OXFORD INDUSTRIAL DECARBONISATION PROJECT

Roadmap and Action Plan

AN ERM REPORT FOR THE ZERO CARBON OXFORD PARTNERSHIP

FEBRUARY 2025

ZERO CARBON OXFORD

Introduction to this report, authors, and disclaimer

ABOUT ERM

Sustainability is our business. As the largest global pure play sustainability consultancy, ERM partners with the world's leading organizations, creating innovative solutions to sustainability challenges and unlocking commercial opportunities that meet the needs of today while preserving opportunity for future generations.

ERM's diverse team of 8,000+ world-class experts in over 150 offices in 40 countries and territories combine strategic transformation and technical delivery to help clients operationalize sustainability at pace and scale. ERM calls this capability its "boots to boardroom" approach - a comprehensive service model that helps organizations to accelerate the integration of sustainability into their strategy and operations.

ERM acquired Element Energy and E4tech in 2021, which are now fully integrated in ERM's Sustainable Energy Solutions (SES) team. The team consists of over 150 specialists bringing deep expertise in the development, commercialisation, and implementation of emerging low carbon technologies across a wide range of sectors, including industrial decarbonisation (hydrogen, carbon capture utilisation and storage, electrification), low carbon fuels and chemicals, the built environment, smart energy systems, electricity and gas networks, low carbon transport and funded project management.

Authors

Silvian Baltac Partner

Amelia Mitchell Managing Consultant

Edward Grindrod Consultant

Disclaimer

This report was developed as part of the ZCOP Industrial Decarbonisation Roadmap Project led by Oxford City Council. The conclusions and recommendations do not necessarily represent the view of Oxford City Council. Whilst every effort has been made to ensure the accuracy of this report, neither ZCOP, OCC, or ERM warrant its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made of this report which liability is hereby excluded.

About this document

This document provides an overview of all work conducted as part of the ZCOP Local Industrial Decarbonisation Roadmap (LIDP) project in 2024. It combines input from several parallel workstreams to culminate in a Roadmap and Action Plan for Oxford's industrial sector to reach net zero by 2040.

Link to other work

The report is accompanied by several standalone reports from different work packages that provide more detail on the background analysis that has been undertaken throughout the project.

Funded by DESNZ through the Local Industrial Decarbonisation Plans (LIDP) grant

Department for Energy Security & Net Zero

Introduction to this report, authors, and disclaimer

ABOUT ZCOP

Since 2021, Zero Carbon Oxford Partnership (ZCOP) and the supporting Secretariat have been working together to enable the city to meet its net zero targets and prepare for climate change impacts. Our members include both universities, both NHS Trusts, the City and County Councils, further education bodies and large businesses such as BMW Mini, Lucy Group, LandSec, SSEN, Unipart, OxLEP, and Low Carbon Hub.

Together Partnership currently involves 21 organisations from 12 sectors, representing over 55,000 employees. It is a proactive network with an established and expanding value proposition.

Partnership members commit to:

- Working to create a zero carbon and resilient Oxfordshire.
- Working on shared projects that deliver greater carbon emission reductions than we could achieve individually.
- Emphasizing local, community and non-carbon benefits of climate action.

ZCOP EXPANSION

Building on the success of Zero Carbon Oxford Partnership, we are expanding to become a countywide body to drive collaborative climate action across Oxfordshire.

Since its formation in 2021, ZCOP has been a successful collaboration between Oxford and County Council and key partners. The Zero Carbon Oxfordshire Partnership will build on this record of enabling partners to collaborate to accelerate climate action, harnessing our collective skills and powers expertise and – increasingly – new sources of funding, to accelerate local net zero projects.

ZCOP and the Oxford Industrial Cluster are keen to support other clusters to develop across the county, learning from our approach and experience from this project.

Industrial organisations are encouraged to contact the secretariat to learn more: ZCOP@Oxford.gov.uk

Disclaimer

This report was developed as part of the ZCOP Industrial Decarbonisation Roadmap Project led by Oxford City Council on behalf of the ZCOP Partnership. The conclusions and recommendations do not necessarily represent the view of any members of ZCOP. Whilst every effort has been made to ensure the accuracy of this report, neither ZCOP, OCC, or ERM warrant its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made of this report which liability is hereby excluded.

Forewords

Cllr Anna Railton

Deputy Leader and Cabinet Member for Zero Carbon Oxford

'Oxford aims to achieve net zero carbon emissions city-wide by 2040 - ten years ahead of the Government's legal deadline. Industry accounts for approximately 17% of Oxford's total emissions, with 66% of the industrial processes running on gas.

Oxford's industrial sector has a global impact and reach but is made up of many relatively small, diverse sites spread across the city, alongside a few larger ones. Therefore, the unique needs of each site and industrial areas need to be considered.

The launch of this ZCOP ID Roadmap and Action Plan is the culmination of 14 months of collaboration among industrial sites, local authorities, decarbonisation experts, network operators and academia. This effort has assessed the current state of industrial decarbonisation and developed a science backed approach to achieve net zero.

This publication marks a major milestone in Oxford's net zero journey, building on ZCOP's 2021 report while advancing the city's industrial decarbonisation strategy. It outlines key actions, such as:

- *Upgrading electricity networks to make electrification the primary decarbonisation method.*
- *Enabling Clusters of businesses to collaborate to solve local barriers to decarbonisation.*
- *Empowering SMEs to join forces to access knowledge and joint solutions, rather than individually.*

On behalf of Oxford City, ZCOP and the newly formed Oxford Industrial Cluster, I would like to extend my gratitude to the Department of Energy Security and Net Zero (DESNZ) and UK Research and Innovation (UKRI) for funding this vital work. I also thank our project partners -- BMW, Advanced Research Clusters Oxford (ARC), Unipart, Oxfordshire Greentech, and Oxfordshire County Council -- for their invaluable contributions of funding, expertise and time, and the 96 organisations who gave their time to workshops, interviews and surveys to ensure this plan reflects local needs and conditions.

The potential impacts are significant: substantial emissions reductions, economic growth, the creation and safeguarding of well-paying jobs, better access to finance and funding, improved availability of low carbon technologies, and enhanced air quality. However, achieving these outcomes requires continued commitment, collaboration, continued Government support, and sustained private investment.

The next steps in the journey to net zero will be guided by the Cluster's use of this roadmap. Moving forward, a shared commitment to collaboration will be essential to meeting the urgency of the challenge ahead.'

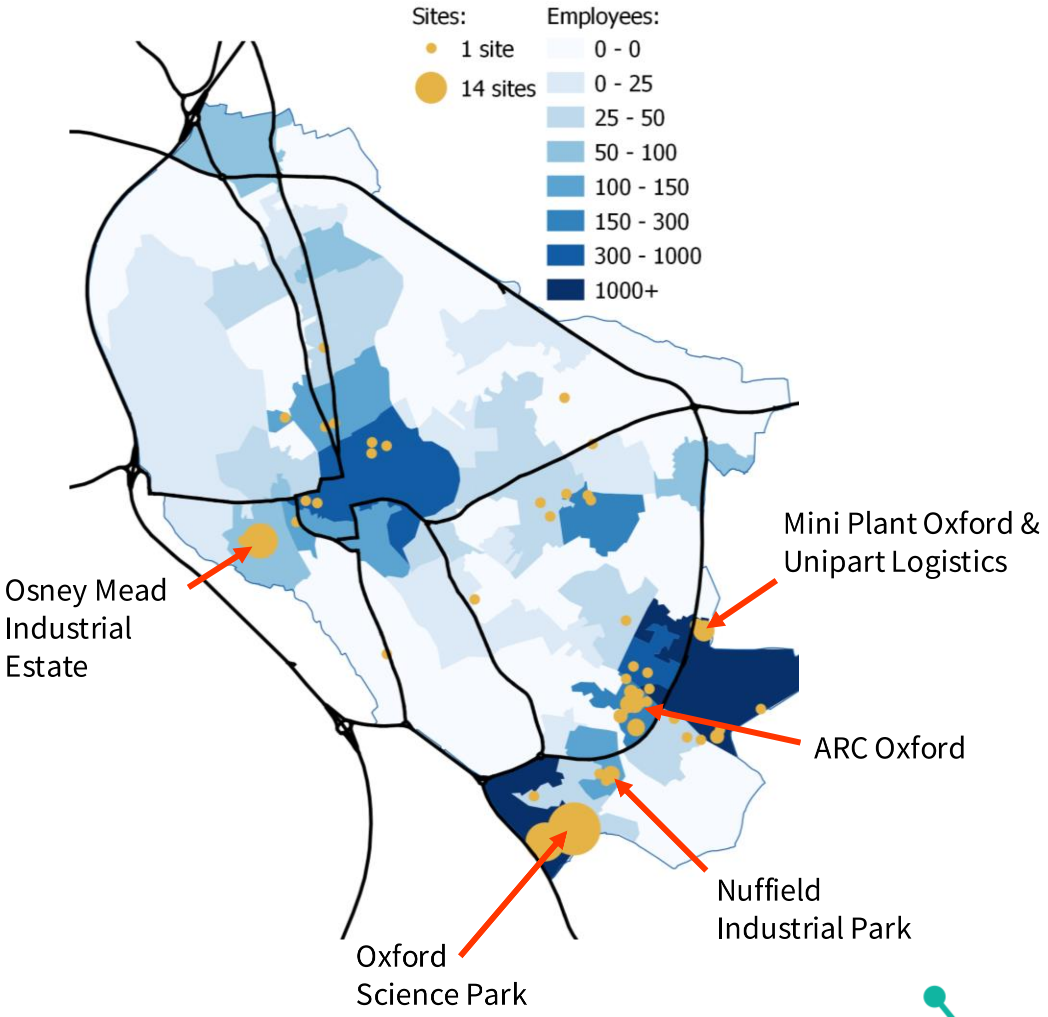
Contents

Roadmap and Action Plan

Oxford's unique and innovative industrial landscape will require collaborative and pioneering decarbonisation solutions

- We define the Oxford Industrial Cluster as **organisations who manufacture, process, or produce goods in Oxford City Council,** including the key sectors of high-tech engineering, life sciences, and automotives.
- Oxford has one large industrial emitter – Mini Plant Oxford – with other sub-clusters of smaller industrial energy users concentrated in **business parks, especially along the ring road in the South-East of Oxford**.
- The **growing life sciences and advanced engineering sectors are driving the expansion of business parks** across Oxford who are looking to accommodate university spin-outs and small and medium-sized enterprise (SMEs) in hybrid lab-office spaces.
- **These established and emerging industrial sub-clusters will require collective, integrated decarbonisation solutions** to decarbonise their industrial processes.
- The main industrial processes are characterised by **low temperature and direct heating processes,** such as gas-fired boilers, medical and lab equipment, food industry chillers, and direct heaters.
- These processes offer opportunities to decarbonise via energy efficiency and management, electrification, heat networks, smart energy systems, and energy storage technologies.
- Oxford's motivated and innovative industrial basis is **well-positioned to capitalise on the opportunities presented by the energy transition** and emerge as a leader in low carbon energy solutions.
- Based on this understanding of the scale, location, and processes leading to industrial emissions in Oxford this roadmap provides a **clear vision for decarbonising Oxford's industrial sites** and **outlines the enabling actions** required to achieve this.

Map of industrial employment and sites in Oxford



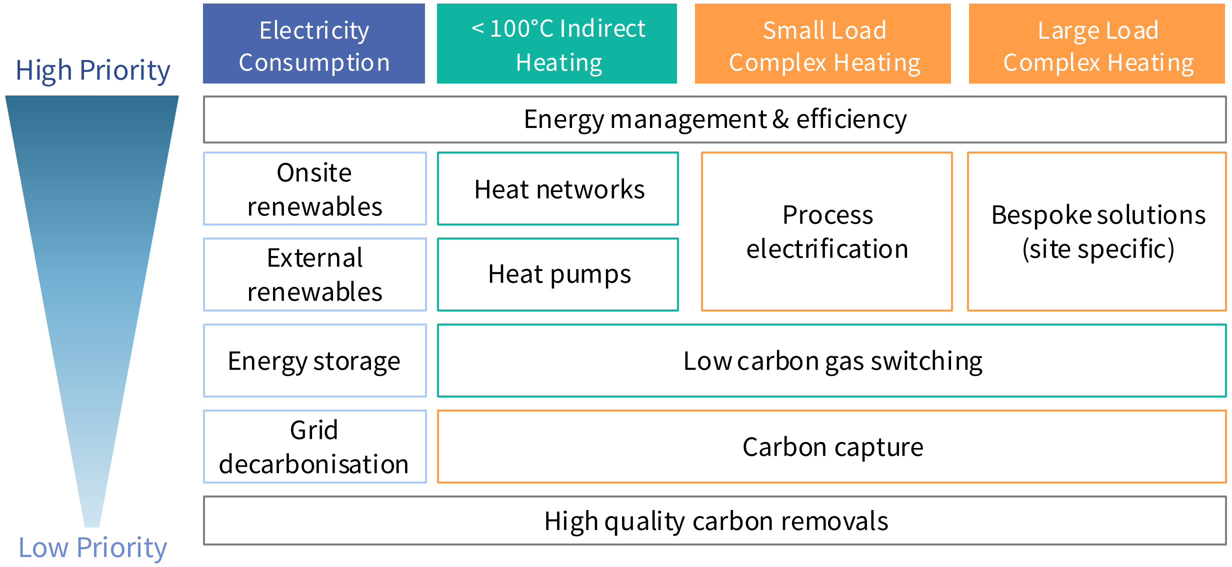
Local renewables, heat pumps, heat networks and process electrification are priority technologies for Oxford industrials

Individual technology assessments were used to prioritise technologies (based on technical considerations, economic factors, wider barriers in Oxford, and stakeholder views) for the range of industrial emission sources identified in Oxford. This includes electricity consumption, low temperature indirect heating (gas boilers), and complex heating* (e.g. ovens and kilns).

High priority solutions for Oxford industrials were identified as:

- **Energy management & efficiency measures,** which will be critical across all processes and technologies, especially innovative and digital/smart solutions to help reduce peak demand and alleviate grid constraints.
- **Onsite renewables** with energy storage for electricity supply (if space and capital are available) or **external renewables** via renewable energy procurement (if onsite renewables are not possible).
- Accessing a **decarbonised heat network** or installing a **heat-pump** to provide low temperature indirect heating (e.g., space heating).
- For complex heating at small loads, replacing natural gas equipment with an **electrified alternative** (e.g., e-boilers or microwave ovens) in cases where technologies are commercially available and where grid constraints are not a barrier. For complex heating at larger loads, the chosen solution is expected to be bespoke to the site.
- **Emerging technologies** will play a crucial role across the full spectrum of solutions to increase feasibility, reduce cost, and enable integration of low carbon technologies.

Overview of technology prioritisation across industrial processes



Lower priority solutions include:

- Waiting and being reliant on **grid decarbonisation,** as UK-wide developments in electricity supply are outside of the Oxford Industrial Cluster's control.
- **Carbon capture** is deprioritised since it is not expected to be economical for Oxford industrials, and the region is not a focus for CO_2 transport infrastructure development.
- **High quality carbon removals** are deprioritised since Oxford Industrial Cluster's focus is on first achieving direct decarbonisation where possible.

*Complex heating refers to processes at >100°C or direct heating technologies.

Local initiatives can accelerate decarbonisation and reduce residual emissions, but an ambitious transformation is needed

Many large industrials and business parks in Oxford have committed to decarbonisation, with ambitious plans for low carbon technology deployments. However, several constraining factors might limit decarbonisation in a business-as-usual case, putting at risk the **Oxford City target for net zero emissions by 2040**.

Our **enabled & locally driven scenario** (consisting of initiatives to increase electricity capacity, expand Oxford's heat network, and engage SMEs) shows how emission reductions could be accelerated and overall residual emissions reduced – **achieving 66% reduction by 2035 and 90% reduction by 2040**. This, however, requires an ambitious transformation of Oxford's energy system and significant technology deployments – **45 MW of process electrification, 11 MW of heat pumps, 21 MW of heat network connections, and 31 MW of local renewables**.

Business-As-Usual Scenario

The business-as-usual case explores industrial decarbonisation in Oxford in a case without further intervention outlined by the actions of this roadmap. Technology uptake is driven by existing plans or national policies and is constrained by barriers such as limited grid capacity, lack of space for onsite renewables, and barriers to engagement for SME industrials.

Enabled & Locally Driven Scenario

Increased Electricity Capacity

Accelerated upgrade of electricity network capacity and/or direct wire connections to local energy generation

Heat Network Expansion

Expanding existing city heat network plans to business parks and large industrials.

Accelerated SME engagement

Overcoming barriers for dispersed SME industrials to engage and invest in decarbonisation.

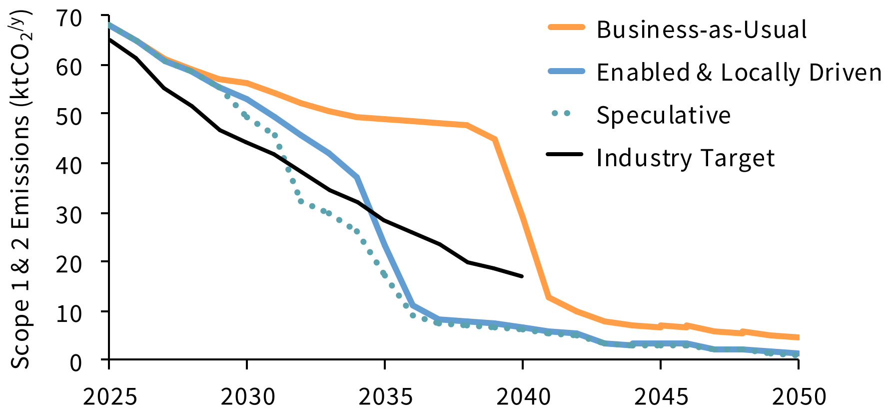
Speculative Scenario

The enabled & locally driven scenario with an additional initiative:

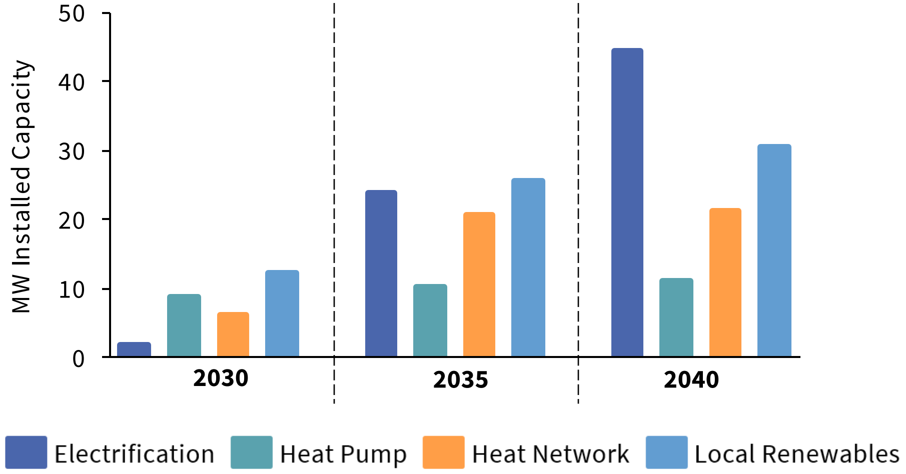
Alternative Gases

Exploring hydrogen and biomethane production for blending into the gas grid as an interim measure.

Oxford industrial cluster emissions across scenarios explored compared to Oxford City's target*



Technology uptake in the enabled & locally driven scenario



*Significant drops in emission trajectories of scenarios for business-as-usual (2040) and enabled & locally driven (2035) are a direct result of upgrades to electricity connections, allowing electrification of energy-intensive processes to occur at a large industrial. Industry target refers to the trajectory developed for industry within the ZCOP '2040 Net Zero Action Plan' for the city of Oxford published in 2021. Residual emissions result from hard-to-abate processes and grid-electricity emissions, with offsets of these residual emissions needed to achieve net zero.

Enablers across skills & supply chain, funding & financing, and cluster development will help drive the transformation

- The Oxford Industrial Cluster has a unique **opportunity to deliver, drive and scale the net zero transition by creating a supportive, holistic environment for decarbonisation** through actions targeting collaboration, financing, planning, skills, supply chain, and regulatory aspects.
- Oxford City Council's ambitious net zero target by 2040 will require substantial investment through a mix of funding and financing solutions and collaborative actions as **industrials, technology developers, and financiers face a broad range of challenges to investing in decarbonisation**.
- When investment is injected to meet the increasing demand for low carbon solutions, on time and at scale, it is crucial to **train a new workforce of certified installers and invest in the scalability of existing supply chains**.
- To develop energy infrastructure, secure funding, and build capacity for a net-zero transition. will rely on Oxford's ability to foster a **collaborative ecosystem of stakeholders**.
- To address this, **the Oxford Industrial Cluster will be established under ZCOP**, bringing together industrial leaders, technology providers, suppliers, trainers, local actors, and investors to drive collective action.
- The Oxford Industrial Cluster will also engage with other sectors to harness synergies and address shared challenges.

