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‘Low Carbon Oxford: A Route Map to 2020’ has been developed by Oxford City Council. The Council would like to acknowledge the support of Aether Ltd in delivering the Sustainable Energy Action Plan which underpins this publication, for their help in running stakeholder engagement workshops and for the support of Low Carbon Oxford Pathfinders and the other organisations who have provided data and commentary that informed the action plan.

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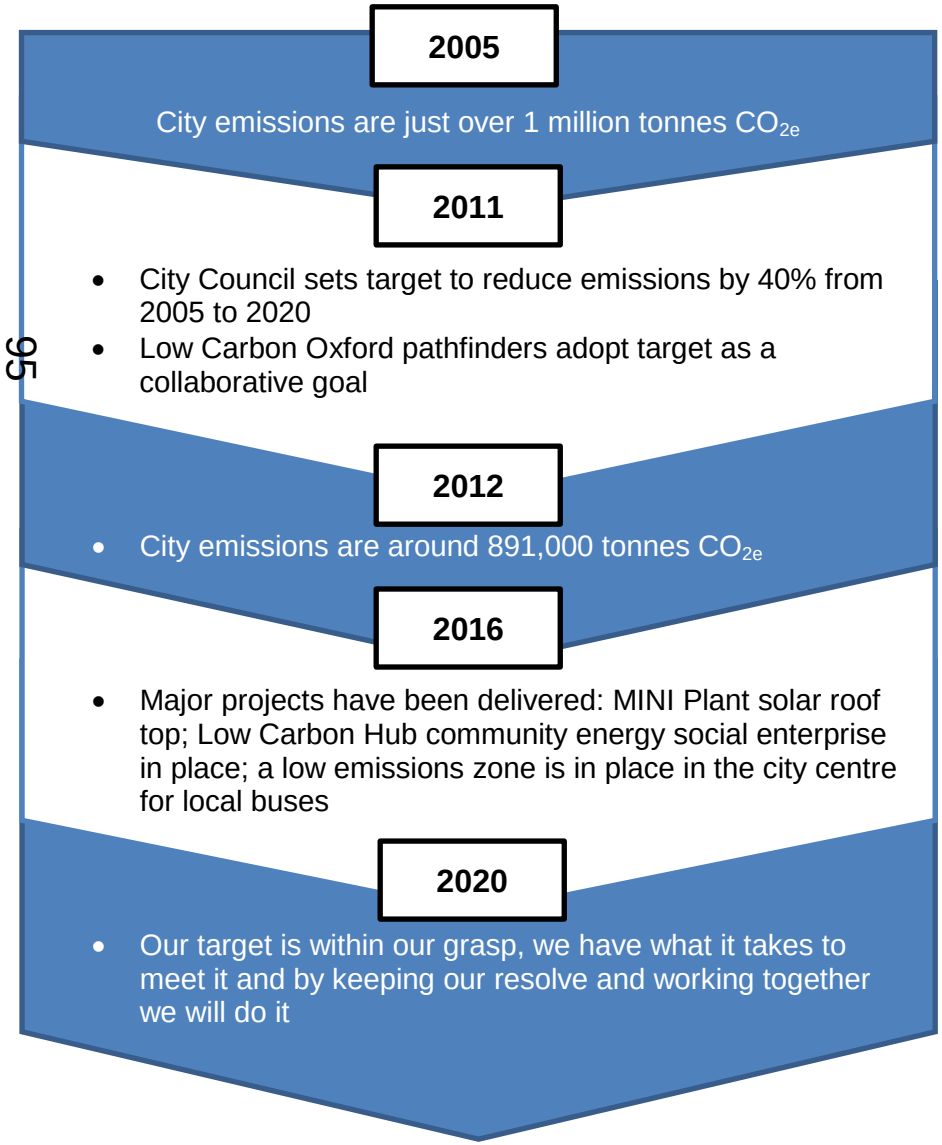
FRONT COVER with graphic

Low Carbon Oxford: A Route Map to 2020

INSIDE COVER:

Our Route Map:

This report tells the story of how the city set ambitious carbon reduction targets in 2011, what progress we've made and action we've taken. Finally it sets out the actions being taken and analyses our prospects of meeting our target.



[Include a table of contents here]

Supporting statements

John Tanner (tbc confirm statement with John):

Our aim to reduce the city's carbon emissions by 40% by 2020 compared to 2005 is ambitious but not beyond our reach. I'm thrilled that this report shows that we're getting there thanks to local as well as national initiatives and that we can be proud of our achievements to date.

Reducing our emissions requires action across the city. The car factory, the hospitals, the bus companies are many others are doing their bit to save energy and cut costs. The public of Oxford is leading the way with recycling, solar panels and bicycles. The report shows that all this is making a difference and creating a more sustainable greener city.

Nick Eyre:

Climate change is a global problem, so it's perhaps tempting to think of it as an issue best left to international negotiators and government. And, of course, they have a role. The international agreement in Paris last year was a major step forward; and our Government's action now needs to catch up with its rhetoric. But the research evidence shows the progress made so far in reducing emissions has not come from grandiose international schemes like carbon markets. On the contrary, the key actions have been, and will go on being, much closer to home, in investments in renewable energy, improving energy efficiency and consuming more sustainably. So cities are well-placed to encourage and cordinate – hence the low carbon route map for Oxford. It sets clear targets and provides a framework for action by households, communities, businesses and the public sector. It challenges us all to do better, but also reminds us that individual actions are not a futile gesture, but part of a bigger movement to protect us all from the threat of climate change.

Oxford's Choices

In 2005

Oxford had a population of around 140,000 and city-wide emissions were around one million tonnes of carbon dioxide equivalent (CO_{2e}) per year. Climate change was creeping up the public agenda and the city was already in the process of modernising its transport system in order to address congestion and air pollution. In the next few years national policy would deliver the Act On CO_2 campaign, interest free loans for energy efficiency for SMEs and 'feed-in tariffs' for those installing solar panels or other renewable energy generation.

In 2010

The Low Carbon Oxford partnership was formed by 15 founding members – who we call pathfinders - who committed to reduce their emissions by at least 3% per year and to work together to gain greater reductions than could be delivered acting alone.

In 2011

Oxford City Council published its first sustainability strategy and set its targets for reducing carbon emissions by 2020 from the baseline of emissions in 2005.

- 40% by 2020 including emissions reductions from the decarbonisation of the national electricity grid

The 40% target was adopted by the Low Carbon Oxford partnership, now grown to 25 organisations, as a collaborative goal and the partnership published its Building Momentum report to establish the baseline emissions and set out the initiatives its members were taking forwards.

In 2012

Our latest, analysed dataset on carbon emissions is from 2012. By then the city's emissions had dropped by 12.8% to just under 900 thousand tonnes of CO_{2e} per year[1]. Part of the reason that reducing emissions is difficult is that Oxford is the eighth-fastest growing city in England and by 2012 its population had increased to around 150,000. This means that *emissions per person* had decreased by the much larger factor of approximately 18% between 2005 and 2012.

In 2015

The city council signed up the Covenant of Mayors: a climate change mitigation initiative launched in 2008 by the European Commission. Signatory cities pledge to reduce their emissions by at least 20% by 2020 and 40% by 2030. Cities also commit to producing a 'Sustainable Energy Action Plan' to set out how they will meet their pledge.

Today

Organisations aroud the city have taken significant action to reduce emissions since 2012. In procuding this report we have captured those actions in order to predict our change of success in 2020. The biggest project is MINI Plant's huge rooftop solar panel installation but we also know that significant incremental change has occurred. Our bus companies have reduced tailpipe emissions through improved buses and driver training; the universities both have in place ambitious carbon management plans and have delivered improvements across their estates. The city council is proud that it has met its target of reducing emissions by 5% every year.

[1] Emissions quoted are estimates based on the modelling undertaken by Aether Ltd. See Annex B for a description of the methodology

Oxford has recognised strengths. It has a rich, knowledge-based economy and the opportunity for local public and private sector organisations to work closely with the researchers to pilot the latest low carbon technologies and processes right here. We are a small city, ideal for testing out new technologies and adopting them at lower cost than elsewhere. Oxfordshire has extremely active communities and the highest density of social enterprises in the county: it a recognised leader in community renewable energy innovation.

