		100%				50%				100%		
	Non-Domestic Insulation		75%	25%			60%	20%			55%	20%	
Community Measures	Community Measures	100%				100%				100%			





CHAPTER 8

FINANCING THE NET ZERO ROUTEMAP

Authored by

IKIGAI

AUGUST 2021

INTRODUCTION

The purpose of this chapter is to outline:

- » The process of, and rationale for, an early stage investability screening process with respect to the Net Zero Route Map to ensure that the solutions identified are investable and deliverable; and
- » Potential sources of public and private sector funding, the characteristics of such sources and likely target asset classes identified in the Net Zero Route Map.

This chapter should be read in conjunction with the two case studies attached at Annexure 1 of this Report applying the above elements to a domestic and a non-domestic decarbonisation scenario, and extrapolating from the solutions proposed for Leiston to draw conclusions for other towns and cities seeking to finance and implement a Net Zero strategy and project pipeline.

This chapter demonstrates the funding support, and an appropriate process for assessing its applicability, to support communities to reach Net Zero. Few are in the "able to pay" market and are able to afford such interventions to tackle their carbon emissions, so external funding, and an appropriate processes for identifying and securing it, is vital.

INVESTABILITY SCREENING PROCESS

PHASING

As described in Chapter 7 - Carbon Reduction Scenarios, a selection of potential ideas to help Leiston achieve Net Zero has been assessed through an optioneering process led by Atkins and Opergy resulting in a short-list of potential technologies and applied solutions ("**Phase 1**").



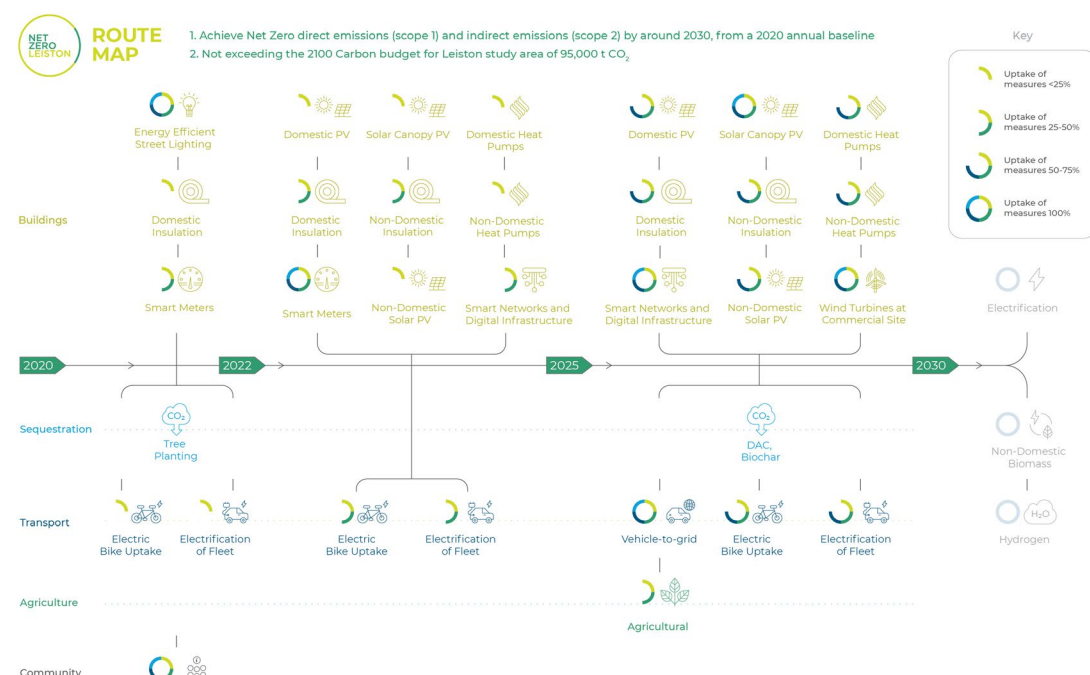


Figure 1 – Net Zero Route Map

Ikigai is responsible for screening this shortlist from a ‘bankability’ perspective, in accordance with certain ‘investability’ characteristics and taking into account sources of capital (both public and private sector) and investment products which (i) are currently available, (ii) may become available or (iii) which could be designed for this specific context (“**Phase 2**”).

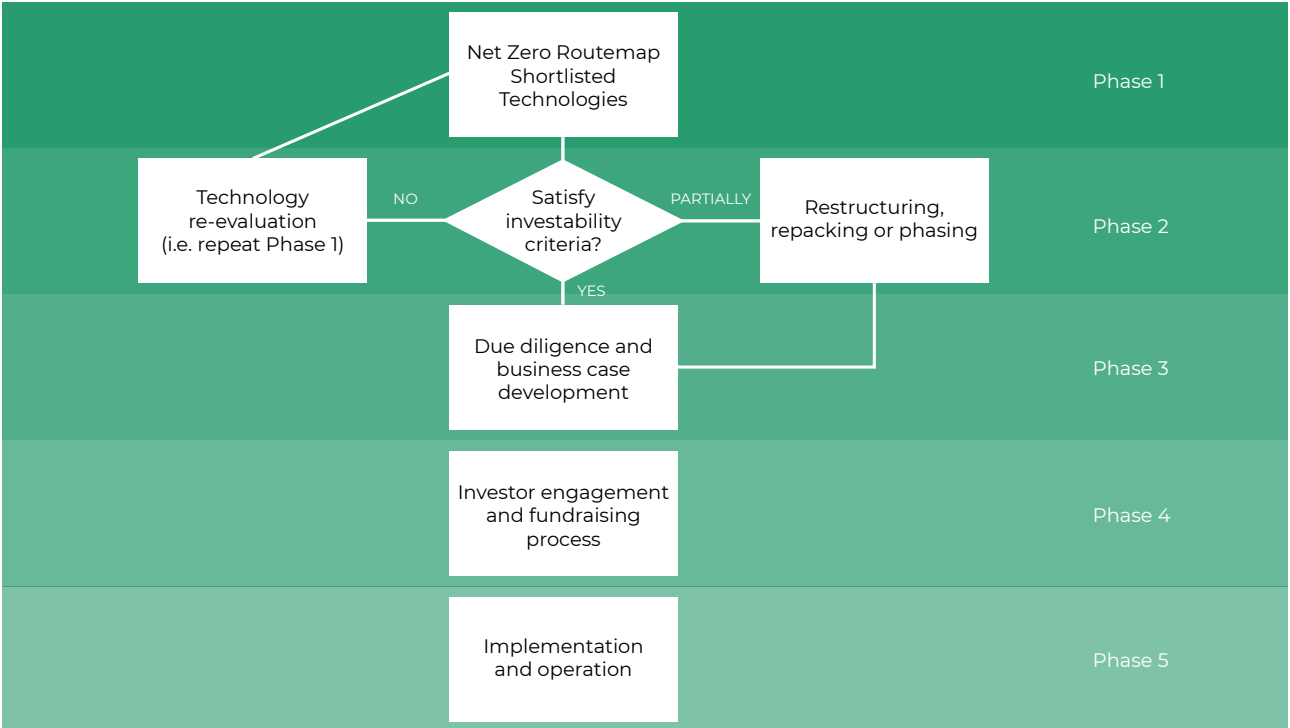
Phase 2 is driven by the desire to focus first on, and to maximise the proportion of, private sector investment available to design, develop and implement Net Zero Leiston. It also aims to consider upfront the replicable approaches and structures which will facilitate rollout of the Net Zero Roadmap to other towns across the United Kingdom by ‘crowding-in’ private sector investment at scale.

This is not to say that there is not a role for investment by the public sector; rather, to prevent ‘crowding-out’ and accelerate sustainable economic growth, Government should do what only Government can do. That being to invest in public goods and other solutions which are more challenging for the private sector to monetise, and to co-invest into phases or aspects of projects which involve risks that the private sector finds hardest to bear alone. These include project, district/zone and regional feasibility analysis, first commercialisation of technologies, solutions for which a liquid market for the benefits and outputs does not yet exist, and enabling infrastructure.

In respect of a specific technology solution, this Phase 2 screening process will be broken down into two elements considered by investors: (i) by type of project, solution or business model (“**Asset Class**”) and (ii) by the specific technology solution.

The screening process will result in one of the following outcomes:

- » It satisfies the investability criteria and progresses to the project due diligence, further concept design and outline business case development phase (“**Phase 3**”) in order to be ready for packaging, investor engagement and fundraising (“**Phase 4**”), and development, construction and operation¹ (“**Phase 5**”);
- » It only partly satisfies the investability criteria but can be re-structured, re-packaged or phased in such a manner as to be able to move to Phase 3 which involves a high degree of stakeholder coordination and systems integration.; or
- » It does not satisfy the investability criteria and the relevant emissions scenario must be re-evaluated from a technology perspective (i.e. Phase 1 is repeated).



¹ Phase 5 is entirely subject to the outcomes of earlier phases (including the chosen funders’ preferences) and the particular solution deployed and, it is assumed will be funded prior to commencement (i.e. either when the project is ‘shovel-ready’ post development in Phase 4 or earlier) so is not covered in this chapter.

RATIONALE FOR A TWO-PART INVESTABILITY ASSESSMENT

In Phase 2, each shortlisted option will be assessed from two perspectives – **asset class and technology risk** – although, in practice, each perspective influences the other and will be considered in parallel in order to draw a conclusion as to whether a particular technology solution should be taken forward to Phase 3.

This split is intended to reflect the distinctions drawn by funders themselves drawing on their preferred level of exposure to, and understanding of, different sectors; types of income; their risk/return expectations and investment horizon; and any impact or strategic objectives they may have. (Such potential sources of capital outlined in section 4 of this Chapter)

However, such distinctions are:

- » Fluid, as investors gain a better understanding of complex interdependencies that are inherent in achieving Net Zero on a regional basis; and
- » Able to be balanced and mitigated, through the packaging of multiple assets/technologies under a single contractual framework, or by introducing different sources of public and private capital into the same structure, as is contemplated in Phases 3 and 4.

ASSET CLASSES CONSIDERED

It is suggested that the Net Zero Route Map can be viewed, for the purposes of considering funding options, through the prism of the types of assets set out in the table below.

Figure 3 – Asset types and characteristics

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
Public good	Energy efficient street lighting, bike paths.	Once provided, is not possible to prevent anyone from enjoying the asset, and therefore there is no incentive to pay for the good because it can be consumed without paying for it.	Public funding is the only option, even if the private sector is involved in implementation via a form of concession or other public procurement process

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
Solutions relating to data analysis, education, behavioural change and operational optimisation	Smart metering, Living Labs, educational programmes, agricultural practices (tree planting, biochar)	No upfront capex involved. May be possible for certain public and/or private sector actors to monetise the outputs of the project on a strategic basis, through commercialisation/productisation, or the sale of carbon credits.	Such projects lend themselves to public/private partnerships and subscription or savings sharing based-business models.
Domestic capital expenditure solutions	See Case Study A at Annexure 1	Compared with commercial and industry focused solutions: » Different delivery models (i.e. led by SME contractors or by other service providers like energy suppliers/supermarkets etc.) » Different ownership models, less capacity for project control (both in development and operation) and key stakeholders (i.e. individual detached homeowners vs flats in common ownership with service charges vs social housing) » Different levels of uptake propensity (i.e. many domestic energy solutions, like heat pumps, have failed to achieve rollout potential because of issues with access, unwillingness of consumers to give up space for equipment, resistance to change and flex limitations on scalability will be factored into funding decisions)	» Different financial products relevant (e.g. mortgage-linked products) » Different types of funders to be involved (i.e. some are more comfortable with funding a large volume of small assets provided the offers can be relatively standardised)

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
		» Different levels of importance placed on commoditisation/ aggregation of the solution (i.e. solution must be able to be rolled out a very large scale across multiple cities – a few thousand houses may not be enough to justify the transaction costs of a bespoke product) » Different capacity for cross-subsidisation of initiatives by strategic investors (e.g. energy suppliers may offer services for customer retention or to meet regulatory obligations such that additional third party or consumer funding is not required) » Different capacity for bundling of products including energy and non-energy solutions to improve bankability (e.g. bundling of power supply with electric vehicle leasing, charging infrastructure and broadband rollout) » Different capacities for the domestic consumer to directly benefit from the intervention (i.e. will the intervention actually reduce their energy bills – variable vs fixed tariffs – or deliver a tax rebate), generate revenue to offset upfront capital costs (i.e. feed-in-tariffs or subsidies) or is the benefit externalised or able to	» (i.e. reduced maintenance costs for a social housing provider can be monetised in shared savings; facilitates regulatory compliance for an energy supplier or portfolio de-risking for an insurer, etc.)

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
		be externalised such that a third party may have an interest in delivering the solution, paying for it and/or funding it (i.e. reduced maintenance costs for a social housing provider can be monetised in shared savings; the solution also facilitates regulatory compliance for an energy supplier or portfolio de-risking for an insurer, etc.)	
Non-domestic capital expenditure solutions	See Case Study B at Annexure 1	» In a behind the meter solution, the focus will be on the specific commercial or industrial customer and the capacity for delivery will be determined by that customer, unless a hybrid model – incorporating revenue streams from other customers or markets - can be adopted. Factors to be considered include: » Is the initiative part of the customer's core competencies? » How bespoke is the technology to the particular customer? » What is the customer's emission and energy consumption profile on an intra-day, monthly and inter-seasonal basis? This will affect the choice of technologies and necessity to bundle technologies. » Does the solution generate a direct monetary benefit to the customer (i.e. via energy savings, additional revenue,	Different kinds of financial products available (i.e. asset/ equipment leasing, project finance, corporate bonds/ balance sheet financing) Strategic joint ventures or public investment may be available where innovation or wider economic development objectives are involved.

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
		reduced maintenance, brownout avoidance, reduced compliance costs, tax rebates/allowance etc.) or an indirect benefit (i.e. ESG realted compliance and reporting, retail sentiment or other publicity benefits)? » How willing is the customer to pay (whether by forgoing savings or paying a fee) for the service/project to be delivered by a third party? Is the customer willing to bear utilisation risk and to what extent? » Is the initiative so integrated with business operations/has such a short payback period that the customer will want to finance it themselves? » Does the initiative affect a service/product provided by an existing service provider? » Could the project provide services to others when not being used to full capacity by the customer (e.g. services to the grid, services to surrounding housing/ commercial properties) and how can these services be monetised? » Can the project/solution be bundled with other services to further decarbonise the customer's operations, improve operational resilience/profitability or enhance revenue streams? » How creditworthy is the customer? How sustainable is the customer's business?	

Type of Asset	Example(s) in Route Map	Key distinguishing characteristics	Implications for investment
Utility-scale generation	Solar canopy PV and, where land available, large scale wind/ solar serving district/ community under 'sleeve' power purchase agreements	» Large scale / high capital expenditure » Revenue streams increasingly merchant (with price and volume volatility / risk) » Affected by capacity constraints of grid infrastructure	Mature and liquid asset class attractive to strategic/industrial and low cost capital (i.e. ESG-focused institutional investors) seeking to deploy large amounts of capital, provided that projects can be structured to deliver a minimum proportion of long term, stable contracted cash flows (typically >30% of total revenues)
Networked infrastructure	Smart district power/ heat networks and digital infrastructure, DAC	» Typically availability-based revenue streams » Subject to project-on-project / stranded asset / connection and utilisation risk » Long asset life (20-40+ years) » Highly dependent on securing a creditworthy, stable and long term anchor customer(s) and/or a Government-backed revenue stream	As above, however returns tend to be lower and technology and roll out risk tend to be perceived as higher (in the UK as compared with other countries). Investor appetite continues to muted pending Government intervention to reduce roll-out risk through planning zoning, preferential development rights, obligations to connect, tax incentives etc.

However, it should also be noted that multi-asset class and/or regional and national (multi-town) funding structures may be possible (in the form of municipal bonds/funds, city decarbonisation-focused charitable foundations, tax increment financing structures, public/private partnerships through development corporations, growth boards or joint ventures).

Such an approach may have benefits over individual project/technology specific funding for the following reasons:

- » **Scale:** some solutions, while essential from a decarbonisation perspective, deliver only marginal returns meaning that they are only attractive to investors at a high volume/large scale deliverable only on a multi-town/regional basis (i.e. most of the domestic solutions referenced in the Net Zero Route Map).
- » **Cross-subsidisation:** some sites within a particular geography may be less attractive for Net Zero solution development than others; and some technologies may be technically optimal but less proven at scale than others. By broadening the physical 'catchment area' for investment to cover other towns or regions with sites that are larger or with more immediately suitable local infrastructure, or by blending mature and innovative technologies in one investment portfolio (e.g. biomass CHP with heat pumps), otherwise less attractive assets become more investable.
- » **Systems-based thinking:** structuring investment on a multi-vector (i.e. power, heat/cool and transport) regional rather than technology specific basis, has a number of benefits from a technical (i.e. systems balancing) and economic perspective (i.e. waste products produced by one party may be able to be sold to another party in order to make both projects more investable).
- » **Retention of value / recycling of capital by local authorities and other public investors:** increasingly we are seeing town and county councils and local growth boards joining forces to pool investment on a semi-commercial, match funding basis. Provided that such investment is targeted into project phases or technologies that the private sector would otherwise find difficult to fund (described in figure 3 above), such investment 'crowds' in the private sector, enabling the public sector to then either (i) exit in whole or part at a pre-defined stage of maturity and recycle its capital (and any return on that capital) into other high priority projects; or (ii) retain an appreciating interest and derive long term income while ensuring that the relevant project(s) deliver on regional growth, sustainability and inclusivity objectives.

FACTORS CONSIDERED IN TECHNOLOGY ASSESSMENT

Having considered the nature of the asset class, the choice of technology to deliver the requisite decarbonisation impact, will further affect the funding options available. Within each asset class, it is suggested that funders will evaluate the following elements.

- » **Technological maturity** - focusing in particular on the extent of operational performance data at a commercial scale with similar conditions re: feedstock/weather/outputs etc., or if not yet available, the extent to which 'in lab' or demonstrator project data can be extrapolated to a commercial scenario.
- » **Commercial readiness** - focusing in particular on comparative capital and operating costs vis a vis output (i.e. levelised cost), creditworthiness and enforceability of the technology brand's warranties.
- » **Delivery mechanics** – what type of delivery partners (e.g. installers) are necessary to manage risks associated with the choice of technology and are these already available in the market, nationally or locally?
- » **Available revenues** – to the extent these are technology (rather than output/customer/location) linked, e.g. technology-linked subsidies, revenue support, grants, export credit guarantees, process insurance, enhanced capital allowances etc.)
- » **Sustainability / emissions** – how does this compare, on a cost per CO₂ saving basis, to alternative technologies.
- » **Scalability / modularity** – this is particularly important if the initial phase is a demonstration project or there is potential for the project to increase in size over time to meet the capacity of the site / customer.
- » **Locational applicability** – whether the technology choice is suitable for the site will depend a variety of factors including weather (e.g. wind/irradiation/temperature), grid infrastructure and customer consumption profile.

PHASE 3: PROJECT SHAPING, RISK ANALYSIS AND MITIGATION

Following the application of the "Phase 2" investability assessment to each of the solutions proposed in the Net Zero Route Map, and any consequential restructuring in order to ensure that the proposed solution would satisfy public and/or private investability criteria, it will be necessary to apply the solution ‘on-the-ground’. This Phase involves preparing an outline project business case (see Annexure 2 to this Report for a proposed generic template for this purpose), undertaking project due diligence and further concept design, to support early prospective investor engagement.

There is a need to balance the opportunities that arise from early engagement with certain types of investors (e.g. strategic/industrials seeking to shape the delivery strategy) and the risks of engaging too early with the investment community and losing investor interest/undermining confidence.

Before embarking on the development of a funding plan and process in Phase 4, further project feasibility analysis and early stage development will be required with respect to the following:

- » Stakeholder analysis (including the kind of data that needs to be gathered and why)
- » Project-specific objectives/measurable outcomes
- » Site suitability / availability of enabling infrastructure (e.g. grid constraints)
- » Planning and property rights risk assessment
- » Corporate structure
- » Business/financial model
- » Technology provider choice and engineering concept (prescriptive vs functional specifications)
- » Package analysis (including asset bundling options)
- » Structuring of project rights/contracting and programme design
- » Early supplier engagement pre-formal procurement (for the purpose of optimising the financial model)

PHASE 4: FUNDING PLAN AND PROCESS

Based on experience of similarly innovative projects with a number of complex stakeholder, contractual, technical and construction risks, the intention to split the process for raising funding into the following steps, some of which may be able to be truncated or simplified to suit the scale of capital investment required to deploy the relevant solution.

1. Initial engagement with relevant public funding entities to explain the overall objectives of the project and understand how and in what circumstances such public bodies may be able to contribute on a financial / non-financial basis (to inform discussions with private sector investors and shape projects/packages/multi-town platforms in line with policy objectives),
2. Preparation of an initial ‘long-list’ of prospective private sector funders whose preferences are aligned with the relevant asset class and specific business case to explain the relevant project/package opportunities; understand how available funding products could apply and if so on what terms and timeframes; further shape project and/or business model design, and encourage funding consortiums to be built where appropriate,

Figure 4 - Private sector investment sources and requirements

Private sector investor type ²	Typical investor preferences / minimum requirements
University, corporate and local authority pension funds, insurance companies and other institutional investors (and their investment managers)	» Long term (20+ years) stable contracted cash flows and/or Government-backed revenue streams » Tend to be the lowest cost of capital » Only invest in mature, proven, scaled technologies » Focus on ESG metrics and reporting

² This list is not a comprehensive list of all investors or financial products that are relevant to investment in decarbonisation solutions and does not include, for example, export credit agencies. Rather it reflects the types of investors that are likely to be most relevant to the types of solutions identified in the Net Zero Route Map.

Private sector investor type ²	Typical investor preferences / minimum requirements
Private equity (leveraged buy-out funds / venture capital)	» Invest in early stage non-publicly traded companies (often only after revenue positive) and projects » Must have clear, relatively short term exit strategy (e.g. IPO, identified strategic investors, debt refinancing) » Seeking high growth companies and high return projects (typically 20-25% IRR during investment period)
Impact investors	» Consider financial and non-financial, measurable, social and environmental impacts » Varying return requirements: (some impact funds are satisfied with relatively low investment returns provided that these are topped-up with non-financial impacts, e.g. community health improvements, whereas other funds' require similar returns to venture capital / private equity)
Strategic/industrial investors	» This group includes technology providers, utilities, trading houses and construction companies » Seeking investments which create synergies with their existing core competencies or the capacity to expand into new markets / technologies » Usually seeking to participate in both investment and goods/services provision » Typically require investment returns that approximate those of their core business but may be prepared to invest in 'loss leaders' if the strategic case is very strong

Private sector investor type ²	Typical investor preferences / minimum requirements
	» May benefit from / be constrained by licencing conditions relevant to Net Zero investment (e.g. power / water utility obligations to install smart metering or invest in energy efficiency for low income customers) » May be able to deploy their brand and/or balance sheet in creative ways (e.g. construction/completion guarantees, technology warranties)
Sovereign Wealth / Multi-lateral Funds / Development Banks	» Typically act through an international investment manager rather than making direct investments, unless alongside other Government entities » Highly strategic investors, acting in alignment with the relevant Government's foreign and domestic policies and often requiring the involvement of companies based in their home jurisdictions » Usually invest on a commercial basis but, through their involvement, may help to attract cheaper private sector investment by offering sovereign guarantees
Capital markets	» May require the issuer to have a credit rating (and therefore more difficult to utilise in the context of independent development projects other than when the issuer has a strong balance sheet) » Investors tend to prefer investments which are not heavily contingent on Government policies / subsidies

Private sector investor type ²	Typical investor preferences / minimum requirements
	» Growing expectation of independent ESG / carbon accreditation (e.g. under Climate Bond Initiative)
Project finance banks	» Only suitable for projects with stable and visible cash flows » May invest short term (e.g. providing a bridge loan for the construction period of a project) or long term (i.e. up to the term of the key revenue contracts in the project) » Heavily structured transactions incorporating contractual controls and the granting of security over project assets and contractual rights
Retail investors	» Investment may be incentivised by way of Government tax incentives designed to support the taking of earlier stage / innovation risk » Non-professional investors investing typically small amounts through a professional investment manager or broker » Increasingly focused on social or environmental impact or community-focused structures
High net worth individuals	» Tend to invest for legacy or in line with their personal passions » Return expectations often similar to venture capital but may be more flexible / informal / charitable » May contribute non-financial investments, e.g. land

Private sector investor type ²	Typical investor preferences / minimum requirements
Crowd-funding	» Characterised by large groups of individuals pooling together small individual investments to provide the capital needed to get a company, business model or project off the ground » Individuals, charities or companies can create a campaign for specific causes and anyone can contribute » Most suitable for projects or companies able to tell an emotive story that connects with the public » May offer a financial or non-financial return (e.g. access to product) or no return at all

3. Consider the potential for (i) the creation of a municipal, regional or national multi-city funding solutions to better facilitate the delivery of systems-based, complementary projects; (ii) cross-subsidisation of projects where necessary; (iii) deliver value to local stakeholders and enabling the recycling of public capital investment; and/or (iv) economies of scale. Associated investment strategies and governance structures will largely be led by the requirements of the specific investors involved. However, at this stage we would recommend engaging with bodies with UK and international experience of delivery of such structures including the Green Finance Institute, the Infrastructure and Projects Authority, accreditation entities (like the Climate Bond Initiative) and the UK Municipal Bonds Agency in order to shape further public and private sector investor engagement, project design and asset packaging,
4. Re-engagement with public funding entities to commence application processes where appropriate to fill any commercial funding viability gap (whether caused by insufficient investment returns to attract private capital given the cash flow/risk profile),
5. Preparation of a high level information memorandum as appropriate,

6. Down-selection to a 'short-list' of prospective funders/strategic partners for involvement in interactive workshops to work through, for each project/package, a financial model (taking into account prospective funder required assumptions/inputs) and the high level information memorandum to understand any additional risks/sensitivities identified by prospective funders and proposed mitigations. This step is necessary to ensure that such risks and sensitivities are addressed in the financial model and the underlying project planning, procurement and contract negotiation process etc. to enable the shortlisted funders to provide a detailed indicative funding offer,
7. Following analysis of indicative non-binding offers, granting of an exclusive mandate to a funder/consortium and commencement of full due diligence and funding transaction documentation leading to signing of commitment and financial close/completion, once planning consent has been granted and other conditions precedent identified during due diligence to first drawdown / first cash call have been satisfied,

CONCLUSIONS

An investable Net Zero Route Map is one that seeks to achieve replicability of solutions and due diligence processes, in order to create the conditions for aggregation and scale-up so critical to attracting a patchwork of public and private sector investment.

However, this Chapter also demonstrates that standardisation also has its limits. A deliverable Route Map requires the balancing of:

- » Community: the sustainable and inclusive growth objectives of the relevant local community stakeholders; *with*
- » Government: national and regional policy imperatives and incentives, *with*
- » Consumers: development and operational constraints, affordability, energy security and customer behaviour, *with*
- » Investors: the technology and asset class preferences of the specific types of investors (including energy suppliers) best able to bear the associated risks

Such an approach does not only require early, continued, bespoke engagement with each of these stakeholder groups, but also creative thinking from Government and the investment community working together to adapt existing, and create new, financial products and structures for a Net Zero world.



ANNEXURE 1 – CASE STUDIES

CASE STUDY A – DOMESTIC SOLUTIONS

Conclusion post-investability screening

The technologies and solution originally shortlisted only partly satisfied the investability criteria outlined below, but should proceed to due diligence, further concept design and outline business case development with amendments as outlined below.

The intention of this case study is to demonstrate how Phase 2 (investability assesment) has been applied to, and has resulted in the restructuring of, the shortlisted option identified by Atkins and Opergy in Phase 1 described in **Chapter 15** and Appendix K (Building Solutions) as summarised below, in order to better align with the requirements of the investors currently most actively deploying capital into this asset class and technology solution and inform Phases 3, 4 (and 5).

PROJECT OVERVIEW AS SET OUT IN THE TECHNOLOGY ROUTE MAP

- » Asset type: Domestic energy efficiency and power/heat generation
- » Sites, ownership and credit profiles:
 - Semi-detached homes for established families (36.8% of Leiston homes / c. 1062 homes – the most common type of property in the UK – primarily owner/occupied with higher incomes) (“**SDH**”)
 - Terraced houses for emerging families (27% of Leiston homes / c. 779 homes - primarily private renters on lower incomes with third party ownership) (“**TH**”)
 - Bungalow houses for retired couples (8.01% of Leiston homes / c. 231 homes – primarily owner/occupied with low fixed incomes) (“**BH**”)



» Sources of emissions:

- Electricity sourced from grid
- Gas for heat, hot water and cooking
- Domestic vehicle petrol / diesel

» Potential emission reductions (in aggregate in Leiston per housing type excluding vehicle emissions):

- SDH: c. 2915 tonnes p.a.
- TH: c. 1905 tonnes p.a.
- BH: c. 590 tonnes p.a.

» Forecast number of homes in Leiston benefiting from technology Route Map solutions in 'reasonable maximum' (80%) uptake scenario: SDH: 850 / TH: 623 / BH: 185 (without accounting for homes for which certain measures may have already been installed or not suitable for the home architecture)

» Est. total capex of Leiston rollout over 10 years (on above uptake scenario and on the basis of the technical Route Map solutions prior to investability assessment restructuring): SDH: c. £27m / TH: c. £27m / BH: c. £7m (**est. total across all housing types: c. £61m**)

» Technologies originally shortlisted in optimal order of installation (CO₂ impact / est. payoff period in years per intervention):

- Cavity/external wall insulation: SDH (cavity wall: -20% / 3.4 yrs); TH (external wall: -20% / 102 yrs)³; BH (cavity wall: -14% / 4.5 yrs)
- Loft insulation (120-270mm): SDH (-2% / 21 yrs); TH (-18% / 2.4 yrs); BH (-2% / 16 yrs)
- Triple glazing of windows: SDH (-8% / 74 yrs); TH (-7% / 73 yrs); BH (-8% / 108 yrs)

- Rooftop solar photovoltaic ("**PV**") and electric battery: SDH (-25% / 48 yrs); TH (-27% / 44 yrs); BH (-24% / 70.9 yrs), before taking into account additional consumption associated with ASHP or EV charging saved by self-consumption of PV and potential revenue from surplus (if any throughout the life of the PV) export to the grid from revenue from Smart Export Guarantee.
- Air Source Heat Pumps ("**ASHP**"): SDH (-38% / +£340 p.a.); TH (-37% / +£330 p.a.); BH (-38% / +£345 p.a.) before taking into account revenue which may be available from current domestic Renewable Heat Incentive (a single lump sum capital expenditure offset payment of £805, and Metering Monitoring and Servicing related payments of £115 per year (in quarterly instalments).
- Domestic electric vehicle ("**EV**") charge points (off-street only): All properties (8% / 0.8 yrs)

» Additional objectives:

- Improvement in wellbeing / health outcomes (TH/BH)
- Scale up and replicability of solution across the UK
- Access existing energy supplier programmes / products for low income households (TH/BH)
- Reduction in air pollution and support to transition to e-mobility (through provision of off-street charging for SDH/BH and on-street charging for districts with a high proportion of TH, assuming a lower likelihood of off street parking in those districts)

Phase 2 - investability review conclusions

Subject to further due diligence, it is proposed that the revised project could be (i) delivered as an entire-town portfolio and (ii) in four phases, rather than one (with some restructuring of the technical solutions as compared to the Route Map where noted below), in order to maximise the potential for a variety of forms of third party finance (to lift the burden of capital expenditure from homeowners and tenants):

Stage 1: installation of smart meters (power, gas and water) and low cost sensors (in order to determine precise causes of waste); home survey to determine, amongst other things, age of boilers (and optimal renewal timetable), type of central heating solution (e.g. night heaters etc.) and occupant rental/ownership (incl. mortgage) position.

³ External wall insulation is required where cavity walls are not present. Where this is required, the properties will likely be of solid wall construction meaning insulation needs to be fitted to the outside of the home. This is much more expensive than cavity wall insulation due to additional time and materials required.

Stage 2: subject to the outcomes of Phase 1, install cavity wall installation (SDH and BH); loft insulation (TH only); triple glazing of windows (all properties).

Stage 3: installation of:

- » As an addition to the technology Route Map following the investability assessment, a network of distributed rooftop and/or ground-mounted PV (benefiting all properties, whether or not the roof structure is suitable for PV installation, optimising behind-the-meter supply, in order to bank and share any non-commodity savings and export tariffs available across the scheme); and
- » Off-street parking EV charge points (which may be combined with domestic batteries and/or an off-peak charging tariff) for SDH and BH and on-street charge points for predominantly TH areas assuming a lower likelihood of off-street parking in those areas.

Stage 4: subject to the outcomes of Stages 1-3, installation of:

- » As an addition to the technology Route Map following the investability assessment, compact heat batteries to displace gas consumption, in particular, in the case of homes with gas-fired boilers of less than 10 years, (In anticipation of technology cost reduction/gas grid decarbonisation, including by way of an increased proportion of hydrogen in the gas network, prior to obsolesce); and
- » Domestic ASHP for low income homeowners or, (as an addition to the technology Route Map following the investability assessment) where sufficient anchor demand to make the scheme economic, external district scale ASHP network (utilising distributed PV) scaling up over time, as any off-gas grid homes and homes with gas-fired boilers coming to the end of their useful life connect to the network (to optimise cost and CO₂ savings and reduce requirements for in-home O&M).

Phase 3 - next steps with respect to project due diligence, further concept design and outline business case development.

Based on the information set out in the Appendix to this Case Study, before commencing detailed project development, the following will be required at a minimum:

- » Feedback from a sample of homeowners of each type in each relevant town with respect to their uptake propensity of each potential solution;

- » Analysis of, and early engagement with, predominant mortgage providers in the relevant town to obtain pre-consent to proposed solutions and to shape mortgage backed financing products; and
- » Education of, and feedback, from planning authority and new home developers and construction companies with activities in the relevant town in respect of viability of installation of such measures in new build and refurbished properties.

Phase 4 – preliminary thoughts on investor engagement and funding plan

Based on experience of similarly innovative projects with a number of complex stakeholder, contractual, technical and construction risks, the process for raising funding is typically split into the following steps, some of which are more relevant than others depending on the characteristics of the asset class and technology choice, and whether, based on these characteristics the project can be shaped to be entirely privately funded/supplied, or will require public sector 'gap' funding.

1. Consideration of whether the proposed solution is available from an existing provider on an “as a service basis” (including where that service is supported by Government grant) such that additional upfront capital expenditure by the homeowner / tenant is not required.

Application to this case study (after restructuring domestic solution taking into account investability issues): Yes

- » **Stage 1:** Smart metering, sensor installation and home energy surveys – This is a free service with respect to electricity and gas offered by most licenced energy suppliers in the UK. Models are also emerging from regulated water utilities for the installation of free water meters for domestic consumers (either funded by such water companies on-balance sheet or from third-party finance).
- » **Stages 2 and 4:** Installation of cavity wall installation, loft installation, triple glazing of windows, heat batteries and heat pumps – these are services offered by licenced energy suppliers pursuant to the Energy Company Obligation (ECO) - a government energy efficiency scheme in Great Britain to help reduce carbon emissions and tackle fuel poverty – however this is available only to homeowners receiving certain social benefits or living in social housing. For homeowners not covered by the ECO scheme, see also mortgage-based finance below.
- » **Stage 3:** Installation of off-street charge points – Licenced energy suppliers are starting to offer partially or fully funded supply and installation of

such charge points (separately or as a package with EV leasing and/or an attractive power tariff to incentivise use of additional grid supplied power at off-peak times). Such offers are supported by a grant £350 grant made available in respect of accredited installers by the Office of Zero Emission Vehicles (OZEV) to domestic users which have an EV delivered not more than 4 months prior to installation.

2. Consideration of whether the proposed solution may be eligible for funding in the context of other initiatives being delivered in Leiston / the relevant town or surrounding area, (whether as part of general economic development focused funds, support for the creation of new business models or commercial scale up of technologies, a community benefit fund required to be set up under planning obligations or other project with similar objectives / beneficiaries which could be expanded or restructured to incorporate the proposed solution).

Application to this case study (after restructuring domestic solution taking into account investability issues): Yes

To be considered on a region-by-region basis with respect to the upfront capex or local business/ skills development associated with each of the following, to (i) provide to private developers/installers pre-commercialisation feasibility analysis funding (prior to attracting private capital investment), or construction phase loans or equity investments (to improve equity returns to attract private capital investment and facilitate recycling of public investment into other local initiatives); or (ii) directly procure:

- » **Stage 3:** community scale behind-the-meter networked ground-mounted shared solar installations and on-street (or other public location) charge points on public property; and
 - » **Stage 4:** external multi-home/district scale heat networks (utilising ASHP).
3. Initial engagement with relevant other public funding to explain the overall objectives of NZL and understand how and in what circumstances they may be able to contribute on a financial / non-financial basis to individual homeowners and in respect of public infrastructure (to inform discussions with commercial private sector investors and shape projects/ packages). If a commercial viability gap later arises, re-engagement will also be required after step (d) below in order to commence specific public funding application processes.

Application to this case study (after restructuring domestic solution taking into account investability issues): Yes

Currently available relevant funding includes as at the date of this case study:

- » Rural Community Energy Fund (provided by Department for Business Energy and Industrial Strategy (BEIS) and Industrial Strategy and Department for Food and Rural Affairs (DEFRA) – up to £40,000 for feasibility assessment costs and up to £100,000 for development expenditure, per project.
- » Public Sector Decarbonisation Scheme (SALIX) – the current phase 2 is targeted at public sector capital works projects that can achieve completion by 31 March 2022 and which require up to £5 million in funding (a further phase 3 is anticipated).
- » In respect of EV charging, an On-street Residential Charging Scheme makes grants available to local authorities to part-fund the procurement and installation of on-street EV chargepoint infrastructure to residential needs (administered by the Energy Savings Trust on behalf of the OZEV) – in the 2021/2022 financial year £20 million funding will be made available under the scheme on a competitive basis, with no minimum or maximum limit on capital cost per project, subject to a cap per chargepoint installation of £13,000 (>£7,500 only where connection costs are particularly high) which must be installed by 31 March 2023.
- » In respect of ASHP installation, the Clean Heat Grant, a proposed upfront capital expenditure grant at a flat rate of £4,000 per home (to be administered by BEIS assuming the consultation recommendations are adopted) with a total of £100m available 2022-2024, replacing the domestic Renewable Heat Incentive for installations after 31 March 2022.
- » In respect of district scale heat networks, the Heat Network Investment Project (HNIP) providing pre-commercialisation and construction grants and construction loans (administered by TriplePoint on behalf of BEIS but closing in 2022) / upcoming Green Heat Network Fund Transition Scheme which will replace HNIP and is open for pre-commercialisation grants of up to £1,000,000 from July 2021. The full scheme will provide both pre-commercialisation and construction expenditure financial support.

4. In respect of individual homeowner projects requiring significant upfront capital expenditure, engagement with predominant mortgage providers with a view to pre-approval of proposed solutions and utilisation / development of a “green refurbishment mortgage” uplift product, that would allow home purchasers and owners to obtain automatic approval, subject to the usual credit/loan-to-value tests, to borrow to fund a variety of pre-approved energy solutions provided installed by accredited installers.

Application to this case study (after restructuring domestic solution taking into account investability issues): Yes

Relevant, in particular, to capital expenditure in respect of the following solutions from which, once installed, the homeowner is eligible for revenue, the improvement is likely to result in home value retention or appreciation, or the relevant capital cost is relatively low compared with the carbon and well-being benefits:

- » **Stage 2:** Cavity wall installation (SDH and BH); loft insulation (TH only); triple glazing of windows (all properties).
- » **Stage 3:** Domestic rooftop solar (pursuant to which the homeowner is entitled to payments for power exported to the grid from licenced energy suppliers supported by the Smart Export Guarantee).
- » **Stage 4:** Domestic heat batteries and ASHP (quarterly payments to homeowners, supported by the Domestic Renewable Heat Incentive).

Green mortgage (and asset-backed finance lease) products have started to become available from both high street lenders as well as niche sustainable finance providers:

- » Funding energy efficient improvements (e.g. Saffron Building Society and Nationwide);
- » Self-renovators (e.g. Ecology Building Society);
- » Equity release in order to fund energy efficient home improvements (e.g. Just Group); and
- » EV finance leases and charge points (e.g. Santander, Octopus).

5. In respect of larger scale projects (i.e. portfolios of domestic properties and public infrastructure projects aimed at residential consumers) in Leiston or the relevant town or a pipeline of towns:

- » Initial 'long-list' prospective private funder engagement with entities whose preferences are indicative of the variety of funding sources listed above to explain the relevant project/package opportunities; understand how available funding products could apply and if so on what terms; and encourage funding consortiums to be built where appropriate. In this context, consideration will also be given to the potential for the creation of a Leiston or relevant town/region specific, multi-asset funding product (e.g. climate bond, low carbon fund, etc.).
- » Preparation of a high level information memorandum on each project/package / a city funding solution followed by down-selection to a 'short-list' of prospective funders/strategic partners with whom Ikigai, NZL and its advisors will engage in interactive workshops to work through, for each project/package, a financial model (taking into account prospective funder required assumptions/inputs) and the high level information memorandum to understand any additional risks/sensitivities identified by prospective funders and proposed mitigations to ensure that these are addressed in the financial model and the underlying project planning, procurement and contract negotiation process etc. to enable the short-listed funders to provide a detailed indicative funding offer.
- » Following analysis of indicative non-binding offers, granting of an exclusive mandate to a funder/consortium and commencement of full due diligence and funding transaction documentation leading to signing of commitment and financial close/completion once planning consent has been granted and other conditions precedent identified during due diligence to first drawdown / first cash call have been satisfied. Following this, the late stage development/construction phase can commence.

Application to this case study (after restructuring domestic solution taking into account investability issues): Yes

From initial prospective private funder engagement, private sector match investment may be available for development and construction of Stages 3 and 4 (portfolios of domestic or larger scale shared solar, district or multi-home scale heat networks and on-street EV charge points) from the following sources:

- » **Municipal bonds:** issued by local authorities funded by private sector debt providers (e.g. Abundance) at more competitive pricing than Public Works Loan Board funding.

» **Regional / technology specific funds:** private-sector investment manager appointed to raise additional private sector capital (from retail or institutional investors matched by public sector grants, loans or equity) focused on a particular technology rollout (e.g. the Zouk Charging Infrastructure Investment Fund or the TriplePoint Heat Network Infrastructure Fund) or on a particular region (e.g. the CBRE managed Greater Manchester Low Carbon Fund).

» **Energy efficiency, real estate and heat network focused funds and private equity:** many such private sector retail or institutional investors funds and private equity investors have an allocation towards a variety of power, heat/cool and fuel efficiency technologies for both domestic solutions and public enabling infrastructure (e.g. Sustainable Development Capital, Asper, Downing, Daimyo, Equitix, Aviva, GLIL, InfraRed, TriplePoint Energy Efficiency Fund, Calisen, Rabobank, AIB etc.).

» **Strategic/industrial investors:** in addition to UK-based energy utilities which are active investors on demonstration projects and large scale rollouts of these solutions, a number of international strategic / industrial investors (e.g. property management companies, utilities, installer operators and trading houses) and equipment suppliers are able to provide development and construction equity co-investment, project finance and vendor finance.

Note that in respect of all of the above sources of capital, investors will typically prefer transactions (whether in respect of a single town decarbonisation, or multi-town portfolios) to require, in aggregate, a minimum investment ranging from £2-5m for retail investment funds up to £50 million+ for institutional investors.

APPENDIX TO DOMESTIC CASE STUDY

In Phase 2, the shortlisted option in this domestic Case Study was assessed from two perspectives – asset class and technology risk – in order to draw a conclusion as to whether the particular technology solution described above should be taken forward from this feasibility assessment phase to development. This Appendix explains the factors taken into account in the asset class and technology risk assessment.

ASSET CLASS ASSESSMENT

This asset class has a number of unique characteristics, which create challenges for scalability, deliverability and profitability of, and the ability to secure investment into, certain domestic decarbonisation solutions:

» Ownership / control: owner/occupied, shared ownership, private rental (and, though not covered in this Case Study) social rental each have different implications re: decision making and capacity for project control and property access.

Title searches will be required to establish the ownership of all properties.

» Uptake propensity: the capacity to rollout a number of possible interventions across a portfolio of properties are affected by a variety of individual homeowner issues including capacity to fund the upfront cost, insufficient space, unfamiliarity with the technology or inconvenience of providing access.

By phasing the rollout of the interventions, commencing with data capture and analysis prior to any capital expenditure, this should improve homeowner / tenant confidence. However, the potential for systems optimisation and cross-subsidisation of interventions should also be considered in package design (in particular with respect to ASHP).

» Lack of commoditisation: while the solution can be standardised to an extent across similar home types, the equipment it is intended to replace, the environment in which it is being installed and operated, and the behaviour of the occupants is not. Scale on a standardised basis is essential to spread third party financing transaction costs.

The product offer should be designed for applicability across the vast majority of homes and provide for: (a) automated demand reduction and operation (rather than depending on tenant behaviour) and (b) designs which maximise external installation of shared infrastructure (as opposed to inside homes, requiring access and causing tenant convenience / maintenance delays) in order to maximise capacity for commoditisation and cost reduction.

» Architectural issues: certain interventions may not be possible (e.g. roof not south facing) or require additional expenditure (e.g. roof maintenance upfront and on an ongoing basis).

Desktop studies should be undertaken to prioritise (a) homes with optimal conditions for rooftop solar (south facing pitched roof in good condition) / ASHP and/or (b) residential districts with available land nearby for ground-mounted community solar / a district ASHP-sourced heat network energy centre,

enabling supply by way of a private network. However, to ensure that all homes in an area can benefit from the cost savings irrespective of architecture, the basis of a 'community sharing scheme' should be investigated whereby the reduced non-commodity costs associated with behind-the-meter supply and any domestic solar export tariffs (i.e. from a single scheme supplier under the Smart Export Guarantee) could be "banked" for sharing between funders and any household which joins the scheme.

- » Credit risk: perceived higher default risk from retail consumers than corporate/public counterparties which may require additional mitigations (granting of security / guarantees).

Default risk data should be collated in respect of energy supply in the areas (or if not available for the area, in respect of types of residents nationally, in order to give funders confidence that default risk is low. Analysis should also be undertaken as to the most common residential mortgage providers in the area and such financial institutions approached to confirm whether they would be prepared to offer a 'green mortgage' offer / uplift (or to grant consent for a third party funder to take the necessary property rights / security) to fund upfront capital expenditure for existing homeowner customers which do not qualify for ECO funding from energy suppliers.

- » Valuation risk: perception that certain interventions could reduce home valuation (or at least not improve value) acts as a disincentive to owners/ mortgagees.

Such valuation risk arguably has reduced as the climate risk has increased and become better understood by homebuilders, valuers, homeowners and mortgage providers, but further education is required.

- » Splitting of costs and benefits: interventions may only benefit the occupant and not the owner or vice versa; or not result in reduced energy bills for the occupant (due to the way in which tariffs are structured); or not generate immediate revenue or valuation uplift to the owner to offset upfront capital costs (i.e. through export feed-in-tariffs).

Interventions which deliver cost savings to the occupier, the upfront costs of which could be funded externally (whether by an energy supplier or a financial institution), and which enhance or do not reduce home valuation should be prioritised. Confirmation should be sought from valuers / mortgage providers that the package of interventions will maintain or enhance home values.

- » Mortgagees: mortgagee consent may be required for the relevant intervention and funding solution resulting in additional complexity and transaction costs.

Confirmation should be sought from the most common mortgage providers in the relevant residential area that consent, where applicable, will be granted for the interventions and the granting of any property rights or security required to implement financing for such solutions.

- » Skills challenges: even if scalability is possible, funders will be concerned about skills shortages for highly specialised activities meaning that rollout may be delayed or underperform. By way of example, this is one of the reasons that the Green Homes Grant has been withdrawn by the UK Government.

A coordinated program of training and accreditation by relevant OEMs of local / regional installers may be required in order to collate a panel of available suppliers approved by third party funders and mortgage providers.

As an asset class, domestic solutions also present a number of opportunities for certain kinds of investors, to deliver:

- » Specific products on a fully-funded basis using well understood, bankable and scalable business models (e.g. smart metering)
- » Bundled products to optimise individual system efficiency and costs of delivery, streamline customer engagement, portfolio scale and revenue streams (e.g. a package of energy and non-energy solutions packaging IoT-based energy demand reduction, efficiency and generation with broadband rollout, and/or EV charging infrastructure with EV leasing):
- » District solutions (after behind the meter solutions have been rolled out to optimise demand and connectivity) to create economies of scale and maximise carbon savings / £, maximise inclusivity (i.e. benefits are shared irrespective of individual home design), reduce intrusiveness of the interventions for individual homeowners / de-risk operation and maintenance (e.g. district heating and community solar sharing schemes).
- » New delivery models by coupling energy solutions with other customer offers where a relationship of trust with the occupant already exists (e.g. Amazon/supermarkets providing grocery delivery or mortgage providers offering "green" mortgage uplifts and installation packages also alleviating concerns around home valuation).
- » Impact based products which measure carbon savings as well as improvements in occupant well-being / health associated with energy related interventions.

TECHNOLOGY ASSESSMENT

Having considered the nature of the asset class, the choice of technology to deliver the requisite decarbonisation impact, will further affect the funding options available. Within each asset class, funders will evaluate the following:

- » Technological maturity - focusing in particular on the extent of operational performance data at a commercial scale with similar conditions re: feedstock/weather/outputs etc., or if not yet available, the extent to which 'in lab' or demonstrator project data can be extrapolated to a commercial scenario).

Smart metering / sensors	Late
Energy efficiency measures (insulation and triple glazing)	Late
Solar PV	Late
Compact heat batteries (phase-change materials)	Medium
ASHP	Medium
EV Charge points	Late

- » Commercial readiness - focusing in particular on comparative capital and operating costs vis a vis output (i.e. levelised cost), creditworthiness and enforceability of the technology brand's performance and availability warranties.

Smart metering / sensors	Late
Energy efficiency measures (insulation and triple glazing)	Late
Solar PV	Late
Compact heat batteries (phase-change materials)	Early
ASHP	Medium
EV Charge points	Late

- » Delivery mechanics – what type of delivery partners (e.g. installers) are necessary to manage risks associated with the choice of technology and are these already available in the market, nationally or locally?

Smart metering / sensors	Available from all licenced energy suppliers
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Energy efficiency measures (insulation and triple glazing)	Constrained by insufficient accredited local installers
Solar PV	Broad skill base available
Compact heat batteries (phase-change materials)	Training needed for accredited installers
ASHP	Training needed for accredited installers
EV Charge points	Broad skill base available

- » Available revenues – to the extent these are technology (rather than output/customer/location) linked, e.g. domestic export guarantees, tariffs, etc.

Smart metering / sensors	N/A
Energy efficiency measures (insulation and triple glazing)	N/A
Solar PV	Smart Export Guarantee
Compact heat batteries (phase-change materials)	Domestic Renewable Heat Incentive
ASHP	Domestic Renewable Heat Incentive
Public EV Charge points	Power sales

- » Sustainability / emissions – how does this compare, on a cost per CO₂ saving basis, to counterfactual technologies. This is calculated on average £/kg CO₂ abated.

Smart metering / sensors	N/A
Energy efficiency measures (wall insulation)	£1.80 / kg CO ₂ abated
Energy efficiency measures (loft insulation)	£12.11 / kg CO ₂ abated
Energy efficiency measures (triple glazing)	£4.37 / kg CO ₂ abated
Solar PV	£0.72 / kg CO ₂ abated
ASHP & Compact heat batteries (phase-change materials)	£1.17 / kg CO ₂ abated
EV Charge points	N/A due to increase in emissions

- » Scalability / modularity – this is particularly important if the initial phase is a demonstration project or there is potential for the project to increase in size over time to meet the capacity of the site / customer.

Smart metering / sensors	High
Energy efficiency measures (insulation and triple glazing)	High
Solar PV	High
Compact heat batteries (phase-change materials)	High
ASHP	High
EV Charge points	High
EV Charge points	High

» Locational applicability – whether the technology choice is suitable for the area of the country, home architecture and space.

Smart metering / sensors	Applicable
Energy efficiency measures (insulation and triple glazing)	Applicable (but dependent on home design)
Solar PV	Applicable (but dependent on roof design, direction and state of maintenance)
Compact heat batteries (phase-change materials)	Less applicable in town connected to the gas grid, than off-gas grid application
ASHP	Limited by available space
EV Charge points	Applicable (design dependent on whether off-street or public)

CASE STUDY B – COMMERCIAL AND INDUSTRIAL ENERGY SOLUTION

The intention of this Case Study is to demonstrate how Phase 2 (investability assessment) has been applied to, and has resulted in the restructuring of, the shortlisted option identified by Atkins and Opergy in Phase 1 described in **Chapter 7** as summarised above, in order to better align with the requirements of the investors currently most actively deploying capital into this asset class and technology solution and inform Phases 3, 4 (and 5).

Project overview as set out in the technical Route Map

- » Asset type: commercial and industrial captive power/microgrid
- » Site: light manufacturing business park (typical of smaller post-industrial towns)
- » Source of scope 1 emissions: electricity (sourced from the grid and possibly diesel-generator back up, varying levels of gas demand)
- » Source of scope 2 / 3 emissions: transport (corporate fleet, staff vehicles and goods transport vehicles to and from site) and supply chain derived
- » Technologies originally shortlisted: wind (one or more 800kw turbines) and electrical storage (lithium-ion batteries) if there are consumer resilience requirements, grid import and export capacity and revenue streams justify the investment
- » Additional objectives: improved resilience and reduced energy costs for business park tenants; attraction of industry and investment to the area; electrical grid reinforcement

Conclusion post-investability screening: the technologies and solution originally shortlisted only partly satisfied the investability criteria outlined below, but should proceed to due diligence in respect of potential Sites, further concept design and outline business case development with amendments to take account of customer/landlord and location-specific factors.

CASE STUDY - ONSITE COMMERCIAL AND INDUSTRIAL ENERGY SOLUTIONS / MICROGRIDS

Shortlisted option: Local small scale wind turbines sized to industrial estate demand with battery storage to maximise generation potential. This measure would only be installed after energy efficiency measures and heat pumps have been installed, hence providing a higher electrical demand to serve.

Phase 2 - investability review conclusions

Subject to further due diligence, it is recommended that the initially proposed asset class and technology solution would be restructured by considering the following:

- » Wind turbines would not be the only energy generation technology utilised; the turbines could be co-located with industrial rooftop (or, subject to available land) ground-mounted solar PV to smooth and harmonise power generation on an intra-day and seasonal basis;
- » Scope for reduction of onsite customer energy demand will be assessed (through the installation of smart electrical and water meters/sensors, LED lighting, automation and energy efficiency equipment and voltage optimisation, depending on the nature of the industrial activities taking place onsite);
- » Generation capacity of each technology would be sized to satisfy up to the current onsite customer demand, adjusted for demand reduction measures, and intra-day/seasonal consumption profile, with sufficient export capacity secured to mitigate against customer relocation and insolvency risk;
- » The potential for increased generation scale over time in line with new tenants/increased production volumes/EV charging demand/space availability and export capacity to the extent that this could improve overall project economics;
- » Whether a battery energy storage system could also be located at the Site, sharing infrastructure installed for the electricity generation assets and the Site's electrical sub-station, generating revenue from the provision of flexibility services to the grid and possibly some services to onsite customers (e.g. time-shifting and UPS/back-up power) and possibly some rental revenue to the landlord; and

- » Whether the energy solution should be combined with electric vehicle charge points and/or other alternative fuels captive refilling capacity (and possibly, corporate fleet conversion) for specific tenants / customer carparking spaces, the business park staff and/or wider public demand if easily accessible from motorways, in order to increase the scale of electrical demand given the likely lengthy dwell times and usage of light/heavy goods vehicles at such a location.

Phase 3 - next steps with respect to project due diligence, further concept design and outline business case development

Based on the information set out in section 1 above, before commencing detailed project development in Leiston or the relevant town, the additional information set out in Table 1 and Table 2 in the Appendix to this Case Study will be required.

In addition, we would recommend confirming early and directly:

- » With the local distribution network operator, to confirm specific import / export capacity constraints if any by way of an initial application having obtained authority to make such application on behalf of the relevant power consumers;
- » With the local authority (as Site permitted development rights are unlikely to be sufficient without a specific planning consent), how the project aligns with the local development plan, its understanding of the technology proposals, and the expected planning application and evaluation process; and
- » With a short list of potential equipment suppliers, pricing, availability of long lead time items and whether supply constraints/price rises are anticipated, and preferred high level concept design for the relevant Site against high level specifications required to align with the consumers' operational requirements.

Phase 4 – preliminary thoughts on investor engagement and funding plan

Based on experience of similarly innovative projects with a number of complex stakeholder, contractual, technical and construction risks, the process for raising funding is typically split into the following steps, some of which are more relevant than others depending on the characteristics of the asset class and technology choice, and whether, based on these characteristics the project can be shaped to be entirely privately funded/supplied, or will require public sector 'gap' funding.

1. Consideration of whether the proposed solution is available from an existing provider on an "as a service basis".

Application to this case study (post-restructuring): Yes

All elements of the solution are available from a variety of licenced energy suppliers, specialist commercial and industrial renewable energy developers and installers able to access third party capital, subject to the scale of the proposed solution, as the smaller and more bespoke the necessary technical/contractual solution and the less creditworthy / able to self-fund the energy consumers are, the fewer “as-a-service” funders are likely to be interested.

2. Consideration of whether the proposed solution may be eligible for funding in the context of other initiatives being delivered in Leiston or surrounding area, whether as part of general economic development focused funds, support for the creation of new business models or commercial scale up of technologies, a community benefit fund required to be set up under planning obligations or other project with similar objectives / beneficiaries which could be expanded or restructured to incorporate the proposed solution.

Application to this case study (post-restructuring): Maybe

The relevance and availability of this type of funding will depend on the economic and industrial development objectives of Leiston / the relevant town and the strategic importance of the particular business park to achieving those objectives.

3. Initial engagement with relevant other public funding entities to explain the overall objectives of NZL and understand how and in what circumstances they may be able to contribute on a financial / non-financial basis (to inform discussions with private sector investors and shape projects/packages in line with policy objectives). If a commercial viability gap later arises, re-engagement will also be required after steps (d) / (e) below in order to commence specific public funding application processes.

Application to this case study (post-restructuring): Yes

Currently available relevant funding for SMEs nationally includes as at the date of this case study:

- » **Low Carbon Workspaces** capital grants, made available to SMEs in various regions of the UK (Buckinghamshire, Bedfordshire, Berkshire, Hertfordshire, Milton Keynes and Northamptonshire) to partially fund upfront capital expenditure in connection with renewable energy technologies, battery energy storage, EVs, LED lighting insulation and automation/controls and voltage optimisation (up to a maximum amount of £5,000 per SME).

- » The **Workplace Charging Scheme**, a voucher-based scheme that provides grant funding for the up-front costs of the purchase and installation of EV charge points (administered by the Office of Zero Emission Vehicles) in the amount of up to £500 per socket at 75% of the total cost of installation with a maximum of 20 sockets able to be installed for dedicated off-street parking for staff, visitor and fleet use.

Other grants, loans and operational stage revenue support are also available to corporates and zones for more innovative technologies or more strategic projects (e.g. through the Industrial Energy Transformation Fund) but these are unlikely to be applicable in this context with these mature technologies.

4. Initial engagement with energy consumer corporate banks to determine whether they offer corporate finance products which offer preferential terms for reducing a particular tenant’s carbon footprint.

Application to this case study (post-restructuring): Yes

Increasingly corporate finance institutions are offering preferential terms (e.g. reduced margins) to their priority customers to incentivise them to act on reducing carbon emission reductions, including by utilising their corporate facilities to invest in self-funding of the solutions identified in this case study.

For SMEs seeking to undertake relatively small amounts of capital investment at their operational sites, to install solutions with short payback periods or those which are integral to their core business operations, corporate financing (or asset-backed financing from their existing corporate financiers) can be more cost effective and simpler than seeking highly structured (and therefore higher transaction cost) off-balance sheet funding.

This is partly because such banks are seeking to reduce stranded asset risk on their portfolios, and partly because such SMEs have already been credit approved by such banks (whereas other funders may require further scrutiny of the business prospects, creditworthiness as well as the cashflows from the proposed energy project itself).

5. If sufficient corporate finance is not available for a specific energy consumer pursuant to (e) or a multi-tenant business park funding solution is sort by the relevant landlord / real estate manager other than on an “as-a-service” basis, initial ‘long-list’ prospective specialist non-recourse private funder engagement to explain the relevant project/package opportunities; understand how available funding products could apply and if so on what terms.

6. Following analysis of indicative non-binding offers, granting of an exclusive mandate to a funder and commencement of full due diligence and funding transaction documentation leading to signing of commitment and financial close/completion once planning consent has been granted and other conditions precedent identified during due diligence to first drawdown / first cash call have been satisfied. Following this, the late stage development/construction phase can commence.

Application to this case study (post-restructuring): Yes

There are numerous UK-based energy efficiency, renewable energy, energy storage and real estate focused retail and institutional funds, trading houses/utilities and private equity investors which have a mandate to invest (equity and, where at least 30% of revenues can be contracted upfront, debt) in business park/SME decarbonisation solutions directly or through a dedicated platform company.

Their interest will depend on:

- » The scale of the capital investment required (usually >£5m per transaction);
- » The risk/return balance (i.e. level of technology, price and volume risk involved); and
- » The replicability of the solution (i.e. provided that there is a pipeline of similar deals – similar contractors, technologies, credit requirements of the counterparties and contractual arrangements etc. – in order to reduce capital costs and have visibility over deployment of capital).

Hence, the design of this solution to achieve economies of scale across multiple towns in the UK.

APPENDIX TO COMMERCIAL AND INDUSTRIAL CASE STUDY

In Phase 2, the shortlisted option in this commercial and industrial Case Study was assessed from two perspectives – asset class and technology risk – in order to draw a conclusion as to whether the particular technology solution described above should be taken forward from this feasibility assessment phase to development.

ASSET CLASS ASSESSMENT

This asset class has a number of unique characteristics, foremost of which is the need to balance the following factors in order to ensure deliverability and profitability of, and to secure investment into, the relevant projects:

- » The customer: the operational and commercial needs of the businesses seeking to benefit from any energy solution, possible capital constraints and likely reluctance to enter into contracts with any suppliers in excess of 5 years;
- » The landlord: the objectives of the landlord to maximise attractiveness of tenancy, minimise capital expenditure and, in respect of the common parts, energy related operational expenditure and therefore its return from the property (if not owned by the tenant);
- » The investors: the investment requirements of potential funders with experience or appetite for the risks (in particular, relocation/insolvency risk in connection with tenant at each business park), contracting structure and terms, return and cash flow profile and delivery/business model, of the asset class, and the capacity for replicability at scale on a relatively standardised basis utilising experienced contractors;
- » The location: the site specific constraints, with respect to existing infrastructure, weather, building/ground conditions etc.; and
- » The community: the aims of the local authority and wider community to drive economic growth.

