Executive Summary

The economy and carbon emissions

Oxfordshire benefits from a strong and knowledge-driven economy, with levels of income typical of its peers in the South East of England and high levels of education. Oxfordshire achieves an average income per head above the level of the South East of England and a disposable income slightly above that for its peer, Cambridgeshire, with some low income and some prosperous households. It has weathered the recession relatively well. In 2011, its income per head was £23,687 compared to £22,369 for South East England. It has a high proportion of population with tertiary education, 47 per cent in 2012 compared to 34 per cent as the UK average, coupled with a very high level of specialisation in knowledge-based sectors such as education, research and development, book publishing and high technology design and manufacturing. Recent years have seen strong growth in wages and profits and in information and communication, manufacturing and household services, while construction and real estate activities have declined. It has not enjoyed the rapid growth in research employment seen in Cambridgeshire; employment in this sector in Oxfordshire grew by only 1 per cent from 2008 to 2010 compared to 23 per cent in Cambridgeshire.

Low carbon sectors generated £1.15 billion worth of sales in Oxfordshire in 2013 and employed 8,900 workers. These sales account for 7 per cent of gross value added in 2011. Between 2011 and 2013, sales and employment increased by 10 per cent and 5 per cent, respectively.

Oxfordshire’s carbon emissions have declined at a lower rate than the UK’s emissions between 2005 and 2011; total carbon emissions have decreased by 14 per cent in Oxfordshire and 17 per cent in the UK. If the current trends continue, Oxfordshire will fall further behind the rest of the country. A 50 per cent reduction target in carbon emissions by 2030 relative to 2008 levels will improve Oxfordshire’s position compared to other regions in the UK. Direct emissions from housing per capita would fall from 1.1 tCO$_2$ in 2011 to 0.6 tCO$_2$ in 2030, which is below the projected UK average, leading to significant energy savings. Emissions from the transport per capita would decline from 2.9 tCO$_2$ to 0.9 tCO$_2$ in 2030, slightly below the UK’s projected average.

Industrial and low carbon performance

There are clusters in high technology manufacturing of computing equipment, medical imaging equipment, chemicals, vehicles and scientific research. There is also a cluster in publishing and comparative advantage in building technologies. In some of these clusters, there have been high levels of productivity growth, which makes rising wages possible, led by medical instruments and computer related activities, but automotive, publishing and research and development have exhibited low rates of productivity growth in recent years, due to weak demand for new vehicles and the transition from paper to e-publishing. In addition, Oxfordshire has significant activity in a number of sectors which are likely to grow in response to demand for low carbon goods and services. Its greatest strength is in buildings technologies and nuclear power services, and it also has significant activities in wind energy, alternative fuels and alternative fuel vehicles.

Business and growth opportunities
National and global efforts to abate greenhouse gas emissions will bring forward large investments in new technologies and services to support them. Oxford has strong positions in nuclear and building technologies, which are or can be low carbon, and whose growth will include replacement and maintenance of existing assets. While it does not currently have relative advantage in any of the broad technology groups expecting the greatest growth, it has significant activity in PV and wind technologies, alternative fuels and alternative fuel vehicles. There are opportunities in these energy sources where global capacity is expected to double or triple by 2030, with alternative fuel vehicles offering particular promise because of its adjacency with the automotive sector, one of Oxfordshire’s existing strengths.

Clusters are important to income levels and growth in the future. They offer depth and liquidity in specialised employment, the scale to allow specialisation and diversity of size to enable rapid adoption and combination of innovations followed by deployment. In Oxfordshire, the large research and science base and high technology manufacturing clusters offer particular scope for adding value through innovation. Together with the demand for low carbon energy sources, the buildings and vehicles clusters may create opportunities for economic growth.

There can be a public role to support research and development, demonstration projects, and to part-pay for invention and the early costs of demonstration and deployment. The public involvement facilitates opportunities for collaboration between organisations and encourages higher levels of investment in innovation. Although clusters generate benefits for their members, without intervention there may not be strong incentives for individual members to seek out these coordination and early stage innovation benefits.

The case for decarbonising Oxfordshire’s infrastructure

There is considerable scope for cost-effective investment in decarbonising infrastructure across all sectors, to support economic growth and help meet carbon reduction targets. As action to reduce carbon emissions steps up, the unit costs of energy services will rise, compounding possible market trends to higher fossil fuel prices. Efficient use of energy through worthwhile investments and practices will free up resources for growth. Furthermore, emissions reductions in productive sectors will be necessary if public goals to reduce emissions are to be achieved, and there is considerable scope for cost-effective or cost-neutral investment in carbon reduction of infrastructure across the public, commercial, industrial, housing and transport sectors.

Oxfordshire’s road transport is around 30 per cent more carbon intensive than the England average and around 50 per cent more intensive than the top quartile, while its housing is around the average national carbon intensity and within less than 10 per cent of the top quartile nationally. These activities are two of the principal areas of household spending and of emissions. Both of them have become more carbon efficient over time; the transport figure faster than the national rate of improvement; the housing figure slipping back from a better-than-average position.

Energy costs are a high proportion of both transport and housing costs and evidence in the form of marginal abatement cost curves suggests that there is considerable scope for improved carbon efficiency in both transport and housing. In transport, improvements in the efficiency of vehicles can release resources for other uses. Many of these improvements pay for themselves in lower fuel bills, but the demands of mitigating emissions may create pressure for action which does not pay for itself. Costs can be
kept down in Oxfordshire by setting appropriate ambitions and planning ahead for efficient, low carbon infrastructure, and there are ways to assist market transformation by encouraging the adoption of appropriate technologies.

**In housing, energy costs are significant fraction of housing costs and proportion of disposable income, especially for lower income households.** The energy and carbon efficiency of housing stock is a priority, especially for poorer households. Here, the maintenance and enhancement of the existing housing stock and the building of new houses offer opportunities for energy savings and emissions reductions. An appropriate choice of measures and long-term anticipation of emission targets would enable the incorporation of low carbon measures at the time of refurbishment and new build, reducing costs overall and avoiding accumulation of a high carbon asset stock. This depends upon a market transformation which, if it is to be effective, will need public support, making use of the strengths of the cluster.
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1 Introduction

The aim of this report is to explain the relationship between low carbon investment in Oxfordshire and economic growth in the area and to discuss the strategic actions which will facilitate future growth.

The report is structured as follows:
− section 2 outlines the economy of Oxfordshire, its drivers of growth and the presents the carbon profile of the county;
− section 3 explains the relationship between low carbon economy and growth;
− section 4 presents some low carbon businesses opportunities for Oxfordshire;
− section 5 discusses future trends and scenarios for Oxfordshire; and
− section 6 suggests some policy and strategy actions to facilitate growth and transition to a low carbon economy.
2 State of the wider economy and low carbon economy

This section outlines the economy of Oxfordshire, identifies drivers of growth and the contribution of low carbon sectors, and describes the carbon profile of the county.

2.1 Outline of Oxfordshire’s economic portfolio

Oxfordshire is a knowledge-based economy with particular strengths in high technology manufacturing clusters. This sub-section paints the picture of its current economic profile with comparisons on a regional and national level.

2.1.1 Outline of Oxfordshire’s economy

Previous studies suggest that economic growth in Oxfordshire is innovation-led (SQW, 2013, Oxfordshire Economic Observatory, 2007). Oxfordshire has a knowledge-based economy and is one of Europe’s leading centres of enterprise and innovation. It has outstanding technology based assets including the University of Oxford, which is among the top universities in the world with outstanding research and teaching; and Oxford Brookes, one of the best performing new universities. It also has a group of large science and other research facilities along with a highly skilled labour force and a higher proportion of graduates than any other English county. Its governance system and business networks support enterprise and innovation.