Drawing on these strengths, sharing our knowledge and collaborating on projects enables us to reduce our emissions in order to meet our target.

	In a Low Carbon Future for Oxford …	Without action …
Our buildings	Our urban landscape integrates the historic buildings with modern needs; people and functionality are the focus of our built environment. The city has been retrofitted to incorporate energy efficiency and renewable energy into its built heritage.	Housing is already unaffordable to many people in Oxford and the city has an old building stock that is expensive to improve. Houses are predominantly being built at the minimum energy standards and without renewable energy generating features such as solar panels, locking future occupants into the likelihood of high energy bills in the future.
Our energy	Oxford's energy needs are minimised because we have high levels of energy efficiency. Energy production is decentralised and produced from local, renewable sources. We have maximised locally owned and managed energy resources. Building owners and occupiers will be integrated into a city-wide community thanks to an intelligent electricity and heat system that maximises the use of low carbon heat, solar power and battery storage. Smart technology will enable access to new energy technologies and spread the benefits across the city	Oxfordshire spends over £1bn on carbon-based energy consumption each year. Little of this energy is produced in the county so nearly all of that money is leaving our local economy. Our local electricity grid infrastructure requires investment and if we choose to upgrade in a way that continues to rely on carbon-based generation, billions will continue to leave our local economy and we will miss the opportunity to have a more resilient energy system that enables greater local production and creates local jobs.
Our transport	Clean air and pleasant streets and highways are enabled because Oxford's essential work-force live close to their workplace. Other workers have the ability to commute using safe and accessible cycling and walking routes or through efficient zero emission mass transport systems and have the technology that assists them to work effectively and efficiently at home. Travel options give people freedom as they work, rest and play. Working from home is easy and effective for all. Smart solutions will further reduce congestion by consolidating and coordinating goods deliveries.	Transport within, into and out of the city is already under significant pressure too. The consequences are apparent to everyone already: increasing congestion has been steadily reducing journey times, and despite some encouraging recent improvements, poor air quality continues to impact on health. Public Health England published a report in April 2014 estimating that in Oxford 55 deaths per year of people over 25 is due to particulate air pollution. This is equivalent to a total of 673 associated life-years lost[2].
Our waste	Our approach to waste has changed fundamentally; waste as a resource is widely understood where waste cannot be reused or recycled it is used in energy generation.	Thanks to the incinerator or energy recovery facility near Bicester, Oxford's carbon emissions from waste have already decreased significantly. However our global material footprint is around 12,000 tonnes of materials every day[3]. Without better management of that supply chain we will continue to 'export our carbon emissions' and remain at risk to impacts of climate change, population growth and economic events.

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332854/PHE_CRCE_010.pdf
[3] From Low Carbon Oxford's Material Oxford report: http://lowcarbonoxford.org/reports/material-oxford/

A Route Map to 2020

The city council set out a high level plan of how the city could deliver 40% reductions in its Low Emissions Strategy in 2013, however we know that even with the best of intentions, the reality always differs from the plan. In addition, the city council, as a signatory to the Covenant of Mayors, must produce a Sustainable Energy Action Plan setting out how it will meet its target.

The purpose of this report is: to understand our situation, to restate our aims and deliver our sustainable energy action plan.

Our target

Method	UK Local Authority reporting method	Covenant of Mayors
Reduction target by 2020	40%	25%

As described in Box 1, the emissions calculations method for the Covenant of Mayors is different from the method used by local authorities in the UK. Oxford's sustainability strategy target is based on the latter method, so we have adjusted our target for the sustainable energy action plan to 25% to take accout of the difference.

Method

Aether Ltd was commissioned by Oxford City Council to undertake analysis of the city's emissions and projected emissions to 2020. The actions were identified in five workshops held with local stakeholders and experts in February 2016. These workshop focused on the following themes: energy consumption in buildings, renewable energy generation, transport, waste and strategic challenges and opportunities.

Results and projections

Box 2 shows Oxford's 2005 emissions, 2012 emissions and the projection of our emissions from 2012 to 2020. The top line is the projected 'business as usual' emissions for the city and the actions that have been taken since 2012, or are planned to be implemented by 2020, inform the 'emissions reduction wedges' on the chart.

This shows that we have made steady progress since 2005 and our actions and intentions are matched to our ambitions for success. However in order to meet the target we need a faster rate of emissions reduction from 2012 to 2020 compared with 2005 to 2012. So a concerted effort is needed to ensure we meet our goals.

Box 1: The Covenant of Mayors and the Sustainable Energy Action Plan method

The Covenant of Mayors is a global climate change mitigation initiative launched in 2008 by the European Commission. Signatory cities pledge to reduce their emissions by at least 20% by 2020 and 40% by 2030. Cities also commit to producing a 'Sustainable Energy Action Plan' to set out how they will meet their pledge.

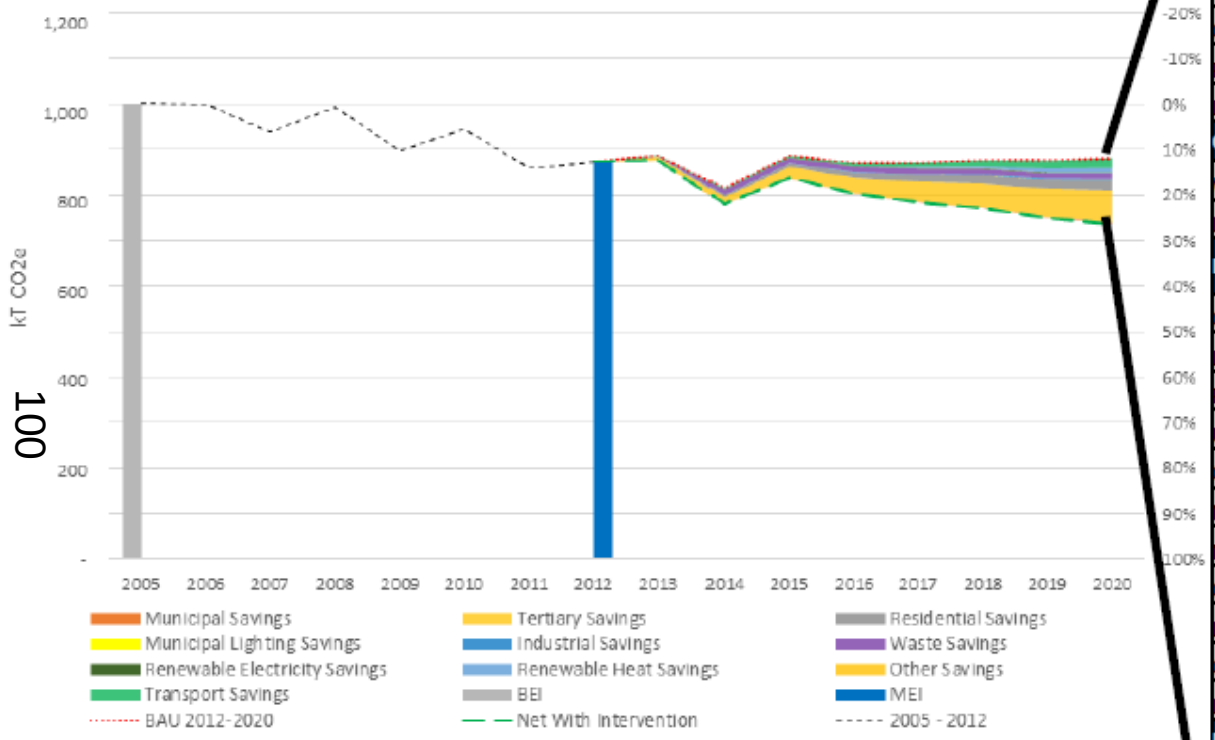
Oxford City Council signed up to the Covenant of Mayors in September 2014; this document summarises to process through which the Oxford's Sustainable Energy Action Plan (SEAP) was developed. Further information on the methodology for the SEAP is given in Annex B.