In Table 1 below the shortlisted option is evaluated against the key asset class characteristics and investability criteria for onsite commercial and light industrial energy solutions and industrial microgrids generally.

The information noted in the second column headed “Application to shortlisted solution / further information required in Phase 3” is that which would need to be obtained from a variety of public and customer-specific private sources on a site-by-site basis in order to shape and optimise development of each project. It is suggested that this could be the basis of utilising of an existing platform or the development of a new interactive application which would allow for easy capture of such data and optimisation of solutions on a relatively standardised basis minimising the need for bespoke site assessment.

Table 1 - Asset class assessment due diligence questions

Factor to be considered in asset class assessment of the shortlisted option by funders	Application to shortlisted solution / further information required in Phase 3
1. What is the customer’s expected emission and half hourly energy consumption profile on an daily/monthly and inter-seasonal basis?	Public data: Obtain annual estimate (based on Energy Performance Certificate rating of each customer) Customer data: obtain customer(s) half-hourly data and historic energy bills.
2. If insufficient customer metering data is available, has additional monitoring been considered?	Customer data: current level of metering to be discussed with customer(s) to determine whether further sensors could economically facilitate capturing more granular energy data and further automation and predictive maintenance (via Internet-of-Things based platforms) so as to deliver cost and energy savings.
3. Has the customer identified any Net Zero/ decarbonisation objectives and a strategy for implementation thereof?	Customer data: customer(s) engagement to confirm.
4. How critical is energy supply to the customer’s operations? Are there certain operations that require uninterrupted power supply 24/7 or certain times of the day/year?	Public data: initial analysis could be undertaken on the basis of typical operations for industries based at the relevant Site. Customer data: customer(s) onsite operations to be evaluated and information to be requested.

Factor to be considered in asset class assessment of the shortlisted option by funders	Application to shortlisted solution / further information required in Phase 3
5. Is demand expected to change over time (whether as consequence of energy efficiency measures, increases/decreases in production or additional onsite demand from EV charging etc.)?	Public data: NZL Route Map assumes a certain level of energy efficiency measures will be implemented in advance of onsite generation being installed. Customer data: Customer should advise on any further major demand variation forecast activities onsite.
6. To what extent have demand reduction/energy efficiency or process optimisation measures already been introduced at the customer’s sites?	Customer/landlord data: Customer should advise on any measures which have already been introduced by individual customers / in respect of the common parts of the business park.
7. Could the project generate a direct monetary benefit to the customer (i.e. via energy savings, additional revenue, reduced maintenance, brownout avoidance, reduced compliance costs, tax rebates/allowance etc.) or an indirect benefit (i.e. ESG reporting, retail sentiment or other publicity benefits)?	This will depend on customer preferences as to risk/return and contracting structures put in place (e.g. does the customer (i) wish to benefit from and pay for brownout cost reduction associated with behind-the-meter availability of the proposed battery energy storage system or (ii) share market risk in order to benefit from revenue sharing in respect of flexibility services provided to National Grid by such battery energy storage system or (iii) is there scope for onsite renewables to be oversized compared with demand such that generated electricity can be on-sold to surrounding demand). Public data: Analysis of available electrical grid import/export capacity to the site and surrounding demand will also be relevant. Customer data: Aims, risks and benefits to be discussed directly with the customer(s) and, if different, business park landlord, as well as surrounding potential demand.

Factor to be considered in asset class assessment of the shortlisted option by funders	Application to shortlisted solution / further information required in Phase 3
8. How creditworthy is the customer? How sustainable is the customer's business/sector?	Public data: customer(s) industries and business models to be analysis in advance of specific credit checks / review of financial statements Customer data: analysis of further creditworthiness information against standardised checks.
9. How willing is the customer to pay (whether by forgoing savings/revenue or paying a fee) for the service/project to be delivered by a third party? Is the customer willing to bear utilisation risk of the shortlisted option?	Customer data: customer(s) engagement with respect to appetite required.
10. Is the shortlisted option part of the customers' core competencies or so integrated with/sensitive to the business operations/has such a short payback period that the customers will want to finance it themselves?	Public data: preliminary analysis to be conducted on the basis of typical profile of relevant industries. Customer data: customer(s) operations and investment preferences to be assessed through direct engagement.
11. Does the shortlisted option affect a service/ product provided by an existing service provider (e.g. existing energy supply contracts)? Or would the service/product supplier have an interest in funding the solution?	Customer data: subject to review of customer(s) electricity and gas bills.
12. Could the shortlisted option provide services to others when not being used to full capacity by the customer (e.g. services to the grid, services to surrounding housing/commercial properties, etc) and how can these services be monetised?	Public data: desktop analysis required to determine surrounding demand to project impact on scaling/nature of the proposed solution. Customer data: see above for item 7.

Factor to be considered in asset class assessment of the shortlisted option by funders	Application to shortlisted solution / further information required in Phase 3
13. Are there any forms of revenue support or subsidy available for the shortlisted option (not specifically related to the type of technology which is dealt with below), e.g. incentives for energy efficiency services or the generation of low carbon power, heat or fuel or flexibility services in commercial and industrial context?	Yes, but it depends on scale of the solution, any innovative technologies chosen and nature of the customer(s). Next steps: Available public support criteria to be analysis vis a vis solution after initial financial modelling is completed to determine whether additional public support is required for bankability.
14. Are there growth prospects for the site or complementary businesses that would be interested moving to the site if the shortlisted option was available?	Next steps: Engagement required with landlord(s) and local authority/regional inward investment teams to understand requirements of prospective tenants or surrounding users.
15. Could additional value be created / would it be easier to fund the shortlisted option if the shortlisted option was sized to meet the onsite customer requirements or oversized (to achieve economies of scale)?	Will be dependent on a number of factors, including surrounding land available/suitable for development of additional generation. Next steps: » Undertake title search and consider planning constraints. » Consider also credit-standing of customer(s). » Consider availability of corporate sleeve PPA in order to reduce merchant risk if an oversized generating facility is technically possible. » Consider available import/export grid capacity to determine economics of oversized generation and/or battery energy storage system.

16. Could the shortlisted option it be bundled with other products/services to further decarbonise the customer's operations or site facilities (e.g. EV charging), improve operational resilience/ profitability, enhance revenue streams?	Next steps: » Review customer(s) operations (in particular re: energy data capture, automation and efficiency solutions), vehicle fleet, customer/staff parking requirements, brownout risk etc. » Consider also whether shared infrastructure on other sites could support customer(s) decarbonisation objectives (e.g. EV/low carbon multi-fuel hubs).
17. Is the proposed business model for the shortlisted option available from existing local/ national providers? If not or not all aspects, is there scope for 'productisation' of the solution as the model could be replicated and scaled?	Yes. Many alternatives from both independent developers, installers, utilities and funders. Next steps: subject to completion of other information gathering and business model confirmation.
18. Is distribution of energy from any other site by way of private wire/heat distribution etc. likely to be a more economic and technically viable solution?	Next steps: Confirm that distribution from alternative low carbon generation further from the Site by private wire/heat network has be considered and dismissed or not available.

TECHNOLOGY ASSESSMENT

Having considered the nature of the asset class, the choice of technology to deliver the requisite decarbonisation impact, will further affect the funding options available. Within each asset class, funders will evaluate the following:

Technological maturity - focusing in particular on the extent of operational performance data at a commercial scale with similar conditions re: feedstock/weather/outputs etc., or if not yet available, the extent to which 'in lab' or demonstrator project data can be extrapolated to a commercial scenario).

- » Commercial readiness - focusing in particular on comparative capital and operating costs vis a vis output (i.e. levelised cost), creditworthiness and enforceability of the technology brand's performance and availability warranties.

- » Delivery mechanics – what type of delivery partners (e.g. installers) are necessary to manage risks associated with the choice of technology and are these already available in the market, nationally or locally?
- » Available revenues – to the extent these are technology (rather than output/customer/location) linked, e.g. technology-linked subsidies, revenue support, grants, export credit guarantees, process insurance, enhanced capital allowances etc.)
- » Sustainability / emissions – how does this compare, on a cost per CO₂ saving basis, to alternative technologies
- » Scalability / modularity – this is particularly important if the initial phase is a demonstration project or there is potential for the project to increase in size over time to meet the capacity of the site / customer
- » Locational applicability – whether the technology choice is suitable for the site will depend a variety of factors including weather (e.g. wind/irradiation/ temperature)

The table below sets out the factors which will be evaluated by funders within each relevant asset class applied against the shortlisted technology solutions, taking into account case-by-base locational factors.

Table 2 - Technology assessment due dilligence questions

Factor to be considered in technology assessment of the shortlisted option (i.e. wind and battery energy storage)	Application to shortlisted solution and alternatives / further information required in Phase 3
1. How well does the energy demand/emission profile of the customer/site map across the capacity/supply profile of the shortlisted option?	Wind turbine and battery energy storage system sizing in the NZL Route Map was completed on the basis of annual values determined from Energy Performance Certificate ratings. Further assessment and basic design is required once actual half-hourly electrical and gas consumption profile data from the customer(s) is available such that technology can be revisited and scale determined (see also items 15 and 16 of the Asset Class Assessment table above). Next steps: obtain customer(s) half-hourly data and historic energy bills.

Factor to be considered in technology assessment of the shortlisted option (i.e. wind and battery energy storage)	Application to shortlisted solution and alternatives / further information required in Phase 3
2. What technology readiness level has the shortlisted option achieved? If it is relatively immature, has it been demonstrated elsewhere at a commercial scale?	Wind turbines and Lithium-Ion batteries are considered mature technologies. Next steps: reconsider whether more innovative technologies may address customer(s) energy challenges more precisely once further information obtained from customer(s).
3. To what extent does the technology engineering concept need be adjusted to be bespoke to the particular customer/site?	Both wind turbines and Lithium-Ion batteries are modular and standardised solutions (unless less mature technologies offer benefits to the customer(s)/area that justify a bespoke solution as a demonstrator). Only system design/balance of plant solution will be bespoke. Next steps: Concept design will need to be prepared pre-planning.
4. What is the estimated capital cost per/MW of each component of the shortlisted option and on what basis has this been estimated? How does this compare to other technologies which could meet the other asset class criteria?	Wind turbines: The estimated capital cost for the wind turbine was derived from BEIS figures published in their Periodic Review of FITs. A figure of £1,604,000/MW was used to estimate the capex of the 800kW turbine, and prelims (10%), contingency (15%), design (5%), cable cost, allowance for electrical substation upgrades, controls and batteries were added on to generated the overall cost. Lithium-Ion Battery: The cost for controls and batteries were taken from a vendor quote. It is assumed any property over 500m² will need a 250kWh battery costing £154,500 and a control system costing £3,000. This equates to £630/kWh. For any property less than 500m², the battery (110kWh) cost is £77,250 and the controls cost is £500. This equates to £706/kWh. The above property scale based estimates assume that the relevant business park is entirely comprised light industry; the actual

Factor to be considered in technology assessment of the shortlisted option (i.e. wind and battery energy storage)	Application to shortlisted solution and alternatives / further information required in Phase 3
	consumption requirements and patterns of tenants and available grid capacity would need to be considered in determining the optimal battery sizing and design, with consequential impacts on pricing. Alternative generation solutions: these include replacing or complementing (to mitigate seasonal variations) wind turbines with rooftop solar PV. Considering technology options purely from the perspective yield, wind is more efficient and has a higher yield over the whole year than solar in the UK. However, yield is not the only consideration in determining whether a project is investable in any particular consumption situation or location in the UK – see in particular question 9 below.
5. What is the estimate operating cost per/ MW(h) of the shortlisted technology and what lifecycle cost have been taken into account in this calculation? How does this compare to other technologies which could meet the other asset class criteria?	Not yet analysed as part of NZL Route Map. Next steps: to be considered as part of further feasibility assessment given that operating costs tend to have a greater impact on investment return than capex in relation to these sorts of asset classes.
6. Taking into account the answers to questions 4 and 5, what is the lifecycle cost (£) / tonne of CO ₂ abatement?	Lifecycle cost of a wind turbine is £1,009.20 / tonne CO ₂ abatement on the basis of the turbine having a 20-year life cycle.
7. Is the proposed technology and installation methodology for the shortlisted option available from existing local/national providers? If not or not all aspects, is there scope for 'productisation' of the solution as the model could be replicated and scaled?	Yes, wind turbines (assuming not roof mounted or innovative designs) and Lithium-Ion batteries are relatively mature technologies with well understood and simple installation methodologies available from a wide variety of local and national suppliers, installers/EPC contractors.

Factor to be considered in technology assessment of the shortlisted option (i.e. wind and battery energy storage)	Application to shortlisted solution and alternatives / further information required in Phase 3
8. Are specific site conditions required in order for the shortlisted option to be viable (e.g. sufficient grid capacity, well maintained roof, etc.)? If so, how likely is that additional infrastructure (and therefore additional cost) will be required in order for the technology choice to be viable?	Yes. Detailed assessment on existing infrastructure and specific locations suitability not yet completed as part of the NZL Route Map. Next steps: » Import/export capacity to be reviewed against local heat maps by way of engagement with local distribution network operator. » Available land onsite to be assessed by way of more detailed desktop study in advance of discussion with landlord(s)/ customer(s). » Available and technically suitable roof space to be considered if insufficient surplus land available on/adjacent to the Site.
9. To what extent would the shortlisted solution require planning consents (or could permitted development be relied upon)?	Wind turbines: will definitely require planning consent and this is a high risk in England. Battery energy storage system: even though containerised, may require planning consent. Next steps: to be confirmed that permitted development rights could not cover containerised batteries and whether alternative generation technology solutions (e.g. solar PV) could reduce planning risk.
10. Would any other regulatory approvals be required for installation and operation of the shortlisted solution, e.g. if a microgrid, do supply licence exemptions apply?	If wind solution is onsite and made available by the generator/landlord directly to consumer(s) on or adjacent to the Site by way of private wire, the exemptions to the requirement to obtain a supply licence to distribute power should apply. Next steps: to be revisited once final technology solution and consumers confirmed.

Factor to be considered in technology assessment of the shortlisted option (i.e. wind and battery energy storage)	Application to shortlisted solution and alternatives / further information required in Phase 3
11. What inputs are required to the shortlisted option (e.g. electricity, gas, water, feedstock, wind, irradiation etc.) and to what extent are these sufficiently available in the area? What evidence is available that this is the case (e.g. met mast data)?	Wind turbines: Local wind resource needs to be checked on the basis of, e.g. met mast data or performance of other wind farms in the area. Sites specific data may be obtained using the MERRA-2 global data set and was used to estimate the generation potential at the site. Battery energy storage system: grid/local power generation.
12. Is the project entirely on the customer's property or third party land? Will the assets delivered form part of the customer's property (i.e. a fixture) or can they be owned independently by a funder (i.e. a chattel)?	Proposed solution intended to be entirely onsite (and will be chattels that can be separately secured in favour of a funder) but land ownership of the business park and surrounding available land will affect the viability of this (sites further afield and private wire connections may need to be considered). Next steps: title searches to be conducted and if these are inconclusive with respect to design of the solution, further discussions will be required with identified landlord(s)/tenant(s)
13. Could the shortlisted option it be bundled with other technologies to further optimise performance/ applicability of the technology? If so, which technologies and how?	Depending on the customer(s) consumption profile, it may be possible to technically optimise the system by combining wind and solar generation (to smooth seasonal variations); energy storage may be added to provide for grid demand reduction / peak lopping and/or resilience and potential revenues from providing ancillary/flexibility services to National Grid; and fleet EV charging or onsite hydrogen production for non-road mobile vehicles / HGVs. See also item 16 in the Asset Class Assessment table above.

ANNEXURE 2 – PRE-COMMERCIALISATION OUTLINE BUSINESS CASE TEMPLATE

Project name	
Brief description	
STRATEGIC RATIONALE	
Decarbonisation potential (scope 1, 2 and 3 emissions)	
Other potential Project benefits	
Key stakeholders (together with nature of business, role in Project and rationale for involvement)	
PROJECT CHARACTERISTICS AND STATUS	
Project location	
Site characteristics (incl. landowner and onsite/ adjacent infrastructure available including import/ export connections etc)	
Links to other projects in Route Map (if any)	
Feasibility analysis undertaken to date	
Overview of Project status	» Base Case Financial model: » Engineering studies: » Project Programme: » Risk register:

	» Planning: » Land: » Network connections: » Offtaker(s): » Procurement:
Overview of potential revenue streams (and related contractual arrangements, including duration and key proposed terms if available)	[Including for each revenue stream (where applicable) counterparty, contracted or merchant, value per unit: forecast units/value in year 1, anticipated growth, anticipated inflation, share of overall revenue in year 1 and length of revenue receipt (years).]
Proposed design by phase (subject to further technical due diligence and system optimisation during the development phase)	Phase 1: » Technology: » Size (MW and MWh or other): » Feedstock/inputs (and relevant assumptions): » Offtaker(s) incl. nature of offtake: » Grid capacity increase required: » Location on site: » Integration to current infrastructure/ new infrastructure required: » Planning/permit requirements: [Repeat as required] Phase 2: » Technology: » Size (MW and MWh or other):

	» Feedstock/inputs (and relevant assumptions): » Offtaker(s) incl. nature of offtake: » Grid capacity increase required: » Location on site: » Integration to current infrastructure/new infrastructure required: » Planning/permit requirements:		
	[Repeat as required]		
Additional technology being evaluated but not yet part of Project design			
Expansion potential / pipeline			
Key dates		Phase 1	Phase 2
	[Milestone 1]		
	[Milestone 2]		
	[Milestone 3]		
	[Milestone 4]		
Factors under consideration in Project structuring			
Assets available as security at Financial Close			



BASE CASE FINANCIAL MODEL (subject to further due diligence)	
Anticipated Project Costs (split into development and construction expenditure for each phase and key assumptions)	
Anticipated Operating Costs (and key assumptions for each phase)	[Including for each phase/component, where applicable, counterparty, firm or variable, cost metric (£/x), forecast cost in year 1, anticipated growth, anticipated inflation, share of overall costs in year 1, length of contract (years)]
Anticipated real pre-tax Base Case Project IRR range	
Anticipated payback period:	
KEY BANKABILITY ISSUES AND MITIGATIONS (subject to further due diligence)	
Technical (if any)	
Commercial (if any)	
Legal/regulatory (if any)	
NEXT STEPS (if any required prior to early engagement with prospective funders)	
Anticipated further costs (and time period) to complete feasibility analysis	
Additional skills required to progress Project	



A JUST TRANSITION





CHAPTER 9

COMMUNITY MEASURES AND ENGAGEMENT

Authored by



opergy

JULY 2021

INTRODUCTION

The NZL Route Map can act as a blueprint to achieving Net Zero in any town in the UK. To achieve implementation of the technologies proposed requires the full engagement and ownership of the community. Furthermore, there are valuable actions the community can take that support and enable the wider programme of carbon emissions reduction, whilst not having a direct impact on scope 1 and 2 emissions.

This chapter aims to highlight the community governance, pilot schemes, engagement and insight learned to-date on NZL. The chapter also highlights important behavioural changes and community enablers that will help support the technological solutions in the Route Map.



NET ZERO LEISTON
TIMELINE OF
COMMUNITY
MEASURES AND
ENGAGEMENT



GOVERNANCE

The parties involved in seeding the Net Zero Leiston project agreed seven founding principles:

1. Ensuring local stakeholders are at the heart of the project
2. Taking a thorough, robust engineering approach, not greenwashing
3. Addressing fuel poverty and providing social mobility
4. Understanding how different technologies work together to create a replicable energy showcase
5. Combining Net Zero ideas with replicable funding solutions
6. Maximising wider benefits and opportunities for all stakeholders
7. Helping the region achieve its climate goals and continuing the UK's focus as a leader in the journey to Net Zero

A supporting governance structure was created to deliver the NZL Route Map and ensure the project is community led with a path to be community owned.

The two main structures are:

1. NZL steering group – this is the key decision-making body which includes representatives from: Leiston Together, Leiston Town Council, East Suffolk Council and Suffolk County Council. Their role includes reviewing and signing off work plans, the content of the Route Map and community engagement efforts.
2. 'Dragons Den' group – a subset of the NZL steering group responsible for providing go/no go decisions on implementation of pilot projects (see Pilots section below for further detail).

COMMUNITY ENGAGEMENT

A key factor to the success of Net Zero Leiston is the community embracing, owning and supporting its goals. To enable this, and to raise awareness of the project in the community, a significant amount of effort has been made to engage the community in a variety of ways. The following details some of the community engagement efforts that have been made in Leiston and why they've been conducted.

What has been evident in our engagements with the community, is that the greater the number of engagements and the wider variety of modes of engagement, the more successful they are. The community itself is varied, with different levels of digital capability and different interests and priorities. For this reason, the messaging used varies across the modes of communication, but is consistent with its branding and tone of voice, to ensure that the NZL brand is recognised and understood.

Leaflet drops

The first form of engagement used in the community was via very traditional means. Upon the launch of Net Zero Leiston in July 2020, a brochure was sent to each household in Leiston, introducing the project and promoting its goals. Recipients were directed to the website and to communicate with us to give us their views. Some members of the community did contact the project to ask questions and to offer support.

The purpose of this engagement was to establish and introduce the project and brand, hence why each home was included in the mailout.

In addition to this, the project has also used letter drops to promote and introduce the pilot schemes for the project. Each home in Leiston will have received one of these leaflets and would have been directed to the website or to phone us, depending on the scheme being promoted.

This form of communication was accessible to the whole community, meaning that its chances of success in achieving the aims were higher.

Door-to-door Pilot Promotion

In addition to letters and leaflets, one of the NZL pilot schemes was supported with doorstep promotion. The contract partner, IHI, delivering the energy efficiency scheme would visit homes who had received a letter from the project, to answer any questions they had on the scheme and sign them up to a survey.

The value of face-to-face engagements is the speed of a decision. If a household has a query on a scheme, they may delay calling to resolve it, meaning that the likelihood of them signing up to the pilot scheme is delayed. If an agent is able to resolve issues on the doorstep, then the household can decide there and then whether they wish to proceed or not.

However, like many areas of society, this form of engagement had to be significantly limited during the pandemic, as social distancing and lockdown restrictions prevented such activity.

Market Research (surveys and focus groups)

In order to better understand the community of Leiston and how the project should communicate to become more successful, a series of market research projects were conducted with The University of Suffolk. This included an online survey, which looked to determine understanding and awareness of key concepts, such as “Net Zero” and “Climate Change”. The survey also looked to determine the priority of environmental issues for people in Leiston. Unsurprisingly perhaps, finances and energy security ranked higher in importance than environmental priorities, but awareness and understanding of climate change, and the effects of it, were well understood. The research found that awareness of Net Zero Leiston was strong in the community, but more work was required to help people really understand what was meant by the term “Net Zero”.

Following the survey, a series of focus groups were conducted, to delve into more detail with the community participants. This resulted in several recommendations and findings which would help support the success of the project.

This form of direct engagement was very detailed, and vital for understanding how the project should communicate. It is difficult to scale up this form of direct engagement to a very large scale. The survey resulted in around 100 responses, with the focus groups securing around 10 participants.

Community Events

One of the more informal forms of community engagement conducted was to attend an event at the local museum in Leiston, The Long Shop Museum, to celebrate “Suffolk Day”. This event attracted a variety of residents and businesses from around the town, in addition to some community leaders. This activity was used to raise the profile of the project and promote the available pilot schemes. The more informal arrangement meant that the community could come and ask questions and directly interact with the project.

Interviews with specific community groups

An early form of engagement, when establishing the goals of the project, was to conduct a standalone review of energy vulnerability in Leiston. A project partner, Energy Systems Catapult, carried out 10 interviews with households in vulnerable circumstances from the community. The insight and output of this can be seen in **Chapter 10**.

This form of engagement enabled to project to hear first-hand experiences from the community, which are vital when establishing appropriate pilots schemes and messaging.

Schools Programmes

The high school in Leiston, The Alde Valley Academy, is a key stakeholder group in the town. It was assumed that children, learning about climate change and the effects it could have on their future, would be more engaged with a project focussed on tackling carbon emissions. Equally, the topic of climate change and reaching Net Zero fits well into the science and geography curriculum. The students themselves, upon understanding the project and its goals, become local champions for the project and begin to raise the profile of it further.



Two schools’ programmes were launched in the school:

- » A climate action programme, supported by a site energy and waste audit, acted as an education programme, raising awareness of the need for the Net Zero Leiston Project.
- » A Net Zero Challenge, where students were encouraged to create their own Net Zero Projects, helping them to learn and understand more about how Net Zero Leiston works.

PILOTS

Net Zero Leiston Tariff

Shortly after launching the project, a low carbon tariff was launched in collaboration with EDF. Having a low carbon tariff would support our transition into Net Zero by raising awareness of how important supporting grid decarbonisation is, and by offering a tariff at a fixed lower price, residents will be motivated to join the scheme.

The initiative was to make low-carbon power affordable for all households and was an exclusive tariff for people living in Leiston, backed by 100% low-carbon sources like nuclear, wind and solar. The tariff was removed from sale in September 2021.

Hybrid heat pumps

Although LPG tanks are considered better than oil tanks (LPG emits 81% of the CO₂ per kWh produced by oil), both are still fossil fuels and therefore emit high levels of CO₂. Residents of Leiston who rely on heating from LPG or oil tanks because their home isn’t connected to the gas network were offered access to a low-carbon hybrid heating system at a heavily discounted price. This adds an air source heat pump to their existing boiler, so they don’t need to replace their existing system. The heat pump provides about 80% of the heating demand, meaning less oil/LPG is used to heat their home, and therefore a reduced carbon footprint. This offer was removed from sale in March 2021. Whilst this offer was useful for residents not on the gas grid, hybrid heat pumps service a small market, and are being superceded by fully electric heat pumps, for example in the governments commitment to financing 90,000 new heat pumps across the UK¹.

Energy efficiency measures

By becoming more energy efficient, residents will save on their energy bills and reduce their carbon footprint. Installing loft insulation, for example, can offer heat savings between 23% - 34%, with savings per year on energy bills ranging from £135 - £240².

Many of the homes in Leiston could benefit from better insulation. This pilot uses the Energy Performance Certificate (EPC) register to pinpoint homes with low energy efficiency, then suggests measures to become more energy efficient, for example through insulation in walls, roofs, or flooring.

The project successfully secured some funding via a Local Authority Delivered Green Homes Grant, by partnering with East and West Suffolk Councils in a bid to BEIS. There were eligibility requirements for homes to qualify for funding, but in many cases this funding mean measures could be installed free of charge to the resident. Additionally, energy company obligation (ECO) funding was used, which had its own set of eligibility requirements, but was another route to free energy efficiency measures for some Leiston homes.

LESSONS LEARNED

Through various interactions with Leiston residents listed above we have learned valuable lessons to carry forward for future pilots and for other replicated projects.

Leiston has a high proportion of residents over the age of 60, but also many under the age of 25. NZL wide disparity presents a challenge in the approach required to reach the target audience. As a result, we have learned how important it is to supplement digital with physical communication such as posters and leaflets.

Other lessons we learned can be seen particularly in the tariff and heat pump pilot, where our project understood the importance of it being community led. We found that generally people will be sceptical about energy companies, presenting difficulties to gain take up for offers which present significant environmental and economic benefits. Engaging community champions to share messaging around the pilot offers was more effective than direct communications from EDF.

Another key lesson regards timing. It has become clear that residents in general are much less keen to make big changes to their heating systems over the winter months. Therefore, pilots to do with improving heating systems are much more seasonal than anticipated, calling for a heavier push during summer months.

Finally, our team has become much more aware of the usefulness of letter drops and posters in key areas of the community. This highlights the need of eye catching yet informative letters/ posters to help spread awareness and inspire change.

PERSONAL BEHAVIOURAL CHANGES AND COMMUNITY ENABLERS

As previously mentioned, the only way the project can progress successfully is through working closely with the community. However, there will be barriers to change within the community which means encouragement and education is necessary to help improve personal behavioural changes. There are also a number of activities that are beneficial to enabling and supporting a Net Zero town, but don't necessarily have a direct effect on emissions and are therefore omitted from the Route Map.

These could include:

- » Encouraging **recycling** and improved waste management, working with local authority partners and their waste management teams, including community outreach and education initiatives.
- » Creating a '**Leiston Climate Assembly**' or similar community group of local champions to promote Net Zero Leiston, resident and business engagement, and identify new ways to engaging the local community, its residents, businesses, and visitors including tourists.
- » **Creating a multi-purpose community facility** – this could act as an iconic project creating a local community hub, hosting education and information on actions to achieve Net Zero, wider energy efficiency, sustainable travel choices, and more information on the proposed technologies in the Route Map.
- » **Community Kitchen facilities** - providing a resource for community allotment holders and local catering businesses. Potentially part of the Community facility providing cold storage, shared kitchens, and flexible community space for events and local community groups.
- » Leiston has a large area of **allotments** and **greenhouses** which provides an opportunity for supporting the community to **enhance local food production**, with local **gardening/allotment clubs**.
- » Local **food sharing clubs**, supported by storage and chilling in the nearby **community kitchen** facilities, if developed as part of the Community Hub, information could be provided on crop rotation, natural fertilisers and soil enrichment, and community education on sustainable food choices, engaging local schools and young children from an early age.

- » Enhancing the use and production of the local allotments will allow more ambitious and experienced growers to adopt innovative **vertical and modern small-scale farming** support, which could further enhance productivity and new types of crops not previously considered viable due to available space.
- » **Community Car share schemes**, which have proven to be popular in many urban areas. Developing a Net Zero Community Car Scheme for Leiston, with access to one or more electric vehicles on a bookable platform, could enhance social mobility and promote low carbon travel choices. Subject to host location(s), solar canopy parking could be integrated with storage and charging bays for local residents. (Note: longer-term, hydrogen fuel-cell vehicles could also be added once refuelling stations are more common)
- » **Encouraging and enabling swap shops** which reduce waste by allowing the community to swap items they don't need for items that they do, rather than buying them new and disposing of items.
- » **Voluntary repair cafés** which are set up to help people repair broken items, rather than throw them away. People with the ability to do the repairs can meet with the community and host repair events.
- » **Community fridges** prevent wasted food, where food that is not needed, but is not finished, is put in a community fridge for others to take when they need to.

(Note: longer-term, hydrogen fuel-cell vehicles could also be added once refuelling stations are more common)





CHAPTER 10

VULNERABLE HOUSEHOLDS

Authored by

CATAPULT
Energy Systems



SEPTEMBER 2020

OVERVIEW

This chapter was authored by Energy Systems Catapult for the Net Zero Leiston (NZL) project.

EnSC's role within Net Zero Leiston is to:

- » Advise how issues of fuel poverty and consumer vulnerability might be addressed in the design and development of Net Zero Leiston,
- » Developing a framework for creating fair solutions
- » Conducting consumer insight activities with local residents.

INTRODUCTION

It is important that the benefits of an energy transition to Net Zero reach vulnerable households or those at risk of fuel poverty. One of NZL's project principles is to address fuel poverty. The causes of climate change and fuel poverty are not the same; therefore the solutions to them are unlikely to be the same. This work explores how we can ensure that the final solution chosen to be part of Net Zero Leiston include those that address fuel poverty and include the needs of vulnerable households.

WHAT MAKES PEOPLE VULNERABLE TO FUEL POVERTY MAY CHANGE IN THE FUTURE

Vulnerability is context-dependent rather than a personal attribute alone. For this work, vulnerability is where personal attributes interact with the energy system that they live (use and buy energy services) in. The transition to Net Zero will include new technologies in people's homes, new ways of buying energy and new organisations that consumers will interact with. The situations that make households vulnerable at the moment may therefore be different to the situations in the future. Changes such as decarbonization, decentralization and digitalization are likely to cause the biggest impacts in household vulnerability in years to come.



ALIGNING SOLUTIONS TO ADDRESS FUEL POVERTY AND ENGAGE WITH THE LOCAL COMMUNITY

Success of a solution is about whether it reaches households at risk of fuel poverty and the impact on them. There are three elements of what it means for a solution to impact fuel poverty in a Net Zero future (Figure 1). NZL aims to be a positive experience for people in the community. Exploring how solutions impact fuel poverty is one way to achieve this.

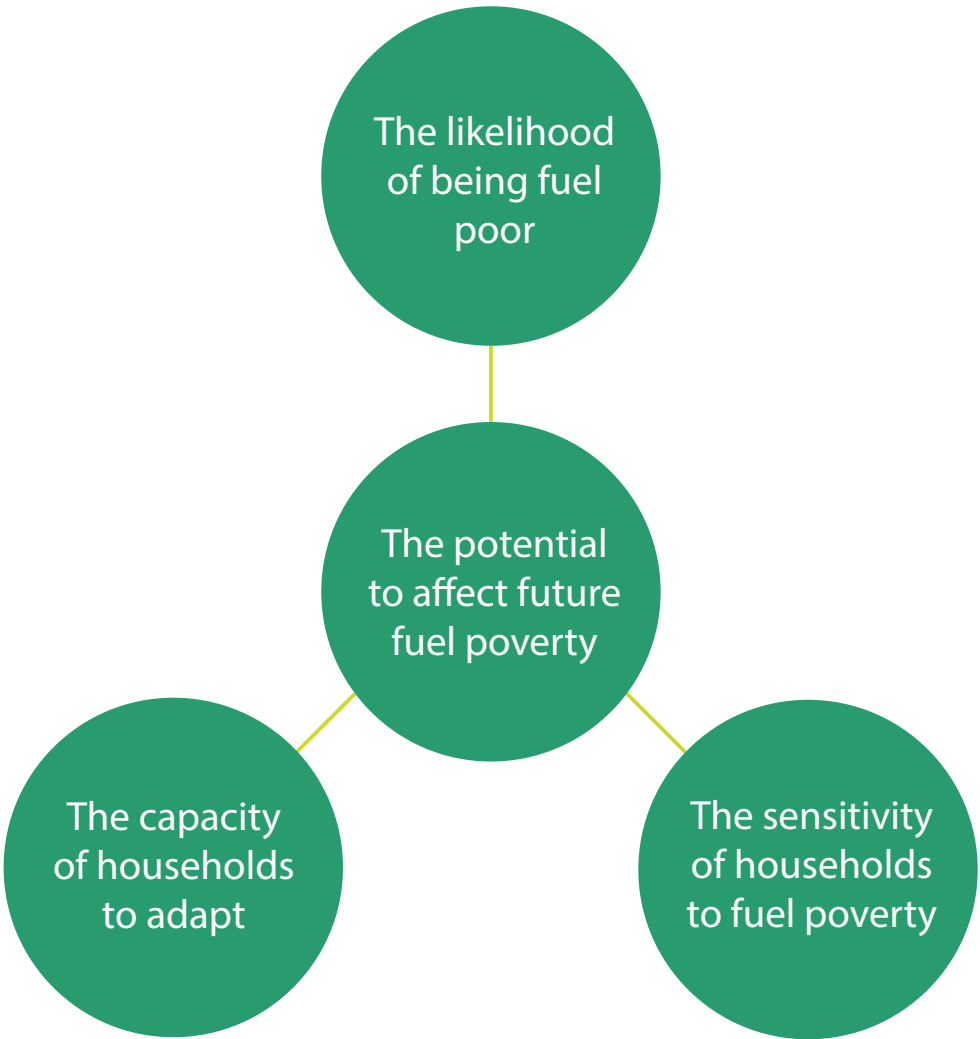


Figure 1: Three elements of impact for households at risk of fuel poverty in the future

DESIGNING NZL SOLUTIONS THAT MEET THE NEEDS OF VULNERABLE CONSUMERS

To design solutions that result in a positive experience for consumers, we need to ensure that the solution addresses the needs they have. Figure 2 is the high level process EnSC use to do this. The work included in this report follows this process.

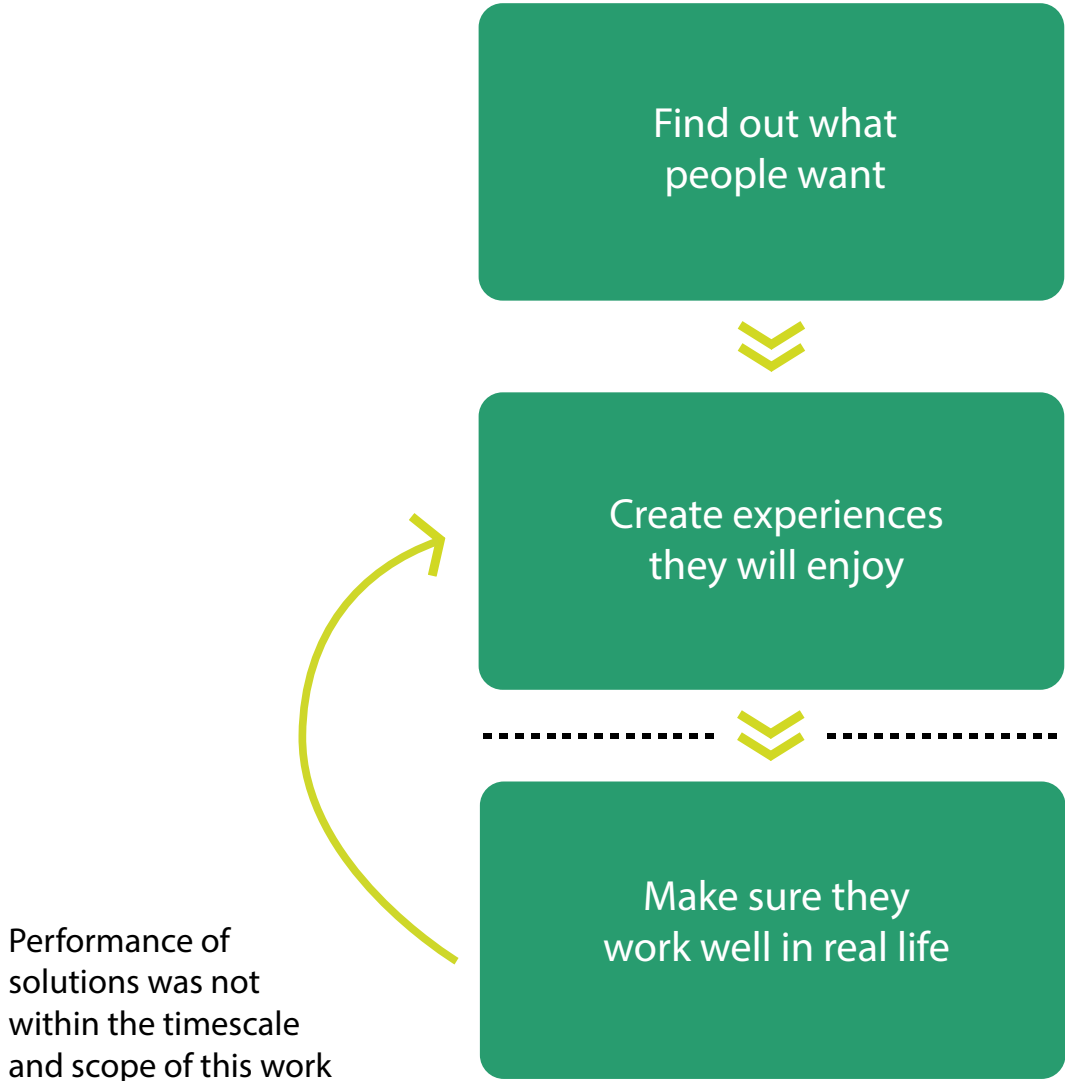


Figure 2: A process for designing consumer-centered solutions

OVERVIEW OF THIS WORK

Outputs of the work by ESC for NZL are shown in Figure 3 and are included in this slide pack.

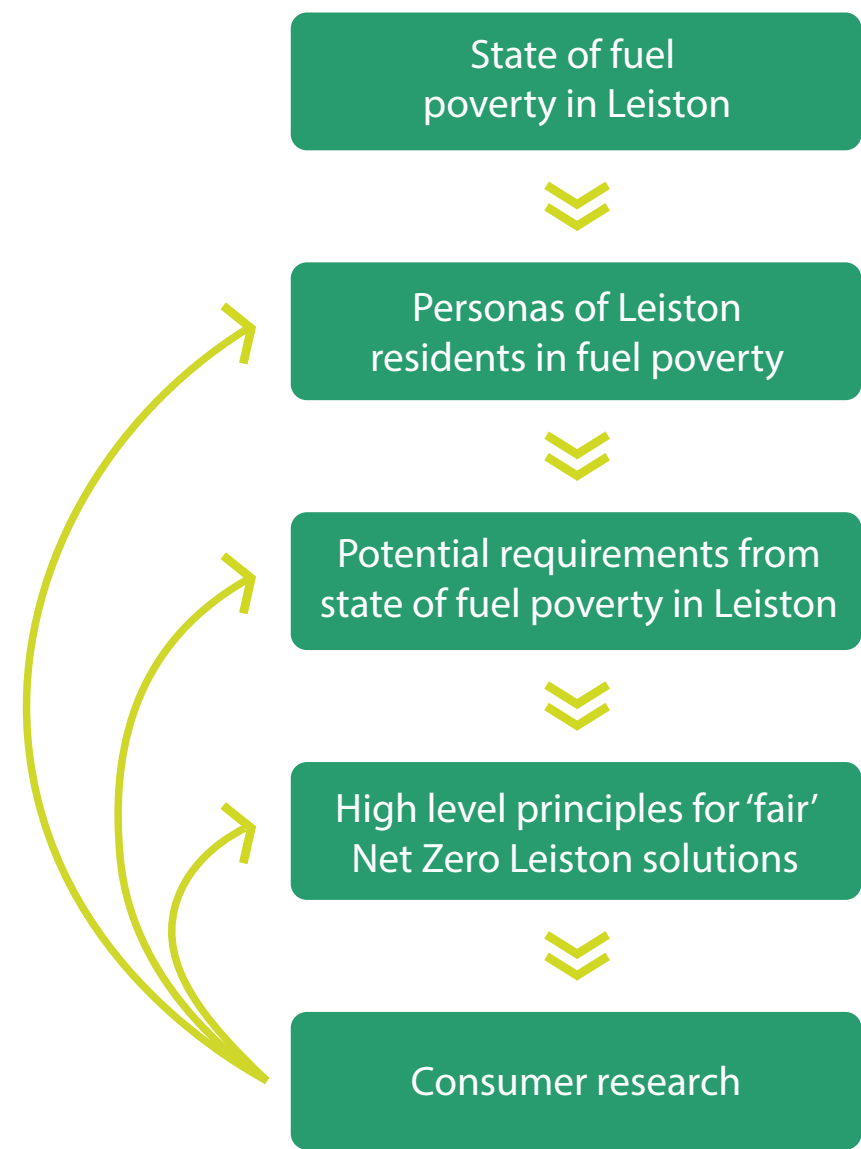


Figure 3: Outputs of work from ESC for NZL

STATE OF FUEL POVERTY IN LEISTON

Key characteristics of fuel poverty in Leiston that should be taken into account when designing fair solutions in Net Zero Leiston:

- Privately rented homes, including those with multiple households within a home.
- Working patterns. Unstable, relatively low incomes from employment largely coming from the hospitality, health and social care sectors.
- Disengaged households. Households that have not switched supplier or tariff. Households who lack basic digital skills and the confidence to manage bills online.
- The hidden fuel poor - households that don't ask for help but may be able to benefit from support on offer.

PERSONAS FOR NET ZERO LEISTON

These personas are fictional residents of Leiston and have been designed to try and capture a range of likely needs and motivations of residents living in the area. Factors that might make a household vulnerable to fuel poverty have been emphasised. Any similarities to real people are purely coincidental. These were prepared by the Energy System Catapult by drawing on desk-based research and some conversations with the Net Zero Leiston Working Group. These personas can be used to test designs and delivery methods for actions planned as part of Net Zero Leiston.

DAX, CHARLIE, SAM AND JOE

A family with two young children. They are trying reduce their energy bill whilst balancing it with the needs of the family.

- » Dax and Charlie work in hospitality, trying to take it in turns to organise childcare between them or with family.
- » They live in a privately rented, terraced house. They sometimes struggle to pay the rent but usually manage within a week or two of when it was due. They claim Universal Credit. They are trying to save for a deposit to buy somewhere but haven't managed to save much towards it.
- » They are thinking of moving out of the area in the next few years. A bigger

town or city might offer more choices of places to work. It would also mean they wouldn't need their car, which is expensive to run, to get to work and school. They often can't park outside their house because parking on the street is very busy.

- » They have recently asked their landlord if they can have a smart prepayment meter as they are worried their hours at work might get reduced soon and they might have trouble managing their costs.
- » They are happy to ask for help but don't know where to start and feel sure that they will soon be able to cope.
- » Looking after the children and getting to work have to come first, other household costs have to be a lower priority. Charlie is constantly looking for deals and offers online for their household essentials.

DENISE

A retired person living in their family home. She is worried about the cost of keeping her home warm and keeping warm is important for her to feel well.

- » She has lived in this home for many decades, its where her and her late husband brought up their children. It's a 3 bed semi-detached house that they own outright.
- » Denise has poor health so a regular health visitor comes to the house and she regularly sees her GP for various aches and pains.
- » She likes having a car because it makes her feel independent and safe in case she has to go to the doctors or the shops and can't walk very far.
- » Her energy bill keeps on rising but she will always pay her direct debit so she doesn't have any debt. Sometimes she might not use the heating to save money and she might reduce other household spending.
- » She has a consistent, stable/secure income but it is low.
- » She doesn't like to change their energy supplier or household contracts with businesses because she is worried about it costing more and things going wrong in the process.

- » She doesn't have a smart phone or use the internet because she doesn't feel its relevant to her and the way she lives.

DAVID

David rents a room from their live-in landlord. He has a good relationship with their landlord and feels comfortable asking for changes around the house but does not want to ask too much and risk getting asked to leave.

- » There are other residents who rent a room in the same 3 bed semi-detached house.
- » He's planning to stay in the area for the remainder of his 6 month contract in the area. It is a zero hours contract at the moment and he drives 5 miles to work each day.
- » His bedroom can be very cold and there is often condensation on the windows but the landlord says its always been like that and nothing would change it.
- » He is only planning to be in the house for 6 months or so at the moment so he doesn't want to look for anywhere else to live. He might end up staying longer but he isn't planning anything long term at the moment.
- » The rent was increased a month after he lived there which was unexpected but he paid it and will spend less on other things to make sure he can afford his bills.
- » He regularly manages his bills online and uses his smart phone often and for doing things more quickly and easily. He thinks buying things is cheaper that way too.

FRAMEWORK SOLUTIONS TO ADDRESS FUEL POVERTY

Creating fair solutions can happen over the length of a standard consumer journey.

We have created principles to understand how a solution could be fair at each of these stages in a consumer journey.

Principles	Description
Desirability (Consumers want it)	This principle refers to how desirable consumers may perceive this solution. This will be influenced by how appealing the features of an offer are to a consumer, how familiar the offer is to them and how much they trust the provider of the offer. For vulnerable consumers in particular, the benefits of a solution could be beyond energy and include mental and physical health benefits or changes in indoor environmental quality.
Ease of access (Consumers can get it)	This principle refers to whether it requires access to certain basic capabilities to access the benefits of it. The main factors that shape this are likely to be whether a household has access to broadband and basic digital skills, whether they have physical space at the property and whether they have permission to make the changes (in terms of landlord and planning permission).
Affordability (Consumers can afford it)	This principle covers the financial requirements on the consumer of the solution. Currently, fuel poverty is used to describe a household's annual income level, but new business models will be part of the energy future and will require a wider understanding of what it means for a household to be able to “afford” them.
Enjoyable (Consumers enjoy it)	This principle refers to whether vulnerable consumers enjoy the experience of using the solution so that they become an advocate for it. This is important for the scale and pace of the transition needed to reach Net Zero.
Longevity (It has a lasting effect)	This principle refers to how long the solution will work to address fuel poverty. For example, changing energy tariffs could reduce costs, but after a period of time (e.g. 3 years) consumers may be able to move to a more competitive deal by switching supplier or tariff. Another example is that insulating a home will only reduce costs whilst that household lives there. Their costs could rise if they have to move to another home (e.g. because they are in privately rented accommodation).

THE USE OF THIS FRAMEWORK WITHIN THE DEVELOPMENT OF NET ZERO LEISTON

A step that uses these principles has been incorporated into the process for approving pilot projects in NZL before showing them to the local representatives in the NZL working group. These principles are also used in shortlisting ideas for the NZL Route Map (led by Atkins and Opergy) from a long list to a medium and then a short list.



CONSUMER RESEARCH: LEISTON RESIDENTS AT RISK OF FUEL POVERTY IN A NET ZERO WORLD

The aim of this research was to create specific characteristics within each of the fair principles for households in fuel poverty living in Leiston. Conclusions from this would enable NZL to design solutions that result in a positive experience for consumers by ensuring the solution addresses the needs they have. We spoke with 10 residents within the Net Zero Leiston boundary in August and September 2020. All names are fictional to protect the identity of the interviewees.

KEY CHARACTERISTICS OF INTERVIEWEES

- » All homeowners
- » Household size: Single resident: 4, two residents: 4, three or more residents: 2
- » Pay their energy bill by a monthly direct debit
- » Half of interviewees had a health condition made worse by the cold
- » Five were retired, four were in employment (part and full time) and one stated ‘other’
- » Some people were very worried about their energy bills, and other people weren’t worried at all

DESIRABILITY

There was a desire to see Leiston town, as a community, take actions to address climate change. People were aware of issues around climate change and its effects on the environment broadly. However, they didn’t think that climate change affects their day to day lives. People had problems with getting comfortable in their homes and had searched for solutions to these problems. The perceived benefits were improving the comfort of the house and reducing maintenance of the building itself. People tried different energy tariffs and



suppliers as well as shopping around for other household services. Some people didn't trust businesses, local and national, currently providing products and services they had considered buying.

"It's what Leiston wants to do and it's a good initiative, I'm all for it 100%. And I want to reduce my energy bills. " - Cam

EASE OF ACCESS

People who didn't use the internet or weren't confident using it did not feel there was a benefit in using it to address the problems they had using and buying energy. They had concerns about data privacy, a lack of trust in businesses working in energy and building improvements and the overall costs of using and buying these technologies and building improvements. When people discussed changing their home, they were not sure what options were best for the property and said they didn't have money needed to make changes.

"[The internet has] no relevance in my life." - Mary

AFFORDABILITY

Most people were very aware of the cost of energy and other household expenses. Budgeting and knowledge of household spending was a common feature of most households. Adjusting their home heating was the main focus of people's efforts so far to reduce the cost of their energy bill. People tried many ways to get comfortable and control their heating at considerable time and financial cost to them. This was mainly focused on additional heaters in the house and energy efficiency improvements to the building. People had predominately spent money on energy-related products to get more comfortable in their home and had bought them as they had money available, rather in one large initial purchase.

When discussing new heating systems and controls, Mary said "It all sounds good, but in the end, it all costs."

ENJOYABILITY

People wanted to be confident they were on the cheapest or best energy tariff they could be. People chose services that matched their environmental values e.g. renewable energy. People currently struggled with public transport and cited it as a reason they couldn't use their car less than they currently did.

When asked about actions taken to reduce their carbon emissions, one resident, Sandra, said, "We use a car, but then [public] transport's really poor around here so that's not something I can do without."

LONGEVITY

People intended to stay in their homes for the foreseeable future and had been resident in Leiston for many years. Interviewees were all homeowners so their situation could be different to those in private or social rental properties. People's lives were complex and dynamic, so services needed to also be dynamic in order to match that their income and needs changed over time.

"I'm quite chuffed that I live in Leiston where we've got the Co-Op which is [...] Fairtrade and environmentally friendly [...] I think there is a lot more we can do."- Cathy

RECOMMENDED CHARACTERISTICS FOR NZL SOLUTIONS FOR THOSE AT RISK OF FUEL POVERTY

Principles	Solutions that work for vulnerable households in Leiston would need to...
Desirability (Consumers want it)	» Build and maintain trust in the organisation providing the solution » Endorsed by local organisations
Ease of access (Consumers can get it)	» Be available online and offline » Be available for homes in different building conditions (such as building age and previous upgrades)

Principles	Solutions that work for vulnerable households in Leiston would need to...
Affordability (Consumers can afford it)	» Spread any high upfront costs out over time to be paid back in small amounts » Enable flexible payment holidays » Guarantee that solutions will reduce their energy bill
Enjoyable (Consumers enjoy it)	» Give them the comfort they want and easy control of their energy in their home
Longevity (It has a lasting effect)	» Be the cheapest deal available to them » Be adapted if people's needs change within the same house

CONCLUSIONS

Main opportunities for NZL identified from this research with local residents:

1. Net Zero Leiston could show local residents the broad range of actions they could take to contribute to climate change and build pride in Leiston about addressing climate change.
2. NZL activity could build trust in organisations delivering solutions using reviews and feedback from residents who have used the solutions and through expert recommendations from local groups they already have pride and interest in.
3. NZL could address fuel poverty by enabling people to control their heating easily and address problems getting comfortable within the building (such as draughts, damp and mould) through innovative solutions that don't require large, initial one-off purchases.



NEXT STEPS

This research has identified characteristics that are important for designing experiences that Leiston households at risk of fuel poverty will enjoy using and benefit from. The NZL pilots will be a great opportunity to design and test great experiences of solutions in real life. Further work could focus on how to design NZL solutions could be delivered through flexible, small payments rather than large one-off purchases and in a way that allows people to get warm in their homes.





CHAPTER 11

ENERGY CONSUMER INSIGHTS

Authored by



INTRODUCTION

Local market analysis and consideration of the study boundary area (as defined in **Chapter 2 - NZL Boundry**) is key to construction of a Route Map which is bespoke and appropriate for the Leiston town and its population. Successful implementation of the Net Zero Leiston Route Map relies on a thorough understanding of the local resident demographic as well as the types of properties in the area, as this guides the types of products, services and initiatives which are both relevant and beneficial to Leiston and its residents.

This chapter will discuss the residential profiling and housing stock of the Leiston area. Data such as population age, occupation, income and housing type has been used to infer market segment profiles for the Leiston population and the three most prevalent segments are highlighted. The segmentation and supporting data gives an idea of the response of the population to initiatives and schemes as well as the potential uptake of low carbon products and services.

1. KEY CHARACTERISTICS

1.1 RESIDENTIAL PROFILE

The age distribution of Leiston (Figure 1) shows that the Leiston area has top heavy age profile, with many residents over the age of 65 and the three most prevalent age brackets all above 70. This is typical for Suffolk, which characteristically has an older age profile than the rest of Great Britain. Leiston has a dominance of skilled and manual workers (Figure 2), which may reflect the workforce of the utilities and energy sector serving Sizewell B. Conversely, Leiston is poorly represented in the higher skilled sectors, including professional and managerial occupations as well as students and unemployed. A high proportion of Leiston residents are also retired, tying in with the age distribution seen in Figure 1. Although some of the population have an annual income of over £50k, the majority of the Leiston population have an income of less than £30k which is indicative of a low-income area (Figure 3).



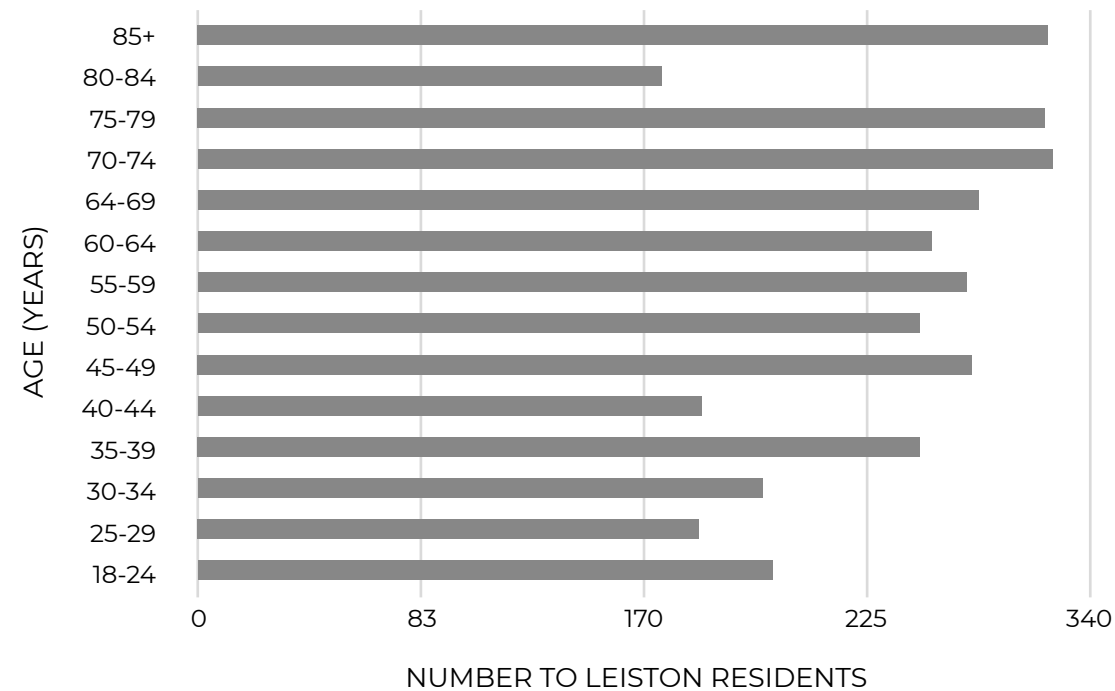


Figure 1: Age distribution of the residents of the Leiston area.

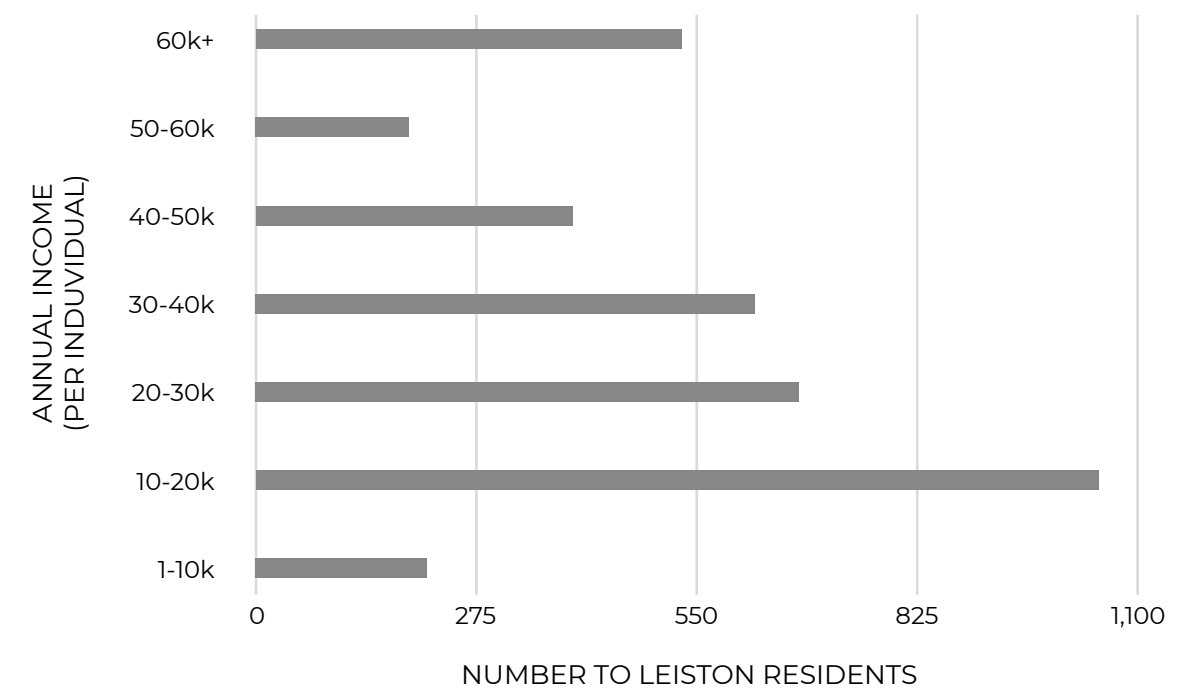


Figure 3: Income profile of the residents of the Leiston area.

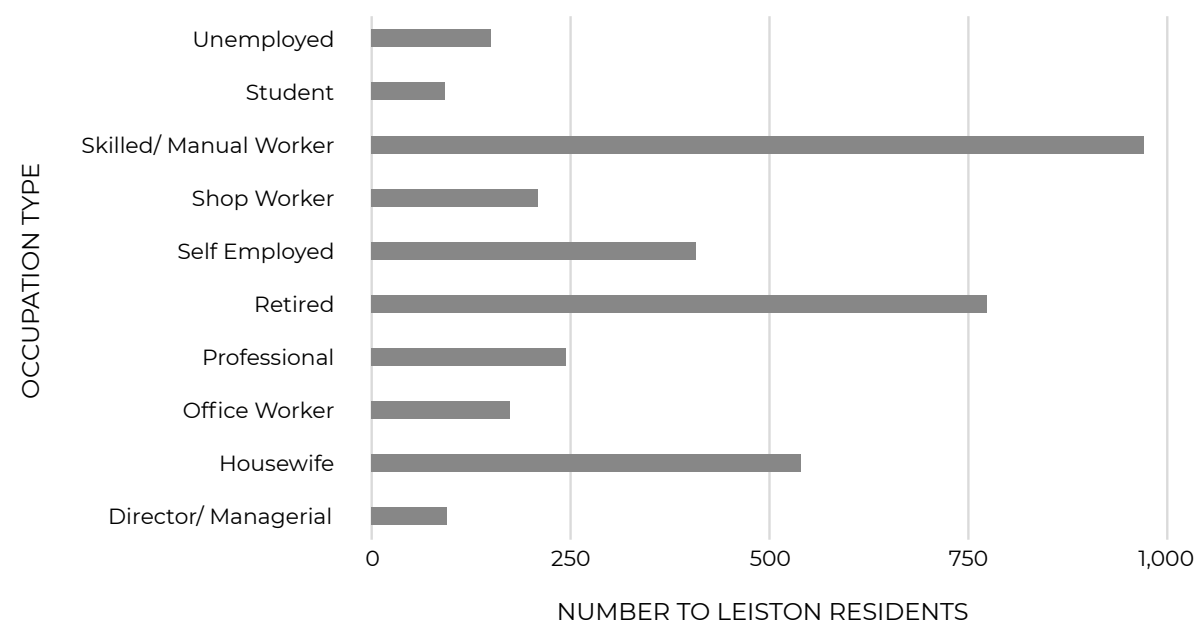


Figure 2: Occupation profile of the residents of the Leiston area.

1.2 PROPERTY PROFILE

Leiston has a mixture of property types, property sizes and tenure. Approximately two thirds of the housing stock in Leiston is owner-occupied, with the other third roughly split between social renting and private renting (Figure 4). Semi-detached properties and terraced properties are the most common housing types, making up over half of the housing stock (Figure 5). The proportion of detached housing is low, which reflects historic land use priorities, with a previous requirement for rapid development transforming Leiston into a high-density town. Subsequently, there is a high proportion of 2 and 3 bedroom properties in the area whereas the number of for five bedroom properties is much lower (Figure 5).

An Energy Performance Certificate (EPC) is a way of measuring the energy efficiency of a home, with A-rated homes being the most energy efficient and G-rated homes being the least energy efficient. The potential EPC rating in Figure 7 shows the rating that would be achieved if all measures recommended by the EPC survey were implemented. Currently just over 13% of homes in Leiston are rated A or B, and 26%

of homes are rated E, F or G. If all measures recommended by the EPC survey were implemented, 54% of homes would be rated A or B and 4% of homes would be E, F or G.