High technology activities make a significant contribution to the overall economic activity in the county. The growth in high-tech activities has been accompanied by a considerable growth in non-high tech, knowledge based services such as financial, legal and business and management. In 2010, 55 per cent of Oxfordshire’s employees worked in knowledge intensive sectors (Oxfordshire County Council, 2012). High tech activities, in 2011 provided 6.2 per cent of Oxfordshire’s total employment; the comparable figure for England as a whole being 5.1 per cent (SQW, 2013).

Oxfordshire has four technology clusters formed by high tech firms, namely:

- bioscience, medical technology and pharmaceuticals;
- physics-related specialisms, including cryogenics, instruments and magnets;
- engineering and electronics, including motorsport; and
- telecommunications, computer hardware and software (SQW, 2013).

Analysis underlying this report indicates that Oxfordshire has great strengths in some of the above mentioned high skill, knowledge and creative sectors. The six most important sectors are manufacturing of computers, book publishing, manufacturing of chemical products, tertiary education, research and
development in natural science and engineering and manufacturing of motor vehicles. Altogether, these sectors employ 35,000 people, accounting for 11 per cent of the total employees in 2011.

2.1.2 Oxfordshire in comparison with the rest of the country

Oxfordshire’s performance across a range of headline economic indicators and on measures of enterprise and innovation compares favourably with South East and national averages. Some indicators are presented in Table 1. Oxfordshire’s economy grew consistently over the period 1997 to 2011, and its Gross Value Added (GVA) per person is well above the national average and slightly above Cambridgeshire (see Table 1). The number of unemployed in Oxfordshire has been consistently below national and regional averages. New enterprises in Oxfordshire have a higher survival rate than the average across the South East region and across England. Data from the Office of National Statistics indicates that Oxfordshire is ranked 7th in the country in terms of gross disposable household income.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Comparators</th>
<th>Oxfordshire</th>
<th>South East</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVA per person in 2011</td>
<td></td>
<td>£23,687</td>
<td>£22,369</td>
<td>£21,349</td>
</tr>
<tr>
<td>New enterprise survival rate in 2010 (for 5 years)</td>
<td></td>
<td>55%</td>
<td>47%</td>
<td>44%</td>
</tr>
<tr>
<td>Percentage of micro firms (employing 9 or fewer people) in 2011</td>
<td></td>
<td>89</td>
<td>90</td>
<td>89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Comparators</th>
<th>Oxfordshire</th>
<th>Berkshire</th>
<th>Cambridgeshire</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVA per person in 2011</td>
<td></td>
<td>£23,687</td>
<td>£33,011</td>
<td>£22,864</td>
</tr>
<tr>
<td>Gross disposable household income per head in 2010</td>
<td></td>
<td>£17,880</td>
<td>£18,010</td>
<td>£16,854</td>
</tr>
</tbody>
</table>


Oxfordshire has the third highest concentration of research and development workers in the country after Cambridgeshire and Hertfordshire (see Table 2). However, there was little growth in Oxfordshire in this sector between 2008 and 2010, only 1 per cent, compared to 23 per cent in Cambridgeshire.
Table 2. Employees in research and development

<table>
<thead>
<tr>
<th>County/ London borough</th>
<th>2008</th>
<th>2010</th>
<th>Change in number</th>
<th>Change, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridgeshire</td>
<td>8,795</td>
<td>10,851</td>
<td>2,056</td>
<td>23</td>
</tr>
<tr>
<td>Hertfordshire</td>
<td>6,226</td>
<td>6,487</td>
<td>261</td>
<td>4</td>
</tr>
<tr>
<td>Oxfordshire</td>
<td>5,974</td>
<td>6,057</td>
<td>83</td>
<td>1</td>
</tr>
<tr>
<td>Camden</td>
<td>6,128</td>
<td>5,426</td>
<td>-702</td>
<td>-11</td>
</tr>
<tr>
<td>Bracknell Forest</td>
<td>4,389</td>
<td>4,516</td>
<td>127</td>
<td>3</td>
</tr>
<tr>
<td>Kent</td>
<td>4,495</td>
<td>4,506</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Hampshire</td>
<td>4,662</td>
<td>4,382</td>
<td>-280</td>
<td>-6</td>
</tr>
</tbody>
</table>

Note: This sector includes biotechnology and the natural sciences and engineering but does not include manufacturing.
Source: Business Register and Employment Survey (BRES)

Despite its performance across a range of economic indicators mentioned above, some prior studies identify several growth related challenges facing Oxfordshire (Oxfordshire Local Enterprise Partnership, 2013; Oxfordshire Partnership, 2009; SQW, 2013). First, the growth in its knowledge intensive economy is slower than its competitors. Second, it has poor infrastructure such as congestion on its roads, slow broadband and poor mobile phone access which reduce productivity. Third, Oxfordshire is not attractive to inward investment; only 3 per cent of South East jobs from Foreign Direct Investment were located in the county between 1999 and 2010 as compared to 16 per cent in Surrey and 15 per cent in Buckinghamshire. Fourth, high house prices and limited housing supply may contribute to the fact that Oxfordshire’s workforce is ageing more quickly than the national average. Lastly, despite the county’s success in producing high tech start-ups, Oxfordshire has produced few businesses that have scaled up to become ‘large’ businesses. This is important as growth in GVA is associated with businesses scaling up from medium to large size.

2.1.3 Comparative advantage of Oxfordshire

Comparative advantage is an important indicator that shows the relative strength of the economy in particular sector. The revealed comparative advantage coefficient for an industrial sector in the regional Oxfordshire economy relative to the economy of England is can be defined as:
The local economy enjoys specialisation in sectors with high comparative advantage coefficients. Any effort to promote low carbon growth in Oxfordshire may seek to identify and build on existing strengths of the local economy. Two types of organisational arrangement can help firms grow faster: clusters and networks, and concentrations of high technology and knowledge intensive sectors suggests the presence of high tech clusters. Firms which operate in such clusters enjoy a variety of benefits including access to a highly skilled labour force, benefit from spill over effects in public and private scientific research and development, inter-disciplinarian R&D and innovation complementarity, scale of production and networks.

**Oxfordshire’s economy enjoys a high degree of specialisation in creative, knowledge intensive and high tech sectors, with the six most important sectors employing 35,000 workers, accounting for 11 per cent of total employees in 2011.** The six sectors with highest comparative advantage, see Figure 1 and Figure 17, are:

- manufacturing of computers and peripheral components, with a score of 10.9;
- book publishing (10);
- manufacturing of chemical products (7);
- tertiary education (4.7);
- research and development in natural science and engineering (4); and
- manufacturing of motor vehicles (4).

Other creative sectors with a strong presence in Oxfordshire include market research and public opinion polling (4.6) and advertising agencies (2.8).
Figure 1. **Oxfordshire has comparative advantage in high skilled, creative and knowledge intensive sectors**

Note: Size of circle indicates the relative size of employment for the sector.

Source: Vivid Economics based on BRES data

High tech industries accounted for 4,000 and 4,600 jobs in Oxfordshire in 2011 and 2012, respectively, while 10,500 and 9,400 persons were employed in the medium high-technology sectors.¹ Table 7 gives a snapshot of the number of people employed in the high skilled and knowledge intensive sectors in Oxfordshire and England in 2011. Specialisation in high skilled sectors means a greater likelihood of high tech clusters forming, due to high concentration of skilled labour.

A more detailed analysis of high skill and knowledge intensive sectors in 2012 reveals that the highest levels of comparative advantage are in:
- manufacture of other chemical products (6);
- manufacture of irradiation, electro-medical and electrotherapeutic equipment (4.7);
- scientific research and development (4.4); and
- manufacture of motor vehicles (4).

