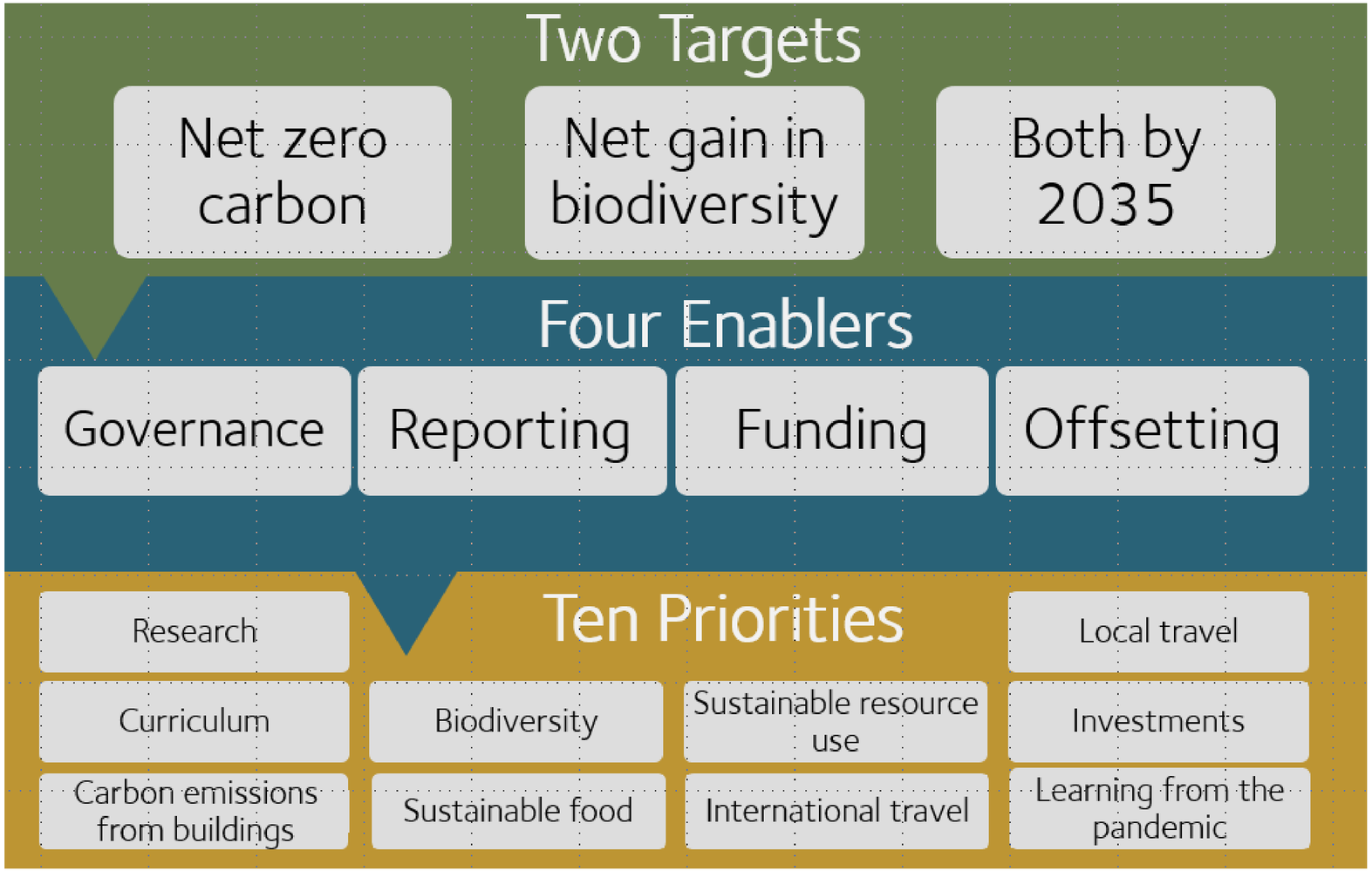
Heat Decarbonisation **Update** University of Oxford

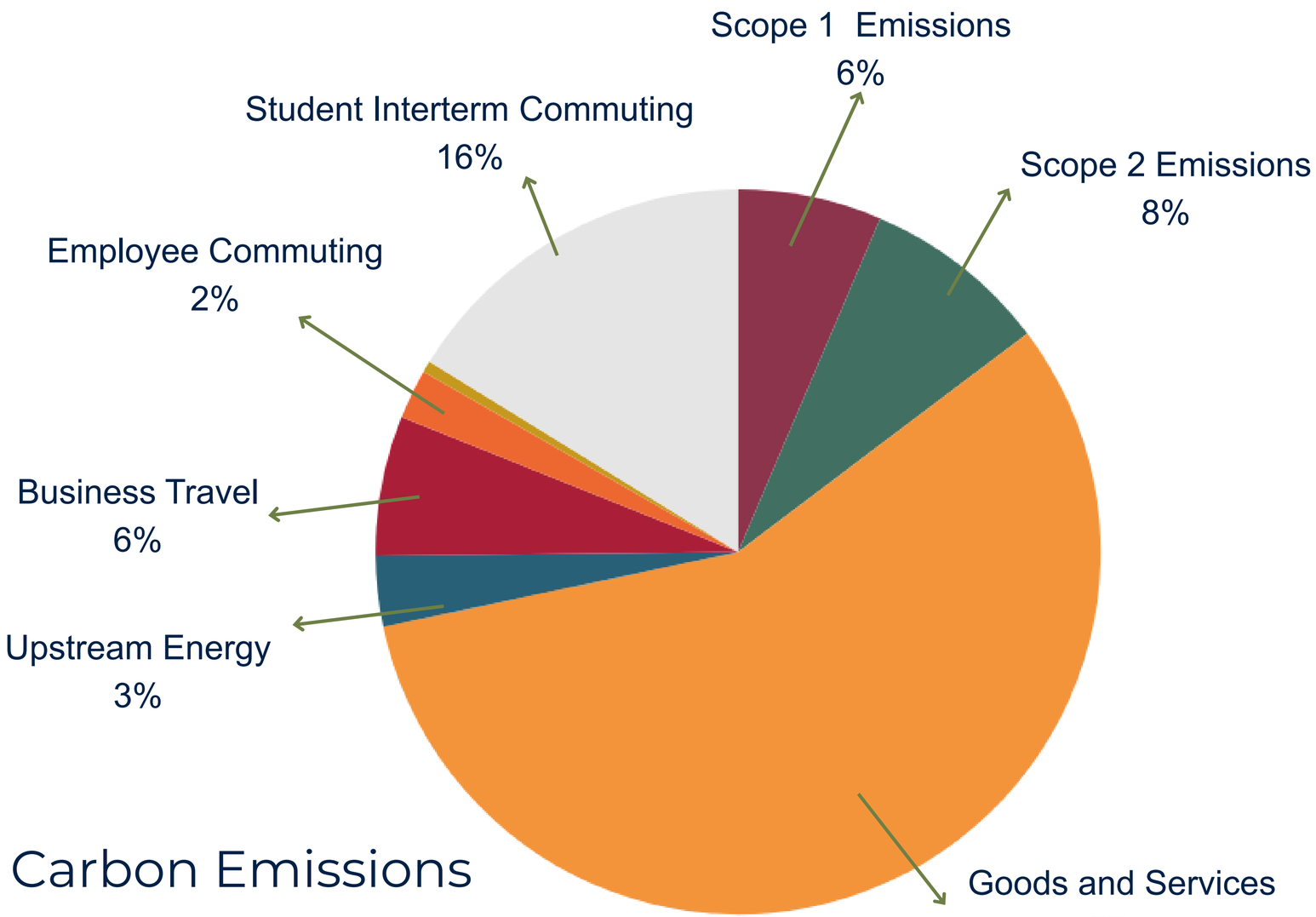
Paul Cross
Head of Energy and Carbon
February 2025