Property Ownership	Number of Properties
Owner-Occupied	2,377
Private Renting	588
Social Renting	718

Figure 4: Local distribution of property ownership in Leiston. Data from CACI database, March 2020.

Property Type	Number of Properties
Bungalow	711
Detached	572
Flat or Maisonette	333
Semi-detached	1,134
Terraced	933

Figure 5: Distribution of property types in Leiston. Data from CACI database, March 2020.

Number of Bedrooms	Number of Properties
1 Bedroom	369
2 Bedrooms	1195
3 Bedrooms	1509
4 Bedrooms	516
5 Bedrooms	94

Figure 6: Distribution of property types in Leiston. Data from CACI database, March 2020.

EPC Rating of Property	Current EPC Rating (Percentage of Homes in Leiston)	Potential EPC Rating (Percentage of Homes in Leiston)
A	0.2%	12%
B	13%	42%
C	24%	31%
D	37%	10%
E	18%	3%
F	6%	1%
G	2%	0%

Figure 7: Current and potential Energy Performance Certificate (EPC) rating of the properties of the Leiston study area.

1.3. SEGMENTATION

Quantitative analysis of a variety of household-level data suggests that Leiston is broadly comprised of three groupings:

- » “Established Families”
- » “Emerging Families”
- » “Retired Couples”

The established families segment encompasses families with older children that typically live in larger properties of 3 or more bedrooms. This group often have disposable income, are homeowners, with billpayers aged between 40 and 60. The emerging families segment includes younger families on lower incomes, with a high proportion of these renting their current home. Retired couples are older and predominantly have low, fixed incomes. It is likely these consumers will account for a strong proportion of the bungalow-owning population of the area. Further analysis and profiling suggest that, as a whole, the residents of Leiston are less likely to engage with the internet, social networking and smart technology relative to the rest of Great Britain as these indicators are all under index.

In the medium to longer term, any new build developments in the area should be considered as new occupants may represent a different consumer demographic and profile, causing a shift in consumer

behaviour, needs and sequential segmentation. These types of shifts could positively affect the speed of uptake in the later stages of the Route Map.

1.4 UPTAKE POTENTIAL OF LOW CARBON PRODUCTS

Leiston's unique residential and property profiles are key to understanding the types of low carbon products that would add the most value to the residents of Leiston. Property profiling is especially important when considering that uptake of home improvement measures such as insulation, double glazing and heating system recommendations are largely property specific opposed to consumer specific. Heat and transport have been highlighted as key areas for carbon emissions reduction (**Chapter 7**) and so products relevant to these categories are discussed, as well as consumer income and attitude which are significant factors for uptake.

Insulation including loft, floor and wall insulation are highly relevant for Leiston properties as EPC data (Figure 7) shows a high proportion of houses could benefit from a significant reduction in heat-related carbon emissions and an increased EPC rating if introduced. Insight carried out by the Energy Systems Catapult (ESC), **Chapter 10**, indicated that insulation products are of interest to Leiston residents, but also highlighted the current barriers to uptake as lack of knowledge about appropriate insulation products and consumer uncertainty around where to begin with installation or product queries. Insulation is an accessible and attractive solution for low EPC-rated homes and low income households as they may be able to take advantage of funding streams such as the Energy Companies Obligation (ECO), and the Green Homes Grant Scheme which includes the Green Homes Grant Voucher Scheme and the Local Authority Delivery Scheme (LAD). Receiving funding support from these schemes will facilitate inclusivity of low EPC rated and low income households, allowing them to also benefit from a potential energy bill reduction in the longer term.

The heat market is reactive, with many consumers only acting when heat appliances break down. This, coupled with low awareness of low carbon heating products such as heat pumps means there is little consumer appetite to embark on large-scale home improvement endeavours with climate change as a principal motivator. Short-term uptake of heat pumps is likely to be low for gas homes, but could be much higher in properties with liquid petroleum gas (LPG) or oil heating where cost saving is a factor and government grants such as the Renewable Heat Incentive (RHI) help to offset initial investment in technology.

ESC consumer insight indicates that Leiston residents would prefer a stepped approach to retrofitting their homes, where small scale measures are implemented in stages, opposed to a whole-home retrofit method. This is predominantly due to the financial implications of a whole-home retrofit and the potential disruption caused. Products and schemes implemented would need to align with this approach and be supported by funding where possible.

In terms of transport, a key facilitator for emissions reduction is electric vehicles. The profile of motorists identified as likely to consider an electric vehicle in the short-to-medium term is predominantly a young male, around the age of 36, with a high annual household income. It's worth noting that the Leiston population demographic does not align with this profile and therefore, uptake of electric vehicles may appear slow in the short term. It will be necessary to account for this challenge in prospective transport strategies and plans for electric vehicle charge points. However, this could change if new government grants or scrappage schemes become available.

1.5 DATA COLLECTION

For residential and property profiling, household-level data was analysed against CACI's (Consumer Database and Information) Ocean database. This database reflects qualities of the UK population, and contains over 500 attributes that help understand consumer demographics, lifestyle, affluence and preferred communication channel. The data is updated quarterly and correct as of March 2020. The n=3,683 households in the IP16 postcode were included in the analysis, covering the settlements of Aldringham, Eastbridge, Knodishall, Leiston, Sizewell, Theberton and Thorpeness, and compared against the Great Britain national average, generated from 29.4 million households.

The EPC rating for n=2441 properties in the study area were analysed from online, publicly available EPC data (Figure 7).

Alongside this, EDF's residential segmentation was also included as a variable in the analysis. This was built in 2019, from a survey with a sample representative of Great Britain's energy billpaying population (n=5,500 respondents), combined with energy consumption and EDF customer data, as well as OCEAN. Seven respective segment profiles were generated, three of which are mentioned in Section 1.3.

Outcomes from Energy Systems Catapult (ESC) targeted consumer insight survey are also referenced (for further details please see **Chapter 10**).



CHAPTER 12

SOCIAL VALUE FRAMEWORK

Authored by



SEPTEMBER 2020

INTRODUCTION

Net Zero Leiston is an ambitious, first-of-a-kind, community-led project developing a Route Map for a Net Zero-carbon community in Suffolk. Using an evidence-based approach, the project identifies a diverse range of potential options to support the local community in moving to a Net Zero-carbon future over the coming decade.

This chapter provides an overview of how the project could deliver social value and measure its impacts.

1. WHAT IS SOCIAL VALUE?

Social value is an approach to commissioning and investing which recognises the social, economic and environmental benefits to communities over and above the direct purchasing of goods and services.

Social value is often a term used by public bodies, whereas corporate bodies typically use 'Environmental, Social and Governance' (ESG) frameworks. ESG is often defined as a broad framework to evaluate corporate entities and geographic regions on how far advanced they are with sustainability against agreed goals. In recent years, ESG has been associated with the 'Just Transition' based on principles and practices that build towards a sustainable and inclusive economy that benefits wider society and the environment. For the purposes of this chapter we will adopt a broadly similar definition.

A social value approach enables a shift from the focus on the cost and financial benefits of a service to the overall value of the outcomes delivered. It can offer significant advantages to organisations by reducing barriers which prevent them from delivering to their full potential and by offering opportunities to:

- » Engage with communities at an earlier stage in the design and commissioning process
- » Demonstrate recognition for the added benefit that any investment can leverage and deliver
- » Use innovation to generate competitive advantage

Social value is typically measured in terms of outcomes and benefits. They are the benefits to the community in addition to the main service being commissioned.

Benefits can take many forms and can include economic, health, and environmental measures. They may be tangible such as new jobs for long-term unemployed people or they may be softer benefits such as involvement of groups who might otherwise feel entirely disengaged.



In the context of Net Zero Leiston, the primary objective is working with and supporting the local community to deliver a range of measures to reduce greenhouse gas emissions and achieve Net Zero emissions by 2030, whilst developing opportunities to create new, long-term jobs, demonstrating new technologies, and delivering direct community benefit.

The Public Services (Social Value) Act 2012 requires public bodies “to have regard to economic, social and environmental well-being in connection with public services contracts; and for connected purposes”.

For East Suffolk Council, as the District Authority covering Leiston, social value is “about maximising the impact of public expenditure”. For the Council, it is a way of thinking about how resources are allocated and used. It involves looking beyond the cost of individual contracts at the collective benefit to a community when a public body awards an appropriate contract. Social value asks the question: If £1 is spent on the delivery of works, supplies and services, can that same £1 also produce a wider benefit to the community?

2. SOCIAL VALUE STATEMENT

The Net Zero Leiston project has created a set of project principles to help steer and shape the development of a robust **Route Map to achieve Net Zero emissions by 2030**. These are:

- a. Ensuring local stakeholders are at the heart of the project
- b. Taking a thorough, robust engineering approach, not greenwashing
- c. Addressing fuel poverty and providing social mobility
- d. Understanding how different technologies work together to create a replicable energy showcase
- e. Combining Net Zero ideas with replicable funding solutions
- f. Maximising wider benefits and opportunities for all stakeholders
- g. Helping the region achieve its climate goals and continuing the UK’s focus as a leader in the journey to Net Zero

The project’s social value statement is:

Net Zero Leiston will work with and support the local community to deliver a range of measures to reduce greenhouse gas emissions and achieve Net Zero emissions by 2030, whilst delivering opportunities to create jobs, demonstrating new technologies, and ensuring direct community benefits.



3. SOCIAL VALUE CONTEXT

In considering the project’s wider approach to delivering social value, consideration has been given to aligning activity to the UN Sustainable Development Goals (SDGs). The overarching ambition of Net Zero Leiston is most closely aligned to SDG Goal 13 – **taking urgent action to combat climate change and its impacts**.

The project will directly and indirectly support action against at least 8 of the 17 goals, notably the following:

- » SDG 7 on affordable and clean energy
- » SDG 8 on inclusive and sustainable economic growth
- » SDG 9 on building resilient infrastructure
- » SDG 11 on sustainable cities and communities
- » SDG 12 ensuring sustainable consumption and production patterns
- » SDG 13 on climate action
- » SDG 15 on sustainable managed forestry, and
- » SDG 16 on promoting just and inclusive societies.

The positive contribution that the NZL project will have on the SDGs is outlined below.





Figure 1 - UN Sustainable Development Goals aligned to Net Zero Leiston

SDG 7 on affordable and clean energy: The UN report on the progress on this goal in 2020 notes that access to electricity and improving energy efficiency are moving forward. The report continues to highlight the need to move to renewable energy much more quickly to meet the goals as defined. Energy efficiency also needs to improve. A 2.7% annual decrease in the primary energy intensity is needed; the current rate of improvement is 2.2% annually. The NZL project will be moving domestic heating, local industry, agriculture, and transport to a Net Zero position. Both energy efficiency and moving energy consumption to sustainable sources will be pivotal to this project.

SDG 8 on inclusive and sustainable economic growth: The 2020 report notes the significant impact that the pandemic has had on the global economy and the resulting recession reducing working hours. There is a need to improve the amount of employment and training available, particularly for younger people. The need for more progress in closing the gender pay gap is also noted. The NZL project is expected to create training opportunities, which should be directed towards local people of all genders and towards younger age groups where appropriate.

SDG 9 on building resilient infrastructure: The reported progress on this goal says that the steady reduction in manufacturing has been amplified by the COVID-19 pandemic noting the impact to global supply chains. Air travel has been particularly impacted with very considerable capacity reduction. The evidence of the decoupling of carbon emissions and GDP growth continues with the continued decline in the CO₂ intensity. The Leiston project will demonstrate the continuation of this decoupling and a Net Zero economy for the area. A focus on community and the local economy is expected to further help the decoupling.

SDG 11 on sustainable cities and communities: Progress is reported for this goal in the 2019 and 2020 reports while noting that the number of slum dwellers is increasing as a proportion of the urban population. The areas that are relevant to Leiston include access to public transport and air quality. The NZL project is expected to promote public transport as part of the reduction of carbon emissions and to deliver an overall improvement in air quality.

SDG 12 ensuring sustainable consumption and production patterns: The global consumption of materials has increased rapidly. The prosperous developed countries have a 40% higher per capita consumption than the global average. The NZL project has the potential to contribute to reductions in material consumption by community-based approaches to recycling and reuse. The replenishment of natural resources may also help to reduce material consumption impacts.

SDG 13 on climate action: The 2020 progress report for this goal mentions that the global greenhouse gas emissions are expected to drop as compared to 2019. It also notes that 2019 was the second warmest year on record and that the 2010-2019 decade was the warmest on record. The report repeats calls for an urgent curtailment of still-rising (as of 2017) atmospheric carbon dioxide levels and the rising costs of disasters attributed to climate change in terms of lives lost and financial cost. The need to decarbonise is becoming more urgent every day as the global community is “far off track to meet either the 1.5 or 2°C targets called for in the Paris Agreement”. Many features of the NZL project will support this goal, particularly the decarbonisation of the region.

SDG 15 on sustainable managed forestry: The forest areas continue to decline. The proportion of forest area fell to 31.2% in 2020 from 31.9%. This is a net loss of 100m ha. Latin America, sub-Saharan Africa and South-Eastern Asia were the areas of most decrease due to land conversion to agriculture. Species extinction risk is worsening with the Red List index declining. The need to protect and expand areas of natural habitats and to promote the species diversity is imperative. The NZL project creates opportunities to improve the situation locally and to demonstrate these widely. To date, opportunities in forestry have been identified, but as the project progresses further initiatives may be identified and should be followed up. The implementation, which is likely to be both community-based and agriculture-led, and the learnings from that will be as important as the specific local solutions that are applied. The replication of the implementation of the solutions will create significant benefit.

SDG 16 on promoting just and inclusive societies: The main opportunity that the NZL project can contribute to this goal is around responsive, inclusive, participative, and representative decision-making at all levels. The Net Zero Leiston (NZL) Working Group is responsible for strategic decision making relating to the production of the NZL Route Map. This collaborative group is supported by (1) a local Leiston Steering Committee which a community-led group responsible for decision making related to implementing low-emission propositions in the town, and (2) an internal EDF NZL Steering Group. The approach of involving the community contributes to the success of the project and the increased adoption of solutions by the wider community as well as other positive outcomes.

To deliver the optimal social value as a part of the NZL project will require a coordinated response across a wide group of stakeholders, from the community and civic leaders, residents, business, and industry. When NZL was conceived in late-2019, the local economy was growing, and communities were thriving.

However, at the beginning of 2020, the global coronavirus (COVID-19) pandemic caused widespread disruption across all areas of society. With three general lockdowns in effect during 2020 and 2021 in England for extended periods, businesses temporarily closing their offices and factories, and residents were asked to not leave their homes except in particular circumstances, the effects on society and the economy have been profound.

There remains a risk that the shift to Net Zero could be overtaken and not realised because of a change of focus towards supporting more traditional economic growth as part of any post-COVID-19 economic response.

With the forecast of economic recession, calls for a ‘clean economic recovery’ are becoming more prevalent in national and international media. Many global leaders are suggesting that we must use this unique period to our collective advantage and not return to business as usual. Instead, many are calling for policies to build a better, more sustainable, more resilient, and more equitable society in terms of recovery from the COVID-19 crisis. Initial indications have been positive that there is a strong ambition by both national and local governments to support the green economy as a major part of the recovery. Slogans such as “Build back better” have been used to communicate this.

In this context, NZL offers an excellent opportunity to support the local community and to be a catalyst for change in ways that could complement any approach taken by government bodies. Providing a community-led response to rebuilding local economies that support the transition to Net Zero could become a replicable model, inspired in part by the ambition of Leiston and the NZL project. The learnings of this project will need to be quickly communicated to enable other communities to benefit from them for the post-COVID-19 recovery.

4. MEASURING SOCIAL VALUE FOR NET ZERO LEISTON

With the Net Zero Leiston Route Map in development, it is difficult to set out an exact approach to measuring social value given the wide variety of potential ideas and concepts under consideration. However, a broad approach underpinned by high-level framework to assess Route Map options being considered, and their potential social value impacts, is possible. Table 1 below shows the indicative outcomes to consider the social value impacts of implementing the Route Map options to deliver Net Zero Leiston.

	Indicative Outcome(s)
Environmental	» Reduced GHG emissions » Reduced Climate Impacts » Reduced air pollution » Sustainable procurement promoted » Increased use of low emission transport » Improved biodiversity » Improved water management » Improved energy efficiency » Reduced water pollution » Reuse of waste streams (e.g. waste heat, wastewater) » Zero impact to, or enhancement of, the adjacent protected sites

Economic	» Support creation of local jobs » Stimulate opportunities for local business » Improved skills for local people » Encourage innovation and uptake of new clean and sustainable technologies » Increase in circular economy supply chain opportunities
Social	» Increased opportunities for disadvantaged people » Improved employability for young people » Reduced crime » Creating a healthier community, both physically and mentally » Improved social mobility » Vulnerable people are helped to live independently » Build and improve community facilities » Strengthen community cohesion between age range, ethnicity and other groups

Table 1 - High-level Net Zero Leiston Social Value Indicative Outcomes

The community of Leiston needs to have the opportunity to review this list of indicative outcomes and to refine and adjust it to ensure that the measures are appropriate for the community now and for the future needs of Leiston. Community involvement is in keeping with the first of the NZL Project Principles. Considering that fuel poverty is specifically mentioned in the NZL Project Principles, an outcome directly linked to fuel poverty should be considered for inclusion.

Figure 2 shows the high-level options assessment model for moving from the long list of options to the medium list and to the short list. The long to medium list assessment has used a qualitative process, with a simple RAG (Red/Amber/Green) criteria based on those listed. This includes a significant focus on emissions reduction and community benefits, including social mobility, local job creation, and impact on vulnerable residents.

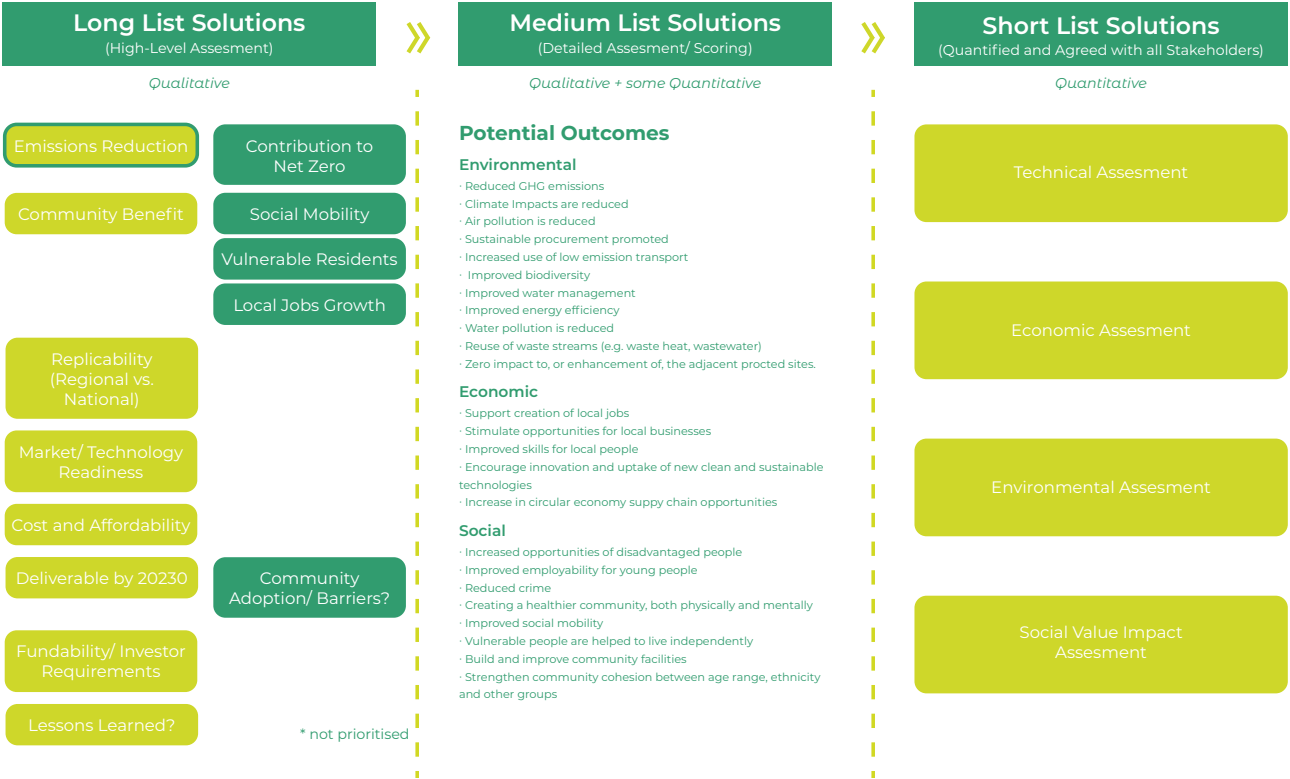


Figure 2 - Options Assessment Process (Indicative)

The next stage is to reduce the medium list to a short list. The process applies a scoring system based on “bang vs. buck”, i.e. scoring of carbon saving potential vs. costs. All the categories are scored between one and five, (five being most positive impact, 1 being most negative). The scores for the other categories can flag an option that should perhaps not progress due to a low score. The top 25% of the measures progress as green and the next 25% progress as amber.

5. IMPACTS ASSESSMENT OF OPTIONS ON SOCIAL VALUE OUTCOMES

The short-listed options have been assessed in terms of their impact on the social value outcomes. Each option has been scored based on its expected impact on each of the outcomes. The scoring is one of: a slight positive benefit, a positive benefit, or a strong positive benefit.

The results of this assessment are in Figure 3 – Assessment of Impact of Options on Outcomes. The options are coloured according to the previous scoring that has put them into the green or amber category. The community options have not been scored in this way due to the relatively low capital cost involved and because they are to be taken forward as a package to deliver the benefit that they will bring collectively.

Clearly there are strong connections between the transport and building options and the economic outcomes. The linkages between the option groups and the outcome groups will be explored later in this section.

1. These options within the community measures need to be given focus to ensure that positive impact in this area is achieved, and
2. When designing other options in different groups, e.g. transport and agriculture, the options should be designed to generate benefits in these outcome areas. These benefits will not be realised automatically; they will need to be built in by imposing conditions on organisations that are to develop offerings in these sectors. For example, if financial or other support is provided to an organisation to fit heat pump systems to domestic properties in Leiston, then a condition might be that at least 15% of the roles created must be apprenticeships that are open only to vulnerable or long-term unemployed people from the local area. If such conditions are not imposed, the benefits of the NZL project will pass by these groups of people that need support and the benefits will be largely felt by more affluent members of the community.

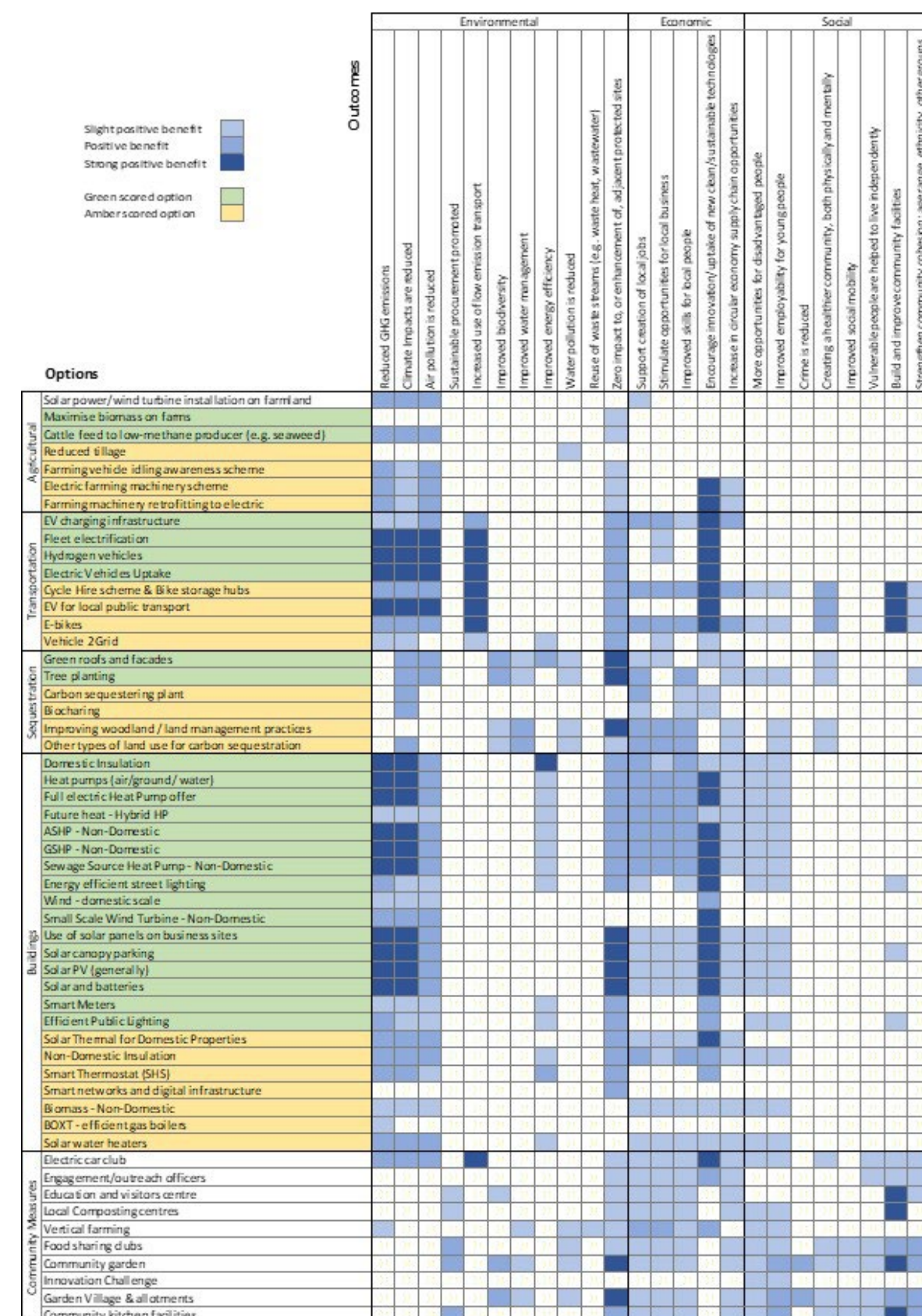


Figure 3 – Assessment of Impact of Options on Outcomes

In order to assess the larger scale connections between the five groups of options: agriculture, transport, sequestration, buildings, and community measures and the three groups of outcomes: environmental, economic, and social, the overall scoring has been reviewed. From this it is clear which of the option groups are supporting the outcome groups, as shown in Figure 4 – Impact of Option Groups on Outcome Groups.

		Outcome Groups		
		Environmental	Economic	Social
Option Groups	Agricultural	0.43	0.26	0.00
	Transportation	1.05	1.20	0.34
	Sequestration	0.64	1.00	0.19
	Buildings	0.74	1.17	0.19
	Community Measures	0.41	0.88	0.84

Figure 4 – Impact of Option Groups on Outcome Groups

Listing these in descending order gives the following sequence, Figure 5 - Hierarchy of Impact of option Groups on Outcome Groups.

Option Group	Outcome Group	
Transportation	Economic	1.20
Buildings	Economic	1.17
Transportation	Environmental	1.05
Sequestration	Economic	1.00
Community Measures	Economic	0.88
Community Measures	Social	0.84
Buildings	Environmental	0.74
Sequestration	Environmental	0.64
Agricultural	Environmental	0.43
Community Measures	Environmental	0.41

Transportation	Social	0.34
Agricultural	Economic	0.26
Buildings	Social	0.19
Sequestration	Social	0.19
Agricultural	Social	0.00

Figure 5 - Hierarchy of Impact of option Groups on Outcome Groups

Economic outcomes are expected to be realised most strongly, and social outcomes least strongly. The transport and buildings options are expected to have the most impact. Agricultural options are not expected to have such significant impacts. A major strength of the NZL projects is the breadth of the options that have been considered and are planned to be taken forward, and that these options are in different groups, positively affecting many sectors of the community. This list should not be taken as a priority sequence; it should be a call to action. This assessment of the impacts is a basis upon which to work. The areas that are not expected to have such a strong impact can be reviewed, developed, and designed to maximise the positive impact that they have on the outcomes, including outcomes that are not currently strongly linked. The example given earlier of ensuring that an organisation that is fitting heat pumps to domestic premises employs 15% of apprentices from vulnerable and long-term unemployed groups would increase the Buildings option group impact on the Social outcome group. Designing the options to incorporate such features to enhance the benefits will ensure that the NZL project has a beneficial and lasting effect on the whole community of Leiston, as well as the headline aim of achieving Net Zero.

6. METRICS FOR ASSESSMENT OF OUTCOMES

The outcomes of the NZL project are broad-ranging and will improve the environment, strengthen the local economy, and socially benefit the community of Leiston. To measure the achievement of the project effectively, measures will be needed. Some metrics will be easy to define, with several options to choose from; some will be more difficult to devise due to the nature of the intended beneficial outcome. A mixture of quantitative and qualitative metrics is likely to be required to assess the full range of outcomes that are expected to be achieved from the range of options that will be selected to be taken forward. It will be important that the metrics decided upon do not create unintended consequences. This will require proper planning and consultation to ensure that the metrics cover a sufficiently broad range of social value outcomes.

The metrics will be valuable to:

- » Ensure that the options that are implemented are delivering the expected benefits by holding the subprojects to account to produce both the planned deliverables and the outcomes
- » Facilitate the communication of the benefits to internal and external stakeholders and to a wider audience.

The metrics should be monitored for a period after the official end of the NZL project. It is important to ensure, and to be able to demonstrate, that the benefits are sustainable. The long life of the technologies being implanted and the need for long-term jobs make this monitoring particularly important for this project.

To ensure that the assessment of the outcomes is not only impartial but seen to be objective, an independent organisation should be appointed to carry out the measurement of the metrics. Two alternatives could be employed:

- » A specialist assessment organisation,
- » A partnership with an academic institution, which might be a local university.

There would be significant advantages for the learnings that come out of the NZL project for the assessment to be over an extended period. A time range of 10-15+ years would seem appropriate considering the life of the project and the technologies being installed. Therefore, an extended longitudinal study would be a good approach. Because other similar projects can benefit from the achievements and lessons learned as time passes, interim reports of the social value achieved must be published regularly to share the learnings. Such a time period would suit an academic institution well.

The selection and appointment of the assessment organisation needs to be an inclusive exercise that is run jointly by the community of Leiston and by the project organisation. A top-down approach by the project this will undermine the objective and neutral stance of the assessor, which is vital to the community accepting the measurement of the project's social value.

The selection and appointment of the assessor needs to start soon so the assessment can be initiated, and the current baseline of the social value measures measured to provide a baseline for the project,

Community involvement in the selection of appropriate social value measures is essential. This should consider both measures that are currently valued and those that are anticipated to be applicable in the future. The agreed social value measures will provide a basis upon which the selection of an assessment organisation can be based.

7. CONCLUSIONS

In summary, the conclusions of this chapter are:

- » The selected outcomes for the NZL project support eight UN Sustainable Development Goals and fits the global and national context including supporting recovery after the global pandemic.
- » Consideration needs to be given to including an outcome directly measuring reduction of fuel poverty as this is one of the NZL Project Principles.
- » The social value indicative outcomes must be the subject of a consultation with stakeholders, particularly the Leiston community, to ensure that they are appropriate now and for the future.
- » The short-listed options, with suitably applied conditions to emphasise delivery of benefits in the Social Outcomes group, should enable all the indicative outcomes to be delivered.
- » Due to their strong linkage, it is important to deliver options from all the groups to ensure that all the outcome groups are delivered. This is particularly important in the case of the Community Measures options group enabling delivery of the Social Outcomes group.
- » Metrics to measure outcomes are important to ensure delivery and enable communication.
- » The social value measurement needs to be over an extended period to properly assess the project and to ensure that the learnings are available to other locations following a path to Net Zero.
- » The measurement of the project's social value should be by an independent assessment body that is objective and can be seen by all stakeholders to be objective.
- » The process of appointing the assessment body needs the involvement and buy-in from the project's stakeholders, particularly the Leiston community.

- » The early commencement of appointing the assessment body will enable a baseline of the social value measure to be taken before the project delivery starts.
- » The alignment between the outcomes for the NZL project and the Sizewell C project will help the projects to support each other to maximise delivery of the outcomes.

8. NEXT STEPS

The immediate next steps to ensure that the NZL project delivers the intended social value are below, and highlighted in Figure 6:

- » Using the list of indicative social value measures as a basis, an exercise was started in the first half of 2021 with the Leiston community to adjust and agree the measures that will be used for the measurement of the social value of the NZL project; delivered as part of the draft Route Map community engagement process.
- » Ensure the agreed social value measures are embedded in the implementation planning for NZL.
- » Consider inclusion of an outcome of reduction of fuel poverty.
- » Start the engagement process of an independent assessment organisation that will carry out an extended longitudinal study over 10-15+ years in order to make baseline measurements before the delivery of the project starts.



Figure 6 - Next Steps on Social Value

GOVERNANCE

NZL: TECHNICAL REPORT





CHAPTER 13

POLICY OVERVIEW

Authored by



NOVEMBER 2021

With Specialist input and review from



INTRODUCTION

Net Zero Leiston is an ambitious, first-of-its-kind, community-led project developing a Route Map for a zero-carbon community in Suffolk. Using an evidence-based approach, the project is identifying a diverse range of potential options to support the local community move to a zero-carbon future over the next decade.

The key stated objective of the project is “to produce a high-level, achievable Route Map, using available technologies, to identify the steps needed to get Leiston to Net Zero.”

The Net Zero Leiston project has created a set of project principles to help steer and shape the development of a robust Route Map to achieve Net Zero emissions by 2030. These are:

- » Ensuring local stakeholders are at the heart of the project
- » Taking a thorough, robust engineering approach, not greenwashing
- » Addressing fuel poverty and providing social mobility
- » Understanding how different technologies work together to create a replicable energy showcase
- » Combining Net Zero ideas with replicable funding solutions
- » Maximising wider benefits and opportunities for all stakeholders
- » Helping the region achieve its climate goals and continuing the UK's focus as a leader in the journey to Net Zero

This summary report provides an overview of relevant local, national and international policy. It draws information from a wide range of sources, summarising the current policy landscape. It then explores how Net Zero Leiston is delivering against these policy areas highlighting challenges and possible opportunities to consider in any future policy landscape.

This report highlights some examples of potential measures being considered and explored, however does not go into detail against each policy area. As projects and the Route Map, and associated delivery and implementation plans, are further defined, alignment with specific and appropriate policies will be considered as part of any business case for funding or investment.



1. LOCAL POLICY CONTEXT

1.1 NORFOLK & SUFFOLK ECONOMIC STRATEGY

The New Anglia Local Enterprise Partnership (LEP) published the Norfolk and Suffolk Economic Strategy in 2017 articulating stretching ambitions and priority actions to deliver increased economic growth, job creation, increased wages and new housing across the LEP geography by 2036.

Targets include 88,000 net jobs; 140,000 new homes; 30,000 new businesses (building on 61,000 existing enterprises); and £17.5bn economic growth in real terms; with a higher proportion of people engaged in the labour market than across the UK.

The strategy highlights the region's diverse £35.5bn local economy and existing specialisms in clean energy, ports and logistics, advanced manufacturing, ICT, life sciences and biotechnology.

Norfolk and Suffolk have a number of key centres of economic activity, with fast-growing urban centres, historic market towns and a largely rural economy. Its natural landscape and cultural heritage give Norfolk and Suffolk its distinctive character.

Norfolk and Suffolk's coastal areas are identified as 'priority places' for growth in the clean energy sectors, including Bacton, Great Yarmouth, Lowestoft and Sizewell, supporting businesses and skills involved in onshore and offshore renewable energy, nuclear, and gas exploration and production.

The strategy highlights that Norfolk and Suffolk is the only UK region to have major projects and investments in natural gas, offshore wind, and nuclear, with forecast investment in excess of £50bn.

New nuclear is identified as a key sector offering opportunities to share best practice and collaborate with other UK regions, in particular Somerset and the South West exploring synergies between Hinkley Point, Sizewell, and potentially Bradwell in north Essex.

The Economic Strategy offers support to businesses growing within these priority sectors, and support to the continued development and growth of the established local clusters in the industries locally.



1.2 NORFOLK & SUFFOLK LOCAL INDUSTRIAL STRATEGY

The Norfolk and Suffolk Local Industrial Strategy was published in draft and endorsed by the New Anglia LEP board and by local partners in October 2019. It is currently awaiting Ministerial sign-off.

The Local Industrial Strategy is the next stage in the evolution and implementation of the Norfolk and Suffolk Economic Strategy. It builds on the Economic Strategy but with a deeper and more focused approach to high growth opportunity sectors and building on established regional strengths.

It focuses on three opportunity areas: clean energy, agri-food and ICT/digital creative.

The strategy also recognises a number of underpinning sectors such as ports and logistics and culture and the visitor economy which underpin the economy.

The golden thread which runs through the Local Industrial Strategy is clean growth, with Norfolk and Suffolk positioned as the UK's clean growth region and leading the transition to a post-carbon economy.

The strategy's clean growth focus builds on the proposition that Norfolk and Suffolk are at the forefront of tackling the challenges and opportunities of climate change. The area's major strengths in low-carbon energy generation and usage, and high-tech sustainable agri-food, present major opportunities.

The strategy highlights that the region is well placed to be a global exemplar for clean, low-carbon energy production, exporting services and skills globally, whilst increasing the availability of affordable, sustainable energy for local communities and businesses.

Planned investments in renewable and nuclear power generation projects, which includes positive support for the development of Sizewell C, could make the region a leading supplier of clean energy to the UK, providing power for up to 58 per cent of the UK's homes.

In addition to the three opportunity sectors, the strategy is underpinned by five foundations:

- » Ideas: Improving collaboration across businesses and sectors, driving up levels of business innovation, whilst increasing the adoption and diffusion of new technologies.
- » People: Continue to grow an inclusive economy with a highly skilled workforce where skills and employment provision meet business need and the aspirations of individuals.



- » Infrastructure: Deliver integrated infrastructure to enable productivity gains and clean growth and to create places that people want to live and work.
- » Business Environment: Creating more high growth businesses, increasing entrepreneurship and helping businesses make the decisions they need to be agile, productive and responsive.
- » Place: Transforming the Norfolk and Suffolk economy into one of the best places in the world to live, learn, work and succeed in business.

These five foundations are aligned with the UK's Industrial Strategy. The Local Industrial Strategy has been adopted by local partners and is awaiting Government approval.

RESPONSE: NZL aligns well with the ambitions set out in both the Economic and Local Industrial Strategies. It embodies the vision of 'clean growth' at the local community level, bringing strong local leadership and enhancing the local 'place'.

NZL will support all three identified high growth opportunity sectors. Clean energy is core to the project, in part by the nature of the project's origins with the Sizewell C project and EDF in the

UK as its initial sponsors, but also how the project will explore greater take up of electric vehicles, electrification of domestic heating, and potential development of local solar or similar clean energy projects.

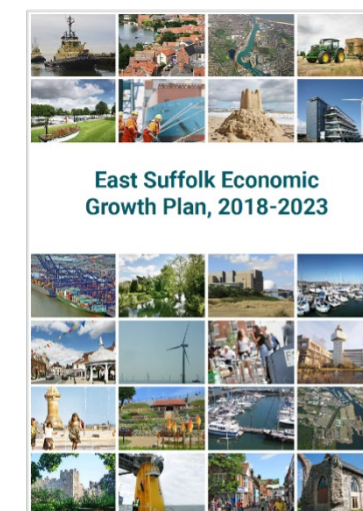
On agriculture, NZL will directly support local food and farming production through targeted support to local allotment holders and community food producers. It will identify options to work with farmers and landowners to sequester carbon and enhance productivity.

On digital, NZL will explore the potential of smarter homes using smart technologies and data to support long term behavioural change across the local area.

NZL is innovative, place-based, focused on enhancing social mobility and creating a carbon neutral community, with a blueprint to support other areas to take similar approaches.

1.3 EAST SUFFOLK ECONOMIC GROWTH PLAN

This Economic Growth Plan 2018 – 2023 sets out how the East Suffolk Council (previously Suffolk Coastal and Waveney District Councils) and its partners will create the best environment for businesses to start up, flourish and grow to facilitate economic growth in the plan period. It has been designed with strong alignment to the Norfolk and Suffolk Economic Strategy focussing on the strengths and opportunities of the local area and will set out how it aims to achieve sustainable growth through maximising the competitive advantage in key sectors such as clean energy, ICT, tourism and logistics.



Promoting growth is one of the central pillars, where the plan identifies four significant economic assets and opportunities that are “amongst the most significant anywhere in the UK”, one of which is Sizewell B and also a second one is offshore renewable energy. Sizewell and Leiston are identified as a priority place to encourage investment and growth, principally linked to the ongoing operation of Sizewell B and development of Sizewell C.

The headline vision for the plan is “that businesses across East Suffolk have the confidence to invest and grow, creating opportunities for people of all ages and improving further the quality of life in an outstanding environment.”

To achieve this, the Council has set out three main priorities:

- » Supporting entrepreneurs and entrepreneurship in East Suffolk
- » Encouraging established businesses to invest and grow
- » Attracting inward investment to East Suffolk, focused around existing and emerging sectors and supply chains

The East Suffolk Economic Growth Plan recognises the potential of the key sectors with high-growth potential including energy, manufacturing and engineering, marine, ports and logistics. East Suffolk Council has committed to supporting the clean energy sector by:

- » Continuing to ensure appropriate land and premises provision in and near Lowestoft to enable the offshore energy sector – and its supply chain – to thrive
- » Supporting the case for investment in Sizewell C, ensuring that this is linked to clear economic development outcomes, and learning from

the experience of other similar ventures (e.g. Hinkley Point) in respect of supply chains, inward investment opportunities, and employment and skills

Supporting the development of the Energy Skills Centre at East Coast College's Lowestoft campus to address skills issues in the energy sector

- » Working with New Anglia LEP to develop the 'East of England Energy Coast', recognising the role, contribution and potential of East Suffolk's specialisms in renewables, nuclear and gas.

1.4 EAST SUFFOLK (SUFFOLK COASTAL) LOCAL PLAN

Despite the merger of Suffolk Coastal and Waveney District Councils effective 1 April 2019, the Local Plan development process for both districts follows different timescales. Whilst the Waveney Local Plan was adopted in March 2019; the Suffolk Coastal Local Plan is currently being examined by an Independent Planning Inspector with comments to be received by July 2020 and adoption due late-2020.

The Local Plan sets out covers the period to 2036. It identifies where growth should be located, and how it should be delivered, setting out the planning policies used to determine planning applications. It covers the former Suffolk Coastal District area.



The plan highlights that Suffolk Coastal has one of the oldest populations of any district in the country, and this places additional requirements on service providers and infrastructure provision. Over the plan period, it is anticipated that the percentage of the population who are working-age will decline.

Suffolk Coastal's landscape is diverse, including large areas of farmland, which support rich biodiversity and contain features of geodiversity. The District contains over 48km of open coastline as well as over 139km of estuaries. Despite this, East Anglia is recognised by the Environment Agency as an area of 'serious water stress'. As one of the driest parts of the country, water resources need to be carefully managed.

The East of England is one of the fastest-growing regions, and Suffolk Coastal is a key contributor to this growth. The District is home to a number of key economic drivers such as the Port of Felixstowe, Sizewell Nuclear Power Station, offshore wind energy developments and BT operations at Adastral Park. These large-scale employers have a local presence but contribute significantly to the national and international economies, and the Local Plan seeks to support this contribution.

In March 2017, the Leiston Neighbourhood Plan was 'made' as part of the Suffolk Coastal Development Plan. The Neighbourhood Plan sets out a vision and strategy for Leiston which the District Council

supports. The Neighbourhood Plan allocates sites for a variety of uses including residential, employment, car parking and tourism which will guide the future development in Leiston until 2029, and which the principles and vision will be retained to 2036 in line with the Local Plan period.

The Local Plan states that by 2036, Leiston will have continued to thrive as a community that recognises and embraces its industrial heritage whilst serving its residents and surrounding communities. The

Local Plan identifies a figure of 100 dwellings, to come forward which is already allocated in the Leiston Neighbourhood Plan or with planning permission.

It sets out that the Sizewell nuclear power station has an influence on Leiston and over the plan period nationally-significant decisions made in respect of Sizewell C, and other major energy projects will have impacts locally. This may include planning policies in respect of local housing needs, the private rented sector and houses of multiple occupation.

The Plans describes that decisions made in respect of Major Energy Infrastructure proposals will be informed by Local Plan Policy, and it is anticipated that these will have a significant impact on the community of Leiston. It is imperative that the Council and the local community work in partnership to ensure that any impacts of these projects are mitigated to the benefit of Leiston and also the wider natural environment.

1.4.1 ENERGY INFRASTRUCTURE

The Local Plan highlights that the Suffolk Coast is at the forefront of low-carbon electricity generation across the country both in respect of onshore and offshore energy. It is essential that major energy infrastructure projects are delivered in

a planned way which takes into account the potential impact of hosting large and nationally significant infrastructure in the District. The Council is committed to working in a collaborative partnership approach with the scheme promoters, local communities, Government, New Anglia Local Enterprise Partnership, service providers and public bodies to ensure the best outcomes of major energy infrastructure projects can be achieved.

The plan identifies that nuclear energy has been generated at Sizewell since the 1960s and will continue beyond the plan period as a result of the continued production at Sizewell B and with the prospects

of Sizewell C. Whilst decisions in respect of the new power station will be taken at a national level as a Nationally Significant Infrastructure Project, the role of the Local Plan will be to consider the suitability of any specific proposal and the mitigation of local impacts (both positive and negative) on the communities across the District and to realise the economic benefits.

The plan does go on to highlight that the Suffolk Coast is under pressure to support developments associated with the offshore energy sector and linking this into the national grid, as well as

inter-continental connections to enable the exchange of electricity with other countries. Investment in a variety of major energy infrastructure projects needs to be supported by infrastructure and facilities onshore, and these sectors are expected to require land to enable activities over the plan period. Where possible companies and developers will be encouraged to work collaboratively and share infrastructure and facilities.

RESPONSE: NZL has been initiated and is initially sponsored by EDF in the UK and the Sizewell C project. Sizewell B, as an existing nuclear power station, already provides a significant proportion of the UK's low-carbon electricity needs and could offer opportunities to demonstrate and test new technologies such as hydrogen production and heat recovery to support the decarbonisation of heat for homes and businesses.

NZL complements plans for the potential 'Sizewell Clean Energy Hub' concept, exploring low-carbon heating solutions, infrastructure to support electric vehicles, hydrogen production for heating and transport, energy storage, direct air capture, and ensuring local community and economic benefits can be realised.

Energy projects in Suffolk with infrastructure needs in or proximity to Leiston, such as offshore wind farms and planned interconnectors, need to be considered in terms of potential collaboration and integration through shared infrastructure opportunities which can directly benefit the local community.

Whilst Sizewell B and, in the future, C and large transmission-connected substation complexes are outside of the immediate scope of NZL, consideration will be given to local opportunities that benefit Leiston town and community, including but not limited to battery storage, local hydrogen production, and low-carbon heat. Local jobs and opportunities for local businesses will also be explored as direct community benefits.

Note: local grid capacity and potential reinforcement measures should be explored with UK Power Networks and Cadent as respective distribution network operators.

The Plans highlights that agriculture and farming are an important part of the District's economy. Traditionally farming provided significant employment opportunities, but over recent years the numbers have reduced due to increased costs and technological advances. However, farming remains a key economic sector in the District and the Local Plan seeks to ensure that appropriate farm diversification schemes can help sustain agricultural operations for the wider benefit.

On investment in Town Centre environments, the Local Plan highlights that all are at least partly within designated Conservation Areas. Any development should enhance and invest in historic environments and infrastructure, including public seating, arts and cultural facilities. This will help promote community interaction and healthy lifestyles. Development in the Town Centre should also provide enhancements for urban biodiversity where possible.

RESPONSE: The NZL Route Map will identify a wide range of options and, where possible, identify and support local businesses and suppliers to adapt, diversify or expand their existing offer.

Building on the community-led approach, businesses in the wider District will be engaged such as BT and the Port of Felixstowe, and offshore wind operators, to explore alignment and synergies on implementing viable Net Zero solutions. Where possible, collaborative programmes will be developed across skills, innovation, and supply chain growth against shared values and goals.

Beyond these larger ambitious projects, NZL will also support local business to improve and enhance local logistics and delivery. It will explore the possibilities of electric vehicles (bikes, cars, small vans) to support deliveries of local goods and services, such as bakeries and other food outlets.

Longer term, wider low carbon and green businesses could be attracted to Leiston given the local focus on Net Zero emissions, further creating local jobs.

1.4.2 ECONOMY

The East Suffolk Economic Growth Plan 2018-23 sets out a vision to 'focus on building business confidence, and with it, both the capacity and ambition of our businesses to invest and grow.' The Local Plan is a key contributor to this vision through the identification of appropriate land, premises and opportunities for economic growth.

The Local Plan states that the District's economy is supported by a high proportion of small and medium-sized businesses which are vital to the local economy and rural communities.

The District is home to a number of large-scale strategic businesses such as the Port of Felixstowe, Sizewell Nuclear Power Station and BT Campus at Adastral Park and it is important that the Local Plan responds to their needs. Not only are these businesses large employers but they also have a positive impact on the supply chains and related commercial activities across East Suffolk and the neighbouring authorities of Ipswich and Mid Suffolk as well the national and international economies.

1.4.3 HOUSING

This Local Plan sets a housing requirement of 10,746 new dwellings over the period 2018 – 2036. A new Garden Neighbourhood is planned for the south of Saxmundham, which will deliver 800 dwellings. Whilst no other new allocations are proposed in the Market Towns; the plan envisages that some small-scale development will come forward over the period.

The Strategic Housing Market Assessment for Ipswich and Waveney Housing Market Areas (2017) (SHMA) is a key piece of evidence which identifies the needs for mix and type of housing across the District to 2036.

The SHMA highlights that within the Ipswich Strategic Planning Area, the population of those aged over 65 is projected to increase by 57.8% to 2036. The East Suffolk Housing Strategy recognises that there is an increasing number of older people living in housing that is too large or is not suited to their mobility needs. It states that there is a need for more housing to be adapted to make it accessible, including higher-

level support for people with mobility problems and chronic health conditions. The development of new housing provides an opportunity to design-in such considerations. Provision of smaller, more suitable, accommodation may result in more of the existing larger properties becoming available

The Local Plan states that high house prices across the District mean that many people struggle to afford to purchase or rent a house on the open market. The Strategic Housing Market Assessment identifies that within Suffolk Coastal median property prices are higher than in the other parts of the Ipswich Area.

The Suffolk Design Review Panel was established by the Royal Institute of British Architects Suffolk in 2012, to help consider the design quality of planning applications. Comprised of local design experts, the aim of the Panel is to promote and encourage high standards in the design of the built environment across Suffolk.

The Local Plan also sets out that the District has varied built and historic environment with significant heritage assets alongside contemporary developments which provide a significant boost to the local economy. It supports that design is a key principle in the creation of sustainable development and should contribute positively to making communities better for everyone. It should be noted that the Local Plans does not currently address existing housing stocks or retrofit opportunities on energy efficiency.

The East Suffolk Housing Strategy (2017–23) identifies affordability as a key challenge and includes an area of focus around having a more proactive role in supporting the delivery of affordable housing. The strategy highlights that social housing applications in East Suffolk far outweigh the available properties each year.

The Suffolk Housing and Health Needs Assessment states that those living in social housing were more likely to say that their health was affected by their home than other groups. Improvements to homes with smart technology, insulation and sustainable heating solutions could be part of a future obligation on social housing (part of future Decent Homes Standards) or could improve existing efforts to maintain properties in social housing.

RESPONSE: The NZL project will have limited direct impact on housing policy. However, the project will identify options to strengthen the local delivery of low and zero-carbon solutions for new housing and supporting existing housing stock to become more environmentally sustainable.

NZL, working with the EDF in the UK domestic customers business, is identifying appropriate measures at a local level to support greater resilience such as retrofitting homes with electrified space heating and reducing emissions from gas and other fossil-fuel heating systems; supporting improved insulation in older buildings, together with low-carbon heating and cooling solutions. The Energy Systems Catapult has advised on these measures could work for more vulnerable households.

NZL will prioritise support to vulnerable residents and those on lower incomes to adapt and retrofit their homes with smart technology, insulation, and sustainable heating solutions improving their ability to meet Net Zero ambitions.

Through an initial 20-home social housing pilot, wider roll-out would have the potential to target and address fuel poor households, providing wider comfort and health benefits, whilst also reducing costs and

emissions.

NZL will enable a more integrated approach to consider the links between housing and occupant health. This goes beyond the core priorities of existing Local Plans, with an approach which could be replicable across other towns and districts when considering retrofit programmes

1.4.4 TOURISM

The Local Plan highlights that the tourism sector is a substantial and important part of Suffolk Coastal’s overall economy, which brings benefit to the quality of life and the wellbeing of communities. Tourism supports businesses, facilities, town centres and community life across the District.

Tourism is an important part of the economy of Suffolk Coastal, contributing 12% to total employment across the District in 2017. The Suffolk Coastal Economic Impact of Tourism Report 2017 identifies that over 6.3 million tourist trips were recorded, generating a total of £325 million total tourism value across the District (Suffolk Coastal).

The Suffolk Coast Tourism Strategy 2013-2023 advocates support for sustainable tourism, with a strong reputation for its positive environmental values which attract visitors throughout the year and encourage effective partnership working to balance the environmental, heritage, economic, and community priorities.

The scenic beauty and landscape qualities that justify the designated Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB) make a significant contribution to the attractiveness of the area.

The importance of conserving the Heritage Coast is outlined in national planning policy. The Local Plan recognises the wider economic benefits that can be brought about through the conservation of the historic environment, bringing significant benefit to local economies and communities.

The plan highlights that tourism can take many forms but within the AONB, and will seek small scale developments which are of a higher standard of design, and proposals that reduce the impact on the environment, by exploring the reuse of existing buildings to ensure that qualities of the area are retained.

RESPONSE: The NZL project is likely to have a limited direct impact on tourism.

Although the project could support some increase in ‘eco-tourism’ from people keen to learn from the Net Zero approaches being delivered locally, new sustainable community and transport facilities could be developed as part of the NZL Route Map, which could attract new visitors.

With tourism identified as a sector affected by the impacts of COVID-19, opportunities could be considered to work with local tourism and leisure facilities to promote Leiston and the surrounding area as a tourist destination, encouraging low-carbon transport options to, from and within the local area.

The focus of the Heritage Coast offers an opportunity to consider what heritage may mean for the

next generation. Whilst heritage is often considered to be more aligned with historic assets, ‘future heritage’ could be considered to be how we respond and adapt to the climate crisis ensuring long term sustainability of the natural environment, and the local community.

Increasing tourism is not a key priority for the NZL project, although the project could have an added value impact on tourism and the visitor economy locally.

1.4.5 TRANSPORT

The Local Plan highlights that Suffolk Coastal has a mixture of urban and rural settlements with limited public transport opportunities in certain parts of the District which places a heavy reliance on the private motor car as a form of transport to conduct day-to-day business.

The plan sets out to acknowledge that sustainable transport opportunities are limited with roads being mostly single track and unsuitable for conventional public transport and the lack of alternatives increases the use of the private car.

However, the Suffolk Local Transport Plan 2011-2031 sets out priorities to support the growth of businesses, reducing demand for car travel, making efficient use of transport networks and improving infrastructure.

Travel Plans are required by the National Planning Policy Framework for all new developments that create significant amounts of movement. The purpose of a Travel Plan is to set out measures to facilitate sustainable forms of travel and reduce the use of the private car. The Local Plan’s Sustainable Transport policy sets out that development proposals should be designed from the outset to incorporate measures that will encourage people to travel using non-car modes to access home, school, employment, services and facilities.

The plan identifies that technological advances in vehicles are beginning to reduce emissions, with the uptake of electric and hybrid cars, vans and bikes. The plan supports the roll-out of electric charging networks for vehicles, although does not go into detail on possible transport locations, ‘hot spots’ or key commuter hub such as community facilities, retail stores, car parks, or railway stations where charging infrastructure may be prioritised. The plan’s parking policy does highlight that appropriate provision for vehicle charging points and ancillary infrastructure associated with the increased use of low emission vehicles will be supported.

RESPONSE: The NZL project will develop ideas and options to support greater uptake of low emissions transport options such as e-bikes, electric vehicles for both individual, commercial, and public transport.

The roll-out of electric charging points for residential properties and businesses will be prioritised, building on the Plug-In Suffolk initiative with Suffolk-based EO Charging. Options under consideration for the NZL Route Map include electric vehicle car share schemes and supporting the potential demonstration of low-carbon delivery vehicles for local businesses.

Green travel plans will be encouraged for the local community, enabling consideration of walking, cycling (including uptake of e-bikes), and use of public transport.

In the future, the NZL project will encourage the demonstration and use of hydrogen fuel-cell and commercial electric vehicles, including vans, heavy goods vehicles, buses, and refuse collection trucks, although some options will be outside of the direct influence of the Leiston community or the NZL project. It is hoped that the development of these technologies accelerates to a point where they are able to be implemented in the Route Map in the future.

The current COVID-19 challenge will require some consideration given government guidance on the use of individual transport in favour of public transport, albeit such advice is considered to be applied in the short term only.

1.4.6 COMMUNITY FACILITIES

The Local Plan describes community facilities and assets as an important part of the social fabric of neighbourhoods and communities. Facilities include shops, post offices, public houses, medical facilities, police facilities, sports venues, cultural buildings, places of worship and places which promote social interaction and provide opportunities for meetings between people who might not otherwise come into contact with each other.

The National Planning Policy Framework reflects the need to plan positively for and promote the retention and development of local services and facilities.

The plan highlights that ensuring the appropriate provision and retention of a wide variety of accessible open spaces and recreational facilities is important and that providing access to these areas is important for people’s mental and physical wellbeing.

The plan also explains that open spaces have a role in helping to support habitat creation, enhancement of biodiversity networks, the aesthetic quality of public realm and built environment and managing surface water; enabling conservation/reuse and supporting the mitigation of flood risk.

Allotments are valuable community spaces that provide people with the opportunity to enjoy an active and healthy lifestyle and benefit the quality of life of residents across the District. They provide opportunities for food production, exercise and community interaction as well as being valuable green spaces which provide habitats for many forms of wildlife alongside the built environment.

RESPONSE: The NZL project recognises that community facilities can and will play a key role in supporting the road to Net Zero. NZL proposes to explore the development of existing community assets to create a facility that encourages greater community interaction and collaboration.

This could include community kitchens providing facilities to store, share and prepare food produced by local allotment holders. The same facility could host community car share/e-bike vehicles and charging infrastructure, in addition to spacious rooms for the local community and religious groups, in a low-carbon and environmentally sustainable building.

NZL will explore options to support local allotment holders to enhance productivity and opportunities for enhanced food production and community sharing, reducing local food miles and associated emissions. This could also include exploring options to utilise waste heat and CO₂ from local businesses or EDF in the UK facilities pumped into glasshouse or polytunnels to enhance output.

1.4.7 CLIMATE CHANGE

Transitioning to a low-carbon future, encouraging the reuse of existing resources (including conversion of existing buildings), and encouraging the use of renewable and low-carbon resources are measures which are promoted by the National Planning Policy Framework and the Local Plan. The National Planning Policy Framework reflects the need to plan positively for and promote the retention and development of local services and facilities.

The plan highlights that Suffolk Coastal is part of the Norfolk & Suffolk Energy Coast which is part of the wider East of England Energy Zone. The New Anglia Local Enterprise Partnership intends to maximise the energy opportunities in this area. This is an intention that the Council will endeavour to support, where possible. The area can contribute towards the generation of renewable and low-carbon energy, most notably through local biomass and anaerobic digestion schemes, solar panel schemes and wind power, including turbines and landing points to serve offshore provision.

The plan states that proposals for energy generation from biomass will be supported in principle, but particular consideration will be given to air quality impacts, transport impacts, proposals for associated buildings and, where relevant, grid connections.

On solar, schemes will generally be supported, particularly in new development. Consideration will be given to visual impact in sensitive locations, including design, siting and, where possible, natural screening.

In respect of onshore wind power, much of the District's environment is a sensitive one and needs protection. The plan will encourage onshore wind within the mix of the generation of renewable energy, most notably to serve local communities. Although generally encouraged, proposals will need to ensure they do not adversely affect the landscape, wildlife populations or habitats and avoid noise pollution.

On sustainable construction, the plan states that buildings are no longer viewed as products of construction but as products of placemaking and design that reflect the environment in which they are situated.

Sustainable construction methods, water efficiency standards and the energy consumption of buildings are largely controlled by Building Regulations. In the interests of mitigating climate change and to help achieve the objectives of the Suffolk Climate Action Plan, the Council will implement higher energy efficiency standards and will expect new developments of more than ten dwellings to achieve a 20% improvement in carbon emissions performance above the Target Emission Rate of the 2013 Edition of the 2010 Building Regulations.

For all non-residential development, the Council will expect compliance with [BREEAM STANDARDS](#). Improved energy efficiency and a reduction in carbon emissions in non-residential buildings can be achieved through various means including orientation, siting, photovoltaics and heat pumps.

The Suffolk coast is known to be one of the fastest-eroding areas in Europe and is vulnerable to major storm surges. These factors make it necessary to actively manage the coastal zone to ensure it is resilient in the face of coastal change by incorporating the holistic principles of Integrated Coastal Zone Management into coastal policies.

The Council, through the Local Plan, recognises that the coast will change and there are both properties and infrastructure at risk. Coastal adaptation is generally considered as a response to coastal change and defined as 'making changes to prepare for and negate the effects of climate change, thereby reducing the vulnerability of communities and ecosystems. (Action on Climate Today).

RESPONSE: The NZL project is one of the most ambitious projects addressing climate change in Suffolk. It offers a direct response to the Council's Climate Emergency declaration and on a holistic basis will deliver a Route Map for a town to reach Net Zero emissions by 2030, two decades ahead of the UK target.

NZL will deliver an evidence-based assessment to achieving Net Zero, using a carbon budgeting approach based on world-leading climate science.

Currently, the NZL Route Map covers a broad range of options from community facilities, enhancing the natural environment, heat, transport, renewable energy, energy tariffs, and agriculture.

No other Net Zero project takes such a whole system, whole community approach, which makes NZL a unique community-led project. A key consideration for the development of the NZL Route Map will be the ability to identify lessons that could be applied at different scales across other communities, towns, cities and regions.

In the future, the NZL project wants to implement the use of hydrogen to decarbonise housing and transport emissions.

1.4.8 NATURAL ENVIRONMENT

The Local Plan describes the District as having a high-quality natural environment which is enjoyed by residents, visitors, businesses and, most importantly, wildlife. The natural environment is primarily rural with coastline, river valleys and undulating countryside interspersed with market towns and villages.

The Local Plan seeks to protect, retain and enhance the high-quality natural environment and designated landscapes and sites found across the District. Of further importance, however, are the wider environmental and ecological benefits provided by the natural environment including, for example, carbon sequestration, natural flood protection and habitat creation.