Figure 2 shows the distribution of jobs created in the high skilled and knowledge intensive sectors, in which the Oxfordshire economy specialises. The sectors most likely to benefit from low carbon growth are manufacturing of motor vehicles, scientific R&D, which includes R&D on natural science, R&D on engineering and technology and interdisciplinary R&D. Higher global demand for low carbon goods, efficient energy systems, new technology for renewable energy and higher demand for alternative fuel vehicle may promote innovation and growth in Oxfordshire.

¹ High skilled and knowledge intensive sector definitions were taken from EUROSTAT.
2.1.4 Drivers of growth in Oxfordshire

Oxfordshire’s share of GVA in the UK economy has grown considerably from slightly over 1 per cent in 1997 to 1.14 per cent in 2010. This corresponds to a total real GVA growth figure of 46 per cent for Oxfordshire compared to 31 per cent for the UK. The highest growth rates occurred in the information and communication, manufacturing and other services and household activities sectors. Real estate activities and construction have shrunk relative to the UK, over the same period (see Figure 3). The combination of higher growth in economic activities and lower level of construction and real estate activities also means that there is pressure on residential and commercial properties in Oxfordshire compared to UK averages.
Oxfordshire’s economy has been growing faster than the UK

Figure 3.

Most sectors where Oxfordshire holds a comparative advantage have a high level of labour productivity. Figure 4 shows labour productivity, measured as GVA per number of employees in 2007 and labour productivity growth between 1990 and 2007 for broad economic sectors in the UK. Median GVA per employee was £46,000 in 2007, while median productivity growth was 2.45 per cent. Manufacturing of computer and office machinery and publishing sectors have had negative productivity growth, mainly due to sharp declines in prices of goods produced in these sectors. Motor vehicle and research and development sectors have high value added per person employed, however their labour productivity growth was below the median. Manufacture of medical, precision and optical instruments has a high GVA per employee and a high productivity growth. By supporting specialisation in motor vehicle research and development, Oxfordshire might increase total value added.
2.2 The low carbon economy in Oxfordshire

This subsection describes the contribution of low carbon sectors to Oxfordshire’s economy.

Oxfordshire has significant activity in a number of sectors which are likely to grow in response to demand for low carbon goods and services. Low carbon sectors generated £1.15 billion worth of sales in Oxfordshire in 2013 and employed 8,900 workers. Between 2011 and 2013, sales and employment increased by 10 per cent and 5 cent, respectively. The sectors with high growth potential are wind energy and alternative fuel vehicles, where currently 2,500 people are employed, accounting for 1.3 per cent of total employment in Oxfordshire in 2012. In addition, Oxfordshire has clear comparative advantage in building technologies (see Figure 5), with high level of employment in this sector due to activities in building insulation. Building technologies employ 1,800 people, accounting for 0.6 per cent of total employment in Oxfordshire in 2012 (see Table 3).

Low carbon building technology can be a major source of employment for Oxfordshire in the future. The strategic housing market assessment for Oxfordshire concludes that approximately 100,000 additional homes are needed across Oxfordshire in the period 2011-2031 (GL Hearn, 2014). This implies high demand for low carbon housing (and low carbon housing technologies such as building insulation for refurbishment and improvement of its existing stock) as Oxfordshire works towards its emissions targets.
Alternative fuels, wind and alternative fuel vehicles are the other low carbon sectors with notable levels of activity in Oxfordshire. Figure 5 suggests that Oxfordshire holds a slight comparative advantage in wind (mainly manufacture and supply of systems and equipment for installation elsewhere) as compared to England. Alternative fuelled vehicles are in their early phase of deployment globally and present significant opportunities for Oxfordshire in future. This is discussed further in section 3.3, which shows that alternative fuels and alternative fuel vehicles are in an early phase of development and hence provide significant opportunities.

Figure 5. Among low carbon goods and services, Oxfordshire has the greatest comparative advantage and scale in building technologies

Source: kMatrix, 2013 and Vivid Economics
**Table 3.** Major low carbon and environmental sectors employed 10,500 workers in 2013

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Building technologies</td>
<td>240</td>
<td>9</td>
<td>11</td>
<td>1,800</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Alternative fuels</td>
<td>210</td>
<td>8</td>
<td>10</td>
<td>1,700</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Wind</td>
<td>190</td>
<td>14</td>
<td>18</td>
<td>1,300</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Alternative fuel vehicle</td>
<td>160</td>
<td>9</td>
<td>12</td>
<td>1,200</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Geothermal</td>
<td>100</td>
<td>12</td>
<td>11</td>
<td>770</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Water supply and waste water treatment</td>
<td>90</td>
<td>4</td>
<td>5</td>
<td>770</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Recovery and recycling</td>
<td>90</td>
<td>9</td>
<td>9</td>
<td>680</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Waste management</td>
<td>65</td>
<td>7</td>
<td>6</td>
<td>570</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Nuclear power</td>
<td>60</td>
<td>4</td>
<td>6</td>
<td>530</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Biomass</td>
<td>60</td>
<td>10</td>
<td>12</td>
<td>510</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Photovoltaic</td>
<td>50</td>
<td>12</td>
<td>15</td>
<td>380</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Energy management</td>
<td>35</td>
<td>9</td>
<td>8</td>
<td>300</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

**Note:** Projected sales growth rates are obtained from K-matrix, employment growth rates are adjusted sales growth rates for labour productivity change between 2011 and 2013. CA is coefficient of revealed comparative advantage.

**Source:** Vivid Economics based K-Matrix data

Given Oxfordshire’s population, the size of its low carbon economy is smaller than that of most other Local Enterprise Partnerships (LEPs) in the UK. Figure 6 shows that Oxfordshire’s low carbon economy in 2012 is in the bottom quartile of all LEP’s in the UK. There were 570 firms operating in this sector in Oxfordshire, compared to 47,000 firms in the UK. Meanwhile, Greater Cambridgeshire and Greater Peterborough LEP registered double the sales figures, number of firms and employment figures of Oxfordshire LEP. After adjusting for population, Oxfordshire’s LEP generated £2,000 worth of low carbon and environmental goods and services per capita and employed 1.6 per cent of the population in these sectors in 2012, while Greater Cambridgeshire and Greater Peterborough LEP performed only slightly better, generating £2,500 worth of sales per person and employing 1.8 per cent of the population.
A more detailed analysis of the low carbon and environmental sectors in Oxfordshire reveals that Oxfordshire has its high comparative advantage in subsectors relating to technologies and research and development in several low carbon applications. The biggest low carbon employers are biofuels, alternative fuel vehicle manufacture, insulation and heat retention materials and wind farm systems, where 4,000 persons were employed in 2013 as shown in Table 8 in the appendix. Four strong sectors with high growth potential in a low carbon scenario emerge out of the analysis based on high number of current employees, comparative advantage and high growth:

- alternative fuel vehicles;
- wind and photovoltaic energy, especially activities relating to systems and equipment;
- insulation and heat retention materials, mainly activities relating to building insulation services, this sector has a particularly high comparative advantage index of 2.3;
- activities related to technologies and research and development in engineering.

Note: based on available data for regional LEP’s in 2012
Source: K-Matrix
2.3 Carbon profile of Oxfordshire

This sub-section presents the profile of carbon emissions for Oxfordshire.

2.3.1 Carbon profile

Carbon emissions per capita were 8 tCO₂ in Oxfordshire in 2011, a little higher than the average for England, 7 tCO₂ per capita. Oxfordshire’s highest emitting sector is transport, which accounts for almost 40 per cent of all CO₂ emissions. Table 4 shows carbon emissions by economic sector for Oxfordshire and England, as well as share of emissions. Local road transport contributes to total emissions proportionally more in Oxfordshire than in the rest of the country. It accounted for 17 per cent of total CO₂ emissions, while the same sector accounted for only 12 per cent in England. Although these figures do not adjust for population dispersion, urban profile and domestic income of Oxfordshire, it is evident that any CO₂ abatement strategy should address local transport. By reducing this component of CO₂ emissions, Oxfordshire may deliver energy cost savings for the local population, which, in turn, can increase disposable income and demand for local goods and services.