The methodology for the SEAP provides a standardised way to predict emissions reductions, providing a useful way not only to set policy locally but also to benchmark it against other cities in the Covenant of Mayors community. The SEAP is not just intended to reduce emissions from the councils's operations, it includes action to reduce emissions from all sources within Oxford's territory and is therefore a key challenge for the public, private and residential sectors alike.

Covenant of Mayors rules stipulate that the impact of national grid decarbonisation should not contribute towards SEAP targets, a key element of Oxford's 40% emission reduction plan. Therefore, this report references two targets:

1. The overall objective to reduce emissions by 40% by 2020 in absolute terms (i.e. including the impact of grid decarbonisation);
2. The objective to reduce emissions by 30% by 2020 through local action only (i.e. excluding the impact of grid decarbonisation).

BOX 2

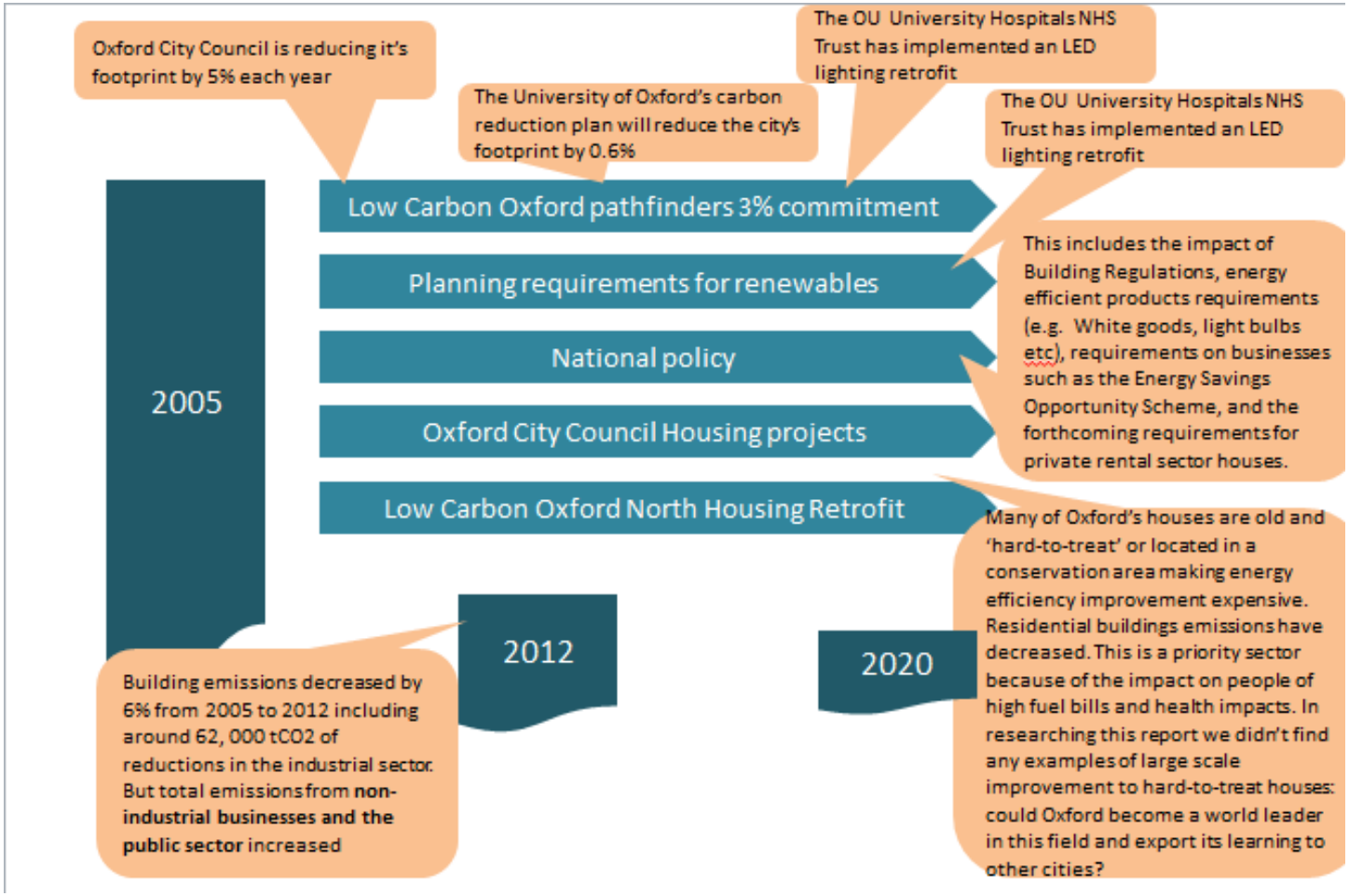


TRANSPORT	21,753
Chiltern Railway Cowley Branch	675
Low emissions Zone	2,719
Go Ultra Low Oxford	31
Train Electrification	574
Oxford City Council - Fleet energy reduction	613
Road biofuels & vehicle efficiencies	17,140
Low Carbon Oxford North Electric Vehicle Summertown	1
OTHER	11,585
Waste Incineration and Recycling	11,583
Low Carbon Oxford Group Tree Planting West Oxford	1
MUNCIPAL, TERTIARY, RESIDENTIAL AND INDUSTRIAL BUILDINGS	101,174
Oxford City Council - Own Estate Reductions	1,799
Low Carbon Oxford Pathfinders - Commercial	2,655
Planning for low carbon development	17,000
University of Oxford	27,293
Oxford Brookes University	3,128
NHS - Lighting retrofit	461
National policy e.g. Building Regs, Products, Smart meterinig,	47,350
OCC Private & Social Housing Energy Efficiency Measures	272
Low Carbon Oxford North Housing Refurbishment	5
Oxford County Council - LED Lights	37
Low Carbon Oxford Pathfinders - Industrial	1,146
LOCAL ELECTRICITY & HEAT/COLD PRODUCTION	12,298
Community renewable energy schemes	427
Project ERIC	94
MINI Plant & Oxford Bus Company PV Installation	1,438
NHS Energy Link	10,339
TOTAL	146,810

In the following pages the actions taken and planned across the city since 2012 and up to 2020 are presented according to their 'emissions sector':

- emissions from energy use in buildings
- emissions offset/saved by renewable energy generation
- emissions associated with transport
- and emissions reductions though the reduction or processing of waste materials

A Route Map to better buildings….



In 2005 The concept of a “smart home energy system” meant a programmable thermostat at best and the thought of controlling our heating from our phones was still the work of science fiction. All the actions identified to reduce emissions from buildings are on-going. They relate, for example, to national policy measures such as building regulations and the implementation of organisations’ carbon management plans: such as the combined efforts of the University of Oxford and Oxford Brookes University which are expected to realise reductions of around 30,000 tCO_{2e} per year by 2020.

Progress Although none of our actions have been 100% completed since 2012, we have confidence that many are progressing according to plan due the public carbon reporting by businesses and the public sector and engagement with sustainability teams through Low Carbon Oxford. In total our planned actions are predicted to lead to around 101,000 tCO2 emissions avoided each year compared with 2012. While this is a significant contribution to meeting our 2020 target, it is less than the City Council hoped for when setting its Low Emissions Strategy: in particular mitigating emissions from residential properties is a critical challenge.

By 2020 … Given this challenge and complex policies it is a strategic priority for key decision makers and influencers around the city to revisit the opportunities available to improve our houses. Opportunities are available: a revised Energy Company Obligation policy will soon be introduced and forthcoming regulations will require all private rented sector houses to have an Energy Performance Certificate rating of at least E. Low Carbon Oxford will kick start discussions on how Oxford can make the most of these opportunities and maximse the local benefits at a roundtable on domestic energy efficiency in early 2017.

