Zero Carbon Oxford Partnership

2040 Net-Zero Action Plan

Report

July 2021

CARBON TRUST

Zero Carbon Oxford is a partnership that brings together universities, hospitals, councils, large businesses, and communities to support the city in its journey to net zero carbon emissions. Those who have signed the Zero Carbon Oxford charter have committed to working together to create a zero carbon Oxford and to collaborate to build a prosperous, sustainable city in which all can share.

The Carbon Trust's mission is to accelerate the move to a sustainable, low carbon economy. It is a world leading expert on carbon reduction and clean technology. As a not-for-dividend group, it advises governments and leading companies around the world, reinvesting profits into its low carbon mission.

Authors

Emma Ashcroft

Associate Director

Emma.Ashcroft@carbontrust.com

Frances Bean

Manager

Frances.Bean@carbontrust.com

Charlie McNelly

Associate

Charlie.McNelly@carbontrust.com

Ben Robertson

Analyst

Ben.Robertson@carbontrust.com

Abbreviations

Abbreviation	Name
ASHP	Air Source Heat Pump
BAU	Business as Usual
BEIS	Department for Business, Energy & Industrial Strategy
CCC	Climate Change Committee
CCUS	Carbon Capture, Utilisation & Storage
CDFI	Community Development Finance Institution
DFES	Distributed Future Energy Scenarios
DfT	Department for Transport
DHSC	Department for Health & Social Care
DNO	District Network Operator
DSO	District Service Operator
EnPC	Energy Performance Contract
EPC	Energy Performance Certificate
FES	Future Energy Scenarios
FHS	Future Homes Standard
GGR	Greenhouse Gas Removals
GHG	Greenhouse Gas
HGV	Heavy Goods Vehicle
LCH	Low Carbon Hub
LGV	Light Goods Vehicle
LEO	Local Energy Oxfordshire
LEP	Local Enterprise Partnership
MEES	Minimum Energy Efficiency Standards
MHE	Material Handling Equipment
MHCLG	Ministry for Housing, Communities & Local Government
OBC	Oxford Bus Company
PWLB	Public Works Loans Board
SBTi	Science Based Target Initiative
SSEN	Scottish & Southern Energy Networks
SGN	Southern Gas Network
SPAB	The Society for the Protection of Ancient Buildings
TCR	Targeted Charging Review
ZEZ	Zero Emissions Zone
ZCOP	Zero Carbon Oxford Partnership

Contents

Figures

Tables

INTRODUCTION

The Zero Carbon Oxford Partnership (ZCOP)[1], comprising of 21 business leaders from the Oxford's universities, institutions and large businesses, has committed to collaborate on achieving net-zero carbon emissions for the city of Oxford by 2040. This is more ambitious than the national UK Government target, which aims for net-zero by 2050. It is an expression of Oxford's understanding that the Climate Emergency requires radical and urgent transition, its lower proportion of hard-to-decarbonise emissions, and a recognition that the city is already a leader in the UK and should continue to lead 'from the front'.

To support in achieving this vision, the Carbon Trust has worked collaboratively with Oxford City Council and all members of the ZCOP to develop and model a pathway to show what net-zero by 2040 looks like in terms of emissions reduction, breaking this down into roadmaps of key milestones to get to 2040, and develop an action plan setting out key actions to achieve it. This work follows on the Oxford Citizens Assembly on Climate Change held in 2019.

The **scenario modelling** *(chapter 1)* provides a potential decarbonisation pathway to demonstrate the scale of decarbonisation that must be achieved across all GHG emission sources to achieve net-zero carbon emissions by 2040. Thus, aiming to inspire ambitious action from all partners through providing the evidence to support robust decision-making. This updates an earlier scenario to reflect latest developments in terms of national, local and region policy, technology developments, national energy scenarios, and commitments from ZCOP partners, gathering and agreed through extensive engagement with the ZCOP partners.

Decarbonisation roadmaps *(chapter 2)* have been developed for five keys sectors: domestic, commercial, industrial, institutional and transport[2]. Additionally, an over-arching strategic roadmap lays out the key 5-yearly sectoral decarbonisation requirements, alongside wider contextual changes at national and regional-levels drawn from across the sector-specific roadmaps. All roadmaps are fed directly by the scenario modelling, extracting the key milestones for each sector to map out a timeline of 'what needs to happen, and by when' for Oxford to be on-track to achieve net-zero by 2040. The roadmaps provide an important step in breaking down the overall net-zero vision into more tangible pieces, by looking at 5-yearly periods by sector, and form the basis from which the actions set out in the action plan have been developed.

Appendix 1 explains in detail the general and sectoral assumptions, agreed with ZCOP partners, which form the basis of the scenario and roadmaps.

Action plan *(chapter 3)* provides a clear initial direction and series of steps for the ZCOP to follow. It lays out a pipeline of near-term and mid-term priority actions for the partnership to consider and drive forwards using sprint (task-and-finish) groups. It offers a starting point around which to build momentum and galvanise partners, as opposed to an exhaustive list of all actions required to achieve the 2040 net-zero Oxford target.

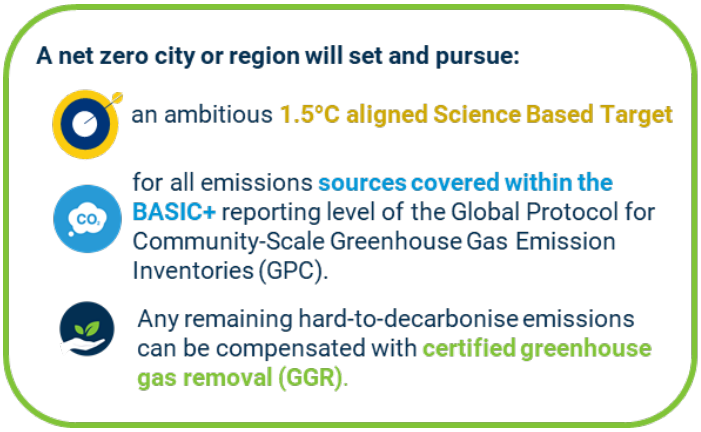
[1] Oxford City Council, 'Zero Carbon Oxford Summit'. Available from: https://www.oxford.gov.uk/info/20291/climate_emergency/1431/zero_carbon_oxford_summit

[2] Given the minimal contribution from the agricultural sector to carbon emissions in Oxford, and the aim for the roadmaps to be feeders for action in priority focus areas, a separate roadmap for agriculture has not been developed. Additionally, waste requirements have been included within the domestic, commercial and industrial roadmaps.

The pipeline of actions was drawn from the existing pipelines of ZCOP partners (building on existing activity), external documents highlighting good practice, innovations and successes implemented elsewhere, and five workshops.

It is important to recognise that to achieve its ambitious 2040 net-zero target, Oxford will require a considerable step-up in support from national government. National dependencies are laid-out in the context section of both the strategic and sector-specific roadmaps, as well as summarised in the national dependencies section of the action plan. The impact of this support, or more specifically the lack of it, is also modelled by comparing the net-zero scenario with a 'Business as Usual' (BAU) scenario considering current policies and initiatives without any assumptions around future policies.

Even successfully following the ambitious net-zero pathway to 2040, in 2040 a portion of residual emissions may require offsetting. Best practice would dictate that ZCOP should seek to take action to reduce residual emissions as close to zero as possible, thus reducing its reliance on an uncertain offsetting market. The size of these residual emissions may shrink as Oxford progresses towards 2040, impacted by emerging technologies and technology innovation that could help Oxford to accelerate progress. There is no globally agreed definition of net zero, however, the emerging consensus amongst the climate change community is that net zero emissions can be achieved by reducing emissions as far to zero as possible, with any remaining hard-to-decarbonise emissions compensated with greenhouse gas removals. The Carbon Trust's working definition for cities[3], is that a net-zero city will set and purse an ambitious 1.5°C aligned Science Based Target for all emission sources covered within the Basic+ reporting level of the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), and any remaining hard-to-decarbonise emissions can be compensated with certified greenhouse gas removal (GGR). This aligns the definition for a net-zero city or region with the SBTi's definition for a net-zero company.



Achieving its net-zero target requires a 'whole-city approach'. Key actors from across the domestic, commercial, industrial, institutional and transport sectors will need to work together, as well as with the energy networks, to unlock transformational change. More widely, a significant degree of behaviour change will also be required across Oxford's

[3] There are a range of leading actors working on defining net-zero in different contexts, with working definitions currently under consultation by the Science Based Target Initiative (SBTi) and part of the Race to Zero campaign in the lead up to COP26.The consensus is that net-zero targets should incorporate a reduction in emissions in line with a 1.5˚ C aligned Science Based Target, with any residual emissions balanced by Greenhouse Gas Removals (GGR).

population. Delivering, facilitating and communicating to support this process of change is the foundational cornerstone of the ZCOP. **Collaboration**, involvement, and input from ZCOP partners has been critical to the development of this project. Partners provided crucial data and steer for the scenario updates, roadmaps, and action plan. Assumptions behind the scenario, which forms the basis for the roadmap and from which the actions in the action plan stem, were subject to several rounds of review via workshops and one-to-one sessions with ZCOP partners before validation. In addition to workshops focused on the scenario and roadmaps, five sector-themed workshops (domestic, commercial, industry, institutional and transport) were used to ideated potential actions collaboratively using Mural (copies of the Mural boards developed are available as supporting files to this report).

Next steps

This action plan has been developed specifically for the ZCOP to own and implement. The action plan sets out several immediately implementable actions for the ZCOP to focus on. Establishing the Partnership's first sprint groups to work collaboratively on these key actions will be a logical next step to turn the ZCOP's shared ambition of net-zero emissions by 2040 into reality. These are task-and-finish groups will gather the key ZCO partners required for delivery of a particular action. Once the action has been completed, the sprint group will dissolve, and a new group will be established around the next selected action, with likely different partners involved. This will ensure groups are agile, with regular, fresh momentum, comprise of the relevant partners and experts, and that workload is spread across partners.

Building on the identified policy deficit, while initial progress can be made by the city alone, achieving a target of this ambition depends on a considerable step-up in national-level policy and funding support. The ZCOP will need to co-ordinate joint lobbying and funding applications to ensure the city secures the support it needs.

In the development of these actions some immediate steps have already been taken and the Partnership now needs to focus on ensuring their success.

Some actions will require wider collaboration, beyond those organisations already involved in the Partnership. Therefore, all communities, organisations and businesses in Oxford are encouraged to commit to reducing carbon emissions and identify opportunities to collaborate towards achieving net zero.

SCENARIO MODELLING

Chapter 1

Model aims

This chapter of the report sets out the results of the Oxford scenario modelling update. The inputs and assumptions behind the model have been updated from previous scenario modelling undertaken by Anthesis in order to bring the projections in line with the new 20404 net-zero target agreed by the Zero Carbon Oxford (ZCO) Partnership.

The overall aim of the scenario is to describe a potential decarbonisation pathway and identify the near, medium and long-term actions needed to put Oxford on track to achieving net-zero carbon emissions by 2040. The scenario also provides a framework to:

- Inform the ZCO Partnership of the scale of decarbonisation that must be achieved across all GHG emission sources;
- Provide evidence to support robust decision-making processes; and
- Inspire radical action from partners.

This version of the scenario is an update to previous versions produced by Anthesis in 2019[5], and subsequently in 2020. The updated scenario raises the level of ambition in order to meet the 2040 target, whilst also considering the impact of recent policy announcements (e.g. proposed ban on fossil fuel heating in new homes from 2025). We have also engaged with the ZCO Partnership to gather feedback on the previous scenarios in order to inform updated assumptions. The assumptions are full laid out in Appendix 1.

In reality, there are a wide range of potential pathways to achieve net-zero, including new opportunities from technology innovations that will arise as the transition takes place. The evolution of technologies and other uncertainties may lead to alternative decarbonisation pathways and therefore, there are naturally uncertainties within the scenario. The use of hydrogen as a fuel is one example of an emerging technology without a clearly defined potential or route forwards in Oxford. Feedback from stakeholders strongly suggests that the use of hydrogen will likely be limited to heavy-duty transport (such as out-of-town buses) and gas grid blending in Oxford. Stakeholders felt that the gas grid in Oxford is not well suited for conversion to 100% hydrogen due to lack of proximity to production and storage, and as a result, hydrogen has not been modelled as an alternative fuel for heat in buildings or industry. Given heat pumps are likely the predominant solution for decarbonising heat in Oxford, the role for hydrogen blending into the gas grid is uncertain, and whilst it may achieve short-term reductions, should not lock in suboptimal solutions. Despite this, it is likely that there will be some requirement for hydrogen deployment locally, particularly with respect to heavy-duty transport, and further investigation into the feasibility of local 'green' hydrogen production through electrolysis will help to shed further light on the role for hydrogen in Oxford.

[4] Oxford City Council, 'Leaders across Oxford support 2040 net zero carbon emissions pledge' (Published 4th February 2021). Available from: https://www.oxford.gov.uk/news/article/1708/leaders_across_oxford_support_2040_net_zero_carbon_emissions_pledge

[5] Anthesis, Oxford City Council: Climate Emergency Strategy Support (September 2019). Available from: https://info.anthesisgroup.com/hubfs/Climate_Emergency_Strategy_Support_report_Anthesis_2019%20(1).pdf?hsLang=en

The scenario focuses on known solutions that can be implemented between the present-day and 2040. However, this does not seek to imply that activities surrounding technology innovation should not be pursued. There are also some areas where it is expected that there will be further decarbonisation beyond 2040 e.g. the carbon intensity of the gas grid and electricity network, which are outside of the direct control of the ZCO Partnership. For this reason, the modelling extends to 2050 in some areas where alignment with national net-zero ambition is useful.

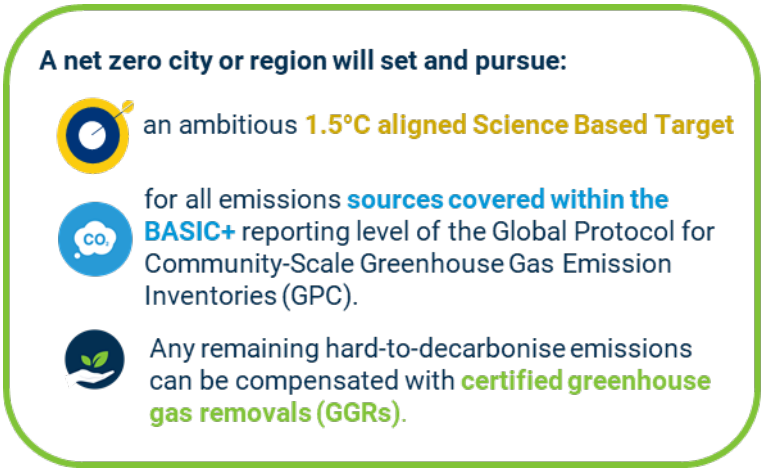
Defining net-zero

Unlike the term 'carbon neutral' (defined by PAS 2060 since 2009), there is as yet no commonly agreed definition of what constitutes 'net-zero'. Many organisations claiming to be 'net-zero' use significant varied interpretations of the term. One of the reasons for the popularity of net-zero targets is that the term itself carries a promise of strong action and a higher level of ambition compared with carbon neutral, embracing the need to halt global emissions, so net-zero is now becoming seen as the hallmark of climate leadership.

There are a range of leading actors working on defining net-zero in different contexts, with working definitions currently under consultation by the Science Based Target Initiative (SBTi) and part of the Race to Zero campaign in the lead up to COP26.The consensus is that net-zero targets should incorporate a reduction in emissions in line with a 1.5°C aligned Science Based Target, with any residual emissions balanced by Greenhouse Gas Removals (GGR).

The Carbon Trust's working definition for cities, is that a net-zero city will set and purse an ambitious 1.5°C aligned Science Based Target for all emission sources covered within the Basic+ reporting level of the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), and any remaining hard-to-decarbonise emissions can be compensated with certified greenhouse gas removal (GGR). This aligns the definition for a net-zero city or region with the SBTi's definition for a net-zero company.

Therefore, the updated scenario is compared against a 1.5°C aligned Science Based Target to ensure that it is on track to meet this definition.



Methodology

The scenario modelling projects decarbonisation measures using a sector-based approach from 2020 to 2050. The model itself is a tailored version of Carbon Trust's in-house scenario forecasting tool that has been adapted to incorporate all of the assumptions and inputs included in the previous scenario work undertaken by Anthesis.

The Carbon Trust received access to the underlying data from Anthesis's 2020 'SCATTER High Ambition Pathway', which was used as a starting point for the updated scenario. Following this, a bottom-up approach was undertaken to calculate the energy change that results from the implementation of various technologies for each sector, requiring an understanding of the technologies, regional insights, growth projections, sectors and fuel breakdowns. The ZCO Partnership were actively engaged with the process, providing crucial data and steer for the scenario updates.

Appendix 1 details if, how and why each of the inputs from the 'SCATTER High Ambition Pathway' were updated. These updates have primarily been informed by:

- Feedback gathered during workshops delivered with the ZCO Partnership stakeholders;
- Documents received from Oxford City Council relating to city-wide strategies, plans and key projects (e.g. heat network feasibility studies)[6];
- SSEN's Distributed Future Energy Scenarios (DFES) 2020 results[7];
- National Grid's Future Energy Scenarios (FES) 2020 data workbook[8];
- New policies and regulations; and
- Project LEO.

[6] Oxford City Council, 'Heat Networks for Oxford - Feasibility studies'. Available from: https://www.oxford.gov.uk/info/20062/carbon_reduction_and_energy_saving/1147/heat_networks_for_oxford_-_feasibility_studies

[7] SSEN, 'Low Carbon Technology Uptake'. Available from: https://www.ssen.co.uk/lctuptake/ ; We also received access to the larger DFES 2020 dataset.

[8] National Grid, 'Future Energy Scenarios 2020'. Available from: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

Model inputs

Following the initial transfer of data from the previous scenario, the Carbon Trust reviewed the scope of the baseline to ensure that it was in keeping with the best-practice GHG Protocol for cities (GPC)9, which is consistent with PAS 2070. According to the protocol, the city footprint should, as a minimum, be inclusive of Scope 1, 2 & 3 (waste) emissions, including:

- Energy-use in buildings;
- Grid electricity;
- Road transport across Oxford; and
- Waste generation and management across the city (including domestic and commercial).

Following this review, we agreed to make the following amendments to the baseline to bring the scope of the emissions considered within the assessment in line with the GPC, and also to improve the accuracy of some projections:

- Including emissions from sewage sludge and incineration because, although being treated outside of the city boundary (and therefore considered Scope 3 emissions), the GPC recommends the inclusion of waste emissions for waste treated both inside (Scope 1) and outside (Scope 3) the city boundary, given cities tend to have a significant level of control over their waste emissions.
- Adding assumptions around gas grid decarbonisation using both hydrogen blending and biomethane injection.
- Accounting for the impact of a planned heat network in Oxford, and adding assumptions surrounding its expected heat sources and long-term expansion potential.
- Adding the use of hydrogen as a transport fuel.
- Reflecting the potential for new flexible ways of working, i.e. work-from-home, to drive-down transport use.

The same sector-based approach to modelling carried out during the previous stage of work was replicated in this scenario to allow for comparison of the reported baseline figures and future projections, and to inform relevant project partners and working groups on sector-specific actions. The sectors are:

- Residential buildings;
- Commercial buildings;
- Institutional buildings (including universities, colleges, councils, NHS buildings etc.);
- Industry;
- Agriculture;
- Waste; and
- Transport.

[9] GHG Protocol, 'Global Protocol for Community-Scale Greenhouse Gas Emission Inventories'. Available from: https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Analysis

Baseline emissions

The baseline year has been updated from 2017 to 2018. Baseline data was sourced from publicly available datasets, such as BEIS10 and DfT[11], along with data from the council where possible. These data sources represent the most recent annual data set, and where there were gaps, Anthesis's 2018 forecast data was used. For most emission sources, an estimate of GHG emissions is made by multiplying activity data by an emission factor associated with the activity being measured. A summary of the 2018 baseline is shown in Figure 1 below.

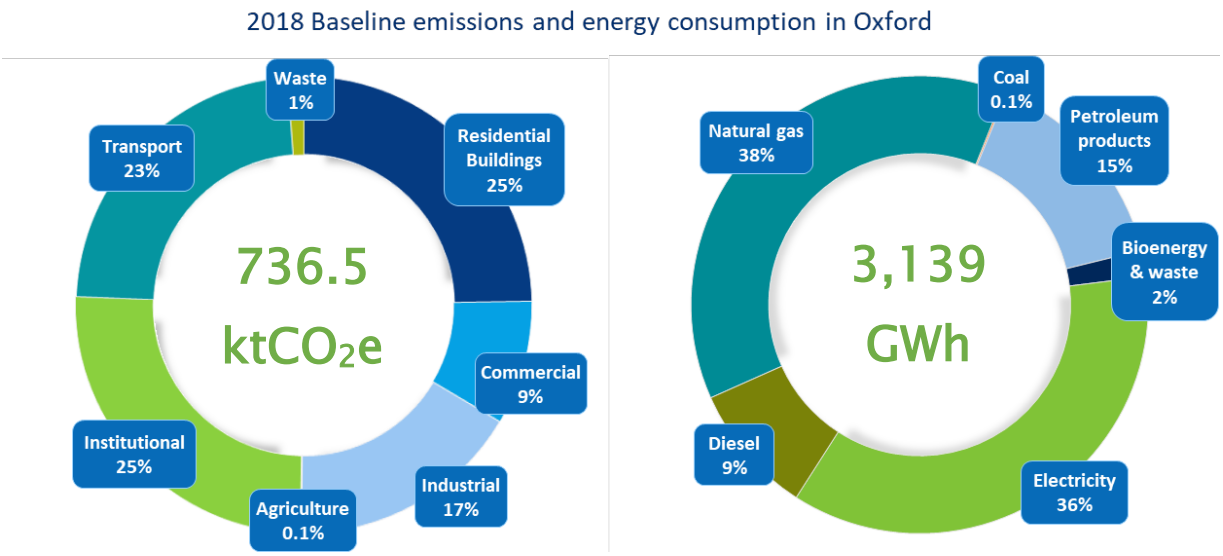


FIGURE 1: 2018 BASELINE EMISSIONS BY SECTOR (EXCLUDING LAND USE, LEFT) AND 2018 BASELINE ENERGY CONSUMPTION BY FUEL TYPE (RIGHT)

The majority of the 2018 emissions arise from the buildings sector (434 $ktCO_2e$), largely due to the high proportion of gas-heated buildings. Transport is the second largest contributor to Oxford's emissions and accounted for 171 ktCO2e in 2018, with private cars being the main source of emissions.

Industry and agriculture accounted for 123 ktCO2e in 2018, while waste (which is divided into recycled waste, solid waste to incinerator, solid waste to landfill, and treatment of wastewater) only accounted for 8.3 $ktCO_2e$.

As data emerges for more recent years it will be important to update this baseline to understand the impacts of changes, such as the global pandemic.

Model outputs

To bridge the gap between the baseline emissions and the 2040 target, we have undertaken a pathway analysis to examine how Oxford can decarbonise its key sectors in order to

[10] BEIS, 'Sub-national electricity consumption data'. Available from: https://www.gov.uk/government/collections/sub-national-electricity-consumption-data; BEIS, 'Sub-national gas consumption data'. Available from: https://www.gov.uk/government/collections/sub-national-gas-consumption-data

[11] Department for Transport, 'Vehicles statistics'. Available from: https://www.gov.uk/government/collections/vehicles-statistics

achieve net-zero by 2040. Through modelling the impact of a range of interventions on future energy consumption and emissions in the city, we can begin to paint a picture of how this may be achieved, and better understand where focus is required.

Under the new scenario, which raises the ambition of the previous 'SCATTER High Ambition Pathway', emissions fall by 88% in 2040, against 2018 levels. This is equivalent to a reduction of 646.1 $ktCO_2e$, resulting in a 2040 footprint of 88.7 $ktCO_2e$, which is almost half of the 2040 emissions originally reported in the 'SCATTER High Ambition Pathway'.

CARBON BUDGETS & PATHWAY

Starting from Oxford's 2018 footprint of 734.8 $ktCO_2e$, we projected emissions over the 22-year period from 2018-2040 to determine five-yearly budgets for the city aligned to the 2040 net-zero target. The five-yearly carbon budgets and an annual emissions reduction pathway can be used to set interim targets against which progress can be tracked. This is shown in Table 1 below.

TABLE 1: FIVE-YEARLY CARBON BUDGETS 2020-2040

Net zero target	2040	
Total carbon budget (2018-2040)	7,624 $ktCO_2e$	
Carbon emissions reduction by 2025 Cf. 2018 base year	-44.3%	(409.6 $ktCO_2e$)
Carbon emissions reduction by 2030	-63.2%	(270.5 $ktCO_2e$)
Carbon emissions reduction by 2035	-78.3%	(159.5 $ktCO_2e$)
Carbon emissions reduction by 2040	-87.9%	(88.7 $ktCO_2e$)
Amount of carbon to be offset in the year 2040		-88.7 $ktCO_2e$

Although Oxford aim to be a net zero carbon city in 2040, it is expected that there may be residual emissions from sources that are out of the control of the ZCO Partnership, such as emissions associated with the electricity grid. However, the carbon intensity of grid electricity in 2040 remains uncertain, with the BEIS projections (the source used to underpin this analysis) currently forecasting that there will a small amount of residual carbon on the network at this point. In contract, the CCC have recommended grid carbon neutrality is achievable by 2035, and the recent National Grid FES 2021 data forecasts the grid intensity of electricity becoming negative by 2040. In any case, an offsetting strategy should consider how to account for any residual emissions (estimated at 88.7 $ktCO_2e$, or 54.8 $ktCO_2e$ with zero carbon electricity). See 'The Role of Offsetting' section below for details.

Figure 2 below shows a comparison of the previous and newly updated scenarios for Oxford, as well as indicative target pathways to align with a 1.5°C Science Based Target and the UK's net zero by 2050 target. The Science Based Target pathway uses an absolute contraction method (-4.2% per annum) to calculate Oxford's share of the global reductions required to limit global temperature rise to 1.5°C; and the CCC's Sixth Carbon Budget12

[12] CCC, 'Sixth Carbon Budget'. Available from: https://www.theccc.org.uk/publication/sixth-carbon-budget/

provides a sectoral breakdown of the percentage reductions needed to comply with the UK's Net Zero 2050 target.

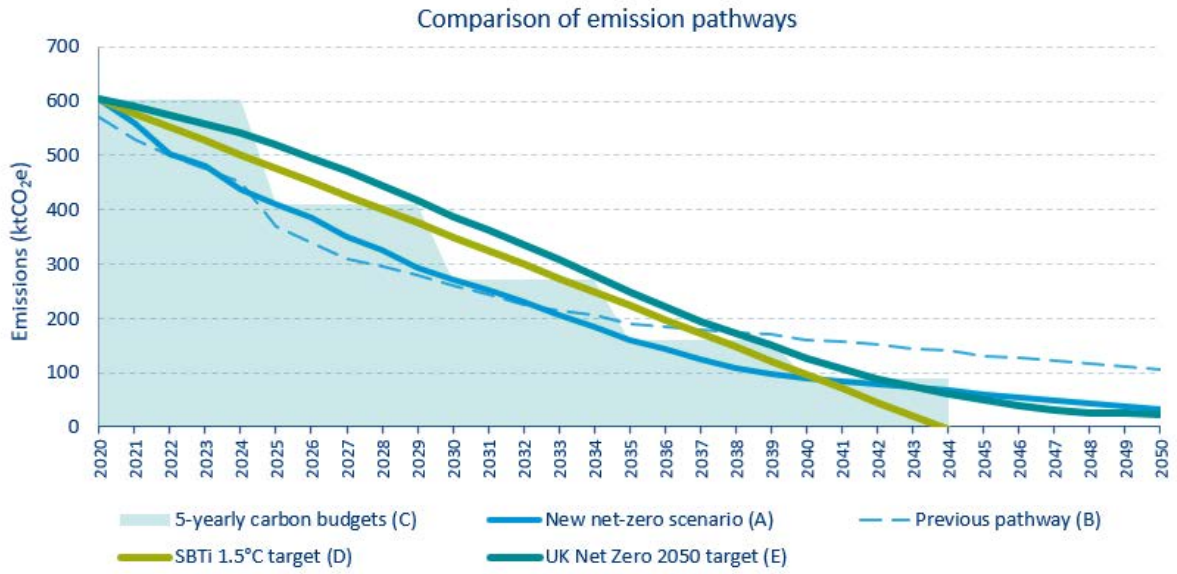


FIGURE 2: EMISSIONS PATHWAY: A) NEW NET-ZERO SCENARIO"; B) PREVIOUS PATHWAY; C) INTERIM 5-YEARLY CARBON BUDGETS; D) 1.5°C SCIENCE-BASED TARGET; AND E) UK NET ZERO 2050 TARGET

The comparison between the emissions pathways, national target and science-based target, shown in Figure 2, illustrates the significance and scale of the challenge. According to Figure 2, the updated scenario is compliant with the SBTi 1.5°C pathway and the UK government's Net Zero 2050 target by 2040, and goes beyond what is necessary to achieving those targets in the near and medium-term. The pathway assumptions focus on the scenario period to 2040 in compliance with Oxford's net zero target. While there is some potential for further decarbonisation post-2040 (mostly from the decarbonisation of waste), there is still uncertainty around how to decarbonise hard-to-reach areas, such as HGV transport, which is demonstrated by a flattening out of the curve. Although, it is possible that technology innovations during the course of the transition could unlock further decarbonisation in the future, it is also possible that some residual emissions in 2040 may need to be offset.

THE ROLE OF OFFSETTING

It is generally accepted that there may be a small amount of residual emissions within a net-zero-aligned pathway, arising from hard-to-decarbonise activities, such as those outside of Oxford's control. However, best practice dictates that all efforts should be made to reduce emissions as far as possible before implementing a credible carbon offsetting strategy for any residual emissions. It would be prudent for Oxford to minimise reliance on offsetting, as far as is possible, particularly given the uncertainty and nascency of the offsetting market for removals. This includes large companies investing in carbon reduction measures within the city, to reduce the amount of offsetting for the city as a whole.