ENVIRONMENTAL SUSTAINABILITY STRATEGY



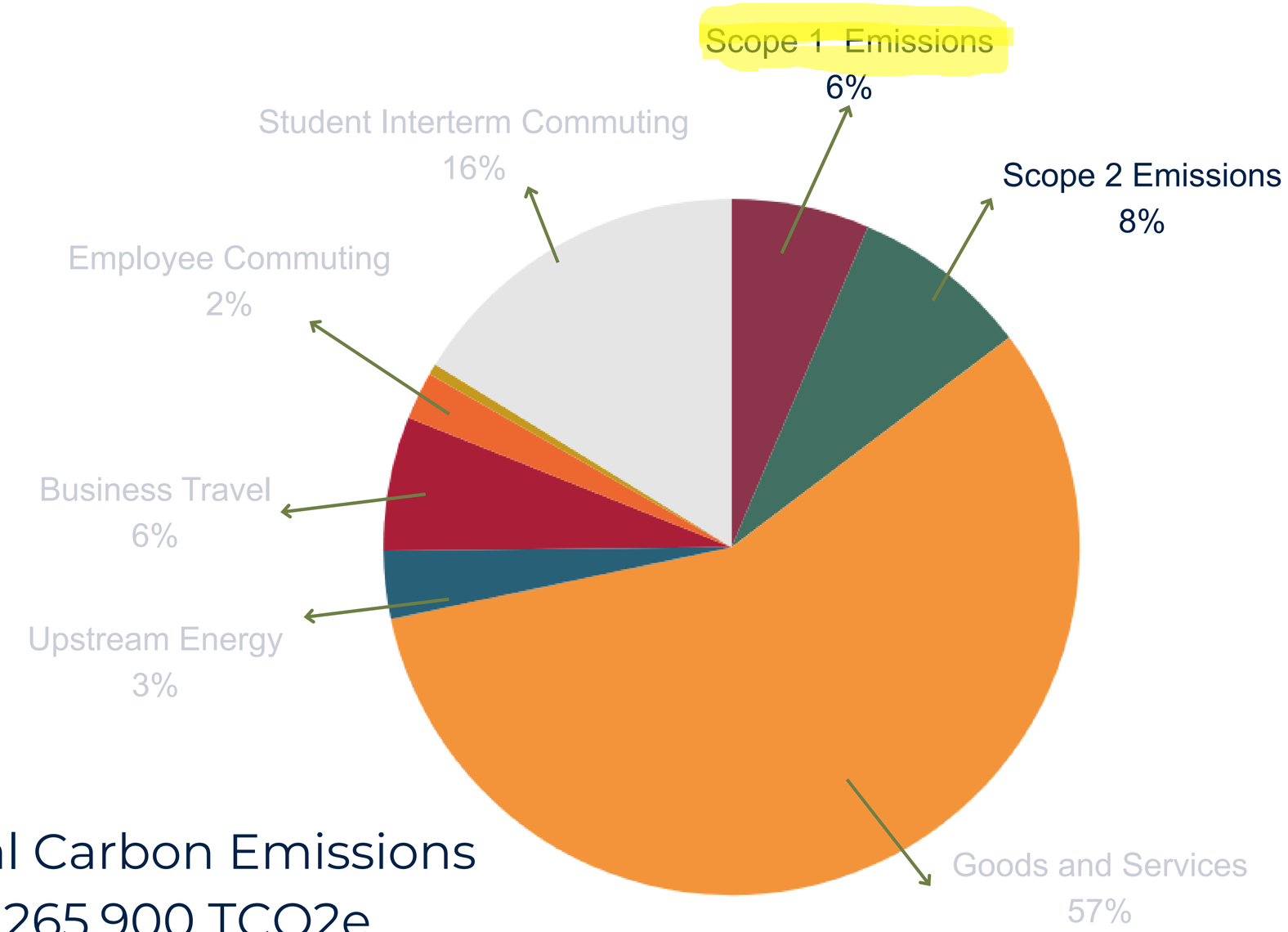
STRATEGIC CONTEXT AND BACKGROUND

2022/23 Carbon Emissions



Total Carbon Emissions