Biodiversity and geodiversity are of great significance representing key elements of a natural capital approach and an integral aspect of the Government's recently published 25-year Environment Plan. Notable natural assets include the Suffolk Coast & Heaths AONB, RSPB Minsmere, Orford Ness National Nature Reserve and Sutton Heath.

The plan highlights that the opportunity exists for development schemes to facilitate the enhancement of the green infrastructure network and to provide a net gain for biodiversity and/or geodiversity by incorporating such principles into the proposal.

The high-quality natural environment is important to many local communities as it positively contributes to the quality of life, quality of place and mental health. The Council recognises that issues relating to biodiversity and geodiversity need to be considered collaboratively with businesses and other stakeholders to ensure that natural assets are protected.

The quality of local landscapes, visible features of land or scenery is a defining feature of the District and the identity of local communities, according to the Local Plan. It acknowledges that the landscape of the District is important to healthy and active communities across the District. Areas of green infrastructure associated with developments support social interaction, wellbeing and ease disturbance on protected wildlife sites, for example, by providing alternative outdoor recreation places.

RESPONSE: The NZL project recognises the crucial role of the natural environment as part of the road to Net Zero. The project Route Map identifies opportunities for investment in afforestation and reforestation projects, which will have significant positive impacts on CO₂ sequestration, biodiversity, and creating green spaces for communities.

NZL identifies that on average, young trees <1yr-10yrs can absorb up to 6kg/yr. More mature trees 10yrs+ absorb 22kg/yr. To offset Leiston's emissions using only new woodland, would require c.4 million trees. Whilst this may be unfeasible due to available land, community woodland areas will play an important component in Leiston's Route Map to Net Zero.

Working with expert partners, such as Rothamsted Research, NZL will explore wider potential changes to enhance the role of agricultural, farmland, and woodland areas across Leiston as a carbon sink with potential to grow through support community carbon removal programmes.

1.5 THE NEW ANGLIA LEP DELIVERY PLAN 2021-22

The New Anglia delivery plan was launched in March 2021.

The four key aspects of the plan are:

- » Covid-19 response and recovery
- » Norfolk and Suffolk - the Clean Growth region
- » International profile and trade
- » Strengthening the LEP

There is emphasis on the area being the UK's leading producer of renewable and low carbon energy. This will support the initiatives that derive from the NZL project as the opportunities to source goods, equipment and services locally are strengthened.

The area also utilises its strengths in order to be a testbed for innovation in industries such as farming and food production, transportation and construction. These are all sectors that need to reduce their carbon footprint and to make real adaptations to deal with the changes in the local climate.

Particular areas of the plan will support the NZL project.

Workforce fit for the future, which includes plans to develop a decarbonisation academy which is planned to support the development and transition of the skilled workforce required for decarbonisation to be possible. The other aspect of this area is to work with industry to understand how existing jobs change and how new roles will be created to deliver the Green Industrial Revolution.

Industry decarbonisation is focused on supporting local industry to decarbonise, enabling the region's economy to deliver the changes needed by expanding capacity, fostering investment in decarbonisation and by securing funding for decarbonisation.

Decarbonisation Infrastructure will identify the investments to support clean growth development and will develop alternative fuels for the transport sector by working with local regional partners.

1.6 THE SUFFOLK CLIMATE EMERGENCY PLAN

On 21 March 2019 councillors at Suffolk County Council voted to declare a climate emergency. The council set up a Policy Development Panel (PDP) to investigate how to cut Suffolk County Council's carbon and harmful emissions on a spend to save basis. The ambition is to make Suffolk County Council (including all buildings, schools and services) carbon neutral by 2030.

Similarly, at its Full Council meeting on Wednesday 24 July 2019, East Suffolk Council voted unanimously to step up its positive work on environmental issues to help fight climate change. It has joined other local authorities in recognising the fact that there is a climate emergency and committed itself to doing more to reduce its own carbon emissions and to encourage communities to help fight climate change.

The Suffolk Climate Change Partnership (SCCP) brings these authorities together to tackle climate change across Suffolk. This group also includes the Environment Agency and other local organisations. The Suffolk Climate Emergency Plan (SCEP) was published to outline how Suffolk could work towards carbon neutrality by 2030. This plan links other key strategies, plans and partnerships to provide an overarching plan for Suffolk. The SCCP have a shared interest in supporting Suffolk's communities, businesses and residents to reduce carbon emissions, realise the economic benefits of reducing energy consumption and adapt to the future impacts of climate change. Their vision is to make Suffolk an exemplar in tackling climate change and protecting and enhancing its natural environment and to be the county with the greatest reduction in carbon emissions.

Examples of strategies that encapsulate the SCEP is the **ESC Housing Enabling Strategy** and the **ESC Environmental Guidance Note** which are intended to provide simple, concise information on best practices for developers seeking to mitigate the impact of the building industry on climate change and provides measures to address the effect of climate change.

RESPONSE: NZL can be an exemplar project for Suffolk, putting into motion the plans outlined in the SCEP. The NZL steering group has members from East Suffolk Council and Suffolk County Council so that experience and opportunities can be shared.

2 UK POLICY CONTEXT

Climate, Net Zero and energy policy in the UK has undergone a major transformation in recent years. While the focus since early 2020 has been combating the global pandemic and more recently the recovery from the economic and social effects of the lockdowns, climate is playing into the policies in terms of trying to maintain some of the positive effects of lockdown and learning from the social changes that have taken place. Some reports and legislation has been delayed as a result of the lockdowns..

In terms of climate policy and shift to Net Zero emissions, the key overarching policy ambition is set out in the Climate Change Act.

2.1 CLIMATE CHANGE ACT

The Climate Change Act 2008 provides a long-term framework to improve carbon management, to help the transition to a low-carbon economy, encourage investment in low-carbon goods and provide an international signal. The

Act previously established a legally binding target for the UK to reduce all greenhouse gas emissions by 80% by 2050, using emissions at 1990 as its baseline. The Act also created 5-yearly 'carbon budgets' as a pathway to meet long-term targets.

On 12 June 2019, the Government laid the draft Climate Change Act 2008 (2050 Target Amendment) Order 2019 to amend the Climate Change Act by introducing a target for at least a 100% reduction of greenhouse gas emissions in the UK by 2050. This is otherwise known as a Net Zero target because some emissions can remain if they are offset by removal from the atmosphere and/or by trading in carbon units. The Order came into force on 27 June 2019.

Since passing this legislation, the Government announced a Net Zero review to be undertaken by HM Treasury. The review consulted widely, drawing on evidence from experts and insights from stakeholders with a key role in delivering the transition and those most impacted by it. The review was published in December 2020 and set out principles to guide decision-making during the transition to Net Zero including carbon pricing as one of the policy levers that will need to be applied to deliver decarbonisation.

The Act has now established a legally binding target of at least a 100% cut in GHG emissions by 2050, to be achieved through action in the UK and abroad. Ministers must report on the policies implemented to meet carbon budgets and produce an annual report to Parliament on the status of UK emissions.

The Committee on Climate Change (CCC) - an independent, expert body to advise the Government on the level of carbon budgets and on progress in meeting these budgets - submits annual reports to Parliament on progress towards targets and budgets.

The Act established a carbon budgeting system that caps emissions over 5-year periods, with three budgets set at a time, to help the UK stay on track for its 2050 target. The first three carbon budgets were between 2008-2012, 2013-2017 and 2018-2022, and were set in law in May 2009.

The fourth carbon budget period, between 2023-2027, was approved by Parliament in 2011 and reviewed in 2014. It puts into law a target to reduce emissions by 50% from 1990 levels by 2025 (the midpoint of the period). The Government needs to report to Parliament on its policies and proposals to meet the budgets and set limits on the purchase of carbon credits for each budgetary period, excluding units bought by UK participants in the EU Emissions Trading System.

With the UK's departure from the EU, participation in the EU Emissions Trading Scheme (ETS) ceased at the end of December 2020. As a part of the Energy White Paper in December 2020 the UK Emissions Trading Scheme was announced as a replacement. There is ongoing discussion as to whether the UK ETS will connect with other ETSs to widen the scope and options for trading.

Since introducing the Climate Change Act, it has been the key driver of action to reduce the UK's greenhouse gas emissions and to ensure steps are being taken to prepare the UK for the impacts of climate change. The CCC's annual progress report to Parliament in July 2019 did highlight some cause for concern. During the previous year, Government introduced new policies to reduce emissions, however their impact is likely to be only incremental. In 2018, a decade since the introduction of the Act, the CCC set out 25 headline policy actions for the year ahead. Twelve months later in 2019, only one has been delivered in full. Ten of the required actions have not shown any tangible progress. As at June 2020, two milestones out of the 31 set out in the 2019 Progress Report have been fully achieved. Partial progress has been made in 15 policy milestones which lie predominantly in the transport and industry sectors, while for others policy development is underway.

The Committee report states that too often efforts have been isolated to single departments or have progressed too slowly. The foundations in the Clean Growth Strategy have not been developed into a co-ordinated approach that will deliver even the existing carbon budgets. The report does highlight some positive areas of progress, including:

- » Coal-fired generation has fallen from around a 40% share of electricity in 2012 to a 2% share in 2019 and offshore wind is now able to provide power at a comparable price to fossil fuels.
- » Electric cars are being released with longer ranges (200+ miles) and are on track to be cheaper to buy and run than conventional vehicles during the 2020s.

- » Emissions across the economy (including international aviation and shipping) fell 41% from 1990 to 2019. Over the same period, the UK economy grew by 78%. In 2019 emissions fell between 3% and 4%.

The annual reports set out a series of recommendations to Parliament. These include:

- » Embedding Net Zero policy across all levels and departments of Government, with strong leadership and coordination at the centre.
- » Put people at the heart of policy design and making policy 'business-friendly'.
- » Support international increases in ambition and celebrate the UK ambition.

With the UK set to host the Conference of the Parties (CoP) to the UNFCCC in November 2021 (originally planned for December 2020, but delayed due to the coronavirus pandemic), the Committee sets out that the UK Government must provide global and demonstrable leadership on climate change.

2.2 CLIMATE CHANGE LEVY

The Climate Change Levy is an environmental tax charged on the energy that businesses use. Its aim is to provide an incentive to increase energy efficiency and to reduce carbon emissions.

The levy was first introduced in 2001 under the Finance Act 2000, and forms part of the UK's wider climate change programme; however, there have been ongoing calls to replace it with a more robust carbon tax.

The levy applies to electricity, gas, solid fuel and liquefied gases used for lighting, heating and power in the business and public sectors. Electricity produced from qualifying renewable sources and energy used and generated in approved combined heat and power schemes is no longer exempt from the levy. There is also a reduced (20%) rate for energy-intensive businesses that enter into voluntary agreements to reduce their energy use and/or emissions.

The levy was amended in February 2018. The new regulations alter the formula used to calculate relief entitlement and aligning the levy to changes made in section 148 of the Finance Act 2016 and came into force in April 2019. The climate change levy changes each tax year. The amount being applied to natural gas increases to bring it closer to the charge on electricity which is being held constant. By 2023 the levy for natural gas will be 6.72p/kWh compared to 7.75p/kWh.

2.2.1 NATIONAL ADAPTATION PROGRAMME

The National Adaptation Programme (NAP), which covers only England, addresses the priority risks identified in the UK Climate Change Risk Assessment 2017, setting out the actions that Government is taking, as required by the Climate Change Act, outcomes to achieve, and the means by which we will be measuring the progress made towards achieving its objectives.

Climate adaptation policy is a devolved matter: Scotland, Wales and Northern Ireland have each established their own adaptation programmes. The NAP for England sets out actions according to five key themes:

- » Natural environment - The 25 Year Environment Plan sets out goals
- » for improving the environment within a generation and leaving it in a better state. It ensures that resources from nature, such as food, fish, and timber, are used more sustainably and efficiently. Maintaining a healthy environment will mean that it is more resilient to the impacts of climate change.
- » Infrastructure – Assets and operators providing fundamental services which ensure the proper functioning of our society and economy, including energy, telecommunications, and transport. Ensuring that infrastructure is located, planned, designed, and maintained to be resilient to climate change, including increasingly extreme weather events.
- » People and the Built environment - The health and wellbeing of the nation are of fundamental importance, and to those end communities and the built environment they inhabit need to be resilient to heat and cold.
- » Business and Industry - Climate change will present risks to businesses and provide opportunities through changes in demand for existing and new products and services. Business operations depend on the resilience to climate change and activities such as local infrastructure, supply chains and distribution channels, and impacts on staff.
- » Local Government - Local Government plays a major role in shaping local places by taking decisions and providing guidance, through the local democratic process, on the urban landscape, the built environment, green and blue natural spaces, and public health.

2.2.2 CARBON BUDGET ORDER 2016

The Carbon Budget Order 2016 sets the carbon budget for the 2028-2032 budgetary period as 1,725,000,000 tonnes of carbon dioxide equivalent (including emissions from international shipping). The budget limits annual emissions to an average of 57 per cent below 1990 levels.

Carbon budgets set a cap on the maximum level of the net UK carbon account for each five-year budgetary period. The net UK carbon account is defined in section 27 of the Climate Change Act 2008.

2.2.3 6TH CARBON BUDGET

The CCC published their 6th Carbon Budget in December 2020.

The UK set its Sixth Carbon Budget (i.e. the legal limit for UK net emissions of greenhouse gases over the years 2033-37) to require a reduction in UK emissions of 78% by 2035 relative to 1990, a 63% reduction from 2019. This was adopted in April 2021 with an announcement to cut carbon emissions by 78% by 2035, based on 1990 levels.

The CCC's document covers national and sectoral policy recommendations and these are supported by various other proposals and guidance about how the transition should be delivered.

National policy recommendations to stimulate green growth to support the recovery from the Covid-19 pandemic including:

- » Deepening public engagement through investments to support measures to lower 'thresholds' to behavioural change, such as energy efficiency or dietary alternatives. This can form part of a public engagement strategy for Net Zero that educates the public, involves people in decision-making and provides trusted information at key decision points
- » Delivering social justice via a clear long-term vision for specific regions coupled with mechanisms that reward the private sector for building industries in otherwise deprived areas, starting now
- » Government leading on Net Zero by requiring any company meeting with ministers and secretaries of state to have a plan to reach Net Zero emissions
- » Leveraging global dynamics by introducing a border carbon adjustment, and consider forming bilateral and multilateral preferential trading arrangements for environmental goods and services

- » Penalising emissions by committing in the UK's NDC to sequester 10% of CO₂ emissions generated by fossil fuels and industry by 2030
- » Increasing business ambition by identifying businesses that shape industries – celebrate and elevate them
- » Accelerating technology via Pathfinder cities that can deliver comprehensive steps towards Net Zero, and demonstrate the interactions required across complex systems of low-carbon electricity, heat and transport
- » Redirecting capital flows by introducing Net Zero aligned and transparent accounting and auditing
- » Harnessing legal avenues by legislating all regulators to regard the Paris Agreement, Sixth Carbon Budget and 2050 Net Zero target in their duties.

Sectoral policy recommendations included:

- » Driving down emissions in specific sectors is likely to require a combination of consistent direction, investable incentives, enabling measures, preparing for the future and fairness.
- » Clear long-term direction will be required. For example, the Government's ambition of 40 GW by 2030 for the offshore wind sector for the industry to plan for increased scale.
- » Businesses and consumers will need investable incentives that favour the low-carbon option, such as up-front grants for EVs and heat pumps, as well as longer-term instruments, such as contracts-for-difference, which provide a consistent return for investors over the course of the investment.
- » Removing non-financial barriers to deployment, such as enabling infrastructure for EV charging and offshore wind networks, or building up new skills in home retrofit.
- » Preparing for future challenges as well as current ones, such as continuing to invest in future technologies such as floating wind alongside support for more established renewables.
- » Focusing on the particular issues for that sector, for example heat policy in residential buildings will need to address fuel poverty, and a strategy for low-carbon manufacturing will need to address competitiveness.

Carbon pricing is specifically mentioned as a critical element of moving the economy to low-carbon options. The importance of a fair and just transition is emphasised.

Supporting local areas, mainly through local authorities (LA), is recognised as important to the delivery of Net Zero. The need to act fast is clear as LAs are now entering into contracts that will have a significant bearing on their ability to achieve carbon neutrality by 2030; the target date that over half of them have set.

The Future Homes Standard is set to be implemented in 2025 or before in England. The report recommends that this be implemented in 2023.

It recommends that the date to reach EPC C in social homes is brought forward to 2028 (from 2030), in line with the Private Rented Sector (PRS) proposals. Government has committed to bring owner-occupied homes to EPC C by 2035.

A policy package is put forward to give clear direction, to make low-carbon financially attractive to establish this important enabling measure, and planning and action to stimulate progress. This includes some technology recommendations around air and ground-source heat pumps and the future use of hydrogen as a fuel in domestic boilers and in hybrid heat pumps.

These policies and recommendations will influence the direction of the NZL project in terms of the speed of the transition and the technology decisions taken during the project lifetime.

2.3 COMPANY REPORTING

While in the UK, there is no requirement to report on climate change; specifically, there are many reporting requirements that may require companies to address climate-related issues.

Company Directors have a role in considering the company's long-term success. [*THE COMPANIES ACT 2006*](#) requires medium-sized and larger companies to provide information about how the directors have performed their duty to promote the success of the company, having regard to the matters set out in section 172, including environmental matters.

The Strategic Report requirements, in addition to the Directors' Report, must include any disclosures of principal risks and uncertainties and relevant non-financial information. [*THE UK CORPORATE GOVERNANCE CODE 2018*](#) (the Code) requires reporting on how opportunities and risks to the future success of the business have been considered and addressed, and there are specific requirements

(including the [*STREAMLINED ENERGY AND CARBON REPORTING*](#) requirements that require information on the impact of the company's business on the environment.

2.4 UK INDUSTRIAL STRATEGY

The UK Industrial Strategy sets out the national approach to boost productivity, grow businesses and create jobs with investments in skills, industries and infrastructure. It indicates this will be achieved through:

- » Strengthening productivity through five foundations:
 - Ideas:** encouraging the UK to be the world's most innovative economy
 - People:** ensuring good jobs and greater earning power for all
 - Infrastructure:** driving a major upgrade to the UK's infrastructure
 - Business environment:** guaranteeing the best place to start and grow a business
 - Places:** creating prosperous communities across the UK
- » Building partnerships with industry and addressing barriers to growth through 'Sector Deals'
- » Building on our established and emerging strengths to tackle 'Grand Challenges' including AI and data, the ageing society, clean growth, and future of mobility

The Industrial Strategy sets out that the move to cleaner economic growth – through low-carbon technologies and the efficient use of resources – is one of the greatest industrial opportunities of our time. By one estimate, the UK's clean economy could grow at four times the rate of GDP. Whole new industries could be created, and existing industries transformed towards a low-carbon, resource-efficient economy.

The Industrial Strategy's delivery has several strands, such as the Industrial Strategy Challenge Fund, managed by Innovate UK which provides funding to support innovation to develop and commercialise solutions against identified 'Grand Challenges'. Sector Deals – agreements between Government and industrial sectors – set out ambitious development plans that will drive investment, innovation and jobs growth. Sector Deals have been agreed in 10 sectors, including construction, offshore wind and nuclear.

The Nuclear Sector Deal builds on the Government's historical partnership with the UK nuclear sector. It ensures that the UK's nuclear sector remains cost-competitive with other forms of low-carbon technologies to support the Clean Growth Strategy. Through adopting new construction techniques and innovative approaches to manufacturing, the deal will reduce the costs of building new reactors in a way that builds domestic supply chain capability and skills.

For local areas, the development of Local Industrial Strategies sets out focused growth opportunities aligned to local strengths and high-value opportunity sectors, building on the five foundations. Developing Local Industrial Strategies is led by Local Enterprise Partnerships or Mayoral Combined Authorities, in partnership with local government and local business leaders.

2.4.1 ENERGY COMPANY OBLIGATION

The Energy Company Obligation (ECO) is a government energy efficiency scheme in Great Britain to help reduce carbon emissions and tackle fuel poverty.

The first phase of ECO, known as ECO1, ran from January 2013 to March 2015. This placed obligations on larger energy suppliers to deliver energy efficiency measures to domestic premises in the UK. There were three main obligations under ECO1 which energy companies were required to meet:

- » The Carbon Emissions Reduction Obligation (CERO)
- » The Carbon Saving Community Obligation (CSCO)
- » The Home Heating Cost Reduction Obligation (HHCRO)

The latest policy, ECO3, commenced on 3 December 2018 and runs until 31 March 2022. The policy is now focused on one obligation, the HHCRO. Under this, obligated suppliers must promote measures which improve the ability of low income, fuel poor and vulnerable households to heat their homes. This includes actions that result in heating savings, including the replacement of a broken heating system or the upgrade of an inefficient heating system.

Under ECO3, suppliers will be able to deliver up to 10% of their obligation through the installation of innovative measures to eligible households. This will be through two key routes: Demonstration actions, and Innovation measures. A technical advisory panel has been set up to review applications made under each route and make recommendations to Ofgem to approve or reject applications. These routes could be applicable to support early priorities under the NZL project and support the replicability aims of the project beyond Leiston.

2.5 CLEAN GROWTH STRATEGY

The UK's Clean Growth Strategy, published in April 2018, sets out a blueprint for Britain's low-carbon future identifying a comprehensive set of policies and proposals that aim to accelerate the pace of 'clean growth', i.e. deliver increased economic growth and decreased emissions.

In the context of the UK's legal requirements under the Climate Change Act, the UK's approach to reducing emissions has two guiding objectives:

- » To meet our domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses; and,
- » To maximise the social and economic benefits for the UK from this transition.

Note: The Clean Growth Strategy was published prior to the Climate Change Act 2008 revision Order

2019, which was approved in June 2019. An Energy White Paper and updated Clean Growth Strategy were anticipated in early 2020, however, they were delayed due to the coronavirus pandemic and economic recovery. The Energy White Paper was published in December 2020, see the section below.

Within the current Clean Growth Strategy, initiatives are outlined to reduce national greenhouse gas emissions in several areas including through improving business/industrial and residential energy efficiency, accelerating the shift to low-carbon transport and delivering clean smart and flexible power. This includes proposals to reduce UK emissions from energy production, phasing out the use of unabated coal to produce electricity by 2025, deliver new nuclear power projects, and supporting future developments of renewable technologies including Offshore Wind.

To complement and support these ambitious objectives, the clean growth strategy pledges government funds to deliver this evolution in UK energy generation to drive innovation and nurture low-carbon technologies. For the first time, this strategy outlines targeted investment across the energy system. The

UK government, in partnership with the Research Councils and Innovate UK, also expects to invest £467m to support development and innovation within the nuclear sector and a further £177m to further reduce the cost of renewables, including innovation in offshore wind turbine technology.

The 50 key policies and proposals set out in the Clean Growth Strategy defined the government priorities. Some have evolved following the updated Energy White Paper; and the 10-Point Plan for a ‘green economic recovery’ in response to the coronavirus pandemic . The policy categories are:

- » Accelerating clean growth
- » Improving business and industry efficiency – 25% of UK emissions
- » Improving our homes – 13% of UK emissions
- » Improving the energy efficiency of our homes; and, Rolling out low-carbon heating
- » Accelerating the shift to low-carbon transport – 24% of UK emissions
- » Delivering Clean, Smart, Flexible Power – 21% of UK Emissions
- » Enhancing the benefits and value of our natural resources – 15% of UK emissions
- » Leading in the public sector – 2% of UK emissions
- » Ensuring Government leadership in driving clean growth

The strategy sets out an investment plan of c.£2.5 billion to drive low-carbon innovation broadly split between Basic & Applied Research, Technology Development, and Technology Demonstration. The roles of UK Research & Innovation, including InnovateUK and the Catapult network of technology and innovation centres, are highlighted as playing a key role in working with business to bring forward solutions that can deliver against the policy areas set out above.

2.5.1 NET ZERO INTERIM REPORT

The Net Zero Interim Report provides an update on the analysis undertaken by HM Treasury’s Net Zero Review. It supports carbon pricing as one of the policy levers that will need to be applied to deliver decarbonisation. The need for a clear policy framework is emphasised as it helps to address uncertainties that would otherwise hold back technology development by the private sector and investment decisions more widely.

It is acknowledged that the transition will affect households particularly through the labour market, and through the price of energy.

The economic effect of the sustained move to Net Zero is likely to continue to be positive for the Anglia region due to the area being one of the two regional clusters for offshore wind. Structural changes in

the economy are recognised, and these will force changes to be made to the taxation system in order to maintain public finances.

The Final Report is due to be published in 2021.

2.5.2 ENERGY WHITE PAPER

The Energy White Paper was launched in December 2020; the first for 13 years. It recognises that a significant gap remains between the proposed emissions cuts and those required under the UK’s climate targets.

Buildings and consumers are expected to be the source of the largest proportion of emissions savings. A variety of technology solutions are expected to be utilised to achieve Net Zero. The New Homes Standard is mentioned and the requirement to stop the connection of any new homes to the gas grid by 2025.

The paper also announced the UK Emissions Trading scheme, to replace the EU ETS.

2.6 25 YEAR ENVIRONMENT PLAN / ENVIRONMENT BILL

In January 2018 the UK Government, through the Department for the Environment Food and Rural Affairs (Defra) published its 25-year Environment Plan, setting out how the UK government intends to work alongside businesses and communities to improve the environment within a generation.

The environment plan sets out the UK’s goals for improving the environment, within a generation, and leaving it in a better state than we found it. The plan sits alongside Industrial Strategy and Clean Growth Strategy. The plan’s first annual progress report was published in May 2019.

The plan sets out proposals on reforming agriculture and fisheries management, achieving high standards for UK land, rivers and seas. By adopting the plan, the government hopes to achieve:

- » Cleaner air
- » Clean and plentiful water
- » Thriving plants and wildlife
- » A reduced risk of harm from environmental hazards such as flooding and drought.
- » Using resources from nature more sustainably and efficiently.
- » Enhanced beauty heritage and engagement with the natural environment.

The plan aims to implement a sustainable fisheries policy as the Government looks to take advantage of the opportunities offered by leaving the EU to bring a world-class fisheries management system that is based on the principle of sustainable yields and helps to restore and protect the marine ecosystem.

Since it published its first annual update in May 2019, the Government has introduced the ‘Environment Bill’ in October 2019. Following a general election, it was re-introduced to Parliament in January 2020. The Bill is moving through the parliamentary stages. As at early May 2021 it is at the Report stage. The next stage will be 3rd Reading before it is passed to the House of Lords. It sets out how the Government plans to protect and improve the natural environment in the UK, building on the position set out in the 25-year plan. The Bill will include a UK Environmental Protections policy which will allow for greater transparency and strengthened scrutiny for Parliament regarding future environmental legislation. In order to strengthen environmental accountability, the Environment Bill will establish a new public body – the Office for Environmental Protection – as the UK’s own independent, domestic watchdog. The OEP is anticipated

to work closely with the bodies such as the Committee on Climate Change in advising and holding Government to account on delivery of climate and environmental policy.

The Environment Bill makes a clear commitment to set an ambitious, legally-binding target for the pollutant with the most impact on human health, fine particulate matter. Reductions in this pollutant will deliver significant benefits to public health and technological advancements, resulting in benefits for the economy. The Bill also strengthens the ability of local authorities to address air quality issues.

On water, measures in the Bill aim to help secure long-term, resilient water and wastewater services, ensuring a cleaner, greener and a more resilient country for the next generation.

The natural environment is highlighted as being in long-term decline and requiring urgent action.

The Bill introduces a requirement for biodiversity net gain in the planning system, to ensure that new developments enhance biodiversity and create green spaces for local communities. The Bill also introduces provisions requiring the development of Local Nature Recovery Strategies across England, which will help local authorities and other public bodies identify priorities and opportunities for enhancing nature.

2.7 TEN POINT PLAN

The ten point plan for a green industrial revolution was announced in November 2020. It appears to have been influenced by the plan issued before by the Net Zero All Party Parliamentary Group (NZ APPG).

The ten points of the plan, with anticipated effects on the NZL project are as follows:

Point 1: Advancing Offshore Wind

- » This policy will continue to support the economy of the Anglia region including Leiston. This will act as an enabler for the changes that are needed for the NZL Project.

Point 2: Driving the Growth of Low Carbon Hydrogen

- » Opportunities to develop green hydrogen in the Sizewell and Leiston area are being discussed supported by nuclear heat or nuclear backed low carbon power.

Point 3: Delivering New and Advanced Nuclear Power

- » The development of the Sizewell C nuclear power station is allied to the Net Zero Leiston project. Net Zero Leiston has been stimulated by Sizewell C with early resources and support for the development of this viable replicable Route Map to achieve Net Zero in Leiston.

Point 4: Accelerating the Shift to Zero Emission Vehicles

- » It is expected that there will be encouragements to move to EVs including EV charging infrastructure and purchase grants.

Point 5: Green Public Transport, Cycling and Walking

- » This is likely to be concentrated in cities, but there may be the opportunity to obtain funding support to improve cycling and walking options in Leiston. Administered by a new body Active Travel England.

Point 6: Jet Zero and Green Ships

- » This is not expected to have any significant impact on the NZL project.

Point 7: Greener Buildings

- » This point includes installing heat pumps to replace boilers as part of natural replacement cycle.
- » New house builds will be to the Future Home Standard that is planned to be implemented in 2025. There will be incremental changes in the intervening years, and as mentioned previously the CCC have recommended bringing this date forward to 2023.
- » Mention is made in the plan of green homes grants, which may financially support changes to be made to home insulation and heating technology.

Point 8: Investing in Carbon Capture, Usage and Storage

- » This is not expected to have any significant impact on the NZL project. It should be noted that Sizewell C is exploring the potential of Direct Air Capture technologies linked to new nuclear, although this is at an early stage of R&D.

Point 9: Protecting Our Natural Environment

- » A Green Recovery Challenge Fund of £40m was announced. This is to support nature conservation and restoration work and hence preserve or create jobs in this sector.
- » Environmental Land Management scheme, including pilots in 2021 to help farmers to invest in modern technology to make their businesses more efficient and more profitable, while reducing their emissions

- » Flood and coastal defences will be financially supported to protect homes, communities and businesses.

Point 10: Green Finance and Innovation

- » Net Zero Innovation Portfolio which is to encourage the development and commercialisation of technologies to decarbonise and help the transition to Net Zero.

A Green Jobs Taskforce is to be established to help develop plans for green jobs in partnership with business, skills providers and unions.

Overall, the contents of ten point plan are encouraging and show that policy is moving in the right direction to support the changes needed by the NZL project. The speed of implementation of the policies will be critical.

2.8 BUDGET 2021

The announcements in the 2021 budget were considered by many to be insufficiently ambitious in the area of promoting activities to combat climate change. There were some areas of optimism, but the necessary scale was not evident.

The Green infrastructure Bank was announced; it is tasked with supporting regional and local economic growth. But there was no announcement of carbon pricing, the freeze on fuel duty was continued and there was no cut in VAT on energy efficiency upgrades.

2.9 GREEN HOMES GRANT

The Green Homes Grant scheme was closed on 31-3-2021, despite the CCC recommending that it continue, be extended and the implementation of a successor scheme in their sixth carbon budget policy report.

The £1.5bn scheme launched in September 2020. About 10% of the intended 600,00 homes were supported.

3 INTERNATIONAL CONTEXT

The UK is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and has signed and ratified an international agreement on climate change, the Paris Agreement¹.

The Paris Agreement on Climate Change and UN's 2030 Agenda for Sustainable Development² provide an international framework for action and to embrace a shared responsibility for the peoples of the world and the planet. They provide a vision for the world that is inclusive, resilient and sustainable.

3.1 PARIS AGREEMENT ON CLIMATE CHANGE

The principal objective of the Paris Agreement is an international pledge to keep the global average temperature increase to well below 2°C above pre-industrial levels and to pursue all efforts to limit the rise to no more than 1.5°C.

The Paris Agreement entered into force in November 2016 and addresses several crucial areas necessary to combat climate change. Some of the critical aspects of the agreement are:

- » Long-term temperature goal (Art. 2). The agreement reaffirms the goal of limiting global temperature increase to well below 2 degrees Celsius while pursuing efforts to limit the increase to 1.5 degrees.
- » Global peaking (Art. 4). To achieve this goal, countries will aim to reach global 'peaking' of emissions as soon as possible, so that a balance can be achieved between anthropogenic emissions by sources and removals in the second half of the century – achieving 'Net Zero emissions'.
- » Mitigation (Art. 4). The agreement establishes binding commitments by all participating countries to prepare, communicate and maintain a nationally determined contribution (NDC) and to pursue domestic measures to achieve them.
- » Sinks and reservoirs (Art.5). The agreement encourages Parties to conserve and enhance sinks and reservoirs of greenhouse gases, including forests and woodland areas.
- » Adaptation (Art. 7). The agreement establishes a global goal to strengthen national adaptation efforts – enhancing adaptive capacity, strengthening resilience and reduction of vulnerability to climate change. It recognises that adaptation is a global challenge faced by all.

- » Support (Art. 9, 10 and 11). The agreement reaffirms the obligations of developed countries to support the efforts of developing country Parties to build clean, climate-resilient futures. Provision of resources should aim to achieve a balance between adaptation and mitigation.
- » Transparency (Art. 13). The agreement relies on a robust transparency and accounting system to provide clarity on action and support by all Parties, with flexibility for their differing capabilities. In addition to reporting information on mitigation, adaptation and support, the agreement requires that information submitted by each Party undergoes international review.
- » »Global Stocktake (Art. 14). A "global stocktake", to take place in 2023 and every five years thereafter will assess collective progress toward meeting the purpose of the agreement in a comprehensive manner. Its outcomes will inform Parties to updating and enhancing their actions and support and enhancing international cooperation.

Following the Paris Agreement, the Intergovernmental Panel on Climate Change (IPCC) published a Special Report in October 2018³ which found that limiting global warming to 1.5°C could be possible but would require unprecedented "rapid and far-reaching" changes in all aspects of society, including a need to reach 'Net Zero' by around 2050.

The special report states that "Limiting global warming to 1.5°C compared with 2°C would reduce challenging impacts on ecosystems, human health and wellbeing, making it easier to achieve the United Nations Sustainable Development Goals,".

When the first version of this report was issued in July 2020, the United States had given notice of its withdrawal from the agreement. This came into effect on 4 November 2020, the day after the presidential elections in the US. However, President Biden signed a day one executive order on 19 February 2021 to re-join the Paris Agreement with immediate effect. This has strengthened the agreement which had been weakened by America's lack of support during the previous four years.

The Nationally Determined Contributions to the Paris Agreement are set by each country that is a signatory to the agreement with the aim of meeting the agreed national target. In December 2020, the UK's Nationally Determined Contribution was strengthened from the previous 53% reduction to a 68% reduction in greenhouse gases by end of this decade. This target had been recommended by the CCC 6th Carbon Budget which had been published earlier in the month.



¹ UNFCC, [The Paris Agreement](#), November 2015

² UN, [Transforming our world: the 2030 Agenda for Sustainable Development](#), 2015

³ IPCC, [Summary for policymakers of IPCC special report on global warming of 1.5°C approved by governments](#), 8 October 2018



3.2 THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

The United Nation’s 2030 Agenda for Sustainable Development is a plan of action for people, planet and prosperity. It seeks to “strengthen universal peace in larger freedom”. The Agenda recognises that eradicating poverty in all forms and dimensions, including extreme poverty, is the greatest global challenge and a critical requirement for sustainable development.

All countries, acting in collaborative partnership through the Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA), have committed to delivering against this plan. The UN is determined to take the bold and transformative steps, which are urgently needed to shift the world onto a sustainable and resilient path.

3.2.1 UN SUSTAINABLE DEVELOPMENT GOALS

In September 2015, all Member States of the United Nations adopted a plan for achieving a better future for all — laying out a path over the coming 15 years to end extreme poverty, fight inequality and injustice, and protect the planet. At the heart of “Agenda 2030” are 17 Sustainable Development Goals (SDGs) and 169 targets which set out a “blueprint to achieve a better and more sustainable future for all”.



Figure 1 - The 17 UN Sustainable Development Goals

In considering the project’s approach to delivery and alignment with international, national and local strategies and policies, consideration has been given to aligning activity to the UN Sustainable Development Goals.

The overarching ambition of Net Zero Leiston is most closely aligned to SDG Goal 13 – taking urgent action to combat climate change and its impacts.

The project will also, directly and indirectly, support action against at least 8 of the 17 goals, notably:

- » SDG 7 on affordable and clean energy
- » SDG 8 on inclusive and sustainable economic growth
- » SDG 9 on building resilient infrastructure
- » SDG 11 on sustainable cities and communities
- » SDG 12 ensuring sustainable consumption and production patterns
- » SDG 13 on climate action
- » SDG 15 on sustainable managed forestry, and
- » SDG 16 on promoting just and inclusive societies.

4 LIKELY EMERGING POLICY

There is a considerable backlog of consultations, white papers, and policy at the moment. While it may seem that the last year has been a busy time for such publications, several releases have been delayed by the Covid-19 pandemic and, as a consequence, the coming months are likely to be even more hectic. The COP26 climate conference in Autumn 2021 is a fixed date which will drive considerable policy activity.

4.1 STRATEGY

Amongst this is the expectation of a ‘comprehensive’ Net Zero Strategy⁴ which is due before the COP26 conference and setting the 6th Carbon Budget to implement the budget published by the CCC at the end of 2020.

⁴ Government to publish ‘comprehensive’ net-zero strategy in build up to COP26. [webpage here](#)

While it may have only an indirect effect on the Net Zero Leiston project, there are changes being considered to the Green Book which is the guidance that is published by HM Treasury on the assessment of public sector projects. This may change how easy it is to obtain grants or other public support for projects that have a positive environmental impact.

4.2 ELECTRICITY

Energy policy will be informed by a call for evidence⁵ that closed at the end of March. The subject of the call for evidence was a high renewable, Net Zero electricity system. It highlights that at times over the first Covid-19 lockdown in spring 2020, wind and solar were generating two thirds of GB power, and that negative prices in the day ahead market have become more common. This resulted in record low carbon intensity for April 2020, but meant that the National Grid Electricity System Operator (NG ESO) needed to take additional balancing actions to keep the system stable. Such conditions are likely to be more frequent as increasing levels of variable renewables come onto the system.

The UK government continues to see nuclear power as a major part of the drive to reduce the carbon intensity of the electricity system. The House of Commons briefing paper “New Nuclear Power”⁶ provides a useful status of the options. Delays have been evident in the development of new nuclear due to a variety of causes with funders withdrawing support and developers moving on to lower-risk projects. The reliance on continued government support and a predictable development timetable are a challenge when government policy tends to be much shorter term than the development cycle of these large installations. Delays in moving the small modular reactor (SMR) opportunity forward have also been evident and the delays have been made worse by the necessary focus on dealing with the Covid-19 pandemic. The pace of development needs to match the needs of the developers and the funders. Further policy in this area is expected when the development is more mature.

4.3 HEATING

The expected Heat in Buildings Strategy⁷ which was due in early 2021 will outline the immediate actions that are to be taken to reduce the emissions from buildings. This will provide some direction to actors in the market to enable appropriate investment decisions to be made. The effect of this strategy will be to provide some direction to the decision making of NZL in terms of the timing of changes to buildings and in the technologies that are likely to be given support.

⁵ Enabling a high renewable, Net Zero electricity system: call for evidence. [webpage here](#)

⁶ (House of Commons briefing paper CBP 8176, 26 February 2021 New Nuclear Power. [webpage here](#)

⁷ Hansard: Heat and Building Strategy. [webpage here](#)



Consultations as to how to phase out fossil fuels from off-grid premises and on the installation of heat pumps to on-grid homes will both provide useful information for policy that will have a direct bearing on the NZL project.

Consultation is expected to take place this year on the energy efficiency of owner occupied homes. The outcomes of this will affect many of the homes in Leiston, though the timescales for any implementation are not yet public. A “long-term regulatory framework” is suggested in the Energy White Paper.

4.4 TRANSPORT

For the transport sector, it is expected that milestones for the phasing out of diesel and petrol cars will be defined and the phase-out of new diesel HGVs will be the subject of a consultation. The move to public transport will be supported by a Transport Decarbonisation Plan and the already-published National Bus Strategy.

Funding is proposed to reinforce roadside electricity distribution capacity to support 2,500 high powered charge points across England’s motorways and major A roads by 2030, increasing to 6,000 by 2035. A further £1bn will also be made available to develop and promote electric vehicles themselves, particularly £582m in grants for those buying zero or ultra-low emission vehicles and a further £500m of support to assist the development of “giga factories” to manufacture EV batteries. This will focus on the North East and the West Midlands linked the Government’s “levelling up” agenda.

4.5 HYDROGEN

The UK Hydrogen Strategy was launched in August 2021. The Hydrogen Strategy is a significant document which supports the ambitions for 5GW of hydrogen production by 2030 for use across the economy. Additionally, the Hy4heat Programme run by BEIS is looking at the future possibilities for Hydrogen for heating, including colourant, odorant, metering, appliances for domestic commercial and industrial settings, hydrogen quality, safety assessment etc has been running for about four years. This is expected to provide some good information and evidence upon which to base policy.

The Government’s Hydrogen Strategy outlines how the UK will rapidly and significantly scale up production and lay the foundations for a low carbon hydrogen economy by 2030 and how government will support innovation and stimulate investment in the 2020s to scale up low carbon hydrogen. The need is to make hydrogen investable so that funding and development by the private sector can move the sector forward on a number of fronts. A report by Eversheds Sutherland states that “...a variety of policy measures will need to be developed to address market failures, remove barriers to deployment, support development and encourage private sector investment.”

⁸ UK Industrial Decarbonisation Strategy: The future is hydrogen. [webpage here](#)



5 OPPORTUNITIES TO GUIDE FUTURE POLICY

The features of the NZL project make it a secure basis which can be utilised by both National and Local Government to create the policies that are needed to drive the significant changes required to ensure that the United Kingdom meets its obligations under the Paris Agreement on Climate Change and other legislation that has been described in this document.

The features of NZL that make it stand out from many other projects include:

- » The geographic boundary ensures that a holistic approach must be taken. This is not a project to decarbonise transport or reduce emissions from buildings; it must do both and tackle all the other causes of carbon emissions within the defined geographic boundary. It therefore also creates an opportunity to demonstrate how the technologies fit together, in terms of the energy flows and in terms of the data flows, controls and inter-operation of technologies to create the overall system.
- » The mix of town and rural geography means that within the project a variety of technologies are likely to be needed to reduce the emissions of buildings due to their different locations in addition to the variety of architypes, usage patterns etc. Working with local allotment tenants, farms and landowners, it also brings the potential to explore agricultural and soil-based carbon reduction options into scope, which could provide useful learning and insight.
- » The technology-agnostic approach of the project ensures that the most appropriate technologies will be used to solve the carbon reduction challenges.
- » The role of local residents and community organisations in the design of the project. This is taking place through the local representatives on the Working Group from the beginning of the project and the use of pilot schemes to gather learning and shape later steps of NZL. This consumer-centred approach of the project ensures that the experience of consumers, especially vulnerable households included in the pilot, is included in shaping how to solve the carbon reduction challenges.

The project will provide robust evidence to demonstrate deliverable pathways to enable other communities to reach Net Zero. These will need to be facilitated by policy frameworks at the national and

local level that help to create markets to enable business models for decarbonisation and which provides structures for interoperability standards will be beneficial to the energy system. These policies will be supported by the data, learnings and insights that the NZL project produces.

The Digital Economy Act enabled data sharing between different agencies in government and energy suppliers to ensure more effective and efficient delivering of benefits to vulnerable households. Smart energy innovation could provide social housing providers with more insight into what their households are struggling with (for example, high energy consumption, low indoor temperatures or damp and condensation) so that improvements to the building can be tailored to the household's needs.

Communities across the UK have declared carbon emergencies and set ambitious targets, with an increasing drive towards planning and implementing Net Zero at a local level. The Committee on Climate Change 2020 Progress Report sets out that for buildings “Local authorities and network operators should be given key roles in driving early progress and planning, backed up by the necessary resources.” and that local areas should be supported to “play a full role in the Net Zero transition, including resourcing, guidance, involvement in local area energy plans”.

Net Zero Leiston provides the opportunity to test and develop local approach at a community scale, lessons from which can guide larger scale projects in the region and across the UK. Although NZL is not taking a full local area energy plan approach (as it would not be suited for a community of this size), the experience in deploying a whole system, multi vector Net Zero plan and engaging with the local community has the opportunity to feed into the guidance for future local area energy planning in both this area and to potentially inform national policy about further rollouts.

5.1 CASE EXAMPLE: LA ROCHELLE, FRANCE

La Rochelle, an ambitious territory aiming at neutrality in 2040 [Provided by Carbone4]

The La Rochelle area⁹ has long been committed to sustainable development. Today, five public bodies across the territory, accompanied by a consortium of 130 public, private and citizen actors¹⁰, have set an ambitious climate objective: to make La Rochelle the first “Zero Carbon Territory” in France¹¹. The strategy includes reducing the territory’s carbon footprint by 30% by 2030 and achieving neutrality by 2040.

⁹ The conurbation of La Rochelle has a population of 170,000. However, the project under discussion here also extends to neighbouring territories and departments.
¹⁰ This consortium brings together the conurbation, the town, the university, the port and the low carbon district Atlantech, as well as 130 partners: associations, companies, citizens, public and private structures.
¹¹ See (in French): [webpage here](#).





Figure 2 - Old Port of La Rochelle, South West France

Based on the three-pronged strategy “sobriety-creativity-solidarity”, and with the willingness of a strong involvement of public and private actors and citizens of the territory, this initiative carries the ambition of replicability. Ten pilot sites have been identified to concentrate initial project investments. The whole project cost is estimated at more than 82 million euros.

Two flagship tools are being developed: A regional data platform, and a ‘carbon aggregator’.

Regional governance of data is essential for the success of such a multi-actor strategy. This is why a digital platform for data collection, processing and management has been envisaged, in which the city plays the role of trusted third party. This first tool forms the foundation of the strategy and should make it possible to measure, monitor and model the region’s GHG emissions, in open source data, while respecting the privacy of individual data points.

The second tool, which is specific to the La Rochelle Zero Carbon Territory project, is the regional carbon aggregator. Its objective is to stimulate and enhance GHG emission reductions and CO₂ sequestration in the city and surrounding area.

Managed by a collective interest cooperative company, it is the technical and financial system of the city that allows the emission and sale of carbon credits, between project holders and buyers.

Its technical component lies in the ability to assess the GHG emission reduction potential of a project and to certify it, based on the regional data platform, the methodologies developed and the French Low-Carbon Label.

Its financial aspect lies in the ability to value these emission reduction certificates in the form of carbon credits and to sell them on a market, limited to local players for now. Depending on the offer and demand,

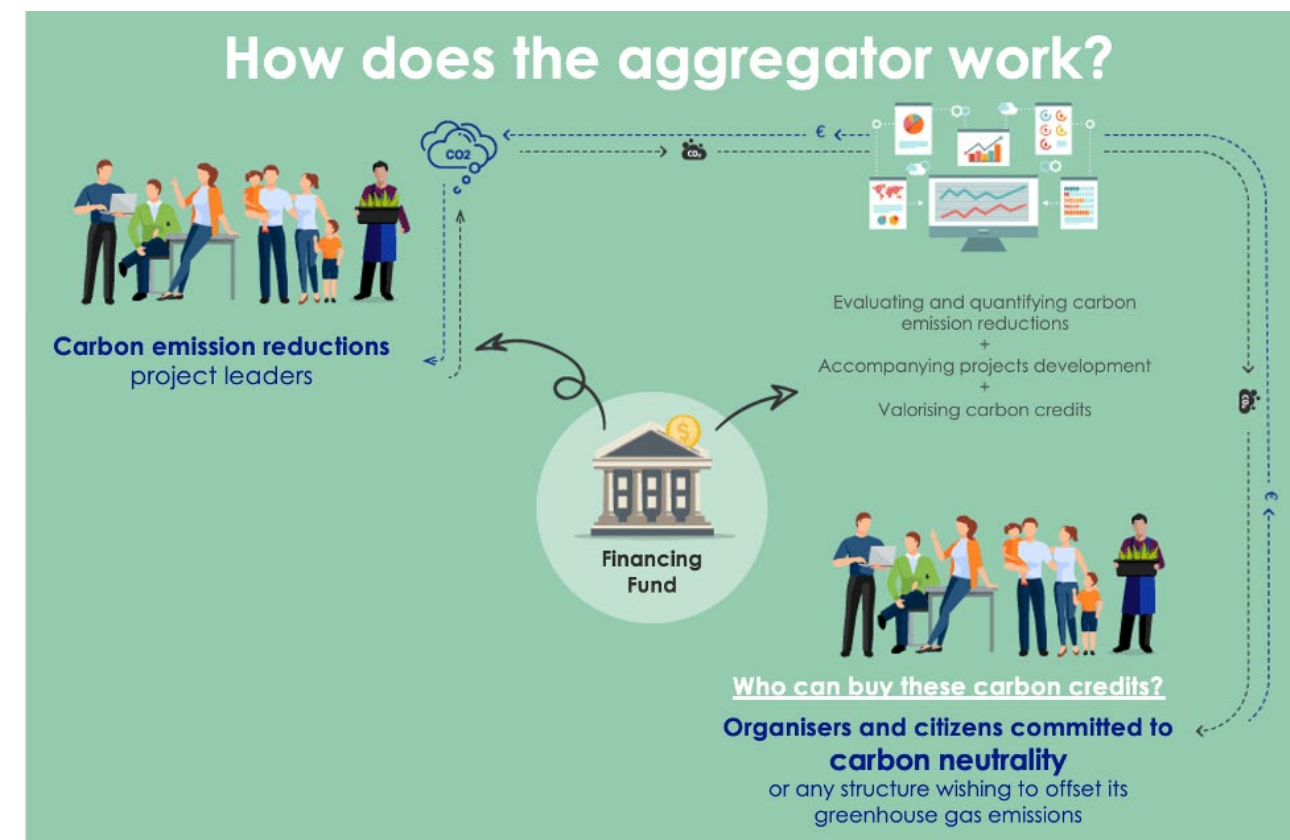


Figure 3 - La Rochelle Carbon Aggregator Mechanism:

The financial mechanism is simple: low-carbon projects, which may be labelled or not, are awarded emission reduction certificates. These certificates can then be sold via the platform to local players who wish to voluntarily purchase carbon credits. In accordance with government directives, carbon credits are prohibited from resale and the aggregator retains a monopoly on transactions¹². One of the strengths of the strategy is the inclusion of all types of actors in the process: project leaders and credit buyers can be public authorities, companies, associations or citizens.

Another strength lies in the pooling of administrative procedures, which makes it easier for small-scale projects to benefit from the labelling process and thus to emerge.

The envisaged market price is 20 €/tCO₂ avoided, possibly adjustable according to the actors, and projects offer and demand. The project will be partly self-financed by an envisaged 25% commission fee applied to transactions. Although the share of self-financing is intended to increase over time with increasing number of credits, it remains low in the early stages and public and private support is necessary to ensure the financial balance of the scheme.

Today, the project seems to be a success, as many players in the area are showing interest in the scheme: in the second quarter of 2019, already more than 50 local companies have been engaged.

¹² The Ministry of Ecological and Solidary Transition has prohibited the resale of local carbon credits by beneficiaries.

It should be noted that several platforms of this type are emerging or under development at the national or regional level. Some of them are aiming to provide a turnkey solution for territories wishing to set up this type of tool.

The Low-Carbon Label, a French public policy at the service of transition

In November 2018, the French Government created its Low-Carbon Label¹³. This label aims to reward projects that are aligned with an ambitious climate strategy but which are excluded from regulation and may, therefore, have difficulty emerging: either because their sector of activity is not covered by public policies, or because their ambition exceeds the requirements of the standards. In this case, the valued reduced emissions do not correspond to all the reductions, but to the additional reductions of the project compared to usual practices.

The Low-Carbon Label makes it possible, on the one hand, to enhance the quality of GHG emission reduction and CO₂ sequestration projects and, on the other hand, to guarantee the climate efficiency of the financing of these projects, for example in terms of contribution to avoided and negative emissions. It is a tool for the decarbonisation of the French economy, aimed at influencing investments, practices and behaviour. It also includes an assessment of certain expected co-benefits (biodiversity, employment, water quality, etc.).

In operational terms, the State establishes a national reference system, approves sectoral methods developed with stakeholders and experts, labels emission reduction projects and finally recognises these emission reductions, together with independent auditors, when local authorities, companies and individuals decide to finance the labelled projects.

Today, 25 projects have been awarded the Low-Carbon Label in France.

Although the French Low-Carbon Label greatly facilitates the implementation of the La Rochelle Zero Carbon Territory project, it is not essential to its viability.

Its contribution for La Rochelle lies in an official recognition of the level of ambition of the emission reductions, the assurance of a robust quantification methodology and the standardisation of approaches and tools for an easier path and better replicability.

However, if the United Kingdom does not embark on a similar undertaking on a national scale, the definition of a methodologically robust tool, based on international standards and shared by stakeholders in the Leiston territory, could play an alternative role. In the United Kingdom, labels such as Woodland Carbon Code and Peatland Carbon Code could be used for this kind of platform, which would cover carbon sequestration projects in forestry and peatlands.

5.2 CASE EXAMPLE: SUSTAINABLE ENERGY FOR THE RURAL VILLAGE ENVIRONMENT, NORTH TIPPERARY

The SERVE project in North Tipperary Ireland began in 2007 and lasted officially until 2012. The population of North Tipperary County was 70,322 in 2011, however the population distribution is sparse, and many residents live in small villages and settlements similar to Leiston. The project was delivered by the North Tipperary County Council and the Tipperary Energy Agency and intended to show that the energy optimisation of whole communities and villages is more efficient than individual building measures. The project took a holistic approach to energy demand reduction and were able to achieve their aims through energy renovations, eco-building constructions and renewable energy technologies for over 600 buildings. They set new standards of energy performance design and renewable energy supply in Ireland.



Figure 4 - New efficient buildings at “Eco-Village”, North Tipperary

Political appetite is essential to achieve ambitious carbon targets. The initial targets of the SERVE project were met and did not change despite the economic crisis in 2008/09 which impacted on the project and many other low carbon projects. The project did however find it difficult initially to sell housing plots in the eco-village and the district-heating system did not break even until many years later than planned. One of the key policy impacts the project had was the use of its monitoring data which was used to influence the National Energy Agency’s energy policy. A monitoring programme of the scale of the SERVE project had not been undertaken in Europe before and enabled Ireland to be the leader in Europe for its open-sourced energy performance database. The SERVE project has also influenced quality standards within the National Dwelling Energy Assessment Procedures.

In the project, residents and businesses were offered grant schemes, delivered by the North Tipperary County Council and the Tipperary Energy Agency. The grants scheme required residents and businesses to think and act holistically to incentivise the holistic engineering approach. To qualify for financial support, a collection of measures was needed to be agreed to which maximised energy savings as well as agreeing to

¹³ See (in French): <https://www.ecologique-solidaire.gouv.fr/label-bas-carbone>

data monitoring on these. There were two different types of grants: energy efficiency grants or renewable energy grants. Initially, residents could choose the measures they wished to undertake and the project would finance up to 35% of the costs however soon this evolved into a SERVE energy efficiency grant which provided £1000 towards mandatory measures with additional payments for non-mandatory measures. Overall, the schemes financed 30% of the total costs of 360 homes and buildings.

One of the conditions for funding by the SERVE project's partners including SEAI required accurate and reliable data monitoring and tracking. The level of monitoring in each house was very new to residents as multiple meters for electricity, gas and renewables were required and data was transmitted via broadband to automatically capture and log consumption.

The North Tipperary SERVE project had a positive impact on policy and industry as shown by a replicated retrofit project in Dumbrane and several awards that the project was nominated for.

5.3 CASE EXAMPLE: LOW CARBON WEST OXFORD

West Oxford is the home of a community-led initiative set up to help and support residents reduce individual and community carbon emissions and create community benefit.

The initiative brings together four volunteer-led charitable and community cooperative organisations: Low Carbon West Oxford, West Oxford Community Renewables, Osney Lock Hydro, and Hogacre Eco Park.

Low Carbon West Oxford was formed in response to growing local concern about climate change, the increased frequency of local flooding including an unprecedented summer flood in 2007, inspiration from other low carbon communities and an awareness that people need to be provided with the means, not just the call, to action on climate change. Residents organised a local demonstration to protest against local flooding and held a number of open meetings to discuss what we could do to reduce the area's contribution to climate change.

These meetings led to the establishment of Low Carbon West Oxford which subsequently merged with two other local organisations: Waste Watchers and West Oxford Wildlife group. Working groups were set up on waste reduction, transport, food, renewable energy, and trees and wildlife. Some projects were later scaled up into an ambitious project that won a number of awards and grants.

The project helps people to take action by offering positive messages about the benefits of tackling climate change and providing a range of ways for residents to reduce their carbon emissions. West Oxford Community Renewables and Osney Lock Hydro (both community benefit co-ops) develop local renewable energy projects financed by a combination of local share offers and grant funding if appropriate. Any surplus income from the sale of renewable electricity and the Feed-in-Tariff is donated to the Low Carbon West Oxford charity, which uses the funds to run further community carbon cutting low carbon living, home energy, transport, food, waste reduction, tree/wildlife, local business engagement projects.



Figure 5 - A Low Carbon West Oxford community demonstration

Low Carbon West Oxford has also established the Hogacre Common Eco Park – a fourteen-acre site that features field, woodland and aquatic habitats and hosts low carbon activities and events. It was a founding member of Low Carbon Oxford and helped to create the Oxfordshire Low Carbon Hub as part of a government funded project with Oxford City Council. It advocates for a supportive local infrastructure and government policy to support local carbon reduction.

Outcomes and benefits delivered

Carbon Reductions from:

- » Renewable energy generation – saves around 190 tonnes of CO₂ per year from renewable energy projects (solar, micro hydro and small-scale wind turbines)
- » Low Carbon Living programme – saves around 130 tonnes of CO₂ per year from around 160 households
- » Tree planting – saves around 25 tonnes of CO₂ per year
- » Car club – around 60 tonnes p.a. from local car clubs
- » Waste reduction – up to 1.53 tonnes of CO₂ avoided per year

Other benefits

- » Waste prevention – around 1.8 tonnes of waste diverted from landfill per year
- » Economic benefits from reduced fuel bills from reduced home energy use and solar photovoltaics (PVs), income stream for the community from renewable energy generation, interest payments for shareholders, local jobs and increased demand for local trades
- » Comfort and health benefits from warmer homes: 112 households with vulnerable and elderly people at risk from a cold home were provided with advice and support
- » Biodiversity benefits – from tree planting and local wildlife projects.



CHAPTER 14

LESSONS LEARNED

Authored by



AUGUST 2020

EXECUTIVE SUMMARY

No town so far has been able to hit 'Net Zero' emissions. Looking at lessons learned is a key enabler for success of any project of any size. This chapter sets out recommendations for Net Zero Leiston and other future Net Zero projects to successfully reach their targets and aims, by analysing similar projects. A long list of projects were mapped to the Net Zero Leiston principles to help identify a shortlist. The chosen projects were North Tipperary SERVE project, Nottingham Net Zero, Le Mené and Reepham Low carbon Community. Conversations with project team members and desk research helped to produce key reasons for success as well as finding reasons for aspects that did not work well. These are published below in the **Lessons Learned Chapter** as well as the lessons learned log.

- » Net Zero Leiston should engage at the individual and street level with residents, businesses, and local community groups. Successful projects in the past have employed a dedicated on the ground project manager and used motivated residents and students to drive the project locally.
- » Net Zero Leiston will need to identify all key stakeholders in the local community, understand their motivations and ensure co-benefits of projects are properly communicated. Language and messaging should be accessible and Net Zero Leiston should welcome feedback through a variety of different digital and non-digital forums.
- » Fuel poverty and social mobility should be key considerations to ensure the project benefits the community and is accepted by all. It is important to focus on how education, jobs, housing, and transport can achieve Net Zero and reduce deprivation. Key performance indicators should link Net Zero's contribution to reducing deprivation.
- » A clear target for greenhouse gas emissions reduction should be set, with an initial footprint, budget and reduction trajectory and an effective and a robust emissions monitoring program in place to measure progress against the targets, enable funding and promote the success of the project.
- » Mature, proven and easy to replicate technologies appropriate to the community's geography and residents' motivations should be used to decarbonise each sector's emissions as well as allowing the local population to co-finance these projects has been a key success for many past projects.



- » Projects should be structured to maximise private sector funding and optimise the cost of capital and draw on public sources of capital (whether that be match debt/equity funding, grants or guarantees etc.) in order to incentivise private sector investment or provide financial support for projects which are in the early stages or costly and would otherwise be unavailable. The project will need strong public authority support and access to grant funding which should align to the projects aims and incentivise 'whole system upgrades' to maximise emissions reductions.
- » Net Zero Leiston should be transparent and open source to educate and communicate widely its findings to local and national audiences, to enable project funding and drive behavioral change in the community. A second town for replication should be explored in terms of how we can adapt the Leiston model locally, to help shape a blueprint for wider roll-out.
- » Cross governance structures are needed across the community and project. Local stakeholders must keep some level of governance to ensure they are drivers of the project as well as a body that can keep a transverse view of the project to ensure consistency and manage knowledge transfer.

AIMS OF THE CHAPTER

Many projects with similar Net Zero and low carbon aims have been attempted in the UK over the last few decades, several of them before the term 'Net Zero' was defined and popularised. Some of the earliest projects include 'Ashton Hayes Smart Village', 'Reepham Low carbon community' and 'North Tipperary SERVE project' and more recent projects include the likes of 'Energy Superhub Oxford', 'Repowering London' and 'Nottingham Net Zero'.

In 2020, the Infrastructure and Projects Authority (IPA) released a report of the 8 principles of project success. Principle 8 is to 'learn from experience' to find relevant learnings from other projects and use it to improve the planning and delivery of the project. Not capturing relevant lessons from other projects can result in project failure according to the IPA.¹

To set Net Zero Leiston up for success, the root causes for failure and success of relevant past and current projects are needed to help shape the Net Zero Leiston Route Map and optioneering process.

This chapter aims to

1. Identify best working practices and key successes from previous projects
2. Identify any challenges previous projects have faced,
3. Set out recommendations for Net Zero Leiston which have been derived from four shortlisted projects as well as additional relevant specific lessons from other projects.

PROCESS

Initially, a long list of 47 similar low carbon projects were collated by our group of expert consultants. The long list of projects was mapped to the Net Zero Leiston principles to identify projects that are most similar to the Net Zero Leiston project and it's aims. A medium list of 21 projects were identified as being aligned with Net Zero Leiston principles and therefore suitable for further analysis. A more detailed qualitative matrix-based approach was then taken based on seven categories that Net Zero Leiston project wants to learn about. This is a process which can be replicated for any project to build an understanding and view of projects similar to their own.