Offsets can be divided into three main classifications:

1. Avoided natural depletion (e.g. avoided deforestation);

2. Avoided emissions (e.g. renewable energy projects, replacing kerosene cook-stoves with solar-powered alternatives); and
3. Greenhouse Gas Removal (GGR).

GGR methods include: biological uptake, such as forestation, peatland and soil carbon sequestration; neutral inorganic reactions, such as enhanced terrestrial weathering, mineral carbonation and ocean alkalinity; and engineered removal, such as direct air capture and low-carbon concrete. Some of these methods offer potential co-benefits of also delivering on biodiversity, flood resilience and wellbeing goals.

It is the view of many across the decarbonisation sector (including Friends of the Earth, WWF, WRI & the Science Based Targets Initiative) that carbon neutrality can be achieved through a range of offsets (including avoided natural depletion and avoided emissions), whereas net-zero can only be achieved through certified GGRs. This is line with the current (not universally agreed) definition of net-zero.

The forthcoming Greenhouse Gas Protocol guidance on accounting for land sector activities and CO_2 removals expected in 2021/22, and will contain guidance on the transparent and robust accounting of emissions sequestered as a result of GGR activity Given the huge uncertainty regarding the future market for certified GGRs and the lack of guidance regarding how to account for GGRs, it is recommended that ZCOP await further certainty and the publication of this guidance before finalising its offsetting strategy.

Sector analysis

A sectoral breakdown of the results from the updated scenario shows the amount of decarbonisation required for each sector to meet Oxford's 2040 net-zero target. Figure 3 shows the emissions reductions from 2020-2040, with percentage change overlaid.

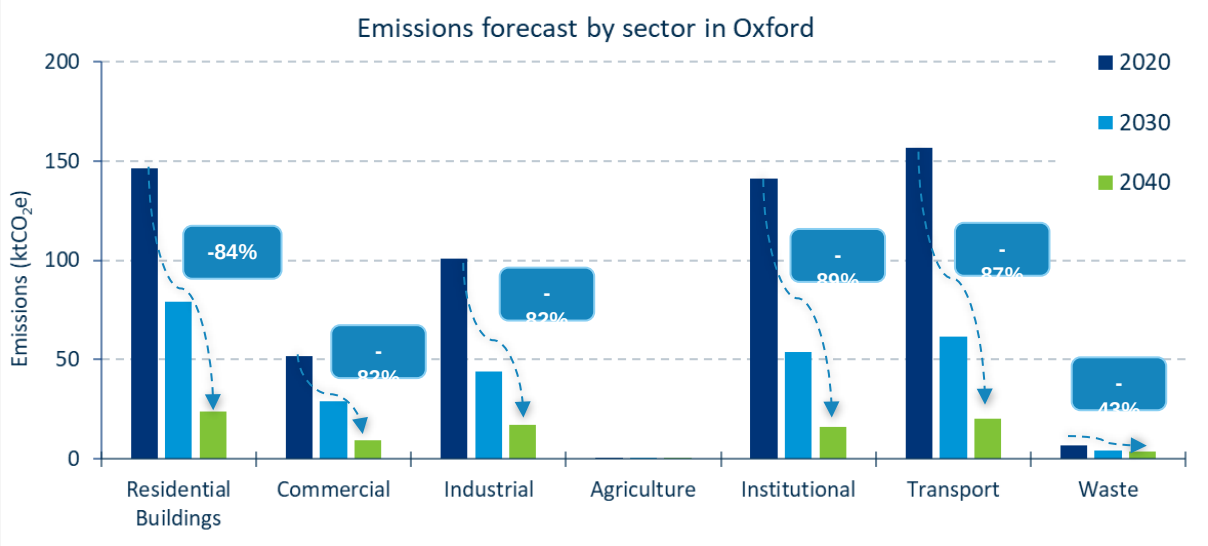


FIGURE 3: MODEL OUTPUT: 2020, 2030 AND 2040 EMISSIONS PROJECTIONS FOR EACH SECTOR CONSIDERED IN THE PATHWAY ANALYSIS

Residential

There are around 55,000 homes in Oxford, with over 60% rated EPC D or below. The strategy for decarbonising buildings in Oxford (Residential, Commercial and Institutional) can be summarised by the uptake of energy efficiency (both building fabric improvements and smart appliances), electrification of heat, and installation of rooftop (or commercial-scale) solar PV. With these measures, it is expected that the average household energy demand (for gas and electricity sourced from the national grids) falls by 61% in 2040.

Retrofit fabric improvements is a high priority for this sector, considered essential not only in reducing carbon impact, but also reducing strain on the electricity grid, which is expected to spike in a 'high heat pump' scenario. The rollout of different energy efficiency measures is summarised in Figure 4 below.

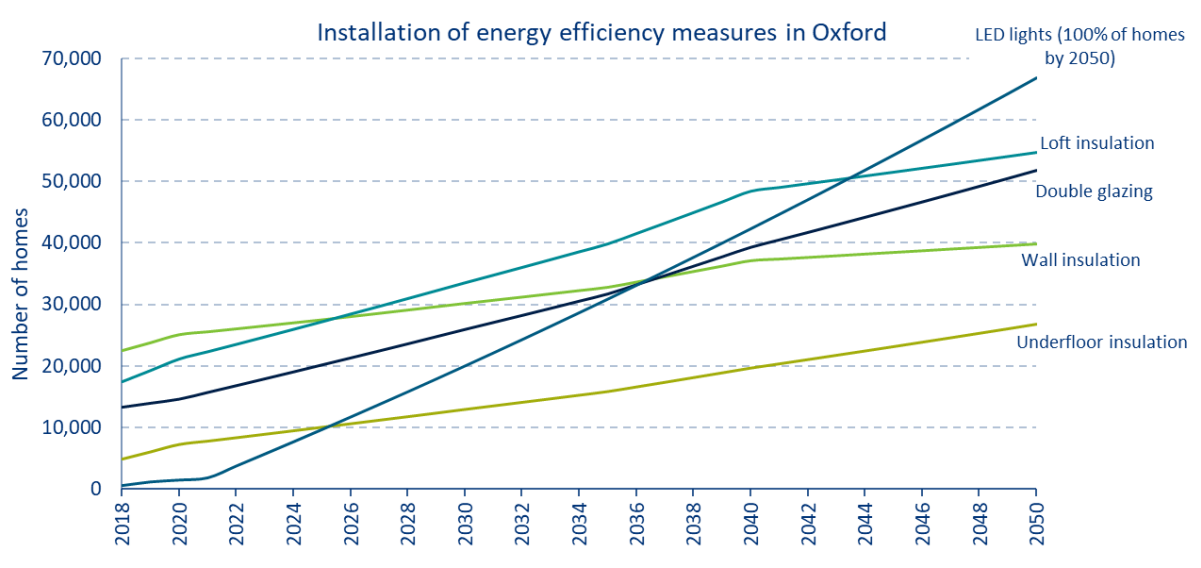


FIGURE 4: REQUIRED ROLLOUT OF ENERGY EFFICIENCY MEASURES IN OXFORD'S EXISTING HOUSING STOCK

The conversion of the gas grid to 100% hydrogen has not been modelled in the scenario due to local constraints regarding the large-scale production and storage of hydrogen. Consequently, a large-scale rollout of domestic heat pumps has been modelled as the main heat solution for homes in Oxford, with over 30,000 air-source heat pumps installed by 2040, equating to an annual deployment rate of 2,100 heat pumps per year. Figure 5 shows the change in domestic heat technologies to 2040.

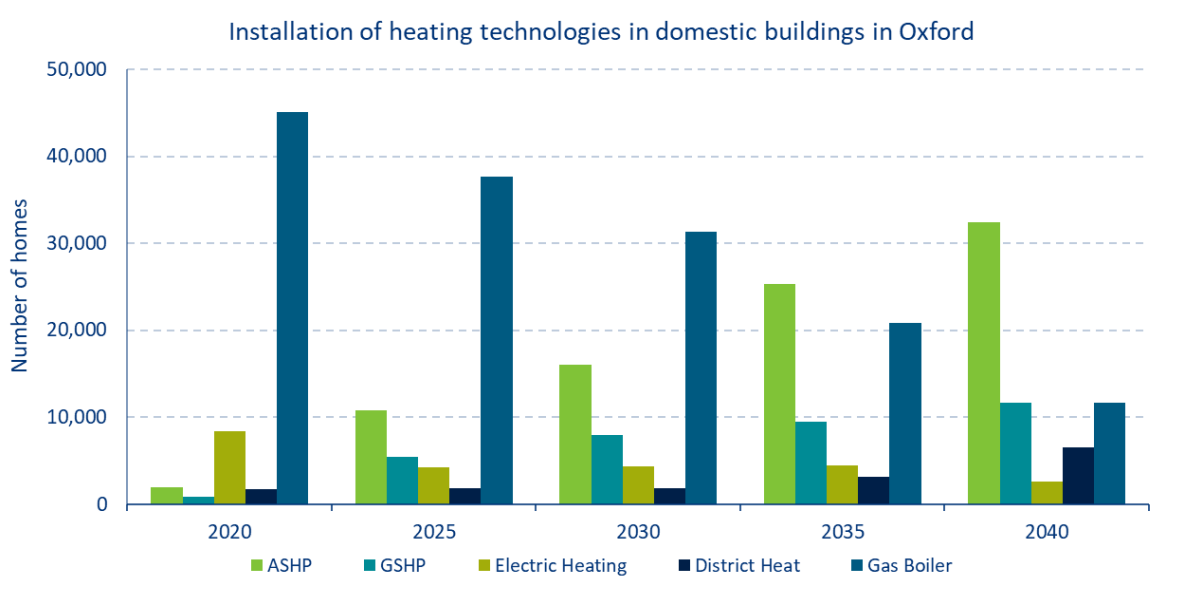


FIGURE 5: REQUIRED DEPLOYMENT OF HEATING TECHNOLOGIES IN OXFORD'S EXISTING HOUSING STOCK

The CCC 6th Carbon Budget dataset[12] suggests that the UK requires a deployment rate of around 1,000,000 heat pumps per year to reach net-zero carbon by 2050, which equates to approximately 1,900 per year for Oxford (0.19% of homes). This is not solely a challenge of installation (for example balancing other considerations, like heritage), but also one of supply, including upskilling contractors and increasing technology production.

Commercial

Commercial emissions account for 9% of the baseline in Oxford (64.8 $ktCO_2e$). As with residential, the commercial sector is expected to decarbonise through fabric improvements, the electrification of heat and site-level solar PV. The measures outlined in the assumptions section (Appendix 1) result in a 49% decrease in energy demand by 2040.

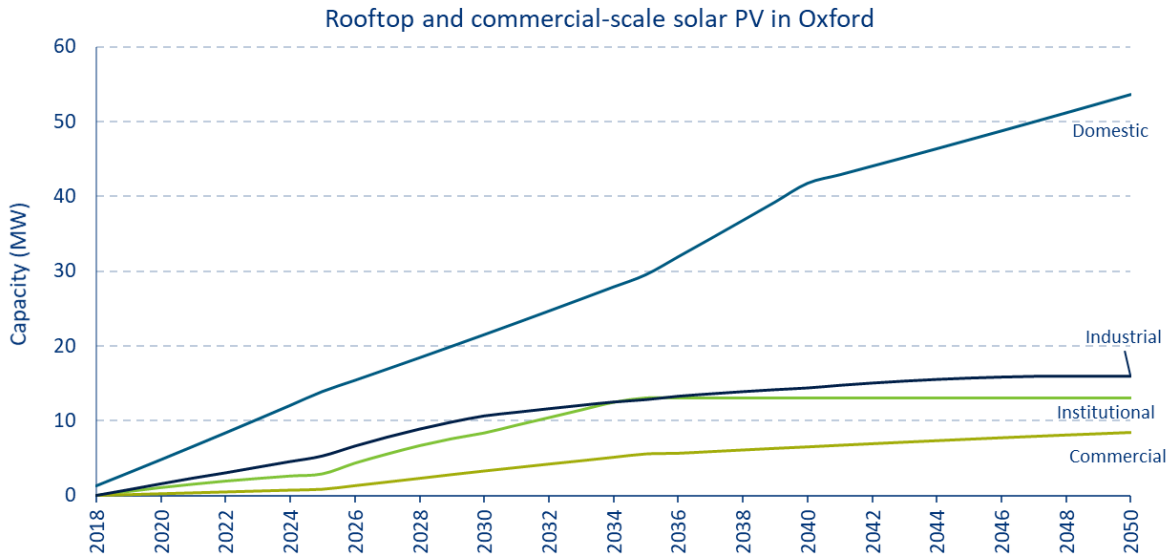


FIGURE 6: REQUIRED ROLLOUT OF SOLAR PV ACROSS SECTORS

Industrial

Prevalent industries in Oxford include the automotive, high-tech engineering and pharmaceuticals sub-sectors. As with residential and commercial buildings, industrial buildings in Oxford are expected to decarbonise through fabric improvements, the electrification of heat and site-level solar PV, but with the addition of the electrification of processes and improvement of process efficiency.

According to BEIS, it is expected that the electricity grid will see rapid decarbonisation through large-scale deployment of renewables while the gas grid remains carbon intensive. It is, therefore, important to electrify industrial processes that have a high reliance on gas. Currently, an estimated 66% of industrial processes in Oxford run on gas, this is required to reduce to 42% by 2040.

Institutional

The institutional sector comprises the following organisations:

- University of Oxford ,
- Oxford Brookes University,
- College buildings,
- Oxford City Council,
- Oxfordshire County Council,
- Oxford Health NHS Foundation Trust
- Four hospitals within the Oxford University Hospitals NHS Foundation Trust,
- Other educational establishments,
- GP surgeries,
- Community buildings,
- Religious establishments etc.

As with residential and commercial buildings, institutional buildings in Oxford are expected to decarbonise through fabric improvements, the electrification of heat and site-level solar PV.

The level of ambition for the institutional sector has been raised above that of the commercial sector as there are fewer organisations that have direct control over a larger number of buildings, the organisations are already well engaged with the ZCO Partnership, and have also set ambitious decarbonisation strategies. As a result of the modelled interventions, institutional energy demand will fall by 64% in 2040.

Transport

According to DfT, there were over 60,000 cars in Oxford in 2019, 0.8% of which were low-carbon. The strategy for decarbonising transport involves the rapid electrification of vehicles, the use of hydrogen and biofuels for heavy-duty vehicles, modal shift from private car usage towards increased public transport-use, and decreased overall use of road transport through cycling, walking, work-from-home, and car sharing.

A breakdown of the projected change in vehicle numbers by type is shown in Figure 6 below.

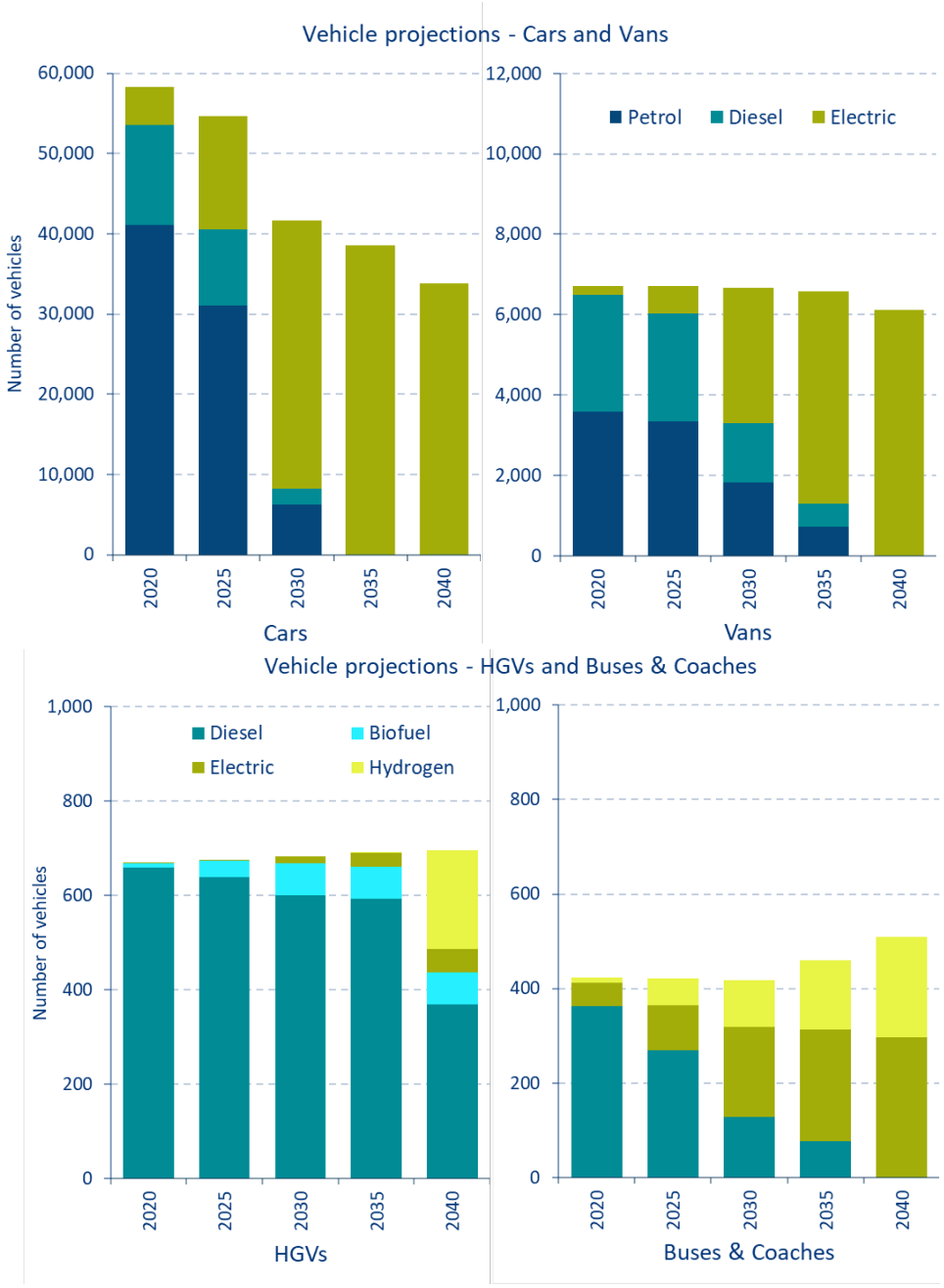


FIGURE 7: VEHICLE PROJECTIONS TO 2040 BY FUEL, SHOWING (FROM TOP LEFT TO BOTTOM RIGHT) CARS, VANS, HGVS AND BUSES & COACHES

Oxford Bus Company (who manage half of Oxford's buses) have a strategy in place to convert their long-distance fleet to hydrogen, recognising the current performance limitations of electric buses at high speeds and longer distances. However, this scale of fuel-switching would require both funding from central government, and the development either of a local hydrogen electrolysis production facility, or a local facility for storage and dispensing of pressurised hydrogen in order to fuel the vehicles each day.

Looking at electric vehicle (EV) infrastructure, by scaling the National Grid FES projection for EV chargers to the rollout for EVs included in this scenario, the number of chargers (by type) needed to meet demand has been estimated.

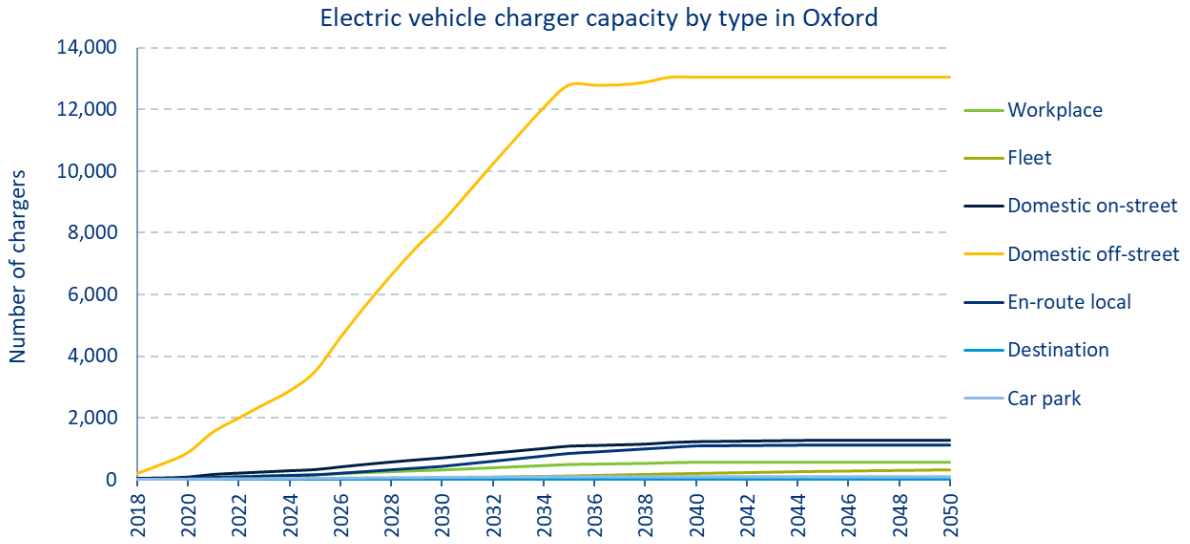


FIGURE 8: ELECTRIC VEHICLE CHARGER PROJECTIONS TO 2040 BY CHARGER TYPE

Waste

Oxford already has a robust waste strategy in place. The city has a high recycling rate of ~50%13 and most non-recyclable rubbish (~95%) is processed at the Ardley Energy Recovery Facility, which has a capacity of 24 MW. The council also collects food waste which is processed at the Cassington Anaerobic Digestion facility, also outside of the city. There remains, however, potential to lower the emissions associated with wastewater; Thames Water (who operate the water treatments works just south of the city) have committed being a net zero organisation by 2030[14] and Ofwat have committed to reducing leakages 50% by 2050.[15]

Residual emissions

As discussed under 'the role of offsetting', there is expected to be some residual emissions in 2040, representing hard-to-decarbonise emissions sources that may be difficult to influence. For Oxford to meet it's 2040 net-zero target, the 'residual' emissions require an offset strategy which should be developed well-in advance. A breakdown of the 2040 residual emissions and energy consumption, projected in the pathway analysis, is shown in Figure 9.

[13] Oxfordshire Environment Partnership, 'Oxfordshire's Resources and Waste Strategy'. Available from: https://www.oxfordshire.gov.uk/sites/default/files/file/waste-and-recycling/OxfordshiresResourcesandWasteStrategy_0.pdf
[14] Thames Water, 'Climate Change'. Available from: https://www.thameswater.co.uk/about-us/responsibility/climate-change
[15] Ofwat, 'Leakage'. Available from: https://www.ofwat.gov.uk/households/supply-and-standards/leakage/

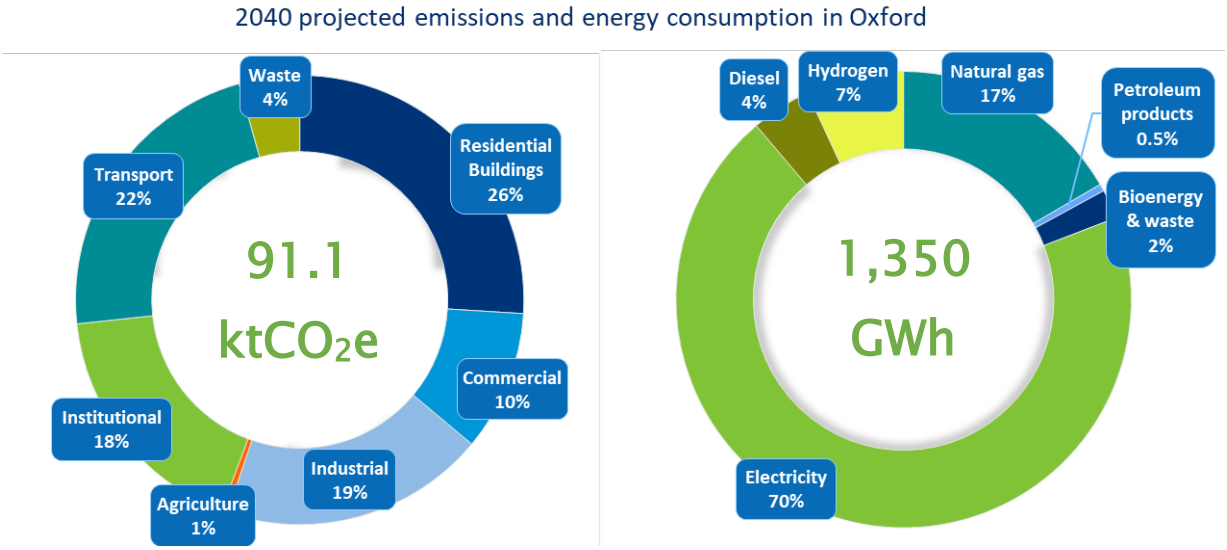


FIGURE 9: 2040 PROJECTED EMISSIONS BY SECTOR (EXCLUDING LAND USE, LEFT) AND 2040 PROJECTED ENERGY CONSUMPTION BY FUEL TYPE (RIGHT)

Just over half of 2040 residual emissions in Oxford arise from the buildings sector (49 $ktCO_2e$) which relates to both electricity and gas consumption. Although only small percentage of buildings are expected to still be connected to the gas network in 2040 (i.e. 18% of homes), the carbon intensity of natural gas is projected to be around 2.5x greater than that of electricity,[16] despite the level of hydrogen blending and biogas injection measures imposed. Further decarbonisation is expected to take place in the long-term to 2050, as more renewables are deployed on the grid and the remaining properties connected to the gas network switch fuels. The projections for the rollout of heat pumps are based on DFES and CCC, however, it is feasible that Oxford could accelerate this rollout at a quicker pace than the national and regional averages, and a key challenge to the ZCOP should focus on how it can collaborate with others to increase the pace of the transition away from gas pace locally to further reduce residual emissions in 2040.

Similarly, the residual emissions in the industrial sector arise from electricity and gas consumption, however, the long-term decarbonisation potential for this sector is less certain. The reliance on gas for many manufacturing processes in Oxford make it difficult to switch to electricity, and therefore, alternative measures, e.g. hydrogen, should be considered. Further investigation into the potential role of hydrogen in the industrial sector in Oxford should be undertaken.

For transport, the main source of 2040 emissions are from remaining diesel freight transport, i.e. HGVs, which have been modelled as gradually converting to hydrogen in the long-term to 2050 in line with National Grid's 'Leading the Way' Future Energy Scenario.

[16] BEIS, 'Energy and emissions projections'. Available from: https://www.gov.uk/government/collections/energy-and-emissions-projections#updated-energy-and-emissions-projections; including projected carbon factors for the electricity grid to 2050.

ROADMAPS

Chapter 2

Roadmap aims

Building on the updated scenario model, decarbonisation roadmaps have been developed for five keys sectors in Oxford[17]:

- Domestic
- Commercial
- Industrial
- Institutional
- Transport

These roadmaps are fed directly by the scenario modelling, extracting the key milestones for each sector to map out a timeline of 'what needs to happen, and by when' for Oxford to be on-track to achieve net-zero by 2040. The roadmaps provide an important step in breaking down the overall net-zero vision into more tangible pieces, looking at 5-yearly periods by sector, and form the basis from which the actions set out in the action plan have been developed.

Alongside sector-specific requirements presented in the roadmaps, there are some figures, such as those around energy generation, grid flexibility and blending, that are included across multiple roadmaps. This is due to their cross-cutting role in both directly contributing to overall emissions reduction and unlocking wider activity.

The sectoral roadmaps provide a more detailed view of the technical net-zero transition requirements within each sector, and provide a common 'vision-setting' reference point for the ZCO Partnership to use in allocating focus and developing actions going forwards. More detailed tables setting out the specifics of each area of activity are provided in Appendix 3 to provide both a more granular view of year-on-year change, and a potential basis for monitoring progress.

Additional to the sector roadmaps, an over-arching strategic roadmap lays out the 5-yearly sectoral decarbonisation requirements, positioning them alongside wider contextual changes at national and regional-levels drawn from across the sector-specific roadmaps. This roadmap is intended for a high-level audience, with the intention of clearly communicating the relative pace of activity that is required across Oxford's five key sectors.

It is important to note that the roadmaps do not propose specific actions the ZCO Partnership could take to support Oxford in reaching net-zero in 2040, but rather draw attention to the focus areas, which will then be addressed through the action plan.

Flexibility and monitoring

While the numbers set out in the roadmaps may be seen (and practically used) as specific milestones, it is important that a degree of flexibility is considered. This is especially relevant in the mid-term (late 2020s into the 2030s) where the context is less concrete and there may

[17] Given the minimal contribution from the agricultural sector to carbon emissions in Oxford, and the aim for the roadmaps to be feeders for action in priority focus areas, a separate roadmap for agriculture has not been developed. Additionally, waste requirements have been included within the domestic, commercial and industrial roadmaps.

be changes, both in terms of strengthened or weakened enabling factors. More broadly, with the roadmap covering a lengthy timescale there is a risk of rigidity over 'locked-in' technology pathways. New innovative solutions, as well as decisive national government steer (such as the expected decision on the long-term decarbonisation of heat in the mid-2020s) on rollout, could substantially alter the current technology mix.

In the face of this uncertainty, an approach to the roadmaps that builds-in resilience is to consider the net-zero pathway requirements as indications of 'level of effort', which could be roughly transposed across to other solutions as needed. In addition to this, focusing on the nearer-term periods of the roadmap (up to 2025 and 2030), and accepting that uncertainty will require a substantial degree of flexibility regarding later years, will ensure practical progress is prioritised above defining a set path.

Periodic reviews of the scenario and roadmap (at least every 5 years) will support readjustments based on changing circumstances, as well as evidence progress towards the overall 2040 net-zero target. Additionally, where deployment data is available it can be monitored against the roadmap monitoring tables. This data is currently difficult to gather and access, however the tables present a number of different options for monitoring, and could be initially used simply based on the data that is available. In cases where dependencies or other challenges delayed implementation, for example, expected time required for the heat pump industry to scale, pathway requirements can be rolled-forwards as increased ambition in later years. This however presents two risks, firstly, the need for implementation to scale rapidly following the removal of barriers, and secondly, that potential delays could increase the residual emissions requiring offsetting.