265,900 TCO2e

2022/23 Carbon Emissions



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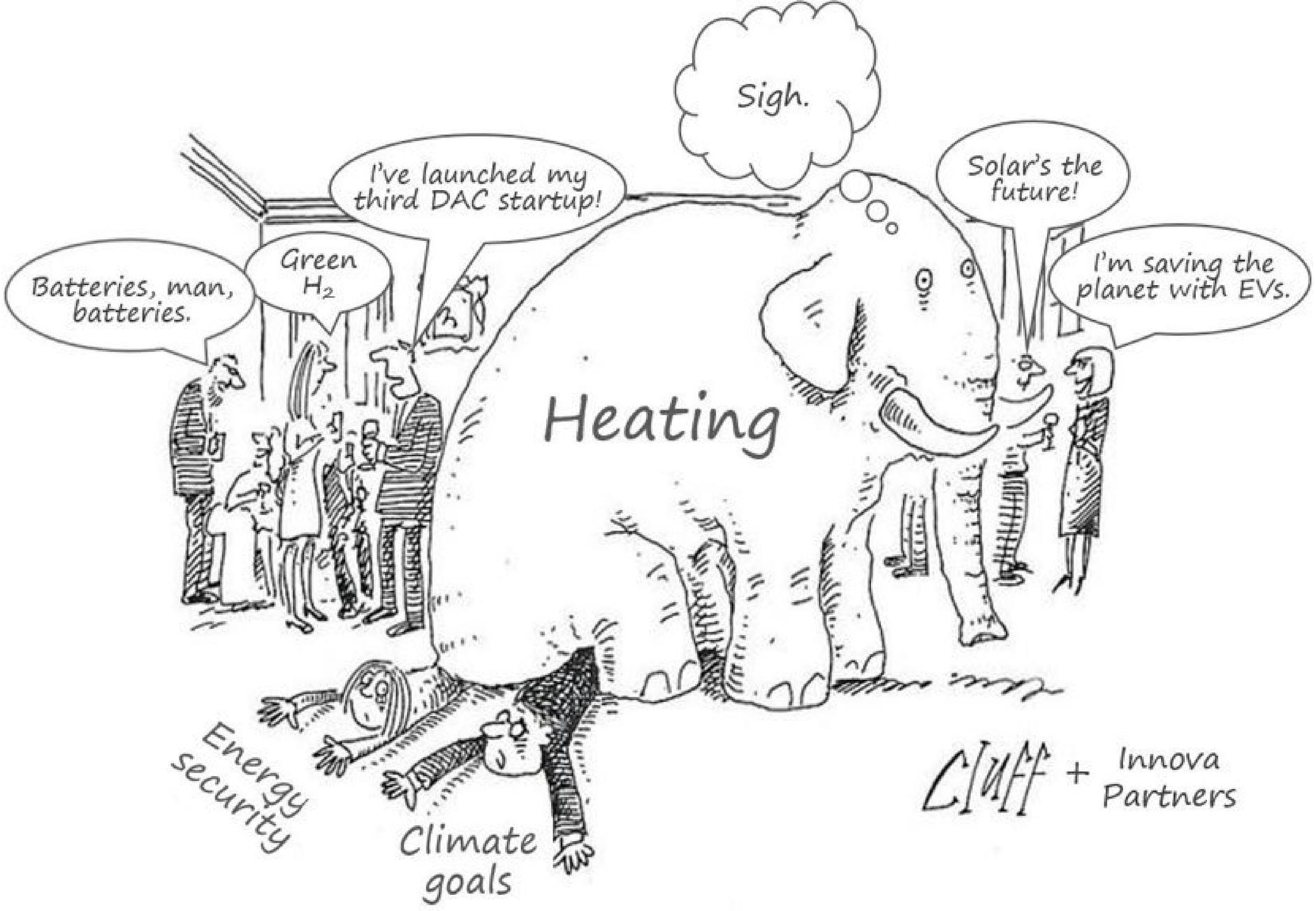
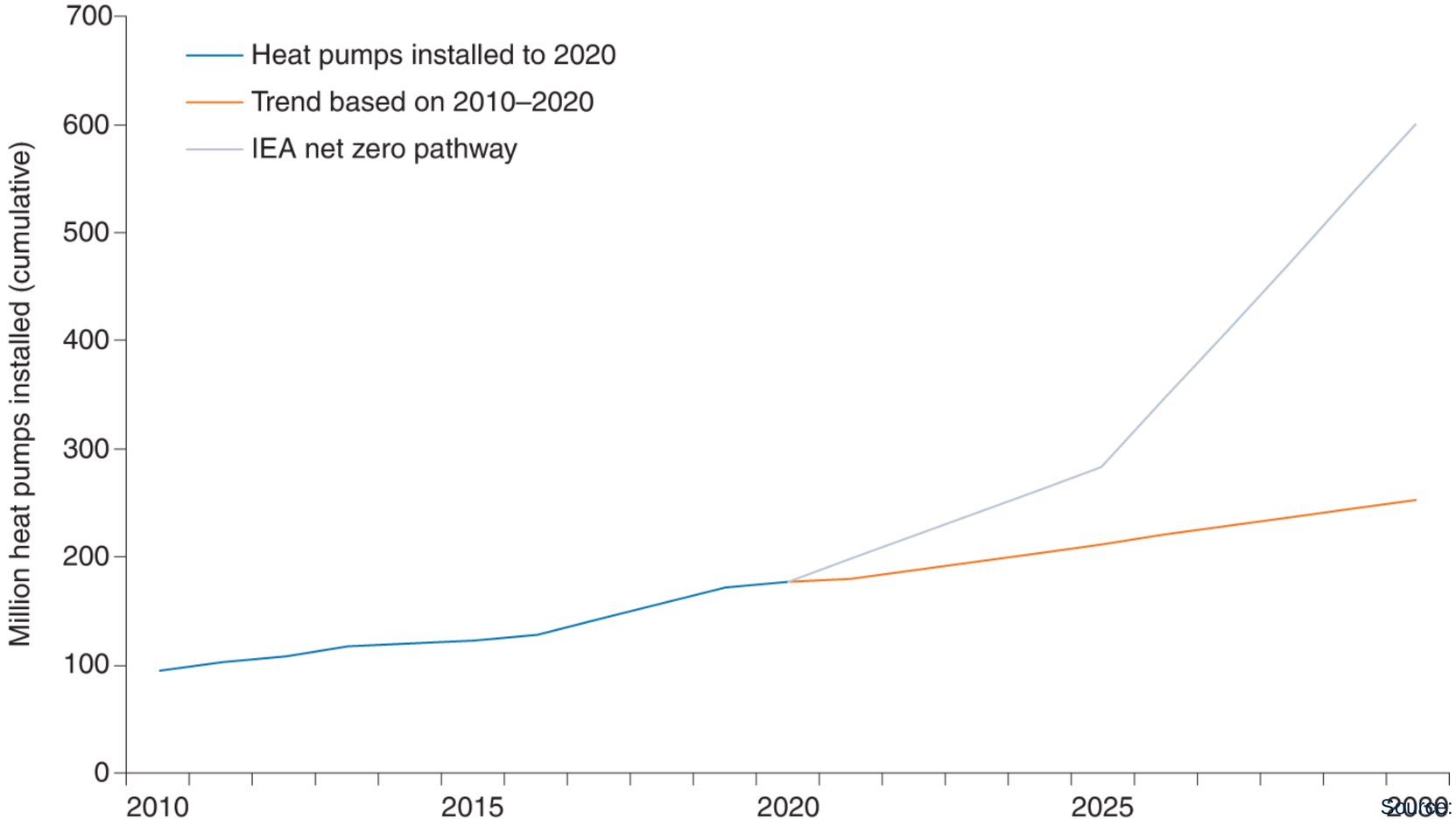