Action case study: Warming Barton - making ‘hard to treat’ homes warmer and more energy efficient in a deprived neighbourhood

Barton in Oxford is ranked amongst the 15% most deprived neighbourhoods in England. Its basic steel frame pre-fabricated houses don’t retain heat, leading to high fuel bills and impacts on health and wellbeing. Low Carbon Hub (LCH) partnered with Oxford City Council to run a pilot to improve the energy efficiency of homes in Barton. Following a successful community engagement programme, a total of 119 households signed up and received a free energy efficiency assessment and advice, resulting in a 579 recommended actions, 206 tonnes of potential CO2 annual savings identified and the possibility for each household to save an average of £450 each on their bills. LCH homes secured Energy Company Obligation (ECO) funding for external wall insulation in sixteen pilot homes which were completed in 2014. Barton resident, John Cavendish commented: *“The evening after the insulation had been put up the house was noticeably warmer … and we can sit in our lounge without a blanket over us!"*

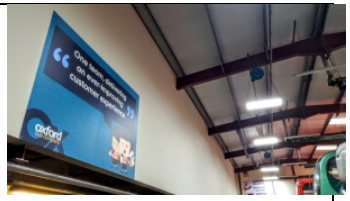
Action case study: Linacre College – engaging students in saving energy

Linacre is one of the newer Oxford colleges, founded in 1962, and has a reputation for green innovation: solar panels on the roof, meat free days in the kitchen, an active Green Society and its own allotment. It is also the first college to invest £100,000 in the Low Carbon Hub’s community-owned, renewable energy scheme.

Every year, the college appoints two Green Students. This is a paid position supported by an anonymous donor. The students are expected to commit some time every month to making Linacre ‘greener’. There are two distinct roles:

Behavioural change - increasing awareness of green issues within the student body. Organising events, such as the Linacre Green Games, which make saving the environment fun.

Technical & financial - monitoring our emissions and suggesting new ways to reduce them, making the college more energy efficient. For example, floor by floor electricity monitoring recently installed in the Griffiths building.

Action case study: Oxford Bus Company saves over 100 tonnes CO2 a year with LED lighting refit One of Oxford Bus Company's (OBC) core values is about operating in a socially responsible manner. The benefits of LED lighting have been known for some time but it was going to take a solid business case and considerable research to get its LED lighting refit project off the ground. OBC's finance and commercial director, Luke Marion, worked hard to put together a solution that best met the needs of the business, as well as exercising its commitment to being environmentally responsible. UK LED were brought in to survey the building and put together a comprehensive proposal for retrofitting the bulbs and fittings to the various areas of the depot. The costs were considerable and came from various sources but conservatively were in excess of £65k. The investment by OBC is expected to save 197,000kWh of electricity each year, leading to substantial cost savings and reducing annual CO2 emissions by more than 107 tonnes.	
Action Case study: NHS energy link set to save 270,000 tonnes of CO2 over 25 years A new gas fired Combined Heat & Power (CHP) engine at the John Radcliffe (JR) Hospital will generate electricity for both the JR and the neighbouring Churchill Hospital. The two hospitals will be connected by the Energy Link pipeline that will carry hot water, a high voltage cable and trunking for high speed internet. There will also be new boilers at the JR and Churchill Hospitals along with a Building Management System (BMS) that optimises both the hospitals' energy and heating usage to ensure better efficiencies and less heat and power wastage. Old lighting in these buildings is also being replaced with new, low energy light fittings. These three components together will allow the Oxford University NHS Hospitals Trust to save upwards of 75% in energy efficiency improvements. When the major project is finished, it should deliver a saving of just over 10,000 tonnes of carbon a year, or a total of 270,000 tonnes of CO2 over the 25-year period; the equivalent to taking 3,000 cars off the road every year.	

Powering up Oxford: local electricity and heat production

In 2005 the idea that local, renewable generation would become common place was one envisaged by only a few. The feed-in tariff incentives for generating low carbon electricity had yet to be introduced and the cost of solar panels was prohibitively high for the majority of businesses and homeowners.

Progress Our analysis ahows that Oxford is taking up renewable energy in line with the expectations of national policies – both at a household level and within organisations. However, the driving force behind solar panel installations, the government's 'feed-in tarrif' incentive that pays for the electricity that you generate, was substantially reduced in 2016. So it is even more important that we take extra local action to find ways to increase our renewable generation, and find low carbon ways to provide heating and cooling, if we want to decarbonize.

Community energy action has been accelerated by the OxFutures programme which was a partnership between the city and county councils and the Low Carbon Hub to scale up local energy projects and ran from 2012 to 2016. Since 2012 it has supported several projects such as hydro-generation on the Thames at Osney Lock Hydro (operational since 2015), and numerous rooftop solar projects such as those at Oxford Bus Company (2013) and Larkrise Primary School (2014). These projects go beyond the national policies because they were only possible due to the very enthusiastic and active community energy community in and around Oxford. Thanks to the funding the Low Carbon Hub has developed its business model and is currently in the process of constructing an ambitious new hydro scheme at Sandford lock. Looking to the future, the Hub are continuing to innovate with exciting projects such as the Hinksey Heat scheme, which could see the Hinksey outdoor pool and neighbouring buildings heated using latent energy souced from the nearby lake.

Action Case study: Community energy: solar schools

As part of the OxFutures partnership project**,** the Low Carbon Hub has been creating renewable energy projects with businesses, schools and communities all over Oxfordshire since 2012. In summer 2015 and 2016, the Hub delivered solar panel projects on 25 schools across Oxfordshire, including Cheney, Larkrise and Rose Hill in Oxford.

Low Carbon Hub's model is that of a double carbon cut and community benefit; investment from community shareholders funds renewable energy projects with payback from government Feed In Tariffs and exports to the National Grid. Schools buy electricity from the Hub at a cheaper rate than usual, and a small amount of income to the Hub is used to support further local community projects

The Low Carbon Hub also delivered major solar PV installation projects with businesses such as Oxford Bus Company, Owen Mumford, Norbar Torque Tools, Prodrive and CTG. Case studies for all of these can be found on the Low Carbon Hub website.

The Hub are currently developing a hydro project at Sandford Upon Thames to help return the Lasher Weir to its historic role as a provider of clean energy. This hydro project will generate 1,600 MWh per year -- the equivalent demand of 450 homes, or most of Sandford. Construction on this project began in September 2016.

Action case study: Hinksey Heat – using lake to power the local community

Oxford's Hinksey Outdoor Pool is one of the Council's largest users of heat. The Low Carbon Hub is working with Oxford City Council to explore the potential for a community owned, low carbon, district heat network centred around Hinksey Pool, using Hinksey Lake as a renewable heat source in conjunction with efficient water source heat pumps. Studies so far have found that there is enough latent heat within the lake to heat nearly 100 houses, plus the local primary school and Hinksey Pool. A technical study concluded that a heat pump based solution offers the potential to eventually reduce the pool's CO2 emissions by over 75% as well as providing an affordable, clean, green energy supply to the local community. For Hinksey Pool this means an estimated reduction of 368 tCO2 in year one. Placing the pool at the heart of a local district heating network could result in additional emissions savings for local buildings connected into the network of more than 70% of their current emissions. The Hub are currently looking into funding models for the project which it hopes can be delivered by winter 2017.

Some of Oxford's biggest employers are making giant strides too. MINI Plant Oxford has installed a massive 11,500 solar panel installation at its Cowley site and the Oxford University Hospitals NHS Trust has received planning permission for its 'Energy Link' project which will reduce the carbon footprint of the John Radcliffe and Churchill hospitals by a third (see case study)

Action Case study: MINI Plant Oxford goes solar

More than 11,500 panels have been helping to harness renewable energy to power Oxford's MINI Plant since 2014. At around 19,000 square metres, the plant's bodyshop now boasts one of the largest, roof-mounted solar farms to be installed in the UK. The photovoltaic system has a generating capacity over 3 MW and generates enough electricity to power the equivalent of 850 households.

The plant's bodyshop, which contains 1,000 robots, was opened at the end of 2013 to build the new MINI hatchback. The building already has an impressive list of environmental credentials including 3,869 individually programmable LED lights, a special energy-saving "rest mode" for the robots, a water harvesting system to supply the toilets and so-called 'heat wheels' in the building's roof to control the recirculation and admission of fresh air to reduce the amount of heating and cooling required.