Development process

The net-zero pathway requirements have been directly extracted from the updated 2040 net-zero scenario. This scenario for Oxford reflects the latest developments in terms of policy, emission projections and input from the ZCO Partnership. Chapter 1, scenario modelling, sets out the methodology and Appendix 1 explains in detail both the general and sectoral assumptions. The pathway requirements are based on the same assumptions agreed with the ZCO Partnership during the scenario workshops. These include:

- Overall reduction in emissions
- Reduction of electricity demand
- Reduction of heat demand
- Reduction in fossil fuel demand
- Installation of specific energy efficiency measures
- Installation of rooftop solar
- Installation of heat pumps
- Heat network connections
- Construction of new (high efficiency) homes
- Recycling rate
- Electrification of industrial processes
- Gas grid blending with biogas and hydrogen
- Vehicle conversion to alternative fuels (hydrogen and biofuel)
- Electrification of cars, motorcycles, LGVs, HGVs, buses and coaches
- Electrification of rail
- Deployment of EV chargers

- Modal shift including increase in public transport use, as well as cycling, walking, working-from-home and car sharing

Each roadmap also includes a context pathway, summarising wider information on activities that are expected to support the transition to net-zero, such as national, regional and local regulations, policies and plans. This contextual information has been drawn from national and regional strategic documents, as well as local authority area plans, programmes and policies, and some have themselves been included as key enabling factors and focal points of momentum. For consistency, the contextual information included has been selected on the grounds that the policy, proposal or target could accelerate, be a dependency or even a challenge for the relevant net-zero pathway requirements of that sector. The roadmaps were developed with strong engagement from the ZCO Partnership, starting with discussions around the revised scenario assumptions, followed by a detailed review session, and finally the use of the roadmaps in each of the action identification workshops. Outside of these structured engagement and collaboration sessions, commentary and information was also received from partners via email, strengthening the contextual foundation of the roadmaps.

NOTE – The action plan follows directly on from the roadmaps, setting out specific, tangible actions to deliver the pathway requirements extracted from the scenario modelling and presented in the roadmaps and monitoring tables. The action plan digs deeper into the national-level dependencies and cross-cutting regional enabling actions included as context for the roadmaps.

HOW TO READ THE ROADMAPS

The coloured arrow is the roadmap itself. Each differently shaded section, following the launch of the action plan, refers to a different five-year period. The roadmap is mainly populated with *net-zero pathway requirements*.

The grey arrow is the national, regional and local context of the roadmap. This flags key policies which could help or hinder efforts to follow the roadmap, and also indicates areas of government focus as well as upcoming decision-points.

ZCO Partnership actions

Actions that are being delivered by, or have been committed to, by ZCO partners.

UK Government actions

Actions that are being delivered by, or have been proposed, by UK Government.

Local authority actions

Actions that are being delivered by, or have been committed to, by local authorities.

Net-zero pathway requirements

'What needs to happen, and by when' milestones extracted from the scenario analysis.

Strategic

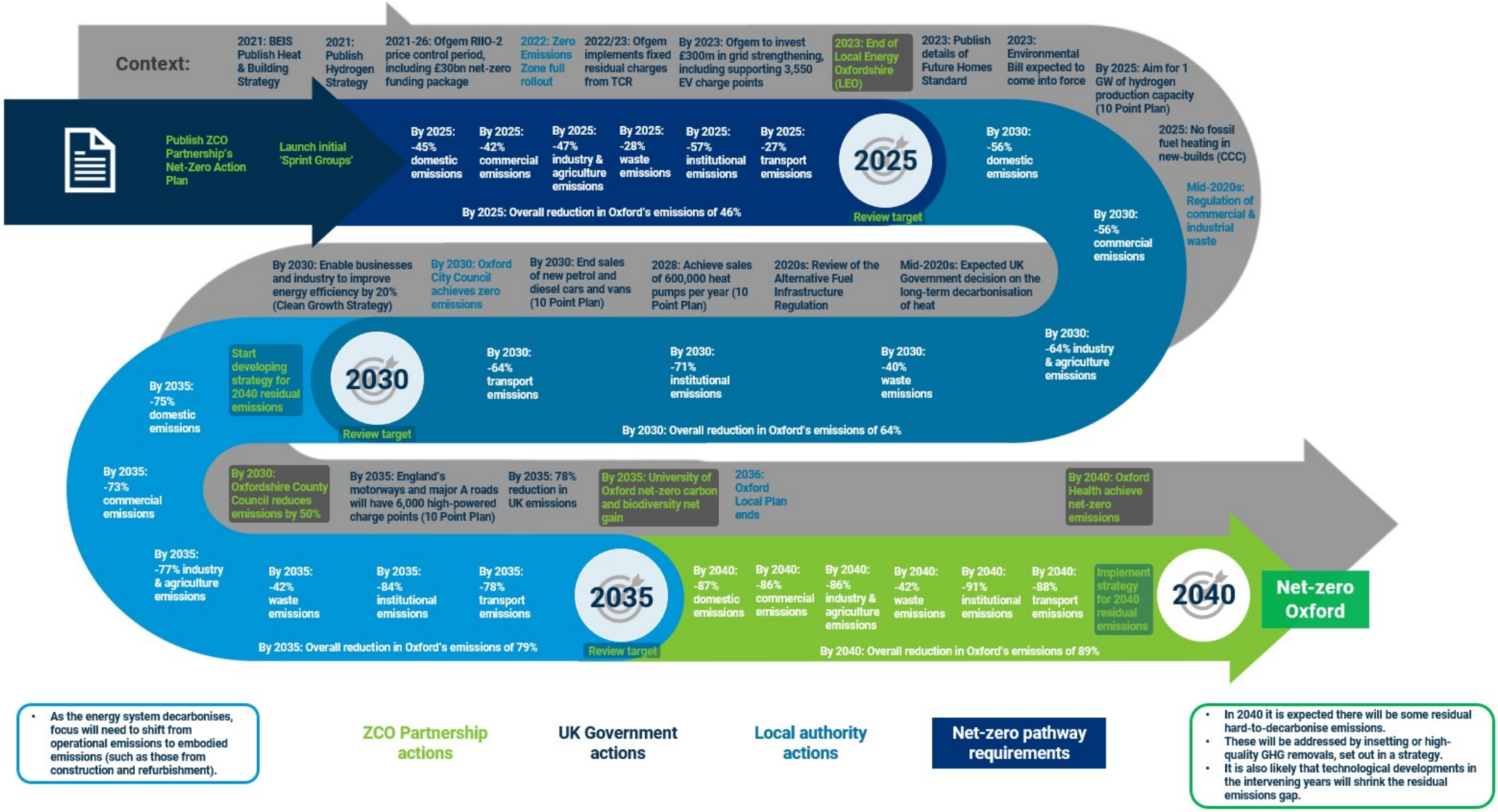


FIGURE 10: OVER-ARCHING STRATEGIC ROADMAP

Domestic

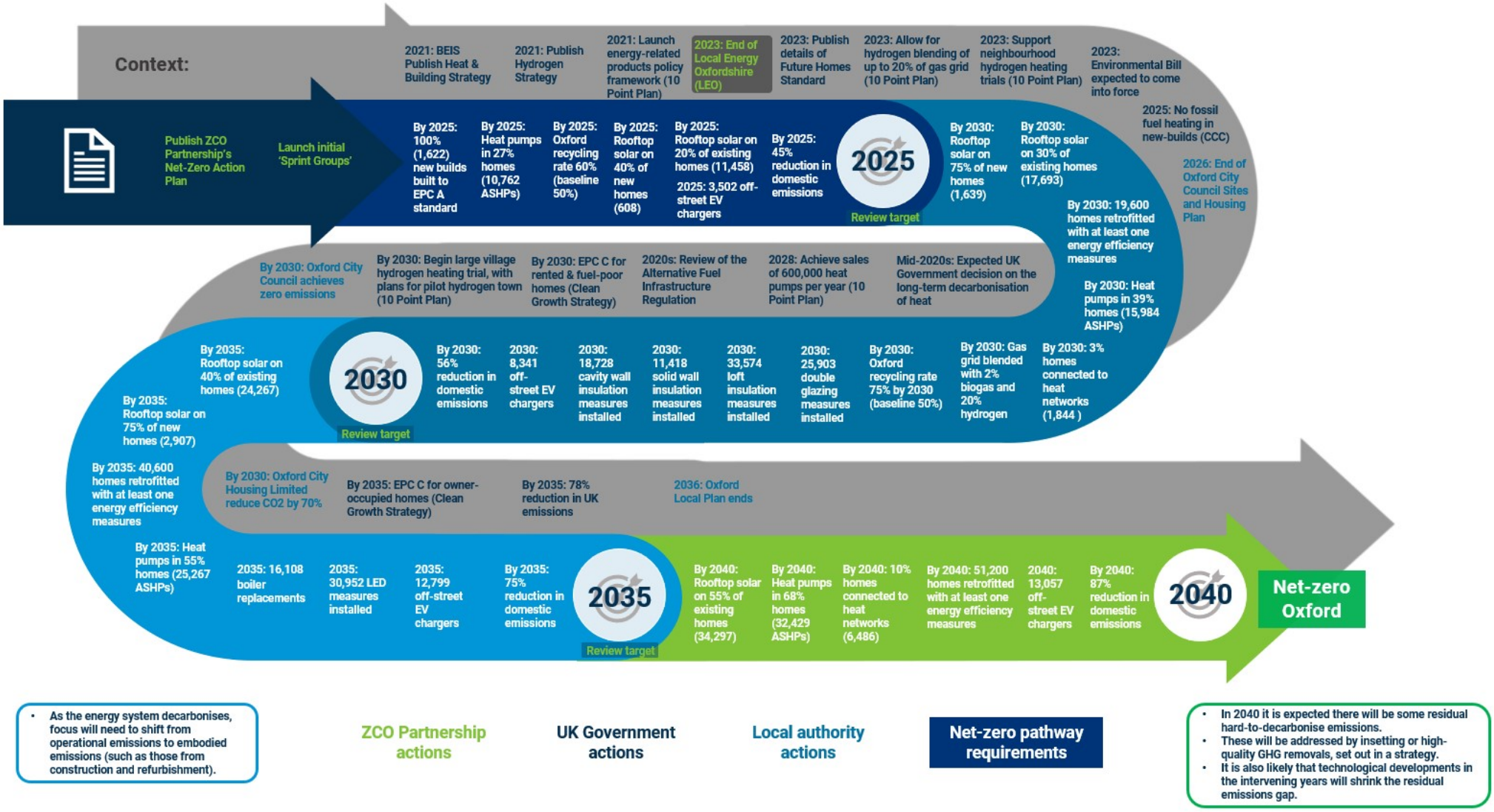


FIGURE 11: DOMESTIC SECTOR ROADMAP

Commercial

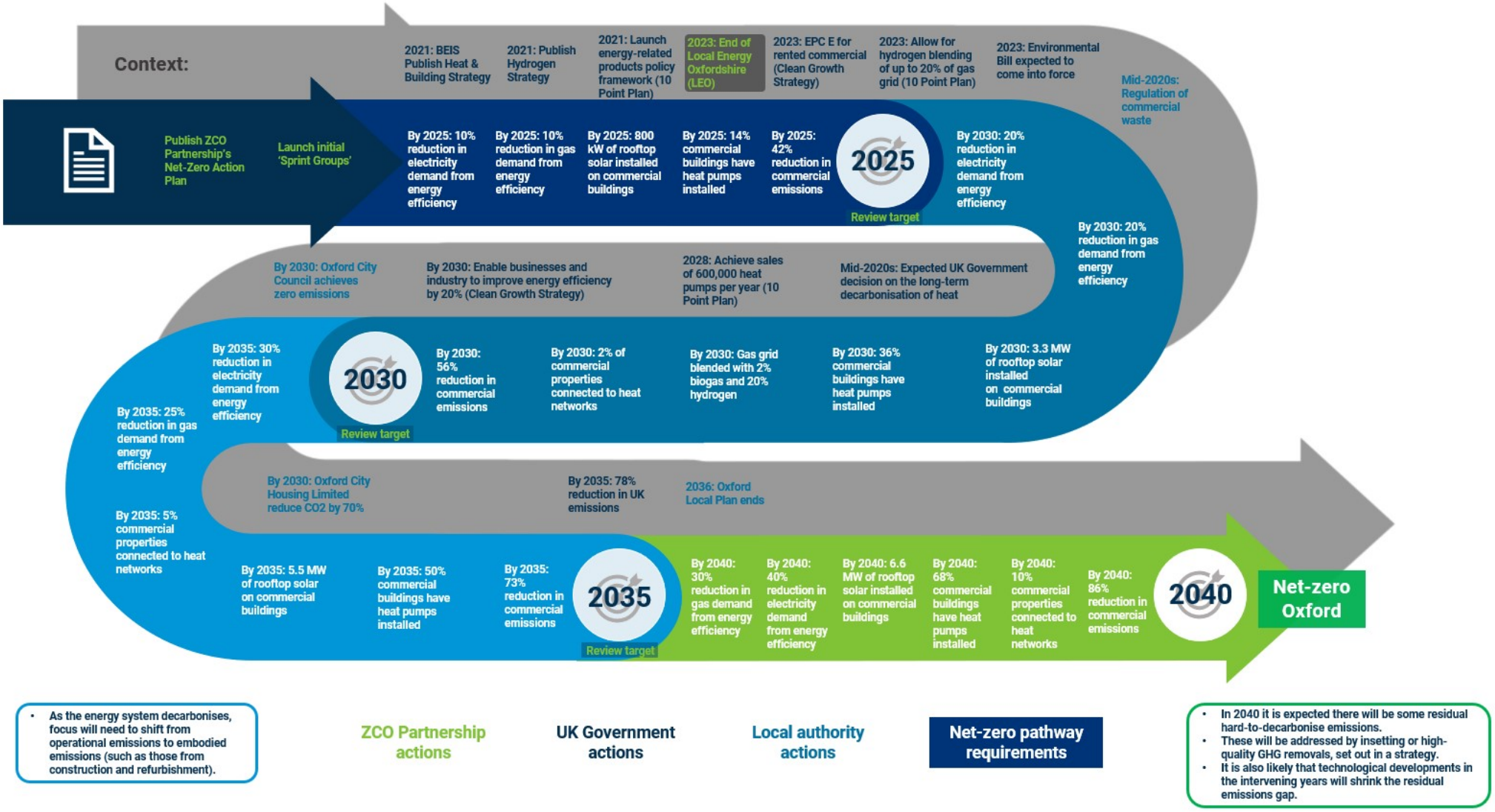


FIGURE 12: COMMERCIAL SECTOR ROADMAP

Industrial

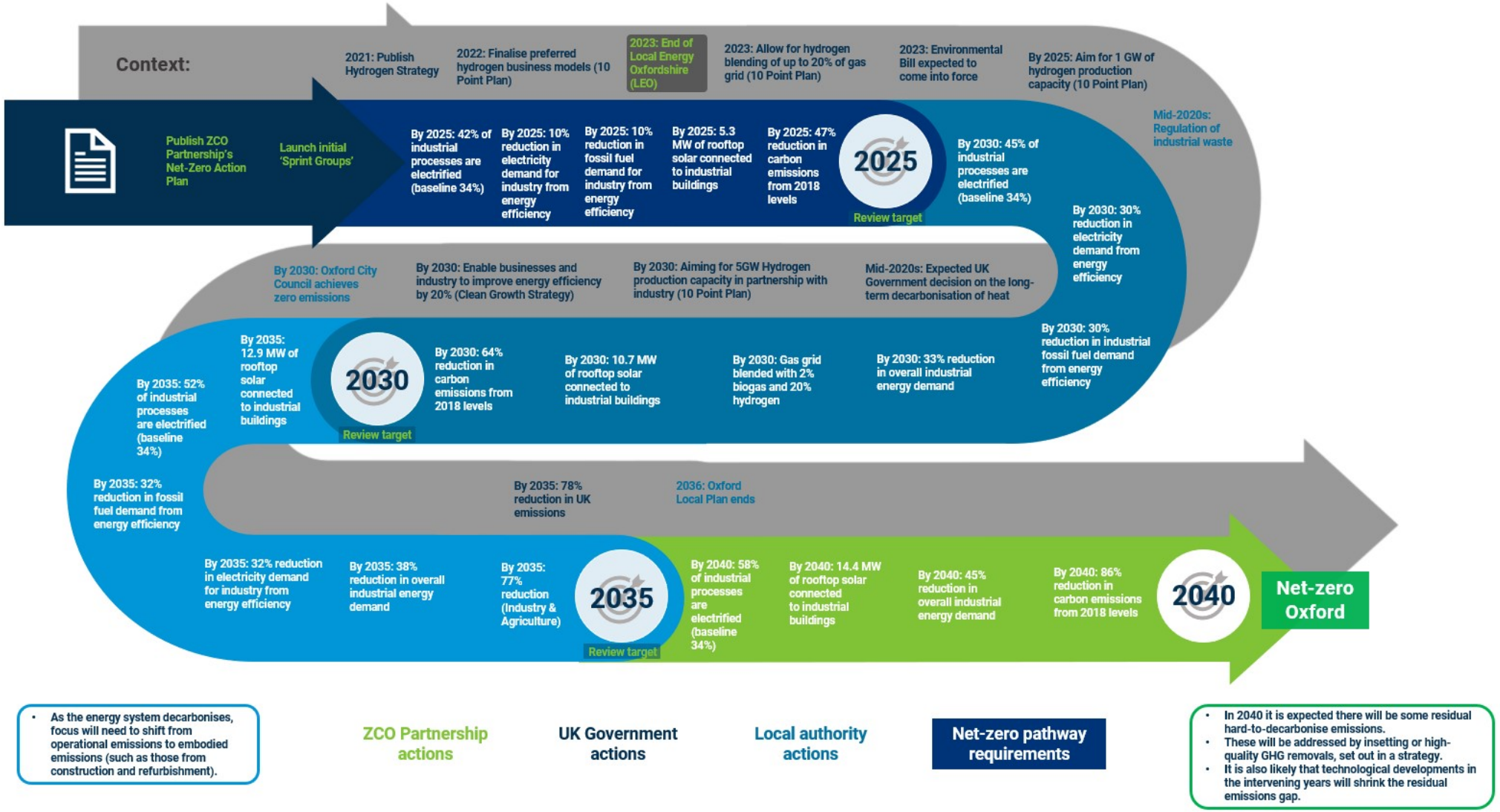


FIGURE 13: INDUSTRIAL SECTOR ROADMAP

Institutional

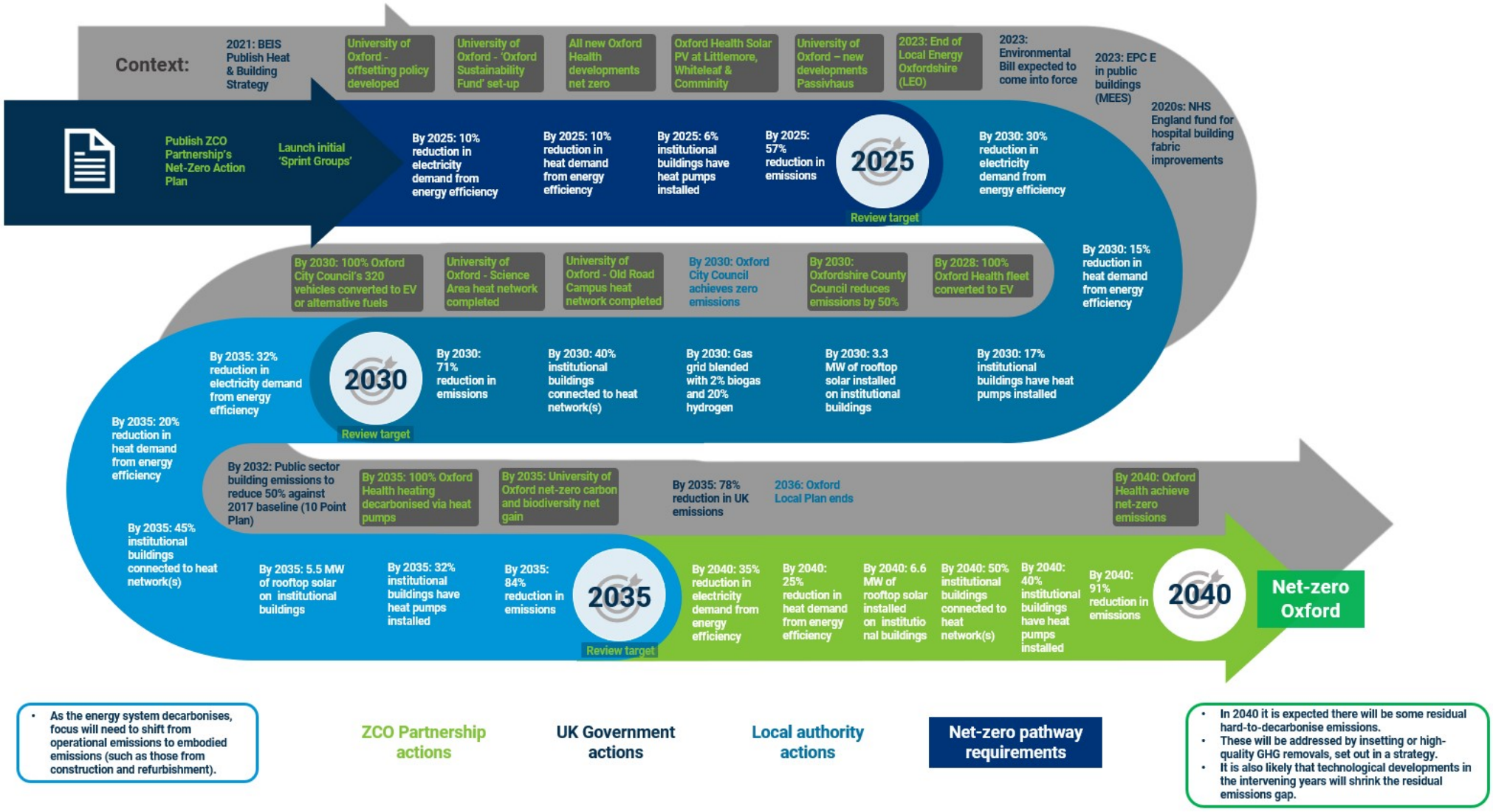


FIGURE 14: INSTITUTIONAL SECTOR ROADMAP

Transport

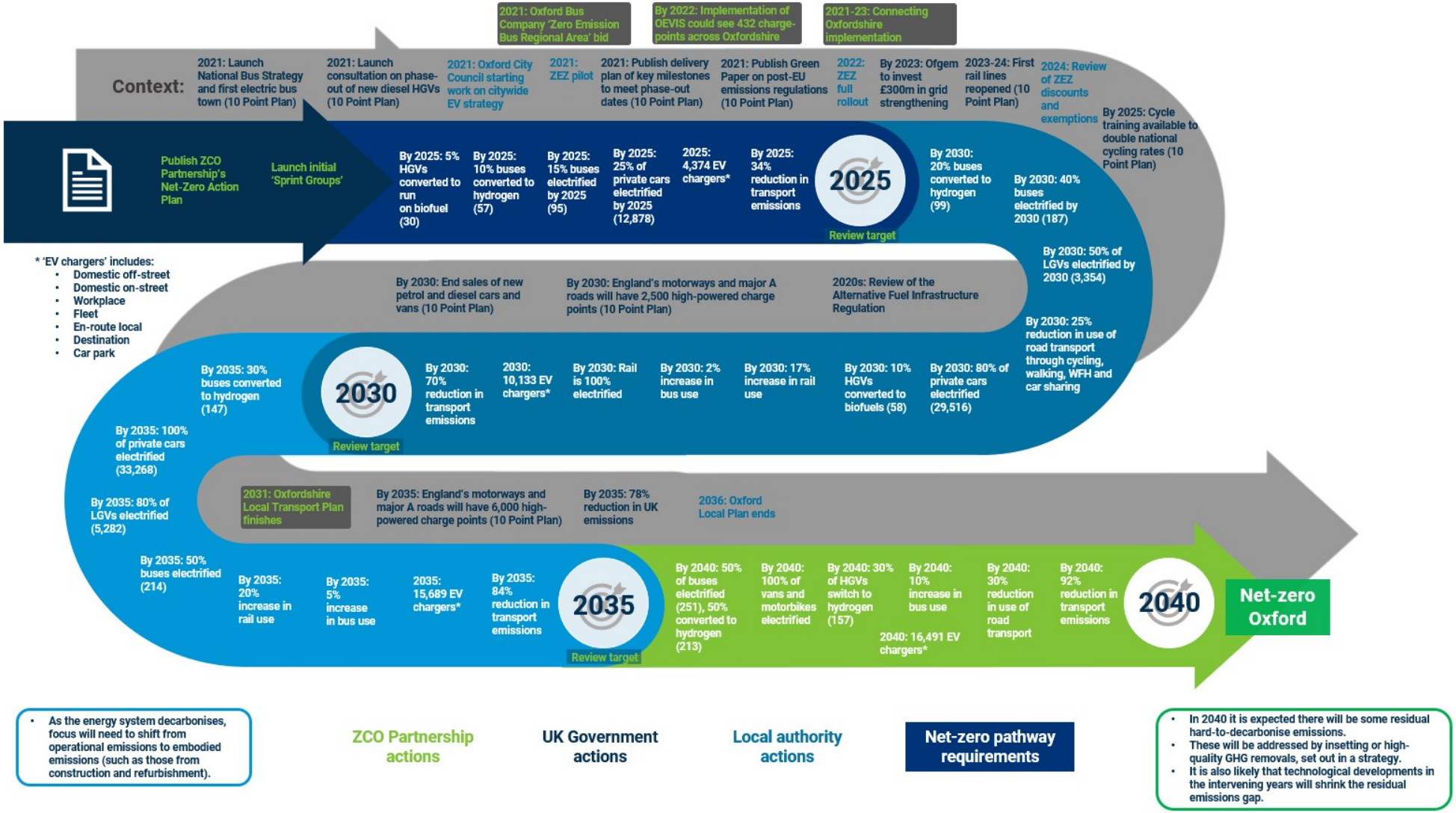


FIGURE 15: TRANSPORT SECTOR ROADMAP

ACTION PLAN

Chapter 3

Purpose of the action plan

This action plan provides a clear initial direction and series of steps for the ZCO Partnership to follow to set Oxford on a path to net zero by 2040. It lays out a pipeline of near-term and mid-term priority actions for the partnership to consider and drive forwards using Sprint Groups. The pipeline of actions represents a starting point around which to build momentum and galvanise partners, as opposed to an exhaustive list of all actions required to achieve the 2040 net-zero Oxford target.

In addition to the overview of 25 key action concepts for progression by the partnership, wider suggestions from partners have also been included, as well as likely themes that will require further consideration and focus between 2030-2040. The reason for focusing the 25 key actions on pre-2030 interventions is that (i) the purpose of the action plan is to guide fast-moving, tangible progress, and (ii) the context surrounding actions post-2030 may have changed considerably (and in unforeseen ways) from the existing context, making any detail provided of reduced utility to the partnership. It is envisaged that, as the partnership works through the pipeline of key actions presented, it can draw on these highlighted focus areas to add new actions to the pipeline.

Development process

The action plan has been closely informed by the updated scenario, via the key net-zero pathway requirements extracted into the roadmaps, and particularly those figures indicating the scale of deployment of various technologies across the key sectors (such as ASHPs, solar PV or cavity wall insulation). The pipeline of actions was drawn from the existing pipelines of ZCOP partners (building on existing activity), external documents highlighting good practice, innovations and successes implemented elsewhere, and ideas generated

through five workshops.

The five workshops were themed by sector (domestic, commercial, industry, institutional and transport) and ideated potential actions collaboratively using Mural and paying close attention to the relevant sector roadmaps. The full ZCOP Net-Zero Actions Pipeline is available as a supporting file in Excel format.

Input from the partners, external sources and workshops were collated into a pipeline, with common actions grouped. The resulting list of potential actions was critically reviewed against the strategic net-zero aims for Oxford, in collaboration with Oxford City Council, before deep-dive interviews focusing on specific actions with relevant partners or groups of partners were organised. These delved deeper into the details of the concept suggested by the partner, and established an understanding of potential appetite to implement, what those implementation steps could be, and what role different partners could be willing to take.

Cost-Benefit Analysis

An indication of potential costs and impact have been provided for five key, near-term actions in the pipeline. These are high-level and should be taken to indicate 'order of magnitude'.

For three (P1, R1, C1), it has been possible to use assumptions and benchmarks to calculate investment costs and carbon savings. For others (G2, S1), the highly uncertain nature of the action details at this stage have necessitated taking a 'case study' approach, laying out costs and impacts from similar actions implemented elsewhere. For the wider pipeline, the specific activities of the actions need to be further defined before savings and costs can be estimated.

The ZCOP should complete detailed quantitative cost-benefit analysis as part of the detailed design process when progressing a key action through a sprint group.