Industrial and commercial emissions accounted for 35 per cent of total emissions in Oxfordshire and 41 per cent of England’s total emissions, respectively. Oxfordshire’s industrial and commercial sectors are, as a whole, more carbon productive than in the rest of England. However, a closer inspection indicates that, after excluding large industrial installations, the rest of the productive sector is slightly less carbon productive. Sixty two per cent of Oxfordshire Gross Value Added (GVA) came from services in 2010, compared to 60 per cent in England, so cost-effective improvement of the energy efficiency of commercial, public and administrative buildings would also be an advantage. The proportion of total emissions from housing is the same in Oxfordshire as it is in England.
Table 4. Oxfordshire County has a higher emission per person than England, carbon dioxide emissions, ktCO$_2$/year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Oxfordshire</th>
<th>England</th>
<th>Oxfordshire (%)</th>
<th>England (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry and Commercial Electricity</td>
<td>1,125</td>
<td>72,662</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>Industry and Commercial Gas</td>
<td>390</td>
<td>28,284</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Large Industrial Installations</td>
<td>18</td>
<td>27,968</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Industrial and Commercial Other Fuels</td>
<td>197</td>
<td>12,908</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Agricultural Combustion</td>
<td>53</td>
<td>2,524</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Industry and Commercial Total</strong></td>
<td>1,782</td>
<td>144,345</td>
<td>35</td>
<td>41</td>
</tr>
<tr>
<td>Domestic Electricity</td>
<td>630</td>
<td>46,850</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Domestic Gas</td>
<td>563</td>
<td>50,570</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Domestic 'Other Fuels'</td>
<td>170</td>
<td>6,827</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Domestic Total</strong></td>
<td>1,362</td>
<td>104,248</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>Road Transport (A roads)</td>
<td>850</td>
<td>43,277</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Road Transport (Motorways)</td>
<td>452</td>
<td>24,407</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Road Transport (Minor roads)</td>
<td>399</td>
<td>31,915</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Diesel Railways</td>
<td>85</td>
<td>1,932</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Transport Other</td>
<td>82</td>
<td>1,776</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Transport Total</strong></td>
<td>1,868</td>
<td>103,307</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td>LULUCF Net Emissions</td>
<td>25</td>
<td>2,127</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>5,037</td>
<td>354,027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population ('000s)</td>
<td>655</td>
<td>53,107</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per Capita Emissions (t)</td>
<td>8</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Emission figures are in ktCO$_2$

**Source:** Vivid Economics based on DECC regional CO$_2$ emissions data

Oxfordshire ranked 45$^{th}$ of counties in the UK in terms of carbon productivity in 2011 and is located in the second quintile of UK regional carbon productivity. Figure 7 suggests that Oxfordshire’s carbon profile could be improved substantially, and any carbon reduction strategy might seek to improve the county’s regional ranking, improving competitiveness.
2.3.2 Carbon emissions trend

Over the period 2005 to 2011 Oxfordshire’s total emissions declined by 14 per cent, while UK emissions fell by 17 per cent. Much of this change might be attributed to recession. Industrial and commercial emissions have fallen by 18 per cent, while the UK emissions fell by 22 per cent. The local transport sector has fallen by 9.6 per cent against 8.9 per cent for the UK. Given recent performance, business-as-usual (BAU) emissions for Oxfordshire could remain proportionally higher than UK emissions.

Oxfordshire has performed well in reducing its emissions since 2008. Figure 8 shows two possible targets for Oxfordshire to 2030. Target 1 is a 27 per cent reduction in emissions on 2008 levels, consistent with the UK’s target, and target 2 is a more ambitious reduction in emissions of 50 per cent on 2008 levels. The targets are discussed in further detail in section 5. Oxfordshire’s emissions in 2011 were slightly below the path to achieve target 2 in 2030, but as mentioned above, a significant proportion of this decrease could be attributed to the recession. When the economy recovers, Oxfordshire may have to increase its efforts if it is to keep up with national progress in reducing emissions. This is a tentative conclusion because of the unusual economic circumstances between 2005 and 2011.
Between 2005 and 2011, Oxfordshire’s carbon emissions per person have declined by 17.9 per cent from 9.4 tCO₂ to 7.9 tCO₂: Oxfordshire’s emissions reduction performance was in the bottom quartile of all counties in England and Wales. The median decline was 20.5 per cent and the top quartile rate was 18 per cent. In the residential and transport sectors, emissions per person fell by 8 and 19 per cent, respectively, whereas for England they fell by 10 and 21 per cent. Many factors have led to the fall in carbon emissions between 2005 and 2011. One of the most severe recessions in recent history hit the global economy and coupled with record energy prices, energy consumption fell sharply between 2005 and 2011. Gross disposable household income per capita in England increased by a meagre 1.17 per cent over the entire period, whereas in Oxfordshire, it grew by a slightly lower rate, 1.07 per cent. Median growth rate for counties in England and Wales was 0.57 per cent. Also, between 2005 and 2011, average domestic gas and electricity bills increased by 77 per cent and 44 per cent in real terms, whereas retail prices of road fuels increased by an average of 35 per cent in real terms. Given the relatively modest fall in Oxfordshire’s carbon emissions per capita, and its average real Gross Domestic Household Income (GDI) per capita growth, its energy efficiency has not kept up with that of the rest of the country.
3 Low carbon economy and growth

This section examines the relationship between low carbon investment and economic growth

3.1 Likely role of green economy in accelerating growth in future

Growth in an economy comes from increases in either input resources or improved productivity. These can be achieved by either an increase in labour, capital or by using an improved combination of inputs (technology).

A low carbon economy can generate local opportunities in three areas: natural capital, lower share of inputs and expanding demand. It can have three effects. First, it can increase the capital stock thereby generating greater value of natural capital such as renewable energy resources. Second, it can lower the intensity of inputs such as fuel and allow for more consumption of final goods and services (improvement in technology). Third, it can expand demand for exports from the economy as demand shifts from high towards low carbon goods and services as improved technology leads to comparative advantage.

It can also generate other benefits for a much wider geography. Some of these include lower costs of environmental deterioration in the long run, less constraint on growth from finite low cost hydrocarbon resources, cleaner air and reduction in other externalities for example to health, and possible reduction in fuel poverty.

3.2 The low carbon economy and growth in Oxfordshire context

Low energy costs are essential for a high standard of living as it leaves a higher disposable income to be spent on other goods and services. This sub-section presents these costs for Oxfordshire specifically for housing and transport (cars and vans) sectors in comparison with England. Some possible opportunities for Oxfordshire in low carbon goods and services at a global scale are summarised. Finally, it explains the relationship between clusters, innovation, externalities and growth.

3.2.1 Costs of energy and standard of living in Oxfordshire

Total annual energy costs per capita in Oxfordshire are about 7 per cent of gross disposable income. The comparable number for both England and the South East of England is 6.6 per cent, indicating that Oxfordshire has slightly higher than average energy costs.