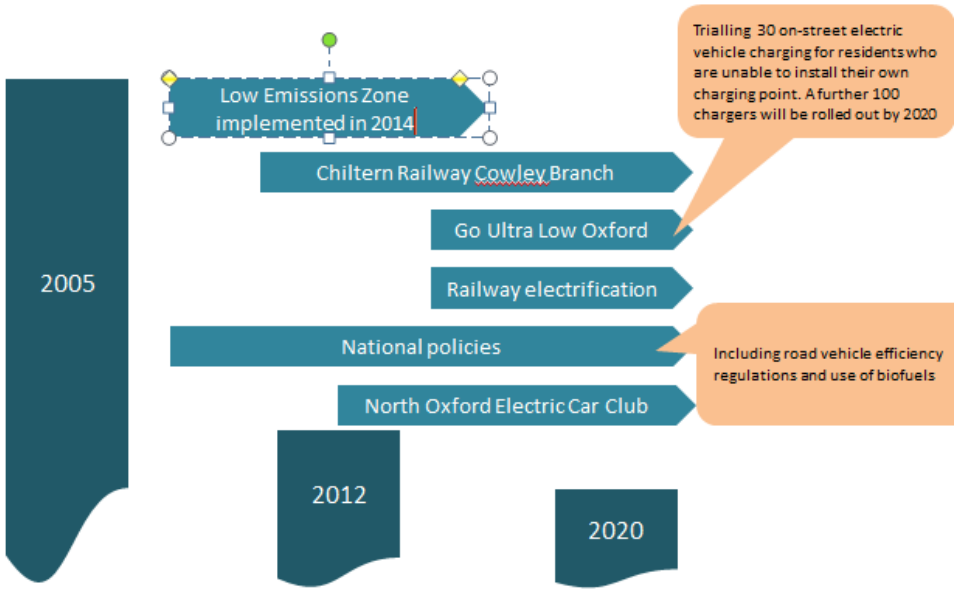
Case Study: Heat pump saves over 100 tonnes of carbon a year at University of Oxford's Plant Sciences building
The expansion of the heating and cooling systems to condition the newly refurbished greenhouses at Plant Sciences provided the opportunity to link the now bigger systems together, to recover excess heat in the cooling circuit, and push this in to the heating circuit and recover excess cooling in the heating circuit and push it in to the cooling circuit directly, using 4 brand new water to water heat pumps.
The end result is the ability to condition a bigger volume of space and reduce overall electricity use at the same time. There are still the traditional air source heat pumps on site that 'top up any' demand expected in the height of summer and depths of winter. The new configuration will work to recover the most energy in all weather conditions. Milder conditions during the winter mean saving more energy because these are the conditions when it can work at its highest efficiency
Savings are around 10% of building electricity use, in spite of the refurbishment increasing the conditioned greenhouse space by 20%. The project is part of the University of Oxford's ongoing carbon reduction programme and will remove 111 tonnes of carbon from the University's emissions, as well as generating annual cost savings to the department in the region of £24k.

The next generation

All the actions above are captured in our Route Map, but we won't stop there. Organisations around the city are looking for new ways to increase low carbon generation, heating and cooling. One way to do this is through 'smart technology' which makes the most efficient use of the resources that we have. For example by combined electricity from solar panels (during the day) and battery storage (to store it up for use in the evening). Project ERIC has already piloted this technology in Rosehill. Low Carbon Hub is leading a partnership bid for funding to further explore the best opportunities for Oxford and Oxfordshire to use and invest in it's electricity grid and Low Carbon Oxford will be working as part of that partnership to engage organisations around the city and county if our bid is successful.

Project ERIC
The community of Rose Hill in the south of Oxford is playing host to a groundbreaking pilot called Project ERIC that combines solar panels and household scale battery storage systems to maximise the benefits of domestic renewable generation – minimising costs to the homeowner, reducing carbon emissions and resulting in benefits to the management of the electricity grid system. This may be just the tip of the iceberg.

Sustainable transport in Oxford



In 2005 Oxford was already in the process of modernising its transport system in order to address congestion and air pollution. The city centre had already been designated an air quality management area because minimum targets for nitrogen dioxide were not met. In 1998 Cornmarket Street was pedestrianized and in 1999 congestion was controlled further by the introduction of bus gates on the High St and relocation of bus stops from Queen Street to St Aldates. As part of the Transform Oxford programme, joint ticketing and co-ordinated routes between the city's two major bus operators were introduced in 2011, avoiding unnecessary duplication of routes by different companies and improving efficiency of vehicle resources.

By 2010 further analysis showed that other hotspots were also at risk and the whole city was decalred an air quality management area. Not all measures to improve air quality will reduce carbon emissions too – but many will. It is also true that some measures to avoid carbon emissions can contribute to air pollution – for example inappropriate design or fuel for biomass boilers and wood burning stoves. So Oxford in 2014 introduced a combined 'Low Emission Strategy' which combines policies to address these duel concerns and this approach is now considered best practice.

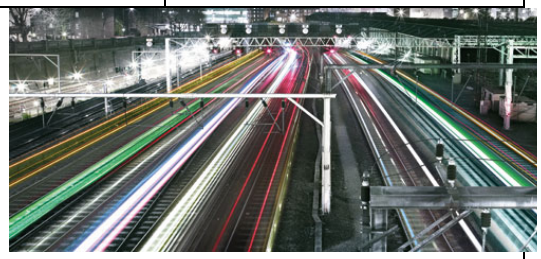
Progress Since 2014 Oxford's Low Emission Zone has been put in place. It limits the nitrogen dioxide emissions permitted on certain roads in the city centre by local buses to a mnimum of "Euro V" standard. Both of the city's major bus operators have now begun to move beyond this minimum standard with the large scale introduction of Euro VI standard vehicles, which reduce NOx levels much further. This has led to significant improvements in air quality, and initiatives such as the introduction of hybrid engined buses have delivered associated reductions in carbon emissions (2700 CO_2e per year), as well as also making our streets a little bit quieter.

Drivers for change:
It's not just progress on our roards: Oxford now has a second train station with new routes into London and the line through central Oxford is to be upgraded to enable electric rather than diesel trains. In addition, the proposed introduction of a Cowley branch line, connecting Oxford's central train station with Oxford Science Park and Cowley Business Park, offers the chance for over 2000 employees each day to change from commuting by car to using public transport.

Looking beyond 2020 the city and county councils are exploring how a Zero Emissions Zone might build upon the existing Low Emissons Zone. The ambition is to implement a ZEZ in Oxford city centre starting from 2020 to be expanded so that the entire city is covered by around 2030/35 and a feasibility study is being commissioned to assess how it might operate.

Action Case study: Chiltern Railways Cowley branch line
Chiltern Railways are looking to open the old Cowley Branch Line – currently used by BMW for freight – to passenger services by 2020. The scheme is seen as key to tackling the city's chronic congestion problems and would serve Oxford Parkway in Water Eaton, Oxford Station, Oxford Science Park in Littlemore and Oxford Business Park in Cowley. It would also link East Oxford to services to London.
A report by Network Rail said increasing the number of tracks from two to four on the stretch would cost between £175m and £375m, with the cost of Oxford Station's redevelopment put at £75m by councils. This major project would be expected to save 675 tonnes Co2 a year.

Action Case study: Electrification of the train line through Oxford
As part of a major national investment programme, the train line into Oxford is to be upgraded. This could enable carbon reductions of up to 574 tCO2/year due to improved train efficiencies. Electrified railways are essential to getting maximum efficiency and capacity from a modern railway. Typically an electric train emits between 20% and 35% less carbon per passenger mile than a diesel train. This benefit will improve as the National Grid decarbonises. Electric trains are cleaner, with zero carbon and other pollutants emissioned at the point of use, and better for passengers as they are faster, quieter, smoother and more reliable than diesels. They are also cheaper to buy, operate and maintain.



Action Case study: Low Emissions Zone reduces emissions from public transport in city centre
Although primarily targeting air quality, the Oxford Low Emission Zone (LEZ) introduced in 2014 also reduces greenhouse gas emissions through more efficient technologies. Each year, the Euro 5 and Euro 6 compliant buses running on Oxford's streets are expected to save 2,718 tCO2 as compared to older buses used before the introduction of the LEZ. The more efficient buses also help bus companies reduce their fuel consumption.
There is an ambition to implement a Zero Emission Zone (ZEZ) in Oxford city centre starting from 2020 which will then be expanded so that the entire city is covered by around 2030/35.
With some of the UK's most environmentally-friendly bus companies operating in Oxford, a simple step residents can take to help reduce emissions in Oxford is to simply leave the car at home and catch a bus instead.

