4 Scenarios for a zero-carbon Oxfordshire

There is widespread agreement on the need to drive down emissions and achieve a zero-carbon economy in Oxfordshire by 2050. However, this will not occur without concerted action at multiple scales and by diverse actors. Although Oxfordshire is reliant to a large extent on transformations at the national or even international level to decarbonise its electricity and transport systems, and to eradicate emissions from its building stock, the county also has the option to lead the way towards drastic emissions reductions, going further and faster than other parts of the UK.

This chapter sets out three different pathways to achieving zero-carbon (**Societal Transformation**, **Technological Transformation** and **Oxfordshire Leading the Way**), and contrasts these with a business-as-usual scenario (**Steady progression**). The chapters which follow provide further detailed analysis of the changes needed to achieve net-zero.

4.1 Methodology and approach

Our scenarios build on comprehensive modelling undertaken by the National Grid (NG) in developing their *Future Energy Scenarios* (FES). The four scenarios in this report align with their 2020 FES, which have also been adapted by the electricity Distribution Network Operator covering most of Oxfordshire: Scottish and Southern Electricity Networks (SSEN), to create the Distribution Future Energy Scenarios (DFES). To differentiate between our scenarios and those set out by NG, we have chosen slightly different names for each of the three pathways to zero-carbon.

Where available for Oxfordshire, data on key indicators such as energy demand, renewable generation, and the uptake of electric vehicles have been used as a starting point and combined with modelling by NG to extrapolate figures for 2030 and 2050. However, population growth on a national scale is forecast to be far more modest than in Oxfordshire. We have therefore adjusted the underlying calculations based on expected growth in housing and population, which are consistent across the four scenarios. Further, the NG FES analysis was conducted before the government brought forward the ban on new petrol and diesel vehicles to 2030, so our projections of EV uptake are more rapid.

None of the scenarios should be interpreted as forecasts or predictions, but instead outline different possible pathways to decarbonising the economy, indicating the scale of investment, societal and technological change needed to meet climate goals. The approach in this report differs from that taken in 2014, which included just one scenario with the level of action needed to meet UK climate goals. This time, three of the four scenarios achieve net-zero by 2050, varying in the extent of social and lifestyle change, technology mixes and local action. However, it should be highlighted that each of these pathways require change across all sections of society, driven by strong policy and public support at the national and local levels.

Housing and population growth projections

Oxfordshire's population is growing rapidly. Up to 2031, the figures in this report are based on data compiled by Oxfordshire County Council's Research & Intelligence team, using housing data forecasts provided by City and District Councils. These figures indicate an average of just under 6,000 new homes added to the dwelling stock each year to 2031. Thereafter, no plans have yet been agreed, and for our scenarios we have assumed an additional 4,000 homes are built each year from 2031 to 2050.

All modelling is subject to uncertainty and error. Future energy scenarios have a tendency towards emphasising technological solutions with a focus on supply,[48] underplaying the significance of economic, social and behavioural drivers of energy demand. Models often make broad assumptions about high levels of energy service demand, characterised by thermostat settings and transport preferences. Ecosystem services and consumption emissions are often treated separately. In response, we have adapted our scenarios to include some additional, difficult-to-quantify, features of a zero-carbon future, with a focus on the demand side.[49]

Although the COVID-19 pandemic led to significant reduction in energy demand during 2020, we have not included this in our underlying calculations. There is limited recent data available at the geographical scale needed, and it is difficult to predict the near term rebound in energy consumption, travel behaviour and associated carbon emissions. While this is a limitation of these scenarios, the uncertainties associated with decadal trajectories outweigh near term fluctuations.

A note on local renewable generation

Our 2014 scenarios included metrics relating to the proportion of electricity and heat demand generated by local renewable sources by 2030. The figures of 56% and 40% respectively were incorporated into the Oxfordshire Energy Strategy as recommendations of what might be needed to halve emissions by 2030.

As mentioned in Chapter 3 and discussed further in Chapter 8, recent developments and future projections indicate that this figure for electricity now represents a highly ambitious pathway. Whereas in 2014, Scenario C assumed significant development of onshore wind in the county, in this report we focus primarily on solar photovoltaics for new local electricity generation, for reasons outlined in Chapter 8.