How to read the action plan

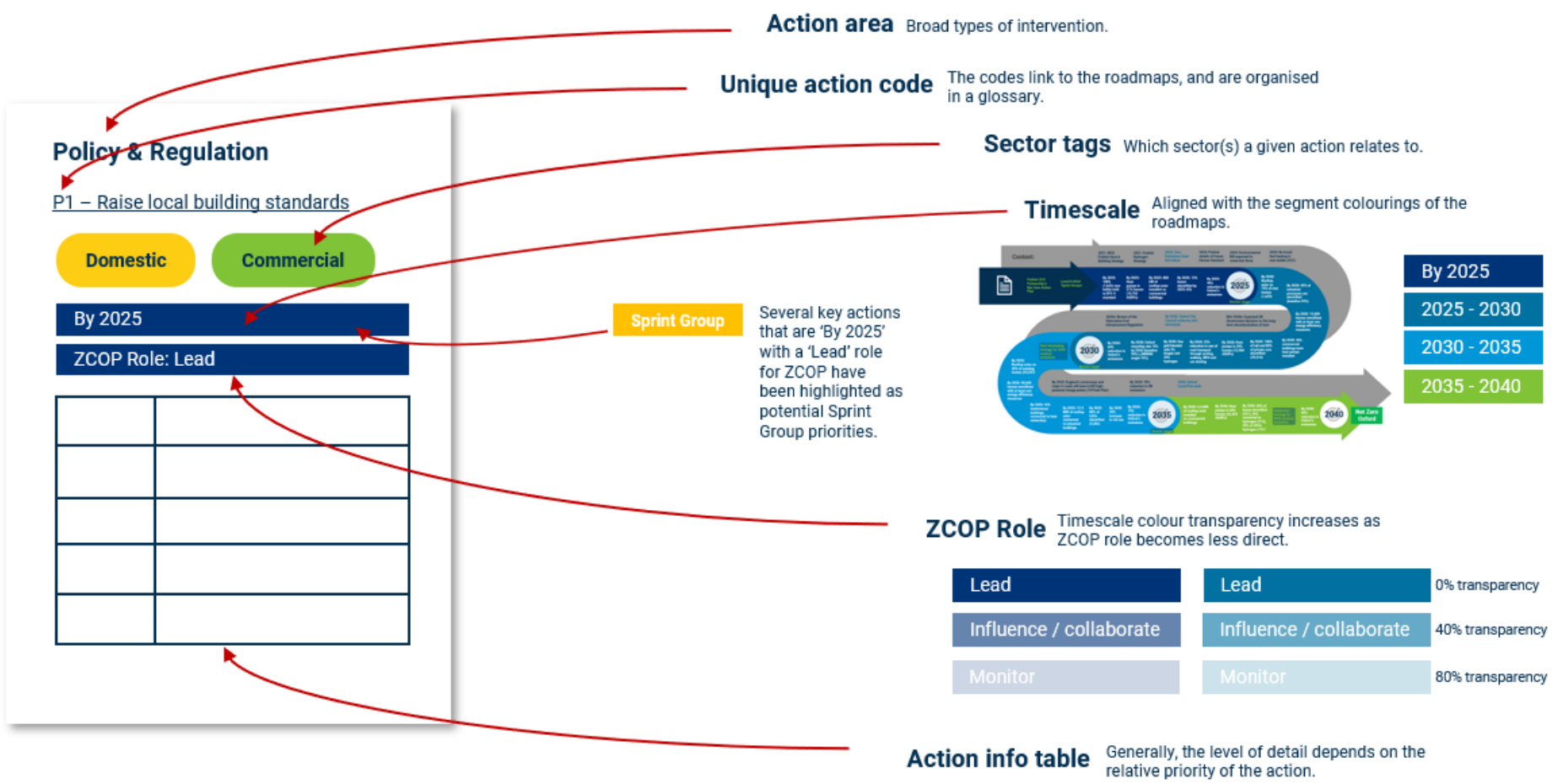


FIGURE 16: GUIDE TO READING THE ACTION PLAN

Implementation

This action plan has been developed specifically for the ZCO Partnership to own and implement. The key hinge between the action plan document and on-the-ground implementation are the 'sprint groups'. These are task-and-finish groups that will be established around specific actions in the plan, and populated by the key ZCO partners required for delivery. Once the action has been completed, the sprint group will dissolve, and a new group will be established around the next selected action, with likely different partners involved. This approach has a number of benefits: (i) it keeps the groups agile, with fresh momentum, (ii) it ensures groups working on a given action are an expert team of relevant parties, (iii) it spreads the workload across partners. Below is a visual guide to how the actions, roadmaps and potential sprint groups fit together.

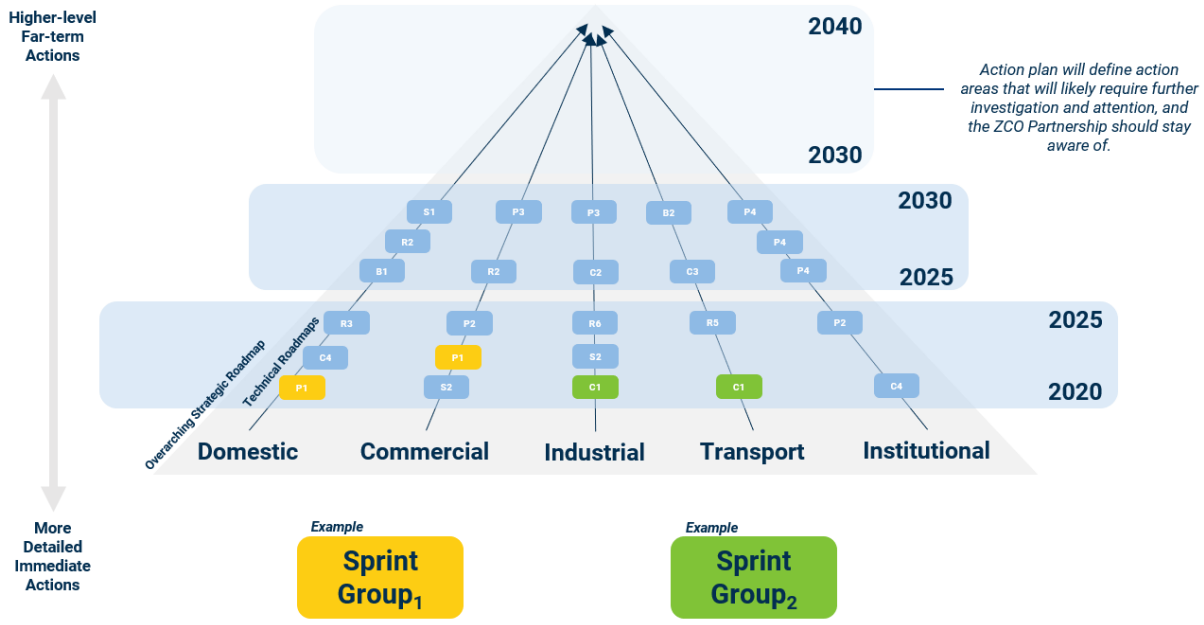


FIGURE 17: VISUAL REPRESENTATION OF HOW THE ACTIONS, ROADMAPS AND POTENTIAL SPRINT GROUPS FIT TOGETHER

The process involves the partnership selecting which actions should be looked at in more detail in each sprint group. As the nearer-term (pre-2030) actions are completed, the partnership will need to select and flesh out further actions, based on the highlighted action areas and any changes in context that has occurred.

Sprint groups

The draft 'terms of reference' for the ZCOP sprint groups can be summarised as:

"Sprint groups (Sprints) are smaller subgroups of the ZCOP intended to act as 'task-and-finish-groups' – established to achieve a specific objective within a defined time limit and subsequently dissolved upon completion.

Sprints will be established by the ZCOP Steering Group on an ad hoc basis to complete specific objectives. They will allow relevant individuals and organisations to come together to explore, action and deliver solutions to particular issues.

Participation in Sprints will be voluntary and open to all ZCOP partners. The ZCOP-Steering Group may choose to limit the number of participants in a particular Sprint for the sake of efficiency or quick decision making.

Sprints will ideally be made up of individuals and organisations with a particular interest, knowledge or influence in the subject of the group, and will be drawn from the membership of the wider Partnership and their stakeholders where appropriate."

It is important to recognise that the implementation of many of the actions in the pipeline is dependent on certain conditions being in place at the national and local levels. At the local level this is addressed through the 'cross-cutting' actions, and the interrelations between the actions in the pipeline at large. The key national dependencies are outlined below.

Enabling actions

'Enabling actions' is a term which encompasses a broad range of activity at a number of scales. In order to clarify this, we have chosen three distinct terms for the action plan:

National dependencies – Enabling actions under central government control

Local dependencies – Enabling actions that ZCO can control/influence

Action dependencies – Dependencies between the different actions in the action plan

National dependencies and policy deficit

It is important to recognise that in order to achieve its ambitious 2040 net-zero target, Oxford will require a considerable step-up in support from national government. This by no means implies that Oxford and the ZCO Partnership cannot forge ahead with real progress under current conditions, but instead seeks to underline the reality that, in order to unlock the transformational change laid out in the scenarios and roadmaps, government support in the form of clear leadership, policy and regulatory frameworks and funding are required. Whilst ambitions have been set around these, there is a current concern that documents such as the 10 Point Plan, while ambitious, lack substance and detail, and have not been followed up with real policy changes to date. The 'Achieving Net Zero' report of the House of Commons Public Accounts Committee, scrutinising UK government progress two years since setting the 2050 target, highlighted the "need to engage more with local authorities about how they can contribute, including ensuring they will have the necessary resources." This follows from 96% of local authorities reporting that funding is a barrier to their climate action, and 93% that legislation or regulations is a barrier.[18]

A number of the most significant national dependencies are laid-out in the context section of both the strategic and sector-specific roadmaps. Additionally, a number are summarised in the CCC's supplementary report 'Local Authorities and the Sixth Carbon Budget' (see Appendix 4). Drawing out a few key areas in greater detail:

- **Energy efficiency – new builds:** The UK Government is due to publish details of the Future Homes Standard (FHS) in 2023, providing advanced notice to the market prior to full adoption. The current proposals are that all new builds will be fitted with low carbon heating and high levels of energy efficiency from 2025, with emissions approximately 75-80% lower than existing building regulations, and zero carbon by 2030. Additionally, the government are consulting on an interim uplift in ambition pre-2025, a 31% reduction compared to current standards. However, following the consultation on the initial draft, a number of crucial elements remain highly uncertain, such as whether local planning authorities will have the power to bring forward the more ambitious FHS requirements to an earlier date. The UK is also in the process of

[18] House of Commons – Public Accounts Committee (2021), Achieving Net Zero: Forty-Sixth Report of Session 2019-21. Available from: https://committees.parliament.uk/publications/4921/documents/49419/default/

the most significant reform of the planning system in several decades, however, as of yet, few details regarding how this could impact issues of climate change have been shared. It is however high likely that embodies carbon will remain unaddressed. Better research and guidance on how to address embodied carbon will be required moving forwards, as this is currently a significant information and policy gap for the construction sector.

- **Energy efficiency – existing stock:** following the failure of the Green Homes Grant, there is a significant gap in the government funding required to support and accelerate the domestic retrofit market, even in the short-term. It has emerged that one weakness of the grant scheme was its requirement for suppliers to be TrustMark registered, a demanding process that many suppliers felt was not justified by the market opportunity. However, the UK Government has made it clear that TrustMark will be central to all retrofit programmes going forwards, therefore a solution to this market barrier will be required. Additionally, whereas high-quality standards, such as PAS2035, promote the whole-house approach to retrofit, government funding pots are currently characterised by focusing around one measure at a time with strict criteria. It is also worth noting that funding to support the retrofitting of hard-to-treat homes (where paybacks do not stack up) will be required, this is of particular importance to cities such as Oxford, which have a significant number of historic buildings. The UK Government has run two consultations on introducing a minimum EPC B standard for non-residential properties (or the highest band that can be cost effectively achieved) by 2030, and appears likely to introduce the policy.[19]
- **Heating:** The UK Government was due to publish both a 'Heat & Buildings Strategy' and a 'Hydrogen Strategy' in 2021, however the former has been delayed due to disagreements over costs. These are expected to show the proposed steps for achieving the ambitious targets of the 10 Point Plan, such as 1GW of hydrogen production capacity by 2025, and sales of 600,000 heat pumps per year by 2028. Notwithstanding this, the critical dependency sits in the mid-2020s, where a decision on the long-term decarbonisation of heat is expected. This will steer the network-level technology balance between the electrification of heat via heat pumps and conversion of the gas grid for hydrogen, as well as potential regional differentiation in approaches. The electrification of heat, combined with the considerable electrification of transport, will necessitate extensive grid reinforcement above and beyond the £40bn Ofgem investment package within the 2021-26 Energy Network Price Controls.[20] It is also worth noting that the Renewable Heat Incentive is tailing off, with commercial support ending in March 2021, and domestic support due to finish in March 2022.[21] In lieu of this there does not appear to be replacement funding lined up, the CCC's 6th Carbon Budget flagged that funding (as well as regulation and policy) is lacking to support the transition to low carbon heat, and that government has yet to take a position on rebalancing policy costs between gas (currently a relatively cheap fuel) and electricity. Regarding heat networks, the UK government currently have an open consultation on heat network zoning, as well as a proposal to give powers to planning authorities to set zoning policies for heat networks within

19 BEIS (2021), 'Non-domestic Private Rented Sector minimum energy efficiency standards: EPC B implementation'. Available from: https://www.gov.uk/government/consultations/non-domestic-private-rented-sector-minimum-energy-efficiency-standards-epc-b-implementation

[20] Ofgem (2021), 'Energy network price controls: Overview of final determinations, 2021-2026'. Available from: https://www.ofgem.gov.uk/system/files/docs/2020/12/riio2_overview_document_web_1.pdf

[21] ICAX, 'Domestic RHI confirmed until 31 March 2022'. Available from: https://www.icax.co.uk/RHI_Continuity.html

local plans. These regulatory interventions could substantially ease the initial stages of heat network feasibility and development by providing upfront clarity to developers.

- **Cooling:** It is also worth noting that as the UK experiences hotter, drier summers, there will likely be a growth in demand for artificial cooling solutions. This will in turn impact grid electricity demand, and potentially decarbonisation.
- **EV infrastructure:** EV infrastructure requires national-level co-ordination and standardisation in order to be rolled-out in an efficient manner. Additionally, as expensive 'hard' infrastructure, a significant portion of funding is required to support local authorities with deployment to meet expected demand. Beyond the charging infrastructure, support for the phasing out of fossil fuel vehicles (for example through vehicle scrappage schemes) will be necessary to ensure vehicle owners are able to afford the switch to an EV vehicle. It is possible policy details around this could be included in the delivery plan of key milestones to meet the phase-out of fossil fuel vehicles mentioned in the 10 Point Plan. Given that the target for the halting of new fossil fuel vehicle sales is 2030, there is significant urgency for both charging infrastructure (and therefore funding for it) to be in place, as well as attendant scrappage or other schemes.
- **Alternative fuels:** In the near-term, the issue of fuel duty exemptions providing a perverse incentive against non-fossil fuel alternatives (such as hydrogen) needs to be addressed.
- **Grid decarbonisation:** The continued and accelerated deployment of large-scale renewable generation is critical to the grid decarbonisation upon which Oxford is reliant.
- **Flexibility:** Transitioning to a flexible grid is a cost-efficient alternative to the traditional grid reinforcement required for mass electrification. In order to enable this, the UK government need to implement market mechanisms which incentivise and support these activities. At an Oxfordshire level, Project LEO has been testing and building such a flexibility marketplace, however this needs to happen at the national scale. The continued roll out of smart meters in every home and business in Oxford, and the passage of regulation to enable DNOs to transition to DSOs, will be crucial to achieving this.
- **Research and development:** In order to successfully and promptly commercialise technologies that will be crucial to the later phase of decarbonisation (e.g. hydrogen or CCUS), government support for research and development (including pilots, trials and demonstrations) is required.

To assess the impact of key national dependencies on achieving the ZCOP's 2040 net-zero target, a 'Business as Usual' (BAU) scenario has been modelled, considering current policies and initiatives without any assumptions around future policies. The projection is primarily based on BEIS future energy projections which estimates that, with the current policies in place, UK energy demand in 2040 will be 4% lower than the demand in 2018.[22] The net-zero 2040 scenario assumes a high level of policy support between now and 2050 to fuel the actions needed to reach decarbonisation targets and consequently, energy demand falls by 56% in the same 22-year period.

As well as the BEIS energy projection, there are a number of ongoing local initiatives in Oxford that contribute to the near-term emissions reduction in a BAU scenario, including:

[22] BEIS, 'Collection: Energy and emissions projections'. Available from: https://www.gov.uk/government/collections/energy-and-emissions-projections

- **Oxford heat network:** Proposed heat networks supplying heat to university and council buildings in Oxford City Centre and Headington;
- **OxFutures:** Provides funding for businesses in Oxford to improve their energy efficiency;
- **Council-led initiatives** such as LED lighting rollout to reduce the council's footprint;
- **Project LEO**: Smart grid and flexibility trials involving homes and businesses in Oxford;
- Vehicle and behavioural changes brought about by Oxford's **Zero Emission Zone**; and
- **Oxfordshire's waste strategy** for household recycling rates.

These have been included since they are within the control of local government and ZCOP partners.

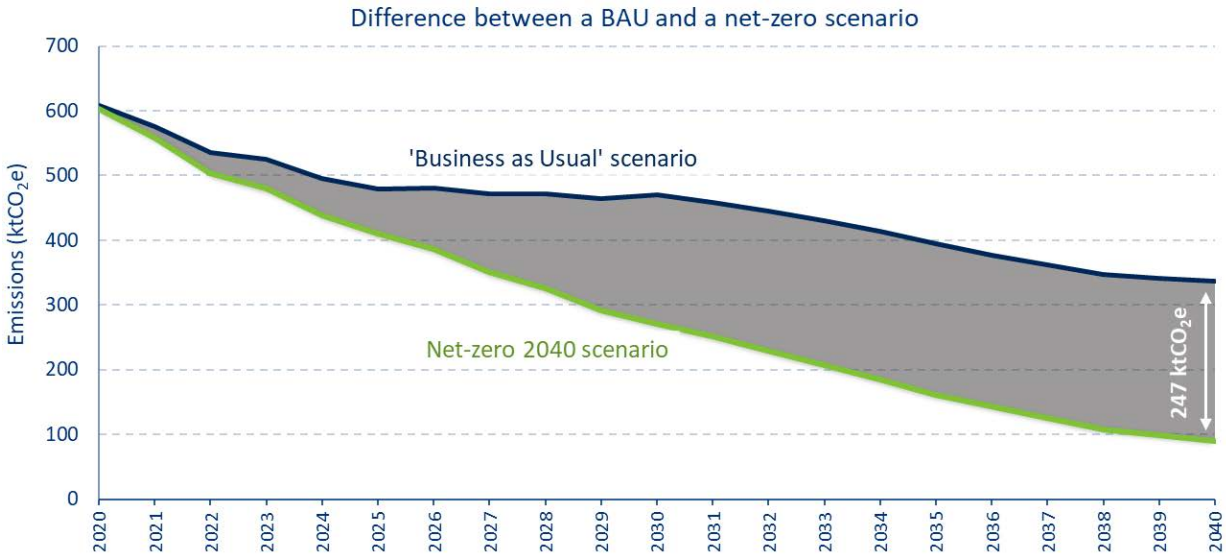


FIGURE 18: 'BUSINESS AS USUAL' SCENARIO (BLUE) AND THE NET-ZERO 2040 SCENARIO (GREEN), WITH THE POLICY DEFICIT REPRESENTED BY THE AREA (GREY) BETWEEN THE TWO SCENARIOS

Figure 18 shows the gap between a net-zero 2040 compliant scenario, and a BAU scenario, otherwise known as the policy deficit. With only the legislated government policies and local initiatives currently in place, annual emissions in Oxford are projected to fall to 337 $ktCO_2e$ by 2040, a 54% decrease from the 2018 emissions. This compares to an 88% decrease in the net-zero 2040 scenario.

The difference, or deficit, between the current BAU trajectory and the net-zero scenario is highlighted in grey in Figure 18. The deficit reaches 247 $ktCO_2e$ in 2040, which equates to an additional 3,260 $ktCO_2e$ of emissions that could be released into the atmosphere during the scenario period if government policy remains the same. Government intervention is crucial for Oxford, and other areas in the UK, to achieve their net-zero goals. The UK Government's Ten Point Plan[23] and Energy White Paper[24] must be backed by policy to give local authorities and stakeholders the power and support to implement their net-zero strategies.

[23] BEIS (2020), 'The ten-point plan for a green industrial revolution'. Available from: https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution
[24] BEIS (2020), 'Energy white paper: Powering our net zero future'. Available from: https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

Policies & regulation

P1 – Engaging with local policy development

Domestic | Commercial | Transport

By 2025

ZCOP Role: Lead	Sprint Group

Concept	Work with Oxford City Council's planning team to engage with and input into the next iteration of relevant Local Plan policies. Explore where opportunities may lie to build-on the Local Plan policies that already go beyond Part L building regulations, across energy efficiency, fossil-fuel heating, private car usage, and accessible waste disposal. This should also involve Oxfordshire County Council, who are working on the Oxfordshire Plan 2050 and the Local Transport and Connectivity Plan (LTCP) (scheduled for consultation in August). A key need for the local authority policy development teams is relevant evidence and research which can underpin policy recommendations. This action should be a focal point for those needs to be expressed and relevant policy development 'intel' provided. This could also link with action G3 'Joint lobbying strategy', as there are several areas where stakeholders and the planning team could look to push government: • Provide guidance on how the new planning reforms (including the Future Homes Standard) are expected to address issues of climate change, including a review of whether this is sufficiently ambitious. • Put in place better guidance for addressing embodied carbon, currently there is relatively little cohesive national guidance. • Recognising there will likely be a gap between high efficiency future developments and full decarbonisation, and that measures (e.g. offsetting) will be required.
Relevant Pathway Requirements	Domestic: • EPC A new builds: By 2025 100% (1,622) new builds EPC A. • Rooftop solar: By 2025 on 40% of new homes (608); By 2030 on 75% of new homes (1,639); By 2035 on 75% of new homes (2,907). • Off-street EV chargers: 2025 (3,502), 2030 (8,341), 2035 (12,799), 2040 (13,057).

Funding Sources	This action may not require the input of additional funding beyond existing team budgets, depending on the extent of team resource time required.
Implementation Steps	1. Congregate Oxford City Council's planning team, heritage team and other key stakeholders (such as Oxfordshire County Council) to discuss Local Plan and LTCP policies, and agree what can and cannot be achieved within the current environment, and what requires further evidence to support the policy change. 2. Focus collective efforts around a number of identified priority areas requiring further evidence. 3. Based on limits set out in (1) and evidence in (2), the planning teams could integrate any further possible ambition into new policy, and that which is not currently possible can form the focal points for lobbying efforts with national government. **Monitoring:** An associated sprint group could look to stay well abreast of local policy developments, and use changes here (and in national level guidance) as the benchmark for impact.
Owners & Champions	Oxford City Council Planning Team
Action Dependencies & Risks	• Details surrounding how the suggested amendments to building regulations, and how the Future Homes/Buildings Standards will be applied, are still outstanding. • It is likely that even when the Future Homes Standard is in place, new developments will not be fully decarbonised, and therefore there will remain some reliance on the ongoing decarbonising of the grid to remove remaining emissions from energy. • The UK Government is currently working on a range of reforms to national policy. They have proposed wide-ranging changes to the system and way Local Plans are designed – there is currently uncertainty around the detail of what the reforms will ultimately look like, what policies will be set at local level as well as how topics like climate change are to be treated. The timetable for these reforms is also unknown, but likely to happen over next few years. • Local Plans need to balance a range of competing pressures on the growth of a region. It needs to deliver upon needs for affordable housing, biodiversity net gain, economic recovery as well as net zero all whilst ensuring development is viable.
Cost-Benefit	**Investment cost: £97,000** This reflects the per annum pro-rata part-time salary of an Oxford City Council officer-grade resource, who can support delivery for 4 years (from 2022 till the adoption of the revised Local Plan in 2025). **Carbon impact: 4 $ktCO_2e$** The carbon impact estimate has been calculated based on improving the energy efficiency of new builds only, and does not include transport or waste. The figure denotes the potential savings possible on top of those expected from existing Local Plan policy RE1 (26 $ktCO_2e$).

The impact has been calculated using the Local Plan figure of 10,884 new homes in Oxford by 2036.[25] The Local Plan requires a 40% reduction beyond the 19% 'code-compliant base case' reduction requirement pre-2026.[26] Post-2026 this additional reduction rises to 50%. Post-2030 new dwellings are to be zero carbon, expressed as a 97% reduction to account for error. The impact of increasing RE1 ambition was estimated by bringing the zero carbon requirement forwards to 2025 (when the revised Local Plan is due to be adopted).

P2 – Streamlining conscientious retrofit within conservation areas

Domestic **Commercial** **Institutional**

By 2025

ZCOP Role: Influence / Collaborate

Concept

Given the multitude of historic buildings across Oxford, it is important that efforts to retrofit the building stock of the city are informed by a strong understanding of heritage and conservation-related constraints. There are a number of possible approaches the ZCO Partnership could consider supporting the acceleration of retrofit within conservation areas:

- Feeding into action R1 'Developing template retrofit buildings', a number of buildings under different conservation restrictions could be included as pilots to demonstrate best practice in navigating the process successfully, via a whole-building approach. The templates for historic buildings would be less focused on the package of measures themselves, and more on the efficient process of agreeing the suitable measures. This is because even similar houses sited in different conservation areas will necessitate a different exact approach. A template could examine the process for a Grade II listed building, for example, and explain 'what is needed':
  - ❑ Thorough understanding of the significance of the building, completed by a heritage consultant (a requirement of national and local policy).
  - ❑ Explanation of the impact proposals will have against this significance.
  - ❑ Detailed drawings and supporting information on the product or measure being installed. In particular, confirmation that the technology is tried and tested, and is known to work for historic buildings. Ideally would be endorsed by Historic England or SPAB.
- The template resulting from the pilot could include a number of guiding prompts. For example, 'Is your building in a conservation area?', ', and if so which one?', 'Is your building listed or in close proximity to a listed building?', and then providing links to the existing resources and information on the different conservation

[25] Available from: https://www.insidehousing.co.uk/news/news/almost-11000-new-homes-to-be-built-in-oxford-as-inspectors-approve-local-plan-66511
[26] Available from: https://www.oxford.gov.uk/download/downloads/id/5101/oxford_local_plan_2036_-_proposed_submission_draft.pdf

	areas in Oxford (e.g. the Littlemore Conservation Area Appraisal), and the types of buildings unable to structurally support retrofit. • Building on the Technical Advice Note (TAN) 15: Heritage and Sustainability Guidance for Householders, a brief supporting note could be published to explicitly encourage the provision of a whole-building plan when submitting an application. • Strongly encouraging use of the pre-application process. This costs a fee, however, results in applications that have a significantly higher success rate, and therefore require less time overall. This could involve an early-stage meeting or site-visit where aims and ideas are shared, and initial responses heard. One format for this could be a public surgery open 0.5 days a week and moving around key conservation areas to provide initial planning advice. • When Oxford City Council has the opportunity to review hard limits in existing conservation policy, ensure this is lined up with decarbonisation objectives, as far as is possible. • Distil key asks for central government to support more costly and complex retrofitting of historic buildings, and conduct unified lobbying to secure this support.
Relevant Pathway Requirements	Domestic: • Existing home receiving >=1 energy efficiency measure: By 2030 (16,600), By 2035 (37,643), By 2040 (48,291). • Rooftop solar on existing homes: By 2025 - 20% (11,458); By 2030 - 30% (17,693); By 2035 - 40% (24,267), By 2040 - 55% (34,297). • Heat pumps: By 2025 in 27% of homes (including 10,762 ASHPs); By 2030 in 39% homes (including 15,984 ASHPs); By 2035 in 55% homes (including 25,267 ASHPs); By 2040 in 68% homes (including 32,429 ASHPs). Commercial: • Rooftop solar: By 2025 (0.8MW), By 2030 (3.31MW), By 2035 (5.6MW), By 2040 (6.6MW). • ASHP: By 2025 (10%), By 2030 (24%), By 2035 (36%), By 2040 (50%). Institutional: • Rooftop solar: By 2025 (2.8MW), By 2030 (8.4MW), By 2035 (13MW), By 2040 (13.1MW). • ASHP: By 2025 (5%), By 2030 (12%), By 2035 (24%), By 2040 (30%).
Funding Sources	This action does not require the input of additional funding beyond existing Oxford City Council team budgets.
Implementation Steps	1. Host discussion with two of Oxford City Council's conservation officers to better develop understanding of conservation perspective, and to inform the suggested options above. 2. Bring together Oxford City Council's heritage team with ZCOP partners with significant heritage or conservation area buildings and potential retrofit suppliers to discuss workable options for retrofit.

	3. Identify overlap between conservation areas and opportunity areas for retrofit. 4. Identify leverage points for potentially updating conservation restrictions in the future, and develop specific guidance for building owners and retrofit suppliers. 5. If deemed necessary, articulate and agree evidence-informed asks to central government for additional support, channelled via Oxford City Council.
Owners & Champions	Oxford City Council, University of Oxford
Action Dependencies & Risks	• Although local planning authorities hold the power to designate and review conservation areas, the UK government is responsible for the National Planning Policy Framework, which sets out the framework for both plan-making and decision-making in respect to applications for planning permission and listed building consent.[27] • Discussions and any agreements regarding heritage limitations should be overlaid onto action R2 'Building stock inventory & pipeline'. • There is a competing pressure of ensuring heritage assets are appropriately protected and not harming Oxford's historic character, and there will likely be those in the community who see this as the first priority. As a consequence, careful communication and behaviour change is needed in parallel. • There is also the challenge that these measures will be more costly than for standard buildings and require tailored approaches. Ultimately, as heritage they already provide value to the city, and this will need to be balanced with sensitive retrofitting.

Other actions considered:

A number of other policy and regulatory interventions were considered as part of the action identification workshops, and pipeline development and refining process, these include:

- Oxford City Council leveraging licensing to drive the electrification of Oxford's taxi fleet. This is already in progress, with 2025 the cut-off date for the provision of non-EV licences.
- Encouraging the growth of car clubs in Oxford, linking-in with the deployment of EV charging infrastructure to ensure car clubs have priority provision as an incentive for their establishment.
- Engaging landlords to set and enforce higher Minimum Energy Efficiency Standards (MEES) for properties. It is important that these are understood as necessary and workable, and that an agile enforcement process is not a significant resource drain on Oxford City Council.
- Introducing a requirement for housing developers to contribute to a carbon offset fund for the city region via Section 106. Although this is not yet currently in place in Oxford, its introduction could be prohibited by the Future Homes Standard. It is also worth mentioning that the Planning Reforms will likely impact these types of

[27] UK Government (2014), Guidance: Historic environment. Available from: https://www.gov.uk/guidance/conserving-and-enhancing-the-historic-environment

contributions, and that contribution demands are not permitted to ask for amounts which would result in development being unviable.
- Implement a Workplace Parking Levy. This has already been designed as proposed as a key pillar of Connecting Oxford, and is currently progressing towards implementation.