Action case study: Oxonbike partnership initiative provides electric and pedal bike hire across Oxford

Oxford's OXONBIKE bike hire scheme aims to get more people out of their cars and onto two wheels. Oxonbike is supported by Oxford Brookes University, the University of Oxford, the NHS Trusts and the City Council and operated by Hourbike. The current network offers 70 bikes at 14 docking stations across the city, including six electric bikes at Oxford rail station.

OXONBIKE provides an affordable sustainable transport for everyone. Pedal bikes are £1 an hour and e-bikes are £2, with free journey periods for annual members.

Levan Chikobava, a medical student living in Jericho, told OXONBIKE how the electric bikes have transformed his daily commute: *'I have been working at the JR hospital and needed to cycle up Headington Hill, which was really annoying. The e-bikes have solved the problem. The price is comparable to the bus, but OXONBIKE is much more flexible and faster. Plus, it's good for my health and the environment.'*

Managing our waste to reduce emissions

Emissions associated with our waste represents only 1% of the city's emissions and waste emissions are not a mandatory part of the Covenant of Mayors reporting requirements. However they have been voluntarily included to better represent the city's emissions. When it comes to our waste, the impact on climate change relates predominantly to the emission of greenhouse gases such as methane, rather than carbon dioxide. For this reason, we have chosen to focus on 'carbon equivalent emissions' in this report so that we capture the impact of all greenhouse gases.

Progress Significant measures have already been implemented to reduce Oxford's emissions from waste, especially through the Energy-from-waste process at the Ardley Incinerator or Energy Recovery Facility which was constructed in 2014.[4] As of today, approximately 98% of residential waste is diverted from landfills and the emissions from waste decreased by 52% from 2005 to 2012.

Oxford also takes significant steps toward decreasing the amount of food going to waste and ensuring that food waste is increasingly recycled for anaerobic digestion. The good news is the actions to reducing emissions from waste needed to meet our 2020 targets are complete. However looking beyond 2020 we will need to do more to reduce emissions further as well as manage our material resources more efficiently.

There is a very strong movement to reduce food waste and to source our food sustainably in Oxford through intiatives such as Good Food Oxford, the Food Surplus Cafe (see case study) and the Oxford Food Bank to name a few. Oxford City Council has launched an initiative to ensure that all flats in the city have a food waste collection service by 2017 but also recognises the need to reduce waste as well as recycle it.

Low Carbon Oxford launched its Material Oxford report in Ocotber 2016 which analysis the material footprint of the city. A key finding was that the city uses around 12,000 tonnes of materials – both locally and globally – every day. The report will inform future events and workshops to help organisations in Oxford act and collaborate on smarter material resource management.

[4] https://www.oxfordshire.gov.uk/cms/content/what-we-are-doing-reduce-landfill

Case study: Ardley Energy Recovery Facility brings an end to landfill Over 7000 tCO_{2e} per year will be avoided due to the Ardley Incinerator or Energy Recovery Facility (ERF) which has been operating since 2014. Treating 300,000 tonnes of non-recyclable waste each year, it will divert at least 95% of Oxfordshire's residual municipal waste away from landfill and generate enough electricity to power around 38,000 homes. The visitor centre at the site, near Bicester, runs regular guided tours for schools and other groups to learn more about the process.	
Case Study: Pioneering flats recycling scheme rolled out in Oxford A third of Oxford's residents live in communal properties, which until recently had limited facilities for recycling waste compared with houses. In 2014, OCC embarked on a project to improve recycling in flats, starting with its own Council properties and Houses of Multiple Occupation (HMOs). Food recycling bins were delivered into communal bin stores, and kitchen caddies, free compostable liners and information were provided to over 16000 properties. Good participation from residents meant that nearly 80 tonnes of food was collected in the first year and in 2015/16 the scheme was extended to privately managed communal properties will be rolled-out to residents in all 19,000 of Oxford's flats next.	
Case Study: Oxford's Food Surplus café – good for people and planet The Oxford Food Surplus Cafe was set up to help redress the imbalance in our food system by reclaiming surplus food and transforming it into delicious healthy meals, helping to reconnect people with the food they eat. Surplus food is collected the day before an event, with the majority coming from the Oxford Food Bank, and the cooking team plan a menu out of the sometimes random collection of ingredients. Using the pay as you feel system, customers contribute either what they can afford or what they think the food, space and idea are worth. Since launching in April 2014, the cafe has run roughly once a month, with an average of 350 customers at each event, preventing nearly 1.5 tonnes of food waste. It is supported by the Community Action Group (CAG) Project, Europe's largest local network of community groups and organisations working on waste and carbon reduction.	

Time To Act

***Organi*sations can …** - reduce costs by investing in energy efficiency: from switching off equipment to investing in smarter building operations there are savings to be made at every budget and size of business - improve resilience by derisking material dependencies using smart resource management - drive innovation by adopting and developing sustainable products and services	*"As a city we've made great strides over the past 5 years in reducing our carbon footprint, and it's really important for us to maintain this momentum to give Oxford a sustainable, prosperous future.* *At Oxford Bus Company we've carried out several innovative schemes to reduce our emissions and have seen a direct positive impact from these on our bottom line. Technology is improving all the time and so we'd encourage our fellow local businesses to look again at the energy saving opportunities that may be available to them. From our experience they may well be pleasantly surprised by the payback periods these can offer."* *Phil Southall, Oxford Bus Company* *Reducing our carbon emissions makes sense in terms of managing premises costs and delivering a sustainable estate, creating well managed facilities and also contributing to energy saving for the city and region.* *We hope at Oxford Brookes University that we deliver a range of innovations around both energy efficient equipment and design as well as generating power to support our estate as part of our commitment to social responsibility.* *Sue Holmes*
Communities can …. • drive local action by working together in a community action group • work together to raise awareness of their neighbours to the benefits of free and low-cost energy efficiency measures, and how to access support for those living in fuel poverty • invest in local energy projects like those run by the Low Carbon Hub and the city's community energy groups	*TBC Seeking testimonial from Sam Clarke, Low Carbon Oxford North*
Individuals can … • "Pledge for Veg": If everyone in Oxford gave up meat for 1 month it could reduce the city's carbon emissions by 6,450 tonnes • "Park the Car": If everyone in Oxford switching from driving to walking or cycling for short journeys it could reduce the city's carbon emissions by 2,871 tonnes • "Switch off and relax": If everyone in Oxford switched off standby equipment for for 1 month, it could reduce the city's carbon emission by 1,241 tonnes • "No fly zone": Travelling from London to Paris or Brussels by train rather than on a plane reduces harmful carbon emissions by 14 times	*"I really enjoyed taking part in the Carbon Oxford Week challenge. Ditching the car was a really eye opening experience- I was able to enjoy walks; take the bus and train; and generally felt quite liberated to have left the car at home."* *LCO Challenge prize draw winner, Sue Henderson, University of Oxford*

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Appendix A: Covenant of Mayors and the Sustainable Energy Action Plan method

The Route Map to 2020 develops future emissions scenarios for Oxford based on projected patterns of national energy use applied at a local level, as well as estimates of local projects and polices. The assessment of historic emissions in the city is the starting point for the emissions scenarios. Data used to estimate the historic energy consumption and emissions in Oxford come from the Department of Energy and Climate Change's (DECC) 'Sub-national total final energy consumption data'[5] which provides data from 2005 to 2014.[6] The dataset provides energy consumption data for the Oxford City Council administrative area from which the emissions can be estimated. 2005 was chosen as the 'baseline year' as this is the closest to the year suggested by Covenant of Mayors, 1990, for which local data are available. Furthermore, to monitor the progress made to date, the energy and emission levels in 2012 have been analysed. The energy and emissions calculated for 2005 and 2012 are referred to as the 'Baseline Energy and Emissions Inventory' (BEEI; Appendix B) and 'Monitoring Energy and Emissions Inventory' (MEEI; Appendix C).

Publicly available UK energy projections were reviewed and draft emissions scenarios were created based on these projections and presented to attendees at the Oxford SEAP stakeholder workshops held between February 11 – 18th 2016.[7] Using the data collected and identified during these workshops, the scenarios could subsequently be revised to further reflect relevant circumstances identified.