Enablers: Skills and Supply Chain

- Increase awareness to drive demand
- Incentives for SME installers
- Building local networks
- Apprenticeships and targeted training

Enablers: Funding and Financing

- Financial capacity building
- Targeted innovation support
- Direct funding support
- Aggregation & portfolio building

Enablers: Cluster Development

- Governance
- Recruitment and fundraising
- Driving delivery
- Monitoring and reporting

This action plan outlines how Oxford stakeholders will collaborate to deliver shared milestones towards industrial decarbonisation

Deployment milestones identified	Timeframe	Measured by	Enabling actions (see next page)
Feasibility study delivered on expansion of heat network to business parks and Cowley area to take decision on whether to proceed further	2026	Decision Announcement	1 / 5
Consolidated and streamlined approach within the Oxford Industrial Cluster to communicate projected electricity demand for industrials to energy networks and local area energy plans	2028	Reports Submitted	1/ 2 / 3 / 5
80% of industrials in Oxford have set targets to decarbonise their heating sources by 2040	2028	Survey	1 / 5 / 6 / 7 / 8 / 11 / 12 / 13 / 14 / 15
Feasibility study delivered on generation and injection of biomethane and hydrogen into the Oxford gas grid for industrial use to take decision on whether to proceed further	2030	Decision Announcement	4 / 11 / 16
Feasibility study delivered on high-integrity carbon offsets to take collection decision on the strategy for their procurement and use	2030	Decision Announcement	10 / 11 / 16
New or upgraded electricity network connections made available where necessary to allow Oxford industrials to connect by 2035	2035	Connection Offers	1 / 2 / 3 / 8
18-26 MW of local renewable electricity capacity deployed for industrial use	2035	Survey / Installation Metrics	1 / 2 / 3 / 6 / 7 / 8 / 12 / 13 / 14
80% of industrials in Oxford have implemented all the low-cost, short-timeframe actions identified in an energy audit report	2035	Energy Audit Follow Up	9 / 11/ 12 / 13 / 14 / 15/ 16
10 MW deployments of heat pumps for industrial use at business parks or dispersed sites	2035	Survey / Installation Metrics	1 / 2 / 6 / 7 / 9 / 11 / 12 / 13 / 14 / 15
Scope 1 & 2 emissions for industrials in Oxford minimised (90% reduction compared to baseline year)	**2040**	**Company Reports**	**All**

The Oxford Industrial Cluster has collaboratively developed 16 actions that enable the industrial sector to reach Net Zero by 2040

Energy Supply Infrastructure

- 1 - Support electrification by unlocking electricity grid capacity constraints
- 2 – Facilitate a SmartGrid demonstration for an industrial sub-cluster or business park
- 3 – Encourage an integrated energy hub project utilising renewables and storage technologies
- 4 - Investigate the potential for alternate gases to support the decarbonisation of industry
- 5 - Support and engage with the Oxford Energy Network plans

Collaborative Financing

- 6 – Facilitate aggregate models including energy 'as a service'
- 7 - Facilitate technology bulk buying / portfolio schemes
- 8 - Facilitate an approach to aggregate PPA demand, enabling a collective PPA model with small offtakers
- 9 - Support industrials to win public and private investment
- 10 - Investigate the potential medium-long term role of carbon offsetting

Cluster Capacity Building

- 11 - Champion extensive knowledge sharing on industrial decarbonisation
- 12 - Continue to expand delivery of energy audits and efficiency advice projects
- 13 – Encourage a local framework for low carbon technology industry entrants and re-trainers
- 14 – Advocate local supply chain engagement
- 15 – Support a local landlord-tenant forum
- 16 – Support an innovative technology register and network

Each action has ‘immediate’ implementation steps to be prioritised and completed during 2026-2030*

Urgent / Critical / Long Lead

Priority topic	Action	Immediate Implementation Steps	Urgency	Timeframe
Energy Supply Infrastructure	1	Engage different users of projected Oxford industrial energy demand to identify synergies and develop a centralised approach to simplify communication	Urgent / Critical / Long Lead	2025-2028
	2	Identify a private network operator partner, investigate potential site options, and undertake a feasibility study to select the first SmartGrid project	Long Lead	2025-2027
	3	Conduct integrated energy hub pre-feasibility in partnership with local area energy planning and supported by extensive stakeholder engagement	Long Lead	2025-2028
	4	Actively engage and support low carbon gas developers/technologies in Oxford whilst assessing potential industrial demand within the cluster	Long Lead	2025-2030
	5	Support Oxford Energy Network feasibility study on expansion to Cowley area with industry engagement and assistance to find an Energy Centre site	Urgent / Long Lead	2025-2028

Priority topic	Action	Immediate Implementation Steps	Urgency	Timeframe
Collaborative Financing	6	Investigate popular as-a-service models to help develop an as-a-service partnership framework and identify suitable suppliers	Critical	2025-2027
	7	Study characteristics of successful bulk-buying schemes and engage stakeholders to inform development of a framework agreement for Oxford industrials	Critical	2025-2028
	8	Research key features of effective aggregate PPAs and engage offtakers and renewable/energy hub projects to match supply-demand potential		2025-2029
	9	Gather existing and create further funding and financing materials to support industrials apply for private and public investment in decarbonisation project		2025-2026
	10	Engage with any local carbon offsetting intitatives about an offsetting feasibility report investigating supply, demand, quality, and procurement pathways		2027-2030

Priority topic	Action	Immediate Implementation Steps	Urgency	Timeframe
Capacity Building	11	Frame an industrial decarbonisation knowledge-sharing plan with a centralised website to aggregate early activities, such as webinars and online training	Critical	2025-2026
	12	Assess existing audit/energy efficiency project capacity, promote the services’ availability to industrials, and look for further funding support	Critical	2025-2026
	13	Lead campaigns to encourage skills development alongside developing a bursary/low-cost loan system to assist with the cost of training/apprenticeships	Long Lead	2025-2027
	14	Initiate a supply chain network to assess procurement priorities for industrials to understand shifts in supply chain demands and constraints	Long Lead	2025-2026
	15	Establish a forum for landlords and tenants to share experiences, solutions, and challenges	Critical	2025-2026
	16	Design the innovation register before publishing innovation challenge statements based on this report to drive innovation for industrial needs	Long Lead	2025-2026

*Requires sufficient resource

The project has delivered a clear, collaborative vision and strategy to efficiently achieve industrial decarbonisation by 2040

The Oxford Industrial Cluster will be established under ZCOP to implement this Local Industrial Decarbonisation Action Plan and Roadmap, with 16 targeted actions identified to be pursued by three ZCOP working groups – Energy Supply Infrastructure, Collaborative Financing, and Capacity Building. Collectively, these actions will support the delivery of key milestones along a shared journey to net zero industrial emissions by 2040.

Oxford is a unique industrial cluster with high ambitions for which collaboration is key as:

- While Mini Plant Oxford may require bespoke solutions to decarbonise, it has synergies in the barriers faced by business parks – requiring upgraded grid capacity and improved renewable energy infrastructure.
- While business parks may have already developed their strategies, they face similar landlord-tenant related barriers that SMEs may encounter.

To foster a collaborative ecosystem of stakeholders and overcome shared challenges the Oxford Industrial Cluster will need to **engage actively with other sectors under ZCOP to exploit synergies between domestic, commercial, institutional and transport decarbonisation**. For more information on the Oxford Industrial Cluster or how to join ZCOP, contact zcop@oxford.gov.uk or visit https://zerocarbonoxford.org.

Zero Carbon Oxford Partnership benefits:

- Support delivery of ESG Goals
- Connect with like-minded organisations and experts
- Participate in collaborative projects
- Local & national policy influence
- Recognition and visibility

By being part of ZCOP, members of will be able to access a wide network of expertise and activities in industrial, domestic, commercial, institutional and transport decarbonisation. ZCOP's strong reputation and track record strengthens benefits of industrial's participation in the Oxford Industrial Cluster. 22 organisations, including BMW Group, Unipart, ARC Oxford, and Oxfordshire Greentech, are already part of ZCOP.

Priority steps and vision

ZCOP actions of the Oxford Industrial Cluster Working Group

ZCOP's aim is for the Oxford Industrial Cluster to grow over the coming years, becoming a nationally and regionally recognised advocate for industrial decarbonisation and growth and linking up with other local clusters in Oxfordshire. The Cluster will drive collaboration on industrial decarbonisation across technologies, a knowledge sharing and a conduit for funding where appropriate.

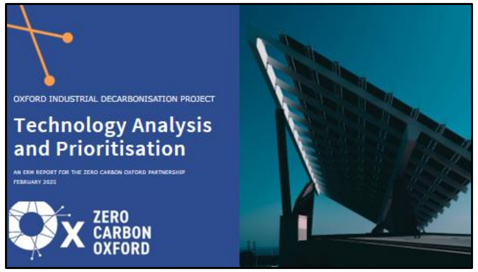
Priority	Recommendation	Responsibility	First steps
1	Establish the Cluster as a self-sustaining model, able to grow, oversee and co-ordinate delivery of the plan.	ZCOP	- Establish Cluster governance, oversight and future operating model within 6 months
2	Continue stakeholder engagement and partnership building.	ZCOP, Oxfordshire Greentech	- Recruit 3 to 6 major organisations to join ZCOP - Support the Cluster dissemination plan and ongoing project and programme delivery - Establish owner tenant group and programme of events
3	Improve and continue data gathering, management and monitoring for future phases and broader use in energy planning work.	Oxford City Council	- Link ZCOP ID to OxLAEP
4	Support funding applications, fundraising and policy support for projects to enable actions requiring funding to take place.	Oxford Industrial Cluster & members	- Integrate pipeline with regional pipelines - Promote public funding opportunities. - Amplify project potential within Oxford task force initiative
5	Anticipate skills need, consider availability and improve accessibility at Hub and for projects.	Oxford City Council	- Contribute Cluster learnings to update to city's green skills assessment and plan
6	Commence programme delivery.	Oxford Industrial Cluster & members	- Coordinated launch event (where resources allow)
7	Local/regional showcase to raise profile.	ZCOP and lead partners	- Coordinate showcase (where resources allow)
8	Undertake follow-on research in public engagement and resources flow mapping.	ZCOP, Oxford Brookes University	- Agree research plan

Supporting Evidence

The roadmap & action plan was developed collaboratively and builds on several detailed supporting studies

- This **Oxford Industrial Decarbonisation Roadmap and Action Plan** has been developed by Zero Carbon Oxford Partnership, ERM, and Oxfordshire Greentech following a series of detailed studies exploring the industrial cluster, its technological options for decarbonisation, the level of ambition required, and the barriers to be overcome.
- Specific targets and actions were developed in **collaboration with local councils, local industrials, energy providers, technology developers, and the investor community** based on the findings from these supporting studies. Further details of the actions developed are included in the Appendix.
- Key outcomes from the supporting studies are **included as Supporting Evidence for this report**, with the individual studies accessible on the ZCOP website. A summary of the methodology for each supporting study is included in the Appendix.

Industrial Landscape & Baseline
- Defined the Oxford industrial cluster, key sectors, locations, and processes.
- Evaluated current energy consumption and emissions.
- Identified future growth of the Oxford Industrial Cluster.



Technology Prioritisation
- Reviewed possible decarbonisation technologies against criteria of technology readiness, cost, applicability, and a range of barriers.
- Identified most appropriate technologies for Oxford industrials.

Scenario Modelling
- Identified business-as-usual uptake for technologies and identified initiatives to accelerate uptake.
- Developed Oxford industrial decarbonisation scenarios and technology uptake targets.
- Evaluated impact of technology uptake on energy, emissions, costs, jobs & gross value added.

Funding and Financing
- Identified barriers to funding and financing industrial decarbonisation in Oxford.
- Explored options for enabling uptake of abatement technologies from a funding and financing perspective.

Skills and Supply Chain
- Identified barriers to abatement technology uptake associated with skills and supply chains in Oxford.
- Explored options for enabling uptake of abatement technologies from a skills and supply chain perspective.

Extensive engagement with local stakeholders ensured the findings of supporting studies and action plan were specific to Oxford needs

Stakeholder Engagement Methodology

Surveys and energy audits

The project developed a survey for industrial organisations to collect energy usage and demand data, and disseminated this to our database. The project also offered free energy audits to 10 organisations via ESOx.

Networking events

The project including two open networking events and two site visits to engage the wider energy and business communities in Oxford, gather support for project activities, and facilitate strategic collaborations.

Stakeholder database

The project compiled a stakeholder database of around 300 contacts, containing information about Oxford's industrials and other relevant stakeholders including contact details, size, and engagement.

Technical workshops

The project held 9 workshops to inform key stakeholders of project developments and to gather their input into project modelling and action planning.

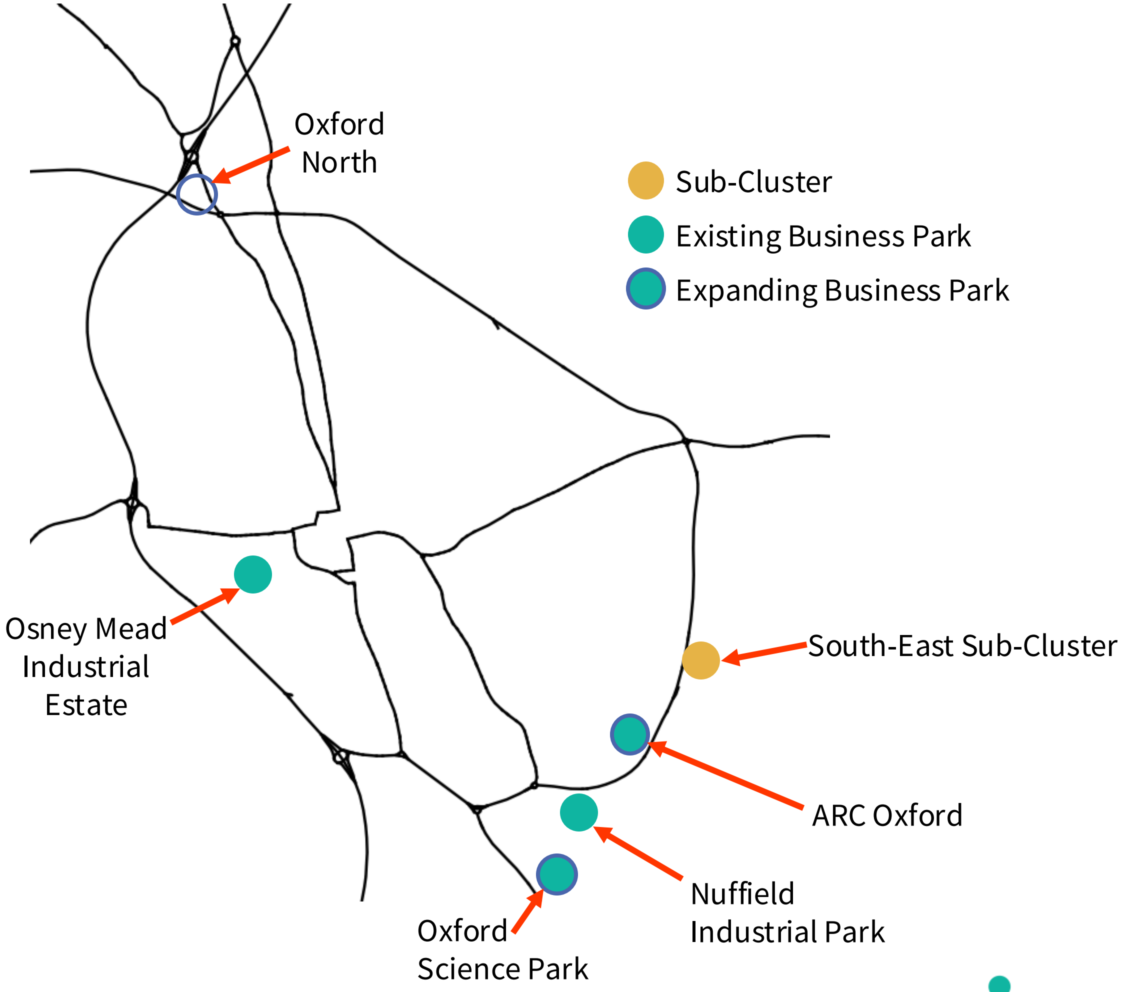
289	Contacts on stakeholder database
224	Attendees across all Events
139	Number of unique event attendees
96	Organisations engaged
64	Percentage of Oxford's known industrials engaged
85	tCO_2e reduction potential from energy audits
30	1-2-1 stakeholder interviews
9	Group workshops
2	Networking events

Oxford's Industrial Landscape and Baseline

Oxford includes a large industrial sub-cluster, several industrial business parks, and many dispersed industrial sites

- This roadmap investigates decarbonisation of the Oxford Industrial Cluster. Oxford's industrial sector is characterised by **dispersed small and medium-sized enterprise (SMEs), numerous university spin-outs**, **few larger emitters**, and clusters of energy users concentrated in **business/science parks**.
- We define the Oxford Industrial Cluster as **organisations who manufacture, process, or produce goods in Oxford City Council,** including the key sectors of high-tech engineering, life sciences, and automotives. Examples of produced goods include biological materials, chemicals, electronic hardware, and medical equipment.
- **The Oxford Industrial Cluster has three core site types defined by their location and scale:**
    - **The primary sub-cluster of industrial activity is in South-East Oxford** which includes some of the largest individual industrial sites in Oxford.
    - Oxford also **has several large business parks**, such as ARC Oxford and Oxford Science Park, which are dominated by life sciences and pharmaceutical SMEs. Co-location of industrials within such business parks offers potential for collaborative decarbonisation solutions.
    - Oxford also has an **important component of dispersed industrials** integrated areas across the city, including in the city centre.
- The Oxford Industrial Cluster therefore represents a complex and heterogeneous industrial landscape that will require a selection of complementary, integrated, and innovative decarbonisation solutions.

Map of current and future industrial sub-clusters and business parks within the Oxford Industrial Cluster



Oxford has a range of innovative industrial sectors, including life sciences and high-tech engineering

Previous studies have noted the most prevalent industrial sectors in Oxford are high-tech engineering, pharmaceuticals, and automotives.[1]

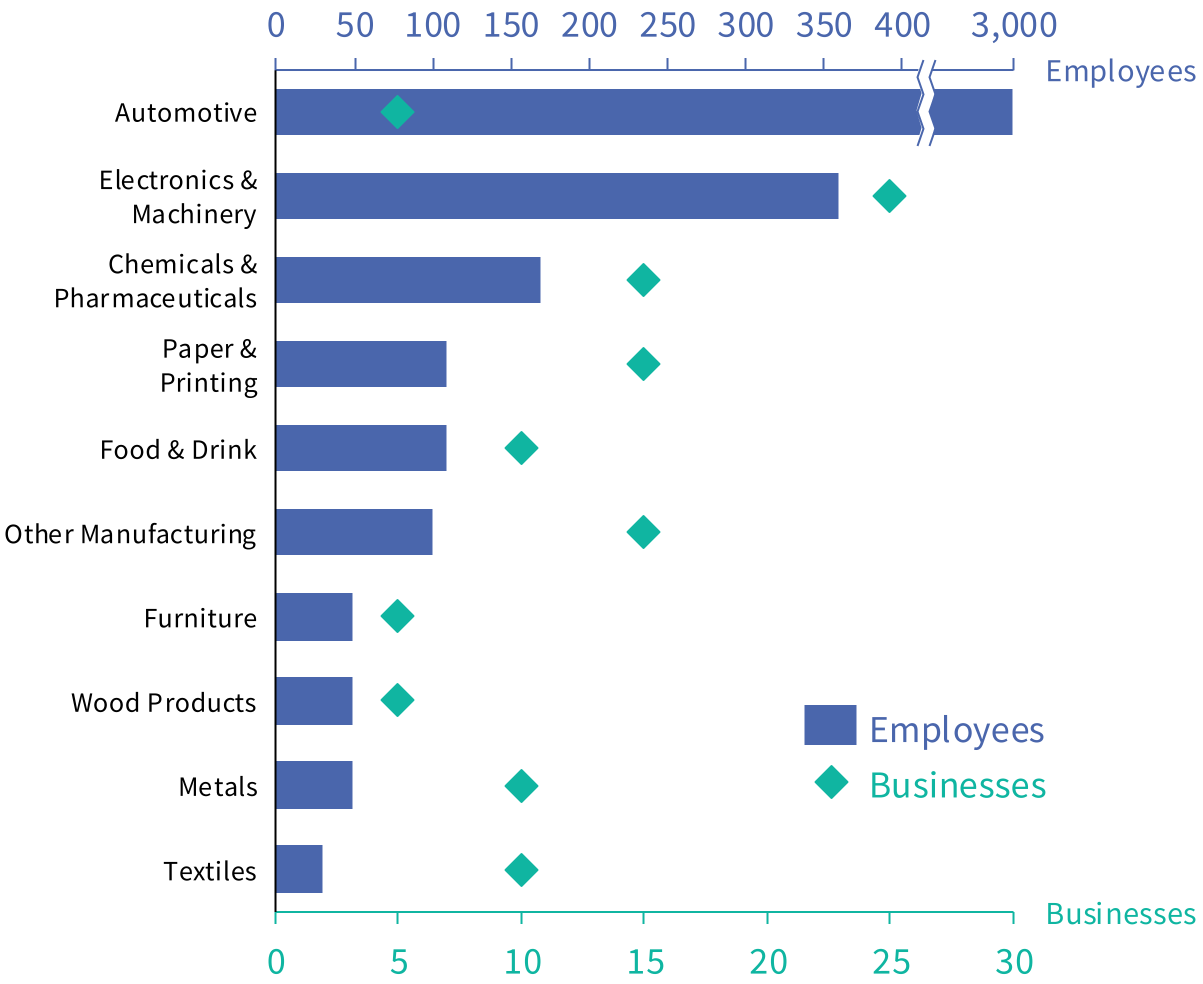
Analysis of national employment datasets[2] reveals an extended set of industrial sectors present in Oxford:

- The **automotive sector**, namely Mini Plant Oxford, which is the largest single site in Oxford by a significant margin.
- **High-tech engineering**, primarily the manufacturing of machinery and electronics.
- Sizeable **pharmaceuticals, life sciences, and chemicals** sectors.
- A **paper and printing sector** which is primarily composed of paper products and commercial printing operations.
- A varied range of **food preparation and distribution** companies, including several distilleries.

A strong scientific research sector is led by the universities and acts as a key driver of industrial innovation in the region.[3]

Furthermore, it was found that most industrial businesses in Oxford have a relatively low average number of employees, highlighting the innovative and SME driven nature of Oxford's industrial landscape.

Breakdown of industrial employment and business count by sector[2]

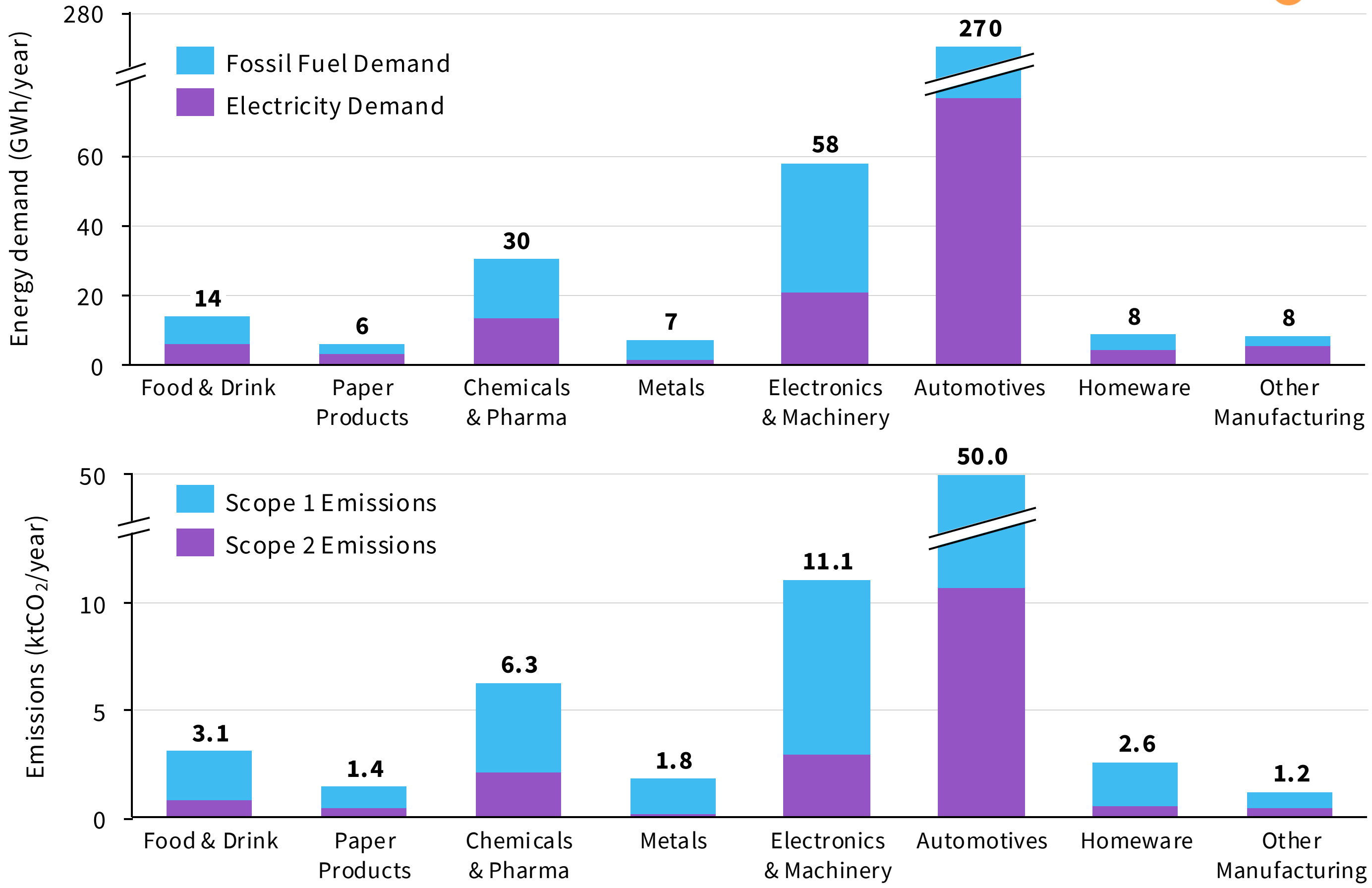


1 - Roadmap and Action Plans - Zero Carbon Oxford Partnership. 2 - See methodology appendix slides. 3 - Research is deemed as complementary to Oxford's industrial sector so is not included directly in the data analysis provided here.