Looking beyond 2030:

Although it is certainly true that a strong policy framework needs to be in place within the next 10 years, this will need to adapt to the progressing context as Oxford follows its net-zero pathway. In particular, there exist emergent areas of new technology and opportunities for extension that could be picked-up for deeper investigation by the ZCOP at a later date.

- Significantly raising the minimum efficiency requirements of new and existing buildings. This could be requiring net-zero new builds by 2030, or significantly raising the requirements for existing buildings beyond EPC C by 2035 for owner-occupied houses and EPC E by 2023 for rented commercial.
- Establishing a policy framework for embodied emissions.
- Widening the scope of the ZCOP action plan to include the city's consumption-based emissions.
- Increasing the geographic boundary of the Zero Emissions Zone, and raising the charges to reflect higher requirements for vehicle efficiency.

Research & development

R1 – Developing template retrofit buildings

Domestic **Commercial**

By 2025	
ZCOP Role: Lead	Sprint Group

Concept	Workshop participants and further interviews flagged that there is currently a lack of real-world information (both on technical performance and business case) around different building retrofit options, and how to deliver them. The solution to this is to bring partners together to complete a number of template building retrofits. These will serve a two-fold purpose: • **Demonstrating the measures:** Provide a crib-sheet based on real-world delivery for potential retrofit actors (public and private landlords, suppliers, developers) to work from with confidence. This should aim to include information on how to reduce costs and disruption, secure residents' buy-in and on technical business case viability. The templates could also enable the 'retrofit co-ordinator' role to change from being highly technical to more of a client-side co-ordinator. The templates could also offer tenants confidence in agreeing to the works, as well as support the landlord in matching-up the building with the correct retrofit package, and suppliers, in a more seamless and replicable process.

	• **Demonstrating the process:** Bring together technical experts (Low Carbon Hub) with retrofit installers (ODS) and technology suppliers. ODS are keen to deliver more retrofit projects across the Oxford City Council housing estate, however, require LCH technical support regarding deeper whole-house retrofit approaches. ODS could identify houses that are representative of a larger target group, and then work with LCH to develop a whole-house plan, sit down with the retrofit co-ordinator to walk-through how it will be installed, and link up with the suppliers on-site to establish working relationships. This process will upskill ODS staff and enable them to then replicate the template for similar houses themselves.
Funding Sources	The template buildings could be collectively funded by a group of partners and retrofit suppliers, by the city or county council, or by a UK government grant funding pot, such as the Sustainable Warmth competition or Social Housing Decarbonisation Fund.
Implementation Steps	1. Select the template buildings, based on the most common building archetypes in Oxford requiring retrofit, different tenancy arrangements and a range of technological approaches (e.g. deep fabric retrofit, different heat pump options, etc.). 2. Low Carbon Hub to scope out the technical design of the measures in the selected buildings, in collaboration with both ODS and chosen suppliers for the various technologies. This could also include owner/landlord/tenant engagement to understand and ensure buy-in. 3. Whilst retrofitting the template buildings, ODS develop experience in the role of retrofit co-ordinator (learning from and being guided by LCH), and build connections with potential technology suppliers. Suppliers will gain experience in installing the measures, and better understand their business cases. **Monitoring:** Install smart monitoring equipment in all template buildings to track real-world energy use and gain an improved understanding of the performance gap. Oxford City Council is signed up to SuperHomes, which already has a model for delivering this type of monitoring.
Owners & Champions	Low Carbon Hub, RetrofitWorks
Action Dependencies & Risks	• Input from action P2 ‘Streamlining conscientious retrofit within conservation areas’ could help inform some of the template buildings, ensuring that a suitable package of measures for buildings within conservation areas can be tested and agreed. • This action could support action S2 ‘Priming the low carbon retrofit supply chain’, as bringing technology suppliers on-site to create linkages and trust with potential scaled retrofit installers (e.g. ODS) will provide confidence that these same suppliers will be called upon as ODS expands its retrofit pipeline.
Cost-Benefit	**Investment cost: £94,000** This reflects the pro-rata part-time salary of an Oxford City Council officer-grade resource, who would oversee delivery for 1 year, as well as capital investment required across four template buildings (£69,000). The four assumed templates are: small flat (£12,000), small mid-terrace (£19,000), small semi-detached (£16,000) and large semi-detached

(£23,000). Each receives a different package of whole-house retrofit measures, with costs reflecting both materials and labour.[28]

Carbon impact: 8.7 tCO_2e
The direct carbon impact has been derived from the estimated energy savings of the four retrofitted buildings: small flat (1.4 tCO_2e), small mid-terrace (2.1 tCO_2e), small semi-detached (2.5 tCO_2e) and large semi-detached (2.6 tCO_2e).[29] However, the aim is for the templates to spark an acceleration of similar retrofits, particularly amongst Council-owned stock. This is uncertain and harder to quantify.

Oxford City Council owns 14% of Oxford's housing stock (~8,700 dwellings).[30] Using the 2011 Census, this can be split across flat (33%), terraced (28%) and semi-detached (30%) dwelling types.[31] Applying the carbon savings of the retrofit templates to each of the aligned dwelling types in Oxford's stock would result in carbon savings of **16 $ktCO_2e$**. It is understood that this is a very high-level estimate and does not reflect the differences between dwellings of the same type. Additionally, it assumes all 14% of Oxford's council-owned stock is addressed. Ultimately, the estimate provides a view on the impact of retrofitting ~8,700 dwellings in line with the templates, in practice it is hoped some of these would be delivered by private landlords.

R2 – Establishing building stock inventory and pipeline

Domestic **Commercial**

By 2025	
ZCOP Role: Lead	Sprint Group
Concept	Use Project LEO and other inputs to develop detailed building stock inventory for Oxford, especially filling in the commercial stock gap. This could provide the information basis for local area energy planning, where detailed modelling of different heat, energy efficiency and flexibility technologies are assessed at address-level, to inform a programme of action.
Funding Sources	This action could be delivered using the existing resources of ZCOP partners.
Implementation Steps	1. Identify all potential data input sources. 2. Complete building stock inventory. 3. Establish areas and buildings for priority attention, and potentially feed gathered data into local are energy planning for a selected city district.

[28] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/656866/BEIS_Update_of_Domestic_Cost_Assumptions_031017.pdf
[29] Available from: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-impact-of-measures-data-tables-2019
[30] Available from: https://www.oxford.gov.uk/download/downloads/id/1075/housing_tenure.xls
[31] Available from: https://www.oxford.gov.uk/download/downloads/id/1070/housing_type.xls

Owners & Champions	Oxford City Council, Oxfordshire County Council, Universities contributing to LEO data platform, Lucy Properties
Action Dependencies & Risks	• Use this action, in combination with the 'Template retrofit buildings' to inform an area-wide retrofit programme that builds-on and broadens Cosy Homes, unlocking delivery and cost-efficiencies.
Impacts	• High-quality data can help inform a pipeline of retrofit actions that have strong business cases and target priority buildings first.

R3 – Whole system network review

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025

ZCOP Role: Monitor

Concept	SGN and SSEN to scope and undertake whole system review to establish ability to deliver the required energy within key timelines.
Funding Sources	SSEN and SGN would provide the internal team resource to complete the study.
Implementation Steps	1. Scope of review agreed by SSEN and SGN. 2. Whole system network review completed. 3. Review findings against roadmaps, and with the ZCOP partners.
Owners & Champions	SSEN, SGN
Action Dependencies & Risks	• This research will underpin many other actions in the pipeline, particularly capital investment projects and programmes.

R4 – Mini-hydrogen network feasibility study

Industrial **Transport**

By 2025

ZCOP Role: Influence / Collaborate

Concept	Conduct a feasibility study on a mini hydrogen network in Oxford. The study will map out the different potential use-cases for hydrogen across the city, and then specifically explore feasibility for bringing together several key anchor loads. Within this, it will be key to understand sensitive loads (e.g. specific temperature requirements), as in these instances electrification might not be suitable.

	This study will also serve as the focal point for gathering interested parties together to commit to pursuing the infrastructure. Bringing demand together enables the business case for expensive equipment, such as a hydrogen reformer (steam or electrolysis), to stack up, and sets the relatively long process of project development in motion, whilst hydrogen safety testing is finalised. Initial discussions have brought together two ZCOP partners (BMW and Oxford Bus Company (OBC)) with local gas network provider SGN. In BMW's Plant Oxford there are 140 pieces of material handling equipment (MHE). Currently, the MHE use batteries, however BMW previously looked at switching to hydrogen. Working up the business case, the upfront investment and savings did not stack up, resulting in a decision to revisit the proposal when the cost of hydrogen has decreased. Although there are also a number of other use-cases on the Plant Oxford site, such as building heating, a solvent afterburner (Regenerative Thermal Oxidiser operating at 1,000°C) for the paint shop (currently being explored in Plant Leipzig), and the paint baking ovens in the paint shop, overall the transition still does not stack up for BMW alone. OBC have a depot across the road from Plant Oxford. Hydrogen buses have a key role to play in OBC's fleet, as electric buses are unsuitable for out-of-town routes. OBC have already looked at installing hydrogen dispensing infrastructure, however the high costs of infrastructure and current lack of maturity of vehicle technology delayed the move. It is likely that only one depot would look to be converted to hydrogen, with routes consolidated around this, due to space requirements of different refuelling/recharging infrastructures. On the whole, OBC are estimating needing to transition 100 buses, based on existing routes, however there would be a strong case for government funding, should a secure hydrogen fuel supply already exist. It is also worth flagging that another ZCOP partner, Unipart, are also very close to Plant Oxford, and could have substantial demand from MHE, big boilers and an on-site CHP. There are also opportunities to link with progress on hydrogen already happening across Oxfordshire. A hydrogen cluster being developed by Living Oxford (Oxford City Council were among the founding members for Living Oxford). There are already a number of projects being developed ranging from initial feasibility through to proof of concept - mobility, production, energy, combined heat & power hydrogen system and alternative to back up generator. The cluster will welcome opportunities to look at Oxford-focused projects. The hydrogen cluster partners consist of OBC, Oxfordshire County Council, Siemens, MOD, EDF, Harwell, UKAEA and others. Additionally, the iHUB in the county council is working on developing a hydrogen strategy.
Relevant Pathway Requirements	Transport: • Hydrogen buses & coaches: By 2025 - 10% (57), by 2030 - 20% (99), by 2035 - 30% (147), by 2040 - 50% (213).
Funding Sources	SGN has funding from Ofgem to do studies via the price control. There is interest to fund this work in Oxford, as, although they have delivered

	similar work in Southampton, there are questions surrounding transitioning inland gas networks.
Implementation Steps	1. Initial project partners will sign NDAs to enable the sharing of detailed information and support SGN with writing up a scope of work for the study. 2. Once written, SGN will send it to the Investment Committee for review. 3. Once approved, more partners can be drawn into the feasibility study (potentially utilising more NDAs) to build up a group of committed partners around Plant Oxford as an 'industrial cluster'. This should also include considerations of more outward facing use, e.g. a refuelling station which could also supply HGVs. 4. Publish feasibility study, and start to develop investment case for demonstration.
Owners & Champions	SGN lead, BMW and Oxford Bus key partners, potentially Unipart also.
Action Dependencies & Risks	• Hydrogen buses only sustain 43mph at the moment, however within the next 18 months this will increase to 56mph. There are currently no hydrogen coaches on the market. • Safety case, no problem in approval, just the time it takes.

Other actions considered:

A number of other potential research areas were considered during the pipeline development and refining process, these include:

- Exploring the potential for waste heat to be captured and utilised, either from sewerage systems or an industrial cluster (e.g. BMW Plant Oxford). Initial feasibility could form the basis for an innovation bid.
- Investigating the potential carbon and grid balancing benefits of high heat retention storage heaters and time of use tariffs. This could build on Project LEO's work on demonstrating and building a flexibility market in Oxfordshire.

Looking beyond 2030:

Given the high levels of uncertainty surrounding a number of technological solutions for decarbonisation, there will need to be a continued process of research to inform deployment and refinement. Additionally, as evidenced by the existence of residual emissions in 2040, new technologies will need to be developed in order to close this gap.

- Improving information and understanding of the performance gap across energy efficiency technologies. Such a study could use smart monitoring equipment to assess a large number of different installation types across Oxford.
- In line with the broader maturation of the technology across the UK, explore the suitability for CCUS to be deployed in Oxford, potentially focused around key industrial sites in Cowley.
- The extent to which hydrogen will be a key decarbonisation technology for domestic heating in Oxford is uncertain. As the hydrogen economy in the UK grows, and the initial neighbourhood and subsequent village heating trials are completed, Oxford could look to conduct its own area trial.

Capital investment

C1 – Bulk-buying scheme for solar PV and heat pumps

Domestic | Commercial | Institutional

By 2025

ZCOP Role: Lead	Sprint Group

Concept	Set up a bulk buying scheme for low carbon equipment (solar PV and heat pumps) to enable local businesses, organisations and households to benefit from lower transaction costs. The Solar Together scheme is currently operational in Surrey County Council, and awaiting launch in 11 other areas. The scheme offers group-buying for solar PV and battery storage for households and SMEs, the process is as follows:[32] 1. **Registration** – Free no-obligation registration for the group-buying scheme. 2. **Auction** – An auction with pre-vetted installers occurs. 3. **Personal recommendation** – Post-auction, a personal recommendation is sent to those registered, based on details provided. 4. **Decision** – Registrant decides whether to accept recommendation and proceed with installation.
Relevant Pathway Requirements	Domestic: • Rooftop solar on existing homes: By 2025 – 20% (11,458); By 2030 – 30% (17,693); By 2035 – 40% (24,267), By 2040 – 55% (34,297). • Heat pumps: By 2025 in 27% of homes (including 10,762 ASHPs); By 2030 in 39% homes (including 15,984 ASHPs); By 2035 in 55% homes (including 25,267 ASHPs); By 2040 in 68% homes (including 32,429 ASHPs). Commercial: • Rooftop solar: By 2025 (0.8MW), By 2030 (3.31MW), By 2035 (5.6MW), By 2040 (6.6MW). • ASHP: By 2025 (10%), By 2030 (24%), By 2035 (36%), By 2040 (50%). Institutional: • Rooftop solar: By 2025 (2.8MW), By 2030 (8.4MW), By 2035 (13MW), By 2040 (13.1MW). • ASHP: By 2025 (5%), By 2030 (12%), By 2035 (24%), By 2040 (30%).
Funding Sources	Oxford City Council would likely need to provide upfront funding, unless purchase commitments were made (and paid for) upfront by those registering. Ultimately, the purchasers of the equipment will provide the funding by buying the units from Oxford City Council.

[32] Solar Together, 'How does it work?'. Available from: https://solartogether.co.uk/info/how-does-it-work

Implementation Steps	1. Determine level of demand across ZCOP partners, and use this 'anchor' demand to establish the scale of the bulk-buying scheme. 2. Reach out to Solar Together to assess whether partnering with them to deliver the bulk buying would be an effective delivery approach. 3. If not, confirm ZCOP purchasing commitments and reach out to technology providers for bulk purchase quotes. Open registration to wider Oxford households and organisations, communicating the likely price. 4. Equipment is purchased, and then sold-on to those who committed. For those also requiring installation, a short-list of local installers will be provided. **Monitoring:** The number of registrants (broken down by type), number and financial size of purchase commitments, level of cost reduction and the demand for installation should be closely assessed during the initial run of bulk buying.
Owners & Champions	ZCO Partnership Secretariat
Action Dependencies & Risks	• If ZCOP is required to purchase equipment upfront, this presents a possible financial risk to the Partnership. • Planning constraints could restrict take up, particularly amongst households.
Cost-Benefit	**Investment cost: £48,000** This reflects the pro-rata part-time salary of an Oxford City Council officer-grade resource, who would oversee delivery for 2 years. However, if the scheme's delivery was fully outsourced to an external organisation (such as Solar Together) resource costs would likely be reduced. The expected private investment cost (end-users purchasing the equipment) is £7.6 million, this includes purchases of solar PV units by domestic and commercial users and ASHP units by domestic users. Larger commercial ASHPs are not included as they need to be highly tailored to the building and therefore are less suited to bulk-buying. **Cost saving impact: £3.2 million** Solar Together Ealing bulk-buying provided a 31% cost saving for solar PV units.[33] A 26% cost saving for ASHP units was derived from taking an average of all Solar Together Ealing discounts achieved. This is a rough estimation method, however there are no heat pump bulk procurement schemes to use as a reference point. It is envisaged that 800 domestic customers register for solar PV (equal to Ealing), commercial customers were conservatively set at 25% of domestic due to a lack of reference points. Similarly, domestic customers registering for ASHPs was set at 50% of solar PV, reflecting that heat pumps are: less well-known as a technology, more expensive, and offer less obvious financial gain. The total cost saving is therefore spread across 1,200 households and 200 businesses. **Carbon impact: 31 ktCO_2e**

[33] Available from: https://ealingnewsextra.co.uk/latest-news/solar-together/

	The direct carbon impact results from the avoided emissions of solar PV replacing grid electricity consumption, and ASHPs reducing gas consumption. This is totalled over a 21-year equipment lifespan, accounting for the ongoing decarbonisation of the UK grid. Domestic solar PV customers received a 2.5kW array. Commercial solar PV customers received a 10kW array. It is assumed there are on average 4 hours of sunshine per day across the year. It is assumed domestic ASHP customers live in EPC D dwellings (the most common EPC Band in the UK), with an average energy consumption of 16,300 kWh/year.[34] ASHPs reduce energy use by a factor of 2.2, representing a carbon saving per customer of 1,635 $kgCO_2e$/year. This is a conservative estimate.[35]

C2 – Greening last-mile delivery through trialling micro-consolidation centres and quiet delivery

Commercial **Transport**

By 2025	
ZCOP Role: Lead	Sprint Group
Concept	Two-pronged approach to improving the efficiency and environmental, social and health impact of deliveries: • Pilot a number of urban consolidation centres around the edge of Oxford. Build on the feasibility studies already completed and learning from the experience of successful schemes in London. The centres reduce the number of vehicle trips due to efficient consolidation and route planning, and also enable goods in LGVs/HGVs to be transferred onto EVs, e-bikes and cargo-bikes for last-mile delivery. The pilots can be digitally monitored to better understand where deliveries can be retimed, re-moded or reduced, and create an evidence base for the consolidation centre model. • Develop a quiet deliveries scheme. Agree and monitor acceptable noise benchmarks, and test the workability of night-time deliveries with the University of Oxford and their local suppliers. This will build an evidence base for wider adoption, reducing daytime delivery congestion.
Relevant Pathway Requirements	Transport: • Decreased use of road transport through cycling, walking, WFH and car sharing: By 2025 (15%), by 2030 (25%), by 2035 (25%), by 2040 (30%).

[34] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/323946/Annex_B_-_Energy_Performance_Certificate_data.pdf
[35] Available from: https://energysavingtrust.org.uk/advice/air-source-heat-pumps/

Funding Sources	Costs could be covered by a combination of the participating pilot organisations (such as University of Oxford or logistics companies), a grant or loan from the ZCOP, and government grant. DfT announced a £2m funding pot to support the uptake of cargo bikes in 2018, following on from the government Call for Evidence 'The Last Mile – Delivering goods more sustainably'.[36] Though this fund is no longer open, given the government recently announced the phasing-out of fossil fuel vehicles, further funding maybe forthcoming.
Implementation Steps	1. Bring together partners to discuss who could trial quiet night-time deliveries, and how to approach piloting an urban consolidation centre approach. 2. The quiet deliveries trial is a low-cost intervention, requiring some internal organisation and monitoring resource, including engagement with suppliers to convince them of the value of the exercise. The urban consolidation centres could operate on a range of models, however the simplest could be to gather several partners and jointly tender a centre to a third-party logistics company (the approach taken by the City of London).[37] 3. Gathering a significant quantity of data is a primary objective of these trials, this will support the development of business cases that scale the approach across the city. 4. Following the completion of the pilots, a review period should share successes and note limitations, before proposing a scaled phase 2. **Monitoring:** Urban consolidation centre(s): vehicle and active trip numbers and length, operational costs (e.g. worker pay), number of deliveries made, number of deliveries per trip and a close comparison against 'Business-as-Usual'. Quiet night-time deliveries: number of deliveries, operational costs (e.g. worker pay) and noise levels.
Owners & Champions	Oxfordshire County Council, Oxford City Council, Universities
Action Dependencies & Risks	• The implementation of the Zero Emissions Zone, and broader Connecting Oxford programme could be significant drivers for the growth of low carbon and active last mile delivery in Oxford. • It will be crucial to get key delivery companies on-board with trialling a micro-consolidation centre approach, as well as quiet night deliveries. There could be resistance should this appear to unfavourably disrupt scheduling and standard operations. • Night deliveries are potentially contentious, as residents may well have different views regarding the threshold of what is considered 'acceptable noise' during late hours.
Cost-Benefit	**Costs**

[36] DfT (2018), 'Funding boost for green last mile delivery bikes'. Available from: https://www.gov.uk/government/news/funding-boost-for-green-last-mile-delivery-bikes; DfT (2019), 'Government Response to Call for Evidence: The Last Mile – Delivering goods more sustainably'. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786879/last-mile-call-for-evidence-government-response.pdf

[37] Logistics Manager (2020), 'Amazon Logistics chosen to run City of London's first last mile logistics hub'. Available from: https://www.logisticsmanager.com/amazon-logistics-chosen-to-run-city-of-londons-first-last-mile-logistics-hub/

DfT and Transport Systems Catapult analysed the costs of implementing an Urban Consolidation Centre in a case study – University Hospital Southampton Foundation Trust (UHS).[38] It found the 2017 (year 1) additional costs were £521,000 per year, rising to £947,000 in 2030 (i.e. paying the freight operator). This increase reflects the growth in the volume of deliveries that was predicted by UHS. These costs are dominated by warehouse operating costs (93%), with the remaining 7% fleet-running costs.

Impacts

The UHS case study also calculated annual operating savings, including: freight operator efficiencies (£175,220 – 2017, £503,960 – 2030) and penalty charges (£760,646 – 2017, £15,124 – 2030).[39] It also quantified wider benefits, including: improved journey times from decongestion (£245,327 – 2017, £201,354 – 2030).

The City of London Corporation's first Last Mile Logistic Hub will repurpose 39 car parking spaces in an underutilised car park into a hub for Amazon Logistics. It will take up to 85 vehicles off the road per day, resulting in 23,000 less vehicle journeys in central London per year. Amazon Logistics is expected to complete all deliveries within a 2km radius of the hub without the need for motorised freight vehicles. The City of London Corporation aims to deliver two further hubs by 2020, aiming for a total of five by 2025.[40]

Gnewt Cargo operates several micro-consolidation centres in central London, working with parcel delivery companies (e.g. Hermes, TNT) to fulfil their last mile deliveries using electric vans and cargo tricycles. Studies on the effectiveness of the project measured a reduction of 67% in the total distance driven by vehicle per parcel delivered (depending on the clients), with a 100% reduction in total CO_2 emissions[41] per parcel delivered in 2016/17.[42] Most of Gnewt's business is fulfilment of last mile deliveries for parcel couriers to central London businesses and residents. Results:

- Reduced overall vehicles miles (e.g. 52% reduction in km/parcel);
- Reduced empty running distance by 66%;
- Reduced distance on main roads by 87%;
- Reduced deliveries on main roads in AM peak by 100%;
- Reduced number of deliveries to end user: Gnewt consolidate a previous average of 20 deliveries per day to Grosvenor Estates head office to one consolidated delivery per day;

[38] Available from: https://s3-eu-west-1.amazonaws.com/media.ts.catapult/wp-content/uploads/2018/07/13095627/Public-Sector-Logistics-Consolidation_On-Line-Report-web.pdf
[39] Available from: https://s3-eu-west-1.amazonaws.com/media.ts.catapult/wp-content/uploads/2018/07/13095627/Public-Sector-Logistics-Consolidation_On-Line-Report-web.pdf
[40] Available from: https://news.cityoflondon.gov.uk/city-of-london-corporation-teams-up-with-amazon-to-cut-delivery-vehicles-and-improve-air-quality/
[41] Electric vehicles were charged with electricity from renewable, carbon-free sources.
[42] Available from: http://transferproject.org/wp-content/uploads/2017/09/JL-LearningFromCaseStudies-20Sep2017.pdf

- Reduced emissions: 81% in local pollutants (i.e. PM, NOx), 88% in CO_2;
- Overall reduction in business costs, largely achieved through reduced fuel costs: 29% reduction in overall costs compared to the previous delivery set up;
- Small increase in staff time (7%) due to transhipment and night-time deliveries. This did slightly increase staff costs although it is seen as a beneficial employment effect.

C3 – Programme to scale domestic retrofit across social and private housing

Domestic **Institutional**

2025 - 2030

ZCOP Role: Lead

Concept

The aim of this programme is to take several inputs and establish an effective delivery supply chain that can support an increased pace of domestic retrofit across different occupancy types. These inputs include: the delivery experience and expertise of LCH's Cosy Homes programme, R1 'Developing template retrofit buildings', R2 'Establishing building stock inventory and pipeline' and P2 'Streamlining conscientious retrofit within conservation areas'.

There are two delivery options, targeted at different occupancy groups, which could be explored:

Public/social: ODS has expressed a desire to increase its retrofit work on the Oxford City Council housing stock. In order to deepen required skills, it is proposed as an actor in R1 'Developing template retrofit buildings'. Whereas R1 we be focused on upskilling on the retrofit measures, process and fostering supplier connections, this action would see this put into practice on the Oxford City Council stock. The programme will identify groupings of houses from Oxford City Council stock and bring together ODS (scaled delivery) and Cosy Homes (expert oversight) to deliver whole-house retrofits at street-scale. Bringing in other specialist retrofit SMEs where possible will enable ODS to benefit from their expertise, and them to benefit from ODS's scale.

Owner-occupied: Establishing an Oxford City Council spin-out a specialist, integrated domestic retrofit SME (conceptually similar to a Public Energy Service Company, however without the contractual complexities of Energy Performance Contracts). This SME would be seed funded by Oxford City Council either entirely or blended with any available government grant funding. Cosy Homes are confident that they can funnel a strong pipeline of excess customers to the SME. The SME

	will provide a 'one-stop shop' that works regularly with a specific list of quality local contractors. This SME would demonstrate an 'integrated approach' as the solution, and crucially evidence and strengthen the integrated supply chain. The SME would operate following the same, quality and effective Cosy Homes model, including requiring RetrofitWorks membership for all suppliers.
Relevant Pathway Requirements	Domestic: • Existing home receiving >=1 energy efficiency measure: By 2030 (16,600), By 2035 (37,643), By 2040 (48,291).
Funding Sources	Retrofitting the Oxford City Council stock could be financed using ECO contributions negotiated from BEIS, or funding from the Green Homes Grant Local Delivery Scheme. Oxford City Council already previously secured £382k from these sources.[43] Additionally it could be funded by the Social Housing Decarbonisation Fund, the first wave of which is opening in Autumn 2021. The spin-out SME to service owner-occupied retrofit demand could be funded from Oxford City Council's budget, from a funding collaboration with Oxfordshire County Council, from a new government grant or from an offset fund established via Section 106. Crowdfunding such an entity is not recommended due to the high investment risk associated.
Implementation Steps	1. Bring together relevant partners (Oxford City Council, LCH, ODS etc.) to discuss which of the strands within this programme should be progressed first. It is likely that this will be the public/social housing strand – discuss practical timelines for planning and starting a programme of works on the Oxford City Council stock. 2. ZCOP to work with Cosy Homes and Oxford City Council to refine the SME concept, and identify the initial seed funding source. 3. Once funding is secured, an initial project pipeline should be planned out, with suppliers brought in ahead of time to ensure a well-managed start. 4. Learnings from Cosy Homes and any public/social housing delivery should be consistently shared with the SME. 5. Once the SME is organically turning over business, and ODS comfortable with handling at-scale deep retrofit, this programme will have achieved its initial objective. **Monitoring:** Smart meters could potentially be used to track the performance of installed measures, however there is uncertainty due to household behaviour. At a macro-level, tracking the number of installations will be a crucial indicator of whether the supply chain is scaling.
Owners & Champions	ZCO Partnership
Action Dependencies & Risks	• This action requires input from: R1 'Developing template retrofit buildings', R2 'Establishing building stock inventory and pipeline' and P2 'Streamlining conscientious retrofit within conservation areas'.