Oxfordshire has higher energy costs per capita for transport as compared to England as a whole; it has similar per capita energy costs for housing. For transport, the costs are 4.4 per cent of gross disposable income for Oxfordshire as compared to 3.7 per cent for England. Figure 9 shows that costs of transport are much higher for Oxfordshire. For housing, the costs are 2.5 per cent and 2.8 per cent respectively.
Although greater carbon efficiency will confer advantage, the effect may be modest because the savings will be small relative to income for most activities and households. Figure 18 in the appendix, shows the carbon cost as a proportion of the level of economic activities in the industrial and residential sectors. While Oxfordshire has a relatively high cost compared to the rest of the UK, the level of the costs themselves are too low to provide strong financial incentives for decarbonisation. Any strategy that relies on a rising energy and carbon prices is likely to result in limited abatement effort, so other policy interventions, such as buildings standards, will be needed alongside prices.

Oxfordshire has wide income inequalities implying that energy costs for the poor are a higher proportion of their income than mentioned above. The median wage in Oxfordshire in 2011 was £24,065 compared to a mean of £31,175\(^2\), with the bottom 10 percentile earning an average wage of less than £7,357. This suggests that energy costs as a percentage of wages are much higher for the bottom decile.

**Figure 9.** Oxfordshire has high energy costs for transport compared to the rest of the country

![Energy costs of transport per person per year (£)](image)

**Note:** Data are not adjusted for urban/rural profile, income and weather. Transport costs are defined as costs for cars and vans.

**Source:** Vivid Economics

### 3.2.2 Opportunities for Oxfordshire in low carbon goods and services

National and global efforts to abate greenhouse gas emissions will bring forward large investments in new technologies and services to support them. The International Energy Agency indicates that the global
capacities for some of these technologies will increase several-fold by 2030. Although Oxfordshire has not obtained a particular specialisation in any of the broad technology groups expecting the greatest growth, it does have strong positions in some.

As discussed above, Oxfordshire has notable strengths in building technologies and nuclear power along with alternative fuels, wind and alternative fuel vehicles. Together with its large research and science base, the high tech clusters of Oxfordshire and demand for low carbon energy sources, some of these technologies, in particular buildings and vehicles may create opportunities for growth in the future. This is discussed in further detail in section 5.

3.2.3 Clusters, innovation and externalities

Innovation is important for growth; its final outcomes are improvements in quality or lower costs of production or both (see Figure 10). The innovation process spans four phases as shown in Figure 10. The first phase is research and development leading to invention, the second phase involves a demonstration to test the invention, the third phase entails commercialisation by introducing it to market, and lastly the fourth phase is widespread use and adoption.

Figure 10. A framework for classifying innovation

Innovation, broadly conceived, includes improved or new products, materials, processes or technologies and business models that are either new to the world (novel), new to a region or business (imitative) or new to the field of endeavour, that is, repurposed (adaptive).

Clusters offer particular scope for adding value through innovation. A cluster is a geographic concentration of interconnected businesses, suppliers and associated institutions in a particular field. They allow for depth and liquidity in specialised employment, the scale to allow specialisation and diversity of
size to enable rapid adoption and combination of innovations followed by deployment. Clusters also lead to information transfer through close proximity and provide a liquid labour market.

As shown in Figure 11, a typical innovation route is that universities obtain funds from the government to carry out the early research and development. This is commercialised by small companies; the presence of a cluster in this phase accelerates the pace of commercialisation. These small suppliers either license their innovations to big companies or become acquired by them, leading to widespread use and adoption.

**Figure 11. Roles in innovation**

![Roles in innovation](source: Vivid Economics)

Innovation can generate benefits for various parties. There are benefits for the innovating firm (private), benefits for both rival and non-rivals in other sectors (public) and benefits for consumers.

The share of public benefits depends on the size of the innovating firm, the level of protection of intellectual property and the presence of a cluster. If the innovating firm has a large size, a larger share of the benefits from the innovation accrues to the firm itself. Similarly, public benefits are lower if the innovating firm can protect its intellectual property effectively. Clusters, as discussed above, lead to faster transmission and adoption of innovations. The automotive cluster of Oxfordshire has some of the world’s leading firms; they have effective intellectual property protection and can capture significant benefits from innovation. It is likely that they still generate real benefits to rivals as the presence of a cluster leads to quick adoption of improved technologies.

The transfers and spill overs of innovation or technology to other sectors (non-rivals) depend on the specificity of the innovation. Spill overs are expected to be high if the innovation has multi and general purpose attributes and uses. (Spill overs are benefits of economic activity that affect those who are not directly involved.) Combinatorial technologies can lead to rapid and high value addition as they can be used in joint production. For example, Oxford University spin-out Oxford Photovoltaics has pioneered the development of solar cells which can be printed onto glass and thereby integrated into the glazing units and services of a building.
Where Oxfordshire does not contribute to new innovations in certain sectors, it can adopt new technologies. As an example, Figure 12 shows growth in the rate of innovation in insulation globally, requiring the construction labour force to become adept in new technologies and approaches. The leading areas for patents in insulation are Germany, France and Belgium. Although the innovation does not originate in the UK, and specifically Oxfordshire, construction workers in the county will have access to these advances.

![Figure 12. Rising rate of innovation in insulation since 2002](chart)

Source: OECD

### 3.3 Key conclusions from sections 2 and 3

Oxfordshire has existing strengths it can play to. These are the four high tech clusters along with knowledge based and creative sectors. It possesses advantage in automotive and certain low carbon sectors such as building technologies, alternative fuels, wind and alternative fuel vehicles.

Efficient and alternative fuel vehicles and building technologies present some of the fastest growth opportunities for Oxfordshire. The science and research base, coupled with the presence of related high tech clusters and high global demand for low carbon opportunities, makes them attractive.

Oxfordshire can improve its energy efficiency, and so increase the share of income that is disposable for its population. High energy costs reduce the proportion of income that can be spent on final goods and
services. Oxfordshire households on low incomes will experience the most benefit from improvements in efficiency.

**Investing in innovation and skill development lays foundations for growth. Innovation underpins growth and future incomes.** Oxfordshire can develop the skills of its labour force, particularly in building technologies, to adopt new global technologies and approaches.
4 Business opportunities

The automotive sector, building technology and insulation, have great potential to grow in the transition to a low carbon economy in Oxfordshire

4.1 Low carbon goods and services growth potential

Low carbon goods and services have strong potential for growth in Oxfordshire and between 2014 and 2016 sectors where Oxfordshire holds a comparative advantage could create up to 700 new jobs. In 2013, building technology especially activities related to insulation, manufacturing of alternative fuel vehicle, wind and photovoltaic energy and activities relating to engineering and technology R&D employed 5,000 workers and generated £680 million worth of sales. The growth projections are based on direct sales projections and adjusted for labour productivity. Longer horizon projections are harder to obtain and are only indicative of trends to 2030.

4.2 IEA technology projections of future trends and opportunities for low carbon technologies

The International Energy Agency technology perspective spans future demand scenarios for low carbon technologies, including alternative fuel vehicle and capacity of renewable energy. Electric vehicles (EV) and plug-in hybrid EV (PHEV) are assumed to reach annual sales of 33 million units by 2030; in 2012 only 80,000 vehicles were sold. Capacity of wind energy increases from 158 GW in 2012 to 1,200 GW in 2030. Photovoltaic capacity is projected to increase from 22 GW to 704 GW over the same period. These three sectors have a very large growth potential: alternative fuel motor vehicles, wind energy, building technology. Promising sectors have strong presence in Oxfordshire with high levels of employment, a high degree of specialisation and/or high potential for growth. Figure 13 shows the comparative advantage of the low carbon and environmental sectors in Oxfordshire, plotted against the development stage of the technologies. Although the photovoltaic sector is not a sector where Oxfordshire holds comparative advantage, it does have a degree of specialisation in related systems and equipment.