The automotives sector dominates the industrial energy demand and emissions baseline in Oxford

- Oxfordshire's Net Zero Route Map & Action Plan[1] concluded **16% of emissions (620 ktCO_2/year) from the county** originated from industry.
- The 2018 ZCOP Roadmap[2] allocated **17% of Oxford City's total emissions, or 123 ktCO_2e/year,** as of industrial origin.
- Further analysis for this roadmap, focused specifically on Oxford's industry, suggests the total energy demand in Oxford's industrial sectors is **just over 400 GWh, with nearly three-quarters currently provided by natural gas.**
- Resulting **Scope 1 & 2 emissions are estimated to total approximately 77 ktCO_2/year.**
- **Energy demand and emissions are dominated by the automotives sector,** which produces over half of industrial emissions in Oxford.
- Other sectors with significant contributions align with previous reports and stakeholder engagement; namely the pharmaceuticals and life sciences sectors, and the advanced engineering industry in electronics and machinery.

Energy demand (top) and emissions (bottom) in Oxford by industrial sector



Source: *ERM analysis of national datasets (DUKES and ONS) complemented by primary data from stakeholder engagement.*
Limitations: *There is considerable uncertainty in the total energy demand and emissions having been derived from national statistics – see appendix for details.*
Location-based accounting: *Analysis for this roadmap uses a location-based approach to emissions accounting (rather than market-based) meaning that the emission-intensity of electricity supplied via grid-connections is taken as the average UK electricity grid intensity. It is however noted that individual industrials may procure solely renewable electricity, allowing them to reduce or eliminate Scope 2 emissions when using a market-based accounting approach.*

Oxford's industrial activity can be characterised by direct and indirect heating processes and electric equipment

Oxford's key sectors are dependent on a wide range of different types of industrial processes.

Most processes are either powered by electricity or fossil fuels. **Stakeholder engagement suggests the use of solid or liquid fossil fuels in Oxford is very limited** and therefore all fossil fuel demand is presumed to be supplied as natural gas.

Survey and audit data highlighted gas-fired boilers, medical and lab equipment, chillers, and direct heaters as key equipment classes in Oxford.

Much of Oxford's light industrial processes will be electrically powered, such as assembly, fabricating, and packaging processes.

Natural gas processes can be subdivided into direct and indirect heating processes:

- **Direct heating**; flame in open air that passes directly over the target (e.g. furnaces, kilns).
- **Indirect heating**; a system where the combustion flue is separated from the system with the target (e.g. heat supply from CHP/boilers).

The **temperature of heating processes is important for assessing the viability of decarbonisation technologies**. High temperature processes (>100°C) may require less mature technologies, such as high temperature heat pumps.

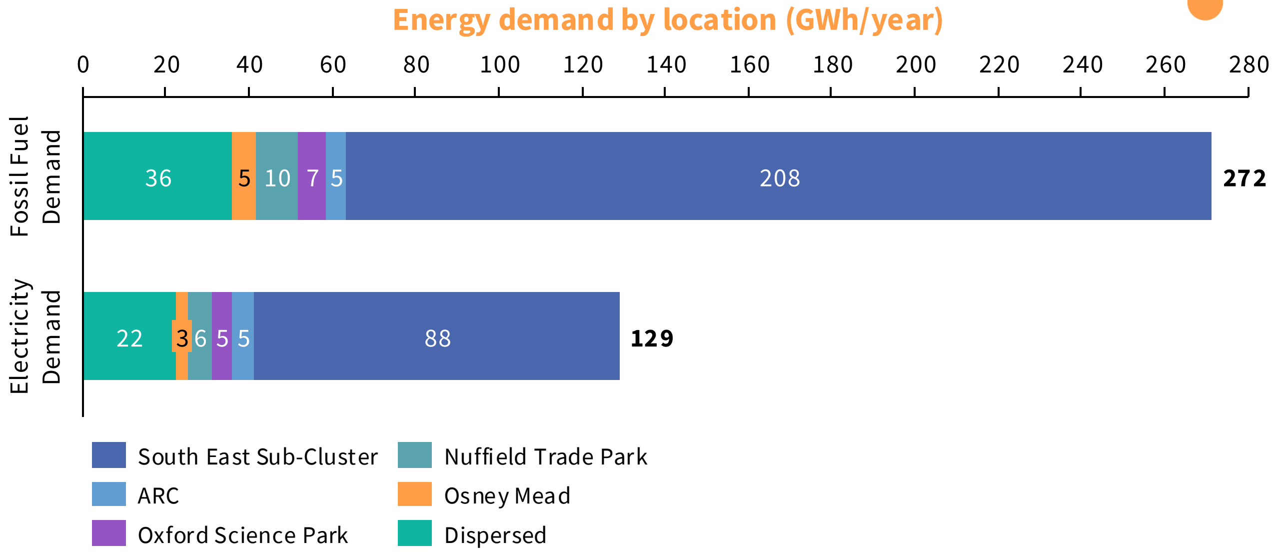
✔ Major energy use

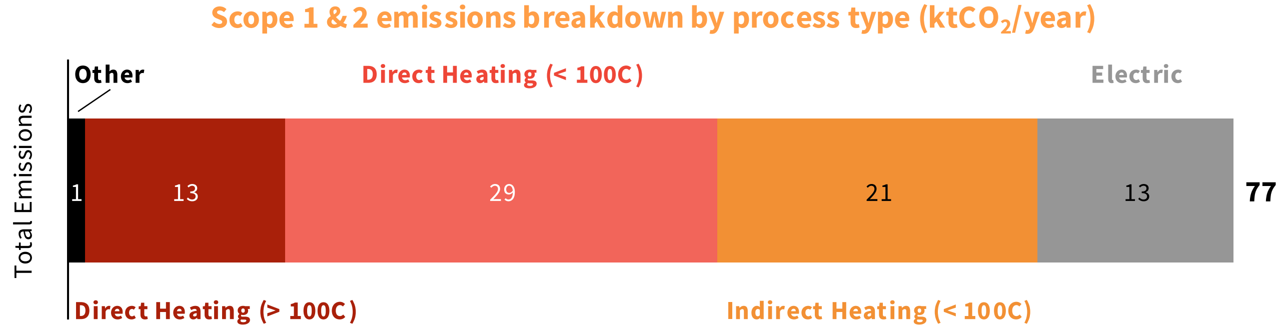
✓ Minor energy use

	Conventionally gas fired				
	Direct Heating (< 100°C)	**Direct Heating (> 100°C)**	**Indirect Heating (< 100°C)**	**Indirect Heating (> 100°C)**	**Electric**
Automotive		✓	✔	✔	✔
High-tech Engineering	✔	✓	✔		✓
Pharmaceuticals	✔	✔	✓		✔
Paper Products	✔		✓		✔
Food and Drink	✔	✓	✔		✓

Mini Plant Oxford in the South-East Sub-Cluster represents the majority of Oxford's industrial energy demand

- A locational breakdown highlights the South-East Sub-Cluster (dominated by Mini Plant Oxford) as by far the largest industrial energy consumer in Oxford.
- Excluding this South-East Sub-Cluster, the **business parks collectively contribute nearly half of remaining industrial activity in Oxford** with dispersed sites contributing the other half. Therefore, it is important to still highlight **dispersed sites as a key contributor to the landscape** of energy demand and emissions.
- **Low temperature (< 100°C) processes dominate the total emissions breakdown**. The emissions from high temperature heating are primarily from the automotives sector.
- **Direct heating processes are the largest contributor to scope 1 and 2 emissions**; however, this is again mainly driven by the automotives sector. Most other sectors have a more even balance of direct and indirect heating requirements.
- Electric processes (such as motors, pumps, and lighting) play a relatively small role in the overall emissions estimate, partly due to the lower emissions intensity of electricity supply. Nevertheless, much of the identified heating processes already, and will increasingly, rely significantly on electricity as an energy source.



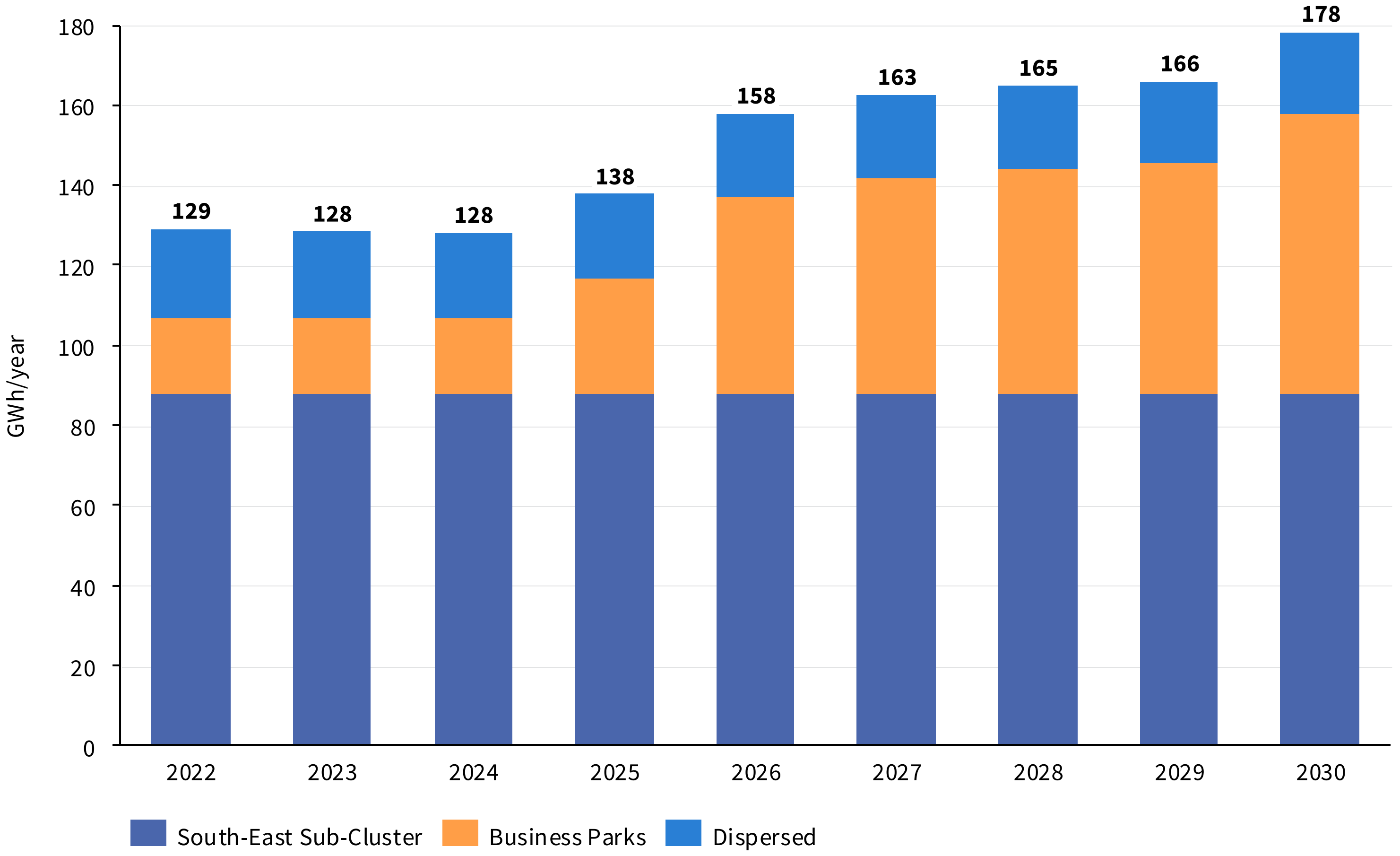


Based on ERM analysis of national datasets (DUKES and ONS) complemented by primary data from stakeholder engagement. See methodology appendix for details and limitations.

Industrial growth in Oxford is driven by the expansion of business parks for SMEs and innovative life science businesses

- Several developers are proposing or expanding existing business parks (ARC[1], Oxford North[2] and Oxford Science Park[3]); with hybrid lab-office spaces a growing commodity in the city demanded by university spin-outs and innovative SMEs.
- These developments will **increase the business park space available to life science and technology businesses by around 200,000 m² in 2030**.
- **New buildings are expected to be almost exclusively electrically heated and utilise electric industrial equipment**; creating additional demand for electrified industrial equipment, renewable energy generation, as well as energy storage and distribution.
- The future for individual dispersed sites is less clear. Aligned with UK projections[4] a slight decrease (12% by 2040) in overall energy demand for dispersed sites is anticipated.

Electricity demand projections for Oxford industrials (GWh/year)



1 – Lab Space for Innovators – ARC. 2 – Oxford North | A new innovation district opening in 2025. 3 – The Oxford Science Park.
4 - Energy and emissions projections: 2022 to 2040 – Annex A.

Technology Analysis and Prioritisation

A broad range of technologies exist to support decarbonisation of industrial emissions

Previous technology reviews

In the 2018 ZCOP Roadmap, **industrial emissions were modelled to decrease 84% by 2040**. This is achieved primarily by:

- "fabric improvements, the electrification of heat, site-level solar PV, … the electrification of processes, and process efficiency".
- gas grid blending with biogas (2%) and hydrogen (20% vol).
- insetting or GHG removals for residual emissions.

The previous roadmap identified the need for detailed work to understand relevance and potential deployment levels of different technologies.

This reports approach

A broader technology list was considered based on literature review, ZCOP member engagement, and previous experience from similar industrial roadmaps.

Deep decarbonisation technologies were reviewed in a detailed template to enable comparability and prioritisation.

Complementary and emerging technologies were assessed with respect to their potential roles in enabling decarbonisation in Oxford.

Decarbonisation technologies were reviewed against several key technical characteristics: **Technology Readiness Level (TRL), Cost, Process applicability, and Site applicability**.

Abatement Technology List	Example Equipment	
Deep-Decarbonisation		Reviewed in detail in this project
Electric Heating	*E-boilers, Ovens, Dryers, Kilns/Furnaces*	
Heat Pumps	*Ground Source, Air Source, Water Source, Industrial*	
Heat Networks	*Waste heat utilisation, Heat pump upgrading*	
On-site Renewables	*Rooftop Solar, Car Park Solar, Urban & Onshore Wind*	
External Renewable Supply	*Direct Wire to Local Renewables, Physical PPA*	
Carbon Capture	*Post-combustion, Pre-combustion, Oxyfuel*	
Hydrogen Fuel Switching	*Blending, Boilers, Dryers*	
Biofuel Switching	*Biomethane, Biogas, Biomass*	
Complementary		Focussed review on key criteria in this project
Energy Efficiency & Management	*Behaviour Change, Process Change, Flexible Operation, Waste Heat Utilisation, Demand Shifting*	
Energy Storage	*Flow Batteries, Thermal, Kinetic, Hydro, Smart/MicroGrids*	
Carbon Offsets		
Emerging		
Alternative Energy Production	*Micronuclear, Geothermal Heat*	
Innovative Fuels	*Green Ammonia, E-fuels, Green Methanol, Syngas*	
Innovative Renewable Generation	*Perovskite Solar Panels, AeroMine*	

Cost competitive and technically mature solutions are emerging to support industrial decarbonisation in Oxford

- Key technologies are already available to decarbonise industry in Oxford. **Mature heat pump and e-boiler technologies can deliver most indirect heat demand** (e.g., space heating, hot water, and steam) for industry in Oxford.
- **Electrification technologies are generally CAPEX intensive, but high efficiencies can lead to OPEX savings,** depending on the comparative price of electricity and natural gas.
- On-site renewables generally have short pay-back periods but are CAPEX intensive. As an alternative, external renewable supply has no CAPEX and can be price competitive with grid electricity but often requires commitment to long-term contracts.
- Heat networks and biofuel switching have been demonstrated in other sectors, however industrial applications are less mature in the UK.
- **Hydrogen fuel switching and small-scale, modular carbon capture technologies are less mature technologies**, can require more complex site/process modifications, and rely on wider energy infrastructure systems.
- **The cost of fuel switching technologies is primarily driven by the fuel OPEX itself**. Biomethane and hydrogen supply remain more expensive than natural gas, however biomethane benefits from no CAPEX requirements for process modifications.
- The cost of carbon capture for even the larger industrials sites located in Oxford is expected to be high, especially with additional transport and storage fees.
- **Energy efficiency and management to reduce total demand will support immediate carbon reductions and also deep decarbonisation technologies** by reducing their cost.
- Energy storage (primarily batteries), emerging low carbon energy/fuel pathways, and innovation for existing renewable technologies should all play a role in the medium term to enable electrification, diversify energy supply, and reduce costs.

Assessment summary of technologies against key criteria

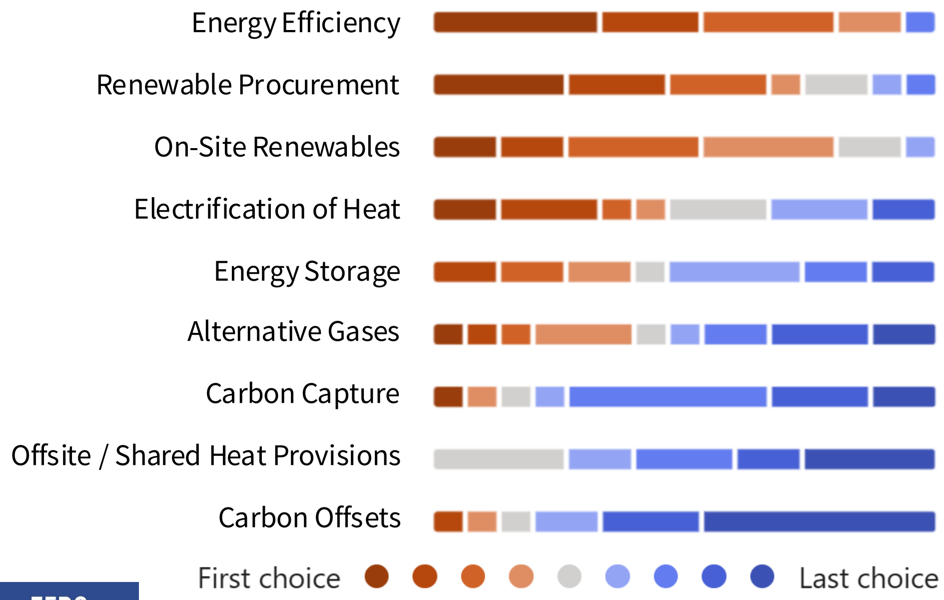
Technology	TRL*	CAPEX	OPEX	Stakeholder Interest	Applicability to Oxford
On-site renewables	7-9	↑	↓	green	green
External renewable supply	9	→	→	green	green
Heat Pumps	6-9	↗	↘	green	green
Heat Networks	8-9	→	↘	amber	green
Electric Heating	5-9	↘	↗	amber	green
Biofuel Switching	7-9	→	↗	amber	amber
Hydrogen Fuel Switching	5-8	↗	↗	red	amber
Carbon Capture	6-8	↑	↗	red	red

*TRL = technology readiness level. TRL 1-3 refers to concept, TRL 4-6 refers to prototype, TRL 7-8 refers to demonstration, and TRL 9 refers to commercial adoption

Stakeholder engagement indicated electrification technologies are the most applicable and interesting technologies for Oxford

- **Workshop and survey engagement in this project showed strong support for all electrification technologies,** despite widespread concerns regarding the ability of the electricity grid to support increased demand. Energy efficiency was also noted as a key aspect of decarbonisation for the large majority of sites.
- **Heat networks were also perceived positively in the workshop engagement,** with attendees keen to learn more about the potential for waste heat recovery – however, the survey showed considerably less interest in shared heating provisions, potentially highlighting the need for further communication and knowledge sharing on the potential benefits of heat networks.
- **Alternative gases and carbon capture were not seen as key technologies** for industry in Oxford because of high costs and substantial energy infrastructure requirements that will be dependent on national policy decisions and roll-out.
- Carbon **offsets were also recognised as a low priority solution** to decarbonising industry.

Stakeholder survey responses on the most applicable technologies to their site



Workshop feedback on the most and least suitable technology for decarbonising Oxford's industry*

* Based on 14 responses for the top 3 technologies and 8 responses for the bottom 3 technologies. The results are scaled for comparability

Stakeholder engagement identified that grid constraints, the dispersed nature of industry, and electricity prices may inhibit decarbonisation

Barriers to industrial decarbonisation

Decarbonisation technologies face a broad spectrum of barriers to deployment in Oxford due to the city's location, current industrial landscape, and available infrastructure:

- **Grid constraints and connections:** Already a major issue in Oxford, grid constraints are posing a barrier to new renewable generation and offtake connections for electrification technologies. The issue may well worsen with electrification of domestic heating, transport, and industry. Grid upgrades are expensive and can delay projects by several years. Energy efficiency, on-site renewables, and energy storage can help alleviate grid constraint concerns.
- **Cost:** High CAPEX requirements for decarbonisation technologies are currently prohibitive for smaller industrials who must use external financing or funding. Nationally, the cost of electricity compared to the price of natural gas remains a key barrier to electrification. Oxford's industrial SMEs will struggle to benefit from significant economies of scale and the city's location reduces the potential to benefit from government funded, infrastructure projects.
- **Support / incentives for small scale industry:** Government's current focus on the large, emissions-intensive industrial clusters has led to a prioritisation of investment, strategy, and incentives to technologies less suited to Oxford's dispersed SME industry. The availability and accessibility (considering resource and financial constraints) of targeted fiscal support, especially for electrification, is a key policy lever to accelerate decarbonisation of small-scale industry.
- **Challenges for infrastructure deployment in a dispersed industrial landscape:** Infrastructure heavy technologies, such as heat networks or hydrogen transport networks, are challenging to deploy in Oxford's dispersed industrial landscape of SMEs. Nevertheless, shared infrastructure can reduce the burden on SMEs trying to develop their own decarbonisation solutions. Property owner-tenant relationships can also make implementing technologies difficult as landlords must invest but the tenant receives most benefits.

Technology and Sector Synergies

- **Industrial heat pump deployment could benefit substantially from cost reductions** based on deployment in residential and commercial buildings.
- Variable renewable generation profiles will not match the baseload electricity demand from industry so **batteries will play an important role in enabling baseload supply and flexibility**.
- **Industry may also be able to connect to heat networks** developed primarily for wider building stock demand.
- **The use of hydrogen or biofuels for transport** may prompt greater production and supply chain capacity enabling economies of scale and wider reaching supply, resulting in lower-cost for industrial users.
- Low carbon **gas blending into the gas grid** could partially decarbonise emissions from sites before they move away from natural gas.

Higher priority technologies for decarbonising Oxford's industrials

High priority technologies are those that are likely preferred solutions for industrials in Oxford this decade. Reasons for being a preferred solution include lower costs, commercial availability, higher maturity, and limited barriers.