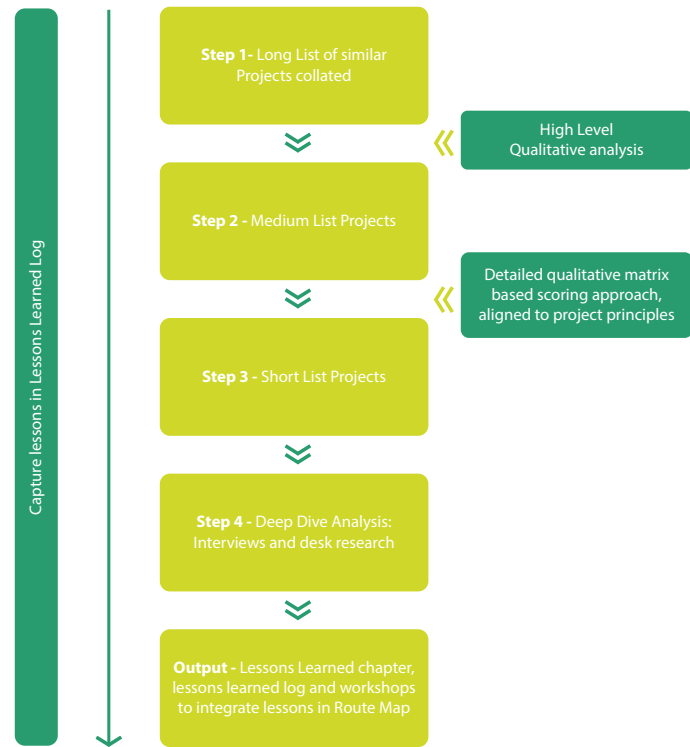
The seven categories are:

- » 'Local Stakeholders at the heart of the project'
- » 'Fuel Poverty and social impact'
- » 'Replicability, Technologies used and Approach'
- » 'Business model and funding solutions'
- » 'Climate and environmental goals achieved'
- » 'Reputation and marketing'
- » 'Governance and policy'

Following discussions with our group of expert consultants, a shortlist of four projects were identified which most thoroughly aligned to the lessons learned categories. Following this, interviews were set up with members of the shortlisted projects, as well as desk research to produce detailed analysis. Lessons from these projects were captured in a log throughout the process for the four shortlisted projects as

well as other specific relevant lessons from other projects. Following completion of the research, lessons learned were circulated to members of the Net Zero Leiston project team to ensure lessons captured have been incorporated into project planning, Route Map chapters and the optioneering process.

Lessons Learned Process



SHORTLISTED PROJECTS

The four shortlisted projects are North Tiperrary SERVE project, Nottingham Net Zero, Le Mené & Reepham’s Low Carbon Community. Key lessons from other projects in the long list that are significant and relevant to Net Zero Leiston have been included and inserted below.

North Tipperary Serve Project - the SERVE project in North Tipperary, Ireland began in 2007 and lasted officially until 2012. The population of North Tipperary County was 70,322 in 2011, the population distribution is sparse, and many residents live in small villages and settlements like Leiston. The project was delivered by the North Tipperary County Council and the Tipperary Energy Agency and intended to show that the energy optimisation of whole communities and villages is more efficient than individual building measures.²

Nottingham Net Zero - Nottingham has made the commitment to become the first carbon neutral city in the country, reaching this target by 2028. This means cutting carbon dioxide (CO₂) emissions from direct and indirect sources that arise from the consumption of energy within the city to near zero.³

Le Mené - In the community of Le Mené, in Brittany, they aimed to be energy self-sufficient across electricity, heat, transport and food sectors. This grassroots project has been driven by elected representatives, inhabitants, and local farmers.⁴

Reepham Low Carbon Community - Reepham is a small Norfolk town of around 1,200 households. When they won a public grant in 2004 for a low-carbon challenge, they began to explore various projects to decrease the carbon footprint of the community, as well as the energy bills of the residents. From 2004 to now, they have more than halved the total amount of emissions of the whole village.⁵

LOCAL STAKEHOLDERS AT THE HEART OF THE PROJECT

It is important to learn about how to keep local stakeholders at the heart of the project as the aim for Net Zero Leiston is to be driven and owned by the community, ensuring decisions that get made are in the best interest for local residents and businesses.

North Tipperary SERVE project

The North Tipperary project did this successfully by engaging with residents on a one-to-one basis at street level and used town hall meetings to give out information to wider audiences. A key part of the project’s success was finding between 10 and 20 motivated residents who became local champions and drivers of the project. The project showed residents, businesses and schools the raw research and energy consumption analysis that had been done to help them better understand the refurbishment and energy consumption measures being proposed. Furthermore, 25% of all project activities were carried out by local companies and contractors.

Nottingham Net Zero

Nottingham Net Zero also aims to keep residents at the centre of what they do. They have kept their language and messaging accessible to all by using units of delivery rather than tonnes of CO₂. Information has been communicated widely through a variety of formats: public places, online platforms, leaflets, webinars and events. They also organised a council wide public consultation from January to March 2020 to gain local feedback. They received around 600 responses to an online survey from businesses, workers and inhabitants and found a high level of support (9 out of 10 respondents) for Nottingham’s Net Zero ambitions. However, further engagement is needed as a large part of residents remain unaware of their Net Zero ambitions.

³ <https://www.edie.net/library/Net-zero-cities--Nottingham-s-mission-to-be-carbon-neutral-by-2028/6953>

⁴ <https://www.mene.fr/un-territoire-pionnier/>

⁵ <https://www.reephamchallenge.org/about>

² <https://smartcities-infosystem.eu/scis-projects/demo-sites/serve-site-north-tipperary>

Le Mené & Reepham LCCC

For Le Mené, the strength of the territory’s transition lies in the involvement of all types of stakeholders, especially farmers and citizens working collaboratively together. Similarly, Reepham’s Low Carbon Communities Challenge is a grassroot project led by influential residents. They developed a very active local network called the ‘Reepham Green Team’ whose objective is to reduce the carbon footprint of the town by implementing numerous and various projects. They initially engaged the community through small initiatives such as litter picks to gain momentum and also involved community groups such as the local rotary club as well as the local council. In addition, the project team was small but utilized consultants and experts when needed for specific projects.

Setting Net Zero Leiston up for success

For Net Zero Leiston to be community led, all projects will need to be engaged openly at an individual street, grassroots level. This is even more important for intrusive solutions such as energy efficiency measures in homes. To drive the adoptability of the project, Net Zero Leiston should help educate residents and businesses on energy consumption and Net Zero, to ensure all relevant community groups accept and drive the proposals themselves. Net Zero Leiston will need to identify all key stakeholders in the local community, understand their motivations and ensure the co-benefits are properly communicated. Identification of local “champions” who will drive the initiatives and efficiently communicate about them is also important. Language and messaging should be accessible and Net Zero Leiston should welcome feedback through a variety of different digital and non-digital forums.

FUEL POVERTY & SOCIAL IMPACT

Positive social impact and addressing fuel poverty are essential for Net Zero Leiston to be inclusive to all residents and provide benefits that improve people’s quality of life, reduces their bills and provides the energy they need to be healthy and comfortable.

North Tipperary SERVE project

Social mobility was an important outcome of the North Tipperary SERVE project. This was achieved firstly through education, funded training courses on high energy performance retrofits and low carbon technologies were provided for construction workers and energy advisors at the Tipperary Institute. Secondly, through employment as the eco-village set up in Cloughjordan attracts up to 300 visitors monthly. Employment has risen as a result and up to 20 permanent jobs have been directly created as new businesses have been setup. Furthermore, the project has led to positive community action by retaining the local train station due for closure and preventing the local school from losing two teachers.

Nottingham Net Zero

The focus of Nottingham Council for fuel poverty is largely on housing and public transport and they have successfully improved social housing stock through energy efficiency programmes. Nottingham Council tracks numerous socio-economic indicators; in their climate plans they highlight job creation and quality of life. Improvements include new parks, garden roofs and walls, no pollution, better waste management and less noisy transport.

Le Mené

One of Le Mené’s aims is to reduce the energy bill of households. They have some fuel poverty indicators, but they are not reported regularly. To help the poorest people reduce their energy bills, Le Mené has set up a building refurbishment platform, based on the French Energy Saving Certificates package. However, it has not been successful as it lacked local technical expertise, had high initial costs of renovations and the numerous public financing bodies were barriers to a large adoption. Le Mené also aimed to stimulate activity through employment by attracting energy start-ups to the area. However, this was not as successful as initially hoped as the area is not attractive enough for startups due to its remoteness.

Reepham LCCC

In Reepham, the project team believed that the key driver for change for most people is money and therefore cost savings associated with new insulation, heating, lighting and transport solutions were communicated to drive change. Through an energy audit completed by Reepham’s Green Team they found that most houses were in poor condition which was both a reason for deprivation and higher carbon emissions. Reepham’s Low Carbon Community has seen a 20% reduction in fuel poverty amongst tenants of social rented housing in Reepham, a significant improvement.

Falkirk Council

Falkirk Council installed eco-friendly boilers in around 900 council properties to replace gas boilers. Households were offered a specialist tariff which unfortunately was significantly more expensive following price increases by the energy supplier. When designing solutions, a holistic thinking approach is necessary to anticipate ripple effects. Otherwise, there is a potential for negative impact on prices and fuel poverty.⁶

Setting Net Zero Leiston up for success

For Net Zero Leiston, a clear objective must be set in terms of fuel poverty and social mobility with associated key performance indicators. Importantly for those in fuel poverty, any measures implemented need to help reduce their bills, ensure they can use the energy they need to be healthy and comfortable and need to be accessible to residents living in different vulnerable situations. The potential negative ripple effects of projects on price and fuel poverty should be identified and avoided. Net Zero Leiston will need to find the key causes for deprivation within the local community and use education, training and local job creation associated with the projects to provide social mobility. In addition, better housing conditions and better transport links are also proven ways to improve social mobility.



⁶ <https://www.thisismoney.co.uk/money/bills/article-7966625/The-eco-boilers-cost-5K-year-green-energy-deal-gone-wrong.html>



REPLICABILITY, TECHNOLOGIES USED & APPROACH

Net Zero Leiston aims to take a whole system and robust engineering approach to produce a replicable Route Map to ensure it achieves its Net Zero goal.

North Tipperary SERVE project

The North Tipperary project used a variety of technologies, including energy efficiency measures in homes (insulation, heating controls, refurbishments), renewable energy (solar and wood chip), district heating, Solar Water Heating Systems, small wind turbines and PV systems. Most technologies were successful except the small wind turbines which faced cost and adoption issues. The SERVE project took a holistic approach and invested in whole system energy renovations rather than separate and ‘one at a time’ individual measures. Whilst this did make gaining investor backing more difficult, the approach worked very well in reducing emissions and as 42% of residents in the region own their home it meant they were more likely to invest in large energy saving upgrades. Based on the success of the SERVE project, a similar community housing retrofit scheme in Drombane was completed.

Nottingham Net Zero

In Nottingham, the council took the approach of finding 5 key sectors of emissions (transport, built environment, energy generation, waste, and water and consumption) and has taken actions for each of those sectors separately. For Leiston, some projects would not be replicable on a small community level as they need a critical mass of residents. Additionally, from consultation they also found that offsetting emissions to reach Net Zero was largely unpopular with residents.

Le Mené

Le Mené successfully implemented technologies by focusing on those that were appropriate and relevant for its rural territory, such as a biogas plant, rapeseed oil refinery, district heat networks, wood biomass boilers and a wind farm all of which could be considered for Leiston’s rural areas.

Reepham LCCC

Reepham’s Low Carbon Community has tested a lot of different solutions with most of the ideas generated from individuals in the community with some direction as a result of initial energy audit studies and surveys. Three of the most successful include the Reepham Insulation Project, Bio-fuel trials and the Reepham car club. They mapped each idea with its benefits, limits and importance to prioritise which should be delivered.

Setting Net Zero Leiston up for success

For Net Zero Leiston to be successful, it is important to not fall into the trap of investing in ‘low hanging fruits’ but rather invest in whole system upgrades where appropriate for consumers as these have a larger emissions reduction impact. Net Zero Leiston should take a robust engineering whole system approach by

analysing the emissions of all sectors within the boundary of the community and use proven and easy to replicate technologies to decarbonise each sector’s emissions. These technologies should be appropriate to the community’s geography and resident’s motivations which will ensure risk minimisation. Several technologies have proved successful in a wide variety of projects such as renewables, EV charging, energy efficiency measures and district heating. Identification of barriers upfront is key to success as well as looking at ‘no regrets’ options which influence behaviour such as cycle lanes and community allotments. To ensure Net Zero Leiston can be replicated, the Route Map should identify other similar towns that would be suitable for a replication project and should be explored in terms of how we can adapt the Leiston model locally, which may help to shape a blueprint for wider roll-out.

BUSINESS MODEL & FUNDING SOLUTIONS

A key condition for project success is appropriate and sustainable business models and funding solutions.

North Tipperary SERVE project

In the North Tipperary SERVE project, residents and businesses were offered energy efficiency and renewable energy grant schemes, delivered by the North Tipperary County Council and the Tipperary Energy Agency. To qualify for financial support, two measures were needed to be agreed; whole building upgrades which maximised energy savings and data monitoring in their homes. The level of monitoring in each house was very new to residents as multiple meters were required however residents responded positively and enjoyed gaining feedback on their own energy use and consumption. Overall, the schemes financed 30% of the total costs of 360 homes and buildings. The main source of grant funding came from the EU CONCERTO funding programme as well as homeowners matching funding and obligated supplier schemes funding energy efficiency measures. Initially in the replicated Drumbane project, the Tipperary Energy agency attempted to set up a supply chain of private businesses, but they couldn’t attract enough private funding due to the low volume of activity. However, new financing mechanisms were successfully tested such as a first of a kind community owned 4MW wind farm where residents could buy shares in the cooperative. To help the project raise initial capital, the Tipperary Energy Agency did the initial feasibility work for the project.

Nottingham Net Zero

Nottingham City Council uses its own investment lever to put money in the projects they want to support. Initially, they evaluated internal budgets to invest the public money aligned with their Net Zero aims. Very few of the measures they have used have required customer funding, and instead they will bid for specific funding programs to develop projects that are expensive and still at a developing stage e.g. the EU-funded vehicle-to-grid (V2G) project. The financing method is technology led and leverages considerably on UK and EU grant funding. This has allowed Nottingham to become a test bed for new trials. For social housing, the financing schemes have worked well by offsetting upgrade costs with the reduction of maintenance costs. However, one challenge Nottingham Council have found is financing solid wall insulation due to the long payback time.



Le Mené

In Le Mené, most initiatives were community owned such as cooperative wind farm and biogas plant as well as the community supporting bids for grants. The key factors found to win grants are: expertise in filling out grant applications; an active watch of all available grants; dedicated resources to ensure the management of the public companies and a facilitator for stakeholder management. It has worked very well to have public authorities strongly supporting the dynamic, taking advantage of the national and local policies and allowing the local population to manage and co-finance projects.

Reepham LCCC

Reepham was given a public grant of £1M from the Low Carbon Communities Challenge and the Reepham LCCC kick-started their 18 different projects. They were reliant on grant funding and after a few years, further funding was needed. They looked at other funding solutions and won further grants from the Department for Transport, Carbon Connections and LEAF.

Bristol City Leap

Bristol City Leap faces some uncertainty over Bristol Energy, a council owned energy supplier that is a key partner in the Bristol City Leap Project. The council is now looking to potentially sell Bristol Energy which could cause a disruption to the project. When choosing partners, Net Zero Leiston should ensure their partners are strong and robust.⁷

Setting Net Zero Leiston up for success

To set Net Zero Leiston up for success, a data and monitoring strategy will need to be put in place to be able to track progress and enable funding from private and public investors. Collaboration between multiple partners is essential for project success and appropriate tailored grant and financing schemes are needed to ensure residents and businesses do not bear all the costs, whilst also achieving the projects aims. Projects should be structured to maximise private sector funding and optimise the cost of capital and draw on public sources of capital (whether that be match debt/equity funding, grants or guarantees etc.) in order to incentivise private sector investment or provide financial support for projects which are early stage or costly and would otherwise be unavailable. Having public authorities strongly supporting the project in policy, public investments and funding grants/bids and allowing the local population to co-finance projects are key funding success factors. When using grants, Net Zero Leiston should ensure that the grants align with the Route Map and decarbonisation plan. Importantly to enable further funding, initially solutions and technologies that can be delivered quickly will need to be deployed to demonstrate results and gather momentum both in the local community and nationally.

CLIMATE & ENVIRONMENTAL GOALS ACHIEVED

Achieving the climate and environmental goals is an important aim of Net Zero Leiston and without it, it will risk Net Zero Leiston failing in its critical priority to decarbonise Leiston.

North Tipperary SERVE project

The SERVE project met many of their targets and with good data monitoring it made it very easy to track. The project planned to install 10 wind/PV system; however, this was not achieved as the costs were too high and there was a lack of appetite from residents mostly due to the technologies being immature and ahead of their time with unproven business models and a regulatory system that didn't enable it. There was also strong interest from residents wanting to purchasing green electricity, but at the time residents did not want to pay the premium for this. Tipperary has limited gas and is dominated by oil or solid fuel which meant district heating was very attractive whilst for villages on gas systems, it proved not cost competitive. The renovation targets were met as energy consumption reduced by over 50% in the 353 monitored houses.

Nottingham Net Zero

Nottingham City Council has already reduced city wide CO₂ emissions by above 41% since 2005, surpassing previous carbon reduction targets. However, they have found it is also important to consider absolute emissions and intensity emissions, as the population is increasing in Nottingham. To measure progress, Nottingham Net Zero breaks action plans into units of delivery for easier understanding and clear reporting. For their carbon baseline, only CO₂ scope one and two emissions are in Nottingham Net Zero's commitment, but they also stress the importance of scope three emissions.

Le Mené

In 2019, Le Mené produced 150% of their need in electricity due to their wind farm, methanation plant and photovoltaic panels. The key factors for achieving environmental goals they found were to define and monitor indicators related to the objectives set, to define an ambitious and quantified action plan and to carry out qualitative and quantitative assessments of the main structuring projects regarding the sustainability of the territory and the goals and indicators.

Reepham LCCC

In Reepham, the community carbon audited one quarter of Reepham's 2,455 residents and 1,064 homes and then analyzed and extrapolated the results to the whole community. This suggested that Reepham emitted 13,288 tons of CO₂ per year from its homes, personal transport and flying which was equivalent to 12.5 tons of CO₂ per household and per year. Residential heating and hot water were the main source of emissions, with Reepham homes emitting 48% more than the national average. A final audit has not been done to find the precise emissions reductions and many projects have not provided publicly available quantitative figures on carbon emissions reductions.



⁷ <https://www.current-news.co.uk/news/bristol-city-council-reportedly-looking-to-cut-loose-bristol-energy>



SIMRIS local energy system

The project attempted to produce a standalone, renewable energy system in the village of Simris. The village ran on 80% grid power for the year that it has been run for. If the village actually functioned in a standalone way, it would have CO₂ emissions rates around 5 times higher than the base Swedish grid production due to the diesel generator and mix of storage and renewables. It is important for Net Zero Leiston to think about the ripple effects of combining ideas.

Setting Net Zero Leiston up for success

A clear target for greenhouse gas reduction needs to be set, with an initial footprint, budget and reduction trajectory and clear monitoring to measure progress. A quantitative complete system approach is needed to reduce emissions for each sector with solutions that consider the adoption rate from the community. Carbon offsets should be used as a last lever and communicated as carbon removals to ensure an engineering approach is taken and Net Zero Leiston does not ‘greenwash’. Even if scope 3 is outside engagement scope, it should be evaluated and understood, to raise awareness among the population.

REPUTATION & MARKETING

Reputation and marketing are two important project success factors, they enable funding, policy and engagement.

North Tipperary SERVE project

The North Tipperary SERVE project had a positive impact as shown by the replicated project in Drombane and the numerous awards that the project was nominated for. The project ran communication campaigns which incentivised changes in behaviour such as residents and businesses being encouraged to purchase electricity from suppliers providing green electricity to the market as well as running campaigns that garnered national and regional media attention. Furthermore, the open-source nature of the project enabled the region to become a hub for energy efficiency and renewable expertise.

Le Mené

In Le Mené, they focused on communicating the co-benefits of the transition in order to reach as many people as possible. The city council has developed a collaborative project called the ‘Great Challenge’ which has the ambition to make all the inhabitants understand the issue of energy transition through simple and practical goals and games.

Reepham LCCC

Reepham has benefited from local influential stakeholders and their storytelling abilities to help the project gain momentum locally and nationally. They found that the best way to spread the message was by word of mouth and online through both trusted existing local organizations and new social networks.

For the ‘word of mouth’ communication, they identified individuals who were key within the village to interact with residents. National press campaigns were also used but had a clear goal of communicating externally to sell the project widely.

Setting Net Zero Leiston up for success

To ensure Net Zero Leiston is successful, dedicated resources for communication and marketing and a clear plan are needed for local engagement and national visibility. Communicating on first successes will be key to gain momentum. Local businesses and networks need to be part of the communication through social media engagement. In order to change the habits of residents, communication and education-based events about all the benefits of Net Zero are also important. Net Zero Leiston should be transparent and open source to become a hub for expertise and replicable.

GOVERNANCE & POLICY

Political will and robust governance will be essential to achieve ambitious carbon targets.

North Tipperary SERVE project

One of the ways the North Tipperary SERVE project influenced policy was through its monitoring data which was used by the National Energy Agency. In North Tipperary, the Tipperary Energy Agency employed one person to project manage the operation locally. In Drombane, the Tipperary energy agency set up a new entity to access local development funding and initially employed students part-time to support the completion of initial energy survey’s and it now employs a few people full time to work and project manage the Drombane project.

Nottingham Net Zero

In Nottingham, the City Council established a flexible and dedicated internal project team to work across and with all appropriate Council services led by its Energy Services. Members of this team are seconded from within the Council to work exclusively on the project. The project is also well supported in the community through a green partnership of businesses and institutions across Nottingham. An example of a successful policy introduced by the council was a Workplace Parking Levy for residents driving their cars to work to fund development of tram network which has been positively accepted.

Le Mené

In Le Mené, the City Council had a key role in the territory in terms of investment but also to coordinate all the different initiatives. Two people from the City Council were dedicated to the technical and communication aspects of the projects, with a full view of the initiatives.



Reepham LCCC

Reepham’s low carbon community had a slightly different approach by organising themselves project by project. The Green Team sat above the projects to help the project manager access funding and contacts to execute their idea. Their approach was focused on local stakeholders who would lead the ideas with the support of the Green Team, local community groups and local council.

Setting Net Zero Leiston up for success

To ensure project success, cross governance structures are needed across the community and project. Local stakeholders must keep some level of governance to ensure they are drivers of the project as well as a body that can keep a transverse view of the project to ensure consistency and manage knowledge transfer.





CHAPTER 15

A COUNTERFACTUAL VIEWPOINT

Authored by



AUGUST 2021

EXECUTIVE SUMMARY

This chapter sets out the potential counterfactual response in not delivering the Net Zero Leiston (NZL) project. It sets out some of the key potential challenges and outcomes should the project not be delivered at all (the ‘do nothing’ scenario), or if the project is only partly delivered.

The chapter is structured in six key sections:

- » Global and National Context
- » Community Climate Leadership
- » Nature and Biodiversity
- » Economic and Industrial sectors
- » Societal and Human Interest
- » Stakeholders Groups

The chapter provided an initial view in June 2020 and has been reviewed and updated in August 2021 to include developments in the intervening period.

GLOBAL AND NATIONAL CONTEXT

At the time of writing, the UK faces the long-term issue of transitioning to a Net Zero economy, and the shorter-term issue of responding to and recovering from COVID-19. The calls for combining the response to these issues into a “clean economic recovery” are becoming increasingly prevalent internationally. Many global leaders suggest that we must use this unique challenge to our collective advantage and not return to business as usual. Consequently, the UK government has issued policies to “build back better” as a means of supporting the economy, with many policies being directed towards the green economy, decarbonisation, and reducing emissions. The UK transition sits in the context of the global situation and the contribution to the UN Sustainable development goals.

Leiston’s current greenhouse gas emissions profile is principally made of three core areas: electricity consumption, gas consumption, and transport.

In broad terms, without this project, emissions should follow a national trend in line with the Climate Change Act 2008 (2050 Target Amendment) Order 2019 which mandates the UK to reach Net Zero emissions by 2050 if not before.



However, more urgent action has been called for locally with Suffolk County Council declaring a climate emergency in March 2019, and East Suffolk Council making its climate declaration in July 2019. Both authorities are now working together and with partners towards the aspiration of making the county of Suffolk carbon neutral by 2030.

The NZL project will enable and accelerate technological changes to reach Net Zero locally putting the town and the county ahead of the expected national trajectory in support of the ambitions of Suffolk Council.

The Net Zero Leiston project is quite unusual as it proposes to tackle the decarbonisation of a geographic area with all the systems within that boundary. Most projects that move the decarbonisation agenda forward consider a technology that can be applied or a specific problem like domestic heating. It is rare for this more holistic approach to be taken.

The opportunity for a system of systems view to be considered is very valuable. The NZL project will create an opportunity to collate the learnings from other projects and to create a more-integrated set of solutions.

Without the project, there would likely be real delays in any meaningful delivery towards Net Zero goals inside the NZL boundary and these particular features of geography and system of systems and the learning and insights that will be generated would not be realised.

In this context, NZL offers an excellent opportunity to support the local community in (a) transitioning to a Net Zero economy, and (b) recovering economically from the impacts of COVID-19. NZL also offers a unique opportunity to government to catalyse change in a way that complements government policies.

COMMUNITY CLIMATE LEADERSHIP

From conception, NZL has been designed to be community-led journey to Net Zero with clear local leadership and demonstrable benefits for residents, local businesses, and the whole Leiston community.

This community climate leadership allows Leiston to be an exemplar to other semi-rural communities in the UK and internationally. Clear community leadership will be significant in:

- » Ensuring climate change issues are given the same priority as the short-term COVID-19 recovery
- » Ensuring Leiston (along with many other coastal and rural communities) is not “left behind” in the emissions reduction policies due to the focus on larger conurbations and city-regions
- » Providing evidence for Suffolk civic leaders that they are addressing the climate emergency and are focussed on climate change, and

- » Encouraging community cohesion and a wider sense of community pride in the local area, which could have a major positive impact on the town and its residents.

NATURE AND BIODIVERSITY

Coastal Suffolk supports diverse ecosystems that provide important habitats for local flora, fauna, and wildlife, as well as supporting local food production.

Maintaining the biodiversity of natural ecosystems in the context of mitigating and adapting to the impacts of climate change is considered by research bodies, including the University of East Anglia and Rothamsted Research, to be one of the most important problems and tasks for people in modern times.

NZL could enhance Leiston's natural environment through afforestation projects to support:

- » Increased biodiversity
- » Improved community health and wellbeing by enabling outdoor activities, with access to green spaces, and
- » Opportunities to enhance carbon sequestration and absorption by plants, trees, and woodland areas.

These would be lost without being included as an important element of the project.

Leiston also has a large area of allotments. NZL has identified options to work with local allotment holders to explore opportunities to enhance productivity and increase local community food production, reducing food miles and carbon emissions in processing and transport.

In terms of local air quality, research during the COVID-19 lockdown during March, April and May 2020 showed a significant improvement that can be obtained by large reductions of transport and vehicle movements. These tend to be relatively local effects, where the benefits of improving and enhancing the natural environment coupled with support for transitioning vehicles to EVs will be felt at the local level. The later lockdowns at the end of 2020 and in early 2021 were not so severe so the reductions were much less noticeable.

ECONOMIC AND INDUSTRIAL SECTORS

Leiston is a post-industrial rural market town, with a mix of retail, leisure, heritage, and culture related businesses. Leiston's leisure, cultural and tourism sectors could be affected by extreme temperature and weather events, both positively and negatively. Hotter summers could increase tourism, whilst colder or wetter winters could create major seasonal fluctuations in local economic activity.

However, two key sectors are leading to Leiston's economic growth: (1) clean energy and (2) agriculture, food & drink production.

Agriculture is an important sector for coastal Suffolk, with farmers and growers playing a significant role as part of Norfolk and Suffolk's £3.6bn agriculture, food and drink industry¹. Longer-term, agriculture may feel the effects of reductions or even increases of yields due to changing climates. These might be driven by increases or decreases in total rainfall, changes to the pattern of rainfall including more intense storms, flooding, and changes to pest species and numbers caused by a warmer climate. Whilst these potential impacts are driven by global climate change; the real impacts will be felt at the local and community levels.

NZL could enable farmers to start cultivating climate change resistant crops (e.g. that are resistant to intense rainfall, longer periods of drought or higher temperatures) and gain experience in growing them, enabling local farmers to be familiar with these varieties before they become essential.

Clean energy is a significant high-growth sector for East Suffolk with access to capital investment estimated at £59.4bn in the wider region to 2040². Suffolk's clean energy sectors could be the most significantly affected should NZL not be fully realised, with implications at local and national levels. A secure and plentiful supply of clean energy is essential for our collective future. We use it to heat and light our homes, to power our businesses and to transport people and goods. Without it, we could not function as an economy or a modern society.

A complete transition of the UK energy system is needed to deliver the UK's Net Zero target for greenhouse gas emissions reductions by 2050. Leiston is strategic location for the UK's energy systems with existing nuclear power facilities, plans for new nuclear, and onshore grid connections for some of the UK's largest offshore wind farms. This offers a major opportunity to lead the development of integrated concepts that can drive local growth, creating jobs, and ensuring security of low-carbon power and heat.

Without NZL's wider integrated ambition, opportunities to innovate on electric vehicles and charging networks, local hydrogen production and energy storage projects, and decarbonisation of heat could all be missed.

In relation to homes, cold homes can often be linked to poorer health conditions. Such conditions have received increasing focus by global health bodies given the coronavirus crisis. NZL, working with the Energy Systems Catapult and the EDF Energy domestic customers business, is identifying appropriate measures at a local level to support greater resilience. This includes retrofitting homes with electrified space heating thereby reducing emissions from gas and other fossil-fuel heating systems, supporting improved insulation in older buildings, and providing low-carbon cooling solutions. Leiston's housing stock is typically Victorian, and in many cases is poorly insulated. Without the holistic approach being proposed by the NZL project, improvements to homes could be uncoordinated or ineffective.

In relation to transport, based on 2018 emissions data, almost every local government area has seen year-on-year increases in emissions. Over the past five years, this equates to an overall increase of c.18% across all road transport emissions³. Transport systems and infrastructure could be affected by extreme climate events. Without appropriate adaptation, this could cause unexpected delays, cancellations, and closures creating isolated individuals and communities with an inability to travel or to transport goods and services.

Route Map options for NZL include supporting people making short journeys to cycle while helping those requiring a vehicle to transition to electric and fuel-cell passenger vehicles, encouraging local car share schemes, and increasing the use of low emission public transport options. Whilst NZL will have limited direct influence on local or national transport-related policy, supporting a modal shift to low emissions vehicles will play a positive and contributory factor.

In relation to water sources, the United Nations state that water is "the primary medium through which we will feel the effects of climate change."⁴ Water availability is becoming less predictable in many places, and increased incidences of flooding threaten to damage or destroy water treatment facilities and contaminate water sources.

Ensuring clean and sustainable water supplies is a national strategic priority which will be felt at the local levels. Whilst there is a limited influence that the NZL project can affect, concepts including seawater desalination facilities could ensure local clean water supplies are plentiful for local communities, agricultural systems, and technologies such as hydrogen production.

SOCIETAL AND HUMAN INTEREST

It is widely acknowledged by global climate researchers and the World Health Organisation that the impacts of climate change will affect human health. This is either directly related to the physiological effects of heat and cold, or indirectly, for example, through the increased transmission of food-borne or vector-borne pathogens or flooding. In particular, Leiston's built environment and infrastructure (such as homes, buildings, water sources, and roads) are likely to be more vulnerable to extreme events (floods and storm events), heatwaves and drought.

STAKEHOLDER GROUPS

The main stakeholder groups are identified and the impact of the partial delivery or non-delivery of the NZL project is assessed for each of these groups.

It is expected that the civic leaders and residents would see the opportunities for community climate leadership and the human and societal factors as particularly acute losses.



¹Economic Strategy for Norfolk and Suffolk, New Anglia Local Enterprise Partnership - [Economic Strategy Evidence Report, December 2017](#)

² 'An Assessment of Land Requirements to support Offshore Energy and Engineering in Waveney' – Opergy Ltd. September 2018

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³ Data sourced from BEIS National Atmospheric Emissions Inventory. Accessed in May 2020

⁴ United Nations, UN Water. <https://www.unwater.org/water-facts/climate-change/>

CHAPTER: A COUNTERFACTUAL VIEWPOINT

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1. INTRODUCTION

As outlined in the executive summary, the key stated objective of the project is **“to produce a high-level, achievable Route Map, using available technologies, to identify the steps needed to get Leiston to Net Zero.”**

The Net Zero Leiston project has created a set of project principles to help steer and shape the development of a **robust Route Map to achieve Net Zero emissions by 2030**. These are:

- a. Ensuring local stakeholders are at the heart of the project
- b. Taking a thorough, robust engineering approach, not greenwashing
- c. Addressing fuel poverty and providing social mobility
- d. Understanding how different technologies work together to create a replicable energy showcase
- e. Combining Net Zero ideas with replicable funding solutions
- f. Maximising wider benefits and opportunities for all stakeholders
- g. Helping the region achieve its climate goals and continuing the UK's focus as a leader in the journey to Net Zero.

2. GLOBAL AND NATIONAL CONTEXT

This section considers the lost opportunities to contribute to the global need to combat climate change.

SUSTAINABLE DEVELOPMENT GOALS

The United Nations (UN) Sustainable Development Goals (SDN) were introduced in **Chapter 12**, and the goals that the NZL project will most impact were outlined.

In terms of the counterfactual, these are the opportunities that will be most significantly missed if the NZL project does not go ahead.

SDG 7 on affordable and clean energy: The positive impact of moving domestic heating, local industry, agriculture, and transport to a Net Zero position by implementing energy efficiency and by moving energy consumption to sustainable sources would be lost if the project was not delivered.

SDG 8 on inclusive and sustainable economic growth: There would be a loss of the expected training opportunities.

SDG 9 on building resilient infrastructure: The continued demonstration of the decoupling of carbon emissions and GDP growth is a useful outcome of the project and the focus on community and the local economy supporting this decoupling provides an additional layer of learning.

SDG 11 on sustainable cities and communities: If the NZL project were not to be progressed, then the expected promotion of public transport to reduce carbon emissions and to deliver improvements in air quality would not be delivered.

SDG 12 ensuring sustainable consumption and production patterns: The contribution to reductions in raw material consumption by community-based approaches to recycling and reuse would not be realised. The replenishment of natural resources to help to offset material consumption impacts would also not take place.

SDG 13 on climate action: This project is focused on climate action. Any reduction in the delivery of the project will affect the contribution to this SDG. The opportunities for decarbonisation and for the demonstration of decarbonisation is considerable; the timing is opportune with significant discussion about climate change in the media. These would be reduced or lost in the event of a reduction of the scope.

SDG 15 on sustainable managed forestry: While afforestation is not a primary goal of the NZL project, it could improve the situation locally and to provide a wider demonstration including the implementation of both community-based and agriculture-led initiatives, and sharing the learnings from them.

SDG 16 on promoting just and inclusive societies: The opportunity of inclusive, participative, and representative decision-making at all levels through the Net Zero Leiston (NZL) Working Group, a local Leiston Steering Committee and an internal EDF NZL Steering Group is an important part of the governance of the NZL project. It will be an opportunity missed if the community cannot contribute to the project.

Given the potential to support the delivery of the Sustainable Development Goals through this project, it would be a significant loss of opportunity if it were not to proceed.

CLIMATE CHANGE EMISSIONS

Leiston's current greenhouse gas emissions profile is principally made of three core areas: electricity consumption, gas consumption, and transport.

A detailed assessment of the area's baseline emissions is available in a separate chapter; however, this counterfactual view explores the potential impacts of not delivering the NZL project by 2030, or the project not proceeding at all.



In broad terms, without this project, emissions would be expected to follow a national trend in line with the Climate Change Act 2008 (2050 Target Amendment) Order 2019 which mandates the UK to reach Net Zero emissions by 2050 if not before.

However, more urgent action has been called for locally with Suffolk County Council declaring a climate emergency in March 2019, and East Suffolk Council making its climate declaration in July 2019. Both authorities are now working together and with partners towards the aspiration of making the county of Suffolk carbon neutral by 2030. The initial steps are baselining the county’s greenhouse gas emissions and developing a long list of possible interventions that the county could pursue as well as national policy areas where the councils should be lobbying central government. Priority actions have been identified. The Suffolk Climate Emergency Plan is currently under review.

It should be noted that some climate change impacts will be felt within the boundary area due to prevailing climate change effects, i.e. extreme weather events. However, this project, while significant, is not large enough to alter, to any measurable degree, many of the climate effects on Leiston or Suffolk, as these can only be mitigated at the national and international scale.

The assumption is that NZL will enable and accelerate technological changes to reach Net Zero locally putting the town and the county ahead of the expected national trajectory. The NZL project will assess options and a Route Map to pull forward technological opportunities and will identify and implement a range of different community-focused solutions. These are unlikely to be otherwise considered, particularly in the rural context, if the project were not to proceed.

CARBON BUDGET & FOCUS ON LEISTON

As set out in **Chapter 1**, 'Defining Net Zero', the size of the challenge for Leiston on emissions reduction is made clear when introducing the concept of a territorial Carbon Budget.

As a result of the targets set out in the United Nations Paris Agreement, the Intergovernmental Panel on Climate Change (IPCC) calculated a global carbon budget where adhering to this budget should stop the world from exceeding the global temperature increase limit.

The Tyndall Centre for Climate Change Research has since developed a methodology to apportion this global budget to the UK. This required further analysis to develop a local carbon budget as the district level, where Atkins developed a tool which allows for the calculation of such budgets using the methodology from the Tyndall Centre to apportion IPCC global carbon budgets (cumulative quantity of CO₂ emissions from all anthropogenic sources to maintain warming well below 2oC) to local authorities for the period 2018-2100.

Figure 1 below shows business as usual emissions versus a local Carbon Budget for Leiston, modelled on a cascading basis from the Paris Agreement global budget calculations. The graph does not reach Net Zero by 2030 simply based on this high-level analysis, and whilst further detailed research is underway, NZL will require a broad range of interventions as part of an integrated Route Map to achieve the target.

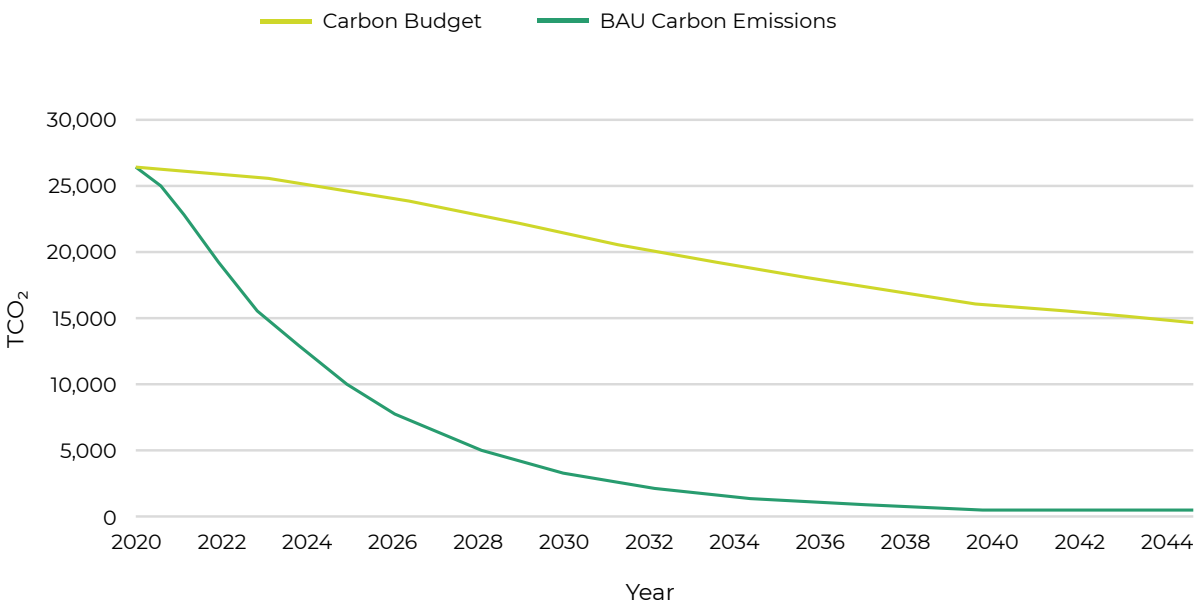


Figure 1 - Carbon Budget trajectory for Leiston versus Business as Usual emissions forecasts [Source: Tyndall Centre for Climate Change / Atkins 2020]

Given this position, the NZL project is about:

- a. Identifying and using solutions to decarbonise more quickly; bringing ideas forward, utilising technologies that are more immediately available rather than ones that may become available in the future (but before 2050), i.e. make changes faster
- b. Exploring novel and innovative interventions such as changes to agriculture, flood mitigation, resistance to diseases and pests, i.e. make wider-scale changes
- c. Modelling and encouraging behavioural changes by the local population that are led by the community itself and which contribute to decarbonisation
- d. Demonstrating and showcasing the way that these technologies, interventions, and behavioural changes are applied within and by the community for the benefit of Leiston’s residents and other stakeholders - make changes for the benefit of the community.

These are some of the direct benefits of this project rather than letting “normal policy change and events” take their course. It is therefore important to be clear about which “camp” each of the lost benefits of not doing the project fits in.

The reason to be clear about this is that the expectation is that the rest of the UK is going to follow the UK national path. Most of the international community will follow the Paris Agreement path. Some significant countries will do things in their own way. The macro-scale climate change effects will happen to Leiston, whether this project goes ahead or not. It is important not to imply that not doing this project means that Leiston will be affected more by these macro-scale climate changes.

Without NZL's stimulus through the project and by working with the community, significant climate action would be led or 'mandated' by government, at either national or local level or by a combination of the two. Both national and local government have very limited capacity and funding to invest in a post-COVID-19 economy, and this is a situation that is likely to persist for some considerable period, so the timing of the project is particularly beneficial to energise the needed change.

Taking a brief look back to comments made by Professor Andy Gouldson from Leeds University, after the 2009 recession and referring to COP 15 in Copenhagen, December 2009, he said:

"If we return to 'business as usual' emissions after the economic crisis is over, the profound and severe risks of climate change impacts will continue to grow. So, the global downturn does not remove the urgent need for a strong agreement to be reached at the United Nations climate change conference in Copenhagen in December,"

Jump forward a decade, and the quote is as relevant today as in 2009 given the forecast economic recession in the wake of the COVID-19 pandemic. More recently Chris Stark, CEO of the UK Committee on Climate Change, is quoted discussing the risks of not pursuing Net Zero goals in a post-COVID-19 economic recovery plan. He said:

"The biggest risk that sits before the global mission on Net Zero is the risk of fossil fuel lock-in. If we choose to do what we did in 2009, we will lock in fossil fuel use with our infrastructure choices, and we would not have enough time to reverse from that now. You are going to see big problems potentially if we make the wrong decisions. That's the biggest risk."

As mentioned earlier, there is a growing focus on a clean economic recovery and a greater focus on sustainable and inclusive growth, more aligned to the goals set out in the UN Sustainable Development Agenda 2030.

"If we return to 'business as usual' emissions after the economic crisis is over, the profound and severe risks of climate change impacts will continue to grow. So, the global downturn does not remove the urgent need for a strong agreement to be reached at the United Nations climate change conference in Copenhagen in December."

Professor Andy Gouldson, Leeds University, quoted after the 2009 recession and referring to COP 15/CMP 5 in Copenhagen December 2009.

3. COMMUNITY CLIMATE LEADERSHIP

From conception, NZL has been designed to be community-led journey to Net Zero with clear local leadership and demonstrable benefits for residents, local businesses, and the whole Leiston community. Whilst there are other examples around the world of similar Net Zero strategies and plans, NZL is a first-of-its-kind project because it is community-led and is in a small town of fewer than 6,000 residents in a rural area. This community climate leadership allows Leiston to be an exemplar to other semi-rural communities in the UK and internationally. The local community has already demonstrated its commitment to tackling climate change, by leading NZL and setting up the Suffolk Climate Change Partnership.

WHAT ARE THE RISKS TO COMMUNITY CLIMATE LEADERSHIP IF NZL DOES NOT PROCEED?

Community climate leadership is one of the key benefits of NZL. Broadly, there are four key risks to community climate leadership in the UK if NZL does not proceed.

1. COVID-19 prioritised over climate change

There is an urgent need for clear community leadership on climate change. However, there is a serious risk that climate change could become a lesser priority than the COVID-19 economic recovery. For example, the emphasis on using cars rather than shared public transport to avoid COVID-19 transmission will be a short-term barrier to the wider adoption of public transport solutions. The emergence of further variants

of COVID-19 might result in sustained barriers to decarbonising such longer distance journeys. When safe to do so, opportunities to reverse this trend will need to be taken to ensure the transition to sustainable transport. To complement this, low-carbon and renewable energy systems have been more resilient than most industries during the COVID-19 crisis. Given Suffolk's wider role in clean energy generation, there is therefore a great opportunity to combine the COVID-19 recovery with the region's Net Zero ambitions. Community climate leadership would play a key role in encouraging these two competing objectives to work in tandem, rather than against each other, and demonstrating the potential to policymakers.



Figure 2 - an EDF Energy sponsored electric car - one of the NZL Route Map options to support Leiston community.

2. Loss of political momentum and credibility

Without NZL and its demonstrable benefits to the environment, Suffolk's civic leaders would lose credibility in their reaction to the local climate emergency declared in March 2019. Elected officials and politicians could be at risk of diminishing local support, thereby creating political uncertainty and potential delays in agreeing future policy directions. Supporting the NZL project will demonstrate that they take climate change seriously and are prepared to follow up their words with action and in so doing enhancing the town's profile, as NZL contributes well to themes in the Suffolk Climate Change Partnership "Suffolk Climate Emergency Plan.

In addition, Leiston and many other rural communities could be "left behind" in the emissions reduction policies. Community climate leadership can act as a mouthpiece to policymakers to ensure that national emissions reduction policies are not purely focused on larger conurbations and cities.

3. Loss of social value and inclusion

Leiston would suffer from a loss of community cohesion. Community climate leadership creates a sense of togetherness and pride in the local area. Losing this cohesion would forgo a hugely positive impact on the town and its residents.

In addition, the NZL project is now in the public domain and attracting media and community attention. Not to proceed, or to delay implementation following the production of the Route Map, would be disappointing and could harm Leiston's community image, local government's commitment to climate action and support for local communities, notably the focus on community, inclusion, equality, and natural environment as part of a Just Transition.

If the NZL project does not proceed, then the locations that are pioneering low-carbon heating and sustainability will continue to be mainly urban communities that have different population profiles, economies, social drivers and ambitions. There is a risk that solutions which have been developed in a more urban setting will be rolled out to rural communities. These may not be the best technologies, and the way that they are implemented may not be appropriate. It is important to create examples of how decarbonisation can be successfully achieved in a more rural community such as Leiston that can then provide demonstrators nationally and possibly internationally.

4. Detrimental effect on the environment

NZL will demonstrate new approaches in the use of low-to-zero carbon technologies, such as heating homes and businesses and supporting a more rapid shift to sustainable modes of transport. Without NZL, there is a risk that local greenhouse gas emissions could continue to increase in the short to medium-term, especially from new homes using fossil-fuelled heating systems and diesel/petrol passenger car journeys increasing.

In addition, the emissions produced by agriculture presents a challenge to NZL, and community climate leadership would help to address this. The farmed landscape of coastal Suffolk, including Leiston, supports outstanding food production while sustaining habitats of international importance. With the sector balancing the evolving changes to the Common Agricultural Policy after the Brexit transition period, and the prospect of economic recession due to the challenges of COVID-19, this places even greater pressure on farmers and producers and the move to Net Zero may not be in their immediate plans as they focus on immediate business survival.

4. COMMUNITY CLIMATE LEADERSHIP

This section explores the counterfactual view of NZL on biodiversity, the natural environment, and ecosystem services.

THE IMPORTANCE OF NATURE AND BIODIVERSITY IN SUFFOLK

Biodiversity is defined as the functioning and ecosystem service provision from many natural and semi-natural ecosystems. Biodiversity is under threat from climate change and other pressures (Millennium Assessment, 2005) and is considered by research bodies – including the University of East Anglia and Rothamsted Research - to be one of the most important problems and tasks for people in modern times. The existing rate of loss of biodiversity is very high, and there is a risk that tipping points in some populations may cause significant disruption to systems that have evolved over millions of years and are unable to cope with the speed of the changes that are currently occurring. For example, the loss of insect populations is affecting the pollination of many plants.

Coastal Suffolk is home to a number of idyllic lowland landscapes. Large numbers of visitors enjoy its mix of beaches, marshes, estuaries, heaths, forests, and farmland. The landscapes also support diverse ecosystems that provide important habitats for local flora, fauna, and wildlife, as well as supporting local food production.

THE CHALLENGES TO NATURE AND BIODIVERSITY IN SUFFOLK

Suffolk is one of the driest parts of the country, with local rainfall typically two-thirds of the national average. When supplies are low, farmers and growers typically compete with the demand for water from homes, business, and the environment.

Organisations such as the National Farmers Union recognise the vital role of Suffolk's natural environment, which underpins a diverse and rich agricultural sector. They have identified major risks associated with the threat of long-term climate change impacts with increased frequency and severity of floods and droughts, putting productive farmland, homes, and businesses under threat.

Beyond agriculture, forestry and woodland areas represent an important consideration with potential for carbon dioxide sequestration and improved biodiversity. However, climate change and extreme temperatures and weather events could also affect woodland species. The need to protect and expand existing areas of woodland and to create new woodland is clear. The diversity of the species in these woods is vital to creating a varied habitat for a wider range of plant, animal, and insect species.

RSPB Minsmere is one of the largest nature reserves in the region and lies just north of Leiston town. The reserve is home to more than 5,000 species, including rare species such as nightjars, woodlarks, stone curlews, and little terns. There is a significant proportion of the UK population of bitterns and is a key site for marsh harriers. Longer-term impacts of climate change will have major impacts on native and migratory birds and wildlife that live and migrate to/from the area.

THE IMPACT OF NZL ON NATURE AND BIODIVERSITY IN SUFFOLK

Whilst NZL is a community-led project and focuses on a specific geographic area; it will have very limited direct impacts in terms of national or global emissions reduction nor the ability to influence major weather or climatic events.

However, without NZL, Suffolk's nature and biodiversity could be vulnerable to:

1. Lack of afforestation projects

These would support increased biodiversity. Afforestation would also improve community health and wellbeing through enabling outdoor activities and could improve access to green spaces.

2. Exposure to environmental disasters such as temperature extremes, flooding, and drought

If these aspects are excluded from the project scope, then these improvements will not be realised. In developing the Route Map for NZL, enhancing the natural environment remains a key consideration. Through NZL's afforestation projects, the local area will have increased woodland and forest cover. Such cover increases natural resilience to flooding and drought, and also provides natural carbon sequestration due to absorption by plants.



Figure 3 - Cattle graze by the ruins of Leiston Abbey chapel [Photo Charles Cuthbert]

3. Lack of community engagement and collective discussion

The community-led approach is important to improve understanding between the groups within the boundary of the NZL project. It is clear from other initiatives that better understanding between groups and collective discussion and decision making are vital to the success of the project. An example of an initiative where problems have arisen is the proposal to rewild areas of cultivated land. The ideas are being promoted by many people and some organisations but are being robustly challenged by some farmers and landowners who do not feel that they are being listened to or that the organisations understand their situation or perspective.

Leiston has a large area of allotments using land both owned and leased by Leiston Town Council. NZL has identified options to work with local allotment holders to explore opportunities to enhance productivity and increase local community food production, potentially supported with new community kitchen facilities which could host wider initiatives and activities supported by NZL such as a community EV car club.

4. Decreased local air quality

In terms of local air quality, research during the COVID-19 lockdown during March, April and May have

shown the significant improvements that can be obtained by large reductions of transport and vehicle movements. These tend to be relatively local effects, where the benefits of improving and enhancing the natural environment coupled with support for transitioning vehicles to EVs will be felt at the local level. These benefits could be diminished without the focus that ‘whole community’ projects such as NZL offers.

Such initiatives may not be considered at a national scale as a contribution to meet the UK’s longer-term 2050 target, relying on more regional and local projects to deliver the changes needed to achieve these benefits.

Without NZL, this type of action could be compromised, losing the ability to enhance the natural environment further, encourage biodiversity, which otherwise could be directly stimulated by local community activities.

“Without the ambition and focus enabled by the Net Zero Leiston project, plans to create a climate-resilient local economy would be compromised and new innovative sectors and technologies or projects not developed or significantly set back.”

5. ECONOMIC AND INDUSTRIAL SECTORS

This section explores some of the counterfactual views of the NZL project concerning areas of economic and industrial sector developments.

LEISTON’S ECONOMY IS EXPOSED TO CLIMATE EVENTS

Leiston is a post-industrial rural market town. Whilst Leiston has a varied economy, its leisure, cultural and tourism sectors are exposed to extreme climate events. Whilst hotter summers could increase tourism, the drawback is that the likelihood of drought increases. Colder or wetter winters could also create unpredictable seasonal fluctuations in local economic activity.

LEISTON’S OPPORTUNITY TO INCREASE TOURISM

Due to NZL being a community-led project, the improvement in community involvement across a wider range of initiatives could lead to increased tourism in the area. For, example, NZL’s positive effect on low-carbon economic growth, resilient agricultural systems, improved biodiversity, and a healthier society, could be attractive for future tourism. Without the focus of NZL, such opportunities could be missed.

LEISTON’S TWO KEY SECTORS

Leiston’s economy has two key sectors: (1) clean energy and (2) agriculture, food & drink production. This section will focus on clean energy as it relates more strongly to the NZL project.

NZL’S IMPACT ON AGRICULTURE, FOOD & DRINK

Agriculture is an important sector for coastal Suffolk, with farmers and growers playing a significant role as part of Norfolk and Suffolk’s £3.6bn agriculture, food and drink industry⁵.

In the short term, without NZL providing community climate leadership, Suffolk’s agriculture, food and drink industries could suffer from:

- 1. Delay or loss of exploring new and alternative growth opportunities, such as food production allotments

Without NZL providing community leadership in exploring new and alternative growth opportunities, the agriculture sectors may see delayed or even not benefit from novel solutions in support for allotments for local food production.

- 2. Loss of crops that are vulnerable to drought, extreme temperatures, or floods

NZL, working with research bodies such as Rothamsted Research, and learning from the John Innes Centre at Norwich Research Park, could enable farmers to start cultivating climate change resistant crops (e.g. that are resistant to intense rainfall, longer periods of drought or higher temperatures) experience could be gained in growing them, enabling local farmers to be familiar with them before they become essential.

- 3. Loss of soil nutrition through lack of carbon sequestration and lack of by-product from local anaerobic digestion facilities (e.g. biochar or bio-digestate)

A January 2020 report published by the Committee on Climate Change – Land Use: Policies for a Net Zero UK – calls for one-fifth of the nation’s farmland to be transformed over the next 30 years into landscapes designed to store carbon and cut emissions. Central to the committee’s proposals is “a high uptake of low-carbon farming practices and releasing 22% of land out of traditional agricultural production for long-term carbon sequestration”.

Chris Stark, the CCC’s chief executive said *“The clear advice is that we need to see a fifth of agricultural land taken out of traditional agricultural production and moved into long-term, natural carbon storage, that means growing trees, restoring soils...There is inevitably some uncertainty about the precise ways in which that needs to be achieved, that means a really strong message to government: They have to get started on this soon.”*

In the longer term, without NZL providing community climate leadership, Suffolk’s agriculture may feel the effects of reductions or even increases of yields due to changing climates. These might be driven by increases or decreases in total rainfall, changes to the pattern of rainfall including more intense storms, flooding, and changes to pest species and numbers caused by a warmer climate. Whilst these potential impacts are driven by global climate change; the real impacts will be felt at the local and community levels.

Without NZL it remains unclear where such innovation and support may emerge in the short to medium term, demonstrating that this project can provide a beneficial framework to help farmers and others in the agricultural sector to navigate this extended period of uncertainty.

NZL’S IMPACT ON CLEAN ENERGY

Suffolk’s Clean Energy sectors could be the most significantly affected should NZL not be fully realised, with implications reaching local and national levels.

Currently, Suffolk has a broad energy mix and presents extreme potential to produce clean energy. This is because:

- » Clean energy is a significant high-growth sector for East Suffolk with access to capital investment estimated at £59.4bn in the wider region to 2040⁶
- » Leiston is home to the region’s only operational nuclear station and there are plans for a new nuclear plant near Sizewell

- » Suffolk sits at the heart of the world’s largest market for offshore renewables and there are plans for developing onshore connections for some of the UK’s largest offshore wind farms
- » Suffolk has plans for developments in solar, biomass, battery storage and hydrogen, and
- » Suffolk has access to potential storage facilities for gas and captured carbon in the Southern North Sea.



Figure 4 – Greater Gabbard Offshore Windfarm, off Suffolk. Onshore grid connection at Leiston.
[Credit: SSE]

Looking ahead, Suffolk is uniquely positioned to capitalise upon the opportunities that clean energy presents. In short, opportunities in clean energy will arise because the demand for low-carbon electricity will increase (according to the Committee on Climate Change, the need for electricity will double by 2050 in the UK, whilst the need for low-carbon electricity will quadruple⁷) whilst the amount of greenhouse gas emissions must reach Net Zero by 2050.

Suffolk’s range of low-carbon energy generation technologies – such as wind, solar, hydrogen and nuclear generation – can play a significant role in this critical transition. This is by virtue of providing low-carbon fuels and low-carbon electricity storage. In addition, as well as producing continuous power, nuclear stations also produce large quantities of heat which can be utilised locally. Nuclear power stations also help to stabilise the electricity system by providing system inertia which is not provided by most forms of renewable generation such as solar PV and wind farms.

Integrating this production with storage, hydrogen production and local energy use can provide synergies in terms of using and managing the electrical grid and enable the greater decarbonisation of heat, transport, and industrial processes.

Co-location of these different technologies – in a clean low-carbon energy hub – creates flexibility, where the by-products from one process can be used to increase the efficiency of another optimised in real-time to deliver the most value to the energy system as a whole.



Figure 5 - Construction of Hinkley Point C Power Station, Somerset. [Credit: EDF Energy]

NZL is focused on stimulating and supporting a community-led response to climate change and a shift to Net Zero. In addition to being home to the Sizewell B power station and plans for the 3.2GW Sizewell C project, Leiston is also the landing point for the 504MW Greater Gabbard Offshore Wind Farm, and 353MW Galloper Offshore Wind Farm.

The NZL project complements plans for the development of a potential Clean Energy Hub at Sizewell, which could support the ‘Energy Transition’ pathway where otherwise the role of nuclear could be limited.

Without NZL’s wider integrated ambition of a community-focused climate change response, strengthened and supported by innovative concepts such as the Clean Energy Hub, the town and the region will lose the opportunity to play a leading role in technology areas, such as:

- » **EV and charging networks** in smaller towns and rural locations may not be demonstrated, risking a continued use of diesel/petrol vehicles for longer in such areas and a net increase or no reduction seen in local transport emissions.

- » **Hydrogen production** at scale may be a major missed opportunity for East Anglia, compromising the wider potential for the region's wider energy decarbonisation plans.
- » **Battery storage projects** may not be realised and bridging the gap between transmission and distribution networks could stall local growth in new housing and employment land.
- » An opportunity to demonstrate the **decarbonisation of heat** in a rural setting will be missed using electrified or hydrogen-fuelled solutions.
- » Synergy with **Offshore Wind** developers may not be realised with the loss of shared or collaborative infrastructure with potential increased costs for consumers, loss of land used for additional onshore substations, and lack of resilience in grid infrastructure.

The construction of national energy infrastructure projects such as Sizewell C and new offshore wind farms could act as demonstration opportunities in low-carbon technologies through the construction and enabling works supply chains, e.g. hydrogen fuel cell or electric HGVs; Net Zero temporary accommodation solutions; using 'low-carbon concrete' acting as a carbon sink in associated developments on site.

Without the ambition and focus enabled by the NZL project, such opportunities could be missed. In summary, plans to create a climate-resilient local economy would be compromised, and new innovative sectors and technologies or projects not developed or significantly set back.

6. SOCIETAL AND HUMAN INTEREST

This section explores some of the counterfactual views of the NZL project concerning areas of societal and human interest.

NZL'S EFFECT ON LIVING STANDARDS AND HUMAN HEALTH

It is widely acknowledged by global climate researchers and the World Health Organisation, that the impacts of climate change will affect human health. This will either occur directly through the physiological effects of heat and cold, or indirectly through the increased transmission of pathogens from food or from other sources, loss of fertile land for food production, or natural disasters.

In this context, a particularly relevant threat to Leiston's residents is the effect that cold homes could have on health and the standard of accommodation. Leiston's housing stock is typically Victorian, and in many cases poorly insulated. Another key cause of cold homes is fuel poverty where homes are often under-heated, with only one room being heated at all. The resulting temperature changes through the house can cause breathing problems. Under-heating, particularly when combined with poorly ventilated spaces, enables damp to penetrate the building fabric promoting the growth of mould. The health conditions include respiratory conditions (e.g. asthma), physical conditions (e.g. diabetes, arthritis), and mental illnesses (e.g. depression and anxiety)⁸. People who have more serious health conditions are often not economically active are therefore more likely to be fuel poor. Earlier elimination of these problems improves resident's health and wellbeing, reducing the demand on the NHS and social services.

Without the integrated and holistic approach being proposed by the NZL project:

1. Opportunities for residents to benefit from government-wide schemes could be missed

For example, opportunities to improve homes under the government's Energy Company Obligation (ECO) energy efficiency scheme might be missed. The ECO scheme encourages energy suppliers to promote measures which improve the ability of low income and vulnerable households to heat their homes.

2. Opportunities to co-ordinate with local government bodies could be missed

Local Government bodies, including Suffolk County and East Suffolk Councils, are identifying new low-carbon solutions for new-build housing to be energy and carbon-efficient, using projects such as the Passivhaus design of Goldsmith Street in Norwich as a benchmark. A project led by Norwich City Council which also won the RIBA Stirling Price in 2019.

3. Opportunities to improve heating, reduce emissions and reduce costs could be missed

NZL, working with the Energy Systems Catapult and the EDF Energy domestic customers business, is identifying appropriate measures at a local level to support greater resilience such as by retrofitting homes with electrified space heating and reducing emissions from gas and other fossil-fuel heating systems, and by supporting improved insulation in older buildings with low-carbon heating and cooling solutions. Through an initial 20-home pilot, wider roll-out would have the potential to target and address fuel poor households, reducing costs and emissions.

The NZL project team is identifying a wide range of possible options and bringing together a broad group of potential investors and bodies to deliver these opportunities.

Without NZL prioritising such measures, it is likely that no direct or proactive efforts would be made on retrofitting existing homes until encouraged or forced to by central government on the UK's journey towards Net Zero by 2050. Even then it is likely that some responsibility will be passed to local government

and existing energy suppliers to support households making the necessary changes. This could lead to a fragmented approach with no coordinated benefits or shared learning that NZL offers, and it likely to be beyond, or after 2025 (at the earliest) due to the planning and development timescales required.