For heat, we are no longer using the indicator: '*renewable heat as a percentage of total heat demand*'. This is partly because it is becoming apparent that, besides improving building insulation, heat pumps will drive the decarbonisation of heating in Oxfordshire, and it is a matter for debate whether these represent local generation or energy efficiency. We have replaced this metric with a simpler indicator which is also used in national policy: the number of heat pumps installed per year. We also include indicators for natural gas and hydrogen demand.

48 Barrett et al (2019). Modelling Demand-side energy policies for climate change mitigation in the UK: A rapid evidence assessment. UKERC Working Paper.

49 It is worth noting that National Grid and other modellers such as the Climate Change Committee have been increasingly including social, cultural and behavioural factors in their scenarios. Our scenarios for Oxfordshire go even further.

4.2 Scenarios

Steady Progression

Steady Progression

Steady Progression extrapolates from trends on emissions reductions. It incorporates recent policy announcements such as the ban on sales of new petrol and diesel vehicles, but progress is uneven across sectors, and it does not achieve net-zero by 2050.

In this scenario, Oxfordshire continues to rely on high levels of natural gas for **heating**, with demand for gas falling by only 6% by 2050. The deployment of heat pumps is gradual. Overall energy demand continues to fall but at a more modest rate due to minimal increases in energy efficiency in buildings and industry.

In **transport**, the majority of small private vehicles are electrified, although some plug-in hybrids remain on the roads. The numbers of people working from home on a regular basis continues to gradually increase from the pre-pandemic baseline, but this results in minimal reduction in vehicle mileage as home-workers substitute commutes for other local trips.[50] Demand for train commuting is reduced however. Railway electrification is achieved for the new East West Rail route, but rising costs hamper progress on the main routes through Oxford. There is more progress in electrifying buses, but this fails to attract many new passengers switching from private transport. Rates of walking and cycling remain low as a proportion of total trips, and cycling culture fails to take hold outside of Oxford City as new housing continues to be built at low densities. HGVs become cleaner by switching to gas, but continue to rely on fossil fuels. Hydrogen does not feature significantly as a fuel for either transport, heating, or energy storage.

Electricity demand remains steady to 2030, and then increases by 74% to 2050 (compared with 2018), driven by substantial housebuilding. It is assumed that from 2025 heat pumps are installed in all new homes, and from 2028 their occupants own one electric vehicle, which they charge at home. **Flexibility** is minimal, with limited smart charging practices and vehicle-to-grid (V2G) deployment. The adoption of flexible practices by householders and businesses remains a niche activity in the near term, but time-of-use tariffs become more widely adopted (54%) by 2050. 60% of electricity generation is provided by renewables by 2030, but most of this is provided by technologies deployed outside of Oxfordshire. Nonetheless, falling prices and increased efficiency lead to an increase in **solar generation** of 32% by 2030 (500 GWh), and 131% by 2050 (880 GWh). Installed capacity of solar reflects the current share of 80% ground mounted, 20% rooftop. However, as electricity demand increases, the proportion supplied by local renewables rises only slightly to 16%, and that remains constant as new installations keep track with growing electricity demand.

In this scenario, in line with recent trends, **land use** is largely unchanged except for the continued loss of farmland for housing development. Over 9,000 ha of land (3.5% of the area of Oxfordshire) is allocated for development between 2011 and 2031. Solar farms expand to occupy an additional 670 ha of farmland. Around half of the land in the county continues to be dedicated to livestock farming, with 27% remaining as intensive pasture (improved grassland), and approximately half of the 43% arable land being used to produce livestock feed. Modest habitat restoration efforts are linked to new biodiversity net gain policies, though these are hampered by intense competition for land.

50 Hook, A., Court, V., Sovacool, B.K. & Sorrell, S. (2020). A systematic review of the energy and climate impacts of teleworking. *Environmental Research Letters*, 15: 093003

Societal Transformation

Societal Transformation

This pathway to a zero-carbon economy is driven by significant changes in consumer practices.

Total energy demand falls significantly in this scenario, with a national programme of retrofit leading the way to achieving high levels of efficiency across Oxfordshire's building stock. **Electricity demand** more than doubles by 2050 compared with 2018, driven by the large-scale deployment of heat pumps to replace gas and oil boilers throughout Oxfordshire. Reflecting this, demand for natural gas falls by 31% to 2030, and by 2050 to zero. From 2025, no new homes in Oxfordshire would be connected to the gas grid, but from 2035, some areas of the county's gas grid are repurposed for **hydrogen**.

