A NET ZERO ROUTEMAP FOR COVENTRY

Your Climate Strategy

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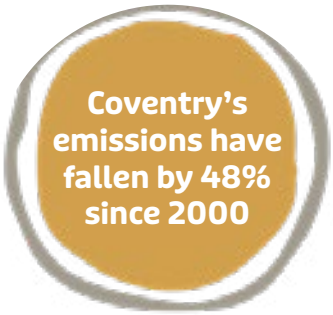


Climate change is a global problem that needs local solutions. Every city, town and community has a role to play in helping to address climate change - but what specifically should Coventry be doing?

As a vibrant and growing city with a population of 345,000 people and an important industrial base, Coventry could do all sorts of things to reduce its carbon footprint. It could retrofit its existing homes and buildings, minimise energy use and maximise the uptake of renewables in new homes and buildings, promote active travel, public transport and the transition to electric vehicles and enable further improvements in industrial energy efficiency. The fact that there are so many options that could be adopted across every area of the city points to the need for a joined-up and evidence-based approach.

This report sets out the results of analysis that assesses past, present and projected energy use and carbon emissions from the different sectors in Coventry. It shows how Coventry's emissions have fallen by 48% since 2000, and it presents data on the split of carbon emissions from housing, other buildings, transport, industry and land-use across the city. Looking forward, it sets out the carbon budgets and targets that Coventry should work towards in order to do its bit in helping the world to avoid the worst impacts of dangerous climate change.

The report identifies and evaluates over 700 of the different options that Coventry could adopt in order to reduce its carbon emissions and transition towards net zero. The report takes into account the specific features of Coventry – for instance in its homes and buildings, its businesses and industry and its vehicle stock and transport systems - and it assesses the scope to deploy each of the different options in the city.

On this basis, league tables of the most cost and carbon effective options that could be adopted across the city are presented, investment needs and paybacks are assessed, and the wider social benefits relating to energy bill reduction and employment creation are set out.

The evidence that is presented highlights the scale and significance of energy use in Coventry – a crucially important issue given the social and economic impacts of recent energy price rises. The analysis shows that as a city Coventry spends over £620 million a year on energy in 2022 – this is money that is leaving the city as a whole every year and that is associated with growing levels of fuel poverty in households and cost challenges in businesses.

However, the analysis also shows that Coventry's annual energy bill could be cut by £170 million a year through cost-effective investments alone. Making these investments could cut the city's carbon footprint by nearly a quarter whilst also creating nearly 107 jobs in the city over the next 20 years. These investments could also help to cut the average household energy bill in the city by 10% and business energy bills by 24%, thereby helping to reduce fuel poverty and improve business productivity and resilience.

In the longer term, the analysis shows that Coventry can meet the legally-binding national target to reach net zero carbon emissions by 2050. Of course, there are challenges in doing this – particularly in terms of unlocking investment opportunities and building public and political support. But the evidence clearly shows that the target can be met and that tackling climate change can absolutely align with Coventry's desire to be a productive, prosperous and inclusive city.

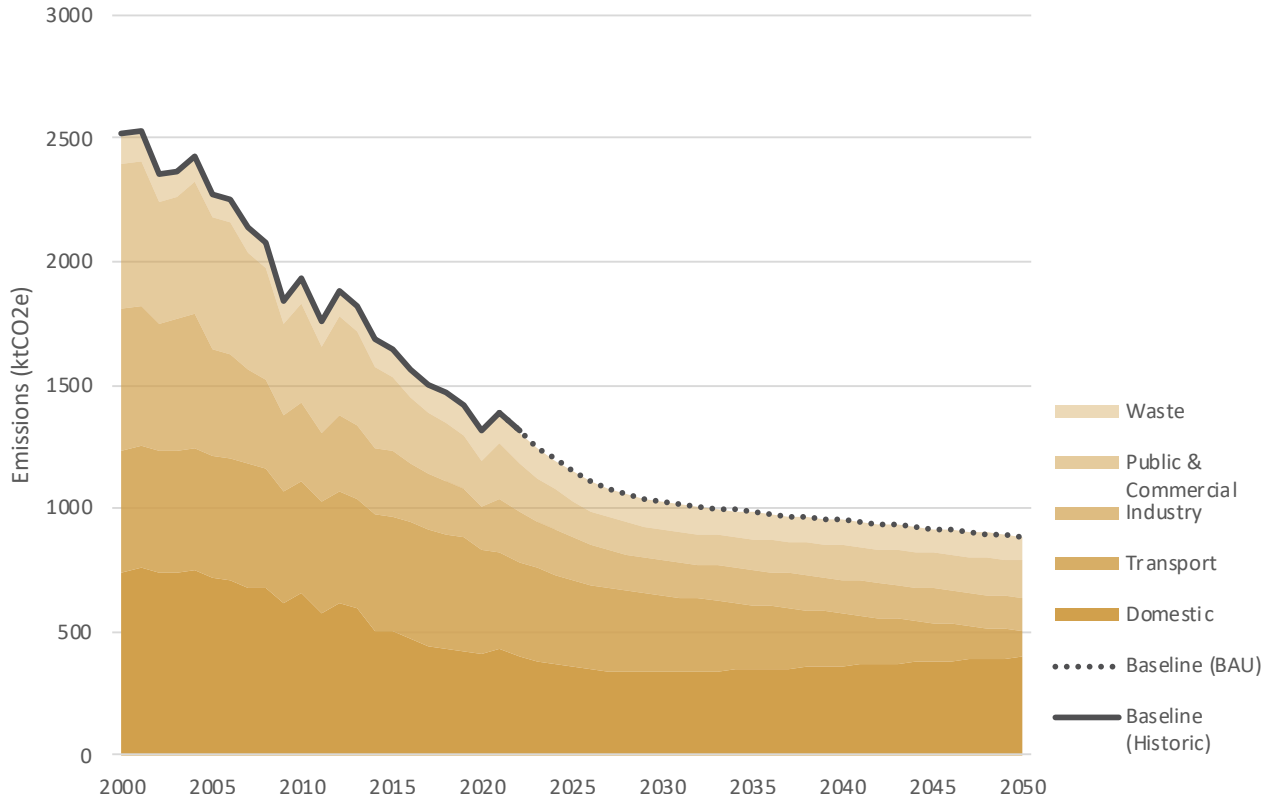
Coventry's Carbon Footprint

Past and Present Emissions

Coventry's direct carbon footprint – coming from its use of fuels such as petrol, diesel and gas (also known as Scope 1 emissions) and from its use of electricity (Scope 2 emissions) - fell by 48% between 2000 and 2022.