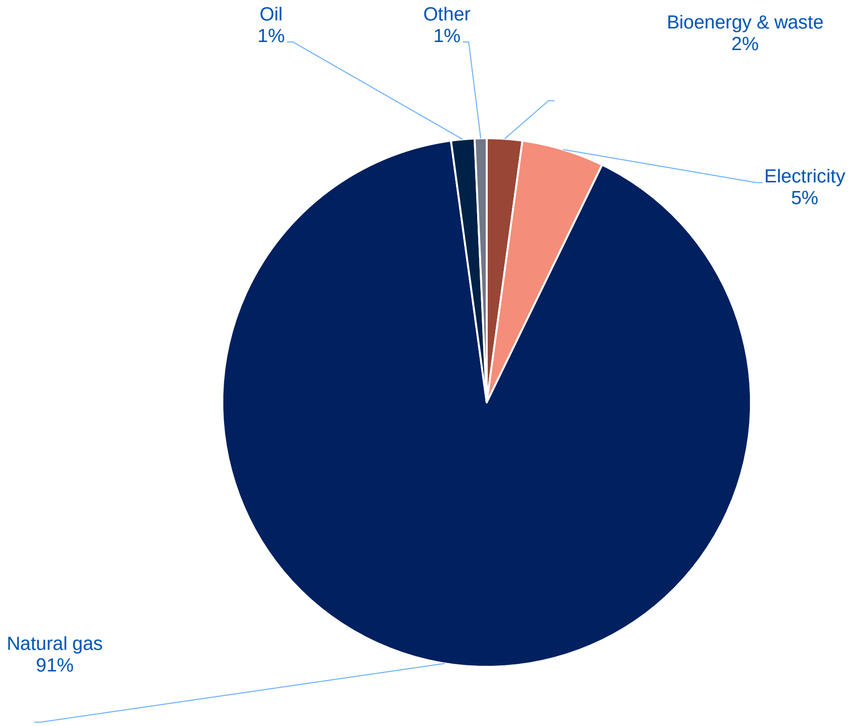
"HAVE YOU NOTICED IT, TOO?"

More than 200m heat pumps installed globally



Source: Rosenow et al. 2022

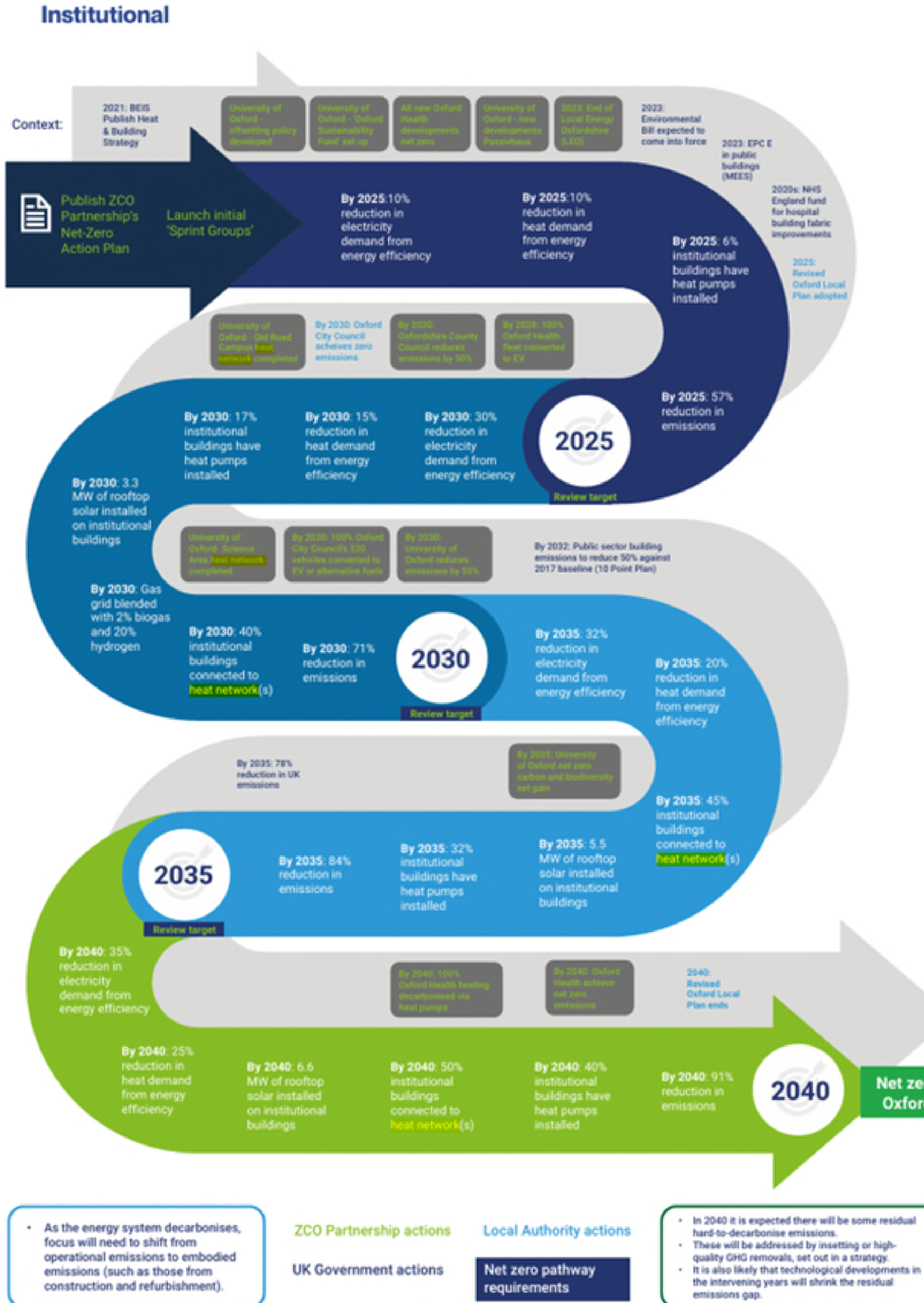
District heating provides 2% of UK heat demand & is almost entirely fossil fuel-based