High Priority → Medium Priority

Electricity Consumption	< 100°C Indirect Heating	Complex Heating	
Energy efficiency: Oxford has already strategized the importance of energy efficiency across all sectors and industry is no different. An efficiency first approach enabled by **emerging smart/digital energy management solutions**, such as automated meter readings, is crucial to decrease total energy demand, immediately reduce emissions, and to minimise the subsequent cost of decarbonisation technologies.			
		Small Loads	Large Loads
Onsite renewables: Localised renewable deployment (either onsite or within a business park) can provide benefits of lower cost electricity whilst alleviating demands on the electricity grid. To achieve the greatest emission reductions, this should be combined with **energy storage**. **Renewable procurement:** If renewables cannot be deployed onsite, renewable electricity can be procured via a physical or virtual PPA. This is less likely to provide cost savings compared to onsite deployment and may not alleviate grid constraints. The emission savings from renewable PPAs may be less reliable due to demand 'matching' uncertainties.	**Heat networks:** Heat networks are the preferred indirect heating mechanism below 100°C due to their ability to re-use waste heat, their economies of scale, and the limited demands placed on the electricity grid (assuming heat sources are carefully located to avoid grid constraints). They initially require collective action and may face barriers associated with capital investment, operational costs, and infrastructure development. Infrastructure may not be developed to sites or business parks around which there is not sufficient demands to justify network deployment. **Onsite heat pumps:** Heat-pumps are commercially available, and their high-efficiency limits the impact on the grid, although grid-constraints may remain an issue for larger sites. Barriers faced include high upfront CAPEX and disruption.	**Process electrification:** For small-scale complex heating processes, electrification technologies are the preferred solution. **Electric boilers or heat pumps** can generate high-temperature steam, and a range of **radiative heating** technologies are commercially available (e.g., ovens, dryers). Electric technologies may provide efficiency benefits, but face barriers of upfront CAPEX and high electricity prices. Process electrification could be co-deployed with onsite renewables to reduce operational costs. Technology readiness may be a barrier.	**Bespoke solution:** There are few sites in Oxford with large demands for high-temperature or direct heating. The best solution for these sites will be bespoke to their circumstances but could include: • **Electric boilers & radiative heating:** These technologies are commercially available but may face grid constraints challenges and very niche processes may face readiness barriers. • **High-temperature heat-pump:** by upgrading lower temperature heat, emerging technologies can reach higher temperatures.

+ Important supporting role of innovation across all technologies: Novel low carbon energy production technologies, innovative approaches to energy efficiency and grid management, and ongoing improvements to existing renewable generation will play a role in the medium-long term to enable electrification, diversify energy supply, and reduce costs.

ZERO CARBON OXFORD

Lower priority technologies for decarbonising Oxford's industrials

Low priority technologies are those that are deemed less applicable or less impactful solutions for industrials in Oxford this decade. These technologies may currently have feasibility challenges, higher costs, technical uncertainties, or other barriers.

Medium Priority → Low Priority

Electricity Consumption	< 100°C Indirect Heating	Complex Heating: Small Loads	Complex Heating: Large Loads

Electricity Consumption

Energy storage: Batteries and thermal energy storage can provide grid balancing services and support smoothing of variable renewable supply to constant baseload demand. **Smart, integrated, control systems** can deliver emissions and cost savings by storing lower cost and emission electricity for peak times.

UK grid decarbonisation: The UK government has a target to decarbonise the grid by 2030. Waiting for this target to be reached limits near-term abatement, increases uncertainty, and does not alleviate grid constraints or provide savings.

Low Carbon Gas Switching:

- Partial **blending of biomethane and hydrogen** into Oxford's gas grid may occur as part of wider national decarbonisation efforts or due to synergies with other sector decarbonisation strategies. This is subject to significant uncertainty on national strategy and network operator developments.
- Hydrogen blending is expected to be limited to less than 20 vol% offering limited decarbonisation.
- Larger sites may be able to access a **dedicated hydrogen supply** for 100% fuel-switching – this could be from on-site or local hydrogen electrolysers or imported from large-scale projects. However, the high-cost of hydrogen means heat-pumps or heat-networks are a higher priority solution for indirect heating.
- Use of **biomethane** as a drop-in natural gas replacement may be attractive for some sites, but barriers exist with the availability of sustainable feedstock and the necessary supply infrastructure to go beyond low percentage blending.

Carbon capture: Economically, carbon capture is more applicable to large-scale, hard-to-decarbonise processes which are not found within Oxford's industrial sectors. There are major barriers to the transport of captured CO_2 from Oxford to the UK's developing offshore CO_2 storage sites which are not likely to be resolved in the near-term, as well as wider socio-environmental concerns. **CO_2 utilisation** is a potential option, but such applications are still relatively novel and would still require large CAPEX investment, additional energy demands, and stable offtake markets.

High quality carbon credits: High-quality carbon removal credits can be used to "neutralise" the final 5-10% of hard-to-abate emissions once industry has decarbonised the rest of its operations. Removals should only be utilised for the residual emissions and therefore are not prioritised.

+ Important supporting role of innovation across all technologies: Novel low carbon energy production technologies, innovative approaches to energy efficiency and grid management, and ongoing improvements to existing renewable generation will play a role in the medium-long term to enable electrification, diversify energy supply, and reduce costs.

Scenario Modelling

Modelling of decarbonisation focused on the five technologies selected as the highest priorities for Oxford's industrials

Our analysis focuses on the five abatement technologies prioritised for Oxford's industrial emissions. The impact of deploying these highest priority technologies has been assessed through stakeholder engagement and subsequent energy, emissions and economic modelling. In addition, the potential for alternative gases (such as biomethane and hydrogen) was explored given its emerging nature and potential synergies with other sectors.

Energy Efficiency

Energy efficiency includes a wide range of measures to reduce energy consumption. It covers demand reduction (e.g., insulation), technology or process improvement, smart controls or digitalisation, and behaviour change.

Heat Pumps

Heat pumps are powered by electricity and act to transfer heat at very high efficiencies, providing space heating as replacements for gas boilers.

Heat Network

Heat networks, also known as district heating, are centralized heating systems that distribute heat from a central source to multiple buildings or facilities within a defined area through a network of insulated pipes.

Complex Electrification

This covers electrification of high temperature or direct heating applications (e.g., ovens, kilns) by replacing them with radiative or resistance heating technologies.

On-site Renewables

On-site renewables refers to the generation of electricity from renewable sources, typically solar photovoltaic (PV) panels, on an industrial site. Users generate a proportion of their electricity demand.

Alternative Gases

Alternative gases such as hydrogen or biomethane can be blended into the gas grid to reduce the overall emissions intensity of gas use in Oxford.

Many Oxford industrials have high ambitions, but these are currently constrained by barriers limiting deployment

Several barriers exist in a business-as-usual scenario

Many large industrials and business parks in Oxford have committed to decarbonisation, with ambitious plans for low carbon technology deployments. Furthermore, the city council is driving for low-emission developments and entities such as Low Carbon Hub are supporting energy efficiency and solar projects.

This study has however identified several constraining factors that might limit decarbonisation. Among others, these include:

Electricity network capacity constraints

Limited space availability for solar PV

Barriers to SME engagement

Business-As-Usual Scenario: The business-as-usual case explores industrial decarbonisation in Oxford in a case without further intervention outlined in the actions of this roadmap. Technology uptake is driven by existing plans or national policies and is constrained by these barriers.

Scenario analysis explores the impact of overcoming these barriers

Enabled & Locally Driven Scenario: Stakeholder engagement has identified distinct initiatives where ZCOP and local entities could collaborate to improve upon the business-as-usual case. Three of these are explored in our 'enabled & locally driven' scenario – combining increased electricity capacity, heat network expansion, and accelerated SME engagement.

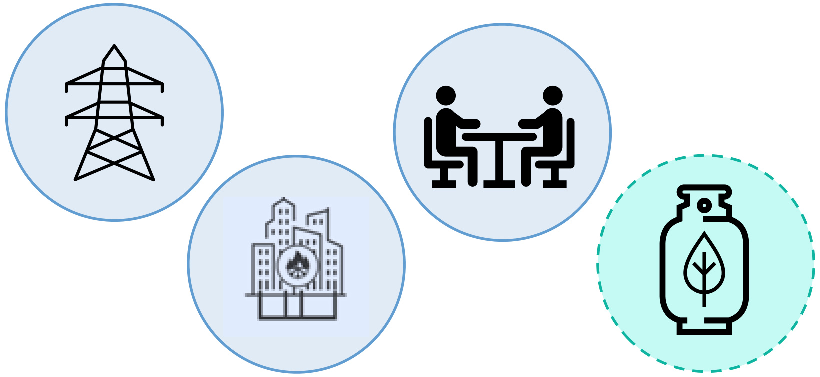
Speculative Scenario: A fourth initiative was explored in an addition to the above as part of a 'speculative' scenario – this investigated the impact of gas grid blending of hydrogen and biomethane as an interim measures.

Increased Electricity Capacity

Accelerated upgrade of electricity network capacity and/or direct wire connections to local energy generation

Accelerated SME engagement

Overcoming barriers for dispersed SME industrials to engage and invest in decarbonisation.



Heat Network Expansion

Expanding existing city heat network plans to business parks and large industrials.

Possible low carbon Gases

Exploring hydrogen and biomethane production for blending into the gas grid as an interim measure.

An enabled & locally driven scenario acts to remove barriers and accelerate uptake of technologies

Assumptions used for modelling Oxford industrial decarbonisation scenarios:

Business-as-usual technology uptake for Oxford industrials:

Energy Efficiency

- Business parks gradually deploy energy efficiency measures as buildings are refurbished, with a 19% energy reduction by 2040.
- Over the next decade, small & dispersed sites slowly deploy 'low-hanging fruit' energy efficiency measures with low capital investment and quick payback periods, achieving 10% energy reduction by 2035.

Heat Pumps

- All new business park developments are built with heat-pumps or electrified HVAC systems. Business parks gradually replace existing gas boilers with heat-pumps as buildings are refurbished.
- Grid capacity challenges delay adoption of large-scale heat pumps in the Cowley area (assumed until 2038)
- Driven by national policies, small & dispersed sites gradually adopt heat pumps from 2035 as existing gas-boilers reach end of life.

Complex Electrification

- It is assumed that Mini Plant Oxford will eventually electrify its complex heating processes in alignment with wider BMW Group developments across Europe. The required additional grid capacity for this is estimated to be significant.

Electricity Supply

- It is conservatively assumed that electricity network upgrades (including possible substation development) in the Cowley area are not completed until 2040, limiting the deployment timelines of electrification for large industrials.
- Onsite renewables (such as solar PV) are deployed extensively at all new business park developments (generating 20% of demand)
- Existing business parks gradually deploying onsite renewables during renovation cycles (achieving 5% of demand).

Enabled & locally driven technology uptake for Oxford industrials:

Energy Efficiency

- Both business parks and SME industrials maximise energy efficiency opportunities, achieving a 19% energy reduction by 2035. This might involve additional retrofits at business parks and investments in measures with longer payback periods.

Heat Pumps & Heat Networks

- All new business park developments are built with heat-pumps or electrified HVAC systems.
- Business parks in proximity to the Oxford Energy Network (a heat network) connect into it by 2030, with other business parks gradually adopting heat-pumps as buildings are refurbished.
- This heat network is expanded to the Cowley area supporting decarbonisation of space heating (assumed by early 2030s)
- Driven by local support, SME industrials gradually adopt heat pumps from 2028 as existing gas-boilers reach end of life, with some SMEs being connected to the heat network instead.

Complex Electrification

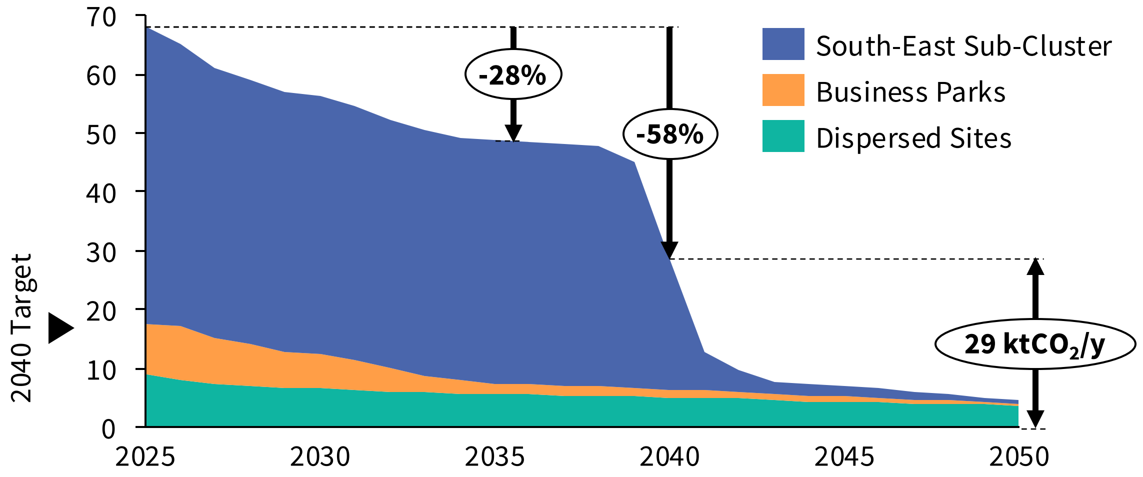
- It is assumed that Mini Plant Oxford will eventually electrify its complex heating processes in alignment with wider BMW Group developments across Europe. The required additional grid capacity for this is estimated to be significant.

Electricity Supply

- Local actions result in accelerated electricity connections in the Cowley area (assumed by 2035) – either through quicker grid upgrades or local energy hub investments with direct wires.
- Onsite renewables (such as solar PV) are deployed extensively at all new business park developments (generating 20% of demand).
- Ambitious uptake of onsite renewables is achieved at existing business parks (10% of demand) by using a range of solutions, such as solar carport and microgrids.

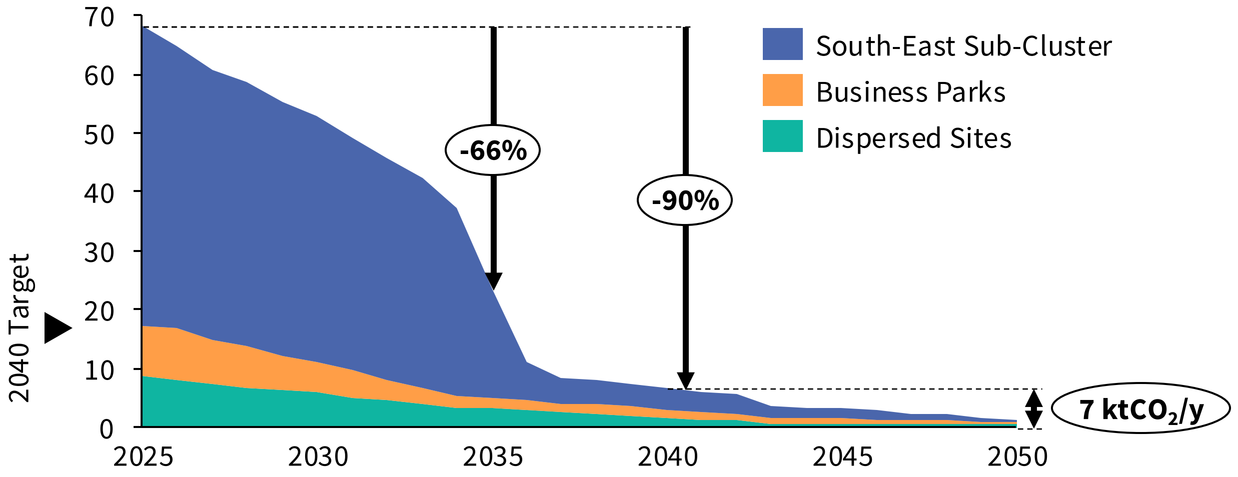
Without local initiatives for industry there is a risk that Oxford City might miss its 2040 target for decarbonisation

Business-as-usual Scope 1 & 2 emissions* (ktCO_2/y)



- In 2021, the Zero Carbon Oxford Partnership (ZCOP) **committed to collaborate on achieving net-zero carbon emissions for the city of Oxford by 2040** – 10 years ahead of the UK target. Oxford industrials were expected to reduce emissions by 82% from 2020 by 2040, with **offsets then needed to achieve net zero due to hard-to-abate processes**.
- More detailed modelling developed in this project reveals that in the **business-as-usual scenario this target is at risk** due to the grid-constraint challenges in the South-East Sub-Cluster and barriers to dispersed SME engagement. The scenario results in a remaining 29,000 tonnes of industrial CO_2 emissions in 2040 – with potential to be closer to 50,000 tonnes if grid connections are slower than assumed.
- Furthermore, there **remains 4,500 tonnes of industrial emissions in 2050** primarily from dispersed SME sites who have not been incentivised to decarbonise complex heating appliances (e.g., ovens, furnaces).

Enabled & locally driven Scope 1 & 2 emissions* (ktCO_2/y)

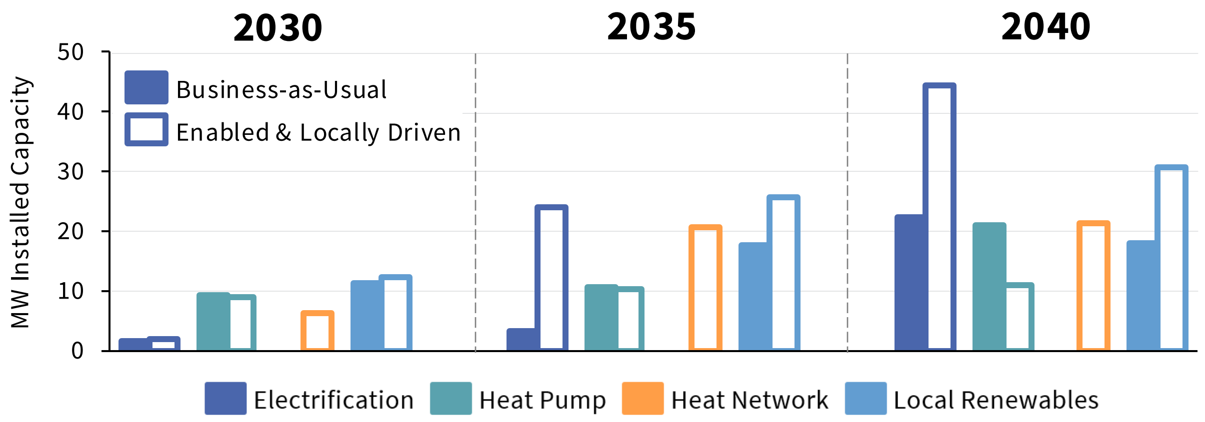


- Our enabled and locally driven scenario suggests that, **with the right enablers and initiatives**, Oxford's industrial sector could achieve a 66% reduction in emissions over the next decade. This path would leave only 7,000 tonnes of remaining industrial CO_2 emissions by 2040, equivalent to **90% reduction compared to current levels of emissions**. Therefore, this project's more detailed modelling shows how Oxford industry could exceed the targets originally set by ZCOP in 2021.
- The **most significant factor in reducing 2040 emissions is the early electrification** of complex heating at large industrials. This is enabled through accelerating grid upgrade timelines – reducing industrial connection times from an assumed 2040 business-as-usual case to an ambitious 2035 enabled case.
- The **expansion of the heat network acts to accelerate decarbonisation** in the early-2030s and thus reduce the cumulative emissions to 2040, although has limited impact on in-year emissions in 2040. **Engagement with dispersed SMEs reduces residual emissions in 2040.**

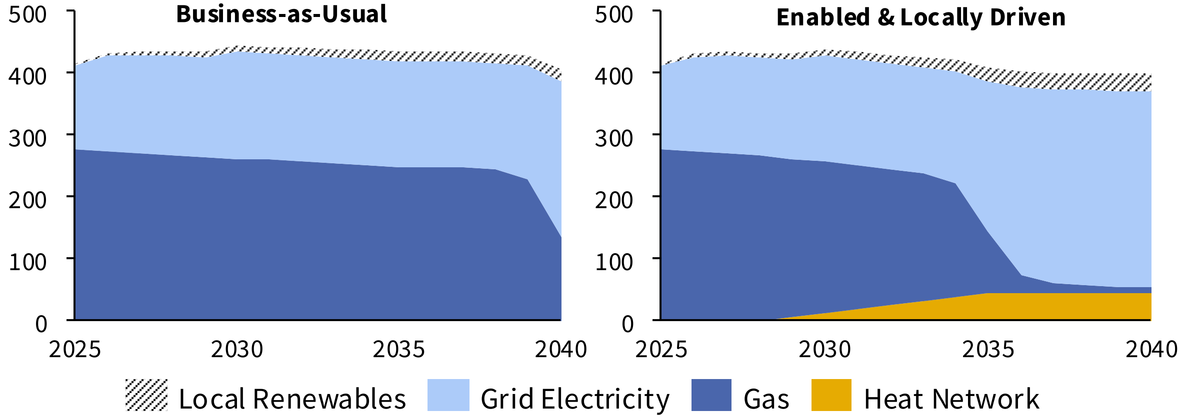
*Significant drops in emission trajectories of scenarios for business-as-usual (2040) and enabled & locally driven (2035) are a direct result of upgrades to electricity connections, allowing electrification of energy-intensive processes to occur at a large industrial. 2040 Target refers to the trajectory developed for industry within the ZCOP '2040 Net Zero Action Plan' for the city of Oxford published in 2021. Residual emissions result from hard-to-abate processes and grid-electricity emissions, with offsets of these residual emissions needed to achieve net zero.