In this scenario, Oxfordshire maintains its 3% share of UK **solar capacity**. This means more than doubling generation by 2030 (850 GWh) and achieving more than 5 times current levels by 2050 (2,100 GWh). In this scenario, the proportion of rooftop solar grows to 25% of installed capacity. Combined with relatively small contributions from landfill gas, anaerobic digestion and biomass, local renewable generation represents 27% of Oxfordshire's electricity demand in 2050.

Flexibility is a major feature of electricity demand, with Oxfordshire's residents playing a crucial role in balancing the electricity grid to maximise the usage of renewable power. In 2030, 29% of households have adopted time-of-use tariffs which incentivise flexible usage, and by 2050 this rises to 73%. Oxfordshire's increasing number of electric vehicles owners adopt smart charging practices, and V2G technology is deployed across 3% of households by 2030, rising to 26% by 2050. Electricity storage in this scenario is largely decentralised, with building-scale batteries coupled with rooftop solar installations, and a role played by aggregators to harmonise their operation at a neighbourhood scale, such as trialled in Project ERIC.[51] Flexibility is also enabled by a substantial increase in remote working, allowing householders greater opportunity to avoid and shift their demand for travel.

A transformation in mobility takes place, as changing travel habits during the COVID-19 pandemic are incorporated into everyday life. Overall **transport** energy demand is reduced, with significant increases in walking and cycling for shorter trips and widespread home working. Incentives and communications campaigns are needed to drive up the use of public transport following the pandemic. These changes are also driven by bold policies such as the implementation of low traffic neighbourhoods, concentrating new housing in mixed-use development at higher densities, and restrictions on vehicular access to town centres. EV adoption is rapid supported by local, shared public charging facilities, and larger proportions of heavy vehicles including buses and HGVs are electrified than in other scenarios. In this pathway, modal shift drives up train usage and investment. All railway lines in Oxfordshire are fully electrified by 2050.

51 Project ERIC ran from 2015–2017 in Rose Hill, East Oxford.

In **Societal Transformation**, greenhouse gas emissions from **land use** are reduced as the result of the widespread adoption of low-meat diets.[52] This reduces the demand for pasture and arable land for livestock feed, freeing up more space for restoration of native woodland, floodplain meadows and wetlands. In addition, less land is taken for new housing due to strong planning guidance that encourages compact development, together with lower reliance on private cars which reduces the space needed for parking. As a result, the target to double Oxfordshire's woodland is achieved, including through integrating new native woodland planting and regeneration into the Nature Recovery Networks along with restoration of natural grassland, wetland, heathland and shrub. Attractive green travel routes are also integrated into these networks and into new developments, further boosting the number of people choosing to use active travel. Agriculture diversifies, including more horticulture and agroforestry, and a wider variety of food is produced for local consumption. Farmers lead the way in enhancing biodiversity and improving soil quality, including planting and expanding hedgerows, leading to co-benefits for natural flood management, water quality and other ecosystem services.

A note on negative emissions and offsetting

For a single county embedded in a national energy and transport system, it is difficult to define and quantify carbon offsetting. Typically this is defined as carbon mitigation or sequestration measures taking place outside a defined boundary, with a need for evidence to prove that the carbon reductions would not have occurred without additional investment and intervention. If we were to draw a boundary around Oxfordshire, then decarbonisation efforts elsewhere in the UK could be defined as offsetting. New installations of renewable generation such as offshore wind could be classed as offsetting Oxfordshire's emissions, as the county benefits from the zero-carbon electricity produced.

Another way to define offsetting might be to refer to negative emissions technologies and nature-based solutions for sequestering carbon remaining from difficult-to-decarbonise sectors such as aviation and shipping. Options include bioenergy with carbon capture and storage (BECCS), Steam Methane Reforming with CCS (to produce hydrogen), and nature-based solutions including afforestation and ecosystem restoration. Although their scenarios rely on negative emissions to achieve net-zero, the National Grid do not rely on negative emissions from overseas.