This substantial reduction stems from a mix of electricity decarbonization, gradual improvements in the efficiency of buildings and vehicles and structural changes in the economy, for example linked to the switch from manufacturing to higher-value production and services.

Figure 1: Coventry's Carbon Footprint - Past, Present and Projected (Direct Emissions - Scope 1 and 2)

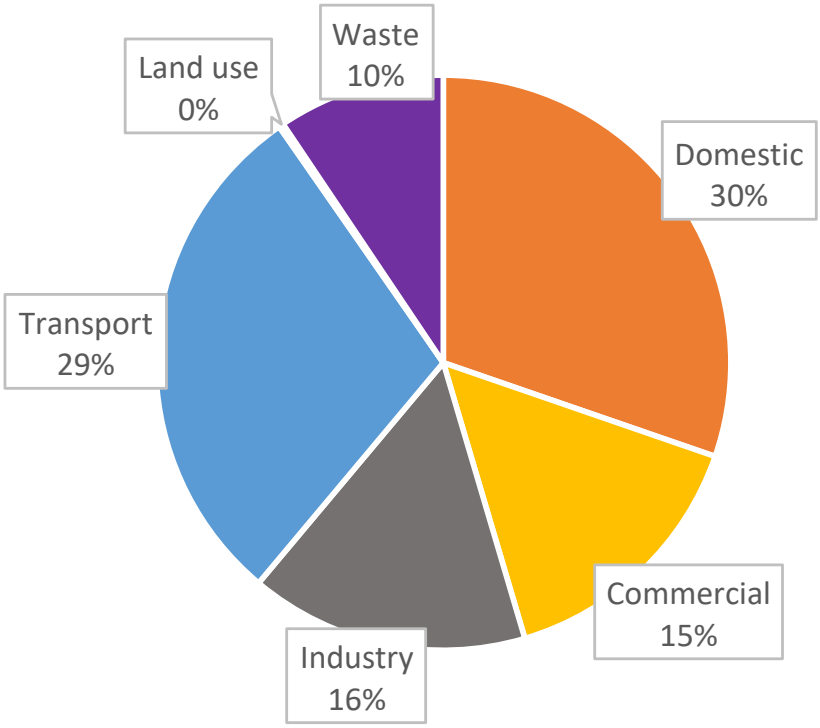


A Sectoral Breakdown of Present Emissions

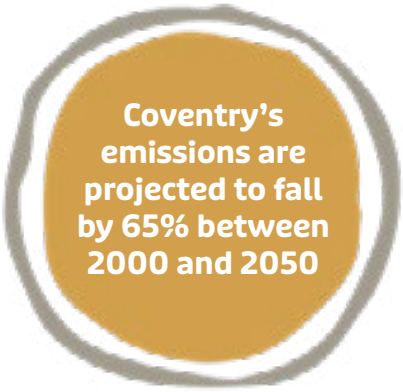
74% of Coventry's emissions come from buildings and transport

Currently, 74% of all emissions from the city come from buildings and transport, with homes accounting for 30%, public and commercial buildings 15% and transport for 29% of emissions. It therefore makes sense to focus the city's decarbonisation efforts on these key sectors. However, as industry accounts for 16% and waste for 10% of emissions they should also be considered. Emissions from land-use, land-use change and forestry (so-called LULUCF emissions) are relatively minor in Coventry.

Figure 2: Coventry's Carbon Footprint - Sectoral Breakdown (Direct Emissions - Scope 1 and 2)



A Projection of Future Emissions

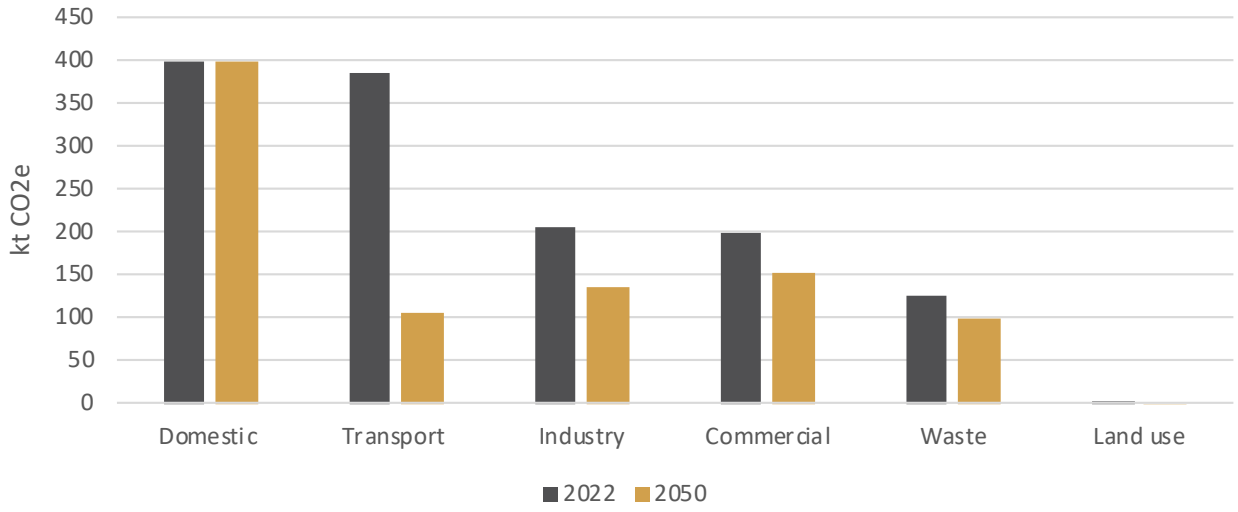


All projections are uncertain, but using forecasted economic and population growth we predict that by 2050 Coventry's carbon footprint will be 65% lower than in 2000. This factors in the ongoing decarbonisation of the electrical grid in the UK, as well as continued energy efficiency improvements in homes, buildings and transport.

We predict that much of the reduction in Coventry's emissions in the period through to 2050 will come from the switch to electric vehicles, and improvements in efficiency in public and commercial buildings and industry. We expect that household emissions are expected to fall on average, but that an increase in the population and the number of households in Coventry will see the overall emissions from homes in the city increase slightly.

A 65% carbon cut from the city between 2000 and 2050 is a big improvement, but it is still a long way short of reaching net zero carbon emissions, especially if Coventry wants to meet its target by 2050.