Ambitious deployments of heat pumps, local renewables, process electrification and energy infrastructure upgrades are needed

Total installed capacity of abatement technologies by 2030, 2035, and 2040 (MW output)



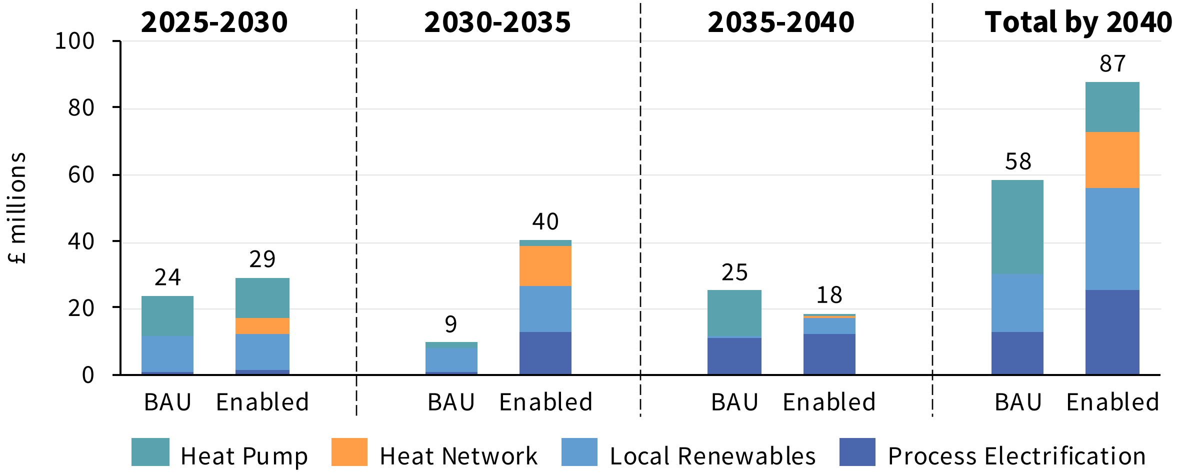
Impact on total energy supply demanded by Oxford industrials (GWh/y)



- The ‘enabled & locally driven’ scenario requires uptake of 45 MW of process electrification, 11 MW of heat pumps, 21 MW of heat network connections, and 31 MW of local renewables. Without heat network connections, an additional 10 MW of heat pumps would be needed.
- **Most heat pump deployments are achieved by 2030**, driven by uptake from business parks as they renovate buildings or build new developments. In addition, 1-2 MW of heat pumps are deployed gradually at dispersed sites through to 2040. In the case where a heat network is not expanded to Cowley, an additional 19 MW of heat pumps are needed to decarbonise the South-East Sub-Cluster by 2040.
- In the ‘enabled & locally driven’ scenario, **connections to an expanded heat network are expected to be achieved by 2035**, accelerating decarbonisation of space heating for the South-East Sub-Cluster and some business parks on the proposed route (as an alternative to heat pump deployment).
- **Local renewable deployments (with energy storage as needed) occur gradually from 2025-2035** as a complementary technology for electrifying heating. Business parks deploy rooftop solar during regular building refurbishments, with additional solar carport deployments also considered in the ‘enabled & locally driven’ case. Local **microgrids may be adopted to balance supply-and-demand** for these local renewables.
- In the ‘enabled & locally driven’ scenario, the **electrification of complex heating at large industrials commences between 2033-2037.** This is expected to place significant extra demand on the electricity network (an estimated 135 GWh per year) and therefore does not occur until Cowley grid upgrades are completed and/or local renewables with direct wire connections become available.
- The combined impact of these deployments is a **phase out of industrial gas usage and a 150% increase in electricity demand**. In the ‘enabled & locally driven’ scenario this occurs before 2040, whereas for business-as-usual it is delayed to the early 2040s. Up to 9% of electricity could be generated locally and heat networks could supply 11% of total energy demand.

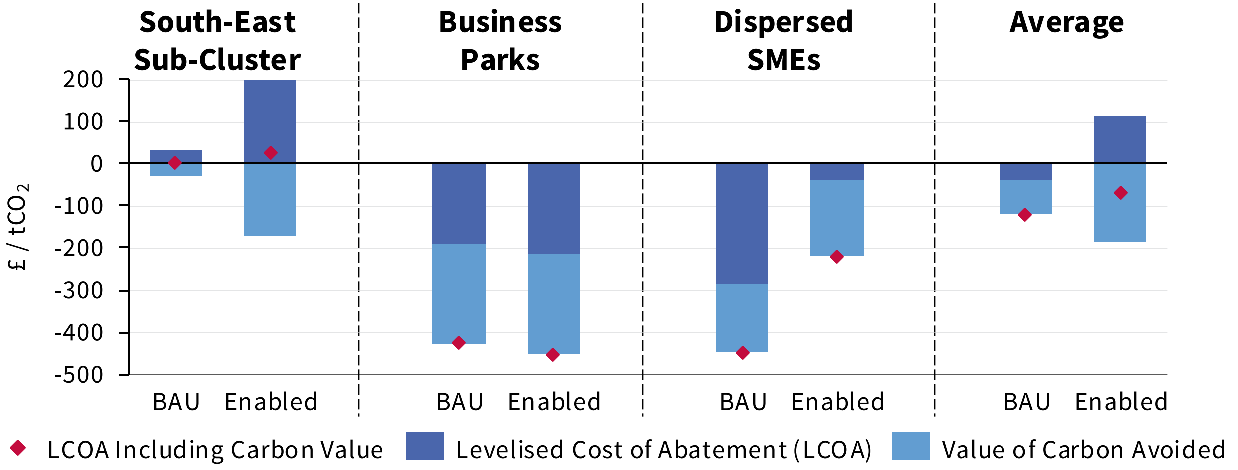
A total investment of £87 million is estimated by 2040, with business parks and SMEs able to recoup costs through energy savings

Capital investment required over period to install abatement technologies



- The 'enabled & locally driven' scenario requires **capital investments of between £20-40 million within each 5-year period from 2025-2040**, totalling £87 million. This is 50% more than the business-as-usual case by 2040.
- **30% of this investment is for process electrification** – electrifying complex heating at large industrials – and includes an indicative cost for grid connections. In contrast, in the business-as-usual case, this investment may be delayed until beyond 2040.
- To decarbonise space heating, capital investments totalling **£15-28 million for onsite heat pumps** are required, with a potential additional **£17 million for connections to a shared heat** network in the 'enabled & locally driven' scenario.
- Lastly, to support decarbonisation, **between £18-31 million could be invested into local renewable generation** projects, such as rooftop solar, solar carports, or energy hubs.

Levelised cost of abatement for different types of industrials



Carbon value refers to an assigned monetary value on CO_2 emissions which is used for decision making. In this analysis, we have aligned with central values used by UK government. These do not typically reflect actual monetary benefits for individual industrials but instead consider system wide benefits and objectives. Individual industrials may develop their own internal carbon value assumptions that differ from those used by policy makers.

- **For business parks and dispersed sites, the upfront costs of abatement measures could be recouped** through energy savings*, with a total reduction in costs seen compared to a 'no abatement' baseline. For dispersed sites, the extent of these savings 'per tonne CO_2 abated' are reduced in the 'enabled & locally driven' scenario as more ambitious uptake occurs.
- **In the South-East Sub-Cluster, it is expected that deploying abatement measures would increase costs overall** compared to a 'no abatement' baseline. The levelised cost of abatement was estimated at £199 per tonne CO_2 (although this is highly uncertain). However, if a monetary value for CO_2 emissions is included the result is approximate cost neutrality, highlighting the importance of internal carbon pricing for large industrials and/or policy incentives to drive decarbonisation.

*While overall a cost saving is estimated by the modelling, the ability to recoup costs will depend upon the commercial arrangement and may be complicated by landlord-tenant dynamics.

Analysis of individual initiatives provides insights on the measures with greatest impacts and investment needs

Impact of individual initiatives when compared to the business-as-usual scenario:

Increased Electricity Capacity

- This initiative has the **greatest emissions impact** of all those investigated, resulting in an additional 26% emissions reduction by 2040 compared to the BAU.
- It impacts the emission trajectory of the **South-East Sub-Cluster**, enabling faster uptake of technologies as grid constraints are overcome sooner.
- The initiative **increases the total capital investment by £34 million** compared to the BAU by 2040, with additional deployments of process electrification, heat pumps, and local renewables (e.g., solar carports and energy hubs).
- The initiative **increases the levelised cost of abatement**, resulting in an average cost of £111 per tonne CO_2 (excl. carbon value).

Accelerated SME Engagement

- The small contribution of SME emissions to overall cluster emissions means that this initiative has **limited impact on emissions** both by 2040 (additional 5% reduction) and cumulatively from 2025-2040 emissions (27,000 tonnes of CO_2 avoided).
- However, this is the **only initiative with a significant impact on dispersed sites** – reducing their emissions by two thirds in 2040 compared to the BAU (from 5,000 to 1,600 tonnes of CO_2 remaining).
- The initiative **increases the total capital investment by £12 million**, with greater uptake of heat pumps, local renewables, and electric appliances.
- The cost of the initiative can be recouped with **cost savings achieved of £24 per tonne of CO_2 abated** (slightly less than the BAU case).

Expansion of Heat Network to Industrials

- This initiative acts to **reduce the cumulative emissions** of the cluster, resulting in an additional 76 thousand tonnes of CO_2 avoided from 2025-2040 compared to the BAU case. It has a relatively **limited impact on emission reductions by 2040** (extra 7% reduction compared to BAU).
- A heat network could be **beneficial to all site types** investigated as an alternative to heat pumps and could also **help overcome local grid connection challenges** for decarbonising heating.
- This initiative **increases capital investment by £7 million** by 2040 compared to the BAU but could halve the demand for heat pumps.
- The **levelised cost of abatement is increased** with an average cost of £21 per tonne CO_2 (excl. carbon value).

Alternative Gases

- This initiative has a **strong contribution to emission reductions** when deployed in addition to BAU efforts – an additional 11% reduction by 2040 and cumulative emission avoidance of 135,000 tonnes of CO_2. However, it has a more **limited impact when adopted in addition to all other initiatives combined.**
- Blending of alternative gases into the gas grid affects the cumulative emissions of the **South-East Sub-Cluster and dispersed sites** as these continue to use gas into the mid-2030s.
- The initiative **increases the levelised cost of abatement for the cluster**, resulting in an average cost of £114 per tonne CO_2 (excl. carbon value).

Impact of individual initiatives on Oxford's emissions, investment needs, and installations

		BAU	Capacity	Heat Network	Engage	Enabled	Alt. Gases	Speculative
Remaining emissions in 2040 - Total	$ktCO_2/y$	**28.9**	**10.2**	**24.0**	**25.5**	**6.5**	**20.7**	**6.1**
- South-East Sub-Cluster	$ktCO_2/y$	22.5	3.8	17.9	22.4	3.6	15.9	3.6
- Business Parks	$ktCO_2/y$	1.4	1.4	1.4	1.4	1.4	1.3	1.3
- Dispersed Sites	$ktCO_2/y$	5.0	5.0	4.7	1.6	1.6	3.5	1.2
Emission reduction in 2040 compared to 2024	%	**59%**	**85%**	**66%**	**64%**	**91%**	**70%**	**91%**
Cumulative emissions - Total	$ktCO_2$	**840**	**658**	**764**	**813**	**599**	**705**	**545**
- South-East Sub-Cluster	$ktCO_2$	672	491	599	672	460	555	416
- Business Parks	$ktCO_2$	68	67	67	67	65	65	63
- Dispersed Sites	$ktCO_2$	101	101	98	74	74	84	66
Capital Investment - Total	£ million	**58**	**92**	**65**	**70**	**87**	**58***	**87***
Levelised Cost of Abatement (excl. carbon value) - All	£ / tCO_2	**-37**	**111**	**21**	**-24**	**113**	**114**	**154**
- South-East Sub-Cluster	£ / tCO_2	32	193	90	45	199	187	238
- Business Parks	£ / tCO_2	-193	-198	-180	-222	-214	-170	-194
- Dispersed Sites	£ / tCO_2	-286	-286	-218	-39	-38	67	27
Levelised Cost of Abatement (incl. carbon value) - All	£ / tCO_2	**-120**	**-62**	**-107**	**-120**	**-72**	**-39**	**-44**
- South-East Sub-Cluster	£ / tCO_2	3	32	-8	16	25	58	47
- Business Parks	£ / tCO_2	-428	-434	-416	-459	-452	-407	-434
- Dispersed Sites	£ / tCO_2	-448	-448	-392	-222	-221	-135	-173
Capacity Installed by 2040 - Process Electrification	MW (output)	**22**	**42**	**22**	**25**	**45**	**22**	**45**
Capacity Installed by 2040 - Heat Pumps	MW (output)	**21**	**31**	**10**	**23**	**11**	**21**	**11**
Capacity Installed by 2040 - Heat Networks	MW (output)	**0**	**0**	**21**	**0**	**21**	**0**	**21**
Capacity Installed by 2040 - Local Renewables	MW (output)	**18**	**28**	**22**	**25**	**31**	**18**	**31**

*Does not include investment in hydrogen and biomethane production

Skills and Supply Chain

BARRIERS AND ENABLERS

Achieving Oxford City Council's ambition of net zero by 2040 will require major uptake of low carbon technologies

- The rollout of low carbon technologies in Oxford is heavily reliant on local skills and supply chains. This analysis sought to understand the key gaps in existing capabilities and provide actionable recommendations to enable the net zero transition through a mixture of stakeholder engagement and literature review.
- To meet the increasing demand for low carbon solutions, on time and at scale, it is crucial to **train a new workforce of certified installers and invest in the scalability of existing supply chains**.
- By showcasing local demand, stimulating interest, and attracting new entrants to the sector, the Oxford Industrial Cluster can enhance workforce capabilities and strengthen the supply chain for the transition:
  - Without **clear customer demand**, SME installers remain reluctant to invest time and resources into offering low carbon services given a lack of capacity to train, certify, and expand into new technologies.
  - Fragmented demand from small-scale projects also limits **Oxford's visibility and attractiveness to suppliers**, who tend to prioritize large-scale, aggregated projects so the Oxford Industrial Cluster should work to aggregate attractive supply portfolios for the supply chain.
  - **Attracting new talent** to the sector is essential to bridge the transition skills gap and can be achieved by **highlighting success stories and developing a local apprenticeship network**, with competitive incentives for both young entrants and mid-career re-trainers.
- The Oxford Industrial Cluster has an opportunity to drive and scale the net zero transition, but success will rely on the ability to foster a **collaborative ecosystem of stakeholders -** including industrial leaders, installers, suppliers, training providers, and apprentices. The Oxford Industrial Cluster should also collaborate with other sectors where similar technologies, namely solar PV and heat pumps, will also be crucial in decarbonising the residential, commercial, and institutional building stock.

To deliver Oxford's ambitions for 2040 Net Zero:

1. Make **consumer demand and future growth** more visible to the supply chain
2. **Develop local skills** to install and maintain these technologies
3. Expand the **local installer base** to a sufficient scale
4. Ensure the timely **availability of necessary low carbon technologies**

The Oxford Industrial Cluster faces a series of significant barriers preventing development of skills and supply in low carbon technologies

Customer demand

Low demand from customers originates from the high upfront costs, low technical awareness, a perceived risk that this technology has not yet been vigorously tested, and a lack of carbon reduction targets within SMEs. Potential installers need to see an increase in customer interest before they would consider offering these services.

Weak supply chain

Both PV systems and heat pumps rely on technology and materials that are largely produced outside of the UK. The availability of components can fluctuate, and manufacturers can deprioritise demand from Oxford.

High costs of business expansion

The training and certification required for low carbon technologies represents a substantial investment for local tradespeople and installers, many of whom are sole traders or SMEs with limited time, resources, and motivation to expand their services into new areas.

Difficulty in recruiting staff

Installers are struggling to recruit new workers with the necessary training. Many of the existing engineers have established careers and may not see the urgency in transitioning to low carbon technologies.

Unawareness of existing training routes

Many potential new entrants into the low carbon technologies field are unaware of the existing courses and training programs offered by colleges and training providers.

Attractiveness of training

Training programs for low carbon tech installation are not perceived as attractive, especially for mid-career entrants who may already have established careers. The demand for low carbon technologies is not clearly demonstrated.

The Oxford Industrial Cluster can undertake enabling activities to engage the supply chain and fill the skill gap in low carbon technologies

Building local networks

A clear pathway from training and qualification into the labour market must be established. The Oxford Industrial Cluster could facilitate **regular industry roundtables,** including installers, wholesale suppliers, and educational institutions, enabling dialogue on the challenges faced by installers.

Partnerships between colleges and local industry can support targeted training, creating a skilled labour pool.

These networks would **streamline procurement, enable group purchasing**, and build a cohesive community of stakeholders attracting suppliers and investors.

The Oxford Industrial Cluster should create an **online platform to link employers and apprentices/re-trainers.**

Targeted training and support

The Oxford Industrial Cluster should collaborate with technical schools, industry associations, and training providers to **establish clear routes into the industry, including hands-on training programs**.

A particular focus could be on creating **hands-on retraining/upskilling programmes and short-term stipends to boost the salary for mid-career professionals** who may not be able to live on an apprenticeship wage.

To boost attractiveness of the sector for students, the Oxford Industrial Cluster can **launch campaigns to highlight career opportunities and showcase success stories**. Emphasis should be placed on **the long-term job security** of renewables installation, and the profitability of the associated businesses.

Increase public awareness to drive demand

Unawareness and perceived complexity of low carbon technologies are key barriers to customer demand.

The Oxford Industrial Cluster can gather and share information on anticipated installations resulting from **the carbon reduction commitments of local businesses and strengthened planning requirements** for new construction. This will increase confidence on the growth of the sector in the coming years.

To build confidence in low carbon technology, the Oxford Industrial Cluster could invest **in educational and showcase projects on their own buildings**. This would provide experience to local, newly trained installers, and allow other businesses to better understand the systems and benefits.

Financial incentives for SME installers

Financial incentives such as **grants or low interest loans** would make it more financially viable for existing installation SMEs to grow in size and expand their offerings.

Installers could receive support to cover the costs of certification, staff training or salary support for new starters, ensuring they have the resources and confidence to move forward with expanding their activities.

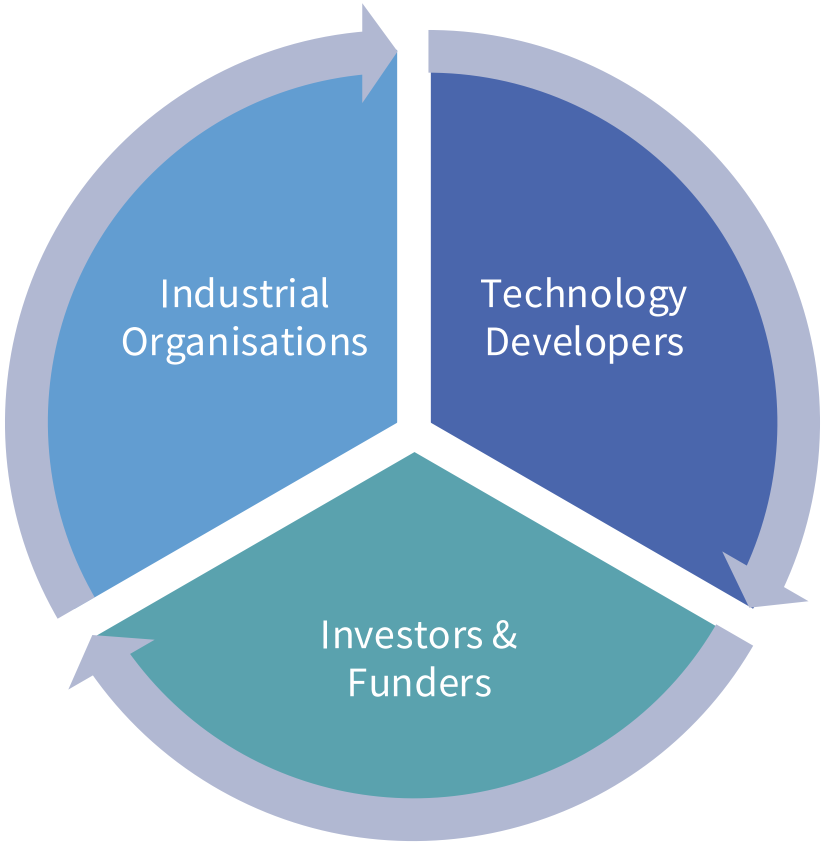
Large industrials/corporates are beginning to prioritise suppliers based on full ESG performance and standard of secondary/tertiary suppliers. In the 5-10 year time frame, the Oxford Industrial Cluster should tailor any incentives to **support installers that source materials locally,** and/or **with transparent supply chains.**

Funding and Financing

BARRIERS AND ENABLERS

To achieve Oxford City Council’s ambition of net zero by 2040 will require substantial investment into decarbonisation technologies

- Financing comes from various sources, such as loans, lines of credit, and issuance of bonds and is generally utilised to supports the overall financial needs of a business. On the other hand, funding is money provided, especially by Government, related to specific projects or stages of growth.
- Oxford City Council’s ambitious net zero target by 2040 will require substantial investment through a mix of funding and financing solutions and collaborative actions as **industrials, technology developers, and financiers face a broad range of challenges to investing in decarbonisation**.
- Industrial companies need to build a business case to convince internal decision makers to invest or seek investment. A decarbonisation technology deployment is generally a **balance between upfront expenditure and long-term cost reductions** – such as reduced fuel cost, maintenance, carbon liability/taxation, or additional revenue generation.
- Oxford’s landscape of industrial **SMEs requires bespoke support to overcome investment barriers associated with their small scale.** The Oxford Industrial Cluster must continuously **engage the investor community** to understand the key parameters required to attract investment.
- By leveraging **innovative financing mechanisms, forming public-private partnerships,** and prioritizing scalable, low-cost technologies, Oxford can unlock the investment needed.
    - The Oxford Industrial Cluster must first prioritise **capacity building and simple partnership/funding mechanisms** to enable industrials to identify and uptake cost-effective decarbonisation solutions.
    - By **aggregating demand, potentially into complex portfolios**, Oxford can generate scale, reduce investment risk, and enable investment.
- The Oxford Industrial Cluster must also **create a supportive, holistic environment for investment through other actions targeting collaboration, policy, planning, skills, supply chain, and regulatory aspects**.



The Oxford Industrial Cluster faces a series of significant barriers preventing investment into decarbonisation projects and technology

Scale

SMEs small-scale decarbonisation projects are unable to benefit from economies of scale, compounded by fixed procurement/installation expenses. Oxford's dispersed industrial landscape also complicates coordination of larger infrastructure projects.

Risk Management

Investors are wary of risks associated with decarbonisation projects, including technical performance risks, market risks, and policy risks due to evolving regulations. Small industrials and innovative technology developers also face financial risk due to limited creditworthiness, further deterring investment.

Upfront Capital Constraints

SMEs face significant challenges in securing upfront capital for decarbonisation projects. They often rely on external funding, which is targeted at limited technologies and competitive / time-consuming to obtain, or private loans that create long-term financial burdens.

Landlord-Tenant Dynamics

A large portion of Oxford's industrial properties are rented, leading to split incentives where landlords are reluctant to invest in energy-efficient upgrades as tenants reap the benefits. Conversely, short-term leases discourage tenant investment in long-term decarbonisation technologies.

Return on Investment

Low carbon technologies often struggle to demonstrate a strong return on investment (ROI) due to market uncertainty, fuel price volatility, and low technical maturity. Without a convincing ROI, or fast payback period, investors are hesitant to support these projects or technologies.

Skills & Resource Gap

Many industrials lack the expertise or human resource capacity to navigate complex funding options or develop strong business cases for seeking investment for decarbonisation.

Innovative funding and financing solutions can enable SME industrials and landlords to overcome upfront capital constraints

- Traditional financing options such as debt and equity financing remain likely pathways for funding mature, low risk decarbonisation projects of widely available and proven technologies being used in familiar sectors. Businesses can also access green loans or bonds, paying back through profits or interest.
- National government grants provide valuable capital or operational support; however, these grants are often competitive, mandate minimum project capacities and act over short timeframes - making it difficult for smaller SMEs to plan for and secure funding. Local governments can also support decarbonisation by providing further financial incentives through **tax reliefs, rebates, and specific funding programs**.
- Blended finance offers a solution to some of these challenges by **combining public and private investment to lower the overall risk profile. Public-private partnerships can provide both financial backing and access to essential expertise**, making projects more feasible. Green leases can also be used to encourage collaborative investment from landlords and tenants.
- For larger decarbonisation projects, **third-party infrastructure investment** is a key opportunity. **External infrastructure providers fund and develop major decarbonisation infrastructure** such as microgrids or heat networks, with businesses paying for services (power/heat) rather than managing the technology themselves. This **reduces both upfront capital needs and operational risks for industrials or landlords, whilst aggregating demand** to produce more investable projects.
- A novel approach for smaller businesses is **decarbonisation-as-a-service which removes the barrier of upfront capital entirely**, allowing third-party providers to install and maintain the technology, while industrials pay a premium over time. As-a-service solutions for technologies such as heat pumps or solar PV systems can be deployed without the need for large initial investments, making decarbonisation much more accessible to Oxford's abundance of dispersed SME industrials.