For clarity and simplicity, we do not refer to mitigation or negative emissions activities conducted outside Oxfordshire as offsetting. We follow NG in planning for net-zero to be achieved within the UK territory, but acknowledge that Oxfordshire will rely on action taken elsewhere. The extent to which it does varies amongst the three net-zero scenarios, including the deployment of solar photovoltaics, and the quantities of biofuels grown as feedstock for electricity generation in BECCS power plants outside of the county.

52 The National Grid Future Energy Scenarios do not provide detail on dietary change, however the Committee on Climate Change's 'Balanced Pathway' involves a 20% shift away from red meat and dairy products by 2030, with a further 15% reduction of meat products by 2050 and their Widespread Engagement pathway has a 50% reduction in meat. Sixth Carbon Budget, p165. Our Societal Transformation scenario sees a 75% reduction for meat but no reduction for dairy, based on a low carbon version of Public Health England's Eatwell Plate.

Technological Transformation

Technological Transformation

This pathway to zero carbon emissions relies on the widespread deployment of existing technologies and the development of new innovations and infrastructures. Although the means by which Oxfordshire's residents travel and heat their homes are transformed, their practices and behaviours undergo less change, and demand for energy services continues to increase. Of the three net-zero pathways, Oxfordshire is most reliant on technologies developed and deployed outside of the county.

In this scenario, **hydrogen** features prominently as a fuel for heating, energy storage, industrial processes and heavy vehicles. It is deployed rapidly with 110 GWh used in 2030, rising to levels of annual demand in 2050 (5,300 GWh) which roughly equates to current usage of natural gas. Natural gas demand falls less steeply than in the other zero-carbon scenarios, as hybrid boilers are rolled out, ready for sections of the grid to be switched from natural gas to hydrogen. At the national scale, natural gas demand remains high in this scenario, as it becomes the primary means by which hydrogen is generated, accompanied with carbon capture and storage technology. However, it is very unlikely that these conversions take place in Oxfordshire, so natural gas demand falls to zero by 2050.

Although the widespread uptake of electric vehicles drives **electricity demand** up (+84% by 2050), this is substantially lower than in other net-zero pathways, due to less electrification of heat. This is reflected in the lower numbers of **heat pumps** installed in this scenario, although even here the number of homes heated with electricity doubles by 2050. The high costs associated with the shift from natural gas to hydrogen are somewhat offset by efficiency improvements in **buildings**, although ambition on energy efficiency in buildings is lower than in other net-zero scenarios.

Although new homes continue to be connected to the gas grid beyond 2025, policy requires that boilers are hydrogen-ready by this date to facilitate a fuel-switch at a later date.

The proportion of **electricity demand** met by local renewables is slightly lower than in the **Societal Transformation** pathway, as a result of relatively lower uptake of rooftop solar as opposed to ground-mounted. As such, the proportion of rooftop solar falls from 20% to 10%, as large-scale ground mounted installations are preferred. At a national scale, new electricity generation is dominated by wind power, but this is not widely deployed in Oxfordshire. The county retains a 3% share of UK solar capacity, and 23% of electricity demand is met by local sources of generation by 2050.

Flexibility features less prominently in this scenario than other zero-carbon pathways, as consumers are more reluctant to shift the times of day when they travel, charge their EVs or carry out energy intensive activities such as laundry, cooking or electric heating. The proportion of households on time-of-use tariffs is only 10% in 2030, rising to 60% by 2050; while uptake of V2G is negligible in 2030, rising to only 11% of car owners in 2050. Technological solutions, as opposed to changing practices, deliver a larger share of the flexibility needed to balance energy supply and demand, and this scenario includes the development of a new 10MW hydrogen peaking plant in Oxford.[53] Learning from the process of installing of a 50MW hybrid battery on the transmission grid as part of Energy Superhub Oxford, a further 50MW storage capacity is deployed to ease constraints elsewhere in the county.

53 This is included in SSEN's future scenarios.

Transport. In this scenario, the electrification of the private vehicle fleet takes place on roughly the same timescale as in **Societal Transformation**, driven by the ban on sales of new fossil fuelled vehicles by 2030. However, growth in public transport use is slower than in other net-zero scenarios due to lower willingness amongst the public to switch away from private modes. As a result, congestion remains a significant issue in the county, with active modes, public transport and remote working only partially offsetting the growing number of trips taken by private car. With car usage remaining high, this scenario requires the most extensive public charging infrastructure and rapid charging is in high demand, but the uptake of V2G by Oxfordshire's EV owners is modest. Both trends drive the need for investment in electricity grid capacity. Although progress is made to electrify railways in Oxfordshire, some routes switch to hydrogen in this scenario. Hydrogen is the fuel of choice for heavy vehicles.