The motor vehicle cluster in Oxfordshire and other high tech sectors can lead innovation in alternative fuel vehicles. Oxfordshire has a large automotive and motor sport cluster as well as a large ICT sector. It also has a strong presence in scientific R&D, space technologies and the composites industry. Electric vehicle technology is at an early stage of adoption and will require a great deal of investment, R&D and innovation. Oxfordshire with its strong high tech clusters can benefit from the growth potential offered by this sector. The presence of a large motor vehicle manufacturer can create demand for investment in automotive R&D and innovation. Oxfordshire can take a lead in demonstrating EVs as an option for local road transport. At some point, it may require investment in charging stations and basic infrastructure to support adoption of electric vehicles.
Building technologies and insulation can play a role in Oxfordshire’s low carbon economy strategy. Oxfordshire has a clear comparative advantage in the building insulation sector with a coefficient of 2.3 and 1,000 workers out of a total 36,000 in the UK based in Oxfordshire in 2013. It also has comparative advantage in the roofing industry. Wall and roof insulation and roof top photovoltaic installation might create medium skill employment opportunities. Oxfordshire can foster skills used to build low carbon houses and could support business models and building processes by sponsoring demonstration projects, industry networks and specialised clusters. The plan to build 100,000 new homes by 2030 offers a platform to create demand at scale for this cluster. Oxfordshire is also home to the first ‘eco town’ project in the UK, with 5,000 homes, a school, community centre and a business centre.
5 Future trends and scenarios

This section sets out two carbon reduction scenarios for Oxfordshire using national pathways and targets and analyses the impact on the economy.

5.1 Committee on Climate Change pathways and local target

The Committee on Climate Change (CCC), in its updated assessment of the cost-effective path to 2030, proposed emissions targets for the UK. It indicates that the total greenhouse gas emissions for the UK have to be cut to 63 per cent of 1990 levels or to 370 MtCO$_2$ in 2030 (Committee on Climate Change (UK), 2013a).

The CCC’s fourth budget sets individual targets to 2030 for the residential and transport sectors of the UK. Direct emissions target for the residential sector is about 61 MtCO$_2$, a 17 per cent reduction by 2030 on 2012 levels. For the transport sector, the target emissions level in 2030 is 68 MtCO$_2$, a 42 per cent reduction from 2012 (Committee on Climate Change (UK), 2013a).

A local emissions reduction target for Oxfordshire established by the Oxfordshire Partnership is used along with the CCC pathways while creating scenarios. According to its report (Oxfordshire Partnership, 2009), the county’s greenhouse gas emissions should be reduced by 50 per cent on 2008 levels by 2030 to reach an emissions level of approximately 3 MtCO$_2$ per year.

The fourth budget of CCC gives baseline emissions for the UK in 2030, which is taken as a business as usual scenario in this report. Under business as usual (BAU), the UK’s carbon emissions in 2030 will be approximately 450 MtCO$_2$, a 23 per cent reduction on 1990 levels. For residential (direct emissions) and transport sectors, the baseline emissions are 88 MtCO$_2$ and 115 MtCO$_2$ respectively (see Table 9).

5.2 Scenarios for Oxfordshire

Currently, Oxfordshire’s per person emissions for the residential sector are comparable to the UK but its transport emissions are much higher. Figure 14 shows that Oxfordshire’s per person emissions in 2011 were 1.12 tCO$_2$ for residential and 2.85 tCO$_2$ for transport; the corresponding figures for the UK were 1.14 tCO$_2$ for residential sector and 1.96 tCO$_2$ for transport.

To catch up with the top quartile counties in the UK for both sectors, Oxfordshire would have to reduce its transport emissions per person by 22 per cent and residential emissions per person by 2.4 per cent (see Figure 19).

There are two business as usual scenarios for Oxfordshire. In the first scenario, BAU 1, Oxfordshire’s emissions grow at the same rate as the UK’s, which is around 3 per cent between 2011 and 2030. In the
second, called BAU 2, Oxfordshire’s trend relative to the UK continues its historical relationship to 2030, rising by about 14 per cent between 2011 and 2030. Table 9 shows the baseline emissions underlying the two BAU scenarios.

The baseline or BAU estimates for both Oxfordshire and the UK can be translated into transport and residential sector emissions estimates per capita (see Table 9). For the UK, this is done by dividing the sectoral baselines by estimated population in 2030. For Oxfordshire, the sectoral baselines are obtained by multiplying total baseline emissions of the county by the expected proportion of transport and residential sector emissions in 2030\(^3\). These are then divided by the estimated population of Oxfordshire in 2030 to arrive at per person emissions.

This report considers two emissions level targets for Oxfordshire in 2030 as shown in Table 9. To achieve the first target, target 1, Oxfordshire has to reduce its emissions by an equivalent percentage as the UK, a reduction of 37 percent on 1990 levels or 27 per cent on 2008 levels by 2030. Accomplishing the second, target 2, requires Oxfordshire to cut its emissions by 50 per cent on 2008 levels.

The two scenarios constructed for Oxfordshire for 2030 are therefore as follows (see Figure 19 and Figure 18):

- it achieves target 1 by reducing its emissions by 27 per cent on 2008 levels (relative to BAU 2); and
- it achieves target 2 by reducing its emissions by 50 per cent on 2008 levels (relative to BAU 2)\(^4\).

By achieving target 2, Oxfordshire aligns its transport emissions per person with the UK’s and has lower per person residential sector emissions (see Figure 19 and Figure 18). Oxfordshire’s transport emissions per capita, on meeting target 2, are 0.93 \(\text{tCO}_2\), slightly lower than the UK’s 2030 target. Its residential emissions per person on the other hand are 0.62 \(\text{tCO}_2\), much lower than the UK’s of 0.88 \(\text{tCO}_2\). See Section 5.5 for a discussion of policies and targets.

In the scenario where Oxfordshire only meets target 1, it has much higher transport emissions per person than the UK; residential sector emissions per person would also be higher than the UK (Table 9 in the appendix and Figure 19 and Figure 18).

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\(^3\) These are estimated to be approximately 18 per cent for residential direct emissions and 34 per cent for transport sector emissions. They are calculated by adjusting the average shares of each sector over 2005-2011 in Oxfordshire’s emissions, by the UK trend of these sectoral shares between 2011 and 2030. For the UK, the proportion of residential emissions (in total emissions) increased by 3 per cent between 2011 and 2030, and the proportion of transport emissions decreased by 1 per cent.

\(^4\) By taking BAU 2 as baseline, this report is constructing the extreme scenarios as in the BAU 2 scenario, Oxfordshire’s emissions are diverging from the UK for both transport and residential sector.
5.3 Marginal abatement cost curves for residential and transport sectors

The Committee on Climate Change (CCC) presents marginal abatement cost (MAC) curves for the residential and transport sectors of the UK to 2030. A MAC curve lays out a set of options available to an economy to reduce pollution. MAC curves give useful insights but carry assumptions embedded in both the unit cost and quantity of abatement estimates.

These UK level MAC curves are scaled down to produce MAC curves for Oxfordshire. This is done by adjusting the 2030 abatement opportunities at the UK level for the level of activity in Oxfordshire and for the emissions intensity of Oxfordshire relative to the UK. The activities mentioned on the national MAC curves are then filtered to keep only the ones under local control or influence. The adjustments are done using the following formula:

\[
2030 \text{ Abatement opportunity in Oxfordshire for sector}_i = \frac{2030 \text{ abatement opportunity in UK for sector}_i \times \left(\frac{\text{emissions intensity of Oxfordshire}}{\text{emissions intensity of the UK}}\right)_i \times \left(\frac{\text{GVA of Oxfordshire}}{\text{GVA of UK}}\right)_i}{\text{adj}}
\]

\[^5\] The CCC has collected data for transport sector abatements to 2030. Vivid obtained this data and created a UK level MAC curve.