3rd Party Infrastructure Investment	Debt & Equity Financing	Blended Finance & Joint Ventures	Government Grants & Business Models	Local Funding, Tax Reliefs, & Insetting	Decarbonisation -as-a-service

The Oxford Industrial Cluster should undertake several enabling activities to unlock the key investment solutions available

Capacity Building

Oxford's industrial landscape requires further **knowledge, skill, and capacity development** to maximise opportunities for investment in decarbonisation.

To support the city's ambitions the Oxford Industrial Cluster should develop a **programme of education, knowledge sharing, match-making, and bid support activities** to empower industrials and technology developers to identify and access optimal funding and financing solutions.

Direct Support

The Oxford Industrial Cluster has the capabilities to directly support and unlock investment opportunities for industrial sites.

Firstly, **establishing partnerships with technology developers** to increase awareness and support for technology deployments.

Secondly, through **channelling national funds to support reduction in the upfront capital** investment for technologies or improve the long-term business case for decarbonisation.

More applicable to innovative technologies that require early-stage support to develop and demonstrate viability

Aggregation

To overcome challenges of scale and limited skills/capacity across Oxford's dispersed SME industrial landscape the Oxford Industrial Cluster should look to **aggregate demand for different technologies,** also in collaboration with other sectors.

This can help **enable bulk procurement and to demonstrate a scalable business case** for large-scale infrastructure investment.

Aggregation can also help **reduce total cost by levering collective bargaining powers.**

Portfolio Development

By combining the prior enablers, the **Oxford Cluster can develop investment portfolios offering diversity across sector, technology, and location to create a large-scale opportunity** for investors to support.

This approach has the benefit of **sharing risk between industrials and can enable multiple investor classes to participate**.

Portfolios can also **balance profiles of more and less attractive projects** to enable planning and investment in all viable decarbonisation solutions.

More applicable to mature technologies that require support to accelerate roll out at scale

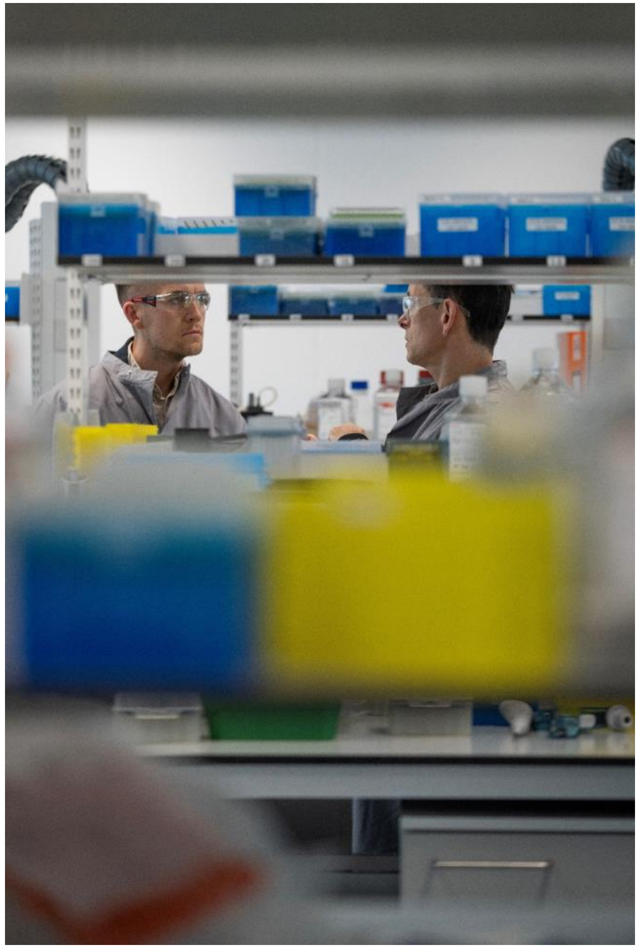
Industrial Cluster Development

The project has delivered a clear, collaborative vision and strategy to efficiently achieve industrial decarbonisation by 2040

To develop this this Roadmap and Action Plan, ZCOP brought together a local leaders, a community of experts and regional organisations focused on addressing the unique challenge of how to achieve industrial decarbonisation for the cities several hundred dispersed and distributed sites. Now, ZCOP will continue to drive forward progress by convening and supporting the development of Oxford Industrial Cluster

The Oxford Industrial Cluster is a cluster with high ambitions for which collaboration is key:

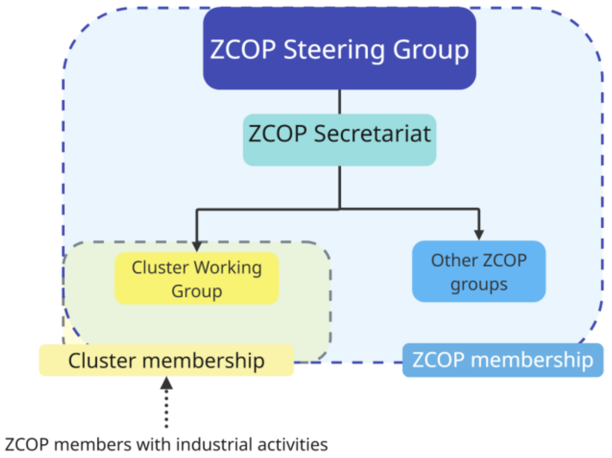
- While our largest sites may require bespoke solutions to decarbonise, they face many of the same barriers as smaller sites – requiring upgraded grid capacity and improved renewable energy infrastructure.
- Clusters are key hubs of local economic activity and an important part of the UK economy. The Oxford Industrial cluster offer high quality jobs that tend to pay above the average UK wage and are key to local supply chains and the local economy.
- Oxford's industrial sector has a global impact and reach but is made up of many relatively small, diverse sites spread across the city, alongside a few larger ones



The Oxford Industrial Cluster will be established under ZCOP to implement the roadmap and action plan, with 16 targeted actions

- By being part of ZCOP, members of the cluster will be able to access this wider network of expertise and activities in domestic, commercial, institutional and transport decarbonisation.
- ZCOP's strong reputation and track record strengthen benefits of industrial's participation in the Oxford Industrial Cluster.
- 22 organisations, including BMW Group, Unipart, ARC Oxford, and Oxfordshire Greentech, are already part o ZCOP.
- **To apply to join the Oxford Industrial Cluster, pleas contact zcop@oxford.gov.uk**

ZCOP and Oxford Industrial Cluster



Steering Group: Provide strategic leadership ZCOP to ensure timely implementation and delivery

Industrial Cluster Working Group to oversee delivery of actions.

Sprint Groups are task-focused, time-bound teams formed as needed basis to advance specific objectives and then disperse.

ZCOP Secretariat will offer administrative and logistical support, ensuring smooth operations, effective collaboration, progress monitor, coordinate funding bids, secure financial resources and facilitate working and sprint group activities.

Partnership benefits:

- Support delivery of ESG Goals
- Connect with like-minded organisations and experts
- Participate in collaborative projects
- Local & national policy influence
- Recognition and visibility

Appendix A - Methodology

Public datasets were used to understand Oxford's industrial energy use and emissions

Data

Public datasets were used to baseline energy demand and emissions for Oxford's industrial sectors[1,2], with additional stakeholder information from survey responses integrated when significant.

Analysis

Baseline Oxford energy demand and emissions: UK industrial energy demand is aggregated by sector from DUKES Energy Data whilst employee data was used to derive a scaling factor for each sector between the number of employees in the UK and Oxford.

Sectoral energy and emissions analysed by location, fuel type, and process: Analysis also provides a breakdown of the energy consumption by the fuel type and five key process types (high vs low temperature, direct vs indirect heating, electric). LSOA data was used to identify sites in different business parks to disaggregate energy and emissions into the key industrial geographies of Oxford.

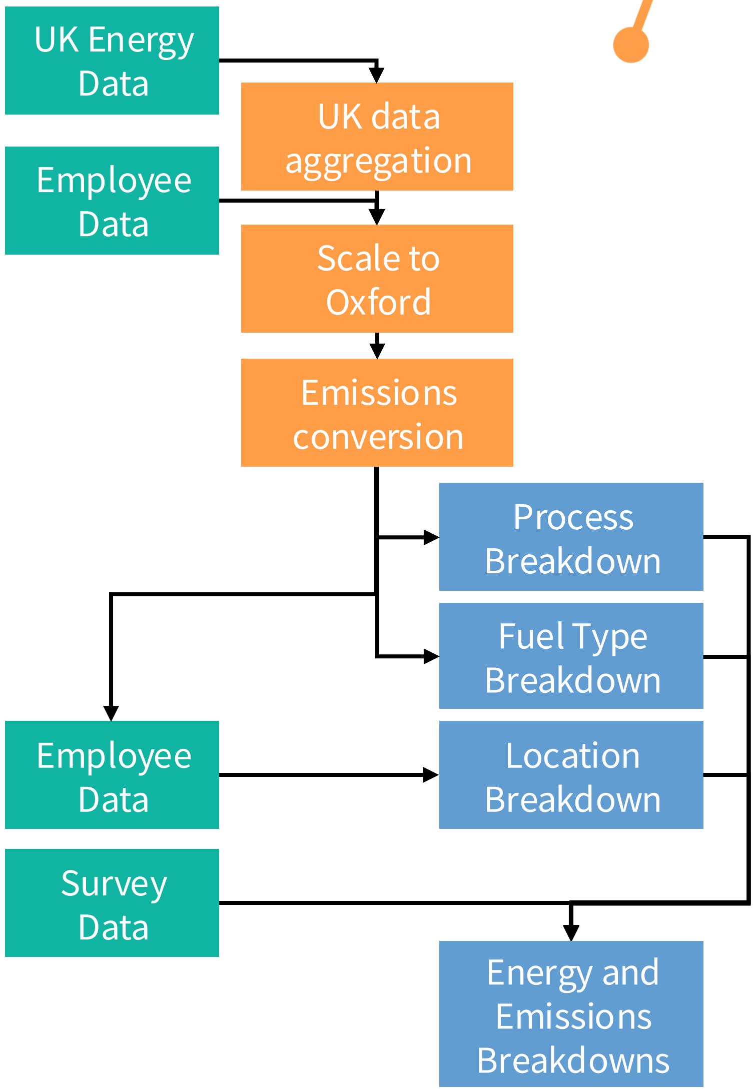
Limitations

The **Government datasets are UK wide so not perfectly representative of industrial energy demand and emissions in Oxford**. Some of the employee and business data is also rounded to ensure data protection/anonymity.

In an attempt to overcome this, the **project collected primary data from surveys and energy audits**. **Survey data from project partners was integrated into the final baseline** to reflect greater certainty in these major energy users.

Other survey and audit data was not considered sufficient to replace the top-down approach as only thirteen dispersed industrials - with total energy/emissions of ~44 GWh/year - were identified, compared to the estimated 100+ dispersed industrials in the City Council region according to the Government data. These **primary inputs also generally included less granularity on the industrial processes and energy demand split** than is available from the Government datasets. Further information on the survey and audits results can be found in the standalone report.

Further work within the cluster should focus on closing this data gap and further refining the city's understanding of the industrial landscape.



1 - Dataset Selection - Query - Nomis - Official Census and Labour Market Statistics.
2 - Energy consumption in the UK 2023 (ECUK_2023_End_Use_tables.xlsx - Table U4)

A holistic approach was used to assess technologies suited to Oxford considering technical factors, barriers, and stakeholder views

Decarbonisation technologies were reviewed against several key technical characteristics:

- **TRL (Technology Readiness Level) -** assesses the current and future technical maturity of the decarbonisation solutions on the industry standard 1-9 scale.
- **Cost –** a review of the key upfront and operational cost drivers to inform the current and future potential for different technologies to be used in Oxford.
- **Process applicability –** red-amber-green assessment for the applicability of technologies to the prevalent industrial processes in Oxford, considering the technical feasibility and technology competition.
- **Site applicability -** red-amber-green assessment for the applicability of technologies to different types of sites seen in Oxford, considering key enablers and barriers to deployment.

The barriers for the decarbonisation technologies were reviewed against six categories: Policy, Environmental, Social, Technological, Regulatory, and Market.

Other key considerations in the detailed review of the decarbonisation technologies are **synergies between technologies, opportunities to collaborate with the decarbonisation of other sectors, and co-benefits**.

Workshop engagement and industrial surveys were used to complement the technology literature review by gathering stakeholder opinions on both the local barriers to deployment and the technical applicability of each technology to industry in Oxford.

Technology prioritisation was developed across the range of industrial emission sources identified in Oxford; electricity consumption, low temperature indirect heating, and complex heating (referring to > 100 °C or direct heating processes). Prioritisation is **based on the outcomes of the technical, barrier, and stakeholder reviews** and ensures the combined technology selection is able to decarbonise all the processes relevant to industry in Oxford.

Barrier to deployment considered

- Market
- Policy
- Regulatory
- Environmental
- Social
- Technological

The impact of Oxford's industrial decarbonisation options has been assessed through energy, emissions and economic modelling

Feasible timelines and magnitudes for the uptake of the prioritised decarbonisation technologies across Oxford's industry were determined through a combination of stakeholder engagement, literature review and targeted analysis.

From this, two options for uptake were considered for each technology category:

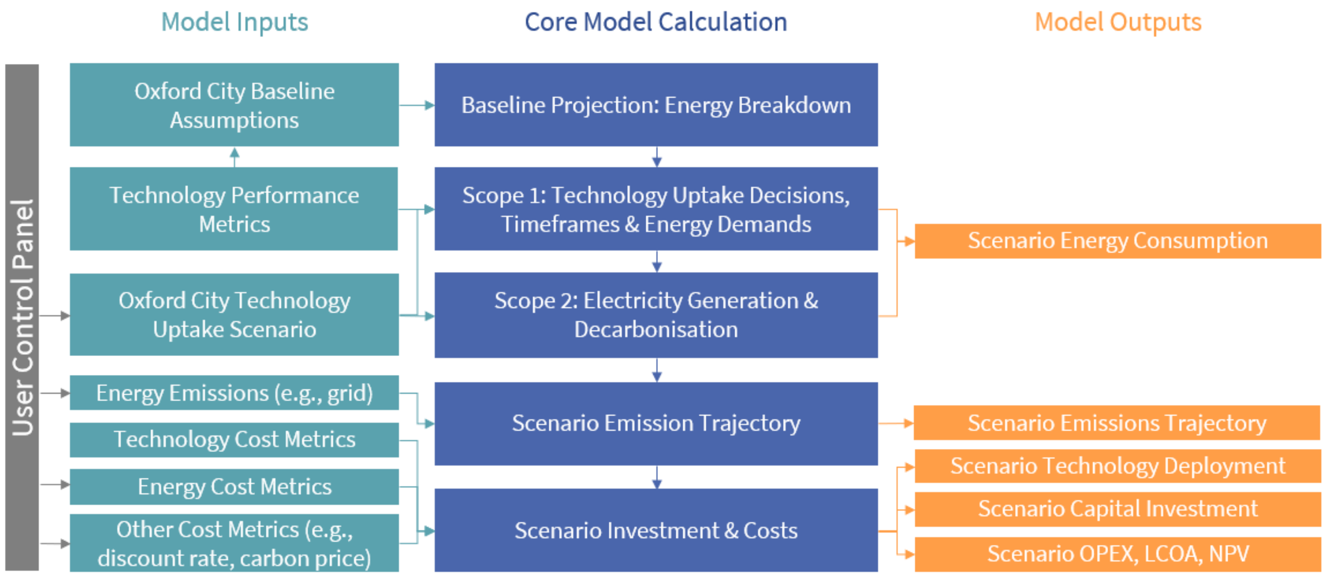
- **Business-as-usual uptake** – the expected timelines and magnitude of technology deployment without further intervention from Oxford City Council, ZCOP, or other local actors (i.e., timelines driven by existing plans or national policies)
- **Enabled & locally driven uptake** – more ambitious timelines and / or magnitudes for technology deployment that could be feasible with increased local interventions and enabling actions taken by Oxford City Council, ZCOP, or other local actors (i.e., timelines driven by increased ambition and local initiatives)

In the case of alternative gases, no current ambitions for increased uptake were identified, so instead a **highly speculative uptake** case was explored.

The impact of technology uptake on Oxford's industry was then assessed through an **energy, emissions and economic model** to understand:

- Rate of technology deployment
- Impact on energy consumption
- Impact on scope 1 & 2 emissions
- Level of investment required
- Overall impact on costs for industrials

Overview of energy, emissions and economic model



Limitations:

- *Decarbonisation has been assessed considering high-level archetypes for demand at dispersed sites, business parks, and the South-East Sub-Cluster with only a limited amount of data on energy consumption and processes made available.*
- *The analysis has not considered the specifics of site-level processes both due to the lack of data and the confidentiality of data where available.*
- *Therefore, all results should be treated as indicative and with high levels of uncertainty. Their purpose is to serve as comparative estimates to evaluate the potential impacts of different decarbonisation initiatives.*
- *Investment and abatement costs are indicative based on information available for this. Further project specific detailed cost assessments should be done in future to evaluate these metrics with greater accuracy.*
- *Further details on modelling assumptions are available in the standalone report.*

Cluster actions were developed through an iterative and collective process, including substantial stakeholder engagement

Longlist Development	Aggregation of action ideas/concepts from all previous work to create a list of approximately 130 potential action statements.
Preliminary Shortlisting	Initial shortlisting reduced the list to around 80 action statements that were then categorised by technology, action area, timescale, and priority.
Action Aggregation	Development of 17 holistic actions that combined complementary action statements.
Stakeholder Workshopping	Two local stakeholder workshops each analysed the key details of six prioritised actions each to support action development.
Finalisation & Validation	Taking workshop, internal, and external expert review the project partners finalised actions, including assigning priority topics and organisations.

- The actions were developed by partners and assessed holistically to ensure coverage in delivering the key interim milestones to enable Oxford to reach net zero by 2040.
- Actions were shortlisted using, and are tagged by, different characteristics to highlight specific features and challenges that should be noted:

Urgent: Require immediate input to unlock decarbonisation opportunities.

Critical: Fundamentally necessary for Oxford to efficiently reach net zero by 2040.

Collaborative: Numerous stakeholders need to work together in the cluster.

Cost Cutter: Delivers a reduction in the overall cost of decarbonisation.

Easy Win: Low hanging fruit that can be easily and quickly improved.

Long Lead: Initiatives with significant deployment time so require early planning.

Low Regret: Easy options to enable decarbonisation that have limited downside.

Action development was performed in parallel to the Governance work and the development of the Oxford Industrial Cluster structure into three priorty topics:

Energy Supply Infrastructure	Collaborative Financing	Capacity Building

Appendix B – Detailed Action Plan

1 - Support electrification & unlocking of electricity grid capacity constraints

Action Area	Timescale	Priority Topic
Transmission & Distribution	Immediate	Energy Supply Infrastructure

Concept: Decarbonisation of heating systems (both high and low grade) using electricity will require significant additional electrical grid capacity to manage peaks of energy demand and supply. Electrification is a high priority due to space constraints at many of Oxford's industrial sites. This action will gather the necessary data to enable transmission and distribution network operators to develop an investment (Strategic Development) plans and secure the necessary resources to remove existing, and anticipated, electrical capacity constraints - allowing electrification to be the leading method for decarbonising the region.

Implementation Steps:

1. *Local Authorities & ZCOP members (including non-industry) to agree a mechanism and forum, to feed large energy demands into the Oxfordshire Local Area Energy Planning process (LAEP), and onwards to SSEN and National Grid.*
   Pending additional resource
2. *Carry out a review of the new, industry-facing data aggregation and ingestion approach for Distribution Future Energy Scenarios (DFES) development piloted under ZCOP ID, which saw Local Authorities and SSEN gather data from industry regarding their estimated future electricity demand >5MVA.*
3. *SSEN, in line with the Strategic Development Plan (SDP) process, to review data and generate plans to prepare the network for expected electrification, accounting for existing plans in the Cowley region and potential to expand these.*
4. *SSEN to continuously feedback to industrial stakeholders and Local Authorities the SDP outcomes and the pathway to facilitate removal of grid capacity constraints. Continued cycle of demand input and infrastructure assessment through a centralised forum for key energy users, LAEP, councils, and SSEN.*
5. *SSEN and LAs to agree how evidence submitted as part of Infrastructure Delivery Plans can be improved to reflect strategic capacity demands timely and accurately, and how these constraints can be regularly monitored to enable SDP and LAEP reviews.*

Funding Source: Existing funding mechanisms, no additional funding necessary.

Carbon / Cost Saving: Grid investment would unlock significant carbon and cost savings through electrification compared to alternative decarbonisation pathways or inaction.

Synergistic Action(s): Heat network development (5) should alleviate overall grid demand through centralisation of heat supply but will still be a significant point demand to be considered in grid planning, SmartGrid development (2) could reduce the grid impact of industrial electrification, and storage-backed renewable projects (3) – potentially with direct wire PPAs (8) – will reduce grid throughput.

Key Risks: Low engagement with DFES process, incomplete data or poor modelling, delays to crucial grid infrastructure upgrade projects, lack of certainty in future needs can cause unjustified plans which do not meet regulatory hurdle.

Technology

Potential participants: Local Authorities, electricity grid managers and operators, large energy consumers within Oxfordshire region.

2 – Facilitate a SmartGrid demonstration for an industrial sub-cluster or business park

Action Area	Timescale	Priority Topic
Transmission & Distribution	2025-2030	Energy Supply Infrastructure

Technology

Concept: Most large industrial sites or science parks under single ownership outsource operation and control of the electricity supply to SSEN, the Public Network Operator. Changes to the electricity supply are made in collaboration with SSEN who install and maintain all necessary infrastructure. One disadvantage of using a Public Network Operator is buildings are considered individually and receive a power allocation based on their maximum power requirement, rather than the realistic usage of a cluster. The use of SmartGrids, developed and operated by a Private Network Operator, can overcome this, reduce grid throughput, and integrate local renewables and energy storage.

Implementation Steps:

1. *Identify a potential Private Network Operator to partner in a feasibility study into potential Micro/Smart grid solutions available. Encourage seeking funding for the feasibility study from UKRI/LIDP, in partnership with the PNO.*
   Pending additional resource
2. *Assess the industrial clusters/business parks in Oxford to identify the current energy use/cost and generation capacity through tenant engagement to determine a feasible SmartGrid project. Gather tenant support, highlight the key advantages/case studies of SmartGrid deployment utilising the ARC Harwell campus as a leading example.*
3. *The Private Network Operator will communicate with the DNO and install new distribution infrastructure to enable the grid to be operated as a SmartGrid with capacity actively managed and coupled to additional renewable energy sources and on-site battery storage to provide resilience and manage peaks in occupier usage.*
4. *The development may offer a strong opportunity for the demonstration of innovative technologies associated with electric/thermal energy storage, demand side response etc. During development ZCOP should identify opportunities to fund/support such projects identified in other actions.*
5. *Continued monitoring and tenant engagement to quantify the energy/carbon savings and stakeholder savings/concerns to inform future projects.*

Funding Source: All installation CAPEX and ongoing maintenance costs are covered by the PrivateNO and recovered through tariffs on the electricity bills. Some funding may be available from UKIB or similar green infrastructure banks, and coupled innovation projects could apply for grants from Innovate UK.

Carbon / Cost Saving: SmartGrids can lead to long-term cost savings for offtakers by avoiding grid fees and utilising low-cost renewables, which also give carbon savings compared to grid electricity.