Source: BEIS 2021

Local Policy Context

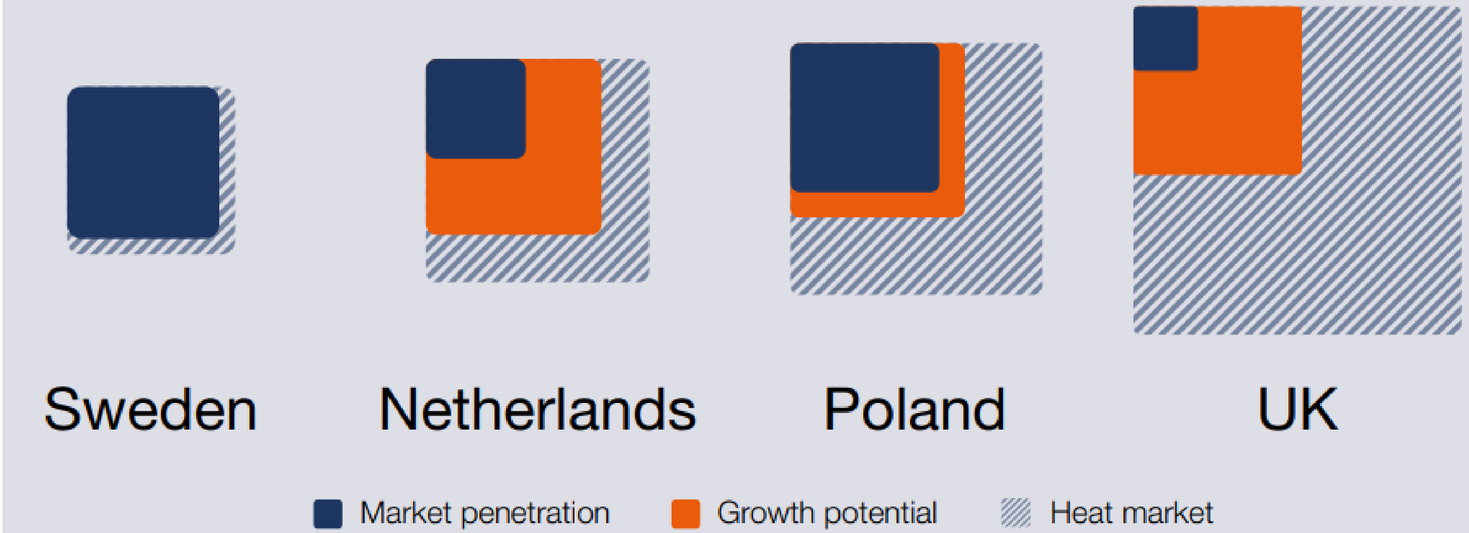
- OCC planning policy currently requires connection to an existing heat network for new build (with exemptions permitted if not feasible) but does not require this for existing buildings (unless PP is required for a project)
- The Zero Carbon Oxford road map, right, (part of the emerging Local Plan 2040) lays out proposals for meeting the city council's target to achieve a net zero city by 2040
- These requirements are not currently mandated by policy, but do offer some specific targets that include OUES buildings, including the delivery of heat networks for ORC and the Science Area by 2030



NATIONAL POLICY CONTEXT

Heat network zoning is core to this growth and when launched in 2025, it will fundamentally transform the development of heat networks in towns and cities across England. Using new legislation under the Energy Act 2023, local communities will be empowered to accelerate the development of heat networks in their area.

Comparison of heat network capacity growth potential
Estimated growth potential of installed district heating capacity in a Heat Road Map Europe 2050 scenario



Strategic Collaboration Off-taker Steering Board SCOSB (under ZCOP)

Lead/chair: Oxford City Council
Strategy Support Team: UO, OBU, County Council…

Liaises with: all off takers; third party heat network provider (***assuming this is the most viable option for off takers and via an accepted procurement process***)

Heat Decarbonisation Programme Steering Group (HDPSG)

Chair: TBC

Members: Chairs of Working Groups; Heat Decarbonisation Programme (HDP) Manager; Head of Environmental Sustainability; HDP Engineer

Reports to: ESSC
Liaises with: SCOSB

Oversees HDP, supports and directs working groups

Commercial Working Group

Chair: Kirsten Gillingham

Members: Director of Purchasing (Jo Sibbald) HDP Manager (Paul Cross); Charlotte Houghton; someone from Iain Critchlows' team.

Reports to: HDPSG
Liaises with: SCOSB

Writes business cases, runs procurement activities, secures funding sources, leads commercial discussions and negotiations

Technology Working Group

Chair: Isobel Hughes

Members: Steven Mearns; HDP Engineer; HDP Manager (Paul Cross); David Wollom; Jesus Lizana

Reports to: HDPSG

Specifies and delivers feasibility studies and designs, delivers building projects, maintains risk/issues register, maintains carbon tracker, pushes for innovation and provides solutions to issues