Figure 3: Coventry's Carbon Footprint - Present and Projected Sectoral Emissions (Direct Emissions - Scope 1 and 2)



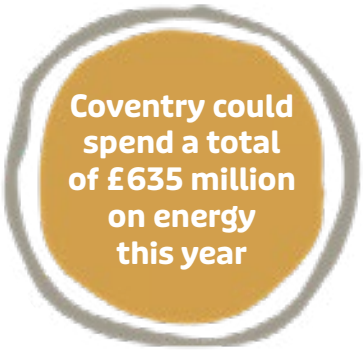
The Importance of Broader, Consumption-based Emissions

Almost every city or town focuses primarily on these direct (or Scope 1 and 2) emissions. However, it is also important to note that these figures don't account for the carbon footprint of goods and services produced elsewhere but consumed in Coventry.

These consumption-based (or Scope 3) emissions add c.80% onto the current carbon footprint of the city, and over time these emissions are falling more slowly. As well as addressing its fuel and electricity use, Coventry should also think about the carbon embedded in its consumption, especially of carbon-intensive products like concrete and steel or meat and dairy.

However, changing the purchasing patterns of organisations and the buying-habits of individual consumers is a complex task that many governments are only just beginning to grapple with. Organisations within the City will need to consider their procurement practices and purchasing policies to reduce the carbon emissions associated with the different products and services they buy.

Coventry's Energy Bills



Total Energy Bills

In 2021, Coventry's total energy bill – covering the cost of all purchases of petrol, diesel, gas and electricity in the city – amounted to an estimated £459m, which rose to £621m in 2022. The cost of energy represents a major drain on the city's economy and a strain for many households, businesses and public services.

We estimate that Coventry could spend a total of £635m on energy in 2023 – meaning that the energy price rises could result in an extra £176m leaving the city economy this year, compared to before the current energy crisis. If energy prices continue at that high level, the total energy bill for the city could reach £646m a year by 2050.

Household Energy Bills and Fuel Poverty

We estimate that in 2022 the average household in Coventry spent £2,813 a year on energy – including the costs of transport within the city. This figure is up 29% from 2021, which was £2,186. For individual households, under current price forecasts, the average annual household energy bill (including household heating and energy use and household's transport costs) could increase to £2,999 by 2050. These increases in energy bills are obviously a hugely significant issue for the c.20% of households – or in other words the 28,000 homes that house 65,000 people - that are in fuel poverty within Coventry.

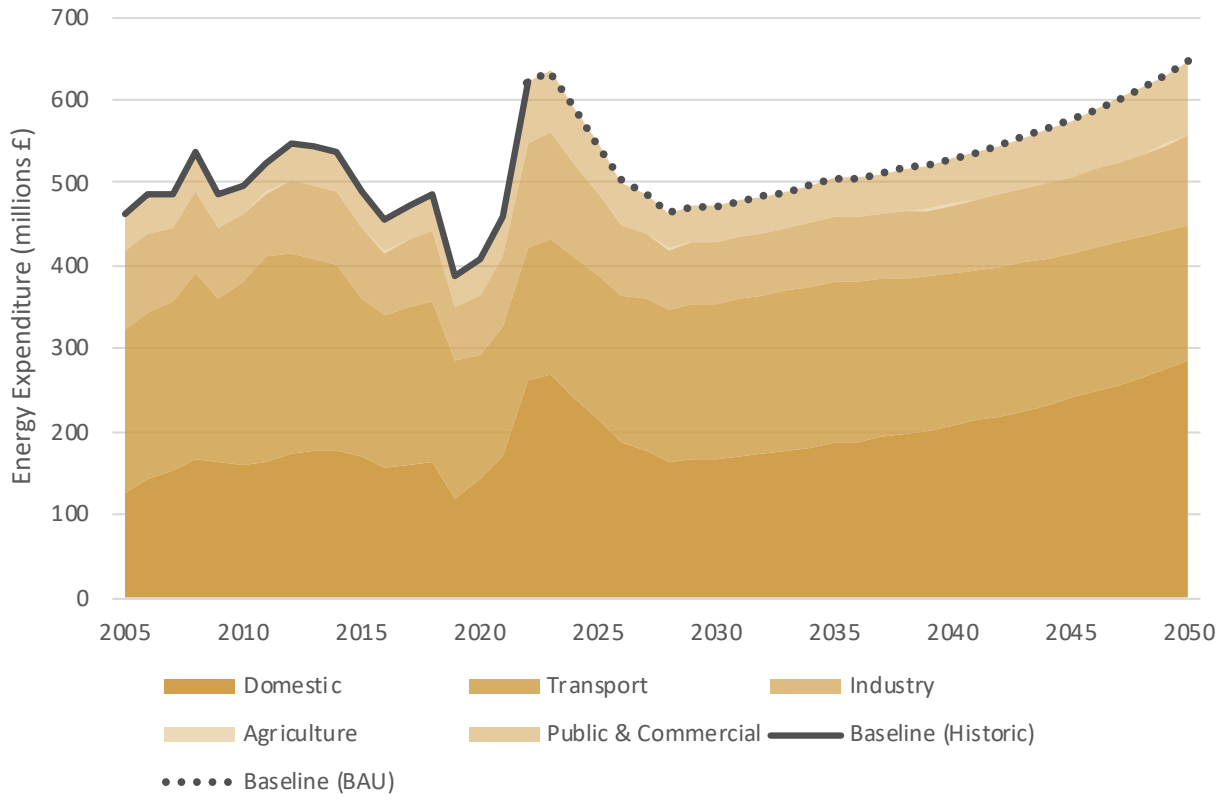
Joining-up Action on Energy Bills and Carbon

Average household energy bills in 2022 were £2,813

Whether at the city level or the household level, energy bills represent a huge outgoing – but it is clear that promoting energy efficiency can play a major role in cutting bills, tackling fuel poverty, protecting businesses and public services whilst at the same time cutting carbon emissions.

As will be shown below, Coventry could cut its carbon emissions by nearly 25% and save £170m a year from its energy bill by investing in measures that would more than pay for themselves over their lifetime through the energy savings that they generate. If it went further to adopt all of the measures that are currently viable, Coventry could cut its carbon emissions by 51% and save £327m a year from its energy bill.

Figure 4: Coventry's Total Energy Bill - Past, Present and Projected



Developing an Evidence-Based Routemap for Coventry

Addressing energy use and carbon emissions in Coventry will require different actors to engage in multiple actions across diverse sectors over an extended period of time. Designing and delivering an effective place-based approach will be much easier with a strong evidence base and a clear vision of the way forward.

In this report we set out a baseline that predicts what will happen to energy use and carbon emissions in Coventry under a 'business as usual' scenario where recent trends continue and current commitments are delivered but with no new major initiatives being adopted.

Against this baseline, we assess what Coventry needs to do to stay within its share of the global carbon budget that is consistent with having a good chance of avoiding dangerous climate change. On this basis, we propose science-based targets for Coventry, including a longer-term target and 5-yearly carbon budgets that the city can work towards over time.