[43] Oxford Mail (2021), 'Council received funding for eco upgrade to housing stock'. Available from: https://www.oxfordmail.co.uk/news/19366183.council-receives-funding-eco-upgrade-housing-stock/

C4 – Combining SME sustainability support with low-interest loans

Commercial | Transport

By 2025

ZCOP Role: Lead

Concept	This action will build on the technical assistance approach developed by OxFutures and further refined by ESOx, by combining it with a sustaining financial incentive that drives higher retrofit uptake amongst SMEs. OxFutures offers free energy efficiency audits to businesses, providing 20% grant to implement the audit recommendations (covering both equipment and labour). However, the programme is based on finite EU funding, and will finish in March 2023. ESOx was developed to offer a financially sustainable solution, and address a market barrier identified by OxFutures – the low uptake rate of SMEs who have completed audits (approximately 1 in 4). It proposed to do this by offering more substantial technical assistance (detailed scoping of measures and project management) coupled with finance from two loan providers that businesses can repay monthly. However, with the market turbulence of Covid-19, competing investment priorities, the reality that energy bill savings did not cover monthly loan repayments and the existence of other grant funding on offer, ESOx has struggled to convince businesses to take on loans and install measures. ESOx's grant is due to finish at the end of June 2021, with a review on continuing planned at the close of FY 21/22 based on fees and grants revenues. This action will continue to ESOx technical assistance model, and establish a new revolving fund to provide significant financial incentive to SMEs in Oxford. The fund could be developed as a Community Development Finance Institution (CDFI), and owned at the county or city authority-level. The fund could potentially be seeded by high net-worth individuals in Oxford, who's investments will be directly supporting small business in Oxford recover from the Covid-19 pandemic by improving their operations. By providing incentives via this model, the attractiveness of the terms can be raised beyond what was offered under ESOx. The two loans providers did not finance projects with repayment periods above 5 years, and with loan values of less than £40k. A revolving fund could potentially offer interest-free, or very-low interest, loans. The technical assistance fee will either be a £2,000 flat charge if the measures are not taken forwards, or 20% of the final capital costs if the measures are implemented. Additionally, the revolving fund could accept projects that blend energy efficiency, solar PV and EV charger measures. This joined-up approach is aligned to how businesses consider their energy, whilst also having

	the effect of stacking the business case to create a lower risk loan opportunity (due to solar PV offering a secure revenue stream). The technical delivery of the measures will be completed by an approved list of contractors that ESOx is currently developing. If possible, ODS will also deliver some of the pipeline, providing secondary benefit to Oxford City Council.
Relevant Pathway Requirements	Commercial: • Reduction in electricity demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (30%), by 2040 (40%). • Reduction in gas demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (25%), by 2040 (30%). • Solar PV Capacity (MW): By 2025 (0.8), by 2030 (3.31), by 2035 (5.6), by 2040 (6.6). Transport: • EV Chargers – Workplace: By 2025 (165), by 2030 (319), by 2035 (501), by 2040 (576).
Funding Sources	The fund could be seeded from funds raised from an offset fund via Section 106, from high-net worth individuals looking to invest in the post-Covid recovery of Oxford's small business sector, or from the Council budget, and could be established as a CDFI – following the success of ART, Birmingham.[44] The rate of return of the energy efficiency projects would not likely be sufficient to support issuing equity shares for public investment, as per the Revolving Construction Loan Facility of the Low Carbon Hub. However, by combining energy efficiency with solar PV, this could sufficiently change the risk profile.
Implementation Steps	1. Action owner to work with interested partied to refine the concept and develop details, particularly around seed funding. 2. Once funders secured, complete detailed design of the revolving fund, and confirm the technical support provider. 3. A project pipeline should be built-out pre-launch, this should prioritise engaging with SMEs which have previously completed audits with ESOx, these include: Manufacturing/retail (32), Hospitality/events (30), Professional services (29) and Charity/social enterprise (14). 4. The fund should be launched with significant outreach to local businesses. **Monitoring:** Success could be measured by the number of loans dispersed, the average size of the loans, the total loanbook, the default rate, the number of individual measures installed and the uptake rate between audits and loans.
Owners & Champions	Technical Assistance – Low Carbon Hub Revolving Fund – Oxford City Council / Oxfordshire County Council
Action Dependencies & Risks	• This action is highly dependent on securing seed funding for the SME revolving fund.

[44] Available from: https://art.madeinthemidlands.com/

C5 – Establishing campus-scale integrated energy systems

Commercial **Institutional**

2025 - 2030

ZCOP Role: Lead

Concept	Identify and select a campus-scale site for cost-optimised energy system transformation, establishing joined-up generation, storage and demand management in line with the Energy Systems Catapult's 'Energy System Integration Guides' approach.[45] Campus-scale sites are ideal for cost-optimised energy system transformation because consumption is large enough for energy efficiency and demand management solutions to have material financial impact, but not so large and complex as to be unmanageable. This approach is well suited to Oxford and the ZCOP due to the large number of campus-scale sites (e.g. universities, colleges, hospitals, business parks and science parks) in the city, and their strong representation in the partnership. There have been previous proposals for linkages between sites, for example, the Warneford Development in Headington, which has both hospital and university buildings on same campus, and where linkage via a hospital heat network was previously considered. This programme would follow the 'Energy System Integration Guides' approach, wherein Energy Systems Catapult looked at how to combine local distributed generation with smart, flexible consumption and demand management in campus scale sites (e.g. hospitals and prisons). The BEIS funded Modern Energy Partners - Phase I[46] tested this approach at four separate public sector campus sites (these are currently in the early stages of implementation), and Phase II[47] has expanded this to 24 sites. The learnings and success of this national-level project should feed into establishing this in Oxford.
Relevant Pathway Requirements	Commercial: • Reduction in electricity demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (30%), by 2040 (40%). • Reduction in gas demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (25%), by 2040 (30%). • Solar PV Capacity (MW): By 2025 (0.8), by 2030 (3.31), by 2035 (5.6), by 2040 (6.6). Institutional: • Reduction in electricity demand from energy efficiency: By 2025 (10%), by 2030 (30%), by 2035 (32%), by 2040 (35%).

[45] Energy Systems Catapult (2018), 'Energy System Integration Guides: Decarbonising complex sites'. Available from: https://es.catapult.org.uk/case-studies/energy-system-integration-guides-distributed-energy/
[46] Energy Systems Catapult (2019), 'Modern Energy Partners aims to save the public sector millions via integrated energy solutions'. Available from: https://es.catapult.org.uk/news/innovative-project-aims-to-save-the-public-sector-millions-through-integrated-energy-solutions/
[47] Energy Systems Catapult, 'Modern Energy Partners: Integrated Efficiency Solutions'. Available from: https://es.catapult.org.uk/news/innovative-project-aims-to-save-the-public-sector-millions-through-integrated-energy-solutions/

	• Reduction in gas demand from energy efficiency: By 2025 (10%), by 2030 (15%), by 2035 (20%), by 2040 (25%). • Solar PV Capacity (MW): By 2025 (2.8), by 2030 (8.4), by 2035 (13), by 2040 (13.1).
Funding Sources	The Modern Energy Partners programme is funded by BEIS. This programme could be funded by the campus site owners, supported by a loans from Oxford City Council via the Public Works Loans Board, if appropriate, or available innovation grant funding. The business case for a site-scale collective group of measures should commercially stack up as a package.
Implementation Steps	1. Identify potential campus sites, and engage with ZCOP partners to gauge interest. 2. Based on initial technical view and site owner(s)/partner(s) interests, select one or two campus sites for detailed design. 3. Detailed design will likely require contracting expert consultants, they will need to produce an investment grade site plan, which can be taken to identified funding sources. **Monitoring:** The most important indicators for success are the investment to payback ratio (repayment period), and the decarbonisation resulting from demand reduction and on-site generation. Smart metering should be installed across the sites prior to installation in order to closely track the performance of the site.
Owners & Champions	Universities, NHS Trusts
Action Dependencies & Risks	• The consideration of heritage limitations links to P2, as the initially selected campuses would need to be modern until discussions with the Oxford City Council heritage and conservation team indicate a path forward for campuses with more heritage sites.

C6 – Deploying EV charging infrastructure

Transport

By 2025

ZCOP Role: Lead

Concept	Install EV charging infrastructure across a strategically selected series of sites (spanning car club locations, light commercial vehicle parking and deprived districts) that align with either specific sites identified in the Oxfordshire County Council's Oxfordshire Electric Vehicle Infrastructure Strategy, the document's strategic objectives, and Oxford City Council's emerging Electric Vehicle strategy. Deploying charging infrastructure is hugely important to the UK phasing out fossil fuel vehicles within its ambitious timeframes. In Oxford, the introduction on the ZEZ add further urgency to the rollout. Although the priority as per the transport hierarchy is to reduce travel first and

	foremost, before encouraging active modes, then public transport and then car sharing before private EVs, in all low carbon scenarios a substantial quantity of chargers that need to be deployed, as soon as possible. Additionally, with EV charging infrastructure for city bus depots will be given a significant capital injection if the ZEBRA bid is successful, focus should shift further down the hierarchy, to car clubs, taxis and light commercial vehicles. However, it is also important to recognise that Oxford City Council should be proactively attempting to ensure an equitable uptake of EVs, and try to avoid a future where low-income households are penalised for driving the most polluting vehicles.[48] In order to do this, building out EV charging infrastructure for private EVs should not be entirely avoided, but instead focused.
Relevant Pathway Requirements	Transport: • EV Chargers – Domestic on-street: By 2025 (334), by 2030 (709), by 2035 (1,089), by 2040 (1,233). • EV Chargers – Workplace: By 2025 (165), by 2030 (319), by 2035 (501), by 2040 (576). • EV Chargers – Fleet: By 2025 (14), by 2030 (39), by 2035 (111), by 2040 (193). • EV Chargers – En-route local: By 2025 (157), by 2030 (429), by 2035 (843), by 2040 (1,086). • EV Chargers – Destination: By 2025 (152), by 2030 (208), by 2035 (229), by 2040 (229). • EV Chargers – Car Park: By 2025 (50), by 2030 (88), by 2035 (117), by 2040 (117).
Funding Sources	Funding could be provided by the PWLB, contributions from Section 106 or the Community Infrastructure Levy, or the Charging Infrastructure Investment Fund. Oxford City Council could also seek to raise a Municipal Community Bond, with a small service charge added to user charging bills to provide a revenue stream to repay investor coupons with interest.
Implementation Steps	1. Aligning timescales, identify and agree target sites. 2. Ensure need for grid reinforcement is checked well ahead of delivery. 3. Secure capital investment to cover the equipment and installation. 4. Secure quotes from local providers, including ODS, potentially using the 'Dutch Model' of procuring by area to deliver consistency and efficiency. **Monitoring:** The number of installed chargers, the cost per charger installed, reinforcement costs incurred, rate of installs, average charger installed capacity. Once operational, if possible, average number of uses/charge-time per charger per day.
Owners & Champions	Oxfordshire County Council, Oxford City Council

[48] Green Alliance (2019), 'Going electric: How everyone can benefit sooner'. Available from: https://green-alliance.org.uk/resources/going_electric_how_everyone_can_benefit_sooner.pdf

Action Dependencies & Risks	• The Oxfordshire Electric Vehicle Infrastructure Strategy (OEVIS) and emerging Oxford City Council Electric Vehicle Strategy will guide implementation of this action. • Building out EV charging infrastructure requires close co-ordination with the DNO to ensure potential grid constraints are identified early and reinforced or avoided.

C7 – Improving bus journey times and regularity

Transport

By 2025

ZCOP Role: Lead

Concept	Under the banner of the Connecting Oxford bus priority improvements, bring together Oxford's bus operators to identify the key 'pinch points' currently slowing bus routes and disruptive service regularity. Discuss these with the Oxford City Council planning and transport teams with an aim to developing implementable trunk-route solutions that improve bus journey times in and out of Oxford and make buses the priority mode, as well as reducing unnecessary bus mileage only operated due to the effects of traffic congestion.
Relevant Pathway Requirements	Transport: • Switch from private transport to buses & coaches: By 2025 (1%), by 2030 (2%), by 2035 (5%), by 2040 (10%).
Funding Sources	The funding sources will depend on the scale of investment required, which will in turn depend on the extent to which infrastructural changes are seen as the correct solution. Investment could be blended between the bus operators and Oxford City Council, whilst also bringing in WPL contributions and finance from the PWLB.
Implementation Steps	1. Initial discussion with bus operators mapping out their perceived key 'pinch points'. 2. Follow-on meeting, presenting these pinch points to Oxford City Council and Oxfordshire County Council to understand where potential solutions may exist, along with journey time improvements that would be expected to flow from these interventions. 3. Once solutions are identified and agreed, a scope for their deployment should be drawn up, including impact assessment and costing. The detail of this stage will depend on the type and extent of the measures proposed. This could also involve a legally-binding commitment to deliver the agreed interventions within a defined period. 4. Installation of measures, with accompanying communication effort to commuters. **Monitoring:** Bus route average journey times, bus delays versus timetabled schedule, bus route passenger numbers (both average weekly and gross annual).

Owners & Champions	Oxfordshire County Council, Oxford City Council, Oxford Bus Company, Stagecoach
Action Dependencies & Risks	• Previous attempts to introduce bus gates in Oxford secured support during consultation stages but were later shelved.

Other actions considered:

A number of other potential capital investment projects and programmes were considered during the pipeline development and refining process, these include:

- Constructing new cycle routes. The successful implementation of the ZEZ and Connecting Oxford programme would reduce the need for constructing and cost of new cycle pathways, by reducing the amount of road traffic, thereby increasing road space for cyclists. Additionally, there are approximately 10 separate projects, including 'quickways' and 'quietways', that have been successfully funded as part of the Active Travel Fund Tranche 2 and are proposed for implementation.
- Universities across Oxford constructing all new university developments to Passivhaus standards, evidencing the suitability of the approach across the broad range of building types that universities demand, and demonstrating visible leadership and innovation.
- Co-locating battery storage with all existing solar PV or other generation assets, as well as all future installations.
- Constructing low carbon-fed heat networks which serve concentrated heat demand in the city centre and on the several key campuses. This is already progressing through two Oxford University heat network projects.
- Establishing transport mode hubs that bring together public transport, EVs and taxis, micro-mobility and active travel, alongside all the required information for making journey decisions. Oxford have a limited number of public transport providers, and a limited number of key hubs. Discussion between these providers and the Oxford City Council transport team is needed.
- Procuring green buses, both electric and hydrogen, en-mass to drive down unit cost. If successful, the near future of this would largely covered by the ZEBRA bid (announcement expected in January/February 2022).

Looking beyond 2030:

The headline message for 2030-40 is that capital investment is required across the board to drive rapid acceleration in the deployment of low carbon technologies in Oxford. These efforts are much less about investing in new solutions, and more investing in getting a massive quantity of equipment installed, technologies that are, mostly, available on the market today.

- Rolling-out hydrogen infrastructure to supply vehicle fuel as well as heating.
- Continuing to scale heat pump and energy efficiency retrofit installations in existing buildings.
- Installing EV charging infrastructure, and offering trade-in discounts or scrappage schemes for owners of fossil fuel vehicles.
- Expanding the developed heat networks beyond institutional and commercial end-user to serve domestic customers.

- Maximising PV deployment across all substantial rooftop sites in Oxford.

Behaviour change, communication & education

B1 – ZCOP strategic communications plan

Domestic | Commercial | Transport

By 2025

ZCOP Role: Lead	Sprint Group
Concept	Develop a centralised plan for communicating with Oxford residents and businesses. This document will ensure a clear and consistent communication approach from the ZCOP, utilising simple language that avoids jargon, considers equity and inclusivity, and leverages existing networks (e.g. schools, community groups, faith groups and the Locality Hub), focusing on three core pillars: • **Heat pumps** - Carefully listening to and addressing the concerns of tenants and leaseholders; • **Retrofit** - The benefits of retrofit (beyond cost savings), when to retrofit a property, and who can you trust to 'get it right'; • **Active travel** - Encouraging the switch the active modes, working from home (where possible) and car sharing.
Relevant Pathway Requirements	Domestic: • Existing home receiving >=1 energy efficiency measure: By 2030 (16,600), By 2035 (37,643), By 2040 (48,291). • ASHPs: By 2025 (10,762), by 2030 (15,984), by 2035 (25,267), by 2040 (32,429). Commercial: • ASHPs: By 2025 (10%), by 2030 (24%), by 2035 (36%), by 2040 (50%). Transport: • Decreased use of road transport through cycling, walking, WFH and car sharing: 2025 (15%), 2030 (25%), 2035 (25%), 2040 (30%).
Funding Sources	This action does not require the input of additional funding beyond existing ZCOP budgets.
Implementation Steps	1. The initial step will involve setting the scope of the communications plan, as it cannot cover all ZCOP activities and retain clarity. 2. Following this a ZCOP team to develop the plan will need to be formed, they will need to engage broadly, with the experiences of existing programmes, with forums and with residents and businesses. 3. Once the plan is drafted it should be circulated for comment within the ZCOP, with concerns addressed prior to it being signed off.

	4. The launch of the plan could aim to coincide with the announcement of another action, potentially the formation of a new sprint group. **Monitoring:** Will likely centre around tracking online engagement, as well as the number of local forums attended.
Owners & Champions	ZCO Partnership
Action Dependencies & Risks	• Communication is complex, and communicating across multiple strands of behaviour change even more so.

B2 – Public dashboard for monitoring ZCOP progress

Domestic **Commercial** **Industrial** **Institutional** **Transport**

2025 - 2030

ZCOP Role: Lead

Concept	Create a publicly accessible online dashboard to communicate progress against ZCOP's decarbonisation objectives. This could integrate both quantitative and qualitative information, and act as a simple communication tool for Oxford's residents and businesses. Where possible data from the monitoring of key actions should be integrated, as well as data from the LEO dashboard. The creation of the dashboard is not a near-term priority, as focus should be on achieving progress before communicating it.
Funding Sources	This action does not require the input of additional funding, only dedicated funding within ZCOP budget.
Implementation Steps	1. From the outset of ZCOP pipeline implementation, ensure all actions have a clear monitoring process in place for agreed indicators (whether qualitative or quantitative). 2. Once sufficient progress has been achieved, create the online dashboard and feed the monitoring information through. This could be updated on a periodic basis, for example bi-monthly or per quarter. 3. Publicly launch the dashboard, and have it as a page on the ZCOP website.
Owners & Champions	ZCO Partnership
Action Dependencies & Risks	• The monitoring dashboard is dependent on reporting progress from across the ZCOP pipeline.

Other actions considered:

A further communication intervention considered during the pipeline development and refining process was:

- A sustainability badge scheme, enabling Oxford business to communicate their alignment with the ZCOP net-zero target, and their engagement in terms of tangible actions taken. A similar scheme has already been established by ESOx, the 'Energy Pioneers Badge'.

Looking beyond 2030:

As Oxford progresses along the net-zero pathway, there will need to continue to be consistent communication to inform and drive uptake for the majority and for 'slow movers'. However, there will also need to increasingly be a pivot, moving from education and behaviour change communications focused on driving adoption, to a service which offers support to those already operating low carbon equipment (for example, 'advice on using your heat pump system efficiently', or 'addressing the performance gap').

Governance & stakeholder collaboration

G1 – Knowledge transfer platform between businesses and academia

Commercial **Industrial** **Institutional**

By 2025	
ZCOP Role: Lead	Sprint Group
Concept	An Oxford 'knowledge transfer platform' would look to unlock innovation, efficiency and productivity improvements by matching up: (i) academics with businesses that require their area of expertise, and (ii) businesses with other businesses that they can learn from. This would enable large and leading businesses in Oxford to provide guidance and support to smaller businesses. One element of this could be leading players in Oxford (e.g. BMW) sharing detailed case studies (e.g. installing a heat pump system in Plant Oxford, or completing an environmental management audit) for others to learn from and use as a guide. The matchmaking, case studies and associated communications would be delivered through existing networks, such as Oxford Greentech, with overall steer from the ZCOP Secretariat. The action could also seek to integrate part (i) of the matchmaking offer with the national-level Innovate UK scheme 'Knowledge Transfer Partnerships' (KTPs).[49]
Funding Sources	Except for part (i) of the matchmaking, this action does not require the input of additional funding beyond existing ZCOP budgets. In the Innovate UK programme, this is covered by a grant, the ZCOP could look to OxLEP to part-fund the academic time spent.
Implementation Steps	1. Complete a detailed design of the potential scheme, including whether it links to the Innovate UK scheme, how businesses will be made aware, and what the matchmaking process will be. 2. Utilise an online form to gather information from businesses (and academics should the action not link with Innovate UK's KTPs)

[49] Innovate UK (2021), 'Knowledge Transfer Partnerships: what they are and how to apply'. Available from: https://www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply#who-can-take-part

	regarding the key questions they face and the learnings they have to share (including any case studies). 3. Looking across the landscape of submissions, the agreed matchmaking process will result in introductions facilitated by the ZCOP, as well as a selection of a number of case studies to be developed based on expressed demand. 4. Once the process is established, the matchmaking and selection and sharing of case studies can continue with ease as long as there is sufficient business demand and interest. **Monitoring:** The number of registered businesses, the number of registered academics, the number of confirmed instances of support, the number of shared case studies. A survey could potentially be shared with engaged businesses to understand any changes in terms of installation of measures.
Owners & Champions	Universities, educational providers, BMW
Action Dependencies & Risks	• The success of the (i) matchmaking portion of the platform depends on there being a suitable pool of academics who are aligned with the needs of Oxford's businesses.

G2 – Active travel commitments

Transport

By 2025	
ZCOP Role: Lead	Sprint Group

Concept	Through Connecting Oxford, the Zero Emissions Zone, and the Oxfordshire Local Cycling & Walking Infrastructure Plan (LCWIP), Oxford has a series of active travel interventions and infrastructure in the pipeline. As part of 'Tranche 2' of UK government active travel funding, at least ten quickways and quietways are being progressed, including Botley Road, Bambury and Woodstock, and the canal tow path, as well as Low Traffic Neighbourhoods and other traffic calming measures. Two potential leverage-points for ZCOP partners to support active travel in Oxford are: • **Providing commitments to supporting the faster introduction of Connecting Oxford and Zero Emissions Zone interventions**, which are critical to freeing up the roads for cycling access, and will substantially benefit from such a unified show of support from some of Oxford's most important organisations. This could even extend to helping design and co-produce actions under these two schemes. • **Leading by example** by installing active travel support infrastructure and measures: Quality bike storage, shower facilities, cycle purchase schemes (Cycle to Work), route planning and an optional cycling road safety lesson. This could also include improved walking routes to bus stops and improves

	cycle parking at bus stops. Where partners are located close together, this could be joined-up to capture scale efficiencies.
Relevant Pathway Requirements	• Decreased use of road transport through cycling, walking, WFH and car sharing: 2025 (15%), 2030 (25%), 2035 (25%), 2040 (30%).
Funding Sources	This action could be delivered using the existing resources of ZCOP partners.
Implementation Steps	1. Bringing together all ZCOP partners to look at providing commitments of support or supportive statements regarding Oxford City Council's two flagship transport decarbonisation initiatives. This will likely require considerable discussion, potentially over multiple sessions, to arrive at either mutually acceptable wording, or a harmonised group approach. 2. Depending on the difficulty of the above step, partners could concurrently or subsequently begin looking at active travel interventions on their estates. This should be the subject of a group session where ideas can be shared, and any partners in close proximity can link up to deliver supportive infrastructure that is more substantial. 3. A further session could be facilitated to discuss Oxford City Council progress in building out active travel infrastructure, for example reviewing the extensive LCWIP project pipeline. **Monitoring:** Number of partners publicly supporting the Connecting Oxford and ZEZ interventions, number of partners installing active travel support infrastructure, and the number of the individual types of measures (e.g. covered bike storage, lockers, shower facilities, etc.)
Owners & Champions	Oxfordshire County Council, NHS Trusts, Oxford City Council
Action Dependencies & Risks	• Issues such as Low Traffic Neighbourhoods have faced some pushback from across Oxford in the recent round of consultation. • The deployment of active travel infrastructure (and growth in users of these modes) is largely contingent on a reduction of motorised traffic. If this does not happen, it will be difficult to allocate enough road space in Oxford for active travel.
Cost-Benefit	**Costs** Birmingham provided up to £10,000 to schools to cover the costs of: secure cycle parking, showers, workbenches, bikes for staff use, bikes for cycle training and accessories (locks, lights, helmets, tools).[50] Greater Manchester workplace grants awarded £750k across 84 businesses to cover CCTV security, lockers, drying rooms, cycle hoists, wall mounted bike racks and 1,228 new parking spaces. This translates into investment per business of £9,000 in active travel-supporting infrastructure.[51]

[50] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742451/typical-costings-for-ambitious-cycling-schemes.pdf

[51] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742451/typical-costings-for-ambitious-cycling-schemes.pdf

Impacts
Annual economic benefits are estimated at between £600-640 per additional cyclist on urban roads.[52] It is worth noting that the greatest impact is due to health benefits (including avoided losses of life, which are by far the largest component), which do not depend on the location or type of facility. In the central Oxford area, a proposal to improve Broad Street for pedestrian and cyclist use was evaluated using the Department for Transport's Transport Analysis Guidance (TAG). The health benefits from increased physical fitness from walking and cycling accounted for the largest (45%) portion of estimated benefits. The benefit-to-cost ratio for the scheme was calculated as 6.5:1.[53]

G3 – Joint lobbying strategy

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025

ZCOP Role: Lead — Sprint Group

Concept

As mentioned in the commentary on national dependencies, a significant amount of additional central government support (whether policy, regulation or funding) is required if Oxford is to achieve its net-zero 2040 target. It is important that lobbying efforts build on existing activity, such as that of Project LEO, and of SSEN, who have a rolling programme of engaging local Oxford MPs. Potential lobbying areas could include:

- Providing substantial funding for heat pumps and energy efficiency retrofitting of the existing building stock.
- Providing clear strategic direction for local energy, in the same way that has been for large-scale generation recently.
- Providing grant funding to support skills training and re-training.
- Enabling local authorities to raise different types of finance.
- Providing additional funding support for retrofitting hard-to-treat historic buildings.
- Ensuring the Future Homes Standard is as ambitious as possible, and that local authorities have the power to go beyond them should they so wish.
- Increasing funding allocated to zero emission bus schemes – current research indicates that the level of funding being allocated to this is around 10% of the level required to affect a nationwide transition.

The sprint group set up to own this could work in close contact, or even overlap, with the sprint group set up to deliver B1 'ZCOP strategic communications plan). This could align efforts to unlock support from central government with the specific areas of action ZCOP is engaging residents and businesses around.

[52] Available from: https://webarchive.nationalarchives.gov.uk/20110407100933/http:/www.dft.gov.uk/cyclingengland/site/wp-content/uploads/2009/03/planning-for-cycling-report-10-3-09.pdf
[53] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371096/claiming_the_health_dividend.pdf

Implementation Steps	1. The first step will be to bring together the ZCOP partners and agree a selection of 'asks'. These will cut across sectors, and will require supporting evidence. 2. Once agreed, the ZCOP should develop and execute a clear advocacy strategy to lobby for key asks, identifying lobbying targets (e.g. local MPs) and potential allies. **Monitoring:** Tracking policy, regulatory and funding developments against organised 'asks' made by the ZCOP.
Owners & Champions	ZCOP Secretariat
Action Dependencies & Risks	• The outcome of lobbying efforts can be highly uncertain.

G4 – Joint funding applications

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025

ZCOP Role: Lead

Concept	Accessing national government funding is critical to Oxford being able to deliver the required acceleration towards net-zero. Funding applications that bring together a number of partners and offer scale are often more likely to be successful. The ZCOP offers a potentially useful umbrella under which the key players in Oxford can be brought together to plan and submit funding applications that will benefit the city. Although each funding opportunity will require different partners' involvement, and be progressed on an ad hoc basis, establishing a process will streamline application development and provide consistency.
Funding Sources	This action could be delivered using the existing resources of ZCOP partners.
Implementation Steps	1. The first step will involve mapping out upcoming pots of central government funding. This could include discussions with central government counterparts to gain a better understanding of the pipeline. 2. Based on this it will be necessary to gather interested partners and potentially group them around certain themes of interest. This could also be an opportunity for partners to agree a broad application process and 'ways of working'. 3. Based on this agreement, the ZCOP will flag relevant funding applications to partners. **Monitoring:** Number of successful applications submitted.
Owners & Champions	ZCOP Secretariat

Action Dependencies & Risks	• This action required central government to make funds available for application.

Other actions considered:

A further governance and stakeholder collaboration intervention considered during the pipeline development and refining process was:

- Running carbon workshops for the board members of organisations in the ZCOP, as well as Oxford organisations more widely. By sharing this information, key decision-makers can be made aware of the urgency of the situation, as well as how actions can be taken and what their potential role is.

Looking beyond 2030:

It is highly likely that new governance and delivery vehicles will be required to deliver the scale of retrofit (both heat pump and energy efficiency) to the existing building stock demanded by the net-zero pathway. At the national level the CCC's 6th Carbon Budget indicated this through calls for a "Net Zero Delivery Framework" that clarifies roles at national, regional and local levels (see Appendix 4).