Academic Liaison and Fundraising Working Group

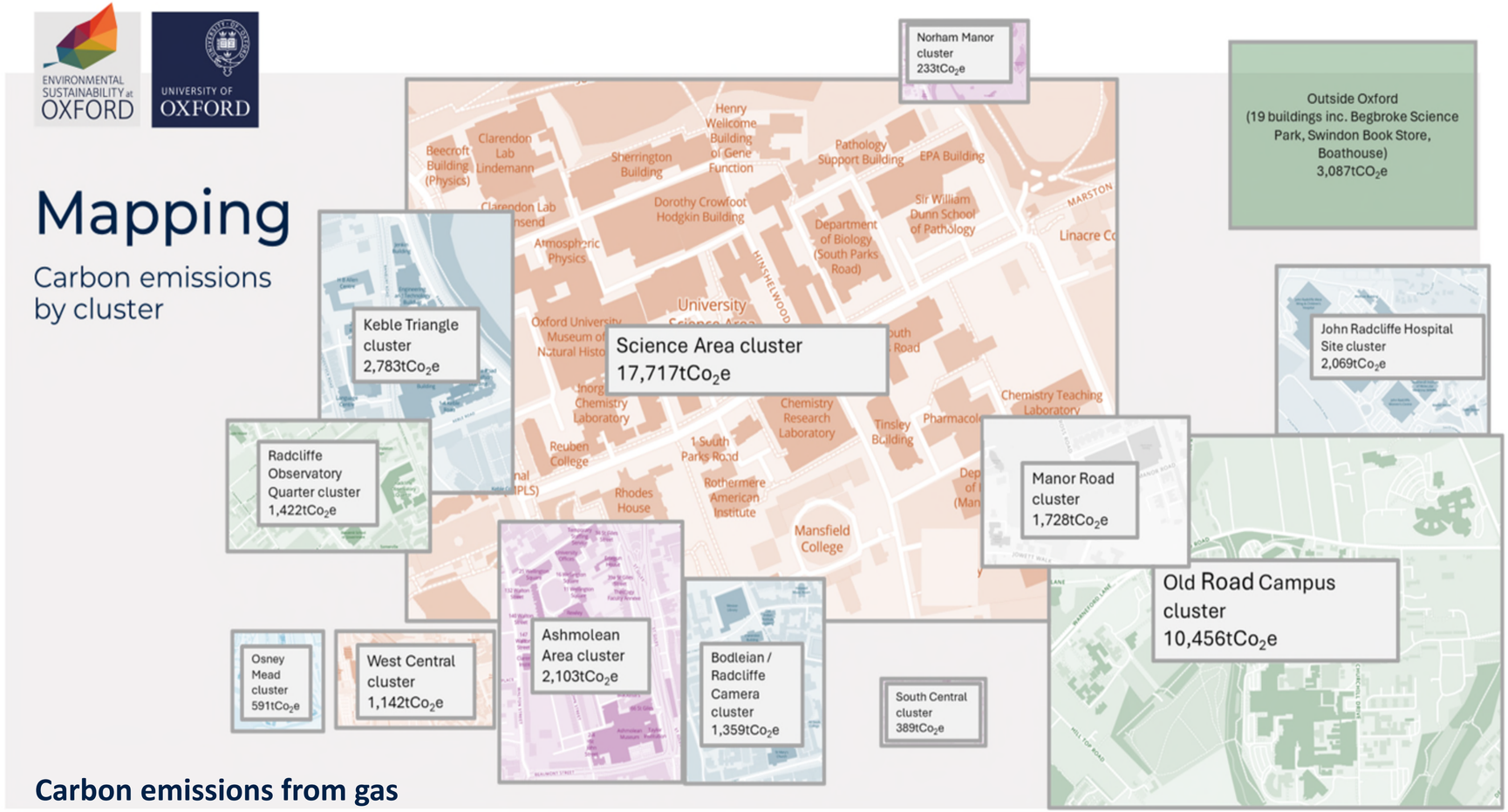
Chair: Paul Shearing

Members: Malcolm McCulloch, HDP Engineer; HDP Manager (Paul Cross); David Wollom, Jesus Lizana,

Reports to: HDPSG

Works across academic groups to identify any synergies or opportunities, leads fundraising opportunities

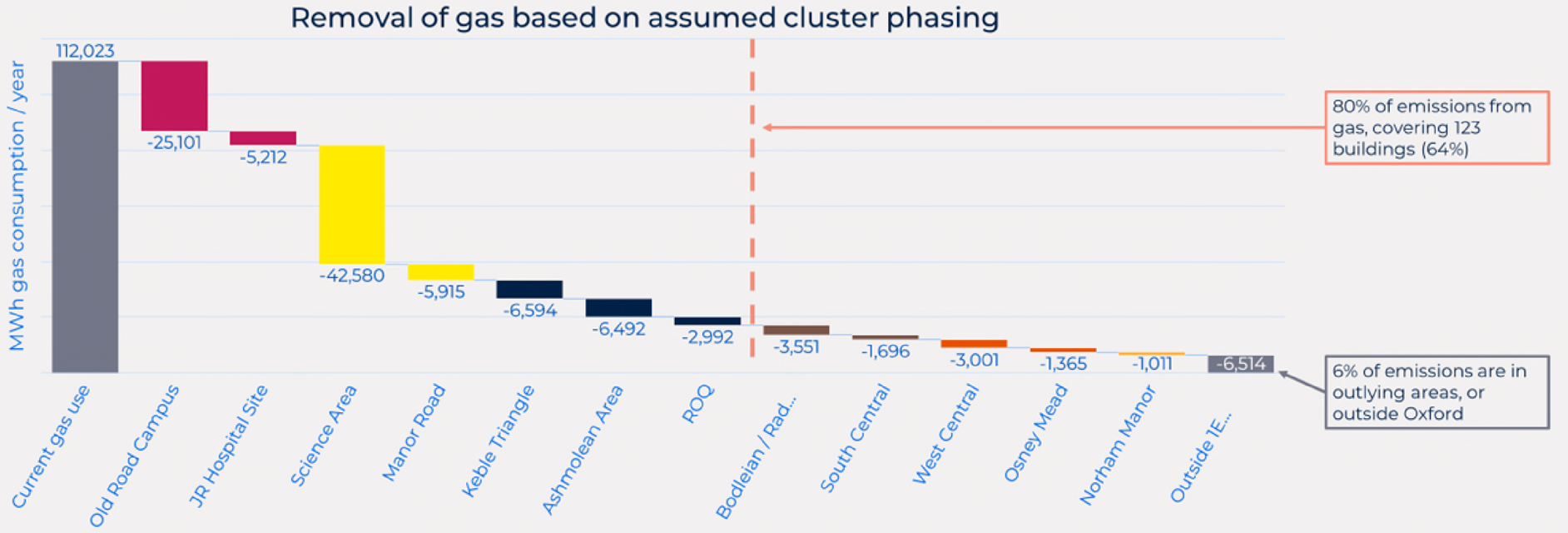
THE TARGET



Carbon emissions from gas during 09/10 was 20,081 TCO2; 80% reduction gives a 2035 target emission of 4016 TCO2