We then identify and evaluate the performance and scope for deployment of a wide range of different energy-saving or carbon-cutting options that could be adopted across the city. We assess these options and provide evidence on a measure-by-measure and a sector-by-sector basis, but we also aggregate the assessment to show what could or should happen across the city as a whole.

Crucially, we look at the costs and the benefits of different levels of action and ambition. We therefore identify both the investment needs and the paybacks that come from the direct energy savings that could be generated with different forms and levels of action. We also consider some of the wider co-benefits of action to help show how Coventry can tackle its contribution to climate change in a way that joins up with its wider social, economic and environmental priorities.

This report highlights the evidence base and shows what could be done – and it sets out some indicative actions that highlight the scale and the pace of change that will be required. This should form the basis of a fuller climate action plan for Coventry that considers the actors and the resources that need to be mobilised, the roles and responsibilities that need to be defined and the capacities (individual, organisational and city-wide) that need to be built.

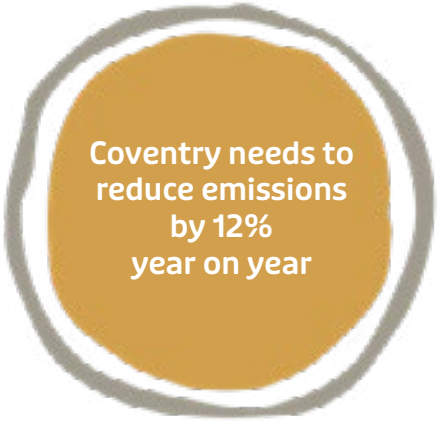
Science-Based Targets for Coventry

The UN Inter-governmental Panel on Climate Change (IPCC) has calculated the total level of emissions that could be emitted globally in the period through to 2100 if we are to have a good (83%) chance of limiting average warming to 1.5^{o}C and so limiting the risks of triggering dangerous levels of climate change.

Dividing this global total by population suggests that Coventry's total share of the global carbon budget for the period through to 2100, consistent with giving the world a good chance of avoiding dangerous climate change, is 9.4 Mt (mega or million tonnes) of carbon and other greenhouse gases (collectively measured as CO_2e). At present, Coventry as a whole is emitting 1.3 Mt of CO_2e a year. This means that at current rates it will have used up its share of the global carbon budget consistent with avoiding dangerous climate change within 9 years[1], during 2031 .

Coventry itself has set a target of reaching net zero emissions by 2050. Figure 5 proposes a gradual pathway to reach this target whilst also enabling Coventry to stay within its share of the global carbon budget. This gradual pathway indicates that Coventry's emissions fall by 12% a year, every year, if Coventry is to stay within its share of the global carbon budget.

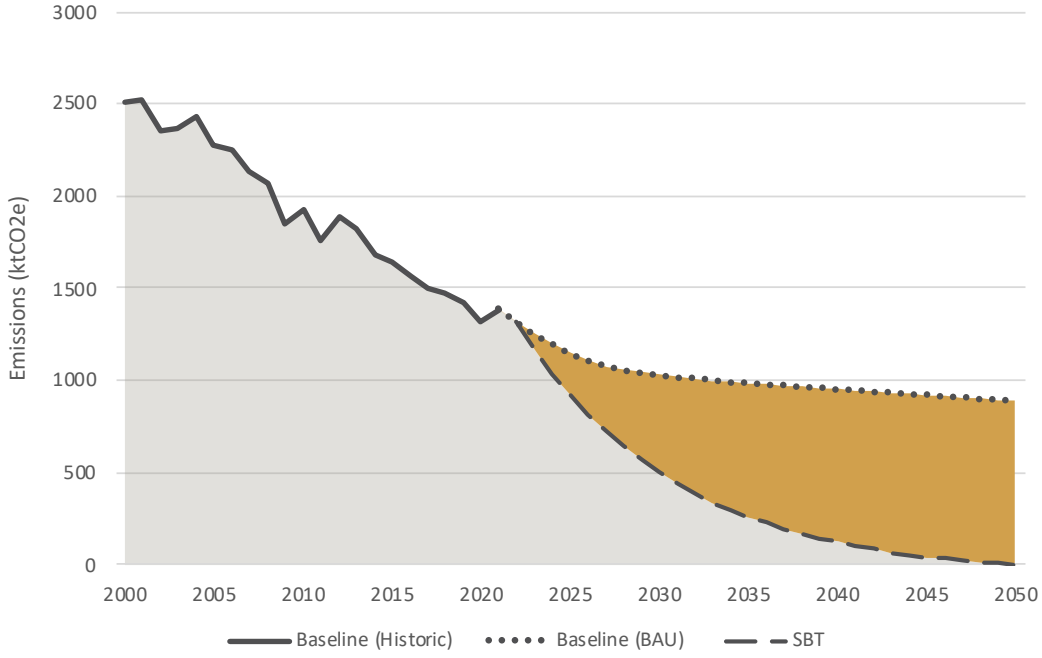
1 If Coventry reduces its annual rate of emissions, it would take longer to use up its share of the carbon budget.



Using this gradual pathway as the basis for 5-yearly carbon budgets suggests that Coventry needs to build on the 48% drop in emissions since 2000 already delivered to achieve reductions of:

- 63% by 2025
- 80% by 2030
- 90% by 2035
- 95% by 2040
- 98% by 2045
- 100% by 2050

Figure 5: A Gradual Emissions Reduction Pathway for Coventry (Direct Emissions - Scope 1 and 2)



Identifying and Evaluating Carbon Reduction Options for Coventry

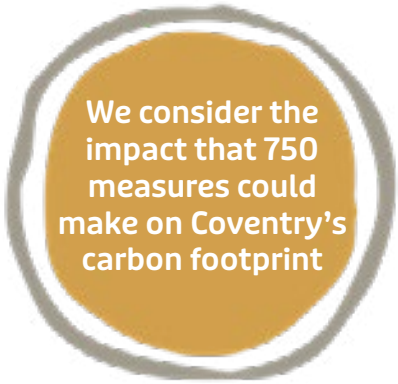
The Scope of the Work

Climate change is a cross-cutting issue. We use energy – and hence generate carbon emissions– in almost everything that we do. As a result, changes are needed in our homes, offices, retail and leisure spaces, businesses, transport systems, waste management systems and so on. There are no silver bullets or big bangs – decarbonisation requires wide ranging and far reaching change.

In this analysis we evaluate the potential contribution of different energy-saving and carbon-cutting options. In the main, we focus on tried and tested options that are already widely available. However, we also consider the contribution that some more innovative or 'stretch' options could make, and the extent to which any residual emissions could be off-set through measures such as tree planting.