Skills & supply chain

S1 – Collaboration with the education sector on low carbon skills

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025	
ZCOP Role: Lead	Sprint Group
Concept	Leverage Oxford's unique position as a global educational powerhouse to develop a network of joined-up low carbon training and re-training courses. This should include offering green apprenticeship and vocational courses for sought after retrofit skills across education providers (certified by appropriate bodies), green 'year in industry' opportunities to foster links with Oxford's commercial and industrial sector, and building-on existing successes such as the Abingdon & Witney College Green Construction Centre. Examples from across the UK should be looked to, such as the Retrofit Academy, Carbon Co-op and Warmworks. As the economy recovers from Covid-19, it is also important to develop the re-training offering across Oxford, this could involve looking to replicate the successful Retrofit GetIn scheme for ex-theatre workers in Manchester.[54] The retrofit skills gap in the UK is acute. Compared the 96,000 fossil fuel heating system installers (mainly gas boilers), and the central

[54] Available from: https://www.retrofitgetinproject.com/services

	government aim of 600,000 heat pump installations per year by 2028, there are currently only 950 MCS accredited heat pump installers.[55] Additionally, despite the government targeting 600,000 homes to be retrofitted per year via the Green Homes Grant, there are only 1,300 installers certified through Trustmark (a requirement of the scheme). Furthermore, there are only 500 retrofit co-ordinators nationwide, a specialist project management role that ensures quality. Currently, less that 10 of the UK's 192 further education colleges deliver retrofit and low carbon heat training.
Funding Sources	Universities, colleges and education provides already proactively invest in developing and refining their course offerings to future-proof them against macro-shifts in the economy. Scaling this into a joined-up network could be funded by the internal budgets of bought-in partners, however funding might also be made available from the Green Jobs Taskforce, following the publishing of its Green Jobs Action Plan, expected in 2021.
Implementation Steps	1. Bring together relevant educational providers from across Oxford (e.g. the Commercial and Knowledge Exchange Director, Oxford Brookes University) to discuss why low carbon skill offerings are not in place, and how best they could be built-out in a joined-up fashion. 2. Understand and agree what the crucial course offerings are for Oxford, addressing different topics and occupational types, and explore how courses could be linked across providers, whether they could fall under a unified Oxford Skills umbrella, and how they could be certified or approved by a relevant professional body. 3. As the courses are being put together, it is also important to listen to potential student needs, and understand why them might apply or not based on certain factors. 4. Communicate this joined-up approach to low carbon skills courses strongly across the city as a significant win for forward-looking education and cross-institutional collaboration, and that it positions Oxford are the leading front of this UK-wide challenge. **Monitoring:** Student application numbers, student drop-off rate, number of certified installers or professionals delivered by the programme.
Owners & Champions	Universities, educational providers, industry
Action Dependencies & Risks	• The creation of new training centres and courses, unless evidenced as demand-driven and commercially viable, will likely not be funded by educational providers and universities already under significant financial pressure due to Covid-19. This creates a need to national government funding.
Cost-Benefit	**Costs** Cambridgeshire and Peterborough Combined Authority is delivering a three-year Health and Care Work Academy programme in partnership with a local college, which will support 2,100 clients at an average cost

[55] Ashden (2021), 'With UK Green Homes Grant scrapped, a training revolution is needed'. Available from: https://ashden.org/news/with-uk-green-homes-grant-scrapped-a-training-revolution-is-needed/

	of £2,482 per client. The programme was funded by a £5.2m bid to the Department for Work & Pensions.[56] **Impacts** Since its inception in 2018, 567 learners have joined the programme, with 107 now working in the sector.[57]

S2 – Priming the low carbon retrofit supply chain

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025

ZCOP Role: Lead

Concept	The ZCOP brings together local authorities, large businesses and institutions to send strong positive signals to the local retrofit market via procurement channels. These demand signals are the single most effective route to encouraging retrofit companies (often SMEs) to invest in upskilling and accreditation (such as RetrofitWorks, TrustMark or EuroPhit). This could initially take the form of a 'notification of opportunity' joint press release, denoting intentions to invest significantly in retrofit, and plans for procurement to require certain quality standards whilst remaining appropriate for SMEs. Quality standards specified in tenders could include requiring Trustmark, PAS2030 or the use of retrofit coordinators in delivering the works. This would tie-in well with Cosy Homes, where contractors seeking to secure work through the programme must sign-up for RetrofitWorks membership. This advanced warning will provide the local Oxford supply chain with the time to prepare for the publication of tenders, giving it the best chance of capturing local economic benefits and delivering quality work. The RetrofitWorks approach involves close engagement with suppliers to support them in understanding what is required of them. The approach works with contractors on-site to ensure real-world quality can be confirmed. RetrofitWorks membership offers support in then achieving TrustMark status. However, Cosy Homes experience has shown that suppliers that have gone through the TrustMark process without the on-site confirmation of RetrofitWorks have no guarantee of the required quality.
Funding Sources	The advanced notice portion of this action could be delivered using the existing resources of ZCOP partners; however the delivery of large-scale retrofit projects will require external investment. This could come

[56] Available from: https://www.local.gov.uk/case-studies/experiences-employment-and-skills-devolution-cambridgeshire-and-peterborough-combined
[57] Ibid.

	from the PWLB, from Salix Finance, from further pots of central government funding, or from negotiated ECO contributions.
Implementation Steps	1. Gather partners and wider parties who are aiming to complete ambitious retrofit programmes, and so would be keen to prime to Oxford supply chain to receive the highest quality quotes possible. 2. Agree the advanced notice text, specifically the quality standard requirements. 3. Develop a roadmap showing the timeline between the advance notice and tender publication and close. 4. Publish the advanced notice. **Monitoring:** The number of local supply chain companies that express interest, and the number who apply to become RetrofitWorks members (or align to any other requested quality standard).
Owners & Champions	Oxford City Council, ODS, LCH
Action Dependencies & Risks	• This action links closely with R1 'Developing template retrofit buildings' and C3 'Programme to scale domestic retrofit across social and private housing'. In both, it is proposed that ODS upskills through collaboration with the LCH, and by bringing suppliers on-site to build networking connections, supplier trust and knowledge exchange. Bringing suppliers on-site is a strong positive signal.

S3 – Accelerating innovative cleantech deployment in industry

Commercial **Industrial**

By 2025

ZCOP Role: Lead

Concept	Local industrial and large commercial businesses and cleantech/innovation companies are invited to submit their interest in the scheme, as well as answer a selection of questions regarding their production process or innovation offering, and are grouped into two lists (A and B). The ZCOP then matchmake industrial facilities and commercial actors (list A) with suitable innovations (list B) that could improve their energy or production efficiency. The matchmaking will facilitate the initial contact and discussion, and, if innovation grant funding can be secured, could offer grants to industrial/commercial sites to encourage their uptake of aligned cleantech. This scheme contributes to the real-world demonstration of Oxford-developed innovations, and delivers real efficiency benefits to Oxford businesses. As part of the 'matchmaking' process, an event could be held to provide cleantech companies with a platform to pitch solutions to gathered industry players, leveraging existing networks like Oxford GreenTech and Oxford Innovation. The scheme should engage closely

	with BEIS's Industrial Energy Efficiency Accelerator to understand learnings and successes, and identify any Oxford-based innovation companies which might be interested.
Relevant Pathway Requirements	Industry: • % of fossil fuel processes electrified: By 2025 (10%), by 2030 (12%), by 2035 (18%), by 2040 (24%). • Reduction in industrial energy demand: By 2025 (11%), by 2030 (33%), by 2035 (38%), by 2040 (45%). Commercial: • Reduction in electricity demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (30%), by 2040 (40%). • Reduction in gas demand from energy efficiency: By 2025 (10%), by 2030 (20%), by 2035 (25%), by 2040 (30%).
Funding Sources	Although the matchmaking portion of the scheme would not be hugely resource intensive, the provision of grants to industrial/commercial sites as an incentive to drive uptake would require securing funding from Innovate UK or UKRI, or potentially OxLEP.
Implementation Steps	1. Complete the detailed design of the scheme structure, matchmaking and grant funding provision. 2. Develop and launch online application page to begin populating the two lists. 3. Begin to facilitate introductions between organisations, encouraging them to collaboratively work-up a potential deployment project. 4. Review potential deployment projects using an expert technical committee, if approved, make an offer of grant funding to support deployment. 5. When grant funding has been used, continue to offer the matchmaking service, being sure to communicate success stories back to the business sector. **Monitoring:** Number of industrial/commercial sites registered, number of cleantech applications submitted, number of matches made, number (and rate) of successful conversions, amount of grant funding dispersed and amount (and ratio) of internal industrial/commercial business investment leveraged in.
Owners & Champions	TBC
Action Dependencies & Risks	• As the UK emerges from the Covid-19 economic crisis, there is potential that businesses will not be looking to trial unknown or innovative technologies in their facilities. This could likely be felt as a risk to smooth business performance and productive output.

Other actions considered:

A further skills and supply chain intervention considered during the pipeline development and refining process was:

- Business scope 3 emissions support. Supporting businesses in Oxford (particularly large businesses with extensive supply chains) with tools to help them measure their

scope 3 emissions and engage with their supply chain to reduce it. This could include the creation of an 'Oxford Charter' for businesses and suppliers to sign-up to, setting an agreed minimum benchmark or commitment to sustainability that flows down the supply chain.

Looking beyond 2030:

As Oxford progresses down it's net-zero 2040 pathway, much of the low carbon supply chain will already need to be operational and scaling by 2030. In line with this, the current supply chain lacks sufficient capacity to service very large procurement exercises, such as joint area-wide initiatives between public bodies. The maturation of the supply chain to handle this scale of activity will enable public bodies pursuing such an approach to capture cost-efficiencies from scale. It is however worth flagging that, in the short-term this is potentially not in the best interests of the supply chain, as it could stifle the innovative testing of many different approaches – as is currently seen. There will also be new areas of the supply chain that could open up, requiring development and scaling, such as hydrogen boiler retrofit.

Cross-cutting

CC1 – Strengthening domestic grid connections

Domestic **Transport**

By 2025

ZCOP Role: Lead

Concept	SSEN to digitalise the property-level paper cards that provide information on grid connection, inputting them into a database which links to their existing online portal, and can give heat pump or EV charger installers an instant yes/no regarding whether reinforcement is required. The digitalisation of the cards in Oxford will be done by area to align with the priority areas for capital investment in charging infrastructure. When a domestic property wants to get an EV charger or heat pump installed, the installer is required to assess the safety of the wiring, estimated existing load, and estimated load post-installation. If certain thresholds are breached, the installer is mandated to contact the DNO to ask permission for reinforcing (this particularly relates to the fuse/'cut-out', which only the DNO is allowed to access). The DNO will the complete a site-visit to check this. Although the targeted turnaround time is 10-days for the DNO, most DNOs across the country are overwhelmed by demand, resulting in waiting times of multiple weeks. The DNOs are collectively trying to reduce the need to conduct site visits, but gathering and sharing data from many sources to provide a degree of pre-screening. Skyline is one project that is sharing data from EV companies, car clubs, etc., as is the app iDentify. Both are due to launch at the beginning of 2022.

	SSEN have expressed that senior management is keen to respond to demands for information to inform deployment. It is recommended that when a significant heat pump or EV charger capital investment programme is developed, Oxford City Council should petition SSEN for this information.
Relevant Pathway Requirements	Domestic: • ASHPs: By 2025 (10,762), by 2030 (15,984), by 2035 (25,267), by 2040 (32,429). Transport: • Off-street EV chargers: 2025 (3,502), 2030 (8,341), 2035 (12,799), 2040 (13,057).
Funding Sources	SSEN has committed to exploring the potential of delivering this using available internal budget.
Implementation Steps	1. Allocate resource to every depot/office where it is known that the paper records are held to scanning/photograph each record. Triage service would be required for issues such as difficult to read handwriting. 2. Information gathered then crunched by the data/analytics team and validated to confirm it's ready to go into the system. Site visits on a sub-set can be used to triple check. 3. Once the information is in the system it should be picked up by the online automation portal. Installers can then submit an online 'application for EV charger' form, which instantly pulls out the key information from the database and offers a quick 'yes' or 'no'. 4. This will reduce the waiting time for the connection of new domestic equipment, accelerate the rollout of EV chargers and improve SSEN capacity for at-scale operation. **Monitoring:** Number of domestic grid connections assessed, signed-off and upgraded.
Owners & Champions	SSEN
Action Dependencies & Risks	• It has emerged that some depots/offices have already thrown away or lost the paper forms.
Impacts	TBC – Qualitative

CC2 – Exploring funding options for the ZCOP pipeline

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025	Sprint Group

ZCOP Role: Lead	
Concept	Investigate the different funding options available to the ZCOP to implement the action plan pipeline. This includes:

	• Engaging with central government to understand what funding streams are available and planned, and how they could be leveraged; • Recommending the use of Section 106, and establishing an 'offset fund'; • Using the Community Infrastructure Levy; • Facilitating crowdfunding, for example by a Community Municipal Bond; • The Public Works Loans Board; • The Carbon Energy Fund for the NHS and wider Public Sector; • Utilising contributions from the Workplace Parking Levy; • Working with Salix Finance to identify and develop funding solutions; and • Exploring available funding from the Local Energy Hub and OxLEP. The work should not only identify funding options, but also look to estimate how much funding is required for implementing the pathway requirements of each of the sector roadmaps (including enabling infrastructure costs, where applicable). Additionally, the potential revenue sources identified should be quantified to highlight the gap, and inform a prioritised plan for securing funding.
Funding Sources	This action could be delivered using the existing resources of ZCOP partners, however, alternatively additionally funding could be sought in order to bring in experienced finance or green finance consultants.
Implementation Steps	1. Agree a research team, and prioritise a number of actions for which identifying funding approaches is most important. 2. Conduct sessions with partners to tap into their considerate business expertise and brainstorm new approaches to funding, as well as strength-testing any initial hypotheses from the research team. 3. Once a shortlist of robust options is in place, reach out to the potential funders to kick-start a discussion around interest, practicability and terms.
Owners & Champions	ZCO Partnership

CC3 – Encouraging ZCOP partners to engage with flexibility markets, including via time-of-use tariffs and Project LEO

Domestic **Commercial** **Industrial** **Institutional** **Transport**

By 2025

ZCOP Role: Lead

Concept	Encourage ZCOP partners to show Oxford-wide leadership and develop their experience of grid energy flexibility by engaging with innovations

	such as the new flexibility market created by Project LEO[58], or through consumer focussed interventions such as time-of-use tariffs. Grid flexibility can be a difficult to understand and intangible concept. This action seeks to introduce it to the ZCOP partners (who include some of Oxford's largest energy consumers) in a simple way, translating a conceptual future into a tangible present. Project LEO provides a helpful definition of grid flexibility: *"Making temporary changes in the way you consume, generate, or store electricity when requested, to support a more efficient use of the energy network. A flexibility provider is a user who provides flexibility services by making temporary changes to the way they consume, generate, or store electricity when requested."* [59] Efficient use of the electricity network by using energy more flexibly is crucial to the success of net zero. The electricity network was historically designed to cater for large, centralised power stations, not smaller and decentralised low carbon generation. Energy flexibility is a key concept to support the network to transition to a low carbon future. Project LEO's flexibility market aims to work with owners of low carbon energy generation and storage (e.g. batteries), or organisations with larger energy demand that can be controlled on request, to bid in to provide "flexibility services" to the District Network Operator (who manages the cables, switches and other infrastructure of the electricity network). This would productively build on Project LEO and secure local partners as champions for flexibility, providing confidence to other businesses and large-energy consumers across Oxford. Time of use tariffs are a comparatively new concept, designed to incentivise customers through their usual energy supplier to use more energy at off-peak times, in order to balance demand. These tariffs charge cheaper rates at certain times of night or day, when demand is at its lowest, and higher rates at popular (high demand) times. Time of use tariffs also present opportunities for domestic properties to be involved in energy flexibility.
Funding Sources	This action could be delivered using the existing resources of ZCOP partners.
Implementation Steps	**Implementation steps for time of use tariffs:** 1. ZCOP discuss time-of-use tariffs, and gauge interest from partners and domestic customers. 2. Seek electricity suppliers that may be willing to support ZCOP in championing time of use tariffs for organisations and domestic customers, and answer detailed questions on operations and impact to build confidence and assurance. 3. Identify groups that would like to make collective switches, gather tariff options, and investigate whether smart monitoring or response equipment is required.

[58] Available from: https://project-leo.co.uk/about/
[59] https://project-leo.co.uk/the-energy-challenge/flexibility-services/

	4. Proceed with the tariff switch, and communicate with the wider Oxford business and residential community. **Implementation steps for Project LEO markets:** 1. Provide a platform for Project LEO to reach out to Oxford businesses and organisations about its local energy flexibility markets, and answer detailed questions on operations and impact to build confidence and assurance, and provide information on how to sign up. 2. ZCOP partners support Project LEO in its messaging and dissemination of learning about energy flexibility markets, where relevant. 3. ZCOP partners consider signing up to participate in the markets themselves, where appropriate. **Monitoring:** How many ZCOP partners take-up time-of-use tariffs, what is the impact on their electricity consumption and bill. How many Oxford-based organisations sign up to work with Project LEO.
Owners & Champions	ZCO Partnership
Action Dependencies & Risks	• This action is dependent on the successful outcome of Project LEO – the establishment of an operational flexibility market in Oxfordshire.

Actions glossary

Organised by sector

Domestic	P1, P2, R1, R2, R3, C1, C3, B1, B2, G3, G4, S1, S2, CC1, CC2, CC3.
Commercial	P1, P2, R1, R2, R3, C1, C2, C4, C5, B1, B2, G1, G3, G4, S1, S2, S3, CC2, CC3.
Industrial	R3, R4, B2, G1, G3, G4, S1, S2, S3, CC2, CC3.
Institutional	P2, R3, C1, C3, C5, B2, G1, G3, G4, S1, S2, CC2, CC3.
Transport	P1, R3, R4, C2, C6, C7, B1, B2, G2, G3, G4, S1, S2, CC1, CC2, CC3.

APPENDICES

Appendix 1: Full list of updated scenario model assumptions

General

- The 2021 updated scenario shows a potential pathway to reach net zero by 2040. In keeping with the previous scenario, there is an emphasis on reducing the overall energy demand and electrifying heat in buildings.
- **Gas grid:** Biogas injection and hydrogen blending have both been modelled on the gas grid. The Didcot biomethane injection point currently contributes ~1% to the gas mix in Oxfordshire, and this is expected to rise incrementally as more local authorities in the area collect food waste. In addition, SGN have confirmed that their gas network is capable of a 20% hydrogen blend, which we have modelled by 2030.
- **District heating:** The mix of heat sources that feed into the heat network(s) in Oxford are cited in two feasibility studies conducted by the University of Oxford, who have recently received funding to develop a heat network in the city centre of Oxford. The network will initially connect to university and council buildings and may expand to other sectors in the future. The studies suggest that in the first instance, gas and biomass CHP will predominantly feed into the network, and as the network expands in the future, it will be able to accommodate a water-source heat pump from 2032 and phase out gas.

Residential buildings

- **Energy efficiency retrofit:** Figures have been calculated by applying the projected change in deployment of each measure (e.g. wall/loft insulation, glazing, LEDs) to the existing housing stock in a given year. The level of ambition of the projected deployment has been kept the same as that proposed by Anthesis in previous modelling. That is, nearly 17,000 individual measures rolled out by 2030, and 48,000 by 2040.
- **Solar PV retrofit:** Deployment of solar PV on existing homes has been scaled to the proportion of homes with suitable rooftops for installation, using data provided by Project LEO. A maximum of 67% of homes with rooftop PV is reached in 2050 and the rate of installation in the near-term has been lowered from Anthesis's projection to ~1,300 homes a year (accounting for market and planning constraints). This was suggested by stakeholders at a workshop ran in March 2021.
- **Heat pumps:** Retained the same level of ambition as the Anthesis modelling, and this is broadly in line with the SSEN DFES 2020 results for Low-Carbon Technology. By 2040, 50% of existing homes have an air-source heat pump installed, and 18% are fitted with a ground-source heat pump.

- **District heating:** The extent of heat network deployment is slightly below the FES 'Leading the Way' and CCC projections, this is because the proposed heat networks in Oxford are primarily focused on institutional buildings. It is projected to connect 10% of homes by 2040.
- **New-build homes:** Under an ambitious scenario, the efficiency level of new-build homes assumes that the Future Homes Standard60 will act as a springboard to enabling local authorities to set more stringent minimum building standards. For Oxford, this means no new homes connected to the gas grid beyond 2025 and new homes are built to EPC A standard. The rollout of solar PV assumes that installation will be feasible for ~75% of new homes by 2030.

Institutional

- **Energy efficiency:** Demand reduction from energy efficiency has been raised from the Anthesis projections (from 14% to 30% by 2030) for institutions, who can improve their building stock through government funding e.g. £600m grant funding for NHS building improvements.61 Stakeholders felt that there is a strong need to improve an inefficient building stock, but that funding is required to do so.
- **Solar PV:** The rooftop and commercial-scale PV ambition for non-domestic buildings has been adjusted to better match the DFES projections for the city of Oxford. 13 MW of commercial-scale PV capacity is projected to connect by 2040, which accounts for approx. 6% of institutional electricity demand.
- **Heat pumps:** Heat pump rollout for institutional buildings has been lowered due to the district heat network which will primarily connect to university and council buildings (17% of institutional buildings fitted with a heat pump by 2030 and 44% by 2050).
- **District heating:** Proposed heat networks in Oxford are primarily focused on institutional buildings, namely university and council buildings (40% of heat demand by 2030 going up to 56% by 2050). Percentages and heat source information were extracted from Heat Network feasibility studies for the city centre and Headington.

Commercial

- **Energy efficiency:** Demand reduction from energy efficiency has been raised from the Anthesis projections (from 14% to 20% by 2030) for commercial (mainly to account for lighting improvements).
- **Solar PV:** The rooftop PV ambition for non-domestic buildings have been adjusted to better match the DFES projections for the city of Oxford. 6.6 MW of commercial-scale PV capacity is projected to connect by 2040, which accounts for approx. 6% of commercial electricity demand.
- **Heat pumps:** Kept heat pump rollout same level of ambition as Anthesis for commercial (36% of commercial buildings fitted with a heat pump by 2030 and 72% by 2050).

[60] MHCLG, 'The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings'. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf

[61] DHSC, 'Build back better: £600 million to upgrade and refurbish NHS hospitals' (Published 10th December 2020). Available from: https://www.gov.uk/government/news/build-back-better-600-million-to-upgrade-and-refurbish-nhs-hospitals

- **District heating:** The extent of heat network deployment is slightly below the FES 'Leading the Way' and CCC projections, this is because the proposed heat networks in Oxford are primarily focused on institutional buildings. In the long-term, we assume that other buildings join to the expanding heat network (10% of commercial buildings by 2040).

Industry

- **Energy efficiency:** Demand reduction from energy efficiency has been raised from the Anthesis projections (from 14% to 30% by 2030) for industry and agriculture (mainly to account for lighting improvements).
- **Solar PV retrofit:** Raised long-term industrial rooftop PV above DFES 'Leading the Way' rates as more potential for industrial sector PV due to higher electricity demand (16 MW by 2050).
- **Electrification:** Kept Anthesis's assumptions around: electrification of industry (increases from 35% of processes in 2018 to 44% in 2030). The result of electrification and demand reductions is that by 2040, gas consumption reduces by 65% from 2018 level, and electricity consumption by 21% resulting in an overall demand reduction of 43% and an emissions reduction of 85%.
- **Carbon Capture & Storage (CCS):** Have not modelled any CCS in Oxford due to lack of available carbon storage sites in Oxfordshire.
- **Process emissions:** Removed 'Industrial Processes' from the baseline. Anthesis estimated baseline for metal and chemical processes from scaled down national figures. However, feedback from stakeholders suggests that there are no such processes in Oxford.

Transport

- **Electrification of cars, vans, motorcycles and rail:** Rollout of car electric vehicles (EVs) have been lowered from Anthesis projections to align more with SSEN DFES results. The deployment of electric car EVs reaches 100% by 2035. Vans and motorbikes reach 100% electrification by 2040. Kept electrification of rail the same as Anthesis (100% by 2030).
- **Electrification of HGVs:** The FES 'Leading the Way scenario' also includes electrification of HGVs in the long-term (14% by 2050) which has been included in the modelling.
- **Electric and hydrogen buses:** Bus and coach projections have also been changed from the Anthesis scenario. Feedback from stakeholders suggest that around half the bus journeys in Oxford are less than 150 miles, making them more suitable for electrification and therefore, we have modelled buses & coaches to be 40% electric and 20% hydrogen by 2030, then 50% electric and 50% hydrogen by 2040.
- **Bio-fuel and hydrogen HGVs:** Modelled some near-term conversion of HGVs to biofuels (10% by 2030) as this is seen as an important stepping stone for HGV

decarbonisation.62 Also included long-term conversion of HGVs to hydrogen (76% by 2050) in line with National Grid's FES.

- **Modal shift:** Included factor for 'decreased use of road transport though cycling, walking, work-from-home and car sharing – 25% reduction by 2030 and 35% by 2050. Percentages estimated from evidence such as initial statistics around working from home, city cycling rates, and the presence of electric car hire initiatives e.g. Co Wheels and Zipcar.
- **Modal Shift:** Kept Anthesis's assumptions around switching from private transport to buses and rail (2% switch to bus, and 17% switch to rail by 2030 as a result of a new rail line).

Waste

- **Waste:** kept Anthesis's assumption of improving Oxford's household recycling rate from 50% in 2018 to 70% by 2030. Also removed the assumption that the total amount of waste produced in Oxford decreases as stakeholder feedback suggested that this is not feasible with a projected population increase in the city.
- **Wastewater:** According to the Anthesis baseline, Oxford uses 13,700 Megalitres each year. According to Ofwat, water usage could be lowered by 10% if leakages are reduced by 50%, which they have committed to achieving by 2050. We have modelled Oxford reaching this target in 2050. In addition, Thames Water have committed to net zero by 2030 which they will achieve by generating their own renewable electricity.

Land use change

- Retained the same rate of change of 'land use' as the Anthesis modelling. Grasslands decrease 10% by 2040 while forests increase 30%. Settlements and croplands are unchanged.

[62] Smart Transport, 'Demand for renewable biofuel set to double in 2020, says CNG Fuels' (Published 20th March 2020). Available from: https://www.smarttransport.org.uk/news/demand-for-renewable-biomethane-fuel-set-to-double-in-2020-says-cng-fuels

Appendix 2: Energy consumption projections by sector

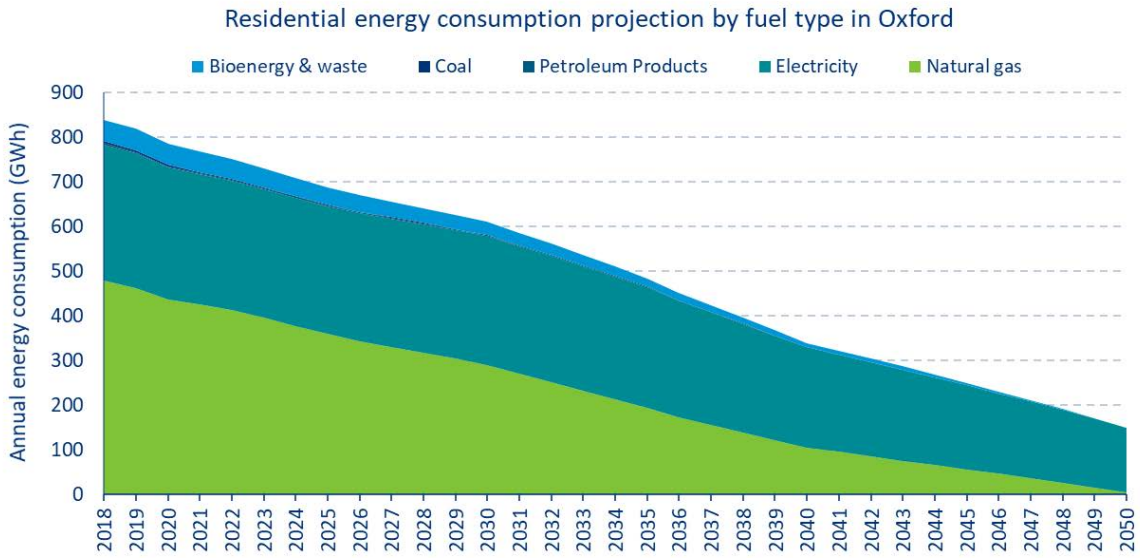


FIGURE 19: RESIDENTIAL ENERGY CONSUMPTION PROJECTION

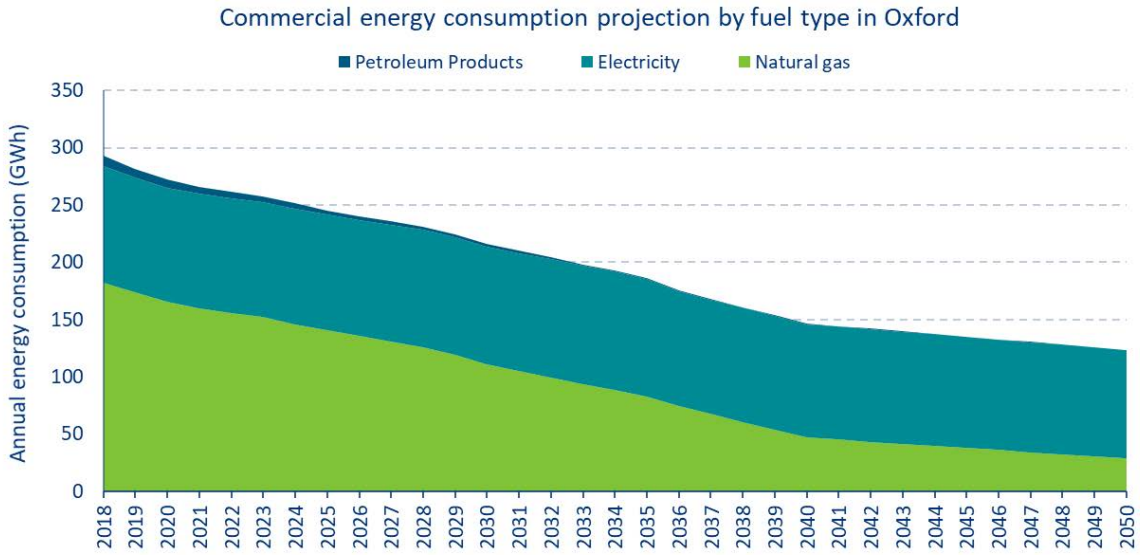


FIGURE 20: COMMERCIAL ENERGY CONSUMPTION PROJECTION

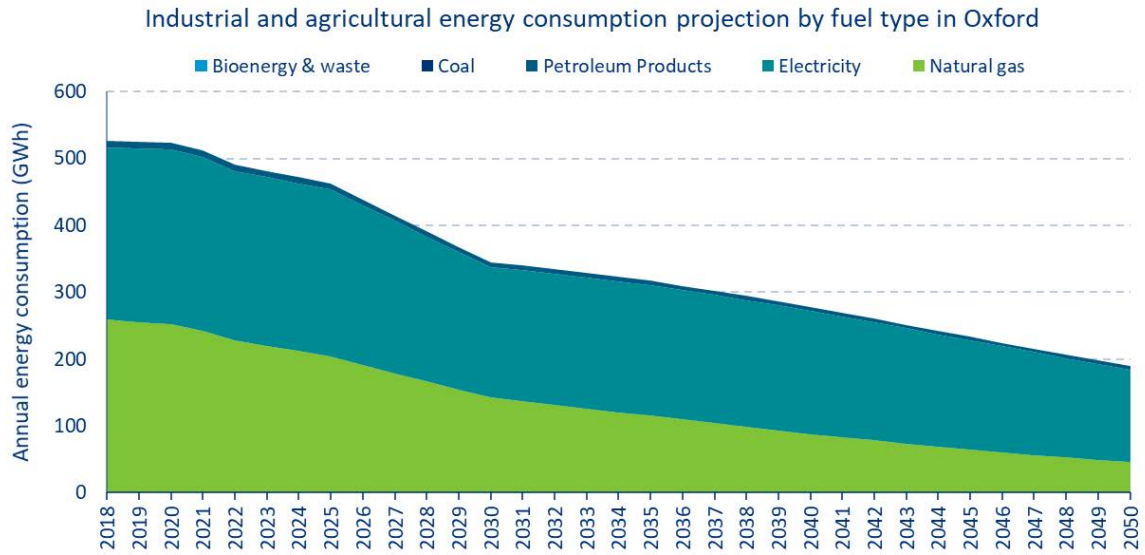


FIGURE 21: INDUSTRY & AGRICULTURE ENERGY CONSUMPTION PROJECTION

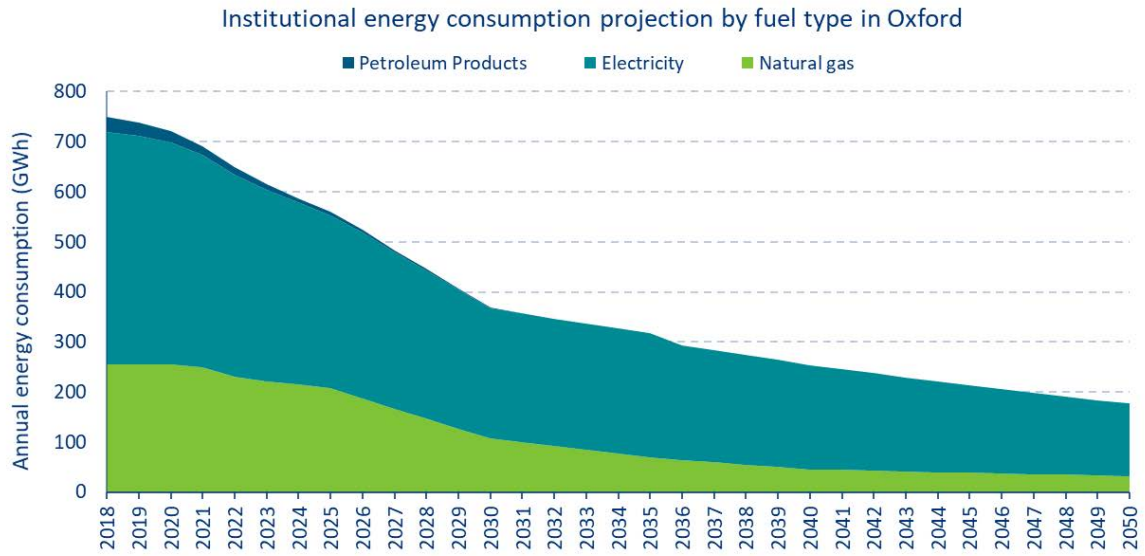


FIGURE 22: INSTITUTIONAL ENERGY CONSUMPTION PROJECTION

Appendix 3: Roadmap monitoring tables

Strategic

TABLE 2: OVER-ARCHING STRATEGIC ROADMAP MONITORING TABLE

Emissions reduction	2018 ($ktCO_2e$)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	204
Oxford Total	***735***	***33%***	***36%***	***42%***	***46%***	***49%***	***54%***	***58%***	***62%***	***64%***	***67%***	***70%***	***73%***	***76%***	***79%***	***82%***	***84%***	***86%***	***88%***	***89***
→ Domestic	182	32%	35%	41%	45%	47%	50%	52%	55%	56%	60%	64%	67%	71%	75%	78%	81%	84%	85%	87
→ Commercial	65	30%	33%	38%	42%	44%	48%	50%	54%	56%	59%	63%	66%	70%	73%	77%	80%	83%	84%	86
→ Industry & Agriculture	123	35%	37%	44%	47%	50%	55%	58%	62%	64%	66%	69%	72%	74%	77%	79%	81%	84%	85%	86
→ Waste	8	20%	23%	26%	28%	31%	34%	36%	39%	40%	40%	41%	41%	42%	42%	42%	42%	42%	42%	42
→ Institutional	187	42%	46%	53%	57%	59%	63%	65%	69%	71%	73%	76%	78%	81%	84%	86%	88%	90%	91%	91
→ Transport	171	16%	20%	24%	27%	35%	43%	50%	58%	64%	67%	69%	72%	75%	78%	80%	83%	85%	86%	88