Note: The 50 per cent target emissions (target 2) are also adjusted for urban/rural profile, income and weather

Transport sector emissions include motorways

Source: Vivid Economics
According to the residential sector MAC curve for Oxfordshire, the potential annual abatements in energy efficiency measures to 2030 are around 22 per cent of 2011 residential emissions or 300 ktCO₂ (see Figure 15). Of these, around 40 per cent are quite cost effective, with efficient lighting, cold appliances and TV (primary and secondary) being the top three measures. The total cost of all abatements net the benefits of cost efficient measures might be around £70 million in 2030 (in terms of 2013 money).

The transport sector MAC curve for Oxfordshire indicates that potential abatements to 2030 are about 700 ktCO₂, accounting for 55 per cent of 2011 road transport emissions in the county (see Figure 16). Almost 70 per cent of the emissions from light vehicles are cost effective. Most of the cost-effective measures include improved internal combustion engines, hybrid electric vehicles (HEV), plug-in electric vehicles (PHEV) and battery electric vehicles (BEV). Abatement costs are highest for small cars. The net benefit from carrying out all the abatement measures for the transport sector might be a saving of £13 million (in 2013 money).

Figure 15. Marginal abatement cost curve for residential sector for Oxfordshire to 2030

Source: Vivid Economics and (Committee on Climate Change (UK), 2013b)

\footnote{The intensity for the residential sector is calculated as the ratio of residential emissions to total number of households; for transport it is calculated as the ratio of road transport emissions to the number of cars and vans.}

\footnote{It is assumed that the ratio of intensities of Oxfordshire and UK remain the same in 2030 for both sectors. The GVA ratios are extrapolated by using a historic trend.}
5.4 Decarbonising residential sector and impact on the economy

Oxfordshire can use its strengths in building technologies to decarbonise its residential sector and meet the 2030 targets along with generating benefits for the economy. As discussed in section 2.2, Oxfordshire has a significant level of activity in building technologies and employed 1,800 people in 2013.

A low carbon approach to building additional dwellings, perhaps as many as 100,000 between 2011 and 2030, as recommended by the strategic market housing review, would help Oxfordshire to lock a low carbon future into a key part of its infrastructure, alongside the retrofit of the existing housing stock.

Low carbon housing would generate additional employment opportunities for the lower-skill workforce well represented in the building technologies sector. Historical data indicates that on an average 2.5 full time equivalent years are required to build a house in Oxfordshire. Constructing 100,000 houses over next 16 years means building 6,250 houses per year, which will employ 11,700 people annually after netting off 4,000 existing jobs. On average, it costs 10 per cent higher to build a low carbon house because of its greater complexity and it demands a higher skilled labour (Zero carbon hub & Sweett, 2014). This implies that a low carbon approach to new housing stock would employ about 1,200 additional people per year until 2030.

There would also be a need for further employment to refurbish and improve the carbon efficiency of the existing housing stock. It is difficult to estimate the number of jobs this would generate.
5.5 Decarbonising transport and impact on the economy

The carbon-reducing options in transport include encouragement of more fuel-efficient vehicles, substitution towards public transport, substitution towards plug-in electric vehicles and greater participation in cycling. These options involve investment in vehicles and infrastructure and some savings of fuel and congestion costs and may bring health benefits from improved air quality and fitness.

Taking investment as an indication of contribution, electric vehicle charging points, costing from £500 to £1,000 each, would involve £14 – 27 million of investment for every 27,000 households (or 10 per cent of current households) installed. The contribution of these initiatives to GDP, GVA and employment depends upon the value for money of the expenditure and its profile over time. High value for money investments will add more to the economy, and low value for money investments will contribute less or detract from the economy.

Plug-in vehicles would stimulate small number of additional jobs for the installation and maintenance of charging points, perhaps of the order of a dozen or so jobs. For every 27,000 units installed over a 15 year period, 8 units would be installed per working day, requiring a small team of installers with sales, administrative and survey support. A further transition to a proportion of electric-only vehicles may result in a net reduction in employment if the vehicles require fewer jobs in repair, maintenance and refuelling.
6 Strategy and policy

The transition to a low carbon economy presents Oxfordshire with opportunities for some sectors to grow and for households to manage rising energy bills.

There will be opportunities in the well-established automotive cluster. Although the cluster may experience significant disruption as it adjusts to tighter greenhouse gas emissions policy, it will benefit from the highly skilled workforce in Oxfordshire and the diversity of engineering and computing research and development which characterises the cluster. There are various ways in which the innovation processes can be supported and strengthened, such as funding of applied research, collaborative working on demonstration projects and networking to facilitate matching of needs and solutions.

There may be an opportunity for a new cluster to emerge. Building technologies in the construction sector is a relatively low skilled area, but like the automotive sector, low carbon policies are driving innovation in the sector and there will be opportunity to grow productivity through investment in skills. This might be fostered, for example, through demonstration projects and sponsored training. There is a large scale opportunity to adopt this innovation in the new house and commercial building planned for Oxfordshire, but due to failures in the market, developers may need encouragement through building regulation and control to implement the growth-enhancing measures that will be available.

Households will benefit from improved housing stock. As energy bills rise, the opportunities to save money through energy efficiency and domestic scale renewable energy will expand and households will benefit from access to information and capable contractors, enabling them to respond. For lower income households, some of whom may be in fuel poverty and who may have limited capacity to invest, local authority led home improvements and other business models for delivery may be used to channel investment, raising the quality of the housing stock, reducing emissions and cutting fuel bills. By increasing (worthwhile) investment and cutting spending on energy, these actions could contribute to economic growth and employment.

Oxfordshire can tackle road transport emissions. National and international policy initiatives will make the private light vehicle fleet more efficient and reduce its carbon emissions and these trends can be reinforced by local action putting in place incentives for car users, encouraging them to adopt new vehicle technologies and making infrastructure available to facilitate this, such as electric vehicle recharging points. Further investment in the road network, public transport and cycling will be justified as the population and housing stock of Oxfordshire increases in order to address congestion as well as emissions.

Low carbon energy production. Similar to other parts of the country, Oxfordshire has the opportunity to take advantage of its natural resources to generate power and has a service sector to support it as well as firms which supply services and manufacturing over a geographically wide market. As demand for low carbon energy production rises, these firms will grow. There may be sufficient strength in some of these
areas for Oxfordshire to invest in hosting research, development and demonstration projects which boost the capabilities of some of its existing entities.

These actions are summarised in Table 5

<table>
<thead>
<tr>
<th>Table 5. Summary of main opportunities for low carbon growth in Oxfordshire</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sector</strong></td>
</tr>
<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Housing</td>
</tr>
<tr>
<td>Automotive cluster</td>
</tr>
<tr>
<td>Building technology</td>
</tr>
<tr>
<td>Roads</td>
</tr>
<tr>
<td>Low carbon energy supply</td>
</tr>
<tr>
<td>Production(^1)</td>
</tr>
</tbody>
</table>

Note: \(^1\) excluding selected clusters
Source: Vivid Economics
References


SQW. (2013). *The Oxfordshire innovation engine.*
Appendix

List of sectors with the highest comparative advantage coefficients in Oxfordshire

Figure 17. Oxfordshire has comparative advantage in high skilled, creative and knowledge intensive sectors.

Note: Size of circle indicates the relative size of employment for the sector.

Source: Vivid Economics based on BRES data.
**Figure 18.** Carbon cost in the industrial and residential sectors in UK counties

Note: Carbon cost is calculated as emissions level multiplied by an assumed carbon price of £30 ktCO\(_2\). GVA is gross value added for the industrial and commercial sectors; GDI is gross disposable household income.