For homes and public and commercial buildings, we consider both upgrading existing buildings and adopting higher standards for new buildings. For existing buildings, we analyse the impacts of improving insulation in lofts, walls, floors, windows and doors, incorporating renewables such as solar panels or air or ground source heat pumps, upgrading or replacing heating systems and switching to more efficient appliances. For new buildings, we consider the potential to build more efficient and well-insulated buildings that are more comfortable and that require less energy throughout their lifetimes.

For transport, we assess the potential to reduce transport demand – for example through home-working or through the development of '15 minute' neighbourhoods – and we consider the potential for more active travel or walking or cycling.



We also look at the scope to promote further use of public transport - especially buses and trains – and for switching the vehicle stock to either electric or more fuel-efficient cars, vans, buses and lorries.

Local and regional data are used to understand the current travel journeys being made by different travel modes (walking, cycling, driving) in Coventry. Using examples from other parts of the UK, and established transport methodologies, we then make two changes to these trips. First, we shift travel journals from higher to lower carbon travel modes. For example, we shift private vehicle travel to walking and cycling while taking into account that only a portion of trips made by car are possible on foot and by bicycle. We then assess the remaining trips in higher carbon travel modes and improve the efficiency of these trips by calculating the effect of petrol and diesel cars, buses and trucks being replaced by electric versions. Both travel shifts and travel improvements are made gradually over the period from 2023 to 2035 to accommodate the need for new infrastructure and time for changes in travel habits.

In industry, we consider the opportunities to switch to more efficient facilities – for example with enhanced energy management and better lighting, heating and cooling, pumping, condensing and processing.

In land-use, we look at the scope to minimise forms of land-use that give rise to emissions – for example from woodland or grassland degradation. We also consider the potential to maximise forms of land-use that capture and store carbon – for example through accelerated land restoration, improved soil management or accelerated tree planting schemes.

In all, we consider the potential contribution that 750 options could make – taking into account their purchasing, installation and maintenance costs, their realistic installed performance (adjusted to account for rebound effects) and their expected lifetimes. We assess the potential rate and extent to which each option could be deployed, taking into current conditions, background trends and the expected rates of population and economic growth in the city. Our analysis factors in forecast energy prices and the ongoing decarbonisation of grid electricity over time.

As well as assessing carbon savings, we look at overall investment needs and the extent to which investments payback through the energy savings that they generate. We also consider the extent to which investments could generate new jobs in Coventry, taking into account the number of jobs per £1m of turnover in each area and the extent to which any jobs created are likely to be retained in Coventry.

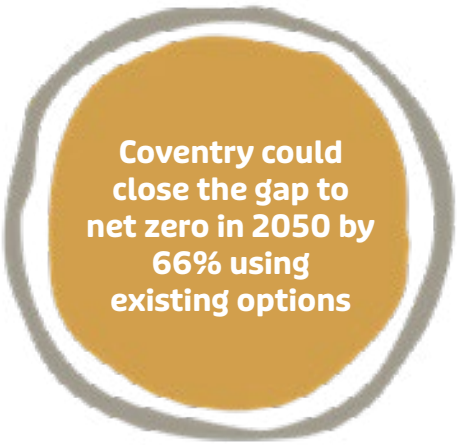
The Results

The presentation of the results

To present the aggregated results in a structured and accessible way, we look at five levels of change:

- Level 1 – the cost-effective options. This includes all options where the investment costs would be more than covered through the direct energy savings generated over the lifetime of the measures.
- Level 2 – the cost-neutral options. This includes all options where collectively the investment costs are cancelled out by the direct energy savings generated over the lifetime of the measures. This scenario incorporates and builds on the cost-effective scenario.
- Level 3 – the technically viable options. This includes all of the options that could be adopted, including those that generate a return on investment, those that break-even and those that do not cover their costs. This scenario incorporates and builds on the cost-neutral and cost-effective scenarios.
- Level 4 – the stretch options. This includes some more ambitious options where cost, benefit and performance data is less available. The forecasts here are therefore less certain and some innovations may be needed to enable these options to be adopted.
- Level 5 – options for offsetting any residual emissions. This considers the extent to which any emissions remaining after the adoption of all of the options in Levels 1-4 could be offset through UK-based tree planting. This is not a recommendation to engage in such offsetting, merely an indicative assessment of the extent of tree planting that would be required to reach net zero.

We also present results for each of the key sectors in Coventry and overall league tables of the most cost- and carbon-effective options, both in the form of 'top ten' tables and through complete tables of all 750 measures.



Aggregated Results

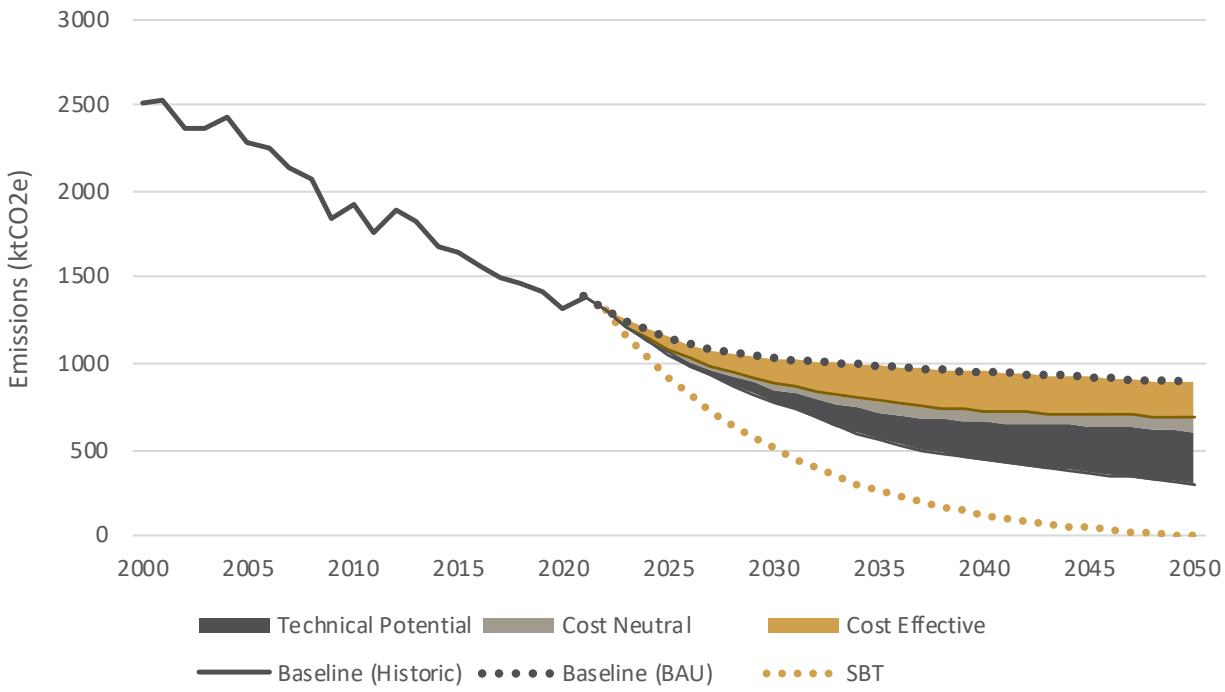
The aggregated results show the contribution that each of the levels of activity could make to cutting Coventry's carbon footprint.