Synergistic Action(s): The landlord tenant forum (15) can be used for initial engagement and latterly knowledge sharing. The action should also work as an example for the investigation of as-a-service business models (6) and grid capacity enablement (1). The SmartGrid project could integrate innovative projects (16).

Key Risks: Landlord-tenant relationships, lack of understanding of SmartGrid benefits, long-term energy contracts, grid connections, stakeholder engagement, complex contractual mechanisms between the network operator, landlords, and tenants.

Potential participants: Business park owners, electricity grid managers and operators, Industrial Cluster tenants

3 – Encourage an integrated energy hub project utilising renewables and storage technologies

Action Area	Timescale	Priority Topic
Generation	2025-2030	Energy Supply Infrastructure

Concept: If electrification emerges as the dominant decarbonisation pathway for industrials in Oxford this will require a substantial supply of renewable electrons. However, grid constraints bound the city's ability to import electricity, and space constraints at industrial sites and within the city area limit the potential for on-site generation. This action therefore aims to support energy developers, landowners, and planning authorities to deliver energy hubs containing a mix of technologies (such as solar, wind, and storage) to generate and distribute baseload, renewable energy to industrial offtakers with large electricity demands through a PPA or private wire connection.

Implementation Steps:

1. *Secretariat to monitor relevant electricity capacity and renewable energy hub opportunities through local planning authority, Local Area Energy Planning (LAEP) process, and Planning Policy and Regional Energy Strategy Plan (RESP).*
2. *Engage council officers & in councils to increase awareness of suitable sites, project developers, and technology combinations for energy hubs from LAEPs and other sources.*
3. *Develop outline business case for support engagement to identify feasible projects considering size, viable land in proximity to industrial off takers; whilst also considering energy demand profile.*

   Pending additional resource

4. *Identify funding opportunities such as tenders and green investment sources, where appropriate, and support with business case.*
5. *Liaise with local community and policy representatives to gauge support for renewable energy infrastructure.*
6. *Continue to promote development of energy policy and strategy for creation of new and integrated renewable energy infrastructure. Encourage inclusion of energy infrastructure considerations within renewal of existing policy and planning documentation.*

Funding Source: Government funding for innovative solutions. Private funding, green investment capital, and community energy funding are viable routes.

Carbon / Cost Saving: From renewably generated electricity displacing direct gas use or gas-derived electricity. Direct-wire renewables may offer cost savings than grid.

Synergistic Actions: PPAs may provide backing to access low-cost financing (8,9). Chance to deploy innovative storage/generation technologies in hub (16).

Key Risks: Identifying suitable land, planning permission, creating/monopolising private wire connections, viability of seasonal battery technology.

Technology

Potential participants: Landowners, renewable project developers, infrastructure development providers, local energy plans, major industrial and other electricity users

4 - Investigate the potential for alternate gases to support the decarbonisation of industry

Action Area	Timescale	Priority Topic
Generation	2030 onwards	Energy Supply Infrastructure

Technology

Concept: Oxford's industrial landscape is dominated by low temperature and electric processes which limits the current competitive use cases for alternate gases (notably biomethane or low carbon hydrogen) in industry. To maintain preparedness for continued technological progress in the development of alternative gas solutions, this action is targeted to investigate the function and value of delivering energy supply from sustainable gases to complement / serve as an alternative to widespread electrification. This will benefit those industries with high temperature and complex industrial facilities in the medium-term, with potential for long-term impact in wider industrial uses.

Implementation Steps:

1. *Secretariat to maintain watching brief of alternate gas solutions with purpose of tracking technological maturity, significant infrastructure developments, and policy decisions (such as grid blending of hydrogen).*
   Pending additional resource
2. *Liaise with prospective industrial off-taker(s) to understand the energy demand profile that could be satisfied by alternative gas solutions*; this *should collaborate with other sectors of Oxford's economy (e.g. transport) where alternative gases could play a significant role.*
3. *Develop knowledge, skills and experience in industry and policy planners to be able to take advantage of alternate gas solutions where they become economically viable; such as through a proactive support of feasibility and pilot projects partnering with technology providers, supporting installation of hydrogen-ready equipment, or through designing mechanisms for the provision of low-risk grant-subsidy.*
4. *Identify and engage existing opportunities for alternate gas production to understand their potential to supply low carbon gases to industry in Oxford.*
5. *Promote an openness within policy and strategy to engage with alternate gas technology. Monitor the development of the UK hydrogen industry including the potential for hydrogen in long term energy storage or the utilisation of excess electricity.*

Funding Source: Government funding if novel solutions. Private funding from commercial provider, network operator or offtaker based upon business case.

Carbon / Cost Saving: Unlikely to replace a significant proportion of existing natural gas demand and the associated emissions – some alternate gases will also retain a notable carbon intensity, especially if initially blended with natural gas. May offer carbon and cost saving in longer-term future however it will require commercial maturity of one or more green alternative gases.

Synergistic Action(s): Many alternate gas technologies need innovation to reach maturity so should be monitored through the innovation network (16).

Key Risks: Limited economic viability at present compared to unabated gas/electrification, biomethane supply limitations, biomethane sustainability concerns, future stranded asset risk if cheaper technology options emerge.

Potential participants: Commercial technology providers, gas network operators, industrial offtakers, project developers, landowners where new operational infrastructure is required

5 - Support and engage with the Oxford Energy Network plans

Action Area	Timescale	Priority Topic
Generation	2025-2030	Energy Supply Infrastructure

Concept: Deliver a partnership approach to evaluating potential opportunities to develop a heat network for the South-East Sub-Cluster in Cowley.

Implementation Steps:

1. *ZCOP to continue supporting ongoing work in delivery of sister heat networks (the Oxford Energy Network) in the City Centre and Headington, thereby improving viability of a Cowley scheme, local supply chains and awareness.*
   Pending additional resource
2. *Large industrials (in particular) to directly engage in and provide data for feasibility study exercise to determine viability of low carbon heat network in Cowley.*
3. *ZCOP to support in wider engagement of SME industrials and non-industrial stakeholders in feasibility study.*
4. *At feasibility stage, investigate potential for industrial waste heat sources to provide heat to the network.*
5. *ZCOP or partners to explore potential to couple innovation projects to the deployment of the heat network; such as heat upgrading systems, thermal energy storage and renewable electricity co-location.*

Funding Source: Feasibility study funded by proposers of Oxford heat networks. Capital outlay for heat network funded by proposers and Green Heat Network Funding.

Synergistic Action(s): Heat network will required additional grid capacity (1) but its deployment will reduce total grid capacity upgrades required considerably. SmartGrid demonstration (2) and integrated energy hub could/should include heat network (if Energy Centre nearby) for load balancing (excess electricity can run heat pumps on time of use tariffs). Action 8 and explore H(eat)PA that would aggregate heat demand and make it easier to achieve Financial Close Local Supply Chain (14).

Key Risks: Large industrials not forthcoming with data; lack of engagement with project; project unable to reach financial close; land availability; grid capacity availability; disruption

Technology

Potential participants: Local Authorities, energy network developers & operators, large industrials, community energy social enterprises, major heat consumers from other sectors

6 - Facilitate aggregate models, including energy ‘as a service’

Action Area	Timescale	Priority Topic
Funding & Financing	2025-2030	Collaborative Financing

Technology

Concept: Aggregation approaches can overcome barriers to decarbonisation technologies. An ‘as a service’ model means partnering with low carbon technology providers to install, where upfront costs of heat pumps or renewables can be paid from savings made. A standardised approach can offer industrials a cost effective solution.

Implementation Steps:

1. *Review established UK aggregate models, including any Partnership Frameworks, governance structure with decarbonisation and renewables providers.*
2. *Engage on aggregation, particularly energy as a service and bulk buy via Heat Pump Summit run by Green TV in Oxford, ZCOP partners, and Oxfordshire County domestic PV trial.* **Pending additional resource**
3. *If funding resource allows consider piloting aggregation approaches for ‘as a service’, bulk buying, and power purchase agreements.*
4. *Encourage partners to develop framework for standardized service delivery, endorsing as appropriate to enable customer confidence.*
5. *Be aware of outputs from pilot deployments with early adopters and any case studies to clearly outline the business case and decarbonisation benefits to future users. An example includes Solar Together (for bulk buying).*
6. *Identify industrial sites, and players in other sectors to aggregate a critical mass of demand to encourage solutions enabling landlords and industrial/commercial tenants to access benefits.*

Funding Source: The project will need to first explore appetite of ESCOs for the capital cost and proposed commercial models. Technology providers may need financial support (potentially from the local authorities) to underwrite where there is financial capital risk of upfront deployment. The CAPEX costs could also be supported by philanthropic organizations/funds or Government (DESNZ) funding.

Carbon / Cost Saving: If the aggregate models allow earlier adoption of decarbonisation technologies this would provide a significant carbon saving. The CAPEX cost saving will be crucial for many of the SME industrials in Oxford.

Synergistic Action(s): Clear potential to work alongside, or within as a procurement mechanism. Create demand to allow investment in local skills (13) and supply chain (14).

Key Risks: External partners introduce uncertainty, revenue shortfalls due market (electricity price) fluctuations can affect profitability, poor performance leading to customer dissatisfaction and contract termination, long contracts for industrials/landlords to commit to.

Potential participants: Local Authorities, SME industrials, technology developers & installers, finance providers, other sectors that require similar technologies

*Upfront funding of heat pumps and on-site renewables, which then paid back over time by the savings created.

7 - Facilitate technology bulk buying/portfolio schemes

Action Area	Timescale	Priority Topic
Funding & Financing	2025-2030	Collaborative Financing

Concept: Bulk purchase of low carbon technologies can overcome challenges of scale and limited skills within Oxford's SME landscape. By aggregating demand for decarbonisation technologies, bulk procurement becomes possible for heat pumps and solar PV, exploring synergies with commercial, institutional, and domestic sectors.

Implementation Steps:

1. *Review established UK aggregate models, including any Partnership Frameworks, governance structure with decarbonisation and renewables providers.*
2. *Engage on aggregation, particularly energy as a service and bulk buy via Heat Pump Summit run by Green TV in Oxford, ZCOP partners, and Oxfordshire County domestic PV trial.* **Pending additional resource**
3. *Research and engage with examples of similar demand aggregation and portfolio development schemes to understand key challenges and benefits; this should include ongoing engagement with the investor community to identify parties who could support portfolio development/demand aggregation approaches.*
4. *Arrange for implementation, monitoring of progress, and addressing portfolio development as a key pathway to manage risk, bundle opportunities, and enable investment.*

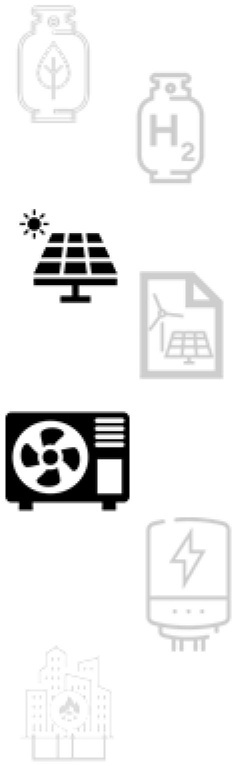
Funding Source: Portfolio/project financing could be provided by a range of institutional/green investors. The action should also investigate potential complementary funding sources such as grants, loans, or contributions from participating SMEs. Green Prospectus/100Together is a potential investment route.

Carbon / Cost Saving: Aggregated purchasing should lead to cost reductions from purchasing power and economies of scale/replicability benefits.

Synergistic Action(s): As-a-service business models (6) could be used as part of the portfolio/aggregation approach, aggregated procurement could be used to incentivize skills and supply chain development (13,14).

Key Risks: Relying on a few suppliers may limit options and increase vulnerability. Lead time risk to deliver larger projects. Skills and supply chain constraints. Standardization challenges for use cases in complex industrial applications. Conflicting procurement requirements/priorities.

Technology



Potential participants: Local Authorities, SME industrials, technology providers, aggregation intermediaries , financiers,other sectors that require similar technologies

8 – Facilitate an approach to aggregate PPA demand, enabling a collective PPA model with small offtakers

Action Area	Timescale	Priority Topic
Funding & Financing	2025-2030	Collaborative Financing

Concept: The large majority of industrials in Oxford are not able to access PPAs due to the standard scale and longevity of these contracts, which often underpin the development of national scale large wind farms or solar arrays. To support Oxford's industrials to access renewable electricity, beyond the limits of on-site deployment, the contractual purchase of clean energy will be necessary until the grid decarbonises.

Implementation Steps:

1. *Review established UK aggregate models, including any Partnership Frameworks, governance structure with decarbonisation and renewables providers.*
2. *Engage on aggregation, particularly energy as a service and bulk buy via Heat Pump Summit run by Green TV in Oxford, ZCOP partners, and Oxfordshire County domestic PV trial.*
   Pending additional resource
3. *Investigate previous examples of aggregated PPA demand and engage with developers/offtakers to understand the key risks, benefits, and solutions available for this pathway.*
4. *Engage industrials with existing PPAs or renewable energy purchasing to understand their potential interest in using a demand aggregation mechanism to support and access local renewable supply. This should also extend to other sectors of Oxford's economy with significant electricity demand.*
5. *Support the creation of the project partnership structure between suppliers and offtakers (and potentially the T/D grid if not a direct wire).*
6. *Ongoing review of the national grid decarbonisation to understand the necessity of continued renewable electricity purchasing.*

Funding Source: No upfront funding is required from industrials, and the use of a PPA could result in reduced electricity bills (especially direct wire opportunities). Aggregated PPA demand from the diversity Oxford's industrials (and potentially other local large energy consumers) could provide crucial financial underpinning for local renewable development projects by providing offtakers to secure the business case and financing for these projects.

Carbon / Cost Saving: *If quantified already in the project*

Synergistic Action(s): This action could underpin some of the business case for the integrated energy hub (3) and be used as an opportunity to upskill the local workforce and supply chain (13,14).

Key Risks: Contractual complexity, long-term uncertainty, electricity price variability invokes market risk.

Technology

Potential participants: Local Authorities, industrials, renewable energy project developers, community energy social enterprises, other sectors that require similar power supply arrangements

9 - Support industrials to win public and private investment

Action Area	Timescale	Priority Topic
Funding & Financing	2025 onwards	Collaborative Financing

Technology

Concept: Decarbonising Oxford's industrial sector will require addressing significant financial and structural barriers to providing investment. Market-ready technologies such as wind and solar may need to be supported for deployment at scale to meet industrial energy demand. Many decarbonisation technologies are still maturing as such may struggle to justify investment by industrial actors as a purely commercial business case. Removing barriers for technology providers, clearly communicating the local challenges and needs of the industrial sector, and fostering innovation are crucial for building confidence in both public and private investment.

Implementation Steps:

1. *Utilise mapping of SMEs, technology providers and investors conducted under the LIDP to aggregate industrial funding requirements and understand funding gaps.* **Pending additional resource**
2. *Actively engage investor communities to understand the key factors required to attract investment such as risk mitigation, scalability, and return on investment. Collate data and project information to support regional initiatives such as OxLEP's Green Investment Prospectus.*
3. *Develop an investor deck showcasing the region's excellence in supporting decarbonisation; emphasize that Oxford(shire) is ahead of other local authorities by highlighting its skills, personnel, expertise, and track record within key organizations (e.g., OCC/ZCOP) that support projects.*
4. *Provide support for SMEs on business rate exemptions for eligible machinery, renewable energy & storage, and a 100% relief for eligible low carbon heat networks.*
5. *Offer bid support activities and coordination to empower industrials, SMEs, and technology developers to identify and access optimal funding and financing solutions, such as expected cluster focused IUK/DESNZ funding in 2025. Including template materials for strong government (and private sector) funding bids.*
6. *Define ongoing structure to inform, engage and amplify combined local and regional voice of industry. Feed industrial position into policy and strategy at local and national level including local area energy planning, green prospectus and UK decarbonisation strategy for formal recognition of needs.*

Funding Source: National/local government funding bodies, Venture Capital, Private Equity, Community, or industry investment. The Oxford Industrial Cluster should also investigate the potential to work with the Green Prospectus/100Together to deliver a potential investment route.

Carbon / Cost Saving: Using appropriate funding and financing mechanisms can save substantial cost for industrials in Oxford and enable earlier deployment of decarbonisation projects leading to cumulative carbon savings.

Synergistic Action(s): Knowledge share and stakeholder matchmaking are crucial in identification of funding and formulation of compelling case studies (11) that can be used to promote investment opportunities. Other financing/funding/procurement mechanisms (6,7,8) should interact here too.

Key Risks: Data sharing amongst industry and associated partners. Funding administration of collective group and associated promotional activities.

Potential participants: Local authorities, industry representatives, local and national funding bodies, investors and brokers, private equity and co-operatives

10 - Investigate the potential medium-long term role of carbon offsetting

Action Area	Timescale	Priority Topic
Funding & Financing	2030 onwards	Collaborative Financing

Concept: Carbon offsetting may offer opportunities for Oxford industrials to accelerate and reduce the cost of decarbonisation, access new funding pathways, compensate for residual emissions, and voluntarily offset current emissions. The use of carbon offsetting/crediting is increasingly scrutinised by the sustainability community to prevent issues with poor quality credits that do not represent a complete tCO_2 and the irresponsible use of credits which could potentially delay direct decarbonisation. Offsetting is likely to be most beneficial for those industrials hard-to-abate emissions or significant, long-term techno-economic barriers to decarbonisation, which in Oxford Cluster is a small proportion of emissions

Implementation Steps:

1. *Secretariat to review and revise 2021 ZCOP statement on offsetting and signpost interested partners to this resource.*
2. *Encourage interested partners to seek reputable carbon credit registry to procure high integrity (removal) credits for compensation, also to look to aggregate demand and procure on behalf of an industrial cluster. This will include a review and update of the existing ZCOP best practise on offsetting and could include the organisations of a session on the topic, based on partner demand.*

   Pending additional resource
3. *If appropriate, encourage Councils to review their own credit portfolio to achieve net zero ambitions; helping to compensate for dispersed SME industrials that have been unable to technically or economically decarbonise.*
4. *If feasible, foster partner investigation into potential for CCU within Oxford, both the availability of high purity emission streams and utilisation demand from existing or emerging, innovative sectors.*

Funding Source: Industrials will fund the eventual procurement of credits to offset residual emissions. A feasibility report would likely need additional government funding.

Carbon / Cost Saving: Offsets are likely to only be required for residual emissions in 2040, modelling suggests this could be 6-30 $ktCO_2$/year in 2040 depending on the rate of decarbonisation . Current credit prices are £1-20/tCO_2 generally reflecting a split between avoidance and removal credits. High-quality removal credits can demand >£100.

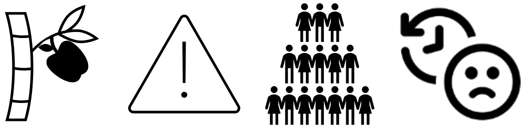
Synergistic Action(s): Feasibility report could feed into the knowledge sharing program (11).

Key Risks: Reputation risk from use of low-quality credits or improper claims/use. High integrity credits may be expensive.

Technology

Potential participants: Local funding organisations or schemes, industrials, carbon offsetting providers or standards or registries, other sectors that require credits

11 - Champion extensive knowledge sharing on industrial decarbonisation



Action Area	Timescale	Priority Topic
Knowledge Sharing	2025-2027	Capacity Building

Concept: This project has identified a sharp discrepancy between industrial organisations with good carbon literacy who have set reduction targets and explored decarbonisation technologies and those with limited knowledge of either the imperative or options for decarbonisation. An extensive knowledge-sharing programme will upskill and level the playing field so that all industrial organisations in Oxford have a base understanding of carbon emissions and hotspots with their organisation, decarbonisation routes and technologies, and where to access guidance and support.

Implementation Steps:

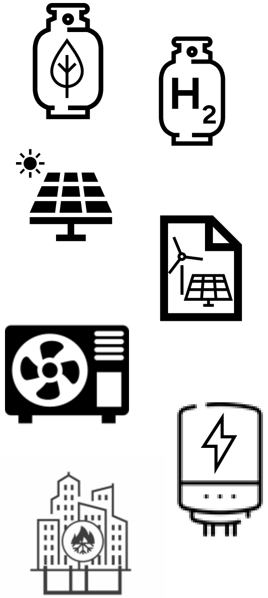
1. *ZCOP will continue to publicise and utilise the work from this project in existing engagement and any further consultation with industrial organisations in Oxford.*
   Pending additional resource
2. *Support interested partners to consider developing an industrial decarbonisation knowledge-sharing plan based around a centralised Cluster including training opportunities, successful case studies, engagements and funding opportunities and include an outreach campaign. The plan can work with local colleges like Abingdon and Witney College and Activate Learning as well as developing a list of mentors who have successfully decarbonised and encourage them to have 1-2-1 conversations with those starting the journey. Utilise Knowledge Transfer Partnerships with Oxford's universities to expand routes to decarbonising hard-to-abate processes. Finally, the plan can explore a kitemark/certification scheme for SMEs undertaking decarbonisation measures to reward efforts/hitting certain milestones, encouraging more uptake and visibility.*

Funding Source: Local authority funding and industrials (through membership of the Oxford Industrial Cluster) are the most likely sources of funding for this program.

Synergistic Action(s): Knowledge sharing can help to raise awareness of funding and financing proposals (6-10) and act as another forum to discuss innovation support (16).

Key Risks: Lack of SME engagement, financial constraints/lack of funding, coordination challenges.

Technology



Potential participants: Local Authorities, community energy social enterprises, low carbon technology business networks, decarbonisation skills providers

12 - Continue to expand delivery of energy audits and efficiency advice projects

Action Area	Timescale	Priority Topic
Funding & Financing	2025-2030	Capacity Building

Concept: Many SME industrials in Oxford still struggle to understand their own energy demand and therefore the opportunities for efficiency or decarbonisation projects to deliver both financial and carbon benefits. Oxford already has an active ecosystem of organisations supporting commercial/institutional/industrial players to undertake energy assessments (audits) and identify project opportunities, led primarily by Low Carbon Hub (LCH). Nevertheless, further integration, capacity, and funding of these services can accelerate decarbonisation of Oxford's industrial cluster.

Implementation Steps:

1. *Support existing energy assessment provision by promoting available opportunities and ensuring data permissions are in place so that information and outcomes can be shared between key institutions working with industrials with the city whilst GDPR is met.*
   Pending additional resource
2. *Identify routes to funding to increase the scale of energy assessments, such as those provided by Energy Solutions Oxfordshire (ESOx), for industrials and related organisations.*
3. *Work closely with capacity and knowledge available through ESOx to develop a framework for identifying, delivering, and monitoring assessment impacts. Feedback from post assessment action can be presented as case studies with return on investment figures, where possible, as well as organisation's satisfaction with installers.*
4. *Consider funding for a new energy technology expert role to actively support organisations with implementing energy recommendations, such as energy monitoring, improved management, etc., including low and no cost actions, to speed uptake of efficiency measures.*
5. *Encourage the cluster to use available energy data to refine baseline and develop long term support to implement recommendations.*

Funding Source: LCH is using its own community benefit funding to expand ESOx assessments, supplemented by UK SPF funding from most District Councils. A medium-term ambition would be to find a sustainability funding mechanism from other sources to deliver audits; this could be the industrial contributing or pre-selected technology providers covering the assessment cost.

Carbon / Cost Saving: Work by LCH indicated that energy management and efficiency projects can save SME sites up to 19% of their energy demand and associated emissions.