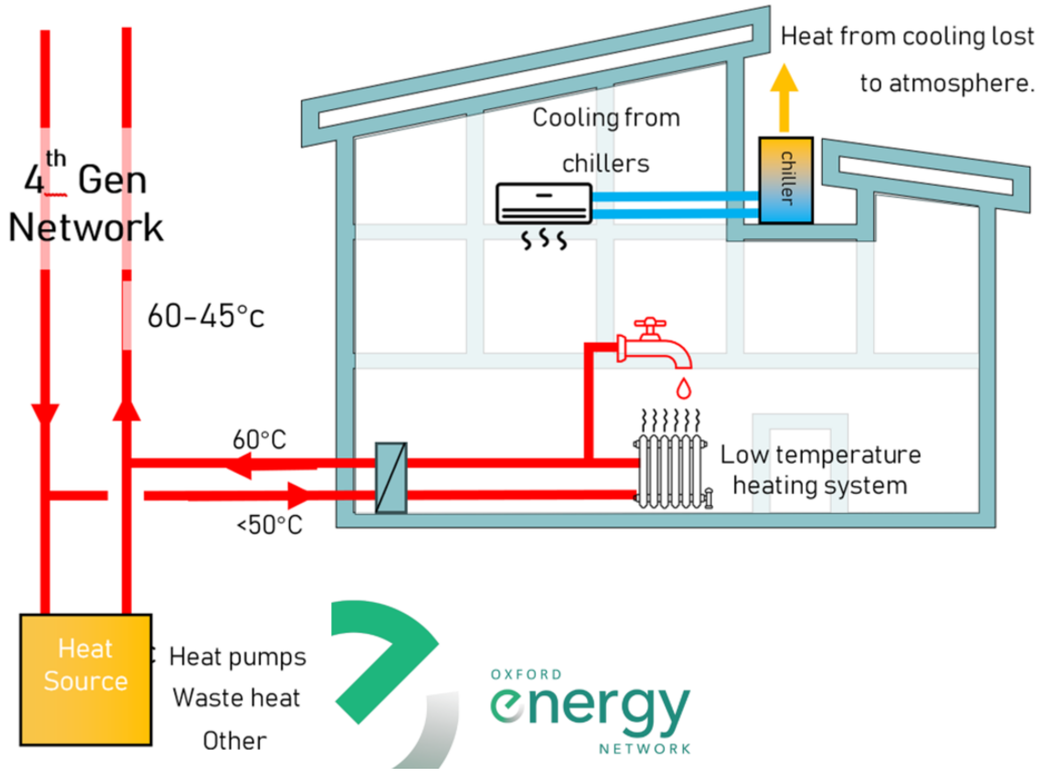
UNIVERSITY OF OXFORD HEAT DECARBONISATION PROGRAMME

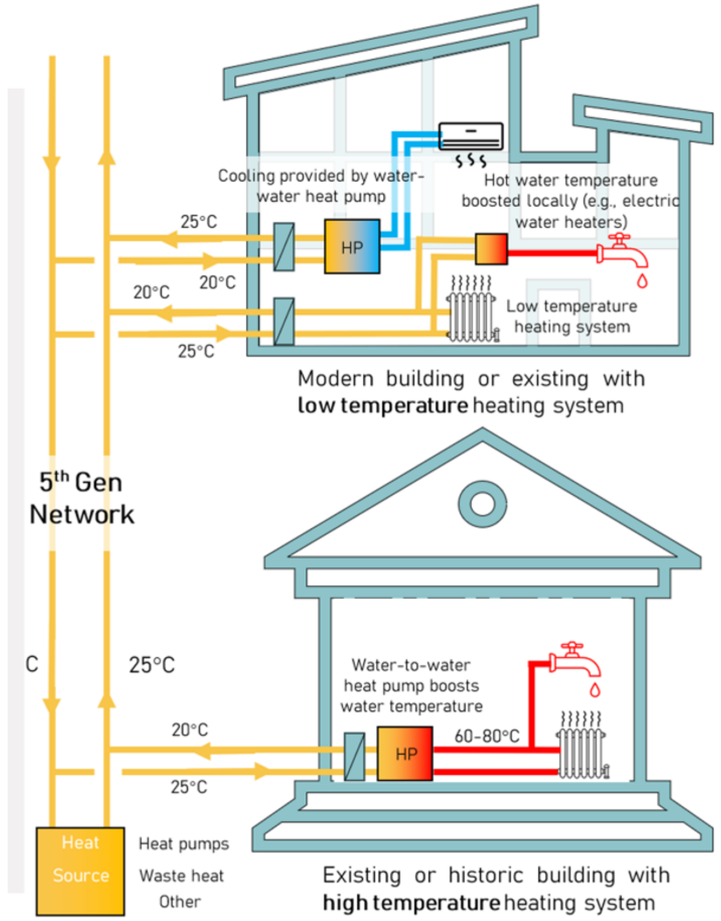
ORC cluster + adjacent first, then Science Area + adjacent, then Keble Triangle + adjacent. Connecting to these three heat network clusters will reach the target of 80% reduction in emissions from gas use



Note, this assumes that non-space-heating gas use is also eliminated, e.g. by changes in technology (e.g., electric autoclaves).
ORC cluster = 27% of emissions, Science Area cluster = 43%, Keble triangle clusters = 14%

TECHNOLOGIES – likely to have both and individual solutions too





Associated strategies/issues: cooling and resilience

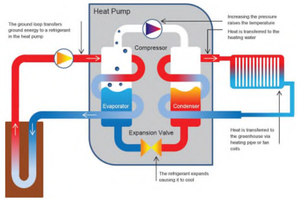
TECHNOLOGY WORKSTREAM - ACTIVITIES

Heat / coolth metering (now)

Trial lower heat temperatures this heating season

Review existing recommendations for controls and Delta T

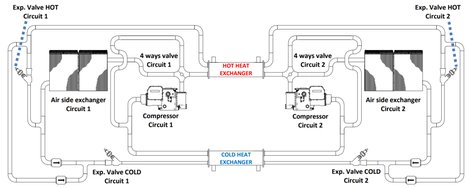
ID which buildings to include in the solution

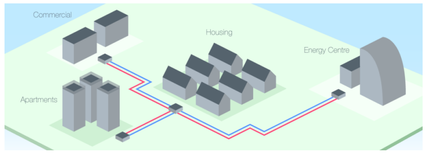


Allocate assumed solutions

ID potential for 4-pipe systems and building to building heat sharing

Consult ARP for lifespans (heating and cooling plant)





ID options for OBC (feasibilities needed)

ID size of commercial ask

ID work outside a heat network (ARP etc)

ID novel / innovative related work / fundraising

Understand → Allocate → Options / solutions

FOCUS ON OLD ROAD CAMPUS

Old Road Campus Heat Decarbonisation

3.2 Energy Metering and Demand

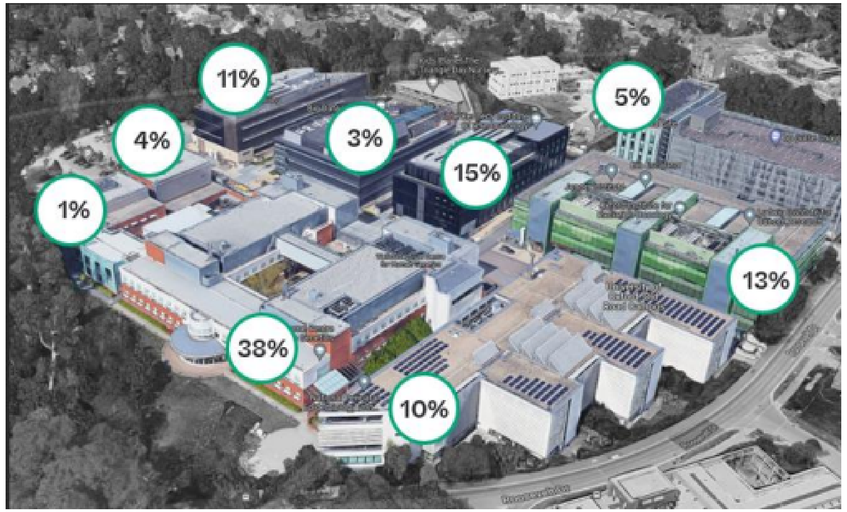
The primary energy consumption for the ORC buildings included within this feasibility report is recorded on a dedicated centralised energy monitoring system (EMS). The EMS constantly records all buildings' gas and electricity consumption data using pulse output energy meters for the individual buildings. The data provided by the recorded metering data and O&M information has been used to inform the basis of the energy and carbon emissions calculations utilised as part of this report.