NZL’S EFFECT ON LOCAL TRANSPORT SYSTEMS

Transport systems and infrastructure could be affected by extreme climate events, and without appropriate adaptation could cause unexpected delays, rail and bus cancellations, road closures creating isolated individuals and communities with an inability to travel or transport goods and services.

Whilst NZL will have limited direct influence on local or national transport-related policy, without NZL there would be less support for a modal shift to low emissions vehicles.

Based on 2018 emissions data from the UK’s National Atmospheric Emissions Inventory, almost every local government area has seen year-on-year increases in emissions from transport. Over the past five years, this equates to an overall increase of c.18% across all road transport emissions⁹.

This is principally passenger vehicles. In East Suffolk, transport emissions make up around 37% of all GHG emissions¹⁰, making it the single largest source followed using natural gas for heating.

Route Map options for NZL include supporting people making short journeys to cycle while helping those requiring a vehicle to transition to electric and fuel-cell passenger vehicles, encouraging local car share schemes, and the creation of and better use of low emission public transport options.

Without the ambition and coordinated community support behind NZL, improved local air quality as a direct impact of reduced emissions from vehicles using combustible fuels may not be achieved, meaning any decrease in associated respiratory conditions is also lost.

Such benefits would be most evident in Leiston itself but may also be evidenced along main transport routes in and out of the town. The air quality along busy routes is often particularly poor, especially where there is traffic congestion or heavy good vehicles. These pollution corridors suffer from high levels of soot particulates from engine exhausts (which are very damaging to health as they pass into the body through the lung membrane), oxides of nitrogen (NOx), and particulates from tyres and brakes.

The reduction in the emissions due to transport that has been seen and measured during the COVID-19 lockdown has been very beneficial to residents. The extended period of working at home has made some business leaders realise that the need to be based at an office is not as clear as it was previously thought to be. This may mean that more people work at home for a larger proportion of the time than before. Nationally this would be expected to reduce the total number of journeys, and the distance travelled, and this may be reflected in the Leiston area. The counter to this is that people working at home during the winter months will be likely to have home heating running. While this is fossil fuelled, the pollution and carbon emissions associated will reduce savings from transport.

The demonstration of these transport options in a more rural setting will be particularly powerful as most initiatives in the transport sector are centred in larger towns and cities. The learnings will be vital to the changing transport technologies and behaviours that are needed for the future in communities like Leiston.

WATER

The United Nations state that water is “the primary medium through which we will feel the effects of climate change.”¹¹ Water availability is becoming less predictable in many places, and increased incidences of flooding threaten to destroy water and water treatment facilities and contaminate water sources.

Water quality and access would be challenged because of climate-related events, with inter-seasonal temperature/weather extremes creating drought and flood conditions, placing additional pressure on water infrastructure to cope.

Ensuring clean and sustainable water supplies is a national strategic priority which will be felt at the local levels. Whilst there is a limited influence that the NZL project can affect, projects such as the Sizewell Clean Energy Hub, with concepts including seawater desalination facilities, could ensure local clean water supplies are plentiful, for local communities, agricultural systems, and technologies such as hydrogen production.



⁹ Data sourced from BEIS National Atmospheric Emissions Inventory. Accessed in May 2020
¹⁰ Data sourced from BEIS National Atmospheric Emissions Inventory. Accessed in May 2020

¹¹ United Nations, UN Water. <https://www.unwater.org/water-facts/climate-change/>





GOLDSMITH STREET, NORWICH
A LOW CARBON SUSTAINABLE HOUSING
DEVELOPMENT IN NORWICH.
WINNERS OF RIBA STIRLING PRIZE 2019.

7. STAKEHOLDERS GROUPS:

Having outlined the principal counterfactual views for NZL, a broad range of stakeholder groups have been identified, and an indicative score applied to each of the key areas this chapter explores.

The stakeholder groups identified are:

- » **Residents:** the community living in Leiston and its surrounding villages,
- » **Civic Leaders:** including elected town, district, and county councillors,
- » **Businesses:** the local business community based and working within Leiston town,
- » **Natural Environment actors:** involved in maintaining and enhancing the environment,
- » **Visitors to the area:** tourists travelling to the area to enjoy leisure, culture, and heritage,
- » **EDF Energy:** a major local employer and sponsor of NZL and Sizewell C developer
- » **Energy system actors:** including offshore wind, national grid, and new developers in hydrogen, battery storage, heating systems and controls, and similar clean energy technologies and systems.
- » **Central Government:** national policymakers and departmental bodies including but not limited to energy, climate, environment, health, and transport.

Table 1 below shows the key groups. Indicative scores are between 1 and 5, with 5 being an area in which the stakeholder group would identify as a key priority area for action and intervention, and 1 being the least important priority area.

	Community Climate Leadership	Nature and Biodiversity	Economic and Industrial Sectors	Societal and Human Interest
Residents	5	4	4	5
Civic Leaders	5	4	4	5
Businesses	4	4	5	3
Natural Environment	4	5	3	4
Visitors To The Area	3	5	3	4
EDF Energy (Investor)	5	4	4	4
Energy System Actors	4	3	5	3
Central Government	3	4	5	4

Table 1 - Counterfactual Stakeholder Priority Scoring

The purpose of the table is to illustrate the likely weighting that the various stakeholder groups would place on each of the key areas that this chapter covers. It is expected that the stakeholders put a different value on the four areas and that while there would be a similarity between some of the weighting profiles the interests of the stakeholders would mean that the profiles will all be different.

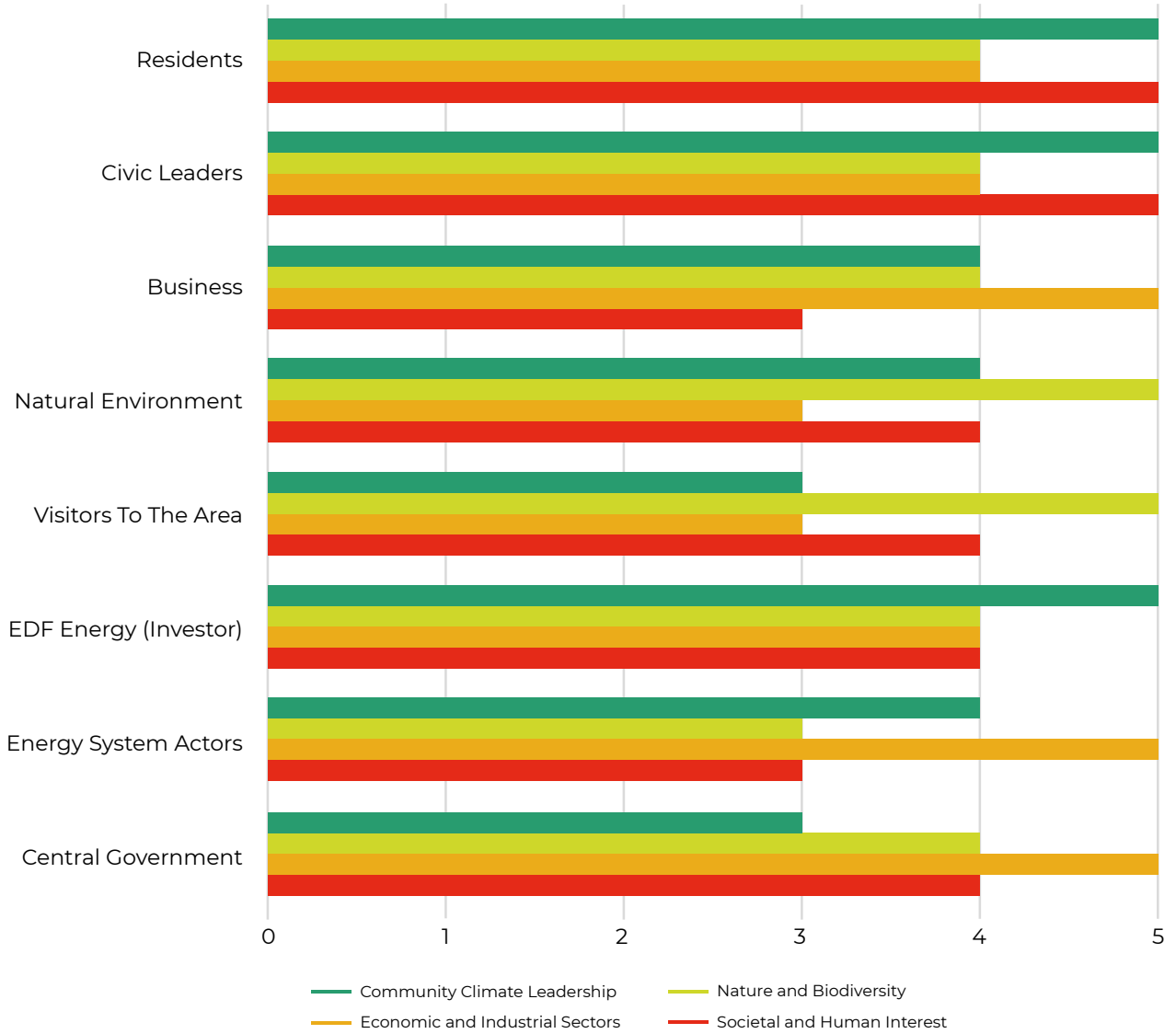


Figure 6 – Chart of Counterfactual Stakeholder Priority Scoring

The stakeholders to the project would, therefore, see the consequences of either partial or complete failure to deliver the NZL project quite differently. It is expected, for example, that the civic leaders and residents would see the opportunities for community climate leadership and the human and societal factors as particularly acute losses, while the natural environment would not be so concerned about impacts to the economic and industrial sectors.

TECHNICAL APPENDICES





CHAPTER 16

BUILDING SOLUTIONS

Authored by



SEPTEMBER 2020

INTRODUCTION

As part of the Leiston Net Zero study, a series of calculations have been carried out to assess the impact of building improvements. These shortlisted options were selected based on a scoring process agreed with NZL that reduced the long list of measures to a medium list then short list. Not all short list measures will be taken forward into the Route Map. The purpose of this chapter is to provide the assumptions and results of the shortlisted building measures calculations and identify the measures taken forward.

The Building shortlist measures were analysed individually looking at carbon saving and CAPEX costs. There are 16 groups of measures that have been considered, both from an energy efficiency and energy generation perspective. These are:

- » Boiler Replacement – Domestic & Non-Domestic
- » Domestic Insulation
- » Non-Domestic Insulation
- » Domestic Heat Pumps
- » Non-Domestic Heat Pumps
- » Domestic Solar PV
- » Non-Domestic Solar PV
- » Wind
- » Smart networks and digital infrastructure
- » Biomass - Non-Domestic
- » Energy efficient street lighting & Efficient Public Lighting
- » Smart Meters & Smart Thermostat (SHS)
- » Solar Thermal - Domestic
- » Vehicle-to-grid
- » Solar canopy parking



The methodology and results of the analysis for each measure can be found in the sections below. The electricity carbon savings will be reported in 2020 figures, in reality this number will differ depending on the year in which the measure is implemented due to grid decarbonisation. The CAPEX costs will also be reported in 2020 costs for continuity.

The CAPEX costs are intended to provide a broad indication of the cost of measures, these do not include contingency, prelims and project management costs, these will be included in final Route Map CAPEX costs. The uncertainty levels are high as the impact of the scenarios is dependent on the behavioural responses of individuals and businesses. Actual costs will depend on the response in Leiston to measures to incentivise change, which will in turn depend on interaction with other measures implemented. Local physical conditions will also influence implementation costs.

CARBON FACTORS

The following carbon emissions factors were used for the fossil fuel and electricity demands. The Greenbook supplementary guidance electricity carbon factors¹ were used, for the baseline emissions the grid average emissions were used as it is based on current energy consumptions. For the demands after measures have been implemented, long-run marginal has been used on any electricity changes as this will impact demand and therefore future requirements of the grid.

Carbon emissions factors can be seen in Table 1 and Table 2.

Table 1 – Fossil Fuel Carbon Emission Factors

Fossil fuel type	kgCO ₂ /kWh
Gas	0.18351 ²
Fuel Oil	0.26683 ³
LPG	0.21419 ³
Wood Logs	0.019 ³
Dual Fuel	0.226 ⁴

Table 2 – Electricity Carbon Emission Factors⁴

Year	Grid average		Long-run marginal	
	Consumption based		Consumption-based	
	Domestic (tCO ₂ /MWh)	Commercial/ Public Sector (tCO ₂ /MWh)	Domestic (tCO ₂ /MWh)	Commercial/ Public Sector (tCO ₂ /MWh)
2020	0.141	0.138	0.296	0.290
2021	0.115	0.113	0.283	0.278
2022	0.107	0.105	0.269	0.264
2023	0.112	0.110	0.255	0.250
2024	0.104	0.102	0.240	0.236
2025	0.105	0.103	0.224	0.220
2026	0.099	0.097	0.207	0.203
2027	0.105	0.103	0.189	0.186
2028	0.100	0.098	0.171	0.167
2029	0.092	0.090	0.151	0.148
2030	0.083	0.081	0.130	0.127

BOILER REPLACEMENT - DOMESTIC

Replacing an old gas boiler can on average save around 10% of heat demand. We have no information about the age of domestic buildings around Leiston, therefore it was assumed that all properties with a gas connection will need a boiler replacement. In reality, buildings with boilers installed in the last 10 years would not need replaced.

Results can be seen in Table 3.



¹ BEIS Green Book greenhouse gas emissions factors, 2020

² BEIS Green Book greenhouse gas emissions factors, 2020

³ SAP 2012. Table 12 Fuel Prices, Emission Factors and Primary Energy Factors

⁴ BEIS Green Book greenhouse gas emissions factors, 2020



Table 3 – Domestic Boiler Installation Results

Category	Value	Unit
Carbon Saving (2020)	605	tCO ₂
CAPEX	5.99	£m

Whilst some carbon savings can be made from the improved efficiencies of new boilers, they are still burning gas, which has a fixed carbon intensity. Due to this, the installation of new gas boilers is not recommended as a route forwards as it does not align with the Net Zero target. For this reason, heat pumps have been considered in place of gas boiler replacement.

Heat Pumps are a well established low-zero carbon technology, and are the preferred option due to the potential for carbon savings and alignment with overall decarbonisation strategy.

This measure is not being carried forward to the Route Map as it is counterintuitive to replace boilers then shortly replace the heating system as a heat pump. As the electricity grid decarbonises, heat carbon emissions will reduce and low-zero carbon electricity generation can be installed to further reduce, whereas gas will remain the same.

BOILER REPLACEMENT - NON-DOMESTIC

Again, there was no information available about age of non-domestic properties or boiler age in Leiston, and therefore the same logic used in the domestic calculations has been applied. It was assumed that all properties with a gas connection would need a boiler replacement, on average replacing an old gas boiler can save 10% of heat demand. In reality, buildings with boilers installed in the last 10 years would not need replaced.

This is a building age-related measure, and is treated as a “mean” measure; i.e. it can be expected that a proportion of such buildings will already have replaced their boiler in the last 10 years. It is also worth noting that where efficiency levels are low, it is likely that normal lifecycle replacement by building owner would generally be imminent.

The size of non-domestic boiler needed is calculated using the load factor of each building type, the load factor determine how peaky the demand is, a low load factor means the demand is peaky, a high load factor means the demand is relatively constant. Using this, the peak heat demand can be calculated using the annual heat demand and number of hours in a year.⁵

Results can be seen in Table 4.

Table 4 – Non-Domestic Boiler Installation Results

Category	Value	Unit
Carbon Saving (2020)	265	tCO ₂
CAPEX	0.91	£m

This measure is not being carried forward to the Route Map as it is counterintuitive to replace boilers then shortly replace the heating system as a heat pump due to greater carbon savings as the grid decarbonises and alignment with overall decarbonisation strategy.

DOMESTIC ENERGY EFFICIENCY

Insulation and energy efficiency measures are a no-regrets option that reduce carbon without the commitment and disruption of changing a heating system. This will be considered before any low-zero carbon generation as it allows the demand to be lowest, therefore the smallest generation will be installed reducing costs.

The following insulation types were considered for domestic buildings:

- » Loft Insulation
- » Cavity Wall Insultation
- » Internal Wall Insulation
- » External Wall Insulation
- » Triple glazing
- » Air Tightness Improvements

EPC data was provided for 52% of domestic buildings in Leiston, this gives information about building construction, current insulation and window type.

Where available, this information was used to inform insulation requirements. Where there was no information, the split for buildings with EPC data was applied across remaining buildings with no data. The building spit can be seen in Table 5 and Table 6 below.

⁵ Load Factor = annual heat demand / (peak heat demand x number of hours in year)

External wall insulation would not be applied to a listed building or buildings in a conservation area.

Roof insulation is only considered for dwellings with a pitched roof, this is due to the high cost of insulating a non-pitched roof.

From EPC data, there were no buildings with triple glazing, so it has been assumed that all domestic buildings in Leiston would have triple glazing installed. Note that we assume all flats in a block would be done at once, otherwise the cost of scaffolding would be prohibitive.

A combination of the above measures will improve the airtightness of the building, therefore the savings and cost of that measure is included in others.

Table 5 – Domestic EPC Construction Type and Insulation Levels

Construction Type	% of EPC domestic buildings	
Cavity Walls	63%	cavity wall construction type
	77%	of cavity wall have insulation
Solid Brick	20%	solid wall construction type
	9%	of solid wall have insulation
System Built	1%	system-built construction type
	95%	of system-built have insulation
Timber Frame	1%	timber frame construction type
	80%	of timber frame have insulation

Table 6 – Domestic EPC Roof Construction and Loft Insulation Levels

Loft Insulation	# of domestic with EPC data	% of EPC domestic buildings
Pitched Roof	1165	78%
Insulation > 250mm	458	39%
Insulation >100mm, <249 mm	482	41%

Energy Savings Trust provides typical savings and costs for installing wall insulation and loft insulation, Table 7 and Table 8 for values used. Table 9 gives the heat savings and installation costs for triple glazing. These are based on a typical triple glazed window cost of £500⁶, and average number of windows in each house type.

Table 7 – Heat Savings and Installation Cost for Wall Insulation

Dwelling Type	Cavity Wall Insulation		External Wall Insulation		Internal Wall Insulation	
	Percentage Heat Savings (%)	Installation Cost (£/ building)	Percentage Heat Savings (%)	Installation Cost (£/ building)	Percentage Heat Savings (%)	Installation Cost (£/ building)
Detached	34%	610	45%	13,000	45%	7,400
Semi-Detached	26%	475	36%	13,000	36%	7,400
Mid-Terrace	20%	390	27%	13,000	27%	7,400
Bungalow	18%	460	24%	13,000	24%	7,400
Flat	22%	345	28%	13,000	28%	7,400

Table 8 – Heat Savings and Installation Cost for Loft Insulation

Dwelling Type	Loft Insulation (0-270mm)		Loft Insulation (120mm-270mm)	
	Percentage Heat Savings (%)	Installation Cost (£/building)	Percentage Heat Savings (%)	Installation Cost (£/ building)
Detached	30%	395	3%	290
Semi-Detached	23%	300	2%	240
Mid-Terrace	25%	285	2%	230
Bungalow	34%	375	3%	280

Table 9 – Heat Savings and Installation Cost for Triple Glazing

Dwelling Type	Triple Glazing	
	Percentage Heat Savings (%)	Installation Cost (£/building)
Detached	10%	6,000
Semi-Detached	10%	4,000

⁶ <https://householdquotes.co.uk/how-much-does-triple-glazing-cost/>

Dwelling Type	Triple Glazing	
	Percentage Heat Savings (%)	Installation Cost (£/building)
Mid-Terrace	10%	3,500
Bungalow	10%	6,000
Flat	10%	2,000

The results of the calculation can be found in Table 10. The carbon savings are shown as 2020 savings, compared to the business as usual carbon emissions. They are also based on 100% of insulation measures being installed.

This measure is taken forward into the Route Map.

Table 10 – Domestic Insulation Results

Category	Value	Unit
Electricity Saving	319,676	kWh
Electricity Carbon Savings (2020)	94	tCO ₂
Fossil Fuel Carbon Savings	1,241	tCO ₂
CAPEX	20.96	£m

DOMESTIC ENERGY EFFICIENCY

Analysis of the non-domestic properties is more complex than the domestic. This is due to the much wider range of building types, nature of ownership, and, primarily, the limited data on the non-domestic stock.

A total of 10 measures have been identified, a brief description of each follows below:

ROOF INSULATION

Ideal for buildings with a loft space, a roof with eaves. For some buildings, this kind of energy efficiency measure would essentially require a new roof, this would increase costs unless it can be coordinated with normal lifecycle roof upgrades/ replacements. This is because of likely structural and access limitations as well as practical coordination with installed building services.

EXTERNAL WALL CLADDING

Most likely to be best suited for taller buildings with a smaller floor area. This is due to the larger wall area in proportion to floor area, therefore more heat is lost through the walls which makes external wall cladding more economically suitable.

IMPROVED CONTROLS

Improving heating or ventilation controls in the buildings. This will be applicable to all buildings and is relatively easy to implement within buildings. This is costed as a representative measure; in reality this will vary between the simple (new central thermostat) to the complex (variable speed drives and setback on larger all-air ventilation systems, boiler optimisation routines, smart metering etc.). The mean pricing has assumed the provision of new thermostatic radiator valves throughout a property as a “mean” measure.

IMPROVED USER BEHAVIOUR

This is applicable to all buildings and is relatively easy to implement within buildings, with the appropriate outreach activity. This would be used to reinforce positive energy saving messages, supplement any EPC advice the building owner may have been given. Assumed that this requires one site visit.

An un-costed benefit of this type of measure is that it can be used to improve data availability on the non-domestic stock.

AIR TIGHTNESS IMPROVEMENTS

Sealing gaps in the building fabric where air could be escaping, i.e. draught seal around doorways and windows. This is applicable to all buildings, and is the basis of the costed measure.

Opportunity during basic works to identify where significant other works may be appropriate; i.e. inappropriate material junctions, or fundamental leaky facades in larger buildings.

GLAZING IMPROVEMENT

Replacing single glazed windows with double glazed or replacing significantly older degrading double glazing if faulty. This is best suited to buildings with significant fenestration, e.g. offices, hotels, general accommodation etc. Would require some disruption to business, but enhance thermal and acoustic comfort as well as energy efficiency.

This is a building age-related measure, and is treated as a “mean” measure; i.e. it can be expected that a proportion of such buildings will already have replaced their glazing. It is also worth noting that where efficiency levels are low, it is likely that normal lifecycle replacement by building owner would generally be imminent.

HVAC INSULATION

Surveying the building pipework, and where appropriate, ductwork insulation. This only applies to building types with pipework. This is more difficult to implement, would require disruption to business, with the extent dependant on the type and size of building.

Typical installations were costed based on our experience of older buildings; works to a plantroom, then wholesale application / replacement of certain lengths of HVAC insulation throughout the building have been assumed, weighted to the size of the building.

HEAT RECOVERY

Recycling the heat used in buildings will reduce the heat demand. Best suited in buildings where there are large spaces being heated or those with a constant base heat demand. Would require some disruption to normal business.

This is easiest to implement into air systems, which is the basis of the typical costing, but it can equally be applied to recover heat for the pre-heat of domestic hot water.

LOW – FLOW HOT WATER

Suitable for buildings with high hot water usage, i.e. kitchens, residential buildings, schools. This would install flow restrictors or new outlets to high hot water use sanitary fittings. Straightforward to install in buildings, minimal disruption to normal operation. Much less likely to be applied to newer / recently refurbished buildings due to the change in trend in sanitary ware specification over the last fifteen years.

DESTRATIFICATION

Suitable for buildings with high ceilings and open spaces but without critical acoustic requirements; heated distribution centres, community halls etc. This would see the installation of controllable ceiling fans to allow the warm air that rises to be circulated back down to where the heat demand is most needed, reducing heat input and roof heat losses. Will cause some disruption to normal operation.

It is relatively easy to spot the significant difference between the analysis of measures between domestic and non-domestic buildings. Unlike domestic insulation levels, available data-sets do not typically provide sufficient information on non-domestic fabric and services nature / condition / age to support the same level of confidence in the analysis. Broad averages have to be applied across the building stock, based on the perception of the typical condition and servicing solution of different types of buildings.

Reflecting the greater complexity of non-domestic buildings, and the reduced level of utility bill “ownership” that is typically found in such buildings, controls measures and user behaviour interventions have been considered to be the priority measures across most building types, along with fabric measures, on the basis that it can be much more expensive and challenging to add fabric efficiency measures to non-domestic buildings, and controls measures can be just as effective in reducing energy wastage.

It has been assumed that all buildings will require a site survey before any energy efficiency measures are applied. This will allow the condition of the building and the condition of the assets to be identified and the best energy efficiency measures selected.

The heat reduction and typical costs for each energy efficiency measure considered can be found in Table 11.

Table 11 – Heat Reduction and Typical Costs

Type	Heat Reduction	Typical Cost (£/ floor area or £/building)	Source
Loft/Roof insulation	4.8%	141 £/m²	SPONS A&B
External Wall Cladding	1.8%	180 £/m²	SPONS A&B
Improved Controls	8.8%	84 £/m²	Atkins Value
Improved User Behaviours	8.8%	£563/building	Atkins Value
Air Tightness Improvements	3%	16 £/m²	SPONS A&B
Glazing Improvement	5.1%	102 £/m²	SPONS A&B
HVAC Insulation	3.3%	3.5 £/m²	SPONS M&E
Heat Recovery	3%	21 £/m²	Atkins Value
Low-Flow Hot Water	3.3%	2.3 £/m²	Atkins Value
Destratification	5%	22 £/m²	SPONS M&E

Up to six energy efficiency measures were applied to each building. This represents the most aggressive approach to heat demand reduction that would be feasible to apply. The priority of energy efficiency measures was chosen based on maximum heat demand reduction provided.

Not all energy measures were applied to all building types, Table 12 shows the measures applied to each building type in Leiston, the most appropriate measures were chosen for each building type.

Table 12 – Non-Domestic Energy Efficiency Measures by Building Type

Building Type	Energy Efficiency Measure to be applied					
	1st	2nd	3rd	4th	5th	6th
General Office	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Air Tightness Improvements
High Street Agency	Improved User Behaviours	Improved Controls	HVAC Insulation	Air Tightness Improvements		
General Retail	Improved User Behaviours	Improved Controls	HVAC Insulation	Air Tightness Improvements	Roof Insulation	
Restaurant	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	Low Flow Hot Water	Heat Recovery
Bar, pub or licensed club	Improved User Behaviours	Improved Controls	Glazing Improvement	Air Tightness Improvements	Low Flow Hot Water	Heat Recovery
Hotel	Improved User Behaviours	Improved Controls	Glazing Improvement	Destratification	Roof Insulation	HVAC Insulation
Cultural activities	Improved User Behaviours	Improved Controls	Glazing Improvement	Destratification	Roof Insulation	HVAC Insulation
Fitness and Health Centre	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Low Flow Hot Water
Public buildings with light usage	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Air Tightness Improvements

Building Type	Energy Efficiency Measure to be applied					
	1st	2nd	3rd	4th	5th	6th
Schools and Seasonal Public Buildings	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Low Flow Hot Water
Clinic	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Low Flow Hot Water
Long Term residential	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Low Flow Hot Water
Emergency services	Improved User Behaviours	Improved Controls	Glazing Improvement	Roof Insulation	HVAC Insulation	Low Flow Hot Water
Workshop	Improved User Behaviours	Improved Controls	Destratification	Roof Insulation	Air Tightness Improvements	External Wall Cladding
Storage Facility	Improved User Behaviours	Improved Controls	Destratification	Roof Insulation	Air Tightness Improvements	External Wall Cladding

Assuming these measures were applied to all non-domestic buildings in the study area, gives the results below, Table 13. When looking at reducing carbon, it is good practice to employ a fabric first approach i.e. reduce demand as far as possible with energy efficiency measures before installed low carbon technology. This benefits two-fold – reducing demand for end users and reducing the size and therefore cost of low carbon technology.

Therefore, this measure will be taken forward into the Route Map.

Table 13 – Non-Domestic Energy Efficiency Results

Category	Value	Unit
Electricity Saving	586,489	kWh
Electricity Carbon Savings (2020)	170	tCO ₂
Fossil Fuel Carbon Savings	823	tCO ₂
CAPEX	33.2	£m

HEAT PUMPS

Heat pumps achieve significant decarbonisation by using electricity from a decarbonised grid in lieu of natural gas or heating oil, and by providing a far superior efficiency compared to conventional electric or electric storage heating.

DOMESTIC

Two types of heat pump were considered for domestic dwellings:

- » Hybrid heat pump
- » Air Source Heat Pump (ASHP)

This calculation looks at installing a heat pump in all domestic dwellings. This will be very challenging and will require resident’s approval. However, given the challenging target of Net Zero by 2030, 100% switch over has been modelled initially.

All savings from this measure are based on the assumption that insulation measures have been applied to all domestic properties before heat pump install.

HYBRID HEAT PUMP

Hybrid heat pumps install a heat pump integrated with the existing heat source. This allows the heat pump operation to be optimised by automatically selecting the generation with the highest efficiency at any given time. Installation of hybrid heat pumps for domestic properties that are off the gas grid i.e. use oil or LPG was investigated.

While installing a hybrid heat pump is a pragmatic approach to installing a heat pump in a domestic property, given it makes use of current heating system, it makes more sense for the zero-carbon agenda to install fully electric heat pumps.

For this reason, hybrid heat pumps will not be considered.

AIR SOURCE HEAT PUMP

As discussed in the Gas Boiler Replacement section, it has been assumed that an ASHP will be installed in all domestic properties in lieu of a replacement boiler or existing direct electric heating. Given this large-scale install across Leiston, the ASHPs will need to be installed with either a power storage battery or a heat battery to reduce impact to local grid infrastructure. This should allow the load to be shifted from peak times via the storage of the batteries. There will still need to be local grid improvements to accommodate the increased electrical demand from multiple households now using electricity from the grid to heat their homes. See ‘Smart Networks and Digital Infrastructure’ section below for further information.

Converting all heating to electric will increase the demand on the network and will therefore result in increased electrical prices, which could result in an increase in utility bills for end users. It is therefore important to consider installing renewable energy generation at each property where an ASHP is installed.

There are 3,683 domestic properties in the study boundary. As we are only considering ASHP install post energy efficiency upgrades, the heating demand will be reduced. There will still need to be changes made to the heating system i.e. emitters will potentially need to be switched. For a typical 2/3 bed house, it has been assumed that a 11 kW ASHP would be installed, with a COP of 2.75. See Table 14 below for typical costs.

Table 14 –Domestic Heat Pump Typical CAPEX Costs

Component	Cost (£/Building)
ASHP CAPEX (11 kW)	£5,958
Heating System Changes (post Insulation)	£1,061
Heat Battery	£4,668
Total CAPEX (post insulation)	£11,687

From the results, Table 15. it can be seen that this measure increases the electrical demand, however, reduces the carbon overall as fossil fuel carbon factors are higher than electricity carbon factors, and many of the domestic properties will be moving away from burning fossil fuels. Given the renewable mix of the grid, and the prediction of grid decarbonisation. This measure is taken forward to the Route Map.

Table 15 –Domestic Heat Pump Results

Category	Value	Unit
Electricity Saving	-7,384,038	kWh
Electricity Carbon Savings (2020)	-2,182	tCO ₂
Fossil Fuel Carbon Savings	5,122	tCO ₂
CAPEX	33.7	£m

The next step is to look at introducing renewable generation at each property to offset the increase in electrical demand.

NON-DOMESTIC

Heat pumps were considered for all non-domestic building types in the study.

Three different types of heat pump system were considered for deployment for the non-domestic buildings:

- » ASHP
- » Ground Source Heat Pump (GSHP)
- » Waste-Water Heat Pump (WWHP)

WASTE-WATER HEAT PUMP

Waste-Water Heat Pumps utilise the heat from waste water, and therefore must be located near a sizable sewer. The cost and complexity for this technology increases the further away from a sewer source the heat demand is. Suitability for a WSHP is based on a peak load of 350 kW or over. All non-domestic building loads in Leiston were <350 kW, therefore WWHP would not be feasible due to the costs involved for a smaller WWHP given the need to break into the sewer.

WWHP typically have a higher efficiency/COP than GSHP or ASHP.

GROUND SOURCE HEAT PUMP

This technology requires clear space near-by for the ground loops or boreholes, as it utilises the heat from the ground. There are two ways to utilise the ground as a heat source – boreholes or ground loops. Given the space available in Leiston, it is assumed that boreholes, with a smaller space demand, will be used. Due to the space required, the town centre areas have been excluded for this option due to the densely populated areas.

For Leiston, GSHP has been considered for the Eastlands Industrial Estate given the space availability for shared community boreholes and the proximity of the buildings, Figure 1. This is 22 buildings, ~8% of non-domestic buildings.

It has been assumed that GSHP would have a COP of 3, with a typical cost of £1650/kW.



Figure 1 - Eastlands Industrial Estate

AIR SOURCE HEAT PUMP

Air Source Heat Pumps are available in smaller sizes than the other two options (GSHP and WWHP), thus making them the best match to smaller heat demands, with a minimum peak heat demand of 4 kW. As this heat pump is exposed to ambient temperatures, it does not suit particularly exposed areas where the temperature frequently drops well below zero or locations near the coast with saline-laden air. The study area has been identified as an area that would, in general, be suitable for ASHP. However, suitability of properties identified for ASHP in the data will need to be reviewed on a case by case basis.

It has been assumed that all remaining buildings i.e. excluding buildings with GSHP, will have an ASHP installed. Assumed COP of 2.75 and typical costs of £1200/kW.

CONTROLS

Converting the non-domestic buildings to heat pumps will significantly increase the power demand to the area and put a lot of pressure on the local grid. To combat this, smart controls will need to be utilised to try and shift demand from peak times, making use of thermal storage, low carbon electrical generation and battery storage. Costs for controls have been included in the PV calculations, however for the non-domestic buildings without PV, the costs have been included in the CAPEX below.

RESULTS

All costs include CAPEX for a 25m³ thermal store, this is an approximate average size required, based on a rate of £1,000/m³. Results can be seen in Table 16 below. This measure results in an increase in electrical demand from the business as usual, however still provides an overall carbon saving due to the offsetting of fossil fuel emissions which are higher than the electricity grid.

Table 16 – Non-Domestic Heat Pump Results

Category	Value	Unit
Electricity Saving	-2,708,267	kWh
Electricity Carbon Savings (2020)	-786	tCO ₂
Fossil Fuel Carbon Savings	2,026	tCO ₂
CAPEX	14.4	£m

As with domestic heat pumps, the next step is to explore the option of installing low carbon electrical generation to reduce the impact on the grid and further reduce carbon. For non-domestic, solar photovoltaic panels and small-scale wind turbines have been considered.

SOLAR PHOTO VOLTAIC PANELS

GIS software has been used to identify buildings that have solar potential. This is based on a simple yes/no – ‘yes’ then the building in which the property is located has either a south-east, south-west or south facing roof. Buildings with negligible amounts of south, south-east, south-west facing roofs e.g. <10 m² have been removed.

This gives 77% of domestic properties with solar potential, and 95% of non-domestic properties with solar potential. The roof area of each property was calculated by looking at the floor area and number of floors. This gives an approximate roof area, however we can assume that not all the roof area will be able to be used to factor in dormer windows, roof pitches etc, as well as accounting for no PV on reverse pitches.

Properties will be reduced by 20% to account for roofs that will not be able to be built on or have no access.

DOMESTIC

For domestic properties it has been assumed that only 60% of roof will be usable for PV installation. The majority of solar generation is during the day, this represents the time when properties are typically unoccupied, therefore batteries will need to be installed alongside the solar panels to allow 100% of solar generation to be used in the property.

Where the generation exceeds the demand and the battery is full, there is the potential that the PV will need to be switched off to avoid overloading the network. To combat this and utilise all technologies together in a residential dwelling, smart controls will be required. Every dwelling will need a smart

controls hub that connects to the phone line or internet as well as routing to a central control point. This is discussed in more detail in a section below, however costs have been included in results in Table 18.

Typical costs are shown in Table 17.

Table 17 – Domestic Solar PV Costs

Component	Cost
Solar PV	£1,371/kW
Battery Storage	£8,000/dwelling
Controls	£500/dwelling

The results below are based on both insulation and heat pumps being installed in the domestic properties. By this stage, all properties have been converted to electric heating so there are no fossil fuel savings to be calculated.

Table 18 – Domestic Solar PV Results

Category	Value	Unit
Electricity Saving	15,403,915	kWh
Electricity Carbon Savings (2020)	4,553	tCO ₂
Fossil Fuel Carbon Savings	n/a	tCO ₂
CAPEX	16.5	£m

NON-DOMESTIC

For non-domestic properties it has been assumed that only 40% of the roof space will be suitable for PV installation and using battery storage, assume that 100% of solar PV generation can be used by the demand. There will need to be a robust smart controls system to ensure the network is not overloaded and allows PV, Heat Pumps and batteries to interface with each other.

Typical costs for non-domestic solar PV can be found in Table 19.

Table 19 – Non-Domestic Solar PV Costs

Component	Cost
Solar PV	£1,000/kW
Battery Storage <500 m² (110 kWh)	£77,250/dwelling
Battery Storage >500 m² (250 kWh)	£154,500/dwelling
Controls for Buildings <500 m²	£500/dwelling
Controls for Buildings >500 m²	£3,000/dwelling

All properties in the Masterlord and Eastlands industrial estates have been excluded as they are included in the wind turbine measure below, and there is not enough remaining demand for both PV and wind to be installed.

The results below, Table 20, are based on both energy efficiency and heat pumps being installed in the non-domestic properties. All properties have been converted to electric heating, courtesy of heat pumps, so there are no fossil fuel savings to be calculated.

Table 20 – Non-Domestic Solar PV Results

Category	Value	Unit
Electricity Saving	1,729,522	kWh
Electricity Carbon Savings (2020)	502	tCO ₂
Fossil Fuel Carbon Savings	n/a	tCO ₂
CAPEX	13.7	£m

WIND FOR INDUSTRIAL ESTATE

Small scale wind turbines were considered for non-domestic properties in the study area. The two industrial estates in town were chosen due to the clustered demands and availability of space for a wind turbine to be installed.

This measure would only be installed after energy efficiency measures and heat pumps have been installed, hence providing a higher electrical demand to serve.

It has been assumed that all properties at both the Masterlord and Eastlands Industrial Estate will have a wind turbine installed as well as batteries to allow the generation to be better utilised by the demand. As with options above, this will need to be connected to a sophisticated controls system, the costs of which have been included in the totals below.

Given the electrical demands of the two industrial estates, an 800 kW wind turbine was chosen for both sites.

Table 21 – Wind Turbine Results

Category	Value	Unit
Electricity Saving	4,315,326	kWh
Electricity Carbon Savings (2020)	1,252	tCO ₂
Fossil Fuel Carbon Savings	n/a	tCO ₂
CAPEX	15.8	£m

This provided a larger saving than installing solar PV, therefore was chosen to be installed instead.

There will need to be appropriate planning in place for this measure to take place and will require the buy-in of local residents. The green space available at the Masterlord Industrial Estate is within 1km of residential dwellings so there is a high chance this could be contested.

If it is not possible to install turbines here, then solar PV panels can be installed instead.

SMART NETWORKS AND DIGITAL INFRASTRUCTURE

This measure is an enabler for the successful integration of other low carbon measures. Without implementing smart controls and upgrading the network, measures such as heat pumps, PV and Electric Vehicles would not be possible.

While there are not specific carbon savings associated with this measure as they are absorbed by others, there is a cost involved. This can be split into two parts:

- » Smart controls
- » Network upgrades

The cost for smart controls has been included in previous results including a smart controls hub that connects to the phone line or internet, as well as routing to a central point of controls.

For domestic and non-domestic buildings smaller than 500 m², this cost has been approximated as £500/dwelling. For non-domestic buildings larger than 500 m² this has been approximated as £3,000/dwelling.

The combination of converting buildings to heat pumps therefore increasing local electricity demand will result in the requirement for local grid improvements. The installation of renewable electricity generation in combination with batteries will in theory help to reduce the impact on the grid infrastructure. There will need to be discussions with the local DNO early on to establish the impact and identify exact costs.

Costs for network upgrades have not been included in the calculations; given the scale of upgrades likely to be required, it will need to be a priority to engage with the local DNO to establish the requirements, constraints and costs for upgrades before any work is undertaken.

It is worth noting that with the increase in electrical demand and associated grid upgrade costs, there could be increase in electricity bills for the local area.

BIOMASS – NON-DOMESTIC RURAL BUILDINGS

Biomass boilers are applicable to all non-domestic buildings, as it requires space for a woodchip / wood pellet store and room for deliveries to be made. However, this additional space requirement can prove to be a constraint for non-domestic buildings in dense areas such as high streets. Another consideration is that it is much less likely to be possible to install biomass boilers in an Air Quality Management Area (AQMA) due to the particulates present when burning biomass.

Given the space requirements and Air Quality issues, it has been decided to assess installing biomass in non-domestic rural properties.

Table 22 – Non-Domestic Biomass Results

Category	Value	Unit
Carbon Savings	135	tCO ₂
CAPEX	0.333	£m

The results were compared to non-domestic heat pumps as you would not install both a heat pump and biomass boiler, it is one or the other as they both serve the same purpose of generating heat.

Heat pumps align with the Route Map to decarbonisation in the long term, relying on the decarbonisation of the electricity grid as well as the many low-zero carbon electricity generation options available. For this reason, biomass will not be considered at this stage as long-term there is no way to decarbonise this generation source and the aim is to achieve Net Zero carbon emissions by 2030.

ENERGY EFFICIENT STREET LIGHTING

Replacing public lighting with LEDs is current good practice, simple and low cost.

East Suffolk Council and Suffolk County Council have an existing 3-year programme to replace current public lighting with LEDs as well as introducing part night lighting where possible and safe to do so . LED replacement is done on a rolling basis as and when current streetlamps reach end of life. The part night lighting reduce energy used, where streetlights are switched off between 12am-5:30am in areas where it is safe to do so.⁷

For this programme to be accelerated, NZL would need to work with the council to support LED changeover before end of life cycle.

SMART METERS

Smart meters are currently available from energy suppliers. This is a no-regrets measure and should be relatively simple to implement as NZL project already have the capability in-house.

There are many benefits to installing a smart meter in a property – allowing the occupier to have more control over their energy usage as well as more information about consumption to allow them to make informed choices to reduce consumption and therefore carbon footprint.⁸

This measure will not directly reduce carbon emissions, however could act as an enabler to encourage users to be aware of how much energy they consume and act as an encouragement to install low carbon technologies.

This measure could be linked to a tariff available only to the town of Leiston to support the Net Zero agenda.

SOLAR THERMAL FOR DOMESTIC

Solar thermal for producing domestic hot water has been excluded for domestic buildings. This is due to current market trends suggesting that where there is space on a roof to mount solar panels, it is more economically sensible to install solar PV.

Specific buildings with high domestic hot water loading and significant roof space may buck this trend, but these buildings will be the minority. Where this is the case, solar thermal could be considered however this will be done on a case by case basis.

This measure was not included in the Route Map.

VEHICLE-TO-GRID

Vehicle to grid is a relatively new concept that used the power stored in electric vehicles (EVs) to provide power to the grid when required. This can be used to offset peak power demands, helping to avoid the local grid from being overloaded.

Given the acceleration of electric vehicle uptake as part of this study, there is great potential for this to be employed in Leiston, especially towards Phase 2 of the road map where there are larger numbers of EVs on the roads.

There will need to be a sophisticated controls system to ensure any power drained from the battery is replenished before the user requires charge for a journey. It will be a challenge to ensure there is always battery available when needed and there may be a requirement for an override button to ensure users can choose to opt out of giving their battery power away. This will need to be deployed with the support of EV users.

It is not possible at this stage to put a number to savings that would be provided by this measure; however it could present an opportunity to allow domestic and non-domestic properties to load shift and avoid peak time tariffs.

This measure could be linked to a tariff available only to the town of Leiston to support the Net Zero agenda.

SOLAR CARPORTS FOR EV CHARGING

Solar Carports can be installed in carparks and used in conjunction with EV charge points to reduce electricity demand and support the existing grid infrastructure. They work best when placed in locations where people park for the majority of the day as this allows the charging to be fully utilised, i.e. park and rides, leisure centres or places of work.

Figure 2 shows the locations of the car parks in Leiston town centre, there is opportunity to install solar carports in these locations to support the uptake of EVs.



⁷ <https://www.eastsuffolk.gov.uk/environment/street-lighting/>
<https://www.suffolk.gov.uk/roads-and-transport/street-lighting-traffic-signals-and-pedestrian-crossings/street-lighting/>
⁸ <https://www.edfenergy.com/smart-meters>

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NZL: TECHNICAL REPORT

From the high transportation scenario, there will be approx. 200 MWh of workplace charging required with the accelerated uptake modelled. There is the potential for this to be served by solar carports. A more detailed study is required to identify optimum locations and generation potential. This would be best installed in the later phases as there will be a larger demand for EV charging at this stage.



Figure 2 – Carpark Locations, Leiston Town Centre

ROUTE MAP – MEASURES SUMMARY

The results from the measure calculations above will be combined with the results of the transportation, agriculture and sequestration measures to create a Route Map to Net Zero by 2030.

From the calculations undertaken above, it can be concluded that the following measures are taken forward to the Route Map:

- » Domestic Insulation
- » Non-Domestic Energy Efficiency Measures
- » Heat Pumps
 - Domestic
 - Non-Domestic
- » Solar PV
 - Domestic
 - Non-Domestic
 - Carports
- » Wind Turbines for Commercial Users
- » Smart Meters
- » Energy Efficient Street Lighting
- » Smart networks and digital infrastructure



CHAPTER 17

TRANSPORT SOLUTIONS

Authored by



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1. INTRODUCTION

Leiston is seeking to become a Net Zero carbon community by 2030. The community is defined by the parish boundary (as shown in Figure 1.1) and the aim is to achieve Net Zero emissions by significantly reducing carbon emissions from all sources within the boundary and balancing remaining emissions with carbon removals through sequestration and capture.

For transport, the emissions in scope are those produced by the combustion of petrol and diesel used by vehicles on the roads within Leiston¹ and the emissions produced by generating the electricity used by electric vehicles on the town's roads².

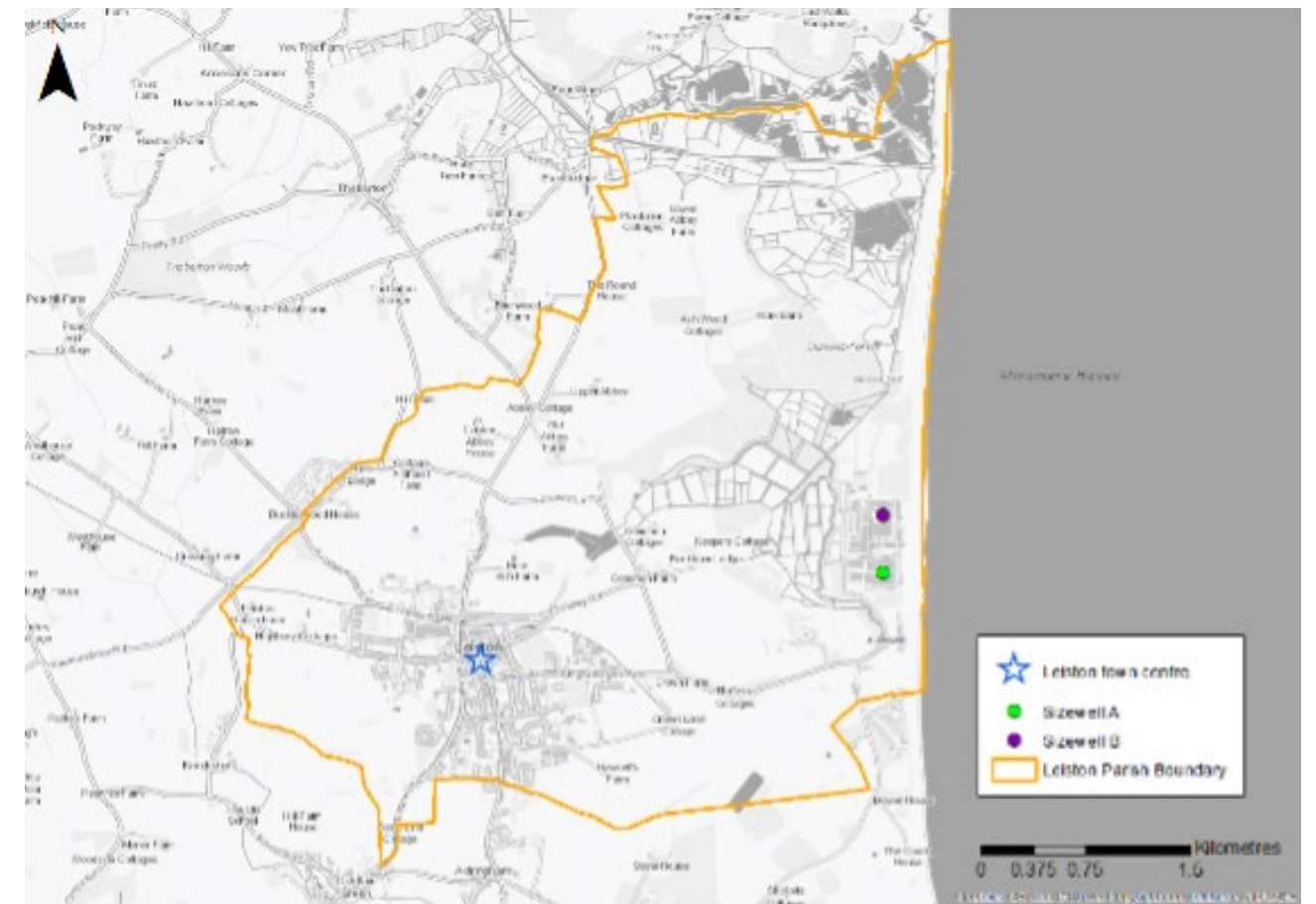


Figure 1.1: Leiston boundary

In Leiston, as at the national level, the key challenge for decarbonising the transport sector is to identify how to provide the benefits provided by the current transport system (in terms of access to services and opportunities) in an alternative, more efficient and less emissions intensive way. The scale of the challenge is increased by the fact that interactions between the transport system and other aspects of society and

¹ Including all trips to, from, within and through Leiston, apart from those travelling to and from the development site at Sizewell C which are out of scope for this commission.

² Note that upstream or Well to Tank emissions associated with the extraction, production and transport of petrol and diesel were not in scope for this assessment.



the economy (such as access to employment) are complex and vary by location. Additionally, transport system changes often lead to or rely on changes in behaviour by individuals and organisations and can cause wider impacts, both positive and negative (e.g. impacts on air quality and accessibility).

Given the complexities involved, measures to successfully deliver substantial and rapid transport emissions reductions whilst maximising wider benefits and minimising/mitigating potential disbenefits need to be developed in the context of an integrated transport plan for the area. The plan would need to be based on an understanding of travel patterns in the area in order to identify the measures required, their likely interactions and potential wider impacts. It would be evidence based and would be likely to cover a range of measures to change travel patterns in terms of the amount and distance of travel and the transport modes and vehicle types used.

The **recommended first step for the transport roadmap** to Net Zero in Leiston is therefore a focussed and **detailed review of transport conditions in Leiston**. The review would provide an understanding of travel in the study area to inform the subsequent **development of an integrated transport plan and detailed road map to decarbonise transport**. This approach would help to ensure that the most appropriate measures are implemented and that their specification reflects the context in Leiston. This should in turn increase the effectiveness of individual measures and the scale of emissions reduction achieved and strengthen Leiston's progress towards becoming a Net Zero community.

The plan would integrate with the wider work required to support delivery of the transport elements of the **Suffolk Climate Emergency Plan**³ which was published in July 2021. The Plan includes 38 actions relating to delivery of low carbon transport in Suffolk indicating that many of the types of transport measures likely to be included in a transport plan for Leiston are well understood.

The option selection process undertaken by the Net Zero Leiston working group in 2020 identified a shortlist of individual transport measures that could play a key role in the plan and road map, focussing particularly on the move to low or zero carbon vehicle types and uptake in bike and e-bike use. The proposed wider integrated transport plan would supplement these measures with more behaviour based measures to change travel patterns and travel modes, as illustrated by the types of measure included in the Suffolk Climate Emergency Plan.

Leiston's plan will also need to be set in the **context of national and regional strategies and policies** including the Department for Transport's Transport Decarbonisation Plan⁴, Transport East's work on decarbonisation pathways⁵ and the Government's Hydrogen Strategy.⁶

This chapter provides further detail on the proposed transport elements of the roadmap for Net Zero carbon in Leiston in the following four sections:

- » **Section 2** provides **further detail on the recommended first step** in the roadmap i.e. to undertake a **review of transport conditions in Leiston** which would inform the **development of an integrated plan** to decarbonise transport which would in turn form the basis of the roadmap.

- » **Section 3** provides **further detail on the transport measures shortlisted by the Net Zero Leiston working group** as having a key role to play in the decarbonisation road map. A number of scenarios are outlined indicating the potential impact of the measures and the types of supporting measures that would be needed to deliver them.

- » **Section 4** sets out **high level indications of costs for the main scenarios** tested. These cost ranges are intended to provide a broad indication of the cost of measures relative to one another. The uncertainty levels are high as the impact of the scenarios is dependent on the behavioural responses of individuals and businesses. Actual costs will depend on the response in Leiston to measures to incentivise change, which will in turn depend on interaction with other measures implemented. Local physical conditions will also influence implementation costs (such as cycle lane construction).

- » **Section 5** provides a brief **concluding summary**.

2. STUDY TO REVIEW TRANSPORT CONDITIONS IN LEISTON AND DEVELOP TRANSPORT PLAN

2.1 INTRODUCTION

This section provides further detail on the recommended first steps in the transport roadmap for Net Zero Leiston. These are firstly to undertake a detailed review of transport conditions in Leiston and then to use the understanding obtained to accelerate carbon reduction, **setting the measures to support uptake of electric vehicles (EV) and bikes/e-bikes** shortlisted by the Net Zero Leiston working group (see box) **in the context of a wider integrated transport plan**. The plan development could link closely with wider work required to support the transport components of the recent Suffolk Climate Emergency Plan, including the proposed update to Suffolk's Local Transport plan.

It will also need to be set in the **context of wider national and regional strategies and policies** that are rapidly emerging in relation to the decarbonisation of the transport sector. The DfT's

³ [Suffolk-Climate-Emergency-Plan.pdf \(greensuffolk.org\)](#) July 2021

⁴ <https://www.gov.uk/government/speeches/transport-decarbonisation-plan>

⁵

⁶

Transport Decarbonisation Plan (TDP)⁷ was published in July 2021 setting out six strategic priorities for decarbonisation of the transport system (see box) and Transport East is developing a regional decarbonisation pathway⁸. In addition, the Government has recently produced its Hydrogen Strategy⁹ which also has implications for the transport sector.

TRANSPORT MEASURES SHORTLISTED by the Net Zero Leiston working group:

- EV charging infrastructure;
- Fleet electrification;
- EV uptake;
- EV for local public transport
- Hydrogen vehicles;
- Cycle hire scheme and bike storage hubs; and
- E-bikes.

Leiston's plan would include the **'place-based' solutions** identified in the TDP and would include a range of integrated measures to decarbonise transport tailored to Leiston's requirements. It would provide the basis for specifying the shortlisted measures appropriately, increasing their impact on emissions and strengthening Leiston's position as a Net Zero exemplar.

The next section (2.2) provides an overview of the range of measures with the potential to contribute to transport decarbonisation. It also outlines the complexity of specifying a combination of measures that is appropriate for the local context, works well together, achieves wider benefits (beyond carbon reduction) and minimises potential disbenefits.

Section 2.3 then sets out a broad scope for the suggested review of transport conditions in Leiston and the way in which the findings would feed into the proposed integrated transport plan.

DfT's Transport Decarbonisation Plan – six strategic priorities for decarbonising transport

- Accelerating modal shift to public and active transport;
- Decarbonising road transport;
- Decarbonising how we get our goods;
- UK as a hub for green transport technology and innovation;
- Place-based solutions to emissions reduction; and
- Reducing carbon in a global economy

2.2. TRANSPORT DECARBONISATION MEASURES

Most transport is a 'derived demand', undertaken to provide those travelling with access to services or opportunities. The aim of transport planning from a carbon reduction perspective is therefore to provide access to the same or equivalent services and opportunities in an alternative, more efficient manner, reducing the energy use and emissions associated with the travel required for access.

Transport measures to reduce carbon emissions are often structured in terms of the **Avoid, Shift, Improve** hierarchy as described further below.

2.2.1. AVOID MEASURES

Avoid refers to measures to **reduce the number or length of trips made**. This could result from replacing a physical journey with online activity or a shorter journey to access more local activity. Examples include continuing the increased levels of remote working and online meetings and use of local shops and services seen during the COVID-19 pandemic.

Measures to reduce travel could include interventions to ensure the quality of broadband connectivity and 5G mobile phone coverage and to increase the range of activities and services available locally, implementing the principles of '20-minute neighbourhoods'. For instance, this could include the introduction of an increased range of shops, leisure and public services available locally, including local work hubs that provide office facilities to support those working remotely and allow a shorter commute, which ideally could be walked or cycled (tying into the Shift measures). There is increasing evidence that measures to increase local activity can be self-reinforcing and bring wider benefits to the local economy and community. Increasing numbers of visitors to local centres encourage further establishment of further businesses and services further increasing activity.

Travel could also be avoided by measures to improve efficiency by combining journeys. This could involve travel planning by individuals to make more efficient use of each journey made by combining purposes in a single trip. However, planning is likely to be particularly effective in relation to improving efficiency of freight trips and deliveries. For instance, the use of a series of common delivery hubs in the town (e.g. deliveries to central lockers rather than to individual homes) and acceptance of increased delivery times (rather than next day or same day delivery) could be used to reduce the number of delivery trips to Leiston associated with online shopping.

20-MINUTE NEIGHBOURHOOD are areas providing most of residents' daily needs within a 20-minute walk or cycle ride. Key features include local shopping and health facilities, education, green spaces, affordable and diverse housing, safe streets, active travel and public transport, and employment (as shown in the widely used graphic below, originally produced by the Melbourne government).



⁷ <https://www.gov.uk/government/speeches/transport-decarbonisation-plan>

⁸ https://www.transporteast.org.uk/wp-content/uploads/Transport-East-Decarbonisation-Evidence-Base-and-Strategic-Recommendations-Report_WEB.pdf

⁹ [UK hydrogen strategy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/uk-hydrogen-strategy)





2.2.2. SHIFT MEASURES

Shift refers to measures to encourage **mode shift so that journeys are made by more efficient, less energy intensive modes**, typically shifting away from more energy intensive car journeys. The measures can be closely related to Avoid measures to reduce journey lengths by increasing levels of local activity which in turn means that additional modes of transport (such as cycling) become feasible options. To be successful, measures to encourage shift need to include interventions to ensure that the mode is easy, reliable, affordable and attractive to use (such as high quality cycling lanes and priority and secure cycle parking provision) and provides connections between key locations. Measures to reduce the priority currently given to car use are also typically required to encourage significant mode shift by creating a more even cost and convenience balance between car and more sustainable modes. Relevant measures include increasing charges for parking and relocating parking to less central and convenient locations.

MOBILITY AS A SERVICE applications Mobility as a Service applications bring together information on a wide range of transport modes and services for instance in a smartphone application. The applications provide features such as end-to-end journey planning, multi-modal ticket purchasing and the ability to earn and spend rewards. It provides a unified framework for accessing shared travel alongside timetabled public transport, reducing complexity and cost, and making the options more integrated, attractive and accessible to users.

The measures shortlisted by the Net Zero Leiston working group of encouraging bike and e-bike use fall within the Shift category and could be supplemented by measures to increase the use of the public transport services available in the Leiston area, including ensuring good cycling links to Saxmundham rail station and local bus routes. The scope for use of conventional public transport is however likely to be limited in a rural location such as Leiston. It is difficult to sustain service provision in areas with relatively low population density and therefore with limited demand for any given movement (as evidenced by the current relatively limited bus provision in the area). There may be individual movements that are made by sufficient people to be served by public transport (for instance potentially serving those working at Sizewell or school journeys). Shared transport alternatives could include establishing lift-sharing schemes, building on the Suffolk Car Share site (potentially as part of a Mobility as a Service offering, see box) and expanding the provision of demand responsive transport in the area (using electric vehicles and ensuring efficient routing). Ensuring availability of clear information to increase awareness of options will also be important in achieving mode shift.

DEMAND RESPONSIVE TRANSPORT services typically serve an identified route and timetable but only run if passengers pre-book and only serve those parts of the routes required by the bookings. If well designed, they can provide an efficient and flexible service.

2.2.3. IMPROVE MEASURES

Improve refers to measures to **improve the efficiency and reduce the emissions intensity of modes that are used**. The options shortlisted by the Net Zero Leiston working group of increasing uptake of electric vehicles (EVs) and provision of supporting charging infrastructure fall within this category. The benefits of EV use could be supplemented by moves to use the smallest vehicle appropriate for each journey. For instance, small or micro cars (or potentially even e-Scooters in future) could be used for most journeys as they involve only 1 or 2 people in the car. Often an SUV or large estate car is used for these short local journeys as it is the household's only car, purchased to meet occasional family needs (such as holidays). This increases the energy use and emissions associated with each journey, with some large cars producing almost double the emissions per kilometre than the levels produced by small cars.

The change to smaller vehicles could be encouraged by EV uptake schemes providing much more favourable costs for smaller vehicles and providing access to occasional use of larger vehicles as required. This approach could be further developed through a move to shared mobility, moving away from individual car ownership to access to a pool of vehicles or car club, hired on a 'pay as you go' per trip basis.

Whilst such a scheme would require careful planning and specification, particularly in a relatively small, rural town such as Leiston, it would bring a number of benefits in terms of encouraging efficient transport use. These benefits would primarily be driven by the fact that individuals would consider the cost of car use on a per trip basis (rather than the current arrangement of significant upfront investment in purchasing, insuring and taxing a car which then makes the additional incremental cost of each additional journey low). Moving to a per journey consideration would make the cost savings associated with more efficient options such as reduced journey length, use of smaller vehicles, car sharing and use of other modes directly apparent in terms of the monetary costs of the options (which would reflect the environmental implications).

The shared mobility system could also be implemented within the MaaS framework, which could be used to ensure fair pricing across multimodal journeys and to further incentivise efficient travel behaviour, such as providing rewards for cycling to the rail station. The system would also bring accessibility and inclusion benefits, providing access to car use for journeys for which alternatives are limited, without the need to be able to afford the high upfront costs of car ownership.

The benefits of shared mobility would increase if it could be rolled out across a wider area beyond Leiston, as suggested in the Suffolk Climate Emergency Plan.

2.2.4. IDENTIFYING MEASURES FOR DECARBONISATION

Identification of the most appropriate combination and specification of measures to achieve decarbonisation is challenging given the need for rapid action, the range of options available (as outlined above) and their potential to interact.

This challenge is increased by the fact that transport impacts on the local community and economy in a number of ways and that transport measures intended to address carbon emissions can have a range of wider impacts, both positive and negative. For instance, changes in the provision and cost of transport can impact the ease and affordability of accessibility to jobs, services and leisure opportunities, whilst increases in cycling levels can improve air quality, physical fitness and health as well as reducing carbon emissions. Measures can also have unintended secondary impacts such as a rebound effect of increased driving as a result of the lower operating costs of EVs (compared to petrol and diesel vehicles).