In this scenario, **agricultural** production is intensified in Oxfordshire, with a larger number of farmers moving to horticulture practices using polytunnels and indoor hydroponics. Intensification is further assisted by technological innovations as automated mechanical weeding, the widespread use of GPS and in some cases, machine learning.[54] As such, levels of food production increase despite some agricultural **land** being allocated for afforestation and solar farms. This scenario features a narrow focus on planting trees, ignoring the value of other habitats and the importance of planting the right trees in the right place. As a result, there are fewer co-benefits for biodiversity or ecosystem services than the other two net-zero pathways, and even some adverse impacts as non-native trees are planted on biodiverse and carbon-rich grassland. Also, without dietary change to free up farmland, and with less compact housing developments, competition for land means that tree planting targets are not achieved.

54 Liakos, K.G., Busato, P., Moshou, D., Pearson, S. & Bochtis, D. (2018). Machine learning in agriculture: A review. *Sensors,* 18: 2674. doi: 10.3390/s18082674

Contributions from the non-domestic sector

As discussed in Chapter 7, the non-domestic sector in Oxfordshire is extremely heterogenous. With more than 32,000 businesses in the county, there is significant variation in the design, fabric and usage of buildings, as well as the business activities taking place within. Whereas for domestic buildings, the number of homes retrofitted to certain standards of energy efficiency is a useful measure of progress, we have used alternative metrics for the non-domestic building stock, focusing instead on the steps taken by businesses to reduce emissions.

There are a wide variety of resources to help organisations develop plans to achieve net-zero. Oxfordshire businesses Seacourt Printers and Anne Veck have developed action packs to support other businesses on their sustainability journeys, while colleagues at Oxford University have helped to launch the SME Climate Hub a repository of advice and resources. Energy Solutions Oxfordshire is a new energy services company launched by the Low Carbon Hub and Oxford Brookes to provide a one-stop shop for businesses to reduce energy wastage.

There are a wide variety of steps that businesses can take to reduce their carbon footprints, and we have selected metrics which will help to indicate that Oxfordshire's business community is taking seriously their responsibility to tackle climate change, by monitoring their impact, developing and publishing net-zero strategies, and taking part in zero carbon networks.

Oxfordshire Leading the Way

In this scenario, Oxfordshire goes further and faster than other areas of the UK in achieving zero carbon emissions. This is driven by high levels of public support for local action and strong policy, as well as lifestyle change amongst householders and communities. Oxfordshire builds on its leadership position in the low carbon sector by attracting investment in clean-tech innovation, and expanding community initiatives and the sharing economy.

Oxfordshire Leading the Way balances the need for societal change and technological innovation represented in the two other zero-carbon scenarios. **Heat pumps** are deployed rapidly in Oxfordshire, alongside a transformative retrofit scheme. The retrofit market is assumed to take several years to create, so numbers start small and build up to market maturity in the 2030s. By 2050 it is assumed that 95% of today's housing stock (280,000 properties) have been renovated to a high standard of efficiency. In Oxfordshire no new gas boilers are installed across the building stock from 2025.

Driven by the rapid deployment of heat pumps and electric vehicles, **electricity demand** in this scenario follows the steep trajectory outlined in **Societal Transformation**. Building on the successful trials of markets for flexibility services in Project LEO, businesses and residents actively engage in **flexibility** practices, saving on energy bills and assisting with grid balancing. **Hydrogen** in this scenario is adopted primarily for heavy vehicles and energy storage, with a small amount generated locally using electrolysis.

This scenario involves a moon-shot for the deployment of **solar photovoltaics**. Oxfordshire's share of UK capacity increases to 4% by 2030, and 6% in 2050. This equates to a *three-fold* increase in solar capacity in the county by 2030 compared with 2019 figures, and *ten-times* by 2050. Accelerated rooftop installations play a key role in achieving these increases, and new-build dwellings include an average of 4kW capacity from 2023. In the medium term (2030), the proportion of rooftop solar increases to 40% of installed capacity, but as the availability of suitable rooftops diminishes and large ground-mounted arrays are constructed, this falls back to 30% by 2050. As a proportion of Oxfordshire's electricity demand, renewables provide 31% in 2030, and 52% in 2050.