» Level 1 – the cost-effective options. Adopting all of the options in this category would enable Coventry to close the gap between its projected 'business as usual' emissions in 2050 and net zero by 23%. To exploit these options, £53m a year would need to be invested across Coventry for the next 15 years, but these investments would cut Coventry's total energy bill by £114m p.a. by 2030 and create 2,133 years of extra employment (i.e. 107 jobs for 20 years)

» Level 2 - the cost-neutral options. In addition to the cost-effective options, including cost-neutral measures would enable Coventry to close the gap between its projected 'business as usual' emissions in 2050 and net zero by 32%. This would require investments of £165m a year for the next 15 years, but this would cut Coventry's total energy bill by £122m a year from 2030 whilst creating 6,954 years of extra employment (i.e. 348 jobs for 20 years).

» Level 3 – the technically viable options. After implementing the cost-effective and cost-neutral options, including all of the technically viable options would enable Coventry to close the gap between its projected 'business as usual' emissions in 2050 and net zero by 66%. This step-change in the level of decarbonization would require investments of £654m a year for the next 15 years, but this would cut Coventry's energy bill by £185m a year from 2030 whilst creating 28,838 years of extra employment (i.e. 1,442 jobs for 20 years).

Figure 6: Coventry's Carbon Reduction Potential - Available Options

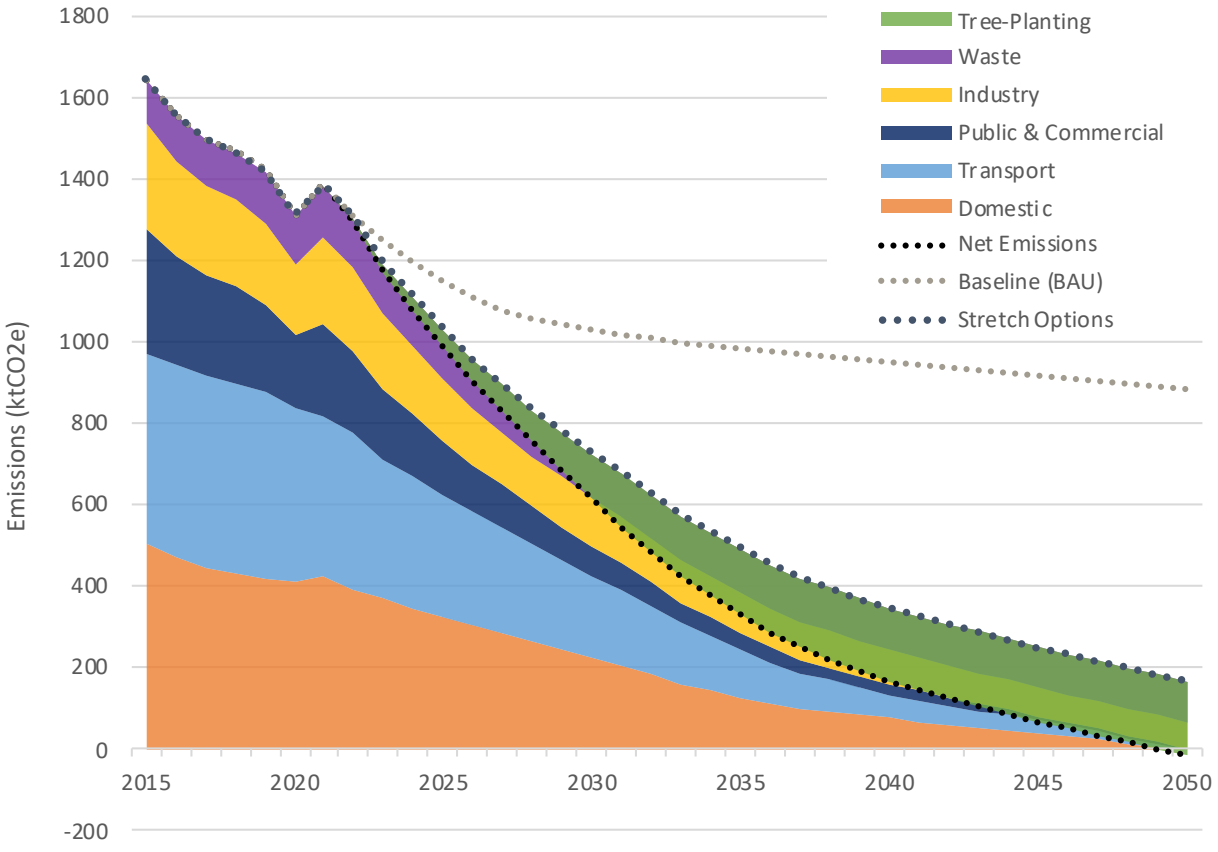


» Level 4 – the stretch options. Going further still to include more ambitious (but as yet uncosted) options for decarbonisation would enable Coventry to close the gap between its projected 'business as usual' emissions in 2050 and net zero by 81%.

» Level 5 - options for offsetting any residual emissions. After adopting the options in each category above, for illustration Coventry could then achieve its target of reaching net zero emissions by 2050 by planting 44 million trees in the UK, which with the densest possible planting would require an area equivalent to 99% of Coventry's total land area.

Investing in existing options could cut Coventry's energy bill by £327m a year

Figure 7: Coventry's Carbon Reduction Potential - Stretch Options and Offsetting Potential



The Most Carbon and Cost-Effective Options for Coventry

There are multiple options that could be deployed as Coventry transitions towards net zero. In this analysis, we focus on the level of carbon reduction and cost-effectiveness of different options. Below we present the 'top ten' league tables for both the most carbon-effective options and those with the highest levels of carbon mitigation. We note that the domestic, public and commercial buildings, transport and industry sectors all have options in the top-ten most carbon-effective league table. This emphasises the need for a cross-cutting, city-wide decarbonisation programme. In Appendices 1 and 2 we present the full league tables extending to over 100 measures.