The scenarios are used for the development of Oxford's SEAP in order to present future emissions projections in the Business as Usual (BAU) scenario, meaning no further actions other than those already embedded in legislation are taken to reduce emissions in the future, and a 'With Intervention' scenario (i.e. with a SEAP). The Route Map 2020 has estimated future emission reductions for a range of actions covering several contributing sectors in order to support targets for the SEAP.

Item 11(a)

Baseline Energy and Emissions Inventory and Monitoring Energy and Emissions Inventory

Developing a BEEI[8] is prerequisite step of the Covenant of Mayors Sustainable Energy Action Plan. The BEEI functions as an estimate of the energy consumption and associated emissions from the city or region for the baseline year, broken down by sector. This is traditionally the starting point for the development of SEAPs, against which any emission targets are set. The development of the MEEI[9] is similar to the BEEI, but instead measures the progress of the SEAP at a later point in time, often in connection to the latest available data year or the year at which the city's SEAP work is commenced.

For Oxford's 2005 baseline year, emissions were estimated to 1.03 million tonnes of CO_2 equivalents (CO_2e). The progress to date were analysed for the 2012 'monitoring year' for which emissions were estimated to 0.89 million tonnes of CO_2e. This represents a reduction of 12.8 % between 2005 and 2012.

[5] Emissions data is calculated using the DECC Sub-national total final energy consumption data (https://www.gov.uk/government/collections/total-final-energy-consumption-at-sub-national-level)
[6] This data is available on a 2 year time lag, the time taken to compile and process the data.
[7] https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014
[8] Referred to as the 'Baseline Emissions Inventory' (BEI) in Covenant of Mayors terminology
[9] Referred to as the 'Monitoring Emissions Inventory' (MEI) in Covenant of Mayors terminology

*"A **Baseline** [Energy and] **Emission Inventory** is a quantification of the amount of CO_2 emitted due to energy consumption in the territory of a Covenant signatory within a given period of time – the recommended base year being 1990. It allows* [signatories] *to identify the principal sources of CO_2 emissions and their respective reduction potentials."*

National Scenarios

National statistics for the Routemap 2020 and SEAP development were provided by DECC and National Grid to provide a starting point for the estimate of future energy demands in Oxford. The BAU scenario provides an estimate of what energy use and emissions that will be likely to occur in Oxford up to 2020 in the absence of any actions to reduce emissions. The 'With Intervention' scenario provides an estimate of what the energy use and emissions will be in Oxford by 2020 if national policies and identified local projections and policies are implemented. These impacts were developed using national estimates for the impact of national policies and local data gathered from Oxford SEAP stakeholders.

Business as Usual Scenario

The BAU scenario assumes no actions are taken to reduce emissions beyond those already in place at the start of the projection period (here 2012). In order to determine the BAU emissions in the absence of any actions and policies/interventions, various national energy projections datasets were evaluated. Two principal sources of national energy projections were identified:

DECC Updated Energy and Emissions projections: 2014[10]

National Grid's Future Energy Scenarios[11] (NFES)

These energy projection models use underlying assumptions based on projected population growth, economic growth, fossil fuel prices and other related variables.

Quantifying local actions

Local actions were quantified through identification of existing and planned projects during the SEAP stakeholder workshops held in February 2016. Data were subsequently collected through 'data requests' and 'key stakeholder engagements' with identified actors in the months following the workshops, estimating impacts from a range of local actions and sectors including community renewable projects, transport low emission zones, and private sector commitments through the Low Carbon Oxford Pathfinders. See Table A1.

Changing carbon intensity of electricity grid

Through the introduction of renewable energy sources for electricity generation, the carbon intensity of the UK grid is expected to decrease.12 The Covenant of Mayors methodology does not account for changing electricity emission factors, but instead utilises a constant carbon intensity for the BEEI, MEEI and

[10] https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014
[11] http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/
[12] http://www.cibsejournal.com/opinion/moving-to-a-zero-carbon-electrically-powered-future/

projected target year. Using the Covenant of Mayors methodology applying a constant electricity emission factor, emissions by 2020 are expected to decrease to 0.72 million tonnes of CO2e. This represents a reduction of 29.6 % compared to the 2005 baseline.

Utilising a projected changing carbon intensity in line with DECC's UK local authority and regional carbon dioxide emissions national statistics 2005 – 2014, Oxford's emissions by 2020 could be expected to decrease an additional 91,800 tonnes to 0.63 million tonnes of CO2e.[13] This represents a reduction of 38.5% compared to the 2005 baseline.

[13] https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2014

Table A1: Local Actions

Key Actions	Responsible body	Implementation timeframe		Estimates in 2020		
		Start time	End time	Energy savings [MWh/a]	Renewable energy production [MWh/a]	CO2e reduction [t/a]
MUNCIPAL BUILDINGS, EQUIPMENT / FACILITIES				5,053	-	1,799
Oxford City Council - Own Estate Reductions	Oxford City Council	2012	2020	5,053		1,799
TERTIARY BUILDINGS, EQUIPMENT / FACILITIES				208,495	-	72,193
Low Carbon Oxford Pathfinders - Commercial	Oxford City Council	2012	2020	7,456		2,655
LES Priority N3 - Planning for low carbon development	Oxford City Council	2012	2020	53,786		17,000
University of Oxford	University of Oxford	2012	2020	76,645		27,293
Oxford Brookes University	Oxford Brookes University	2012	2020	8,785		3,128
NHS - Lighting retrofit	NHS Trust	2012	2020	859		408
Building Regs 2010	National Policy	2010	2020	16,216		5,774
Building Regs 2013	National Policy	2013	2020	654		233
Products policy	National Policy	2009	2020	25,194		8,971
Smart Metering	National Policy	2012	2020	5,675		2,021
ESOS	National Policy	2016	2020	1,745		621
ND RHI	National Policy	2012	2020	4,670		1,663
CRC	National Policy	2012	2020	3,563		1,269
PRS Regulations	National Policy	2016	2020	3,247		1,156
RESIDENTIAL BUILDINGS				84,400	-	24,090
OCC Private Housing Energy Efficiency Measures	Oxford City Council	2012	2020	162		63
OCC Social Housing Energy Efficiency Measures	Oxford City Council	2012	2020	720		206
Building Regs 2010	National Policy	2012	2020	19,569		5,582
Building Regs 2013	National Policy	2014	2020	308		88
Products policy	National Policy	2012	2020	33,794		9,639
Smart Metering	National Policy	2012	2020	13,176		3,758
Domestic RHI	National Policy	2012	2020	8,378		2,390
ECO/Green Deal	National Policy	2014	2020	8,278		2,361
Low Carbon Oxford North Housing Refurbishment	Community Group	2012	2020	16		5
PUBLIC LIGHTING				68		32
Oxford County Council - LED Lights	Oxfordshire County Council	2015	2020	68		32

INDUSTRY				8,420	-	2,998
Low Carbon Oxford Pathfinders - Industrial	Private Sector	2012	2020	3,217		1,146
Building Regs 2010	National Policy	2012	2020	1,370		488
Building Regs 2013	National Policy	2014	2020	10		4
Products policy	National Policy	2009	2020	714		254
ESOS	National Policy	2016	2020	419		149
ND RHI	National Policy	2012	2020	2,491		887
CRC	National Policy	2012	2020	81		29
PRS Regulations	National Policy	2016	2020	118		42
TRANSPORT				88,560	-	21,759
Chiltern Railway Cowley Branch	Chiltern Railways	2018	2020	2,760		675
Low emissions Zone	Oxford City Council	2014	2020	10,808		2,719
Go Ultra Low	Oxford City Council	2016	2020	151		37
Train Electrification	National Rail	2019	2020	2,283		574
Oxford City Council - Fleet energy reduction	Oxford City Council	2012	2020	2,505		613
Road biofuels (RTFO 8%)	National Policy	2017	2020	25,799		6,313
Road vehicle efficiencies	National Policy	2012	2020	44,248		10,827
Low Carbon Oxford North Electric Vehicle Summertown	Community Group	2012	2020	5		1
LOCAL ELECTRICITY PRODUCTION				-	3,652	1,900
Community renewable energy schemes	Oxford City Council	2015	2020		796	378
Project ERIC	Project ERIC	2015	2020		175	83
Oxford Bus Company PV Installation	Oxford Bus Company	2013	2014		120	64
BMW PV Installation	BMW	2012	2013		2,560	1,374
LOCAL HEAT/COLD PRODUCTION				36,433	-	10,392
NHS Energy Link	NHS Trust	2017	2020	36,433		10,392
OTHER				-	-	11,585
Waste Incineration and Recycling	Viridor & Oxford City Council	2014	2020	-		11,583
Low Carbon Oxford Group Tree Planting West Oxford	Community Group	2012	2020			1
TOTAL				431,429	3,652	146,749

Appendix B: Baseline Emission Inventory (BEI)

Description: This worksheet contains Oxford's Baseline Emission Inventory (BEI) established for the year 2005

Source: The document draws on data from the Raw Data and Input Calcs sheet, which contains data for Oxford from Oxford City Council's own reporting, Oxfordshire Council (public lighting), and DECC's sub national total final energy statistics.