Domestic

TABLE 3: DOMESTIC SECTOR ROADMAP MONITORING TABLE

Action area*	2018	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040

*Estimated no. of existing homes receiving >=1 fabric EE measure(s)***	0									*16,600*					*37,643*					*48,291*
Solid Wall Insulation	5,199	7,389	7,880	8,376	8,877	9,375	9,878	10,387	10,900	11,418	11,917	12,421	12,930	13,443	13,961	14,617	15,280	15,948	16,623	17,304
Cavity Wall Insulation	17,273	18,629	18,622	18,614	18,605	18,631	18,657	18,681	18,705	18,728	18,746	18,763	18,780	18,795	18,809	19,002	19,195	19,389	19,585	19,781
Loft Insulation	17,497	23,577	24,790	26,015	27,253	28,494	29,744	31,009	32,285	33,574	34,815	36,065	37,329	38,603	39,890	41,568	43,262	44,972	46,696	48,437
Underfloor Insulation	4,946	8,431	8,991	9,557	10,129	10,697	11,271	11,852	12,437	13,029	13,597	14,172	14,753	15,339	15,930	16,678	17,434	18,197	18,966	19,744
Double Glazing	13,252	16,763	17,876	19,001	20,138	21,268	22,410	23,563	24,727	25,903	27,035	28,178	29,331	30,496	31,672	33,160	34,663	36,179	37,710	39,254
LEDs	0	3,839	5,794	7,768	9,766	11,784	13,825	15,890	17,975	20,083	22,212	24,364	26,539	28,734	30,952	33,192	35,455	37,739	40,046	42,374
Action area*	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Air Source Heat Pump	300	5,437	7,192	8,967	10,762	11,785	12,818	13,863	14,918	15,984	17,803	19,641	21,497	23,373	25,267	26,673	28,091	29,524	30,970	32,429

Ground Source Heat Pump	0	2,645	3,547	4,459	5,381	5,892	6,409	6,931	7,459	7,992	8,283	8,577	8,874	9,173	9,475	9,907	10,343	10,783	11,226	11,674
Electric Heating	9,188	6,759	5,911	5,053	4,185	4,209	4,232	4,256	4,280	4,303	4,327	4,351	4,374	4,398	4,422	4,064	3,703	3,337	2,968	2,594
District Heating	1,723	1,763	1,773	1,784	1,794	1,804	1,814	1,824	1,834	1,844	2,102	2,362	2,625	2,890	3,158	3,810	4,469	5,135	5,807	6,486
Gas Heating	46,225	42,170	40,689	39,187	37,666	36,436	35,190	33,928	32,649	31,354	29,301	27,223	25,122	22,996	20,845	19,052	17,238	15,404	13,549	11,674
Solar PV Retrofit	1,098	6,914	8,411	9,926	11,458	12,678	13,911	15,159	16,419	17,693	18,981	20,282	21,597	22,925	24,267	26,233	28,218	30,224	32,250	34,297
Solar PV New-Build	-	254	355	473	608	767	950	1,156	1,386	1,639	1,893	2,146	2,400	2,653	2,907	3,160	3,414	3,667	3,921	4,174
New-Build EPC A	-	724	985	1,284	1,622	1,960	2,298	2,636	2,974	3,312	3,650	3,988	4,326	4,664	5,002	5,340	5,678	6,016	6,354	6,692
New-Build EPC B	-	483	521	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541
Action area*	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
New-Build EPC C	-	483	521	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541

Off-Street EV Chargers	201	2,000	2,444	2,877	3,502	4,601	5,647	6,623	7,533	8,341	9,280	10,227	11,153	12,056	12,799	12,799	12,807	12,891	13,057	13,057

* All figures are numbers of installations, apart from row 1, and those for 'New-Build'.

** The 2030 figure is taken directly from previous Anthesis modelling, which also stated a figure of 3,000 homes in 2018. We used the relationship between these two figures to extrapolate for 2035 and 2040, this does not relate to the gross number of individual EE measures deployed. We also baselined 2018 as '0' and negated 3,000 from the subsequent 2030, 2035 and 2040 figures.

Commercial

TABLE 4: COMMERCIAL SECTOR ROADMAP MONITORING TABLE

Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Reduction in electricity demand	102 GWh	6%	7%	9%	10%	12%	14%	16%	18%	20%	22%	24%	26%	28%	30%	32%	34%	36%	38%	40%
Reduction in gas demand	182 GWh	6%	7%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
Air Source Heat Pump	0%	6%	7%	9%	10%	13%	16%	18%	21%	24%	26%	29%	31%	34%	36%	39%	42%	44%	47%	50%
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Ground Source Heat Pump	0%	2%	3%	3%	4%	6%	7%	9%	10%	12%	12%	13%	13%	14%	14%	15%	16%	16%	17%	18%

Electric Heating	15%	12%	11%	11%	10%	9%	8%	7%	6%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
District Heating	0%	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	4%	4%	5%	6%	7%	8%	9%	10%
Gas Heating	85%	83%	81%	80%	77%	75%	71%	66%	62%	57%	54%	50%	47%	43%	40%	35%	31%	26%	22%	17%
Solar PV Capacity (MW)	0	0	1	1	0.8	1	2	2	3	3.31	4	4	5	5	5.6	6	6	6	6	6.6
Solar PV as % of total Oxford electricity demand	0%	0%	1%	1%	1%	1%	2%	2%	3%	3%	3%	4%	4%	5%	5%	5%	5%	6%	5.80%	6%

Industrial

TABLE 5: INDUSTRIAL SECTOR ROADMAP MONITORING TABLE

Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
% of industrial processes electrified	203 GWh	6%	7%	9%	10%	10%	11%	11%	12%	12%	13%	14%	16%	17%	18%	19%	20%	22%	23%	24%

Reduction in industrial energy demand	525 GWh	6%	7%	9%	10%	14%	18%	22%	26%	30%	30%	31%	31%	32%	32%	33%	33%	34%	34%	35%
Solar PV Capacity (MW)	0	3.0	3.8	4.5	5.3	6.6	7.8	8.9	9.8	10.7	11.2	11.6	12.1	12.5	12.9	13.3	13.6	13.9	14.2	14.4
Solar PV as % of total industrial electricity demand	0%	1%	1%	2%	2%	3%	3%	4%	4%	5%	5%	5%	6%	6%	6%	6%	6%	7%	7%	7%

Institutional

TABLE 6: INSTITUTIONAL SECTOR ROADMAP MONITORING TABLE

Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Reduction in electricity demand	465 GWh	4%	6%	8%	10%	14%	18%	22%	26%	30%	30%	31%	31%	32%	32%	33%	33%	34%	34%	35%
Reduction in gas demand	255 GWh	4%	6%	8%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%

Air Source Heat Pump	0%	3%	4%	4%	5%	6%	8%	9%	11%	12%	14%	17%	19%	22%	24%	25%	26%	28%	29%	30%
Ground Source Heat Pump	0%	1%	1%	1%	1%	2%	3%	3%	4%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%	10%
Electric Heating	15%	12%	11%	11%	10%	9%	8%	7%	6%	5%	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%
District Heating	0%	6%	7%	9%	10%	16%	22%	28%	34%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%
Gas Heating	85%	79%	77%	76%	74%	67%	60%	54%	46%	38%	34%	30%	26%	22%	18%	16%	13%	11%	8%	6%
Solar PV Capacity (MW)	0	1.9	2.2	2.5	2.8	4.2	5.4	6.6	7.5	8.4	9.4	10.4	11.5	12.5	13.0	13.1	13.1	13.1	13.1	13.1
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Solar PV as % of total institutional electricity demand	0%	0%	1%	1%	1%	1%	2%	2%	3%	3%	3%	4%	4%	5%	5%	5%	5%	6%	6%	6%

TABLE 7: TRANSPORT SECTOR ROADMAP MONITORING TABLE

Action area	2018	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Decreased use of road transport through cycling, walking, WFH and car sharing	-	9%	11%	13%	15%	17%	19%	21%	23%	25%	25%	25%	25%	25%	25%	26%	27%	28%	29%	30%
Switch from private transport to buses & coaches	-	1%	1%	1%	1%	1%	1%	2%	2%	2%	3%	3%	4%	4%	5%	6%	7%	8%	9%	10%
Switch from private transport to rail	-	3%	4%	4%	5%	7%	10%	12%	15%	17%	18%	18%	19%	19%	20%	20%	20%	20%	20%	20%
Electrification of Cars	***1%***	***14%***	***18%***	***21%***	***25%***	***36%***	***47%***	***58%***	***69%***	***80%***	***84%***	***88%***	***92%***	***96%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
→ Petrol Cars	42,144	37,132	35,229	33,192	31,115	25,511	20,099	15,044	10,454	6,273	4,942	3,659	2,395	1,173	0	0	0	0	0	0
→ Diesel Cars	12,833	10,671	10,014	9,339	8,658	7,042	5,508	4,089	2,821	1,681	1,315	968	632	308	0	0	0	0	0	0

→ Electric Cars	681	8,042	9,776	11,393	12,878	17,544	21,531	24,825	27,560	29,516	30,312	31,197	31,979	32,578	33,268	30,957	29,396	27,981	28,588	27,45
→ Petrol Motorcycles	1,745	1,237	1,133	1,036	942	751	579	425	289	171	133	97	63	31	14	0	0	0	0	0
→ Electric Motorcycles	0	206	246	282	314	423	514	588	646	687	701	715	729	741	753	699	663	628	594	560
Electrification of LGVs	***0%***	***6%***	***7%***	***8%***	***10%***	***18%***	***26%***	***34%***	***42%***	***50%***	***56%***	***62%***	***68%***	***74%***	***80%***	***84%***	***88%***	***92%***	***96%***	***100%***
→ Petrol LGVs	3,741	3,496	3,447	3,396	3,336	3,036	2,736	2,432	2,129	1,827	1,600	1,378	1,158	938	720	556	413	272	134	0
→ Diesel LGVs	3,033	2,835	2,795	2,753	2,705	2,461	2,218	1,972	1,726	1,481	1,297	1,117	939	760	584	451	334	221	109	0
→ Electric LGVs	28	389	484	579	673	1,216	1,757	2,293	2,826	3,354	3,737	4,123	4,516	4,895	5,282	5,359	5,557	5,750	5,938	6,121
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Electrification of HGVs	***0%***	***0%***	***0%***	***0%***	***0%***	***1%***	***1%***	***1%***	***2%***	***2%***	***2%***	***3%***	***3%***	***4%***	***4%***	***5%***	***5%***	***6%***	***6%***	***7%***
Hydrogen/biofuel HGVs	***0%***	***3%***	***4%***	***4%***	***5%***	***6%***	***7%***	***8%***	***9%***	***10%***	***10%***	***10%***	***10%***	***10%***	***10%***	***16%***	***22%***	***28%***	***34%***	***40%***

→ Diesel HGVs	667	651	647	643	639	631	624	616	608	601	599	598	596	594	593	549	504	459	414	369
→ Electric HGVs	0	0	0	0	2	5	7	9	12	14	16	19	22	25	28	32	36	40	44	49
→ Biofuel HGVs	0	19	24	29	34	41	47	54	61	68	68	69	69	69	69	69	69	69	69	69
→ Hydrogen HGVs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	84	126	168	210
Electrification of Buses & Coaches	***0%***	***9%***	***11%***	***13%***	***15%***	***20%***	***25%***	***30%***	***35%***	***40%***	***42%***	***44%***	***46%***	***48%***	***50%***	***50%***	***50%***	***50%***	***50%***	***50%***
Hydrogen Buses & Coaches	***0%***	***6%***	***7%***	***9%***	***10%***	***12%***	***14%***	***16%***	***18%***	***20%***	***22%***	***24%***	***26%***	***28%***	***30%***	***34%***	***38%***	***42%***	***46%***	***50%***
→ Diesel Buses & Coaches	409	323	305	287	269	241	212	184	156	129	120	111	101	89	77	65	53	39	23	0
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
→ Electric Buses & Coaches	1	71	80	88	95	119	138	157	176	190	203	215	232	234	236	238	240	242	247	296
→ Hydrogen Buses & Coaches	0	22	27	32	57	67	76	84	91	99	109	120	130	139	147	158	170	184	198	213

Electrification of rail	0%	11%	14%	17%	20%	36%	52%	68%	84%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
EV Chargers	***366***	***2,583***	***3,126***	***3,656***	***4,374***	***5,671***	***6,913***	***8,074***	***9,160***	***10,133***	***11,287***	***12,457***	***13,605***	***14,725***	***15,689***	***15,785***	***15,892***	***16,077***	***16,384***	***16,49***
→ Domestic off-street	201	2,000	2,444	2,877	3,502	4,601	5,647	6,623	7,533	8,341	9,280	10,227	11,153	12,056	12,799	12,799	12,807	12,891	13,057	13,05
→ Domestic on-street	50	219	259	297	334	420	502	577	647	709	785	863	939	1,014	1,089	1,108	1,130	1,153	1,205	1,233
→ Workplace	7	99	122	144	165	199	232	263	293	319	355	392	429	465	501	513	525	538	561	576
→ Fleet	0	8	10	12	14	19	25	30	34	39	55	70	85	98	111	128	144	160	178	193
→ En-route local	14	96	116	137	157	211	266	320	374	429	511	594	677	760	843	891	940	989	1,037	1,086
Action area	**2018**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
→ Destination	82	126	135	144	152	163	175	187	198	208	208	212	217	222	229	229	229	229	229	229
→ Car Park	12	35	40	45	50	58	66	74	81	88	93	99	105	110	117	117	117	117	117	117

Appendix 4: Climate Change Committee's recommendations to national government for supporting local authorities

Box 1
Recommendations to Government

In order to enable local authorities to effectively deliver climate action in the UK, the Government will need to develop clear policy, including guidance on the role of local authorities in delivering Net Zero, and empower local authorities with appropriate levels of funding and support.

Policy

- **Develop a Net Zero Delivery Framework which aligns and clarifies national, subnational, regional and local delivery roles** and areas for collaboration as part of the Government's forthcoming Net Zero Strategy. It should provide clear outcomes and direction to reduce uncertainty, provide additional powers where needed, identify public and private investment and enable flexible delivery at the faster pace of ambitious areas. This should also allow local authorities to set higher standards through the planning system.
- **Consider introducing a Duty on local authorities to act in accordance with Net Zero by delivering climate action plans within a common reporting system.** A corresponding recommendation to local authorities is to develop standardised reporting and benchmarking, the Government should encourage and support this, and should receive data and use it for policy making. Any new duty should be fully funded.
- **Make policies consistent with delivering Net Zero by reviewing evidence provided in this and other reports, and in requests from local authorities.** Government should remove blocks and align powers and policies to be consistent with delivering Net Zero. This is important for Planning policies, financial appraisal and managing public transport as a whole system.
- **Support area wide planning for regional delivery of energy, transport systems and building retrofit.** This planning should support governance and delivery stakeholders and a strong social process for public engagement. It should include robust Local Area Energy Planning that identifies heat zones for buildings, building retrofit priorities. It should also include city-wide or area-wide transport planning for decarbonised transport. A Duty to Collaborate between agencies and local authorities could be considered.

Funding and Support

- **Increase funding and support for local authorities to develop skills and capacity** to plan and implement climate action across both emissions reduction and climate adaptation in their local areas. This should include sufficient core funding and training to ensure that climate skills are embedded in all roles and that there is widespread access to specialist energy and retrofit skills.
- **Provide coherent cross-departmental support on climate action**, building on the positive models of OLEV, HNDU and Sustainable Scotland Network support to local authorities. This should support local authority staff to deliver on buildings and transport decarbonisation in particular. Such offices should enable seamless communication between government officials and local authority officers.

- **Introduce significant, non-competitive long-term investment** in retrofit, heat decarbonisation infrastructure and public transport and give flexibility to local authorities to blend budgets to deliver multiple co-benefits. Short-term competitive funding for narrowly specified projects with tight bidding times makes it very hard for smaller authorities with less capacity to apply and concentrates funding in certain areas. HMT should ensure that funding is made over longer time periods to enable better delivery. Government should ensure the National Infrastructure Bank finances Net Zero schemes and that the UK Shared Prosperity Fund provides long-term funding through development funds to kick start infrastructure investments at scale which can be refinanced at a later date.
- **Align public spending with Net Zero:** Review the Government's Green Book policy guidance, and business case tools, such as DfT's WebTag, to incorporate a stronger focus on carbon reduction and co-benefits in business cases and financial appraisal. Funding allocated directly to LEPs and Combined Authorities for economic development should strongly align with the Net Zero agenda.
- **Ensure that funds for pilot and innovation projects include budget for evaluation and for the longer-term consideration of replication and scaling up viable models.** The CCC's scenarios identify large gaps in national policy for buildings and transport decarbonisation. Without action to fill these gaps, projects are likely to remain stuck at the pilot stage. Note: not everything will work.

Communications and Engagement

- **Deliver a national climate communications and public engagement programme that can be tailored at a local level.** Funding to local authorities and their partners to deliver such a programme will enable public engagement and support local delivery of shared national objectives.

REFERENCES

Oxford City Council, ‘Leaders across Oxford support 2040 net zero carbon emissions pledge’ (Published 4th February 2021). Available from: https://www.oxford.gov.uk/news/article/1708/leaders_across_oxford_support_2040_net_zero_carbon_emissions_pledge

Oxford City Council, ‘Zero Carbon Oxford Summit’. Available from: https://www.oxford.gov.uk/info/20291/climate_emergency/1431/zero_carbon_oxford_summit

Anthesis, Oxford City Council: Climate Emergency Strategy Support (September 2019). Available from: https://info.anthesisgroup.com/hubfs/Climate_Emergency_Strategy_Support_report_Anthesis_2019%20(1).pdf?hsLang=en

Oxford City Council, ‘Heat Networks for Oxford - Feasibility studies’. Available from: https://www.oxford.gov.uk/info/20062/carbon_reduction_and_energy_saving/1147/heat_networks_for_oxford_-_feasibility_studies

SSEN, ‘Low Carbon Technology Uptake’. Available from: https://www.ssen.co.uk/lctuptake/

National Grid, ‘Future Energy Scenarios 2020’. Available from: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

GHG Protocol, ‘Global Protocol for Community-Scale Greenhouse Gas Emission Inventories’. Available from: https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

BEIS, ‘Sub-national electricity consumption data’. Available from: https://www.gov.uk/government/collections/sub-national-electricity-consumption-data

BEIS, ‘Sub-national gas consumption data’. Available from: https://www.gov.uk/government/collections/sub-national-gas-consumption-data

Department for Transport, ‘Vehicles statistics’. Available from: https://www.gov.uk/government/collections/vehicles-statistics

CCC, ‘Sixth Carbon Budget’. Available from: https://www.theccc.org.uk/publication/sixth-carbon-budget/

Oxfordshire Environment Partnership, ‘Oxfordshire’s Resources and Waste Strategy’. Available from: https://www.oxfordshire.gov.uk/sites/default/files/file/waste-and-recycling/OxfordshiresResourcesandWasteStrategy_0.pdf

Thames Water, ‘Climate Change’. Available from: https://www.thameswater.co.uk/about-us/responsibility/climate-change

Ofwat, ‘Leakage’. Available from: https://www.ofwat.gov.uk/households/supply-and-standards/leakage/

BEIS, ‘Energy and emissions projections’. Available from: https://www.gov.uk/government/collections/energy-and-emissions-projections#updated-energy-and-emissions-projections

House of Commons – Public Accounts Committee (2021), Achieving Net Zero: Forty-Sixth Report of Session 2019-21. Available from: https://committees.parliament.uk/publications/4921/documents/49419/default/

BEIS (2021), 'Non-domestic Private Rented Sector minimum energy efficiency standards: EPC B implementation'. Available from: https://www.gov.uk/government/consultations/non-domestic-private-rented-sector-minimum-energy-efficiency-standards-epc-b-implementation

Ofgem (2021), 'Energy network price controls: Overview of final determinations, 2021-2026'. Available from: https://www.ofgem.gov.uk/system/files/docs/2020/12/riio2_overview_document_web_1.pdf

ICAX, 'Domestic RHI confirmed until 31 March 2022'. Available from: https://www.icax.co.uk/RHI_Continuity.html

BEIS, 'Collection: Energy and emissions projections'. Available from: https://www.gov.uk/government/collections/energy-and-emissions-projections

BEIS (2020), 'The ten point plan for a green industrial revolution'. Available from: https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution

BEIS (2020), 'Energy white paper: Powering our net zero future'. Available from: https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

Inside Housing, 'Almost 11,000 new homes to be built in Oxford as inspectors approve local plan' (Published 20th May 2020). Available from: https://www.insidehousing.co.uk/news/news/almost-11000-new-homes-to-be-built-in-oxford-as-inspectors-approve-local-plan-66511

Oxford City Council, 'Oxford Local Plan 2036 – Proposed submission draft 1st November - 13th December 2018'. Available from: https://www.oxford.gov.uk/download/downloads/id/5101/oxford_local_plan_2036_-_proposed_submission_draft.pdf

UK Government (2014), Guidance: Historic environment. Available from: https://www.gov.uk/guidance/conserving-and-enhancing-the-historic-environment

BEIS (2017), 'What does it cost to refrofit homes? – Updating cost assumptions for BEIS's energy efficiency modelling'. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/656866/BEIS_Update_of_Domestic_Cost_Assumptions_031017.pdf

UK Government (2019), 'National Energy Efficiency Data-Framework: impact of measure data tables 2019'. Available from: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-impact-of-measures-data-tables-2019

Oxford City Council, Households by tenure 2011 Census. Available from: https://www.oxford.gov.uk/download/downloads/id/1075/housing_tenure.xls

Oxford City Council, Households by accommodation type 2011 Census. Available from: https://www.oxford.gov.uk/download/downloads/id/1070/housing_type.xls

Solar Together, 'How does it work?'. Available from: https://solartogether.co.uk/info/how-does-it-work

Ealing News Extra, ‘Join over 800 local households and save money on solar panels’ (Published 22nd May 2018). Available from: https://ealingnewsextra.co.uk/latest-news/solar-together/

DECC (2014), ‘Energy Performance Certificate data’. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/323946/Annex_B_-_Energy_Performance_Certificate_data.pdf

Energy Saving Trust, ‘Air source heat pumps’ Available from: https://energysavingtrust.org.uk/advice/air-source-heat-pumps/

DfT (2018), ‘Funding boost for green last mile delivery bikes’. Available from: https://www.gov.uk/government/news/funding-boost-for-green-last-mile-delivery-bikes

DfT (2019), ‘Government Response to Call for Evidence: The Last Mile – Delivering goods more sustainably’. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786879/last-mile-call-for-evidence-government-response.pdf

Logistics Manager (2020), ‘Amazon Logistics chosen to run City of London’s first last mile logistics hub’. Available from: https://www.logisticsmanager.com/amazon-logistics-chosen-to-run-city-of-londons-first-last-mile-logistics-hub/

DfT (2018), ‘Consolidating public sector logistics operations’. Available from: https://s3-eu-west-1.amazonaws.com/media.ts.catapult/wp-content/uploads/2018/07/13095627/Public-Sector-Logistics-Consolidation_On-Line-Report-web.pdf

City of London, ‘City of London Corporation teams up with Amazon to cut delivery vehicles and improve air quality’ (Published 15th December 2020). Available from: https://news.cityoflondon.gov.uk/city-of-london-corporation-teams-up-with-amazon-to-cut-delivery-vehicles-and-improve-air-quality/

GIZ (2017), ‘Learning from case studies: Last-mile delivery, digitalisation and consolidation centres’. Available from: http://transferproject.org/wp-content/uploads/2017/09/JL-LearningFromCaseStudies-20Sep2017.pdf

Oxford Mail (2021), ‘Council received funding for eco upgrade to housing stock’. Available from: https://www.oxfordmail.co.uk/news/19366183.council-receives-funding-eco-upgrade-housing-stock/

Energy Systems Catapult (2018), ‘Energy System Integration Guides: Decarbonising complex sites’. Available from: https://es.catapult.org.uk/case-studies/energy-system-integration-guides-distributed-energy/

Energy Systems Catapult (2019), ‘Modern Energy Partners aims to save the public sector millions via integrated energy solutions’. Available from: https://es.catapult.org.uk/news/innovative-project-aims-to-save-the-public-sector-millions-through-integrated-energy-solutions/

Energy Systems Catapult, ‘Modern Energy Partners: Integrated Efficiency Solutions’. Available from: https://es.catapult.org.uk/news/innovative-project-aims-to-save-the-public-sector-millions-through-integrated-energy-solutions/

Green Alliance (2019), 'Going electric: How everyone can benefit sooner'. Available from: https://green-alliance.org.uk/resources/going_electric_how_everyone_can_benefit_sooner.pdf

Innovate UK (2021), 'Knowledge Transfer Partnerships: what they are and how to apply'. Available from: https://www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply#who-can-take-part

Taylor I and Hiblin B (2017), 'Typical Costs of Cycling Interventions: Interim analysis of Cycle City Ambition schemes'
Available from:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742451/typical-costings-for-ambitious-cycling-schemes.pdf

SQW Consulting (2008), 'Planning for Cycling'. Available from:
https://webarchive.nationalarchives.gov.uk/20110407100933/http:/www.dft.gov.uk/cyclingengland/site/wp-content/uploads/2009/03/planning-for-cycling-report-10-3-09.pdf

DfT (2014), 'Claiming the Health Dividend: A summary and discussion of value for money estimates from studies of investment in walking and cycling'. Available from:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371096/claiming_the_health_dividend.pdf

Retrofit Get-in Project, 'How retrofit can build back better'. Available from:
https://www.retrofitgetinproject.com/services

Ashden (2021), 'With UK Green Homes Grant scrapped, a training revolution is needed'. Available from: https://ashden.org/news/with-uk-green-homes-grant-scrapped-a-training-revolution-is-needed/

LGA (2020), 'Experiences of employment and skills devolution: Cambridgeshire and Peterborough Combined Authority'. Available from: https://www.local.gov.uk/case-studies/experiences-employment-and-skills-devolution-cambridgeshire-and-peterborough-combined

Local Energy Oxfordshire, 'Understanding flexibility services'. Available at: https://project-leo.co.uk/the-energy-challenge/flexibility-services/

MHCLG, 'The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings'. Available from:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf

DHSC, 'Build back better: £600 million to upgrade and refurbish NHS hospitals' (Published 10th December 2020). Available from: https://www.gov.uk/government/news/build-back-better-600-million-to-upgrade-and-refurbish-nhs-hospitals

Smart Transport, 'Demand for renewable biofuel set to double in 2020, says CNG Fuels' (Published 20th March 2020). Available from:
https://www.smarttransport.org.uk/news/demand-for-renewable-biomethane-fuel-set-to-double-in-2020-says-cng-fuels

/

The Carbon Trust is a company limited by guarantee and registered in England and Wales under Company number 4190230 with its Registered Office at: 4th Floor, Dorset House, 27-45 Stamford Street, London SE1 9NT.

Published in the UK: 2021.