Energy demand associated with **transport** falls following the COVID-19 pandemic, as Oxfordshire residents incorporate walking and cycling into their daily routines, with more amenities being provided locally, and businesses support remote working. Reduced car-usage is also driven by extensive pedestrianisation measures implemented by Oxford City and the market towns, workplace charging levies, the proliferation of low traffic and higher density neighbourhoods, and the expansion of shared transport options. Vehicle electrification occurs more rapidly than in other net-zero scenarios, and sharing business models, including autonomous fleets, are pioneered in Oxfordshire, driven by a thriving automotive sector. This leads to reduced car ownership. Freight consolidation centres and other localised warehousing and production enable low carbon local delivery of goods throughout urban areas.

Oxfordshire's **land**-based resources play a critical role in supporting decarbonisation efforts at the national scale. This means that a greater proportion of land is allocated for growing bioenergy crops than in other net-zero scenarios, used for power generation, aviation and shipping. The proportion of land currently used for meat and dairy production is reduced as a result of changing diets to make way for bioenergy crops, ecosystem restoration and solar arrays. Solar farms are built throughout the county, but still only occupy less than 1% of land area. Agriculture diversifies and a wider variety of food is produced for local consumption. Permaculture practices are pursued, and the number of allotments in Oxfordshire triples. New local initiatives such as community gardens, farmers markets and land trusts crop up around Oxfordshire. Membership of Good Food Oxford and the Community Action Network quadruples by 2030.

Quality vs quantity

The nature of scenario modelling means that the focus is inevitably on **quantity**: adoption of heat pumps and EVs, numbers of homes retrofitted, businesses conducting energy audits and hectares of trees planted.

Although more difficult to capture in scenario modelling, **quality** is crucial. The 'performance gap' describes the difference between actual and modelled energy usage for buildings, and can be as high as 60% in low energy housing.[55] An integrated approach to quality assurance (such as the systems and standards advocated by the Passive House Institute) is needed to get real-life energy performance down to the levels assumed in the quantitative analysis. Similarly, householders' capacity and willingness to shift their electricity demand matters just as much as the numbers adopting time of use tariffs and V2G technology. Businesses may conduct regular energy audits and monitor their carbon footprint, but acting on this information is what counts. Finally, hectares of trees planted per year is a crude measure, which ignores the importance of selecting species which enhance biodiversity and provide additional ecosystem services besides carbon sequestration, as well as the need to restore a balanced mix of different habitats.

Ultimately, what counts towards climate goals is actual, observed emissions reductions, rather than the number of homes renovated, trees planted, heat pumps installed or EVs registered. The difference between modelled and observed outcomes depends on the quality of design and workmanship, the performance of installed technologies, and user preferences and behaviour.

55 Gupta, R., Howard, A., Kotopouleas, A. & Krishnan, S., 2019. Meta-study of the energy performance gap in UK low energy housing. In: ECEEE Summer Study Proceedings. Presented at the ECEEE, Belambra, Presquile de Giens, France.

Scenarios	Steady Progression		Societal Transformation		Technological Transformation		Oxfordshire Leading the Way		Notes
Indicator	2030	2050	2030	2050	2030	2050	2030	2050	
Buildings									
No. of pre-2020 homes renovated	3,000	30,000	8,900	280,000	3,000	150,000	8,900	280,000	Supply chains and governance arrangements will take 5–10 years, so little change before 2030.[56]
Energy standard for retrofits, $kWh/m^2/year$ (useful energy; domestic space heating only)	100	100	100	60	100	100	100	60	
Average EPC rating for all buildings	D	D	D	B	D	C	D	B	Current average is D; improvement requires support to achieve higher ratings and a regulatory minimum standard to make low-rated buildings unusable (with finance and other support for upgrades).
Percentage of Oxfordshire businesses conducting annual carbon footprints and/or energy audits	3%	6%	15%	80%	10%	40%	20%	80%	Figures refer to businesses with employees (excludes sole traders)
Proportion of large businesses with published net-zero strategies	5%	30%	60%	95%	30%	60%	70%	100%	
Coverage of business networks dedicated to achieving zero-carbon (% of total number of businesses)	3%	10%	20%	40%	5%	15%	25%	50%	Examples include Zero Carbon Oxford Partnership and Oxfordshire Greentech, but more are needed. Figures exclude sole traders.
Heat									
Natural Gas demand (GWh)	4,800	4,900	3,600	0	4,300	0	3,300	0	Demand in 2018 was 5,270 MWh
Hydrogen demand (GWh)	20	160	19	1,600	110	5,300	30	1,800	Currently negligible.
Number of heat pumps (total installations)	41,000	190,000	120,000	390,000	64,000	250,000	130,000	390,000	There are roughly 1,500–2,000 heat pumps in Oxfordshire currently.