Of course, decision-making should be guided by a wider range of criteria than just carbon- and cost-effectiveness. Assessing the readiness or capacity of Coventry to adopt different options – for example considering their political, social, financial and institutional readiness – can provide a more rounded or multi-criteria view of the most suitable options. Whatever criteria are applied, there should be clear social, economic and environmental benefits from having an informed, evidence-based approach.

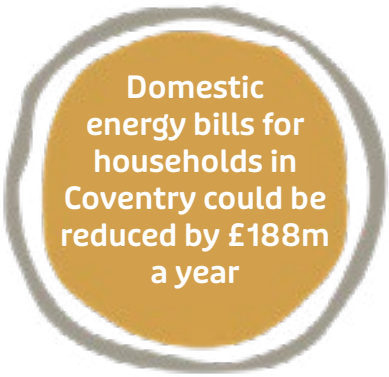
Table 1: Top Ten List of the Most Carbon-Effective Options

Measure	Carbon Abatement (kt CO_2e)
External wall insulation in domestic buildings	1010
Whole house retrofits in domestic buildings	882
Heat pumps in domestic buildings	624
Internal wall insulation in domestic buildings	570
Condensing and insulation measures to boilers and steam piping in industry	533
Solar PV in domestic buildings	520
Improving efficiency of boilers and steam piping in industry	371
Fabric improvements in industrial buildings/warehouses	312
Loft insulation in domestic buildings	287
Passivehaus standards in new retail buildings	280

Table 2: Top Ten List of the Most Cost-Effective Options

Measure	Cost per tonne (£)
Reduced standby consumption in domestic buildings	-12248
Large petrol car journeys to electric bus journeys	-3315
Medium petrol car journeys to electric bus journeys	-3214
Small petrol car journeys to electric bus journeys	-3110
Large petrol car journeys to diesel bus journeys	-2493
Medium petrol car journeys to diesel bus journeys	-2144
Large diesel car journeys to electric train journeys	-1921
Small petrol car journeys to diesel bus journeys	-1459
Turn unnecessary lighting off in domestic buildings	-1341
Reduce heating for washing machines in domestic buildings	-1341

Results by Sector: Housing



Under a business as usual scenario, which includes ongoing decarbonisation of grid electricity, a continuation of the background trends that are gradually improving the energy efficiency of the housing stock in Coventry, and forecast growth in housing numbers in Coventry, we project that the city's housing related carbon emissions will decrease slightly by 0.2% by 2050. With a central price forecast, this suggests that the average household energy bill in 2050 (excluding transport) will be £2,999 a year.

Hydrogen heating and the introduction of green methane to the natural gas grid are potential interventions that were not included in this analysis. With respect to hydrogen heating, recent academic reviews find that compared with alternatives such as heat pumps, and district heating, hydrogen use for domestic heating has a worse economic profile, is more resource intensive, and is associated with larger environmental impacts[2] . With respect to green methane, costs were not found to be competitive with alternative technologies.

It should be noted that the following scenarios (cost-effective, cost-neutral and technical potential) are cumulative, where mitigation from cost-neutral (level 2) is inclusive of and builds on the options from the cost-effective scenario, for example.

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2 Rosenow, J., 2022. Is heating homes with hydrogen all but a pipe dream? An evidence review. *Joule.*

Riemer, M., Zheng, L., Eckstein, J., Wietschel, M., Pieton, N., & Kunze, R. (2022). Future hydrogen demand: A cross-sectoral, global meta-analysis. *Notes.*

The potential for decarbonisation:

- Level 1 – the cost-effective options: With investments of £16 million a year for the next 15 years, overall emissions from Coventry's growing housing stock could be reduced by 21% by 2050. This would also reduce the total household energy bill (excluding transport) by £34 million a year by 2050.
- Level 2 – the cost-neutral options: With investments of £67 million a year for the next 15 years, overall emissions from Coventry's growing housing stock could be reduced by 28% by 2050. This would also reduce the total household energy bill (excluding transport) by £46 million a year.
- Level 3 – the cost-effective options: With investments of £330 million a year for the next 15 years, overall emissions from Coventry's growing housing stock could be reduced by 78% by 2050. This would also reduce the total household energy bill (excluding transport) by £118 million a year.

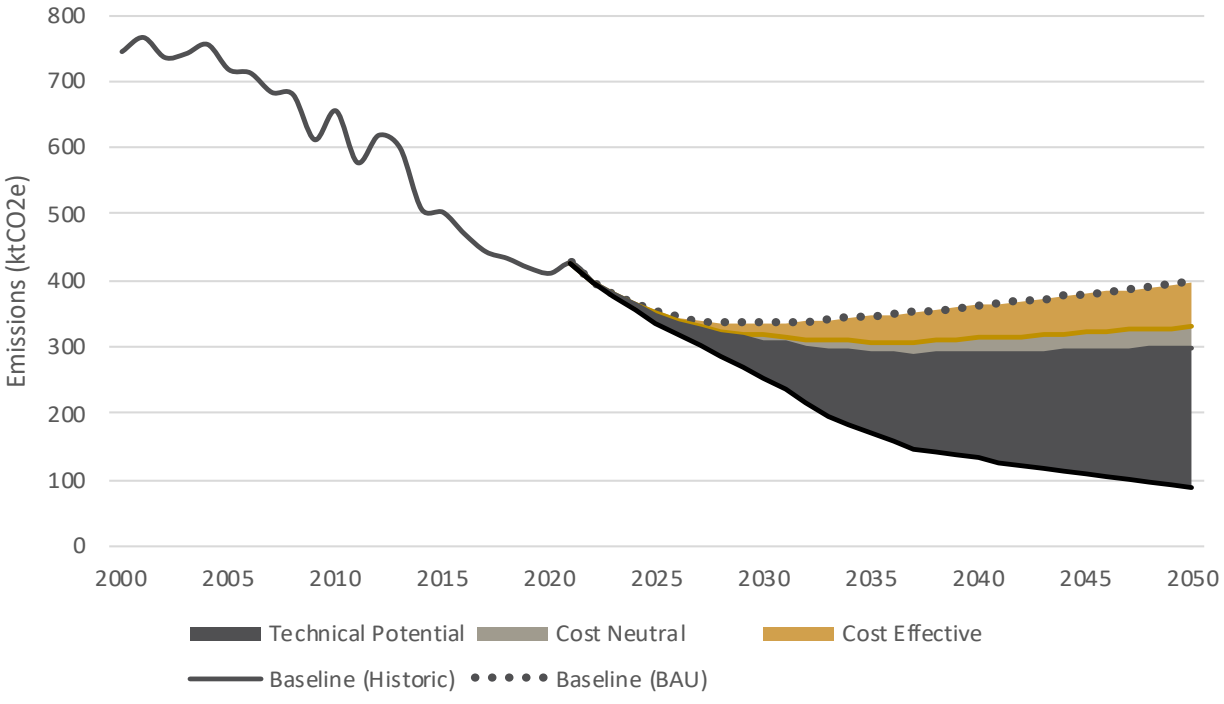
Table 3: Most Carbon-Effective in Homes

Domestic Sector	Carbon Abatement (kt CO_2e)
External wall insulation in domestic buildings	1010
Whole house retrofits in domestic buildings	882
Heat pumps in domestic buildings	624
Internal wall insulation in domestic buildings	570
Solar PV in domestic buildings	520
Loft insulation in domestic buildings	287
Passivehaus standards in new domestic buildings	270
Gas combi-boilers in domestic buildings	221
Reduce household heating by 1 C in domestic buildings	207
Cavity wall insulation in domestic buildings	161