Responses to transport measures are strongly dependent on the local context, including the characteristics of the residents and organisations in the area and the trips they make, as well as the characteristics of the existing transport system. Therefore, to ensure effects are optimised, transport

measures should not be specified and implemented in isolation. As outlined above, change is likely to be most effectively achieved through a wider plan based on an understanding of the local transport context and incorporating integrated measures to change travel patterns in terms of amount and distance of travel and mode and vehicle types used.

Development of a plan allows interactions to be identified and provides the basis for a common understanding between the range of stakeholders likely to be involved in successfully delivering change in the transport sector. This will include engagement with the ongoing work to support the transport actions for the Suffolk Climate Emergency Plan, including the proposed update to the Suffolk Local Transport Plan.

2.3. REVIEW OF TRANSPORT CONDITIONS AND DEVELOPMENT OF INTEGRATED TRANSPORT PLAN FOR LEISTON

The shortlisting process undertaken by the Net Zero Leiston working group identified a number of measures that are likely to play a key role in the transport roadmap to Net Zero for Leiston, focussing on achieving changes in road vehicle type and increased bike use. At this stage there has not been the opportunity to set these measures in the context of a wider integrated plan for transport in the Leiston area.

Therefore, it is recommended that the first key step in the transport roadmap for Net Zero Leiston should be to undertake a detailed review of transport conditions in the town to inform the development of an integrated transport plan, co-ordinating with ongoing work to support the Suffolk Climate Emergency Plan where relevant.

In general terms the review would be intended to make best use of available evidence, supplemented by new surveys and observations where possible, in order to obtain a sound understanding of travel patterns in Leiston.

The types of issue to be reviewed would include

- » Trip patterns - in terms of key destinations that people visit from Leiston and key origins of people visiting Leiston and the transport modes they use, including increasing understanding of:
 - How commuting patterns have changed since the 2011 census illustrated in Figure 2.1;
 - The impacts of COVID-19 on trip patterns for all purposes and how permanent they might be (for instance the significant rise of home working and online shopping);

- The services and opportunities provided in Leiston and those that residents travel outside to visit, to understand the extent to which they might alternatively be provided locally (or online);
- School travel patterns;
- The nature of tourism in Leiston; and
- The scale and nature of freight travel associated with Leiston's businesses.

- » Public transport usage and potential gaps in services provision;
- » Community transport usage;
- » Pedestrian and cycling activity;
- » Car ownership patterns (e.g. vehicle age and size);
- » Composition of the van and HGV fleets owned by local businesses;
- » Home parking arrangements (e.g. on street parking for terraced houses and implications for EV charging);
- » Potential for cycle lane provision and associated challenges;
- » Public views on transport provision and potential changes; and
- » Quality of broadband connectivity and mobile coverage.

Collation and analysis of data of this type about Leiston would provide a strong basis for understanding the types and combinations of measures that would form part of an integrated transport plan, with measures selected to reduce carbon emissions rapidly in Leiston, whilst delivering other benefits (such as improved air quality and physical fitness) and minimising or mitigating potential disbenefits.

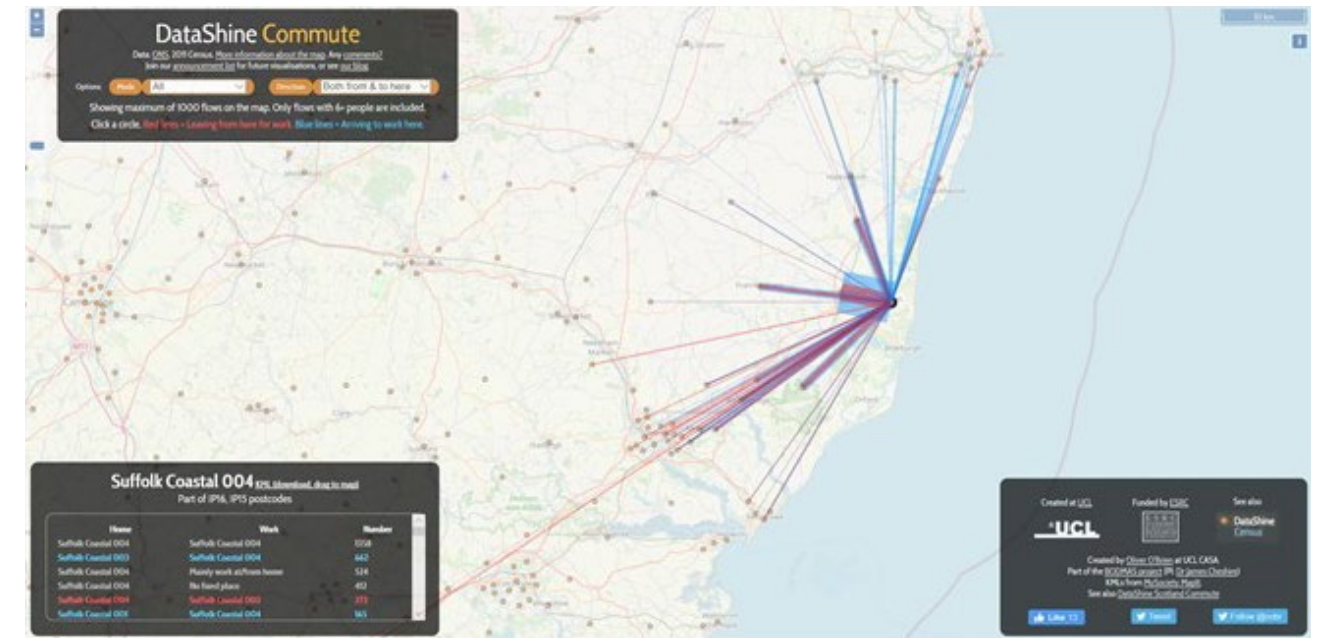


Figure 2.1: Census 2011 journey to workflows to and from the Leiston area¹⁰

3. SHORT LISTED TRANSPORT MEASURES

3.1 SHORTLISTED OPTIONS

As outlined above, following a long-listing, medium-listing and short-listing exercise, a number of measures were identified by the Net Zero Leiston working group as potential options for decarbonising the transport sector in Leiston, focussing on changes in road transport vehicles and increasing bike and e-bike use.

The measures shortlisted were as follows:

- » Hydrogen vehicles;
- » EV charging infrastructure;
- » Fleet electrification;
- » EV uptake;
- » EV for local public transport;

¹⁰ From UCL Datashine website, <https://commute.datashine.org.uk/#mode=allflows&direction=both&msoa=E02006290&zoom=10&lon=1.1761&lat=52.1806>. Data presented here is at MSOA level but is also available in other sources at LSOA level

- » Cycle hire scheme and bike storage hubs; and
- » E-bikes.

This shortlist can be grouped into three main measures:

» **Implementation of hydrogen vehicles;**

» **Electrification of the vehicle fleet:**

- EV charging infrastructure;
- Fleet electrification;
- Electric vehicles uptake;
- EV for local public transport;

» **Increase in cycling:**

- Cycle hire scheme and bike storage hubs;
- E-bikes.

The level and extent of implementation of each measure was not defined as part of the shortlisting process although the overall objective of achieving Net Zero emissions in Leiston implies ambitious action.

The following sections provide further detail on the different ways in which the level and extent of the three main measures could be defined, the supporting measures that would be needed to achieve them and the implications for the decarbonisation of the transport sector in Leiston.

3.2. HYDROGEN VEHICLES

Hydrogen fuel cell vehicles do not produce tailpipe CO₂ emissions. However, emissions are produced upstream during the production of hydrogen. The level produced depends on the hydrogen production process used. If it is produced through the currently common commercial process of steam methane reformation (SMR)¹¹, the well to wheel¹² emissions associated with powering a medium hydrogen car are estimated to be approximately 44% lower than

those for an equivalent petrol car¹³. The emissions reduction achieved could be substantially improved in the future if carbon capture and storage was used to capture the CO₂ produced during the SMR process (producing 'blue hydrogen'). Alternatively, hydrogen could be produced via electrolysis, a process using electricity to break water into hydrogen and oxygen. The CO₂ emissions from the process depend on the carbon intensity of the electricity grid and would decrease as electricity generation continues to decarbonise. Hydrogen has the potential to be a zero emissions fuel 'green hydrogen', if produced using zero emissions electricity from nuclear or renewable energy sources.

However, hydrogen vehicle uptake relies on the presence of appropriate refuelling infrastructure and supporting distribution of hydrogen. Unlike the electric vehicle charging network, there is no existing hydrogen fuelling infrastructure and incremental development of a network is challenging.

The Government's Hydrogen Strategy¹⁴ (published in August 2021) highlights the challenge of infrastructure provision and suggests that regional distribution networks are not likely to develop before the mid 2030s.

The Strategy identifies that hydrogen has the potential to complement electrification to provide zero emissions energy for heavier vehicles such as HGVs, buses and trains in scenarios where battery technology does not suit the vehicles' needs (for instance for long range travel). It does not identify any significant market for hydrogen cars and vans. This is consistent with the views of other sources such as the Climate Change Committee¹⁵ and the Energy Systems Catapult¹⁶ which indicate that hydrogen cars and LGVs are unlikely to account for a significant proportion of the future fleet as they will not be cost competitive with EVs.

It will not be practical to introduce hydrogen vehicles in an individual small town such as Leiston without the confidence that a wider refuelling infrastructure will exist to allow the vehicles to refuel when they are travelling elsewhere. In the timeframe to 2030, hydrogen vehicles are therefore likely to be viable options in Leiston only for fleets of vehicles that return regularly to a single origin point at which they could be refuelled without requiring a wider infrastructure. There do not appear to be any significant locally based fleets of goods vehicles that could use hydrogen on this basis, but it could be a viable option for the bus fleet. As bus emissions account for less than 0.5% of total transport emissions in Leiston, for simplicity and clarity the analysis below assumes electric bus use.

Hydrogen cars, LGVs and HGVs have therefore been ruled out of this assessment as an option for Leiston, even if hydrogen infrastructure is brought to Leiston for other purposes (such as heating).

¹¹ Producing hydrogen using methane as a feedstock and releasing CO₂ during production.

¹² Emissions generated throughout the process of extracting, producing, transporting and using a transport fuel or other energy vector. This is generally considered the fairest basis on which to compare vehicles with different fuel or other energy vector as it accounts for the full lifecycle impacts of the vector. Well to wheel emissions for petrol and diesel account for the extraction, processing and transport of the fuel, adding about 25% to the tank to wheel emissions, according to Defra Greenhouse Gas Emissions Conversion factors.

¹³ Department for Transport (DfT), 2018, Transport Energy Model

¹⁴ <https://www.gov.uk/government/publications/uk-hydrogen-strategy>

¹⁵ Committee on Climate Change, 2018, Hydrogen in a Low Carbon Economy. In addition the CCC's 6th Carbon Budget published in December 2020 assumes that electric rather than hydrogen vehicles will dominate the zero emissions fleet for cars and LGVs. The DfT's Transport Decarbonisation Plan published in July 2021 makes similar assumptions.

¹⁶ Energy Systems Catapult, 2020, Innovating for Net Zero.

3.3. ELECTRIC VEHICLES (EVS)

3.3.1. OVERVIEW

3.3.1.1. CARS AND LGVS

EVs account for a low but increasing proportion of car sales (3.2% in 2019 and 10.7% in 2020¹⁷, compared to 1.9% in 2017¹⁸, although the 2020 figure may be distorted by the impact of the COVID pandemic on buying patterns).

The term EV can be used in a number of ways, most typically including Plug In hybrid vehicles as well as battery electric vehicles. Hydrogen fuel cell vehicles can also be included in the category. Battery EVs are the most relevant for achieving Net Zero in Leiston. Plug In hybrid vehicles use petrol or diesel for some of their operation¹⁹ and hydrogen fuel cell vehicles have been excluded from the analysis (as described in Section 3.2).

Battery EVs are seen as viable alternatives for cars and light goods vehicles by bodies such as the Climate Change Committee²⁰, the Department for Transport²¹ and the Energy Systems Catapult²² and produce considerably fewer carbon emissions per kilometre than petrol/diesel vehicles if using low/zero emissions electricity²³. Based on recent UK electricity generation, emissions rates from an average electric car are estimated to be approximately 66% lower than the rates from an average petrol car²⁴, and the percentage difference will increase as electricity generation continues to decarbonise (BEIS forecasts of electricity carbon intensity through time are shown in Figure 3.1).

Electric vehicles also bring wider benefits, including improved local air quality and reduced noise disruption.

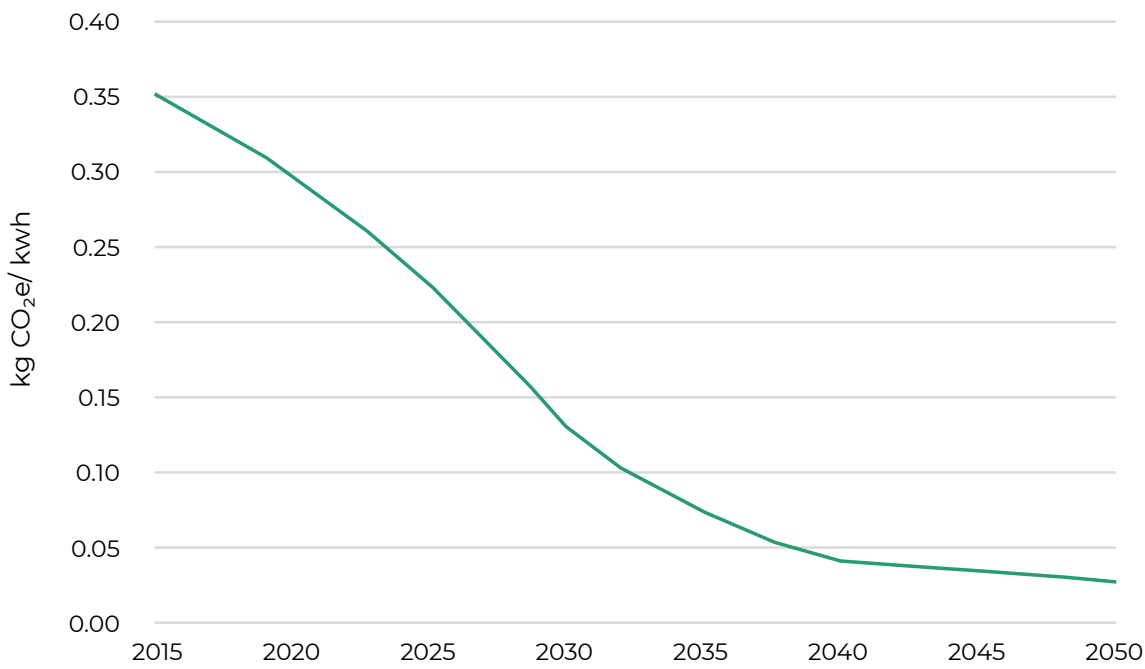


Figure 3.1: Projected carbon intensity of electricity generation (BEIS, marginal domestic intensity)²⁵

However, the transport carbon emissions Baseline scenario identified for this study in 2020 included only relatively slow electrification of the fleet, reflecting limited uptake of EVs and the fact that the fleet turns over at a fairly slow rate. New vehicles only account for approximately 7% to 8% of the total fleet in each year²⁶. On that basis, by 2030 about 60% of the fleet will have been purchased since 2022, and in the Baseline scenario defined, only a limited proportion of the sales in each year over that time frame will have been EVs.

The Baseline identified used the DfT TAG appraisal fleet assumptions²⁷. These assume modest ongoing uptake of EVs (based on continued national measures to promote uptake such as grants and charging infrastructure provision) leading to 14% of car vehicle kilometres and 5% of LGV vehicle kilometres (and 0% of HGV vehicle kilometres) being assumed to be undertaken by EVs in 2030. The low proportion of Baseline sales partly reflects the fact that EVs are expensive to purchase relative to petrol and diesel alternatives (with a differential of approximately £10,000, partly offset by available government grants²⁸).

¹⁷ [Electric vehicle market statistics 2021 - How many electric cars in UK ? \(nextgreencar.com\)](#) – 2019 figures comprised approximate 1.6% PHEV and 1.6% BEV, 2020 figures were 6.6% BEV and 4.1% PHEV

¹⁸ Committee on Climate Change, 2018, Reducing Carbon Emissions UK Progress Report to Parliament.

¹⁹ The DfT Transport Energy Model assumes electric operation for 62% of vehicle miles and petrol or diesel for 38%, DfT 2018, Transport Energy Model Report. The calculations for the CCC's 6th Carbon Budget assumed a 50% split between electric and non-electric

²⁰ Committee on Climate Change, 2019, Net Zero and 6th Carbon Budget, December 2020 assumes that electric rather than hydrogen vehicles will dominate the zero emissions fleet for cars and LGVs.

²¹ The DfT's Transport Decarbonisation Plan, July 2021 projects extensive uptake of BEV for cars and LGVs.

²² Energy Systems Catapult, 2020, Innovating for Net Zero.

²³ Though it is important to note that, taking a lifecycle perspective including the production of the vehicles, the saving is reduced as electric vehicles are more carbon intensive to produce than petrol or diesel vehicles (largely due to battery production). Nonetheless recent analysis such as the works supporting Ricardo, 2020, Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA, Final Report for the European Commission, DG Climate Action has confirmed that, for vehicles undertaking average mileage EV have lower lifetime carbon emissions with current electricity grid carbon intensity and savings will increase as the grid continues to decarbonise.

²⁴ DfT, 2018, Transport Energy Model Report.

²⁵ DfT, 2020, TAG Databook using data from BEIS 2019, supporting tables to HM Treasury supplementary appraisal guidance on valuing energy use and Greenhouse Gas emissions.

²⁶ DfT, 2020, Vehicle Licencing Statistics Tables Veh0101 and Veh0150.

²⁷ DfT, 2020, TAG Databook using data from BEIS 2019, supporting tables to HM Treasury supplementary appraisal guidance on valuing energy use and Greenhouse Gas emissions.

Local Government Association, 2020, Decarbonising

²⁸ Local Government Association, 2020, Decarbonising Transport: Accelerating the Uptake of EVs, <https://www.gov.uk/plug-in-car-van-grants> Grants are available of 35% of the purchase price of eligible cars up to a maximum of £3000. For eligible vans the grant is 20% of purchase price up to a maximum of £8000. In March 2021 the grants were reduced to a maximum of £2500 per car and between £3000 and £6000 for vans, depending on size.

However, since the Baseline was developed, the Government has announced a ban on the sales of petrol and diesel cars and vans from 2030 and hybrid vehicles from 2035 (in the 10 Point Plan for a Green Industrial Revolution published in November 2020²⁹). This ban was reiterated in the DfT's Transport Decarbonisation Plan published in July 2021³⁰ and consultation is currently ongoing on the best way to deliver it. This change will accelerate the uptake of EVs. Views vary on how rapidly uptake of EVs will occur before the ban. The Society of Motor Manufacturing and Traders published an estimate in June 2021³¹ indicating that by 2030 over 20% of cars in the fleet will be battery EVs (and 7% will be Plug In Hybrids). This is towards the bottom of the range of estimates (for instance the CCC forecast higher uptake³²). However, it is based on recent purchasing behaviour and forecasts of relative costs of different vehicle types and the anticipated level of government support for EV purchase.

The operating cost savings associated with electric vehicles mean that, above a threshold annual mileage, the lifetime costs of owning an electric vehicle are lower³³. Purchase decisions tend to be made on the basis of costs of owning over 3 or 4 years and confidence in second-hand values³⁴. Recent analysis by the Energy Systems Catapult suggests that, with ongoing cost reductions and government grants, the costs of owning and operating a small electric car are lower even over a four-year period of consideration³⁵.

Recent surveys also show that a significant proportion of the population remains uncertain over EVs, partly because of cost and partly because of range anxiety and associated concern over the availability of chargers. A recent survey published by the SMMT³⁶ (carried out shortly before the 2030 sales ban was announced) indicated that, whilst 37% of those surveyed were optimistic about buying a full EV by 2025, 44% felt that they would not be ready to own an EV even by 2035.

The Local Government Association's briefing on accelerating the uptake of EVs highlights a number of policy levers to help to accelerate EV uptake, as illustrated in Figure 3.2.

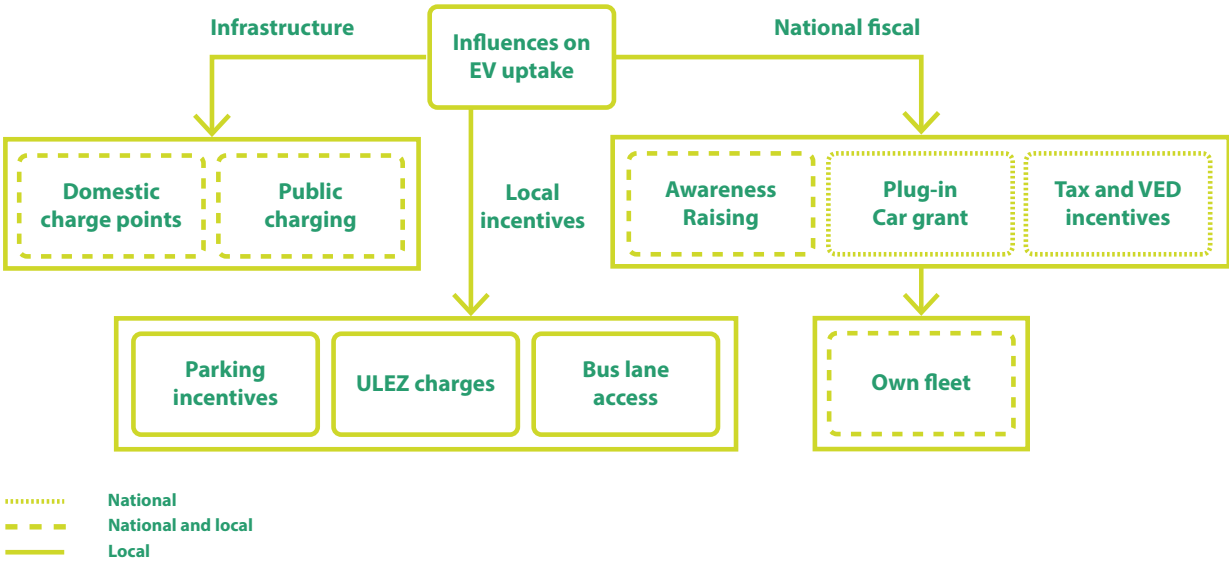


Figure 3.2: Policy levers for EV uptake³⁷

Whilst the figure suggests that a number of measures are best undertaken at national level, substantial local action will be required to overcome the public uncertainty issues identified above and accelerate the uptake of electric cars/LGVs in Leiston beyond average national levels.

Action is likely to involve either of the following routes (or a combination):

- » Providing considerable subsidy for EV purchase or use and supporting infrastructure, to overcome the up-front financial deterrent to purchase. The measures would also need to be supported by information and awareness raising; and
- » Implementing penalties for the use of petrol and diesel vehicles. This is likely to involve either a ban or charging of some form (for instance equivalent to the charges for Clean Air Zones being proposed in some cities to improve local air quality), either of which will be very challenging to deliver.

Table 3.5 at the end of this section provides more details on the types of measures that could help to accelerate EV uptake. As the table shows, the relevance of the measures identified will vary significantly between the different types of trips contributing to the traffic in Leiston.

Traffic within the parish comprises the following five categories of trips:

1. Residents travelling into/out of/within Leiston;
2. Leiston employees travelling into/out of/within Leiston;

²⁹ [The ten point plan for a green industrial revolution - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution)

³⁰ [Transport decarbonisation plan - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/transport-decarbonisation-plan)

³¹ [SMMT-new-car-market-and-parc-outlook-to-2035-by-powertrain-type-11-06-21.pdf](https://www.smmt.co.uk/wp-content/uploads/2021/06/SMMT-new-car-market-and-parc-outlook-to-2035-by-powertrain-type-11-06-21.pdf)

³² For instance, the Balanced Pathway in the CCC's 6th Carbon Budget, 2020 assumes uptake of nearly 35% BEVs and 9% PHEVs by 2030 (assuming a ban on both battery and plug in hybrids by 2032).

³³ Local Government Association, 2020, Decarbonising Transport: Accelerating the Uptake of EVs,

³⁴ Ibid.

³⁵ Energy Systems Catapult, 2020, Accelerating to Net Zero – analysis in the report suggests that over the 4 years between 2019 and 2023 a battery EV VW Golf would cost £25,289 to buy (with a grant) and operate, whilst a petrol version would cost £26,134,

³⁶ Survey for SMMT by Savanta ComRes who interviewed 2,185 adults online in the UK, filtering to those who hold a driving licence, between 21-24 August 2020. Data were weighted to be demographically representative of the UK by age, gender, region and social grade. <https://www.smmt.co.uk/2020/09/billions-invested-in-electric-vehicle-range-but-nearly-half-of-uk-buyers-still-think-2035-too-soon-to-switch/>

³⁷ Local Government Association, 2020 Decarbonising Transport: Accelerating the Uptake of EVs.

3. Local visitors/deliveries (i.e. cars/good vehicles from surrounding area/towns);
4. Longer distance/occasional visitors/deliveries (e.g. tourists/ shop deliveries etc); and
5. Through trips.

Vehicles driven by residents and employees account for approximately 60% of car traffic and 40% of LGV traffic³⁸ and are the vehicles most regularly used in Leiston, for which it is most likely to be possible to implement a measure to influence vehicle choice. The remaining categories (3 to 5) are likely to represent vehicles that visit Leiston more occasionally and for which it is difficult to influence vehicle choice.

3.3.1.2. HEAVY GOODS VEHICLES (HGVs)

Electric HGVs are not yet viable as it is not yet possible to produce a battery capable of moving heavy vehicles over the long-haul distances required. Road based charging (for instance through overhead catenaries³⁹) is considered to have potential to allow electrification of the HGV fleet. However, the use of vehicles of this type in any given town would rely on widespread roll out of the catenary infrastructure which is unlikely to have occurred by 2030.

As the goods vehicles in Leiston appear to be largely deliveries from elsewhere (rather than associated with local firms), there will be limited scope to influence them and so the most viable options for reducing diesel HGVs in Leiston are likely to involve logistical adjustments to use smaller EV vans for some trips to Leiston. Avoiding the use of diesel vehicles all together is likely to require consolidation centres on the edge of the town. Goods would be unloaded and transferred to smaller EVs (which would have limited impact on emissions at the national scale, as discussed further below).

3.3.1.3. BUSES

Buses are particularly suited to electrification due to the stop start nature of their duty cycle which benefits from the efficiency of electric engines. On the basis of the 2017 electricity grid emissions factor, the Department for Transport (DfT) estimate that the CO₂ emissions rate of an electric bus is 64% lower than a standard diesel bus and 60% lower than an efficient diesel bus⁴⁰, with the scale of reduction increasing with the decarbonisation of the grid.

³⁸ High level estimate based on information from the Sizewell VISUM traffic model and the DfT's TEMPRO trip end data for the area and additional data on van traffic.

³⁹ Centre for Sustainable Road Freight, 2020, White Paper: Decarbonising the UK's Long-Haul Road Freight and Minimum Economic Cost – report suggests that Building a network of overhead catenary cables along 7,500 km of the UK's major road network would electrify approximately 65% of freight travel.

⁴⁰ DfT, 2018, Transport Energy Model Report.

Electric buses currently have ranges of up to 450km for single decker vehicles, increasing as battery technologies improve⁴¹. This should be sufficient for the routes serving Leiston⁴². However, if longer ranges are required, as noted in Section 3.2, buses are the one fleet type for which hydrogen may be a low carbon fuel option in Leiston (as fuelling could be provided at a single point in the depot and no wider infrastructure would be required). The emissions savings would initially be lower, currently estimated to be 45% relative to a standard diesel⁴³, but as outlined in Section 3.2, could increase through time if carbon capture and storage was incorporated in the SMR hydrogen production process or there was a move to producing green hydrogen using electrolysis using zero carbon electricity.

3.3.2. SCENARIOS TESTED

3.3.2.1. DESCRIPTION OF SCENARIOS

Five scenarios were tested to further understand the potential emissions impact of increased EV uptake:

- » Theoretical maximum: Illustrative test to indicate the impact on emissions if all traffic in Leiston was converted to EVs;
- » National action: Test to indicate the potential impact of the national 2030 petrol/diesel car/van sales ban announced by the Government since the Baseline for the study was developed: and
- » Three scenarios focussing on accelerating the uptake of EVs by residents and employees in Leiston, with three levels of emissions impact assumed: Low, Medium and High, described further below.

The **theoretical maximum scenario** assumes the same level of traffic as in the Baseline (by vehicle type) but also assumes that all vehicles travelling are EVs, using electricity at the carbon intensity projected by BEIS for 2030 (0.13 kg CO₂e/kWh).

Full electrification of the fleet is identified in the Suffolk Climate Emergency Plan as a requirement of achieving Net Zero by their target date of 2030. However, the Plan also identifies the substantial challenges in achieving such a rapid and large scale shift in a fleet of hundreds of thousands of vehicles (across Suffolk) and identifies the need for national government action for the change to be possible. The scenario has been included for illustrative purposes to provide an understanding of the theoretical maximum emissions impacts of electrification. However, it is not considered a deliverable scenario, particularly when implemented for Leiston alone. As outlined above, the projection of EV uptake with national action

⁴¹ Low Carbon Vehicle Partnership, 2016, Low Emission Bus Guide: Table 4.

⁴² Route 64 between Aldeburgh and Ipswich is 50km long and Route 521 between Aldeburgh and Halesworth is 42km long.

⁴³ DfT, 2018, Transport Energy Model Report.

(national average of approximately 20% of BEV cars, 7% of PHEV cars and 18% of BEV vans by 2030) means that significant action would be required to achieve a fleet of 100% EV by 2030. The action required would be made more challenging by the fact that fleet turnover is relatively low (7% to 8% of the fleet per annum) and 40% to 60% of car and van traffic in Leiston (and a higher proportion of HGV traffic) is associated with occasional visitors to the area or traffic passing through. This subset of traffic would comprise a large number of different vehicles over the year that could not be captured through targeted measures to encourage EV uptake.

Therefore, the only plausible approach to achieving a fully electric fleet on Leiston's roads by 2030 would be to ban non-EV vehicles within the area. Such a ban would be likely to be unpopular and difficult to deliver as it would have a significant impact on the community and their access opportunities.

To limit the negative impacts of the measure on accessibility and the economy, it would be likely to be necessary to supplement the ban with:

- » Significant financial support to encourage residents and employees to upgrade to EVs;
- » A potential Park and Ride site served by EVs (including e-bikes) at the boundary of Leiston to allow visitors with non EVs and the residents who do not upgrade their vehicles to leave them outside the exclusion area and travel in; and
- » A similar arrangement for freight i.e. consolidation sites at the boundary allowing for freight to transfer to smaller vehicles that are sufficiently small to be EVs (or potentially hydrogen as this could be a dedicated fleet that could return to a single fuelling station).

These measures would be costly and would be likely to be unpopular. Additionally, the effect of the Park and Ride and consolidation sites would be to cause petrol/diesel vehicles to stop at the parish boundary and transfer to EV (or e-bikes etc.) and therefore save the emissions just for the final leg of the journey. Although this would contribute to the required reduction in emissions in Leiston, the approach would not contribute significantly to emissions reductions nationally. Emissions savings in Leiston may also be partially offset at a wider level by vehicles rerouting to avoid the ban and therefore taking a longer route, again not aligning well with the more general ambition of national emissions reduction.

Three main scenarios tested have therefore been specified to focus on changes that are considered more deliverable and would be aligned with contributing to decarbonisation nationally, i.e. by focussing on electrification of vehicles (rather than just sections of journeys).

The three Leiston specific scenarios build on an intermediate scenario estimating the impact on EV uptake of the national action of banning the sales of petrol and diesel cars and vans from 2030 (and plug in hybrids from 2035). The estimate is based on:

- » The SMMT's June 2021 forecast⁴⁴ based on recent sales and current levels of government support; and
- » An assumption that rural areas such as Leiston would be about a year behind the national average uptake as denser urban areas tend to lead on uptake. This is illustrated in the vehicle registration figures for 2018 to 2020 which show that the proportions of cars and vans registered in East Suffolk district and Suffolk county that are ultra-low emissions vehicles follow about a year behind the national average proportions (i.e. proportions in 2020 in Suffolk are broadly equivalent to the national average proportions in 2019)⁴⁵.

The specification of the three scenarios for Leiston has been based on the assumption that accelerating EV uptake beyond the level associated with the sales ban would require further financial support for EV purchase/use and awareness raising measures. It was assumed that the most cost-efficient way to specify the measures would be to focus on the vehicles that travel most in Leiston i.e. the vehicles of residents, employees (living elsewhere) and local businesses in the town.

As outlined above, a considerable amount of uncertainty around EVs remains amongst the public, driven particularly by concerns about cost, range and charging availability. Therefore, to accelerate EV uptake beyond the level associated with the sales ban would require a number of measures. As discussed in Section 2, identification of the most effective measures would require input from the review of local transport conditions. However, wider evidence suggests that relevant measures are likely to involve some combination of actions similar to the following:

» **Financial incentives for EV use** e.g.

- Additional grants to offset the additional upfront purchase cost differential or
- An opportunity to lease or hire the EVs at a subsidised rate to overcome the high upfront cost of new vehicle purchase.

Leasing and hiring opportunities would be likely to expand the number of households in scope as most buy second hand cars and therefore the high upfront costs of new vehicles, even with grants would be likely to be out of reach.

A shift to subsidised pay as you go shared mobility using EVs (which could be tied in with e-bike provision) could have further benefits of reducing car use (as each journey is paid for in full at the time of travel) and the use of oversized cars. However, it is likely to be challenging to implement measures of this type in an area the size of Leiston alone.

⁴⁴ SMMT-new-car-market-and-parc-outlook-to-2035-by-powertrain-type-11-06-21.pdf

⁴⁵ [Vehicle licensing statistics: 2020 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/vehicle-licensing-statistics-2020) Tables VEH0132a - Ultra low emission vehicles (ULEVs) 1 licensed at the end of the quarter and VEH0105 Licensed vehicles at the end of the year by body type and upper and lower tier local authority 1

- » **Awareness raising measures** to provide well targeted information to increase understanding of the characteristics of EVs including the financial support available, the low operating costs, ease of driving and increased ranges and the availability of charging.
- » **Provision of charging points** at households/workplaces and in public areas to provide increased confidence, particularly amongst those without access to dedicated parking at home.

As outlined in **Chapter 2** - NZL Boundry, these measures would need to be part of an integrated plan and aligned with a range of other measures to reduce travel and encourage mode shift in order to maximise emissions savings. Supporting measures would also be required to mitigate any tendency to a rebound effect (i.e. people travelling more as a result of operating costs for EVs being lower than those for petrol and diesel cars).

The measures also need to be specified to work with existing planned upgrades of vehicles. Considering emissions from the wider perspective beyond Leiston, measures to encourage early scrappage would need more careful consideration as the process of vehicle production also involves significant generation of carbon emissions (accounting for 40% to 60% of lifecycle emissions for electric cars⁴⁶). For this reason, measures in the wider plan to encourage making good use of fewer vehicles (e.g. through shared vehicles) rather than less intensive use of more vehicles would also make a wider contribution to emissions savings by reducing vehicle production.

3.3.2.2. SPECIFICATION OF SCENARIOS

The impact of EV uptake measures is hard to predict as they rely on behaviour change amongst individuals and organisations. However, to provide an indication of potential scale of impact, the four scenarios have been defined to provide an understanding of the potential impact if **focussed investment and awareness raising could accelerate EV uptake in Leiston relative to the national average**.

The four scenarios are specified as follows:

- » **National action** assumes **1 year lag** on the estimated national average impact of the petrol/diesel car and van sales ban (i.e. the proportion of EVs in on the road in Leiston in 2030 is equivalent to the national average in 2029), reflecting the fact that uptake is likely to be slower in rural areas like Leiston than denser urban areas (as outlined above);

⁴⁶ Ricardo, 2020, Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA, Final Report for the European Commission, DG Climate Action. Analysis undertaken for the study suggests that, on average across the EU28, production accounts for 15% to 20% of lifecycle greenhouse gas emissions for medium petrol and diesel cars and over 40% of emissions for Battery Electric Vehicles. For the UK the figure is closer to 60% due to the relatively low emissions intensity of the electricity supply.



- » **Low** effort could **accelerate uptake by 1 year** i.e. the proportion of EVs in the affected fleet in Leiston in 2030 is equivalent to the national average (20% cars BEV, 7% car PHEV, 18% LGV BEV);
- » **Medium** effort could **accelerate uptake by 1.5 years** (i.e. the proportion of EVs in the fleet in Leiston in 2030 is assumed to be equivalent to DfT’s estimate for the national average 6 months later – i.e. 22% cars BEV, 7% car PHEV, 21% EV LGVs); and
- » **High** effort could **accelerate uptake by 2.5 years** (i.e. the proportion of EVs in the fleet in Leiston in 2030 is assumed to be equivalent to the national average estimated for 18 months later – i.e. 27% cars BEV, 8% car PHEV, 27% EV LGVs).

The High levels of vehicle uptake are towards the upper end of uptake ranges identified in the literature⁴⁷. For the car fleet proportions to be achieved, over 40% of the new vehicles purchased between 2022 and 2030 would need to be BEVs⁴⁸, representing a considerable increase from 2019 when BEVs accounted for 1.5% of annual car sales. The figures in 2020 suggest progress in the right direction with a step up to BEVs accounting for 6.6% of car sales⁴⁹. However, this was in the context of reduced car sales overall due to the impacts of the Covid 19 pandemic and there remains some uncertainty over the extent to which the trend will continue. Achieving over 40% of sales on average between 2022 and 2030 would require a continuation of the scale of increase in BEV sales seen between 2019 and 2020 year on year throughout the 2020s.

The level of intervention required to achieve a specified EV uptake response is difficult to forecast because the impact depends on behavioural responses amongst individuals and organisations and is therefore highly uncertain. For the purposes of the assessment, the scenarios have been assessed on the basis of an assumed increase in scale of grant per vehicle and increasing charging provision, as well as supporting staff time to raise awareness and administer the financial incentives, as summarised in Table 3.1.

⁴⁷ For instance, the High scenario projects a total of approximately 35% of the car fleet being EVs (BEV and PHEV) in 2030. This is equivalent to the SMMT’s High scenario which assumes continued grants for EV purchase through the 2020s and that financial support makes EVs cost comparable with petrol and diesel cars by the mid 2020s. Other forecasts do project even higher levels of EV uptake. For instance the Balanced Pathway from the CCC’s 6th Carbon Budget projects EV accounting for 35% of the car fleet during 2029 as do the two most ambitious of the National Grid’s four 2021 Future Energy Scenario (i.e. Leading the Way and Consumer Transformation) [Future Energy Scenarios | National Grid ESO](#). These forecasts have a very steep upward trajectory in the late 2020s and rely on a very rapid uptake of EVs from the early/mid 2020s with BEVs already assumed to account for nearly 50% of car sales by 2025 in the CCC’s Balanced Pathway [Sixth Carbon Budget - Climate Change Committee \(theccc.org.uk\)](#)

⁴⁸ As approximately 7% to 8% of the total vehicle fleet each year, leading to a position where approximately 60% to 70% of vehicles in the fleet in 2030 will have been purchased since 2021.

⁴⁹ Electric vehicle market statistics 2021 - How many electric cars in UK ? (nextgreencar.com)



Table 3.1: Specification of indicative Low, Medium and High impact EV uptake scenarios

Scenario	Grant (or equivalent) ⁵⁰	Charging points	Aim	Electric bus implementation	Freight consolidation
Low	£1500 per car £3000 per van	For each household/ employee with EV grant + 10 public chargers, of which 3 are rapid	To accelerate Car and LGV EV uptake to match the national average forecast with the 2030 sales ban (from a year's lag)	25% of buses serving the 2 local routes ⁵¹	Small scale measures to move some deliveries to Leiston to electric vans (reducing emissions by 1%)
Medium	£3500 per car £7000 per van	For each household/ employee with EV grant + 20 public chargers, of which 7 are rapid	To accelerate Car and LGV EV uptake by 6 months relative to national average	50% of buses serving the 2 local routes	Small scale measures to move some deliveries to Leiston to electric vans (reducing emissions by 2%)
High	£6000 per car £12000 per van	For each household/ employee with EV grant + 30 public chargers, of which 10 are rapid	To accelerate Car and LGV EV uptake by 18 months relative to national average	75% of buses serving the 2 local routes	Measures to move some deliveries to Leiston to electric vans (reducing emissions by 5%)

3.3.3. ESTIMATED SCENARIO IMPACTS

Table 3.2 summarises the estimated annual emissions saving relative to the Baseline for each of the scenarios specified above, accounting for tailpipe⁵² emissions within the Leiston boundary for petrol and diesel vehicles and the emissions associated with generating the electricity used to charge electric vehicles. The impacts were calculated on the basis that traffic levels in Leiston remain unchanged from the Baseline in the same year but that the proportions that are travelled by EV increase as outlined above, with petrol and diesel vehicle kilometres reducing accordingly. Average emissions per vehicle kilometre for each vehicle and fuel type are assumed to remain unchanged.

The results show that the combination of national action and each of the Low, Medium and High scenarios only achieves a fraction of the theoretical maximum scenario and represent a saving of between 6% and 10% of 2030 baseline emissions (of 3,840 tonnes). This reflects the scale of challenge in changing the fleet within 8 years and the fact that only a proportion of traffic is in scope (i.e. the traffic associated with residents, employees and local businesses, accounting for approximately 60% of car traffic and 40% of van traffic).

Table 3.2: Estimated emissions impact of EV uptake scenarios in 2030

Scenario	Estimated CO ₂ e emissions savings relative to Baseline in 2030 (tonnes p.a.)
National action	140
Low*	240
Medium*	300
High*	410
Theoretical max	3,150

*Low, Medium and High scenario emissions impacts all include the impacts of national action plus the further uptake described above

Achieving high levels of EV uptake within Leiston would also deliver emissions savings beyond Leiston (on the remainder of journeys made to and from Leiston) and would bring wider benefits, in particular air quality improvements as a result of reduced emissions. However, it would be important that measures to promote EV uptake were delivered alongside measures to avoid a ‘rebound effect’ whereby people are encouraged to drive more when using an EV, due to the lower running costs. Without demand management measures, rebound has the potential to cause a significant increase in vehicle kilometres travelled with negative impacts for traffic levels and associated congestion and severance effects.



⁵⁰ Available to Leiston residents, business and employees with eligible vehicle numbers estimated from data from the Suffolk Observatory <https://www.suffolkobservatory.info/> on household numbers and car/van ownership in Leiston, Census 2011 Journey to Work travel data from the Propensity to Cycle Toolkit (described further in the next section).
⁵¹ Route 64 between Aldeburgh and Ipswich and Route 521 between Aldeburgh and Halesworth.

⁵² Tank to wheel emissions or those produced at the point of fuel combustion in the car.



3.4. BIKE/E-BIKE SCENARIOS

3.4.1. OVERVIEW

There is increasing recognition of an important role for cycling in reducing carbon. This is moving away from some past views that active modes (i.e. cycling and walking) would have a relatively limited contribution to decarbonisation because, whilst accounting for a significant proportion of car trip numbers, those within feasible distance bands for active mode use account for a relatively small proportion of car emissions offering limited potential for reduction⁵³.

From the perspective of integrated planning for carbon reduction, there is recognition of the increased value of combining cycling infrastructure provision with measures to localise activity (the Avoid measures outlined in **Chapter 2**), bringing more trips within distance ranges that could be cycled. Additionally, the growth in e-bike use considerably expands the distance that can be considered cyclable. The Local Government Association (LGA) briefing on e-bikes⁵⁴ notes that their use increases potential commuting distances by 15 to 20 miles. The briefing also quotes recent work by the Centre for Research into Energy Demand (CREDS) suggesting that, in a hypothetical scenario in which all car trips in rural and suburban areas that could potentially be undertaken by e-bike switched away from car, it would reduce car emissions by 50%⁵⁵.

Increased levels of cycling (and walking) also bring a number of wider benefits including improved air quality and physical fitness and therefore health, as well as greater equality of accessibility through improved provision of low-cost transport and increased leisure and economic activity in the local community.

There is clear potential for cycling in the Leiston area as it is relatively flat and many trips in the area fall comfortably within ranges that can be reached within 30 minutes, even on a conventional bike. For instance, Google maps directions, assuming conventional cycle use, suggest that Aldringham and Coldfair Green are less than 10 minutes away from Leiston, Sizewell is just over 10 minutes away (and satellite images suggest it is already served by some cycle lanes from Leiston), Thorpeness is 10 to 15 minutes away, Aldeburgh, Saxmundham (with a rail station), Westleton and Darsham are all 20 to 30 minutes away and Yoxford (also with a station) just over 30 minutes away.

3.4.2. SCENARIOS TESTED

The Propensity to Cycle Toolkit (PCT) was used as the basis for defining a range of scenarios to assess the potential impact of uptake of cycling measures. The toolkit was developed by the University of Cambridge and academic partners⁵⁶, drawing on the Census 2011 journey to work data at the most detailed LSOA to LSOA⁵⁷ level, along with details of local population and geographical characteristics and high level information on cycling levels in other scenarios.

The scenarios include:

- » Government Target – meeting the UK government target of doubling cycling use;
- » Go Dutch – achieving average Dutch levels of cycling, with the assumption that Dutch levels of cycling infrastructure are also provided; and
- » E-Bike – building on Go Dutch to allow for the additional impact of e-bike uptake.

In estimating levels of cycling for commuting between any given origin destination pair in each scenario, the PCT takes account of local characteristics such as population (age and gender), route lengths and traffic levels, hilliness and current cycling levels. The tool also estimates the implications of increases in cycling levels for car driver trip numbers (i.e. the extent to which mode shift away from car is assumed to occur).

The measures required to achieve cycling uptake are relatively well understood, Sources such as the LGA briefing⁵⁸, Transport for Quality of Life⁵⁹ and the PCT documentation⁶⁰ highlight that high-quality cycling infrastructure including segregated cycle lanes and storage is a key requirement. Grants are also identified as an important measure to encourage e-bike uptake⁶¹, along with campaigns to increase awareness of cycling options.

Table 3.6 at the end of this section provides more detail on the type of measures that could achieve increased bike and e-bike uptake. As for the EV uptake measures, measures to encourage cycling in Leiston could be most effectively specified and implemented in the context of a wider integrated transport plan based on local evidence.

⁵⁶ Lovelace, R., Goodman, A., Aldred, R., Berkoff, N., Abbas, A., & Woodcock, J. (2017). The Propensity to Cycle Tool: An open source online system for sustainable transport planning. Journal of Transport and Land Use, 10(1). <https://doi.org/10.5198/jtlu.2016.862>. The Propensity to Cycle Toolkit was initially funded by DfT and has been developed by academics at the University of Cambridge, University of Leeds, University of Westminster <https://www.pct.bike/tabs/about.html>

⁵⁷ Lower layer super output area to lower layer super output area.

⁵⁸ Local Government Association, 2020, Decarbonising Transport: Growing cycle use.

⁵⁹ Transport for Quality of Live/Friends of the Earth, 2019, Briefing: Segregated cycles and e-bikes – the future of urban travel.

⁶⁰ Lovelace, R., Goodman, A., Aldred, R., Berkoff, N., Abbas, A., & Woodcock, J. (2017). The Propensity to Cycle Tool: An open source online system for sustainable transport planning. Journal of Transport and Land Use, 10(1).

⁶¹ Transport for Quality of Life, 2019, The Case for a UK Incentive for E-bikes. A review of European experience for the report suggested that incentives of £250 and above per bike are effective.

⁵³ Trips < 5 miles and 5 to 10 miles each account for less than 20% of car emissions (less than 40% combined). According to analysis presented in Transport for Quality of Life, Friends of Earth, 2018, More than Electric Vehicles. The report notes that the data behind the analysis is old, using DfT from 2008, but that it appears to be the latest available.

⁵⁴ Local Government Association, 2020, Decarbonising Transport: Growing cycle use.

⁵⁵ Philips, I., J. Anable, and T. Chatterton, 2020, e-bikes carbon savings - how much and where? Centre for Research into Energy Demand: Oxford cited in Local Government Association, 2020, Decarbonising Transport: Growing cycle use.



As for the EV uptake scenarios, the level of intervention required to achieve a specified cycling uptake response is difficult to forecast because the impact depends on behavioural responses amongst individuals and is therefore highly uncertain. Therefore, for the purposes of the assessment, Low, Medium and High impact indicative scenarios were specified on the basis of the following assumptions:

- Provision of a grant for all Leiston residents or employees wanting to purchase a bike or e-bike, combined with some cycle priority improvements in the centre of Leiston would achieve an uptake in cycling amongst the eligible population, specified as a proportion of between 35% and 65% of the Government target of doubling cycling is achieved, amongst those eligible for a grant⁶²;
- The grant would need to be supplemented with the provision of a high quality segregated cycle lane between journey origin and destination and reliable cycle storage and charging points at the destination in order to achieve cycling levels (and impact on car driving) in line with those predicted in the PCT e-Bike scenario amongst the subset of the population served by the cycle provision as well as being eligible for grants⁶³.

The Low, Medium and High scenarios therefore assume increasing levels of grant (for residents and Leiston employees) and of cycle lane and cycle storage provision, as outlined in Table 3.3.

Table 3.3: Specification of indicative Low, Medium and High impact bike/e-bike scenarios

Scenario	Cycle grant	Cycle storage hubs	Cycle lanes
Low	£350 per bike ⁶⁴ + maintenance	4 total: 1 at Saxmundham station 3 in Leiston, 1 in centre, 2 on outskirts (for those wishing to avoid cycling in the centre)	Limited provision within Leiston, equivalent to providing 1 km of lane Segregated cycle lane to Saxmundham station
Medium	£500 per bike + maintenance	6 total: Low + 1 at Sizewell 1 extra in Leiston	As low + Increased provision in Leiston, equivalent to providing 2 km of lane in total Segregated cycle lane to Sizewell (improving on current provision)

Scenario	Cycle grant	Cycle storage hubs	Cycle lanes
High	£700 per bike + maintenance	8 total: Medium + 1 in Aldringham 1 in Coldfair Green	As medium + Increased provision in Leiston, equivalent to providing 3 km of lane total Segregated cycle lanes to Coldfair Green and Aldringham

3.4.3. ESTIMATED SCENARIO IMPACTS

Table 3.4 summarises the estimated annual emissions saving relative to the Baseline for each cycle/e-bike scenario, accounting for the savings in tailpipe (tank to wheel) emissions within the Leiston boundary for petrol and diesel vehicles and the emissions associated with generating the electricity used to charge electric vehicles (offset by the electricity required to charge the electric bikes).

The impacts were calculated on the basis of the PCT estimates of the reductions in car driving commuting trips as a result of increased cycling in each scenario. Commuting totals were adjusted to account for increased cycling (and reduced car travel) for other journey purposes on the basis of national average cycling patterns⁶⁵. An allowance was made for the electricity consumption of e-bikes and it was assumed that those switching from car driving to cycling in each scenario would result in a reduction in vehicle kilometres proportionately across all car fuel types (using Baseline proportions).

The results show that the Low, Medium and High scenarios each generate a saving of less than 2% of 2030 baseline emissions (of 3840 tonnes).

However, as outlined in previous sections, the emissions impacts of cycling measures would be likely to be increased if applied in conjunction with more comprehensive measures as part of an integrated transport plan. In particular, measures to change land use planning and provide more services locally would help to bring more trips within the range for cycling. Additionally, a wider roll out of high-quality infrastructure across a wider area, which could be associated with the actions identified in the Suffolk Climate Emergency plan, would substantially increase uptake.

Table 3.4: Estimated emissions impact of bike/ e-bike uptake scenarios in 2030

⁶² The low grant + central cycle lane measures was assumed to achieve 35% of the increase to the government target, medium grant + central measures 50% and high 65%.
⁶³ Population directly served by the cycle lanes was estimated on the basis of a proportion of the population living in the LSOA served, reflecting density along the cycle lane's route.
⁶⁴ Ibid.



⁶⁵ DfT, 2019, National Travel Survey.



Scenario	Estimated CO ₂ e emissions savings relative to Baseline in 2030 (tonnes p.a.) ⁶⁶
Low	20
Medium	40
High	50

Providing high quality cycling infrastructure and achieving high levels of cycling/e-biking within Leiston would also deliver emissions savings beyond Leiston (at the origins and destinations of the cycling trips) and would bring a range of wider benefits.

Organisations such as the Local Government Association⁶⁷ also emphasise that cycling activity brings valuable additional benefits to the local community, including improved physical health for cyclists, air quality improvements and potentially increased local economic activity in areas served by good cycling provision.

Table 3.5: Measures to encourage electrification for cars and goods vehicles

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliverires	Through	
Subsidised access to shared use EVs as part of wider MaaS/ mobility credit system	Y	Y	?			» Would need a substantial subsidy and other measures to make the option cheaper and more attractive than continuing with current car ownership. Success would also require awareness raising measures and reliable and easy availability of vehicles.

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliverires	Through	
						» Maximum effect would be achieved if the focus was on primarily providing small, energy efficient vehicles with occasional access to larger vehicles as required. » System likely to be more effective if covering wider area than Leiston alone and covering all modes (e.g. e-bikes, public transport as well as car use).
Subsidised leasing of EVs	Y	Y				» Potentially building on EV leasing arrangements that EDF offers its current customers. » As for the previous measure, a substantial subsidy/other measures are likely to be required to make the option cheaper and more attractive to vehicle owners than continuing with current car ownership.

⁶⁶ The bike/e-bike uptake measures have a larger impact when applied alone (i.e. without the EV uptake measures), as a higher proportion of the vehicle kilometres removed due to mode switch are petrol and diesel and therefore more emissions intensive. However, the results are presented rounded to the nearest 10 tonnes given the levels of uncertainty involved and the differences are not visible once rounding has occurred.

⁶⁷ Local Government Association, 2020, Decarbonising Transport: Growing cycle use.

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliveries	Through	
						» Again, maximum effect would be achieved if the focus was on primarily providing small, energy efficient vehicles with occasional access to larger vehicles as required provided as part of the leasing arrangement
Grant for EV purchase	Y	Y				» Some grant provision is required to achieve the baseline and national action levels of EV uptake. Increased levels would be required to accelerate take up. » This approach limits the number of households able to afford EVs, as purchase still requires a large upfront investment.
Public charge points – Leiston destinations	Y	Y	Y	Y		» Some charge points would be required to achieve the baseline and national action levels of EV uptake. Increased roll out would be required to accelerate take up. » Needed to address range anxiety – mainly for those visiting Leiston but also potentially for residents without access to dedicated parking.

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliveries	Through	
						» A proportion of chargers would need to be rapid to help fulfil this role.
Public charge points – other key destinations	Y	Y	Y			» Some charge points would be required to achieve the baseline and national action levels of EV uptake. Increased roll out would be required to accelerate. » Needed to address range anxiety for those travelling from Leiston - by providing charging at their main destination. » Likely to be difficult to find destinations with sufficient trips from Leiston for this to be worthwhile. The destinations with most trips from Leiston are likely to be those nearby, for instance Saxmundham station, which are well within range, potentially limiting the value of the measure.
Grant for charge point at home, work or on street	Y	Y				» Need to ensure the local electricity distribution network can support scale of charging implied by the levels of uptake.

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliveries	Through	
Increased charges/ parking ban for petrol/ diesel	Y	Y	Y	Y		» Likely to be unpopular, intended to introduce regular cost savings as a benefit of EV use.
Charge or ban on entry for petrol/diesel vehicles	Y	Y	Y	Y	Y	» Extremely challenging to implement. However, a ban is likely to be only way to achieve full electrification of travel within Leiston. » May lead to some additional mileage and emissions due to through trips rerouting (e.g. Westleton to Aldringham trips may divert around Leiston) unless the same approach is applied more widely.
Park & ride/ consolidation centre at the edge of Leiston	Y	Y	Y	Y	Y	» Sites served by EV goods vehicles for 'last mile' deliveries and e-bikes/e-scooters/e-taxi for passengers, depending on scale of use (e-bikes/ scooters would need appropriate road allocation see below). » Likely to be the only viable option for electrifying goods vehicles as the HGVs

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliveries	Through	
						travelling within Leiston are originating elsewhere and long distance and so will not be able to change to use EVs. » This approach would be to supplement the previous measure (particularly if applied as a ban). » However, the message of very narrow area of focus of saving emissions just for the final leg of journeys does not align well with the message of needing to work at a broad scale to meet the scale of the carbon reduction challenge. Although it would contribute to the required reduction in emissions in Leiston, the approach would not contribute significantly to emissions reductions nationally. Emissions savings in Leiston may also be partially offset at a wider level by vehicles rerouting to avoid the ban and therefore taking

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors/ deliveries	Through	
						a longer route, again not aligning well with the more general ambition of national emissions reduction.

Table 3.6: Measures to encourage walking/cycling/ (and potentially use of e-scooters)

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors	Through	
Subsidy to purchase bike/e-bike + support for maintenance	Y	Y				Measure to encourage bike purchase and help to keep bikes in functional shape.
Bike hire			Y	Y		Largely to ensure cycling is a readily available option for visitors or for those with out space for cycle storage or means to maintain bikes.
Hub providing secure bike parking and charging in Leiston	Y	Y	Y	Y		To encourage cycling into Leiston.
Hub providing secure bike parking and charging in other key destinations	Y?	Y	Y	Y		To encourage cycling to other locations.

Measure	Trip categories affected					Comments
	Residents	Employees	Local visitors	Occasional visitors	Through	
Provision of high quality, segregated cycling lanes on routes between Leiston and neighbouring settlements	Y	Y	Y	Y	Y	High quality, segregated cycle lane provision is recognised as a key requirement in achieving a step change in cycling levels. Satellite imagery suggests there may be potential to achieve this without loss of road space, given the rural location and adjacent verges and fields.
Provision of high quality, segregated cycling lanes in Leiston	Y	Y	Y	Y	Y	Likely to involve reallocation of road space away from cars/goods vehicles e.g. allocation of parallel roads in town centre. Likely to be challenging to deliver in a built-up area but, as in previous measure, is likely to be important in delivering significant increase in cycling levels.
Mobility credit scheme to incentivise active travel	Y	Y				Potentially cycling certain journeys could earn credits e.g. for bike maintenance or public transport use or other local activity. Would need to be tied into wider transport plan.
Provision of more services locally to reduce trip lengths e.g. remote working hubs	Y					This entry represents a series of potentially important measures reflecting planning changes to change trip patterns to reduce trip lengths and bring more journeys within the range of walking/ cycling.

4. ESTIMATED SCENARIO COSTS

4.1. INTRODUCTION

This chapter provides indicative estimates of the costs associated with the Low, Medium and High impact scenarios described for EV uptake and bike/e-bike uptake.

The ranges quoted are intended only to provide indicative ranges to allow measures to be compared with one another. They should be treated with caution as they include considerable uncertainty for a number of reasons, including the following:

- » The scale of intervention required to achieve the EV and bike/e-bike uptake is uncertain as it depends on behavioural responses which vary by individual, organisation and community. For instance it is not possible to be certain about what will be required to encourage people to switch to EVs ahead of the sales ban in the context of current public uncertainty over cost, range and charging provision leading to the responses to the SMMT survey (undertaken just ahead of the sales ban announcement in 2020) in which over 40% of respondents suggested they would not be ready for an EV by 2035⁶⁸, as referenced in **Chapter 3**. Behavioural responses will also depend on local context, including other transport measures, which are not fully understood at this stage.
- » Costs per intervention also vary by location (for instance the construction costs for a cycle lane would vary according to location and construction complexity).

4.2. ELECTRIC VEHICLE UPTAKE SCENARIOS

Table 4.1 provides indicative ranges for the costs for the Low, Medium and High scenarios for EV uptake. The last column summarises the main inputs to the costs for each scenario which are based on the following key assumptions:

- » Significant financial incentives would be required for the purchase of each vehicle in addition to the existing government grants of 35% of purchase costs (to a maximum of £2,500 for electric cars, £3,000 for vans of 2.5 to 3.5 tonnes and £6,000 for vans of 3.5 tonnes), as well as £350 towards a home charger⁶⁹ (which are all assumed to contribute to the Baseline trend in EV uptake). Table 4.1 shows the assumptions made about the support provided for each new vehicle (based on current grants and recent research⁷⁰) which might be provided as a grant or lease subsidy or in another form;
- » A private or workplace charger would be fully subsidised for each vehicle (costs derived from data from the Department for Transport (DfT)⁷¹;
- » A number of public chargers would be provided at key destinations in Leiston, including a proportion of rapid chargers to help alleviate range anxiety and provide options for residents without dedicated home parking (costs derived from data from the DfT); and
- » Staff time would be required throughout the time period to raise awareness, administer the financial support and facilitate measures to improve freight logistics and transfer some deliveries to electric vans.

The costs are based on increasing levels of financial support for vehicle ownership/use to increase levels of uptake between the Low, Medium and High scenarios. The support is expressed in terms of a grant per vehicle for simplicity but could be used in other ways, for instance subsidised vehicle leasing or support for shared ownership/mobility as a service provision. As outlined above the High impact scenario implies that over 40% of cars being purchased in Leiston between 2022 and 2030 would need to be BEVs. Achieving this level of increase in uptake would be likely to need additional measures to overcome resistance to EV ownership and to change vehicle usage and ownership patterns.

The costs estimated assume that no upgrade to the local electricity Distribution Network is required to support the level of vehicle charging implied by the scenario. If upgrades were required, they would be likely to add substantially to the scenario cost.

⁶⁸ Survey for SMMT by Savanta ComRes who interviewed 2,185 adults online in the UK, filtering to those who hold a driving licence, between 21-24 August 2020. Data were weighted to be demographically representative of the UK by age, gender, region and social grade. <https://www.smmmt.co.uk/2020/09/billions-invested-in-electric-vehicle-range-but-nearly-half-of-uk-buyers-still-think-2035-too-soon-to-switch/>

⁶⁹ Grants currently available are detailed on <https://www.gov.uk/plug-in-car-van-grants>

⁷⁰ For instance SMMT recently suggested tax incentives equivalent to approximately £6000 would encourage increased EV uptake <https://www.smmmt.co.uk>

⁷¹ DfT, 2019, Electric Vehicle Charging in Residential and Non-Residential Buildings.

Table 4.1: Indicative cost ranges for EV uptake scenarios

Scenario	Indicative cost range (undiscounted)	Comment
Low	£2 - £5 m	» Additional £1,500 grant for cars, £3,000 for vans+Charging point for each EV
		» Staff time for awareness raising, scheme admin (including freight logistics improvements)
		» 10 public chargers (3 rapid)
		» 25% of buses on local routes electrified
		» No allowance for upgrade to electricity distribution network
Medium	£5 - £10 m	» Additional £3,500 grant for cars, £7,000 for vans+
		» Charging point for each EV
		» Staff time for awareness raising, scheme admin (including freight logistics improvements)
		» 20 public chargers (7 rapid)
		» 50% of buses on local routes electrified
		» No allowance for upgrade to electricity distribution network
High	£10 - £15 m	» Additional £6,000 grant for cars, £12,000 for vans+
		» Charging point for each EV
		» Staff time for awareness raising, scheme admin (including freight logistics improvements)
		» 30 public chargers (10 rapid)
		» 75% of buses on local routes electrified
		» No allowance for upgrade to electricity distribution network
Theoretical max	Not costed – assumed undeliverable	» Assumes all traffic within the town (through and from and to all destinations) is by EV – considered undeliverable without wider change beyond Leiston.