56 Construction Leadership Council (2020), Greening our existing homes national retrofit strategy.

Scenarios	Steady Progression		Societal Transformation		Technological Transformation		Oxfordshire Leading the Way		Notes
Indicator	**2030**	**2050**	**2030**	**2050**	**2030**	**2050**	**2030**	**2050**	
Transport									
Battery electric vehicles as proportion of all light vehicles on the road	25%	95%	37%	99%	35%	99%	40%	99%	Currently <1%
Number of battery electric vehicles (BEVs)	130,000	600,000	195,000	500,000	185,000	525,000	210,000	450,000	There are roughly 430,000 vehicles in Oxfordshire currently, of which 2,500–3,000 are BEVs.
Domestic and workplace charge points	80,000	200,000	68,000	165,000	74,000	175,000	58,000	150,000	There are roughly 2,000 to 2,500 chargers currently.
Public charge points	7,000	18,000	10,000	25,000	15,000	26,000	16,000	36,000	There are roughly 240 public chargers currently. Includes shared residential charge points (e.g. on street). The European Commission recommends 1 public chargepoint is installed for every 10 EVs on the roads.[57]
% Telecommuting	10%	15%	30%	40%	10%	20%	25%	35%	Defined as percentage of labour force working primarily from home. In 2019, about 5% of those in employment in the UK said they mainly worked from home, although this rose to 47% during the first lockdown in April 2020.
Active travel investment	£10	£15	£20	£40	£15	£30	£25	£40	Per capita, per year, including capital and revenue based on 2021 prices. In 2018/19 active travel investment averaged £6 per person.[58]
Electricity supply									
Solar generation (GWh)	500	880	850	2,100	700	1,400	1,100	3,900	Solar generation was 382 GWh in 2019. In ST and TT, solar capacity remains 3% of UK total. In OLTW, this increases to 4% by 2030 and 6% by 2050.
Total renewable electricity supply (GWh)	660	1,000	1,000	2,200	870	1,500	1,300	4,000	Renewable generation was 533 GWh in 2019.

57 Transport & Environment (2018), Roll-out of public EV charging infrastructure in the EU.

58 Cycling and walking investment strategy Report to Parliament, p24. February 2020.

Scenarios	Steady Progression		Societal Transformation		Technological Transformation		Oxfordshire Leading the Way		Notes
Indicator	2030	2050	2030	2050	2030	2050	2030	2050	
Renewable electricity supply as a percentage of electricity demand	16%	16%	25%	27%	23%	23%	31%	52%	Current renewable electricity generation represents 15% of demand
Flexibility									
Percentage of households with time-of-use (TOU) electricity tariffs	6%	54%	29%	73%	10%	60%	35%	83%	Flexibility figures are taken directly from National Grid's 2020 scenarios. Currently <1%.
Percentage of households utilising vehicle to grid technology	0%	5%	3%	26%	0.2%	11%	5%	45%	Percentage of all households, although not all own vehicles, nor have access to off-street parking.
Land use									
Hectares of trees planted per year	60	60	430	430	210	210	430	430	Tree planting is enabled by dietary change in ST and OLW.
Hectares of agroforestry, hedgerows and garden trees planted per year	0	0	1,400	1,400	0	0	1,400	1,400	Farmer and community participation enables additional tree planting in ST and OLW.
Hectares of natural grassland, heath, scrub and wetland restored per year	5	5	400	400	0	0	200	200	ST aims to double the area of non-woodland semi-natural habitats from 4.5% to 9%. OLW is constrained by heavy demand for land for solar and biofuels.
Percentage of land used for ground-mounted solar generation	0.15%	0.26%	0.23%	0.57%	0.24%	0.45%	0.23%	0.99%	This is calculated based on an area for Oxfordshire of 260,500 ha (2,605 km^2).
Hectares of land used for bioenergy crops	0	0	10,000	10,000	20,000	20,000	25,000	25,000	All scenarios include less than the NG's estimated need for bioenergy, due to land use constraints. The remainder must be grown elsewhere in the UK or imported. ST relies on demand reduction to reduce need for BECCS.
Percentage of food demand met in Oxfordshire	60%	40%	95%	60%	55%	39%	87%	55%	Based on area needed to produce food with an equivalent calorific value. Currently Oxfordshire meets the equivalent of 74% of its food demand. This increases with low meat diets but decreases over time with high population growth and loss of farmland for housing, afforestation, biofuels and solar.