Building Name	Heat Demand (kWh)	Fabric Heating, %	Ventilation %	Domestic hot water load %
HWB PI	320	26	70	4
HWB Molecular	379	19	77	4
HWB Human Genetic	3,218	45	51	4
NDM	1,004	44	46	10
BDI	342	55	35	10
Kennedy	922	39	51	10
Innovation	624	16	69	15
Research	1,714	65	27	8
Richard Doll	572	42	58	N/A

Table 4 - Building heating, ventilation and DHW system percentage loads.

Each of the buildings' primary heating and percentage fabric, ventilation and domestic hot water loads has been calculated using the mass flow rates, flow and return temperatures recorded on the operating and maintenance 'As-Built' record drawings and schematics, commissioning records and schedules. The energy consumption for each system within the building has been calculated and tabulated above (Tables 3 & 4) This is then used as the basis of the carbon offsetting calculations.

At present there is very limited data available on energy sub-metering within the buildings. Sub-metering data allows us to see actual demand usage of the systems and then verify the buildings operational profiles. This is particularly important when plant sizing to ensure that peak demands can be identified. CPW would recommend a metering appraisal is undertaken and meters installed to allow capture of half hourly heating, cooling and electricity data to generate demand profiles at building and sub-circuit level for accurate future analysis.



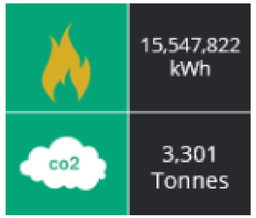


Figure 3 – Carbon Produced by heat generation

The focus of the decarbonisation is reducing current heat demand and the carbon associated with gas fired heating plant. Figure 3 indicates the proportion of carbon generated by each of the buildings, this has been considered when rating the buildings. To decarbonise the heat, the reduction of 3,301 tonnes of CO_2 is the focus of the further analysis within this report.

FOCUS ON OLD ROAD CAMPUS

KEY QUESTION: TECHNOLOGY: WE HAVE LIMITED HEATING/COOLING DATA - HOW DO WE KNOW WHEN WE HAVE ENOUGH DATA TO DESIGN A SOLUTION?

calculations utilised as part of this report.

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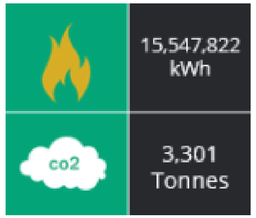

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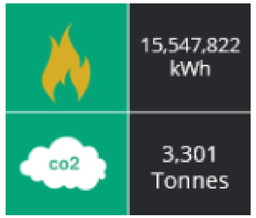

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Source: Rosenow et al. 2022

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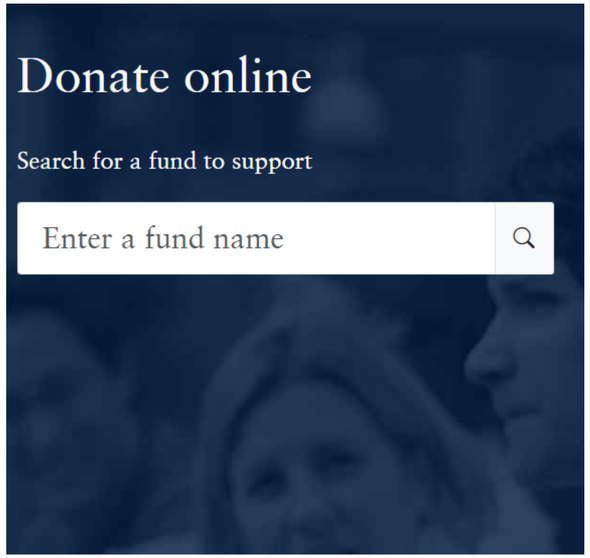
3,301 Tonnes

KEY QUESTION: TECHNOLOGY: HOW DO WE MONITOR TO MAKE SURE BUILDINGS DON'T SLIP BACK TO POOR PERFORMANCE?

Source: Rosenow et al. 2022

ACADEMIC WORKSTREAM - ACTIVITIES



KEY QUESTION: ACADEMIC: HOW DO WE MAXIMISE IP AND MONETISATION AND GRANT RAISE?

A Strategic Industry-Academia Alliance.

The approach integrates five core components:

-**Create an Oxford working group** on ZERO Buildings: Oxford academics / Industry / University Estates / Sustainability Team / …

-**Structure for a position paper**: prepare the structure and key questions to answer for a position paper to share the best and worst practices-

-**Lead Postdoctoral Researcher** with strong industry connections. Responsible for coordinating data collection and synthesising evidence from both industry partners and Oxford academics to address these key questions

-**Organise a 1-day conference** at Wolfson College to present these questions – academics & Industry collaboration.

-**Writing and dissemination:** ZERO Institute will translate these activity and conference findings into press releases and a position paper, ensuring the agreement of all academic and non-academic communities in Oxford.

The final target is to position Oxford as a reference institution sharing the best and worst practices in the building industry. This project will be an initial 6-month activity to launch a long-term research programme at the University of Oxford.

DOWNSIDES / COMPROMISES OF A MARKET-PROVIDED HEAT NETWORK

Energy costs – there is little market for decarbonised heat so assessing value for money carries risks

Commercial – few deals mean that until the Government produce proforma contracts, each is negotiated separately (though plenty of people in the same position): clarity on carbon intensity, responses to network outages, incentives for reducing demand for heat and reducing return temperatures, compliance with best practice, ability to scale up and flex with changes to the supplied estate – all need to be considered

COMMERCIAL WORKSTREAM

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KEY QUESTION: COMMERCIAL: HOW DO WE ENSURE THAT THE BENEFITS OF BEING A FIRST ADOPTER OUTWEIGH THE RISKS?

NEXT STEPS and Q&A

Set up soft market testing to inform the university on the appetite for private sector investment in heat decarbonisation solutions.
Identify demolitions, refurbishments, additions and subtractions so far as known to clarify the scope of the operational estate for heat decarbonisation purposes
Specify a programme of physical interventions to enable heat decarbonisation
Enhance the collection of heat and cooling consumption data across the estate, prioritising ORC for the coming 2024/25 heating season
Produce a detailed proposal for the heat decarbonisation of ORC and consider taking it to market for further design and delivery.
Continue to work with Oxford City and County Councils on how to develop the feasibility for installing a heat network (including working on alternative options)

Environmental Sustainability team

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ENVIRONMENTAL SUSTAINABILITY at OXFORD

UNIVERSITY OF OXFORD