Synergistic Action(s): Contribute to knowledge sharing regarding energy efficiency (11), support identification of potential use cases for innovative solutions (16), and audits could also act a key mechanism to join up and promote the financing solutions identified (6-8).

Key Risks: Lack of qualified auditors, data quality and accuracy, limited return on investment, regulatory uncertainty, landlord-tenant relationships.

Technology

Potential participants: Local Authorities, providers of quality energy audits, SME industrials, other sectors that require similar support with low carbon technologies

13 – Encourage a local framework for low carbon technology industry entrants and re-trainers

Action Area	Timescale	Priority Topic
Skills & Supply Chain	2025-2030	Capacity Building

Concept: The training programmes in the industry are currently fragmented, with limited visibility and inconsistency in formalised pathways, like the MCS-accredited programs. Additionally, salaries for apprenticeships are not attractive enough for individuals entering the workforce later in life. Companies are reluctant to train to new low carbon technologies as they don't see much customer demand and training new employees invokes some time-consuming paperwork. Oxford City Council and ZCOP are well-placed to create a framework for supporting new entrants and re-trainers looking to become heat pump and solar PV specialists – including both applications for the installation of new technologies and preparing for the expected growth in demand for maintenance of these technologies as they are deployed at scale.

Implementation Steps:

1. *ZCOP will continue to publicise available training through appropriate communication channels as well as, where appropriate, highlighting career opportunities in the sector and showcasing skills success stories to inspire potential entrants.*
   Pending additional resource
2. *Encourage the Oxford Industrial cluster to work with local colleges to ensure students have hands-on training by investing in technical equipment or through industry partnerships and identify potential funding and knowledge/experts to support training programmes.*
3. *Motivate partners to investigate a potential salary support scheme (3 to 6 months) for older apprentices and re-trainers or a bursary or low/zero cost loan system to assist individuals or companies with the costs of training, MCS accreditation, other administrative tasks, and the potential lost revenue from attending training or taking on the additional work required to upskill a new employee.*

Synergistic Action(s): Skills development will be crucial in delivering the technologies at scale as envisioned by the funding and financing actions (6,7). Some aspects of the skills training could also overlap with the knowledge sharing ambitions (11).

Key Risks: Rapid market growth may lead to poor-quality installations by insufficiently trained installers. Poor quality installations may deter other businesses from adopting the technology.

Technology

Potential participants: Local Authorities, local colleges and other skills providers, technology installers,other relevant organisations addressing skills development

14 – Advocate local supply chain engagement

Action Area	Timescale	Priority Topic
Skills & Supply Chain	2025-2030	Capacity Building

Concept: The current supply of low carbon technologies in Oxford is limited, making it challenging for customers to find qualified andcertified installers. The market is dominated by SMEs, and these companies face additional challenges in expanding due to recruitment difficulties, limited access to financing, and uncertainty in the demand. Moreover, the supply chain is heavily reliant on imports, which create vulnerabilities, extend lead times and raise ethical concerns around sourcing practices. Through targeted actions, the Oxford City Council could actively support local installers, stimulate customer demand, and in the long term promote the development of local manufacturing.

Implementation Steps:

1. *Secretariat to signpost interested partners to collaborate, share best practice in local supply chain issues, and identify mutual opportunities for support. This could lead to a collective procurement scheme, encouraging companies in the region to participate in joint purchasing for solar PV installations. It could be coordinated through a local wholesaler (for example Ultimate Renewables in Bicester) who will understand the international supply chain as well as local issues.*
   Pending additional resource
2. *Collect, where possible, information on local businesses that plan to adopt heat pumps or solar PV to demonstrate actual customer demand.*
3. *Encourage the Cluster to investigate options to create local incentives (grants) for SMEs exploring domestic manufacturing opportunities and identify support for businesses trying to start or expand their production capacity. Cluster partners could lobby the UK government for policy interventions and investments.*
4. Motivate the Cluster to continually assess procurement priorities through existing networks and targeted outreach, such as surveys, to understand shifts in supply chain demands (from manufacturing to wholesalers) to enable rapid decarbonisation.

Synergistic Action(s): Supply chain engagement will be crucial to understand the availability and interest to support aggregated procurement schemes (6,7) and support renewable energy hub development (3).

Key Risks: Slow uptake of local businesses, coordination challenges, insufficient manufacturing capacity, cost competition from international competitor with cheaper labour/energy costs.

Technology

Potential participants: Local Authorities, enterprises supporting businesses, technology developers, supply chain bodies, technology wholesalers,other relevant supply chain organisations

15 – Support a local landlord-tenant forum

Action Area	Timescale	Priority Topic
Knowledge Sharing	2025-2030	Capacity Building

Concept: Much of Oxford's industrial community operates in rented buildings or business park complexes owned by commercial landlords. The project has revealed several barriers this can place in the path of decarbonisation. To help overcome these barriers this action will set up a landlord-tenant forum to share experiences and suggestions. One key activity will be to investigate the potential for co-investing and benefit sharing between landlords and tenants based on the deployment of low carbon technologies, including where third-parties may operate shared infrastructure within business parks; such as heat network or Private Network Operators.

Implementation Steps:

1. *ZCOP will engage stakeholders via a property owner and tenant event addressing barriers to decarbonisation and solutions, such as the Green Leases Toolkit from the Better Buildings Partnership.*
   Pending additional resource
2. *Promote solutions to owners and tenants, particularly among industrial parks, by collaborating with relevant stakeholders and sharing best practice.*
3. *Make use of existing resources and / or seek expert advice (i.e. legal) to develop a set of green lease clauses that could be adopted by landlord/tenants building on similar work developed by the Better Building Partnership over the last few years.*

Funding Source: Government or philanthropic grants. The forum could also consider charging a nominal membership fee to participating landlords and tenants.

Synergistic Action(s): The forum can act as a key messaging tool for several of the other actions that look to support industrials SMEs on funding (6-8) and to support other deployment projects (2,3,5).

Key Risks: Lack of participation, Conflicting interests, Regulatory uncertainty, Financial constraints, Technological limitations, Data Sharing reservations

Technology

Potential participants: Landowners, business parks, industrial tenants, and other relevant organisation supporting sustainable via leases, etc.

16 – Support an innovative technology register and network

Action Area	Timescale	Priority Topic
Knowledge Sharing	2025-2030	Capacity Building

Concept: Develop a live, public, local, and emerging electrification technologies register to developers at early TRLs allowing continued monitoring and matchmaking them. Build on Oxfordshire Greentech's existing innovation network with universities, tech developers, investors, and undertake match-making with industrials for demonstration projects of emerging electrification technologies.

Implementation Steps:

1. *Continue ongoing networking events for the zero-carbon innovation community with presentations on emerging technologies and matchmaking opportunities.*
2. *Work with Oxfordshire Greentech to understand current provision and what could be added, and with related innovation networks like Cambridge Cleantech and the Climate Tech Supercluster to expand the reach to innovators and investors beyond Oxford. Explore launching an Industrial Special Interest Group.*
   Pending additional resource
3. *Engage others supporting local innovation e.g. Oxford University Innovation, the science parks, Oxford Science Enterprises, angel networks. Work with them to identify emerging companies/solutions.*
4. *Develop and publish a challenge statement(s) from the final ZCOP ID report to identify innovation needs from the industrial sector.*
5. *Design the frame of the register, a location to host it, and the management structure to triage applications. The register needs sorting criteria to help industrials/investors identify what is relevant to them, e.g. TRL, technology type, service type, what the innovator needs (data, demos, funding etc.), applicable industrial sectors etc.*
6. *Identify what industrials could offer to innovative companies i.e. data, overview of physical assets, business and technical support, demonstration/testbed sites.*
7. *Enable matchmaking through Meet the Buyer days to support the undertaking of pilot projects and monitor success of technology implementation. Publish case studies/success stories.*

Funding Source: Events and register maintenance could be funded by a membership/events fees for those participating in the Oxfordshire Greentech network/*Special Interest Group*. Additional funding will likely be required to establish the register, this could be from Innovate UK funding or other local/national schemes.

Synergistic Action(s): Knowledge sharing on innovative solutions (11,15), potential to deploy projects with microgrid feasibility pilots (2), heat network deployment (5), or integrated energy hub (3).

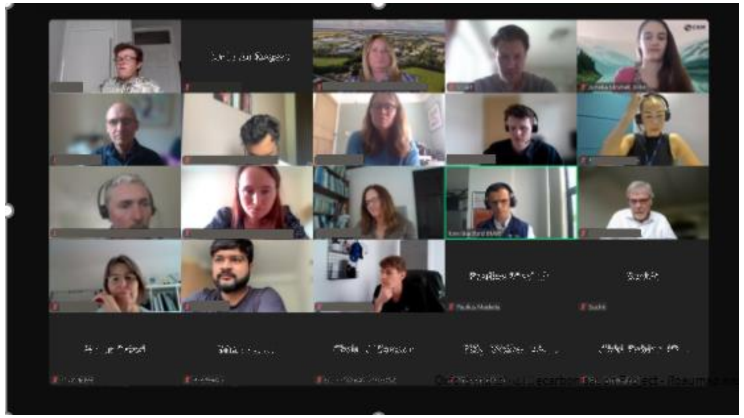
Key Risks: Insufficient market supply of electrification technologies locally, particularly if industrial challenges are not well articulated to the market. Insufficient facilities/space to act as a testbed for new technology. Ongoing low risk appetite from the investment community for climate tech hardware. Funding for the network/register - limited available from local government and innovators.

Technology

Potential participants: Local Authorities, innovation business networks, research & innovation institutions, science parks, industrials seeking innovative solutions

Appendix C – Stakeholder Engagement

Workshops



Workshop I

Project kick off

26th March

Online workshop

We introduced the project and made initial connections with local industry and key actors. We also informed the early-stages of roadmap development by gathering insight on the scope of industries, emissions and decarbonisation options to be included.

Workshop II

Baseline, techs and modelling

25th April

Online workshop

We gathered feedback on the latest baseline assessment of Oxford's industrial energy demand and emissions. We also collected insight on scenario development to ensure representative and useful output.

Workshop III

Skills & Supply Chain

20th June

In-person workshop

We presented the local/national context for green skills & supply chains, and interrogated existing challenges/barriers. We then gathered feedback on their implications for meeting targets, and potential solutions.

Workshop IV

Funding and finance

1st July

Online workshop

We highlighted the financial opportunities associated with decarbonisation technologies and assessed investor and fund expectations for supporting projects. We also discussed local financing barriers and potential solutions.

Workshop V

Systems modelling

11th July

Online workshop

We gathered feedback on early results from scenario analysis, discussing feasibility and impact on Oxford's energy system. We also collected opinions on a proposed third hybrid scenario.

Workshop VI

Action Planning

5th September

In-person workshop

With key stakeholders, we assessed six project ambitions and, through this, established and prioritised key actions for the decarbonisation of Oxford's industry. We also identified future collaboration opportunities for Oxford's organisations.

Workshop VII & VIII

Action Planning follow-ups

24th September + 15th October

Online workshops

We explored the actions raised in the previous workshop in more depth. We prioritised 12 actions to discuss and flesh out with key stakeholders. This helped us to prepare the action plan for validation from a wider stakeholder ecosystem.

Workshop IX

Action Validation

19th November

Online workshop

We presented and gathered feedback on the project's key findings and proposed action plan. In breakout sessions, we conducted more thorough investigations into each action, before presenting updates on the future of the Industrial Cluster.

Networking events

15th May, MINI PLANT OXFORD

In this networking event, we introduced a broad ecosystem of individuals and organisations to the project. Presentations from Oxford City Council and BMW Group gave an overview of the project and its implications for Oxford's industries. We also showcased a diverse range of relevant climate solutions through an exhibitor carousel and facilitated strategic connection-building and collaboration.

22nd November, MINI PLANT OXFORD

In this networking event, we presented key project findings and outputs to a variety of key stakeholders and situated the project in the context of wider local and national action. We hosted a panel discussion with senior leaders to consider project implications and collaboration opportunities to action net zero. We also presented updates on the future of ZCOP and the Industrial Cluster, including the county-wide expansion.

Site visits

Exchange visit, 7th March

In this exchange visit, we explored the key project sites and identified initial opportunities from a geographic proximity perspective. We also detailed the plans and challenges to decarbonisation for each site, while identifying possibilities for collaborative action both during the project and after.

Chelveston Renewable Energy and Innovation Park, 19th Sep

In this site visit, we were introduced to the site, its role in industrial decarbonisation and innovation, and local energy planning and policy. We learnt about their wind and solar energy production, battery energy storage and hydrogen strategy, while exploring potential future collaboration and knowledge exchange opportunities.

Learnings

Discrepancy of carbon literacy within the cluster. An ongoing challenge for the next stage of this project will be how to communicate about decarbonisation action going forward, bearing in mind that large businesses like MINI Plant Oxford and Unipart Logistics have dedicated environmental sustainability resource with comprehensive carbon reduction plans, whereas many SMEs in the city will be aware of the need for decarbonisation but without the knowledge or policy/funding impetus to create a carbon reduction plan. Multiple targeted forms of messaging for different stakeholder types may be required.

Landlord tenant disincentives. Many SMEs in the city don't own the building they're sited in, making carbon reduction measures difficult for both tenant and landlord. For landlords, retrofit measures / renewable energy generation capacity would often not accrue as a benefit to them, with tenants being the ones to save money on their energy bills. But equally, tenants are not incentivised to push for carbon reduction measures as their tenancy period might be short-term. A tenant-landlord forum is one of the identified actions from the action plan; this will be critical to better understanding commercial dynamics and exploring different mechanisms to incentivise carbon reduction on both sides.

Harder to engage SMEs (particularly B2B) – decarbonisation not seen as a priority. We had good engagement from project partners, Oxford Science Park and other larger organisations within the city, but struggled to engage smaller businesses. We had some good interactions with SMEs in the B2C space i.e. we gave free energy assessments to a coffee roastery, a brewery, and a bakery. But other SMEs, particularly in the pharma and healthtech space, were difficult to engage. Despite multiple emails, contacts via LinkedIn direct message, and phone calls, several SMEs didn't engage at all, or some who responded let us know they felt they couldn't engage because they were too busy.

Energy assessments not as popular as anticipated. Despite what was considered a valuable offer to under resourced businesses, we struggled to find enough SMEs interested in taking up the offer, possibly due to lack of policy direction and customer demand for change. Many of those that did engage were already thinking about sustainability and had started taking carbon reduction measures – a case of "preaching to the converted".

Appendix D – Case Studies

BMW Group's MINI Plant Oxford is the cities major industrial emitter and focussed on decarbonising it's operations

MINI Plant Oxford is a major automotive manufacturing facility located in Oxford, England. The plant has a long history having first opened its doors in 1913. Over the past century, the facility has played a crucial role in the production of iconic Mini vehicles.

Today, **MINI Plant Oxford employs over 3,500 people**, making it a significant employer in the local region. The plant is responsible for the production of a wide range of Mini models exporting them all over the world.

The facility utilizes state-of-the-art manufacturing processes and technologies to ensure the high quality and efficiency of its vehicle production. With its rich heritage and skilled workforce, MINI Plant Oxford continues to be a vital component of the BMW Group's global automotive operations.

Parts of the Assembly Building at MINI Plant Oxford are over 100 years old and the roof spans over 82,000 square metres. To improve the efficiency of this building, **works are currently taking place to insulate the roof and a new heating system is being installed**. Combined, these measures will **reduce energy costs by almost 50%,** while conserving an integral part of the Plant's long-standing history.

The Body Shop has a roof-mounted solar array and when it was first installed in 2014 it was one of the largest in the UK. The photovoltaic system comprises of **11,500 solar panels, covering 20,000 square metres** (equivalent to five football pitches), generates the equivalent of the **electricity consumption of over 930 households, and reduces the annual carbon footprint by around 1,500 tCO_2e.**

UNIPART

Colleagues	Turnover	CO2 reduction	Postcode	Science Based Targets	Net zero
12,500	£1,047.9m	9%	OX4 6LN	Near-term, Net-zero	2040

Cowley DC

BSI ISO 14001 Environmental Management CERTIFIED

BRITISH SAFETY COUNCIL Globe of Honour 2022 Winner

860,000 Sq Ft

24/5 operations

300 colleagues

12 clients

Advanced Supply Chain Institute

Supporting Research Projects from Oxford Brookes: Top 5 transformation for a sustainable automotive supply chain at Unipart Logistics.

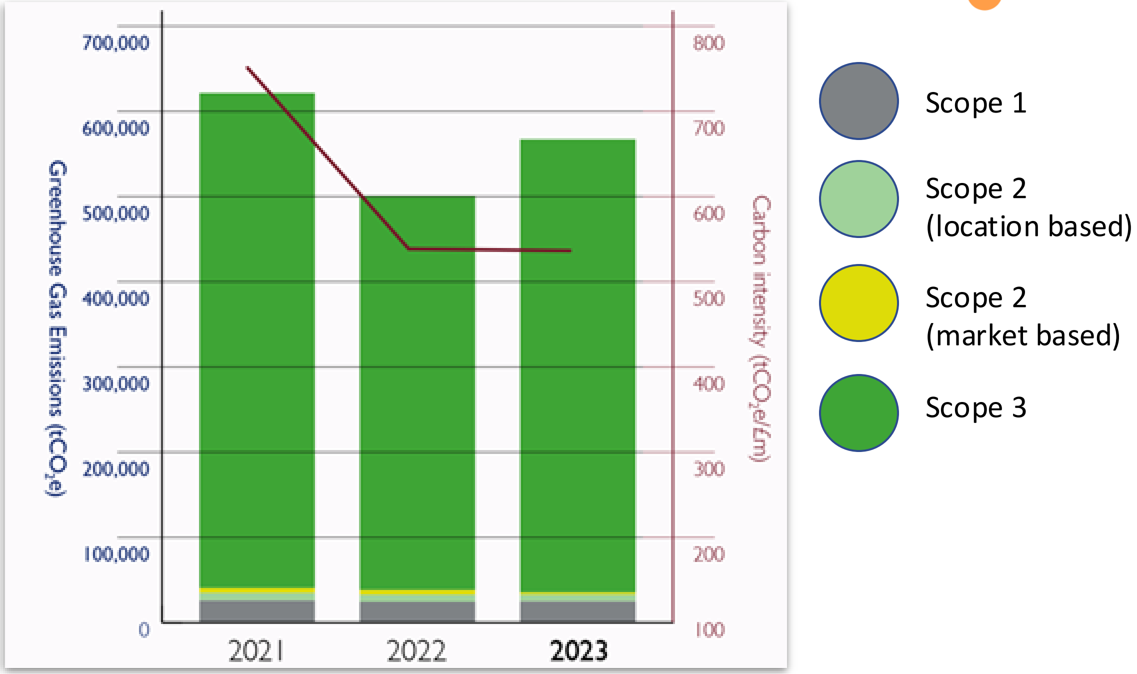
To date Unipart has reduced:

9%

of carbon dioxide equivalent (tCO2e)

4,253 tonnes of carbon dioxide equivalent in Scope 1 and 2 operations

49,212 tonnes of carbon dioxide equivalent in Scope 3 emissions



- **Forward and reverse logistics processes** across 12 clients
- **Green electricity** (546,941 kWh annum, no carbon) and **procured green gas** (513,813 kWh annum, 132.6tCO2e)
- **Consumption reduction targets** of 10% (electricity) and 5% (gas). Cowley **saved 96tCO2e in 2023** by reducing gas consumption by 42%, and reduced this by a further 29% in 2024.
- Key process for energy use is **space heating, lighting** and some **biomass used for heating**
- **Submetering** installed on site projected **12% of energy savings in 2024.**
- **3 day Green Overdrive** event took place in June 2024 to **educate colleagues** and develop **environmental opportunities**

UNIPART OUR CARBON PLEDGE RACE TO ZERO

Seacourt Printing demonstrate the viability of decarbonising industry in Oxford

Seacourt
Planet Positive Printing®

Seacourt offers **printing services**, operating from the Horspath Road Industrial Estate and employing 28 persons. The key process for energy use at the site is printing, but the site uses electricity for lighting, cooling and office equipment, as well as printing machinery.

Seacourt's annual electricity consumption is 189 MWh, in addition to the 36 MWh generated through their own solar PV. Seacourt switched to **100% renewable energy procurement** back in 2003, powering the business **with wind, solar, wave and biomass energy**. Switching to renewable energy saves **709 tCO_2** annually.[1] **They have no gas usage on site**.

Seacourt also uses electric or hybrid company vehicles, which they calculate saves 17 tCO_2 per year.[2]

99.3% of their carbon impact is within their supply chain, but through Climate Impact Partners, **Seacourt offsets 105% of their supply chain's environmental impact**.

- Seacourt's annual Scope 1 emissions - direct emissions from owned, leased or directly controlled mobile sources - total **8.4 $kgCO_2e$.**
- Seacourt's annual Scope 3 emissions total **1,199 $kgCO_2e$**.

Seacourt also **invests in carbon reduction projects** that benefit local communities, e.g. Gyapa cook stoves.

Seacourt's Gareth and Nick Dinnage win a prestigious Queen's Award (Image: Seacourt)

Looking forward: Seacourt are testing a **regenerative business model** with Oxford University and sustainability consultancies, considering environmental impact beyond carbon emissions. They also are planning **to install showers and secure bike parking** so more employees can cycle to work, as well as change **all company vehicles to full electric**, and **use cycle couriers** for Oxford customers. Since the majority of their carbon footprint is from Scope 3 emissions, they are also **engaging with their suppliers about renewable energy** and other sustainability strategies.

[1,2] Seacourt-Magazine-Issue-2.pdf (oxfutures.org)

ARC Oxford represents a vision to develop sustainable hubs for science & innovation to catalyse sustainable industrial growth

ARC (Advanced Research Cluster) Oxford is an 88-acre Campus with over 50,000m² of commercial space used by 30 science & innovation businesses, representing a workforce of 3,500 employees in 2023.

By 2030, ARC Oxford is anticipated to double in size, reaching 100,000m² and 7,000 employees. This will significantly impact its **energy demand, increasing from 8–10 GWh/year to an estimated 20–24 GWh/year** as it welcomes more organisations with higher energy needs for advanced sciences.

ARC is aiming to transition its built environment towards Net Zero with a focus on limiting the upfront embodied carbon of its new developments and by cutting operational carbon emissions from its property portfolio. The **main challenge is to phase out fossil fuel as primary energy source for space heating through electrification**, while minimising base building energy demand by applying a Fabric First approach and incorporating Low & Zero Carbon (LZC) technologies at both building and Cluster level.

A Refurb & Retrofit programme has allowed ARC to improve energy performance of its exciting assets, and new developments will be aligned with the highest industry standards. However, deep decarbonisation of ARC Oxford will require strong partnership and collaboration with the science & innovation businesses operating within its buildings.

Existing solutions and emerging innovative technologies will have a key role to play, including but not limited to: **solar car ports, off-site solar generation with private wire connection, privatised distribution network (SmartGrid), and the connection to a heat network**.

ARC Oxford newest development: The Ascent. *An all-electric, BREEAM Excellent lab-enabled building designed to achieve a 40% reduction in operational carbon emissions compared to current building regulations and seeking to meet Planet Mark certification embodied carbon limit of 600kgCO_2e/m².*

ERM

For information on this report,
please contact the authors at:
silvian.baltac@erm.com

For information on the project,
please contact ZCOP at:
smorgan-price@oxford.gov.uk

ZERO
CARBON
OXFORD