Source: Vivid Economics based on DECC regional CO\(_2\) emissions data

**CO\(_2\) Emissions have declined sharply over the period 2005 to 2011 due to lower economic activities and high energy prices.** The rate of decline was lower in Oxfordshire than in the rest of UK. Oxfordshire was located in the bottom quartile of all counties in England and Wales. Table 6 shows the rates of decline in the different subsectors of the economy.

**Table 6.** Oxfordshire emissions have decreased at slower pace than UK emissions, between 2005 and 2011

<table>
<thead>
<tr>
<th>Variable</th>
<th>Oxfordshire</th>
<th>England</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial and commercial</td>
<td>-18.1</td>
<td>-22.7</td>
<td>-21.7</td>
</tr>
<tr>
<td>Residential</td>
<td>-15.6</td>
<td>-17.6</td>
<td>-17.1</td>
</tr>
<tr>
<td>Local transport</td>
<td>-9.6</td>
<td>-9.4</td>
<td>-8.9</td>
</tr>
<tr>
<td>Total</td>
<td>-14.4</td>
<td>-17.5</td>
<td>-17.3</td>
</tr>
</tbody>
</table>

Note: Percentage change in carbon emissions between 2005 and 2011

Source: Vivid Economics based on DECC regional CO\(_2\) emissions data
Figure 19. To reach the top quartile, Oxfordshire would reduce per person transport emissions by 22 per cent and per person residential sector emissions by 2.4 per cent.

Note: Transport sector emissions exclude emissions from motorways.
Source: Vivid Economic, DECC, 2011

High tech and low carbon industries in Oxfordshire

High tech industries accounted for 20,000 jobs in Oxfordshire in 2011 and constitute an important asset to the county’s economy. Oxfordshire has high comparative advantage in the innovative, high skill and knowledge intensive sectors, as shown in Table 7.

Table 7. High skill and knowledge intensive sectors are prominent in the Oxfordshire economy

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Comparative Advantage index</th>
<th>Oxfordshire, thousand employees</th>
<th>England, thousand employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>High tech</td>
<td>1.3</td>
<td>4</td>
<td>213</td>
</tr>
<tr>
<td>Medium high tech</td>
<td>1.2</td>
<td>11</td>
<td>634</td>
</tr>
<tr>
<td>High tech knowledge intensive services</td>
<td>1.2</td>
<td>16</td>
<td>948</td>
</tr>
<tr>
<td>Knowledge intensive financial services</td>
<td>0.4</td>
<td>5</td>
<td>928</td>
</tr>
<tr>
<td>Knowledge intensive market services</td>
<td>1.0</td>
<td>35</td>
<td>2,558</td>
</tr>
<tr>
<td>Other knowledge Intensive services</td>
<td>1.2</td>
<td>115</td>
<td>7,011</td>
</tr>
<tr>
<td>All sectors</td>
<td></td>
<td>321</td>
<td>23,073</td>
</tr>
</tbody>
</table>
Note: Reported figures are number of employees in thousands. Comparative advantage index is the ratio of the employment shares for the sector in the two economies.
Source: Vivid Economics based on BRES data

In low carbon and environmental goods and services, Oxfordshire’s biggest low carbon employers with a relatively high degree of specialisation are alternative fuel vehicles, insulation and heat retaining material and wind systems, as shown in Table 8.

Table 8. Oxfordshire has clear comparative advantage in engineering and R&D

<table>
<thead>
<tr>
<th>Sectors level 2</th>
<th>Sectors level 3</th>
<th>Employment</th>
<th>CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative fuels</td>
<td>Other bio fuels</td>
<td>1,240</td>
<td>1.0</td>
</tr>
<tr>
<td>Alternative fuel vehicle</td>
<td>Alternative fuels (main stream) for vehicles only</td>
<td>1,180</td>
<td>1.1</td>
</tr>
<tr>
<td>Building technologies</td>
<td>Insulation and heat retention materials</td>
<td>960</td>
<td>2.3</td>
</tr>
<tr>
<td>Wind</td>
<td>Wind farm systems</td>
<td>630</td>
<td>1.3</td>
</tr>
<tr>
<td>Water supply and waste water treatment</td>
<td>Water treatment and distribution</td>
<td>590</td>
<td>1.0</td>
</tr>
<tr>
<td>Wind</td>
<td>Large wind turbine</td>
<td>410</td>
<td>1.1</td>
</tr>
<tr>
<td>Building technologies</td>
<td>Doors</td>
<td>320</td>
<td>1.1</td>
</tr>
<tr>
<td>Waste management</td>
<td>Construction and operation of waste treatment facilities</td>
<td>300</td>
<td>1.5</td>
</tr>
<tr>
<td>Recovery and recycling</td>
<td>Waste collection</td>
<td>290</td>
<td>1.1</td>
</tr>
<tr>
<td>Photovoltaic</td>
<td>Systems and equipment</td>
<td>230</td>
<td>1.1</td>
</tr>
<tr>
<td>Nuclear power</td>
<td>Nuclear power plant operations</td>
<td>220</td>
<td>1.5</td>
</tr>
<tr>
<td>Carbon capture and storage</td>
<td>Engineering</td>
<td>170</td>
<td>77</td>
</tr>
<tr>
<td>Geothermal</td>
<td>Consulting and related services</td>
<td>160</td>
<td>1.0</td>
</tr>
<tr>
<td>Biomass</td>
<td>Biomass furnace systems</td>
<td>100</td>
<td>1.1</td>
</tr>
<tr>
<td>Marine pollution control</td>
<td>Technologies, research and development</td>
<td>79</td>
<td>25</td>
</tr>
<tr>
<td>Noise and vibration control</td>
<td>Technologies, research and development</td>
<td>79</td>
<td>12</td>
</tr>
<tr>
<td>Recovery and recycling</td>
<td>Technologies, research and development</td>
<td>79</td>
<td>4.5</td>
</tr>
<tr>
<td>Energy management</td>
<td>Technologies, research and development</td>
<td>79</td>
<td>4.2</td>
</tr>
<tr>
<td>Waste management</td>
<td>Technologies, research and development</td>
<td>79</td>
<td>1.1</td>
</tr>
<tr>
<td>Alternative fuels</td>
<td>Bio fuels alternative for vehicles only</td>
<td>70</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Developing carbon scenarios for Oxfordshire

Oxfordshire ambitious carbon reduction will allow it to reduce its carbon intensity to UK level in the transport sector and have a much better intensity in the housing sector.

| Table 9. Possible target emissions and business as usual scenarios for 2030 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Oxfordshire                     | Business as usual 1 (BAU 1) | Business as usual 2 (BAU 2) | Target 1 (relative to the UK) | Target 2 (50 per cent abatement) |
| Total (ktCO₂)                   | 5,183            | 5,756           | 4,180           | 2,867           |
| Transport (ktCO₂)               | 1,754            | 1,981           | 1,281           | 686             |
| Residential (ktCO₂)             | 914              | 1,015           | 715             | 460             |
| Transport per person (tCO₂/person) | 2.41            | 2.68            | 1.73            | 0.93            |
| Residential per person (tCO₂/person) | 1.24            | 1.37            | 0.97            | 0.62            |
| UK                              | Business as usual | Target          |
| Total (ktCO₂)                   | 447,400          | 368,389         |
| Transport (ktCO₂)               | 115,000          | 68,000          |
| Residential (ktCO₂)             | 88,225           | 61,357          |
| Transport per person (tCO₂/person) | 1.64            | 0.97            |
| Residential per person (tCO₂/person) | 1.26            | 0.88            |

Population in 2030

| Oxfordshire | 740,000 |
| UK          | 70,000,000 |

Note: These emissions are not adjusted for urban/rural profile, income and weather

Residential sector emissions include only direct emissions

Source: Vivid Economics, (Committee on Climate Change (UK), 2013b) and (Oxfordshire County Council, 2014)
**Company Profile**

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