4.3. BIKE AND E-BIKE MEASURES

Table 4.2 provides indicative ranges for the costs for the Low, Medium and High scenarios to support bike/e-bike uptake. The last column summarises the main inputs to the costs for each scenario. As outlined above, costings are very broad ranges as it is difficult to predict what will be required to encourage people to change behaviour.

The key inputs to the cost assumptions were:

- » Average unit cost for segregated cycle ways derived from DfT⁷² and used by Sustrans⁷³;
- » Evidence from European experience quoted by the Transport for Quality of Life⁷⁴ indicating that grants of £250 and above are sufficient to encourage e-bike uptake;
- » Costs of cycling hubs and charging points (from DfT⁷⁵);
- » Estimated length of cycle lanes (from Google maps);
- » Estimated number of households and employees, from local population data⁷⁶ (for potential bike grant uptake).

⁷² DfT, 2017, Typical Costings for Ambitious Cycling Schemes.
⁷³ Sustrans, 2019, Common misconceptions about active travel investment.
⁷⁴ Transport for Quality of Life, 2019, The Case for a UK Incentive for E-bikes. A review of European experience for the report suggested that incentives of £250 and above per bike are effective.
⁷⁵ DfT, 2017, Typical Costings for Ambitious Cycling Schemes.
⁷⁶ Data obtained from the Suffolk Observatory, <https://www.suffolkobservatory.info/>

Table 4.2: Indicative cost ranges for bike/e-bike uptake scenarios

Scenario	Indicative cost range (undiscounted)	Comment
Low	£5 - £10 m	» Cycle lane to Saxmundham and 1 km within Leiston » £350 grant per bike » 4 cycle storage/charging hubs » Staff time for awareness raising and administration
Medium	£8 - £15 m	» Cycle lane to Saxmundham and Sizewell (improvement) and 2 km within Leiston » £500 grant per bike » 6 cycle storage/charging hubs » Staff time for awareness raising and administration
High	£10 - £20 m	» Cycle lane to Saxmundham, Sizewell (improvement) and Coldfair Green and Aldringham and 3 km within Leiston » £700 grant per bike » 8 cycle storage/charging hubs » Staff time for awareness raising and administration

5. CONCLUDING SUMMARY

Transport is recognised to be one of the most challenging sectors to decarbonise. The current transport system is highly dependent on emissions intensive fossil fuels and making changes to the system is challenging for a number of reasons. These include the fact that:

- » The transport system has a number of complex interactions with the community and economy;
- » Each transport measure can have a range of impacts (for instance on accessibility to jobs and services and/or air quality); and
- » The scale of impacts of measures are highly dependent on behavioural responses from individuals and organisations which can be hard to predict and typically vary according to local context.

Developing an evidence based integrated transport plan is therefore the most effective way to deliver actions that are specified to suit the local context and to achieve rapid decarbonisation as well maximising other potential benefits and minimising potential disbenefits.

It is therefore recommended that the first step on the transport road map to Net Zero Leiston is to undertake a comprehensive review of local transport conditions and use the findings to inform the development of an integrated transport plan, linking in where relevant to the work being undertaken to support the Suffolk Climate Emergency Plan, including the proposed update to the Suffolk Local Transport Plan. The Leiston review will facilitate the development of a more detailed road map and provide the context for specifying the supporting measures required to deliver the measures shortlisted by the Net Zero Leiston working group i.e. accelerated EV and bike/e-bike uptake.

The shortlisted measures are likely to play a key role in the roadmap to Net Zero Leiston and the scenarios set out in in **Chapters 3 and 4** were developed to provide an indication of the potential scale of their impact. Table 5.1 and Table 5.2 summarise the estimated emissions impact and indicative cost ranges respectively for the Low, Medium and High scenarios specified.

Table 5.1: Estimated CO₂e emissions impact EV and bike/e-bike uptake scenarios in 2030 relative to the baseline (tonnes CO₂e p.a.)**

Scenario	EV uptake	Bike/e-bike uptake ⁷⁷	Combined EV and bike/e-bike uptake
National action	140	0	140
Low*	240	20	250
Medium*	300	40	330
High*	410	50	450

**Low, Medium and High scenario emissions impacts all include the impacts of national action plus the further uptake described above

**Note that totals may not sum due to rounding

Table 5.2: Indicative cost ranges for EV and bike/e-bike uptake scenarios (£ mill, undiscounted)

Scenario	EV uptake	Bike/e-bike uptake	Combined EV and bike/e-bike uptake
Low	£2 - £5 m	£5 - £10 m	£7 - £15 m
Medium	£5 - £10 m	£8 - £15 m	£13 - £25 m
High	£10 - £15 m	£10 - £20 m	£20 - £35 m

Both sets of measures would require ambitious levels of behaviour change from individuals and organisations in Leiston (in terms of vehicle purchase and use choices and levels of cycling). The scale of change would be likely to require financial incentives as well as the provision of sufficient good quality infrastructure. The range of the cost estimates in Table 5.2 reflects the degree of uncertainty over the level of investment that would be required to achieve a projected level of behavioural response. The uncertainty would be reduced if the measures were introduced in the context of the wider transport plan and a review of local transport conditions.

The figures in Table 5.1 show that, despite the scale of change required, the emissions reductions impact of the measures are relatively modest compared to the total Baseline transport emission of 3,840 tonnes of CO₂e in 2030. The EV uptake scenarios reduce emissions by between 6% and 10% relative to the Baseline and the cycling scenarios reduce emissions by less than 2%. The combined High scenario reduces emissions by approximately 12%.

The limited scale of impacts reflects a number of aspects of the challenge of decarbonising transport including the fact that measures focussed on the travel of the residents, employees and business in an individual town are only able to influence a proportion of the traffic and emissions in the area and that updating the road vehicle fleet is a relatively difficult slow process, particularly when undertaken at the local scale.

The measures are also less effective when considered on a standalone basis, as presented above. Wider measures in the integrated transport plan would help to optimise carbon emissions savings, both within Leiston and beyond.

The wider transport plan would also be important in optimising the wider impacts of the shortlisted measures. Valuable wider benefits include air quality improvements due to reduced emission of local pollutants caused by the change in vehicle type and reduction in car based travel. In supporting EV uptake, it will be important that the wider plan includes measures to avoid a ‘rebound effect’ whereby people are encouraged drive more when using an EV, due to the lower running costs. Without demand management measures, rebound has the potential to cause a significant increase in vehicle kilometres travelled with negative impacts for traffic levels and associated congestion and severance effects.

Additional benefits of successful cycling measures include significant health benefits associated with improved physical fitness of the cyclists and associated economic benefits of reduced sickness and absence. These impacts can be attributed a monetary value (using the WHO’s HEAT tool⁷⁸) and typically play a key role in making the business case for cycling schemes

Good quality cycle infrastructure could also lead to increased leisure and economic activity in the areas served. This impact, in conjunction with wider measures in the plan, could become a reinforcing trend towards localisation of activity, of the type occurring in Transition Towns such as Totnes⁷⁹. Increased local activity in the town could develop a virtuous circle of increasing the level of activities and services provided within Leiston, further increasing the proportion of trips made to local destinations, bringing them within the range of cycling (or walking). In addition to a range of wider benefits such as supporting the local economy, this process of localisation would in turn reduce longer car trips to and from Leiston, contributing to greater emissions reductions and strengthening Leiston’s status as a Net Zero exemplar.



⁷⁷ The bike/e-bike uptake measures have a larger impact when applied alone (i.e. without the EV uptake measures), as a higher proportion of the vehicle kilometres removed due to mode switch are petrol and diesel and therefore more emissions intensive. However, the results are presented rounded to the nearest 10 tonnes given the levels of uncertainty involved and the differences are not visible once rounding has occurred.

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⁷⁸ [HEAT v4.2 \(heatwalkingcycling.org\)](#)

⁷⁹ <https://www.transitiontowntotnes.org/about>

CHAPTER: TRANSPORT SOLUTIONS



CHAPTER 18

AGRICULTURE SOLUTIONS

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This chapter discusses the extent to which agricultural or land use measures could reduce the estimated 250 to 300 t CO₂ that agriculture represents of the total CO₂ emissions in the Net Zero Leiston (NZL) project area. In making such an assessment two general points are important.

Agriculture is currently responsible for some 10% of total UK greenhouse gas (GHG) emissions (Defra, 2019). However, this share varies between GHGs, with agriculture being the source of 49.3% of Methane, 69.8% of Nitrous Oxide and only 1.6% of Carbon Dioxide (CO₂) emissions. Largely because of this, most publications on agricultural mitigation measures focus on Methane and/or Nitrous Oxides, with the effectiveness of measures presented in terms of reductions in CO₂e (CO₂ equivalent). This limits the amount of research that can be drawn upon to assess only changes in CO₂ emissions.

A second consideration is that the impact of many measures will vary according to the specifics of the agricultural enterprise (e.g. soil types, crops grown, livestock holdings, machinery and cultivation methods use etc). Since information on several of these characteristics is currently lacking for the NZL project area there are limits on the precision with which the effects of measures can be estimated. This document therefore seeks to identify the magnitude of impact from different types of measure and identify a rough priority order in which they should be considered. There are several software tools that have been developed to estimate farm carbon budgets and a relevant next step would be survey work to collect farm-level information and assess options using one of the following:

- » Cool Farm Tool (<https://coolfarmtool.org/>)
- » Farm Carbon Toolkit (<https://www.farmcarbontoolkit.org.uk/>)

The remainder of this chapter first considers mitigation measures related to agricultural sources of CO₂ and then examines the impacts of land-use changes. Insights from these two sections are then brought together to suggest priorities in a plan to reduce CO₂ emissions as part of the NZL project.

AGRICULTURAL SOURCES OF CO₂ EMISSIONS

The main sources are combustion (both stationary and mobile) and via applications of fertilisers (liming and urea). Within the UK, combustion sources account for 79% of CO₂ emissions and fertiliser applications the remaining 21% (Defra, 2019). Issues related to combustion are given limited attention in the agricultural research literature, Buckwell (2019, p.12) noting:

“The challenge for farm (and forest) CO₂ emissions from tractor and other mobile machinery, and power, cooling and heating (e.g. crop drying) is essentially no different to the considerations for decarbonising transport and power in other business sectors.”



The extent to which CO₂ emissions from heating/cooling on farms could be reduced depends on what is currently in place, but options could include the replacement of oil or gas with low-carbon electricity, biomass boilers, solar water heating or heat pumps.

For machinery, a key consideration is the extent to which diesel can be replaced by a high biodiesel blend or electricity. Many machinery manufacturers (e.g. John Deere, New Holland) now offer engines that can run biodiesel, though sometimes the blend is limited (e.g. 20%) and there have been instances of farmers reporting performance problems associated with such fuels (Tasker, 2019). Electric tractors are now becoming commercially available (see e.g. <https://www.fendt.com/int/fendt-e100-vario>), though currently at the lower end of the performance range.

For both stationary and mobile combustion there should be scope to substantially reduce CO₂ emissions on NZL project area farms (e.g. perhaps by over 100 t CO₂), but the extent of any such reduction will depend on what the farms are currently doing, so better knowledge in this respect is important.

Measures such as manure planning, controlled release fertilisers or other forms of precision agriculture as cost-effective ways for farms to reduce CO₂ emissions (Newell Price et al., 2011; Vivid Economics and UK CEH, 2020). A drawback, however, is that the effect on CO₂ emissions is likely to be relatively small, so even if major improvements in fertiliser use efficiency were achieved it is unlikely to result in more than a 20 t CO₂ reduction in the NZL project area.

LAND-USE CHANGE AND CO₂ EMISSIONS

Although the net contribution of land-use change to total carbon emissions may appear based on the BEIS local authority statistics and the National Atmospheric Emissions Inventory (NAEI) gridded data it needs to be recognised that this reflects a combination of emissions from land use categories such as croplands and settlements and sequestration from grassland and forests. There is consequently the potential for changes in land use to make substantial contributions to meeting objective such as Net Zero emissions (CCC, 2020).

Estimating the effects of land-use changes on carbon emissions is a complex exercise (see CEH and Rothamsted Research, 2018), but simple approximations can be made by comparing estimates of net emissions with areas of land to derive per hectare values. Table 1 presents two such sets of approximations, one based on UK Greenhouse Gas Inventory data (Ricardo Energy & Environment, 2020) and the other using BEIS statistics and CROME agricultural information for East Suffolk (BEIS, 2020; Rural Payments Agency 2020).

Table 1: Estimates of CO₂ emissions for land use categories.

Category	UK Emissions t CO ₂ e / Ha	East Suffolk Emissions t CO ₂ / Ha	UK Change from Cropland t CO ₂ e / Ha	East Suffolk Change from Cropland t CO ₂ / Hectare
Forest Land	-5.09	-8.25	-7.44	-8.62
Cropland	2.35	0.37	0.00	0.00
Grassland	-0.65	-0.70	-3.00	-1.08
Wetlands	1.78	0.00	-0.58	-0.37
Settlements	4.08	2.11	1.73	1.74

There are some obvious differences between the estimates but particularly when they are presented as changes from cropland (the two rightmost columns) the general trends are quite similar. This provides some confidence that even though the calculations are simple they provide an indication of the likely magnitude of change.

Based on these estimates it is possible to evaluate the impact of changes in land use in the NZL project area. The CROME statistics for 2019 identify 690 hectares of cropland in the project area so Table 2 shows the impact of changing the land use on 5% of this (35 hectares) using both set of estimates. These results suggest that changing 35 hectares of cropland to forest would result in an emissions reduction of some 260 to 300 t CO₂, while conversion to grassland would produce a reduction of up to 100 t CO₂. Many factors could influence these changes (e.g. soil type, type of forest, grassland management) but they give a sense of the magnitudes involved.

Table 2: Estimated effect of CO₂ emissions in the NZL project area from a 5% reduction in cropland.

Category	5% Reduction in Cropland UK Estimates t CO ₂ e	5% Reduction in Cropland East Suffolk Estimates t CO ₂
Forest Land	-260.56	-301.85
Cropland	0.00	0.00
Grassland	-104.89	-37.63
Wetlands	-20.15	-13.11
Settlements	60.50	60.85

Another important land use consideration is the management of areas of peat. Peatlands are the largest natural terrestrial carbon store and according to the IUCN store more carbon than all other vegetation types in the world combined. However, the condition of peatlands is strongly related to land use and areas

that have been cultivated or drained can be substantial GHG emitters (Evans et al., 2017; ONS, 2019). This is relevant to the NZL project because a map published by Natural England (2010) identifies a substantial area of deep peat (approximately 100 hectares) largely corresponding with the boundary of the Sizewell Marshes SSSI (see Figure 1). If this peat resource is in poor condition or damaged it could emit substantial amounts of CO₂, equally if restored or in good condition it could be an important means of sequestration. Either way, this element of natural capital needs consideration in the NZL plan.

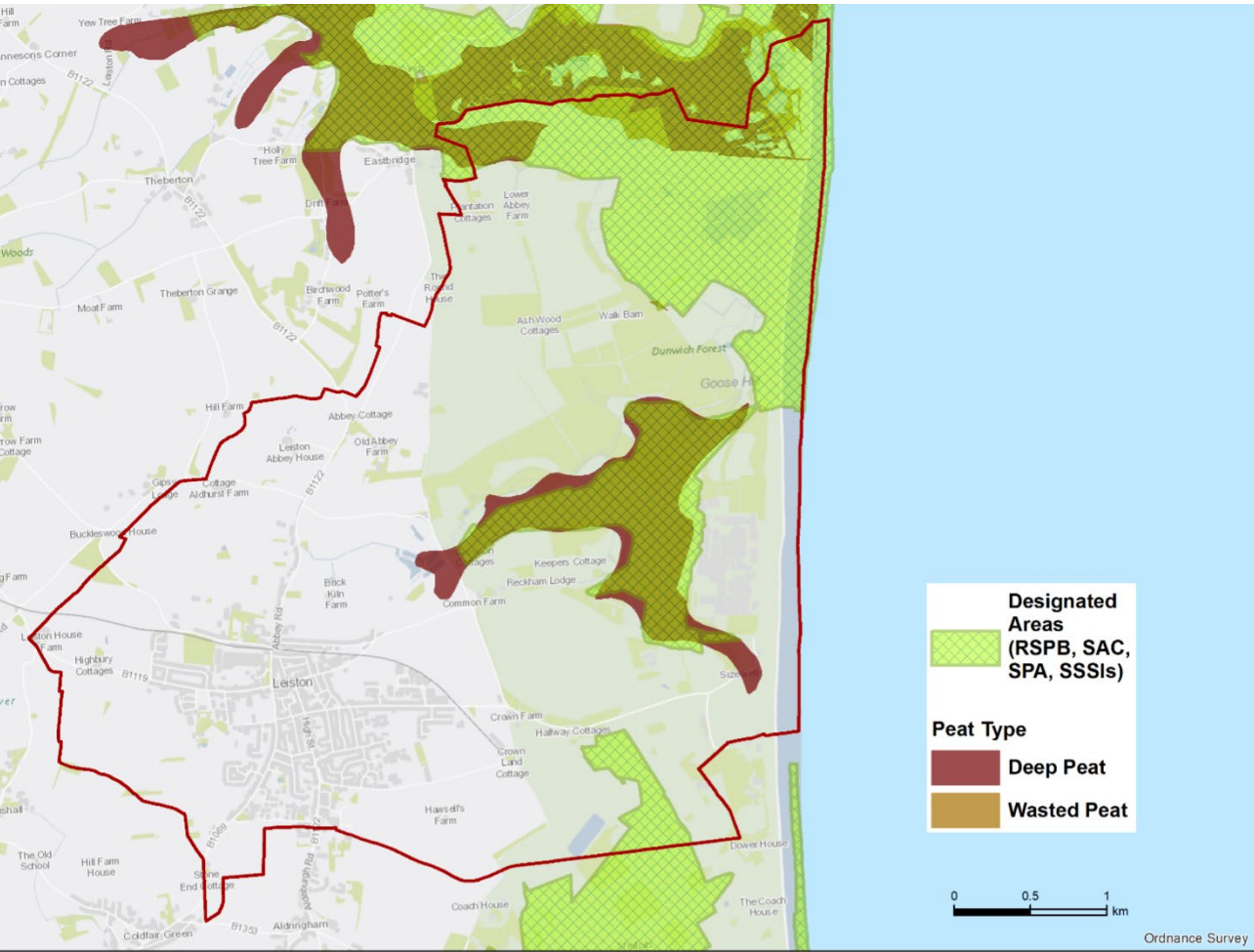


Figure 1: Peat resources and designated conservation areas in the NZL project area.

EVALUATING COSTS AND BENEFITS

An analysis recently conducted by Vivid Economics and UK CEH (2020) for the Committee on Climate Change (2020) provides a useful insight into the likely lifetime costs and benefits of different options. Table 3 summarises some relevant results, indicating for each option:

- » Private Costs – to land managers for implementing each option
- » Private Benefits – revenues to land managers
- » Social Costs – wider benefits to society (including carbon sequestration, recreation)
- » Marginal Abatement Costs per t CO₂

Table 3: Cost and benefits of different land use and management options.

Mitigation Option	Private Costs £/ Hectare	Private Benefits £/ Hectare	Societal Benefits £/ Hectare	Abatement Cost £/ t CO ₂
New coniferous woodland planting	£26,542	£5,517	£151,125	–£212
New broadleaved woodland planting	£28,020	£2,426	£115,540	–£73
Miscanthus	£49,698	£18,225	£90,753	£48
Short rotation forestry	£33,358	£2,679	£2,617	£2,145
Silvoarable agroforestry	£3,518	-	£4,893	£96
Silvopastoral agroforestry	£2,763	£73	£1,899	£186
Hedgerow expansion	£1,932	£5	£350	£448
Restoration of upland peatland	£4,362	-	£17,734	£24
Restoration of lowland peatland	£5,586	-	£18,447	£45
Restoration of woodland to bog	£9,075	-	£17,441	£117
Crop and soil management	–£58	-	£373	–£203

Source: CCC (2020) Tables 3.3 and 3.4. Costs and benefits are calculated as Net Present Values.

The results in Table 3 show that many land use options reduce CO₂ at a marginal abatement cost of less than £100/ t CO₂. As a category, low crop and soil management practices have negative marginal abatement costs, avoiding carbon emissions while also saving private costs. Conifer and woodland planting have negative abatement costs because of the associated carbon sequestration. Other measures such as peat restoration and Miscanthus also have relatively low CO₂ abatement costs, although the latter has much higher private costs.

Based on the preceding discussion the following are recommended, in order of feasibility and likely effectiveness, as measures to account for the 250 to 300 t CO₂ attributed to agriculture in the NZL project area.

- » Improvements in fertiliser management and application practices
- » Decarbonisation of stationary farm combustion (heating and cooling)
- » Greater use of biodiesel or electrical farm machinery
- » Conversion of some cropland to forestry or grassland
- » Investigation of the scope for improved peatland management

A combination of these measures is certainly capable of producing a 300 t CO₂ reduction and potentially could make a larger contribution to meeting the Net Zero objective. To assess the most appropriate balance requires more information on farm characteristics and will certainly necessitate financial support to be implemented.

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CHAPTER 19

CARBON REMOVAL SOLUTIONS

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1. INTRODUCTION

As part of the Net Zero Leiston roadmapping project, three carbon reduction scenarios have been identified. All require an element of increased greenhouse removal (GGR) to achieve Net Zero annually. The scenarios are:

- » Max-Max
- » Reasonable Max
- » Alignment to Carbon Budget Case

It has been estimated that the LULUCF sector in Leiston is responsible for an overall removal of CO₂ from the atmosphere in the order of 3,725 tonnes per year, based on analysis of available spatial data and cross-referenced with BEIS local authority estimates. As no land use changes are underway and there is no recent history of land use change, the Business as Usual (BAU) case is taken to be a continuation of the use of the land in the same manner as since 2007, with the same yearly CO₂ removal rates continuing after 2030. For the additional required sequestration, a shortlisted range of measures is considered. These are:

- » Tree planting;
- » Direct air capture;
- » Biochar;
- » Reduced tillage;
- » Green roofs and façades; and
- » Other land use measures.

This chapter is structured to present an overview each shortlisted measure, including information about the magnitude of potential removals, cost and some commentary on the feasibility, timescales and expertise required to implement the measure.

In section 8 of this chapter, the two scenarios requiring the highest and lowest removals are addressed with an indicative range of the shortlisted measures and an idea of potential cost is given.

In section 9, the parity between nature positive solutions and carbon removals is highlighted, enabling Net Zero Leiston to enhance biodiversity and reduce carbon emissions concurrently.



2. TREE PLANTING

2.1. OVERVIEW

Planting and growing new trees leads to CO₂ being removed from the atmosphere and stored in living biomass, dead organic matter, and soils. Leiston currently has 268 ha woodland cover, around 15% of the total land area.

2.2. CARBON REMOVALS

Data collated by Natural England suggests broad-leaved woodland greenhouse gas removal rates of 11 tCO₂ per hectare per year [1].

The Committee on Climate Change (CCC)'s 'Land use: Policies for a Net Zero UK' report [2] recommends UK forestry cover is increased from 13% to at least 17% by 2050 as part of the country's Net Zero solution. Increasing Leiston's woodland cover to 17% (planting an additional 36 ha of woodland, roughly 60,000 trees [3]) would remove **396 tCO₂ per year**.

The ambitious Speculative scenario set out by the CCC would see 30% of UK agricultural land released for afforestation. Applying this rate of afforestation with new broadleaved woodland in Leiston (217 additional hectares, 350,000 trees, on currently agricultural land) could generate additional removals of **2,384 tCO₂ per year**.

If land currently used for crops is converted to woodland, this also provides the additional benefit of removing a source of emissions.

It is important to note that sequestration by trees occurs over a long period of time, and that afforestation is not a permanent sequestration mechanism. After planting, maximum sequestration rates occur at around year 10, continuing a further 10-90 years, after which time the trees are mature and no longer draw down carbon.

Any measure which relies on the biosphere for removal and storage also presents the challenge that vegetation is relatively ephemeral and CO₂ can be released back into the atmosphere [4]. Long-term maintenance of the woodlands must be guaranteed, and thought must be given to how wood products will be utilised. For example, burning wood products for fuel without carbon capture and storage (CCS) will release the stored carbon to the atmosphere. Use of wood as a construction material is important in this regard. Work to develop skills and markets for timber products in the long-term may be required.

2.3. COST

The CCC estimates the private net present value (NPV) of planting trees at -£21,000 per hectare for conifers, and -£25,600 per hectare for broadleaves, assessed across a 100-year life [2]. The largest element of this cost is land acquisition.

During this time period, revenue would not be available from timber as the woodland would only reach maturity towards the end of the period. From 30 years after planting, some revenue from thinning (selective removal of trees to improve growth rate and health of the rest of the woodland) would be available.

Grant aid is available for establishing new woodland in England [5]. This includes up to 80% of the standard capital costs for trees, tree guards, fencing and gates, capped at an average of £6,800 per hectare across the area, plus a contribution of 40% of the costs of roads and tracks.

2.4. FEASIBILITY

This measure could be rapidly deployed in the sense that no specific technology needs to be developed; afforestation work is already happening around the UK. There are no significant energy or water requirements, and relatively few GHG emissions associated with planting and management.

The key challenge with this measure is availability of land for afforestation. Engagement work will be needed with landowners in Leiston, and other members of the local community, to understand the appetite for woodland planting and diversification into agro-forestry. Woodland planting does provide many other social benefits including recreation and health, air quality improvements and flood risk management. The CCC estimates £89,900 social value per hectare associated with broadleaved woodland [2], however these benefits are not realised immediately due to the slow nature of woodland establishment.

3. DIRECT AIR CAPTURE

3.1. OVERVIEW

Direct air capture (DAC) systems are technologies which remove CO₂ from the air. They work by taking in ambient air, either naturally or using fans, and chemically binding the CO₂ in the air with a filter before expelling the depleted air [6].

Following removal from the air, the captured CO₂ is transported from the system for utilisation or storage. Utilised carbon typically returns to the atmosphere in a relative short period of time, however options for storage of CO₂ can lead to long residence times. Engineered process options for storing captured CO₂ include:

- » Geological storage (e.g. oil fields, coal seams, saline-filled basaltic rocks);
- » Supported amine absorption; and
- » Lime-soda process (precipitation of calcium carbonate in water).

The high cost of the DAC process is the main barrier to its use, however system costs could be lowered significantly with commercialisation in the 2020s. Systems can be categorised as high temperature aqueous (HT DAC) solutions, or low temperature solid sorbent (LT DAC) systems. LT systems have lower energy demands and are therefore likely to be a preferred technology.

3.2. CARBON REMOVALS

Theoretically, a DAC plant could be sized to meet any demand. Existing operational pilot plants of an industrial scale claim varying capacities of carbon removals [7]. Climeworks, based in Zurich, is a well-known low temperature solid sorbent-based DAC company who claim to capture 900 t CO₂ year⁻¹ at a current cost of \$600 (£450¹) per tonne, projected to reduce to around \$100 (£75) per tonne within the next decade. The annual removal capacity of one Climeworks standard-sized unit (around the size of a shipping container) fitted with six filters is 300 tonnes of CO₂.

It is important that energy used to power the system is low-carbon, otherwise this would counteract the emissions captured [6].

3.3. COST

Estimated CO₂ capture costs of LT and HT DAC systems (powered by hybrid PV-Wind-battery systems, at 8,000 full load hours per year, based on a conservative scenario) are set out below on a per decade basis from 2020-2050 [6].

Table 1 - DAC systems costs per tCO₂

DAC Options	2020	2030	2040	2050
Cost (£/t CO ₂) – LT DAC Without free waste heat	200	90	60	50
Cost (£/t CO ₂) – LT DAC With free waste heat	120	55	35	30
Cost (£/t CO ₂) – HT DAC Without free waste heat	240	120	80	60

3.4. FEASIBILITY

DAC incorporates a range of technologies at varying stages of readiness for implementation. Early deployment is likely by 2030, with large scale deployment possible by 2050 [4].

It is necessary for DAC systems to be located at sites of abundant and very low-cost renewable electricity in order to maximise net CO₂ capture and keep costs at a minimum. DAC systems also benefit from being located near to a source of free or very low-cost waste heat, which further brings down costs. An additional challenge exists around how to deal with the resultant high-purity CO₂ stream.

4. BIOCHAR

4.1. OVERVIEW

To produce biochar, biomass is burned in the absence of oxygen (a process called pyrolysis). A very stable organic material is produced, which can be applied to agricultural soils and provide a long-term store for carbon [2]. There may also be co-benefits to soil fertility and increased crop yields.

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¹ Based on the average exchange rate in the year the estimate was made, 2018.

4.2. CARBON REMOVALS

Soil carbon storage can vary considerably depending on soil type and profile, and the characteristics of biochar materials vary depending on what the biochar is made from.

It is estimated that, on a life cycle basis, biochar produced from different crops can remove between 2.1 and 4.8 tCO₂ per tonne of biochar [8] [9]. The total carbon sequestration potential then depends on the application rate to land. Studies have shown that biochar can have positive effects on crop yields with application rates of 5-50 tonnes per hectare, as long as it is accompanied by appropriate nutrient management [10] [11]. As a stable form of carbon, biochar remains in the soil for many years and is therefore not re-applied once the total application level has been reached.

With 722 ha of annual cropland, Leiston has the potential to sequester a large quantity of carbon through biochar application. Applying 50 tonnes per hectare could lead to removals of 170,000 tCO₂.

4.3. COST

Estimates for costs of production to application of biochar in the UK vary from \$230 (£143²) profit to \$330 (£206) cost per tCO₂ [12].

4.4. FEASIBILITY

Biochar is a theoretically established GGR method which is not widely used due to current availability of biomass and pyrolysis facilities. It has not yet been demonstrated at scale in the UK [2]. It is estimated that this approach could be implemented at a large scale before 2030 [13], however the availability of biomass resource is likely to continue to present a limitation in the UK [14]. Although land is required for both growing biomass and for spreading, the land for spreading does not have to change land use and biomass growth could be combined with afforestation. The pyrolysis process itself produces energy for use.

In the UK, the Environment Agency's low risk waste position statement (LRWP 61) allows up to 1 tonne of biochar to be spread per hectare, per year. Quantities above this level would require an environmental permit. It is noted that the CCC does not include biochar in its Net Zero scenarios, due to concern about unforeseen long-term side-effects [2]. However, they do support research to better understand these. Once such concern is that biochar application may lead to increased emissions of other greenhouse gases, such as N₂O.



² Based on the average exchange rate in the year the estimate was made, 2011.

5. REDUCED TILLAGE

5.1. OVERVIEW

Soil tillage practices have a substantial impact on the greenhouse gas balance in soils. Arable cropland is likely to be the only land use in the Leiston area which is a net emitter of CO₂ rather than contributing to removals. Hanging agricultural practices such as tillage or crop rotations can work to increase soil carbon content, either by reducing emissions or turning the soil into a carbon sink. This is the result of reduced soil porosity under zero tillage conditions, which reduces the respiration of aerobic organisms by reducing movement of water and air through soils.

5.2. CARBON REMOVALS

Studies suggest that conventional tillage systems result in 26-31% higher net global warming potential compared to zero tillage systems [15]. This is despite increased emissions of N₂O which can result. It has been suggested that changing from conventional tillage to zero tillage might lead to carbon sequestration [16], however there have been conflicting findings [17], and it typically considered an emissions reduction measure rather than a greenhouse gas removals measure.

Emissions from agricultural soils are estimated at 65 tCO₂ per year in the baseline scenario. Reducing these by 25% would lead to savings of 16.25 tonnes CO₂ per year.

5.3. COST

Costs of implementation on croplands and grazing lands range from a saving of \$12 (£8.89³) per tCO₂ to a cost of \$3 (£2.22) [14].

5.4. FEASIBILITY

The practices required are typically well understood by farmers and land managers, with some already used in places. Mostly don't require new machinery

³ Based on the average exchange rate in the year the estimate was made, 2016.



or infrastructure. Barriers to implementation currently lack of understanding of the benefits, and lack of policy support [4]. Benefits of this approach include the fact that land use change is not required, and practices may also increase soil fertility, workability and crop yield.

It should be noted that this is not a long-term GGR mechanism, as it is estimated that soil saturation would probably be reached in 10-20 years. Once saturated, the soil is even more susceptible to releasing CO₂ back to the atmosphere if it isn't maintained. Reversibility is the key risk to this approach.

This measure is not compatible with use of biochar, as this must be tilled into the soil.

6. GREEN ROOFS AND FAÇADES

6.1. OVERVIEW

Green roofs and façades (also known as living walls) are vegetated surfaces on building roofs and external walls. Green roofs can be split into two main types; 'extensive' green roofs with substrate depth of less than 15cm, and 'intensive' green roofs with a greater substrate depth [18]. Green façades may be created using climbing plants, by growing plants in substrate on the walls, or by hydroponic (soil-less) systems.

Green roofs need to be installed on roofs pitched at no more than 30° [19]. This means that roofs could not be retrofitted to a typical UK house, which has a pitch of 40-50° [20]. Green façades are likely to be too heavy for a typical home without structural work being undertaken. For this reason, it is likely that only non-domestic buildings in Leiston are likely to be suitable.

6.2. CARBON REMOVALS

Research into the carbon-capturing performance of green roofs has revealed a range of potentials, varying with substrate type and depth, vegetation type and climate [18]. Sequestration rates as high as 36 kgCO₂/m²/yr have been recorded [21], although some studies have found green roofs to actually be net emitters of CO₂ [22]. The average sequestration rate from a range of studies presented in a 2020 summary paper [18] was 8 kgCO₂/m²/year.

Substrate-based green façades typically have a substrate depth half that of a green roof [23] and therefore have less ability to sequester and store carbon. As an approximation, it is assumed the sequestration capacity of a green façade is half that of a green roof, at 4 kgCO₂/m²/year.

Leiston has approximately 71,200 m² non-domestic roof area. If 10% of this had a suitable pitch, this measure could draw down around 57 tCO₂e. With only a relatively thin layer of substrate involved in a green roof, saturation is likely to be reached within a decade. After this time, carbon would be stored but not continue to be removed from the atmosphere.

Installation of green roofs and façades, as with any land-use change measure, is not a permanent sequestration measure. Once vegetation and substrate are fully established, they remain a store for sequestered carbon but do not continue to remove it from the atmosphere.

6.3. COST

The cost of installing a green roof in the UK can vary from £50/m² for an extensive sedum roof to £200/m² for a planted intensive roof [19] [24]. This does not include any reinforcement work needed to the structure or roof. Installing 7,120m² green roof could cost £1.5M, giving a high cost per tCO₂ of around £26,000.

Green façades are typically more expensive; the living wall on Edgware Road Underground Station cost £600 per square metre [25]. A reliable irrigation system is essential, with system requiring 5-15 litres per day for a 10m² area. The long-term irrigation and maintenance of these systems is a key expense [25]. It is considered that the expense of green wall systems, the low potential applicability to existing buildings in Leiston and the low removals potential mean that green façades are unlikely to be a preferred option.

6.4. FEASIBILITY

Green roofs use existing technology and have been used successfully for several decades.

Intensive roofs consist of a thick soil layer and need to be accessible for maintenance. They require much more care than extensive systems, and place a significant weight on the building; substantial roof support is required. Lightweight extensive sedum systems are cheaper to install and easier to maintain, however they do not sequester as much carbon. Green façades pose similar challenges around structural soundness. A sub-construction is placed on the façade, onto which modular elements are attached.

The feasibility of retrofitting green roof and façade systems depends on the availability of suitable buildings.

Whilst green roofs and façades retrofitted to existing non-domestic buildings may bring biodiversity and

wellbeing benefits, it is unlikely that they would provide significant carbon removal potential due to the low number of suitable buildings in Leiston. They are also likely to be expensive per tCO₂ removed. This type of measure is likely to be more applicable in an urban environment with large building surface area, and in areas of new development where green roofs and façades can be designed in.

7. OTHER LAND USE MEASURES

7.1. IMPROVING LAND MANAGEMENT PRACTICES

Improved woodland, wetland and other land management practices can increase the carbon removal and storage potential of that land, both in vegetation and soils. Without a detailed understanding of current land quality and what improvement might be attained, it is not possible to quantify potential carbon removals for these measures. To further understand this, ecological and soil surveys, plus engagement with local landowners and users, would be required to identify opportunities to improve management practices.

7.2. OTHER TYPES OF LAND USE CHANGE

It is not only woodland which sequesters carbon. Wetlands, grasslands and perennial cropland can also lead to carbon removals. However, if land is to be taken from its current use to create a new type of land use for GGR, woodland is the best land use type to choose. Wetland may remove more GHG, however, they cannot be created from a different land use. Carbon benefits from other land use changes have not been considered further in terms of calculation; they may provide benefit, however this is likely to be less than that generated by tree planting.

8. REMOVALS SCENARIOS

8.1. INTRODUCTION

Two scenarios are presented to indicate a potential mix of removal measures, their removal rates, and their capital and/or operational costs spread across the lifetime of the measure.

8.2. MAX-MAX CASE

This scenario represents the maximum possible emissions reductions, requiring annual removals of 5,028 tCO₂ pa to achieve Net Zero carbon. An approach to achieving this is set out in Table 2 in an indicative range of measures. This could achieve removals of 5,183 tCO₂ pa, which would go a little beyond Net Zero.

The scenario increases the cover of woodland from 15% of the total land area to 19%, with tree planting on agricultural land. This is broadly in line with recommendations from the CCC that UK woodland cover should increase to at least 17% [2]. It also includes the application of biochar at a conservative rate on 25% of arable land. Finally, the scenario includes a DAC plant, providing opportunity to implement a demonstration unit of this emerging technology. Green roofs are not included in the mix of measures due to high cost per tCO₂, and reduced tillage because of its relatively low potential for removals.

The potential costs of these measures are also presented, using figures of £/tCO₂ and multiplying by tCO₂e/yr. In actuality the cost of many measures will be front-loaded. There is a great deal of uncertainty around costs, particularly for biochar which has been reported to both bear a cost and produce a net profit in different instances. The range in DAC costs results from different technology types and whether a free supply of waste heat can be sourced.

Table 2 – Scenario 1 – Max-Max Case

Measure	Detail	Net carbon removals ⁴ (tCO ₂ pa)	Likely maximum cost (£ pa)
Baseline	Existing land uses are estimated to provide net removals which are assumed to continue beyond 2030	3,725	0
Tree planting	Increasing woodland cover from 15% to 19% by planting trees on cropland	792	£18,500
	Loss of 72 ha annual cropland for tree planting	6	
Biochar	Application of 1 tonne per hectare per year biochar on 25% of remaining arable land	360	£74,000 ⁵
DAC	A single DAC unit, roughly the size of a shipping container	300	£36,000
Total		5,183	£130,000

⁴ Made up of removals and emissions reductions.

⁵ Some studies have shown biochar application to lead to an overall profit for the landowner.

8.3. CARBON BUDGET ALIGNMENT CASE

Scenario 2 looks to present a reasonable maximum GGR for each measure to achieve the target to Net Zero. It achieves a total removal rate of 7,702 tCO₂ pa, excluding any DAC technology which could theoretically be limitless in capacity.

The scenario uses a higher rate of tree planting than the first scenario, in line with the CCC’s Speculative scenario [2]. Biochar is applied at a conservative rate across all arable land (the carbon savings figure could also be achieved by applying biochar to a smaller area of land at a higher rate). Biochar must be tilled into the soil, meaning that this measure cannot take place at the same time as a reduced tillage system. As biochar has a higher removal rate, it has been preferred over zero tillage. Green roofs are also included in this scenario, though it is noted that they are an expensive option and are likely to only maintain their removal rate for a relatively short period of time (perhaps a decade).

Table 3 – Scenario 2 – Carbon Budget Alignment Case

Measure	Detail	Net carbon removals (tCO ₂ pa)	Likely maximum cost (£ pa)
Baseline	Existing land uses are estimated to provide net removals which are assumed to continue beyond 2030	3,725	£0
Tree planting	Converting 30% agricultural land to woodland	2,384	£55,500
	Loss of 217 ha annual cropland for tree planting	20	
Biochar	Application of 1 tonne per hectare per year biochar on all arable land (remaining after tree planting)	1,061	£220,000
Green roofs	Green roofs on 10% of non-domestic building roof area	57	£140,000
DAC	A DAC plant could be sized to meet any demand	Unlimited	n/a
Total		7,702 ⁶	£415,000

9. NET ZERO LEISTON AND NATURE POSITIVE

When the UK Government first declared a climate crisis in May 2019, it also declared a biodiversity (nature) crisis.

The UK is now one of the most nature-depleted countries in the world. The UK is the worst performing of the G7 nations, the third worst in Europe and 228th in the world in terms of its loss of biodiversity⁷. In the UK, 60% of all monitored species are in decline and 10% are at risk of extinction. These statistics exclude the footprint we export elsewhere.

Leiston is on the edge of an area of outstanding natural beauty⁸ with a plethora of rare and unique species of bird, animal and plant. Leiston, and Suffolk, face the same climate crisis as the rest of the UK, likewise the same biodiversity crisis.

9.1. NATURE MATTERS

Nature matters, not only for its own sake but also for our own. Nature provides the air we breathe, the clean water we drink, the food we eat. As many of us have discovered during the Covid-19 pandemic lock-down, nature also provides an escape, something beautiful that can nourish our wellbeing, both physically and mentally. Nature helps us be more resilient, for example to floods or coastal sea level rise. Nature attracts visitors and supports our tourist economy. Put another way: a healthy planet underpins a healthy society; and, a healthy society is a prerequisite for a healthy economy.

9.2. NATURE POSITIVE

More nature requires us to become nature positive. Fortunately, this is now increasingly recognised. In 2019, the UK Government committed to protecting 30% of the UK’s land by 2030⁹. Similarly in 2020, Suffolk County Council agreed a Biodiversity motion, which states that it “resolves to implement a biodiversity strategy setting out how to increase Suffolk’s biodiversity, halt the loss of habitats and species, and reintroduce declining species in suitable locations.”. To achieve these goals in Suffolk, everyone has a part to play - rural and urban communities; investment, energy and infrastructure; planning and regulation; politicians and civil society.

⁷ <https://www.rspb.org.uk/globalassets/downloads/about-us/48398rspb-biodiversity-intactness-index-summary-report-v4.pdf>

⁸ Suffolk Coast & Heaths AONB

⁹ <https://www.bbc.co.uk/news/uk-54320030>



⁶ Excluding DAC



Restoring nature not only helps our health and wellbeing and nature, it also helps fight climate change. By locking up carbon in trees, soils, saltmarsh and seas, we can make a tangible and visible difference to reduce the impacts of global warming and help us towards Net Zero.

9.3. GREENHOUSE GAS REMOVALS AND NATURE POSITIVE PROGRAMMES

The carbon baseline assessment for Leiston showed that nature is already removing 24% (=3.7kT CO₂ p.a.) of the current annual emissions from buildings, transport and agriculture. The key is to protect, manage and restore nature.

The climate and biodiversity crises are interlinked so enhancing the natural environment is included in this roadmap alongside the focus on de-carbonisation.

Working with the Town Council, the Net Zero Leiston group will identify potential new programmes for the enhancement of nature - for example, several of the carbon reduction measures noted in this chapter, urban tree planting, woodland planting, restoration of meadow and water-meadow, green roofs and facades, low-carbon intensive farming, green infrastructure to help drainage, reducing farmland tilling to reduce the amount of carbon released and enhance its biomass.

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LOCATION SPECIFIC ELEMENTS





CHAPTER 20

NON-CO₂ EMISSIONS

Authored by



carbone 4

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INTRODUCTION

The purpose of this chapter is to give a definition of the non-CO₂ gases, identify the main sources of emissions in the UK context, explain why they are considered negligible in the case of the Net Zero Leiston project, and give overall guidelines on how to calculate a baseline and a reduction target.

NON-CO₂ EMISSIONS DEFINITION AND MAIN CONTRIBUTORS IN THE UK

Non-CO₂ gases emissions contributing to global warming and covered by the Kyoto Protocol include methane (CH₄), nitrous oxide (N₂O) and fluorinated gases (HFCs, PFCs, SF₆, NF₃)

At a national level, it is worth noting that CO₂-equivalent greenhouse gases emissions (all emissions converted into the equivalent amount of CO₂ through the GWP100 metric) are composed of 81% of CO₂ emissions and 19% of non-CO₂ emissions¹.

CH₄ and N₂O are the major non-CO₂ contributors with respectively emissions of 51.5 MtCO₂eq and 20.4 MtCO₂eq (2018), over a total of 85.8 MtCO₂eq for non-CO₂ emissions¹.

Thus, these two gases represent 84% of non-CO₂ emissions in 2018. In consequence we will focus below on these two gases only.

In the UK, main methane emission sources include (% of emissions refer to the year 2018):

- » The agriculture sector, in particular: enteric fermentation and waste from livestock (49% of emissions)
- » Waste management, in particular landfill and waste-water handling (37%)
- » Fugitive energy emissions, in particular: exploration, production and transport of gas (7%)

The main nitrous oxide emissions sources include:

- » The agricultural sector, in particular: direct and indirect soil emissions (mainly due to fertilizers), and livestock wastes (70% of emissions)
- » Waste management, in particular waste-water handling and composting (7%)
- » LULUCF, in particular: direct emissions from changes in soil decomposition following the disturbance of soil in land conversion (7%)

¹ <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>



NON-CO₂ EMISSIONS IN THE LEISTON PERIMETER AREA

BEIS² LA emissions statistics do not provide non-CO₂ emissions data at the regional level.

In the perimeter area defined in **Chapter 2**, no major non-CO₂ emission source has been identified, so the assumed and calculated non-CO₂ emissions are negligible, namely no major livestock activity or landfill.

Leiston is expected to have low non-CO₂ emissions, as agriculture, waste management, gas production/transport and LULUCF are expected to be a very small part of Leiston economic activity.

Therefore, Leiston non-CO₂ emissions are considered to be relatively negligible compared to CO₂ emissions.

METHOD TO ESTIMATE NON-CO₂ LEISTON BASELINE AND TARGET

It is worth noting that in its 1.5°C Special Report, the IPCC highlights that non-CO₂ gases emissions must be reduced rapidly but should not necessarily be equal to zero.

Ideally non-CO₂ emissions should be measured and reduced as much as possible.

In this document, we do not set a specific target for non-CO₂ emissions reduction, as it is considered negligible compared to CO₂ emissions.

However, we suggest below a method for doing so.

First, non-CO₂ emissions in the boundary area should be estimated bottom-up from the main activities which contribute to these emissions - namely agriculture, waste management, energy, LULUCF - and using standard emission factors.

Second, a reduction target must be set for each greenhouse gas.

This reduction target is a trajectory that will decrease continuously over the next century (after 2030, and after 2050). Yet it is not necessary to reach Net Zero emissions, as opposed to CO₂, due to different lifetimes in the atmosphere. CO₂ remains virtually forever in the atmosphere (at human timescale), explaining the need to set a total budget. On the contrary, the lifetime of methane is 9.1 years and nitrous oxide 131 years³. Another reason why no Net Zero targets should be set for non-CO₂ gases is the inexistence of non-CO₂ sinks.

An emission target should be set for each year (or for example each 3-year period), and actual emissions should be compared vs. this target.

To set the target, an option would be to align with the reduction target from IPCC 1.5°C Special Report.

As an example, emission reduction targets are c.-40% and c.-10% in 2030 for methane and nitrous oxide respectively (compared to 2010 levels). Note that these targets depend on the scenario considered; an average target has been selected here.

CONCLUSION

In summary:

- 1. At UK scale, GHG emissions are mainly CO₂ emissions (81%).
- 2. Because major non-CO₂ gases have a relatively short lifetime in the atmosphere compared to CO₂, emissions do not need to be reduced to zero, as opposed to CO₂.
- 3. In the perimeter defined in **Chapter 2**, no major source of non-CO₂ gases has been identified.

For these reasons, Net Zero Leiston will focus on CO₂ emissions reduction and CO₂ removal, and will not include a target for non-CO₂ emissions reduction.

Nevertheless, a non-CO₂ emissions reduction target could be included at a later stage of the project.



¹ <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>

³ IPCC AR5 report





CHAPTER 21

SIZEWELL INFRASTRUCTURE - CURRENT AND POTENTIAL

Authored by



NOVEMBER 2021

INTRODUCTION

The purpose of this chapter is to provide an overview of the linkages that have been considered between the concept of the potential Sizewell energy hub and the Leiston Net Zero initiative. It also details a full carbon lifecycle assessment for Sizewell C, if built, and a similar analysis for Sizewell B which are excluded from the Net Zero Leiston boundary for the purposes of replicability.¹

In this chapter, 'Sizewell' covers a range of facilities or areas of the overall Sizewell facilities, including;

- » Existing Sizewell B station
- » Proposed new Sizewell C station
- » Potential new development associated with Sizewell C (e.g. new industry, data centres etc)
- » Workers accommodation associated with Sizewell C construction

It should be noted any linkages ruled out under the preliminary Route Map are not precluded from consideration as the Net Zero Leiston strategy develops over coming years.

1.1. CURRENT INFRASTRUCTURE

The purpose of the Route Map is to create a replicable model to be utilised by similar towns around the country. The Net Zero Leiston project will be a demonstration of a community taking ownership of its carbon emissions and showing the way to reach Net Zero. Most rural towns do not have large infrastructure like a nuclear power station within their boundary, so to include them would reduce the replicability of the project. However, as this study is on the Leiston boundary, it's logical to assess and address the emissions which are being excluded, with justifications for the exclusion, for full transparency.

Whilst the current and potential power stations have their own plans for reducing their emissions, these are out of the control of the local community and due to the nuclear site licencing restrictions, it is more difficult to address measures on the site without regulatory approval.

It is worth noting, whilst the excluded emissions are not insignificant, the power stations themselves make a significant contribution to the decarbonisation of the UK by providing low carbon electricity, decarbonising power and other industries around the UK. Consequently, by excluding the carbon emissions associated with the power stations, the carbon savings enabled by offsetting other baseload power source (predominately fossil fuelled gas and coal plants) emissions are also excluded from the project.

¹ Technical Note 02 – Study Boundary



1.1.1. SIZEWELL B

Sizewell B is a pressurised water reactor operated by EDF Energy on the Suffolk coast, 1.5 miles from Leiston. The analysis on the carbon footprint for Sizewell B is currently being updated, but we can reference a 2008 study completed an AEA to understand its carbon footprint.

The net annual output of Sizewell B is 1191 MW which means it is capable of supplying just under 3% of the UK's current electricity needs.

The total greenhouse gas emissions per kilowatt hour of generation for Sizewell B have been calculated to be 6.04 g CO₂ eq per kilowatt hour of electricity generated.

Over the lifetime of the plant, which is expected to be 40 years of operation, in addition to time for construction and decommissioning, the estimated total generation of electricity is around 376 TWh, therefore, an estimate for the emissions over the lifetime of the project are expected to be around 2.3 million tonnes of carbon dioxide.

1.1.2. SIZEWELL C

Sizewell C (SZC) is a proposed 3.2 GW, twin European Pressurised Water Reactor (EPR) design, nuclear power station, which would be built directly north of the currently operating Sizewell B on the Suffolk coast, approximately 1.5 miles from Leiston.

For SZC, an extensive lifecycle carbon emissions assessment, conducted by an independent consultant and verified by another third party, found that the carbon lifecycle emissions would be approximately 5.5 g CO₂ eq per kilowatt hour of electricity generated.² This figure is below the median level attributed to nuclear and half the median level attributed to offshore wind by the IPCC study on carbon emissions.³

This analysis measured the total carbon emissions attributable to SZC to be around 10 million tonnes of carbon dioxide. This is for the whole lifecycle, including the nuclear fuel cycle, 60 years of operation, and decommissioning, which is a period of over 90 years. The carbon avoided when SZC generates electricity compared to a gas-fuelled power station means that SZC will 'offset' all the construction emissions (40% of the total) within 5 months of operation.

In addition to this huge carbon reduction potential, the project is constantly looking at ways that we can reduce this carbon footprint even further. For example, SZC is investigating the opportunity to use alternatively fuelled HGVs and on-site power generation during construction, such as electric or hydrogen fuelled options, to reduce the construction phase carbon emissions.

² "Carbon focused Life Cycle Assessment of the proposed Sizewell C nuclear power plant development" – May 2021 - available from Sizewell C on request

³ https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf#page=7



1.2. POTENTIAL INFRASTRUCTURE

1.2.1. COGENERATION

SZC is exploring ways to potentially extract and export heat from SZC through cogeneration in order to be able to power a number of heat intensive applications directly. Cogeneration on a nuclear plant is both efficient and cost-effective. It is efficient because heat is the primary energy source of a nuclear power plant, therefore any utilisations of this heat directly would avoid the efficiency losses incurred through the conversion of heat energy to electrical energy. Additionally, heat from a nuclear power plant is the cheapest form of low carbon heat according to a study by Columbia University⁴.

Initially, SZC is exploring on three potential future applications for cogeneration. These are district heating, direct air capture and hydrogen production as described further in the sections below. Please note that these applications do not form part of the initial stage(s) of the Net Zero Leiston Route Map.

1.2.2. DISTRICT HEATING

The potential to extract heat from Sizewell to provide low carbon heat to Leiston within the early years of the Route Map was considered. While this would provide a genuine low carbon source of energy – and help to tackle a key Net Zero challenge in terms of displacing gas fuelled space heating in buildings – ultimately the cost effectiveness of a major pipework connection (flow and return) linking the two sites for the early phase(s) is not sufficiently robust.

However, moving forwards, the large quantity of heat available from Sizewell should be assessed on a wider geographic scale, potentially to serve the Port of Lowestoft or even further afield, as a source of low carbon heat to help the wider UK Net Zero strategy. Once a larger overall heat load has been identified, a connection to Leiston could be made as part of a much wider heat network, helping further decarbonise heat within the study area.

Conclusion: district heating from Sizewell does not form part of the initial stage(s) of the Net Zero Leiston Route Map, but will be considered as a longer-term option should a larger heat network from Sizewell be developed.

⁴ "Low-Carbon Heat Solutions for Heavy Industry: Sources, Options, and Costs Today" by Friedmann, Fan, and Tang (Oct 2019)



1.2.3. ELECTRICITY

The electricity generated by Sizewell is intrinsically low carbon. Having considered how this source of energy could be leveraged by the Net Zero Leiston scheme, the team concluded there are four options:

- » **Option 1: Direct use**, via a private wire physical connection between Sizewell and Leiston
- » **Option 2: Indirect use**, via an electricity purchasing contract that can credibly demonstrate production & consumption in the same physical area and matched on a time basis
- » **Option 3: Indirect use**, via an electricity purchasing contract that can credibly demonstrate production & consumption in the same physical area, but not time matching
- » **Option 4: Indirect use**, via a contract based on purchasing electricity from any low carbon source, that is neither in the same physical area nor time matched

Of these four options, we consider option 1 (direct use) is a genuine low carbon option – but similar to the district heating option is not cost effective (and the national grid already exists for the purposes of transmitting and supplying electricity).

Option 2, 3 and 4 (indirect use) are all sub-sets of the same option, but importantly with differing credibility from a ‘greenwash’ perspective. Option 2 would be credible, as it matches production and time in the local area.

Option 3 and 4 are less credible. We consider these amount to ‘off-setting’ and should therefore not be considered for Leiston (i.e. this is similar to planting trees in one country and taking the carbon credit in another country).

On balance, local generation of low carbon power in and around Leiston has been prioritised for the Route Map (e.g. local PV panels), as part of a balanced solution for generation and supply under the Route Map.

We would however note that Sizewell contributes to the UK’s overall low carbon power mix and therefore Leiston benefits indirectly from this, in the same way as the rest of the country.

Conclusion: electricity supply (direct or indirect) from Sizewell does not form part of the Net Zero Leiston Route Map.

1.2.4. CARBON CAPTURE

As part of SZC’s plans for a potential low-carbon energy hub, a BEIS-sponsored project⁵ is underway to develop technology to capture carbon from the ambient air (known as direct air capture or DAC) that can potentially be powered by heat from SZC. This is a fast developing technology, with only circa 15 DAC plants operating worldwide currently⁶.

At the time of publication, SZC is working with engineering, academic and industrial partners to design a demonstration unit that could in the future be scaled and integrated with an operational SZC power plant. The captured CO₂ could either be permanently stored below ground or used in the production of fuels, chemicals or other products containing CO₂.

The captured CO₂ could either be permanently stored below ground or used in the production of fuels, chemicals or other products containing CO₂.

We consider there is good potential to deploy this technology linked to Sizewell and the option has been progressed to the Sequestration sub-section of the overall Net Zero Leiston short list measures.

Conclusion: DAC associated with Sizewell has been further considered as part of the Net Zero Leiston Route Map..

1.2.5. HYDROGEN

Hydrogen is considered a prominent option to help displace natural gas consumption under the wider Net Zero transition. For the buildings sector, the primary strategy is to burn hydrogen within local boilers in the same way as we currently use natural gas, most likely supplied via the current gas distribution network.

Hydrogen is considered a prominent option to help displace natural gas consumption under the wider Net Zero transition. For the buildings sector, the primary strategy is to burn hydrogen within local boilers in the same way as we currently use natural gas, most likely supplied via the current gas distribution network.

Conclusion: use of hydrogen produced at Sizewell does not form part of the Net Zero Leiston Route Map.

⁵ Direct Air Capture and Greenhouse Gas Removal Programme (TRN 4696/11/2020)

⁶ As at 2020. Source: <https://www.iea.org/reports/direct-air-capture>

1.2.6. TRANSPORT

The transport sector is intertwined between Leiston, Sizewell and the surrounding area;

- » Workers live locally and travel to/from Sizewell,
- » Freight and deliveries pass through the Leiston study area travelling to/ from Sizewell
- » General freight passes through both the study area and the Sizewell area.

Having considered this, the team has concluded the short-listed transport measures under the Route Map should primarily centre on local Leiston solutions, including; local EV charging infrastructure, e-bikes and Vehicle-to-Grid⁷ ('V2G').

However, there may be linkages through EV/ hydrogen based local public transport, and this will be considered as a short list option.

Conclusion: transport options associated with Sizewell has been further considered as part of the Net Zero Leiston Route Map.

1.2.7. TEMPORARY ACCOMMODATION

A significant scale temporary workers accommodation facility will be provided for the Sizewell C development, some of which is likely to sit within the Leiston Study Boundary area.

Where local low carbon electricity generation is considered (over and above building scale) including PV and Wind generation, these could be dual purpose for both Leiston and the workers accommodation site. For example, a PV farm could provide power to both sites, or could be prioritised for the workers accommodation until it is removed (probably c2030) and revert to serving Leiston subsequently.

Conclusion: consideration of providing Sizewell temporary accommodation with low carbon energy from Leiston will be further considered as part of the Net Zero Leiston Route Map.



⁷ V2G describes a system in which plug-in electric vehicles, such as battery electric vehicles (BEV), communicate with the power grid to sell demand response services by either returning electricity to the grid or by throttling their charging rate. V2G storage capabilities can enable EVs to store and discharge electricity generated from renewable energy sources such as solar and wind, with output that fluctuates depending on weather and time of day.



ATKINS

Atkins is a leading global design, engineering and planning consultancy. Atkins provides expert support to the energy industry to help transform the potential of existing infrastructure, as well as new resources and technology, to improve lives through safer, cleaner and smarter energy. Atkins has demonstrated wider leadership in the Net Zero space with their 2019 report Engineering Net Zero and are committed to their vision, Brilliantly Engineering a Cleaner Safe Net Zero World.

Atkins is leading the overall consultancy input to the project, working towards the overall Net Zero Route Map for the district of Leiston. This has included setting the study boundary, defining Net Zero, baselining carbon emissions and setting out the infrastructure base case for the area. Martin Gray is leading the overall Atkins team for the study, coordinating input from our subject matter experts on energy, carbon, transport and environment.

IKIGAI

Ikigai is a Net Zero bankability consultancy, co-developer and technology accelerator. They bridge the gap between the key stakeholders in the energy transition - investors, consumers, Government and innovators – to deliver investable, profitable solutions to decarbonise core infrastructure (water, waste, airports, ports), industrial zones and cities.

Ikigai has developed a methodology for evaluation of the investability of the technology roadmap for NZL and is supporting NZL to refine project concepts from a risk and value perspective, before engaging with prospective public and private investors on the various asset classes and technologies identified.

ENERGY SYSTEMS CATAPULT

ESC is an independent, not-for-profit centre of excellence set up to accelerate the UK's transformation to a low carbon energy system, and to ensure UK businesses and consumers capture the opportunities of clean growth. It takes a whole-systems view of the energy sector, helping to identify and address innovation priorities and market barriers to decarbonise the energy system at least cost.

ESC has supported NZL with expert consultancy to help ensure that the needs of households in vulnerable circumstances are at the heart of decision making for the project.

Dr. Rose Chard is a prominent advocate for a fair and just transition to a low carbon energy system, and her experience in consumer insight has been invaluable in the development of the project.



OPERGY

Opergy is an East Anglian-based clean energy consultancy which connects businesses with experts to offer key insights to optimise business performance, and develop new and innovative low carbon technologies and solutions to tackle climate change. Opergy have facilitated more than £7bn investment in regional clean energy projects and businesses.

Opergy has enabled new connections to the NZL project across the region and has contributed to several chapters for the route-map, including views on the counterfactual to the NZL project – what would happen if NZL didn't go ahead; alignment against local to international climate policy; and scoping a range of community-focused solutions that will contribute to reaching Net Zero.

Johnathan Reynolds is on the board of the New Anglia LEP and is a champion of the region's clean energy ambitions and ensuring the path to Net Zero is clear.

CARBONE 4

Carbone 4 is a leading independent consulting firm, specialized in energy transition, that offers its expertise to private or public players. Convinced that anticipation of the constraints of climate change is the best option, Carbone 4 assists its clients to help them transform these constraints into a tremendous innovation accelerator, a commercial differentiator and a motivation for teams.

UEA

UEA's research focuses on some of the most important global challenges facing society.

UEA's world-class researchers influence policymakers and industry leaders across the globe, with new ideas, knowledge and solutions that have a far-reaching impact.

Building on their disciplinary strengths, their interdisciplinary approach - together with their culture of innovation - creates a catalyst for truly pioneering research.



SIZEWELL C

Sizewell C, a proposed new nuclear power station in Suffolk, has the potential to generate the reliable low carbon electricity the country needs for decades to come. It will also make a lasting positive difference to the economy in the east of England. The project is being led by EDF. The project submitted the DCO application to the Planning Inspectorate at the end of May 2020 and concluded the examination phase in October 2021. If the DCO is accepted, the project could start construction in 2022, using a replicated design from the Hinkley Point C project. Once operational, Sizewell C could produce around 7% of current UK demand in low carbon power.

The Sizewell C project has provided some seed funding and project support, as well as useful contacts and partners, to help launch the Net Zero Leiston project alongside the Leiston community.