4.3 Investment and economic impact

In a report for the Committee on Climate Change (CCC), Cambridge Econometrics estimated that GDP at a national level would be 2–3% higher between 2020 and 2050, and would generate around 300,000 additional jobs if the UK follows a path to net-zero.[59] Although the investments needed in developing and deploying the solutions for reducing carbon emissions are high, especially in the near term, they predict a net economic benefit.

The economic impacts of the transition are likely to be geographically uneven, and the CCC acknowledges that many jobs will be lost, for instance in the oil and gas sector. Oxfordshire's economy, which is already dominated by the service sector and high-tech manufacturing, stands to benefit substantially from this transition. However, to capitalise on this opportunity, there is a need for unprecedented levels of investment in transport, buildings and the energy system in Oxfordshire.

Based on available evidence and without using econometric modelling techniques, we have provided estimates of the additional investment needed to reach the 2030 goals outlined in **Oxfordshire Leading the Way**.

	Investment 2021–2030	Notes
Transport		
Active travel	£100m	
Vehicle fleet decarbonisation	£240m	Majority of additional investment needed is focused on LGVs, HGVs and buses, as it is expected that the total cost of ownership for battery-electric passenger-cars equals or even undercuts current costs for conventional vehicles before 2030
Electric charging infrastructure	£150m	Includes public and private
Rail electrification	£125m	Based on 50% of the non-electrified[60] multi-track line being electrified at an average cost per km of £1,750,000.[61]

59 Cambridge Econometrics (2020), Economic impact of the Sixth Carbon Budget.

60 The stretch of mainline rail from Reading to Didcot has already been electrified, representing 10% of Oxfordshire's total railway.

61 Railway Industry Association (2019), Electrification cost challenge.

	Investment 2021–2030	Notes
Buildings		
Housing retrofit and heat pumps	£1.5bn	Assumes that costs of (re-)training the workforce are met at national level as part of a strategic re-positioning of the economy to meet decarbonisation targets. Assume £25K per retrofit; £10K per HP. Majority of investment is private.
Business advice and engagement services	£50m	Assume a network of 100 decarbonisation consultants working with local businesses (upscaling OxFutures) @ £50K per consultant per year
Renewable energy		
Solar generation	£630m	Based on CAPEX installation costs of £750/kWp and OPEX of £7000/MW/year.
Grid infrastructure	£450m	Based on £30bn UK CAPEX network investment in CCC's balanced pathway, scaled by Oxfordshire's forecast demand contribution.
Battery Storage (supply side)	£100m	Based on CAPEX installation costs of £500/kWe and OPEX of £25000/MW/year.
Land use & natural ecosystems		
Strong planning policy	Low cost	Strengthen planning policy to protect carbon-rich habitats, encourage green roofs and rooftop solar, and mandate compact, walkable low carbon development. Green roofs expected to reduce building heating and cooling costs and walkable neighbourhoods expected to deliver healthcare savings.
Awareness raising to encourage low meat diets	Low cost	Expected to reduce healthcare costs
Tree planting	£113m	Planting 22,600 ha of tree and agroforestry cover by 2050 at £5000 per ha of cover.59
Plant 8,500 km of hedgerows	£44m	Based on estimate of £526/100m for 8,500 km of species-rich hedge including hedgerow trees.[62]
Habitat restoration	£31m	Estimated £800 per ha for 9000 of meadows and £8000 per ha for 3000 ha of wetlands

62 Warner, E (2020), Opportunities for biodiversity enhancement on the University Estate.