Table B1. Total final energy demand

Category	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	Heat / cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	7,605		12,002													19,607
Tertiary (non municipal) buildings, equipment/facilities	451,762		665,676													1,117,438
Residential buildings	249,953		919,562		4,957				4,275	4,641						1,183,388
Municipal public lighting	6,022															6,022
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	208,963		308,271		102,339				146							619,719
Subtotal buildings, equipments/facilities and industries	924,305	0	1,905,511	0	107,296	0	0	0	4,421	4,641	0	0	0	0	0	2,946,174
TRANSPORT:																

Municipal fleet						3,769										3,769
Public transport						60,115										60,115
Private and commercial transport						171,230	274,272									445,502
Subtotal transport	0	0	0	0	0	235,115	274,272	0	0	0	0	0	0	0	0	509,387
Total	**924,305**	**0**	**1,905,511**	**0**	**107,296**	**235,115**	**274,272**	**0**	**4,421**	**4,641**	**0**	**0**	**0**	**0**	**0**	**3,455,560**

Table B2. CO2 or CO2 equivalent emissions

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/ cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	3,614		2,453													6,067
Tertiary (non municipal) buildings, equipment/facilities	214,655		136,064													350,719
Residential buildings	118,765		187,958		1,412				1,451	1,804						311,390
Municipal public lighting	2,861															2,861
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	99,289		63,011		29,156				50							191,505
Subtotal buildings, equipments/facilities and industries	439,183	0	389,486	0	30,569	0	0	0	1,500	1,804	0	0	0	0	0	862,542
TRANSPORT:																
Municipal fleet						1,008										1,008
Public transport						16,084										16,084
Private and commercial transport						45,814	69,443									115,257

Subtotal transport	0	0	0	0	0	62,907	69,443	0	0	0	0	0	0	0	0	132,350
OTHER:																
Waste management																27,692
Waste water management																
Please specify here your other emissions																
Total	**439,183**	**0**	**389,486**	**0**	**30,569**	**62,907**	**69,443**	**0**	**1,500**	**1,804**	**0**	**0**	**0**	**0**	**0**	**1,022,585**

Corresponding CO2-emission factors in [t/MWh]	0.475		0.204		0.285	0.268	0.253		0.339	0.389					

CO2 emission factor for electricity not produced locally [t/MWh]	0.475

Table B3. Local electricity production and corresponding CO2 emissions

Locally generated electricity (excluding ETS plants , and all plants/units > 20 MW)	Locally generated electricity [MWh]	Energy carrier input [MWh]											CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for electricity production in [t/MWh]
		Fossil fuels					Steam	Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal								
Wind power														
Hydroelectric power													0	0
Photovoltaic													0	0
Combined Heat and Power														
Other *Please specify:* _____														
Total	0.0												0	

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Table B4. Local heat/cold production (district heating/cooling, CHPs…) and corresponding CO2 emissions

Locally generated heat/cold	Locally generated heat/cold [MWh]	Energy carrier input [MWh]										CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for heat/cold production in [t/MWh]
		Fossil fuels					Waste	Plant oil	Other biomass	Other Renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal							
Combined Heat and Power													
District Heating Plant(s)													
Other *Please specify:* _____													

Total	**0.0**											**0**

Appendix C: Monitoring Emission Inventory (MEI)

Description: This worksheet contains Oxford's Monitoring Emission Inventory (MEI) established for the year 2012 with constant emission factors (same as 2005) as used by the Covenant of Mayors

Source: The document draws on data from the Raw Data and Input Calcs sheet, which contains data for Oxford from Oxford City Council's own reporting, Oxfordshire Council (public lighting), and DECC's sub national total final energy statistics.

Table C1. Total final energy demand

Category	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/ cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	5,694		11,351													17,045
Tertiary (non municipal) buildings, equipment/facilities	500,954		604,778													1,105,732
Residential buildings	226,890		722,319		4,806				2,770	4,652						961,437
Municipal public lighting	5,858															5,858
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	154,121		187,424		61,200				1,018							403,763
Subtotal buildings, equipments/faciliti	893,517	0	1,525,872	0	66,006	0	0	0	3,788	4,652	0	0	0	0	0	2,493,835

es and industries																
TRANSPORT:																
Municipal fleet						6,748										6,748
Public transport						63,348										63,348
Private and commercial transport						206,059	193,593									399,652
Subtotal transport	0	0	0	0	0	276,154	193,593	0	0	0	0	0	0	0	0	469,747
Total	**893,517**	**0**	**1,525,872**	**0**	**66,006**	**276,154**	**193,593**	**0**	**3,788**	**4,652**	**0**	**0**	**0**	**0**	**0**	**2,963,582**

Table C2. CO2 or CO2 equivalent emissions

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/ cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	2,706		2,320													5,026
Tertiary (non municipal) buildings, equipment/facilities	238,028		123,617													361,645
Residential buildings	107,807		147,642		1,369				940	1,808						259,566
Municipal public lighting	2,783															2,783
Industries (excl. industries involved in the EU Emission trading scheme)	73,230		38,310		17,436				345							129,321
Subtotal buildings, equipments/ facilities and industries	424,555	0	311,888	0	18,805	0	0	0	1,285	1,808	0	0	0	0	0	758,341
TRANSPORT:																
Municipal fleet						1,765										1,765
Public transport						16,572										16,572
Private and commercial transport						53,907	47,531									101,438
Subtotal transport	0	0	0	0	0	72,245	47,531	0	0	0	0	0	0	0	0	119,776
OTHER:																
Waste management																13,364

Waste water management																
Please specify here your other emissions																
Total	**424,55**	**0**	**311,88**	**0**	**18,805**	**72,245**	**47,531**	**0**	**1,285**	**1,808**	**0**	**0**	**0**	**0**	**0**	**891,481**

Corresponding CO2-emission factors in [t/MWh]	0.475		0.204		0.285	0.262	0.246		0.339	0.389						

CO2 emission factor for electricity not produced locally [t/MWh]	0.47515
% of electricity not produced locally	100.0 %
CO2 emission factor for electricity produced locally [t/MWh]	0.00
% of electricity produced locally	0.0049%

Table C3. Local electricity production and corresponding CO2 emissions

Locally generated electricity (excluding ETS plants , and all plants/units > 20 MW)	Locally generated electricity [MWh]	Energy carrier input [MWh]											CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for electricity production in [t/MWh]
		Fossil fuels					Steam	Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal								
Wind power														
Hydroelectric power	33.0												0	0
Photovoltaic	10.4												0	0
Combined Heat and Power														
Other *Please specify:* _____														
Total	43.4												0	

Table C4. Local heat/cold production (district heating/cooling, CHPs…) and corresponding CO2 emissions

Locally generated heat/cold	Locally generated heat/cold [MWh]	Energy carrier input [MWh]										CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for heat/cold production in [t/MWh]
		Fossil fuels					Waste	Plant oil	Other biomass	Other Renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal							
Combined Heat and Power													
District Heating Plant(s)													
Other *Please specify:* _____													
Total												0	

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