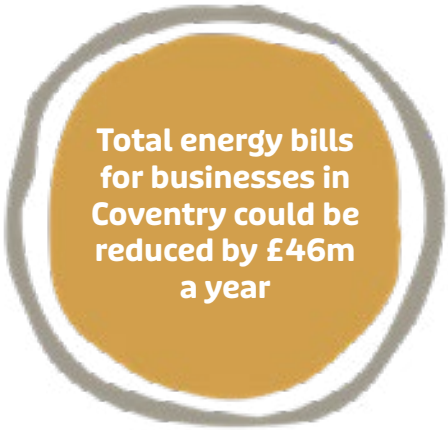
Table 4: Most Cost-Effective in Homes

Domestic Sector	Cost per tonne (£)
Reduced standby consumption in domestic buildings	-12248
Turn unnecessary lighting off in domestic buildings	-1341
Reduce heating for washing machines in domestic buildings	-1341
Low energy lighting in domestic buildings	-592
District heating networks in domestic buildings	-577
Biomass boilers in domestic buildings	-515
Tank insulation in domestic buildings	-475
Lowering thermostats in domestic buildings	-322
Loft insulation in domestic buildings	-313
Reduce household heating by 1 C in domestic buildings	-296

Figure 8: Coventry's Carbon Reduction Potential: Housing



Results by Sector: Public and Commercial Buildings



Under a business as usual scenario, which includes ongoing decarbonisation of grid electricity, a continuation of background trends that are gradually improving the energy efficiency of the public and commercial building stock in Coventry, and forecast growth in the floorspace of public and commercial buildings in Coventry, we project that this sector's carbon emissions will decrease by 24% by 2050.

- Level 1 – the cost-effective options: With investments of £14 million a year for the next 15 years, emissions from public and commercial buildings in the city could be reduced by 38% by 2050. These investments would reduce the total energy bill for public and commercial buildings in the city by £21 million a year by 2050.
- Level 2 – the cost-neutral options: With investments of £33 million a year for the next 15 years, emissions from public and commercial buildings in the city could be reduced by 42% by 2050. These investments would reduce the total energy bill for public and commercial buildings in the city by £25 million a year by 2050.
- Level 3 – the technically viable options: With investments of £145 million a year for the next 15 years, emissions from public and commercial buildings in the city could be reduced by 74% by 2050. These investments would reduce the total energy bill for public and commercial buildings in the city by £46 million a year by 2050.

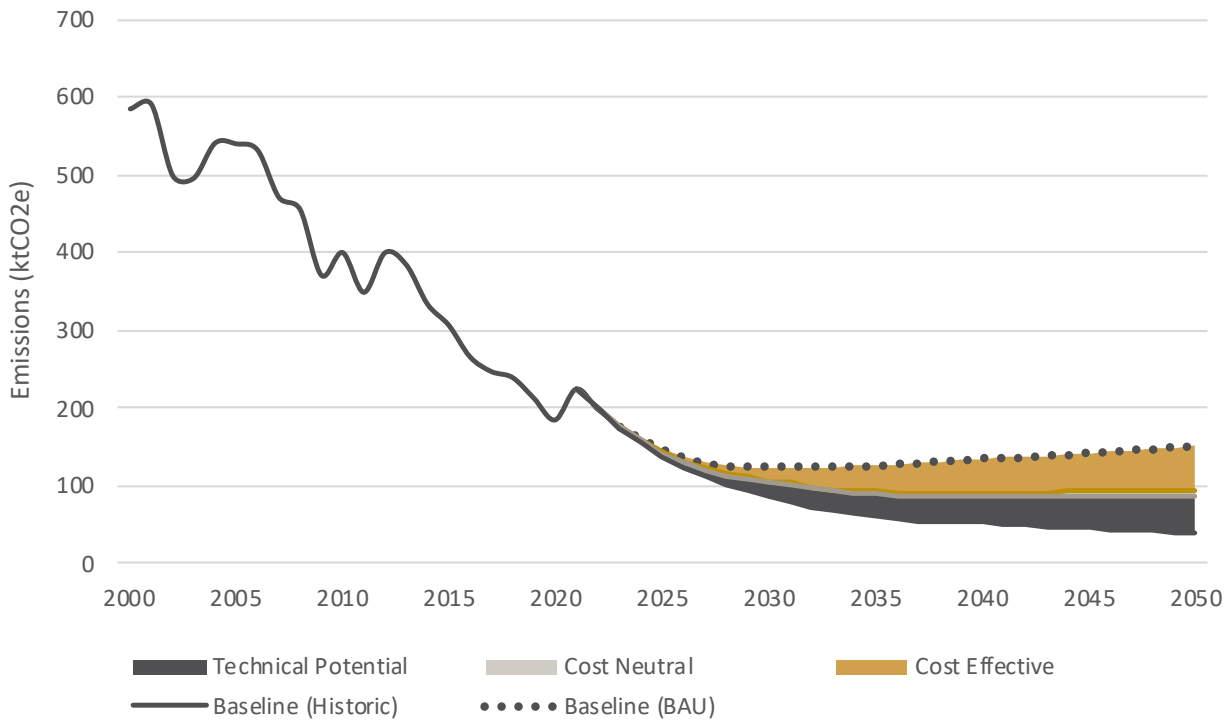
Table 5: Most Carbon-Effective Options in Public and Commercial Buildings

Commercial Sector	Carbon Abatement (kt CO_2e)
Fabric improvements in industrial buildings/warehouses	312
Passivehaus standards in new retail buildings	280
Air tightness in retail buildings	191
Air source heat pumps in retail buildings	134
Passivehaus standards in new office buildings	132
Area-based commercial retrofits in retail buildings	121
Area-based commercial retrofits in industrial buildings/ warehouses	89
Passivehaus standards in new in industrial buildings/ warehouses	74
Air source heat pumps in office buildings	61
Area-based commercial retrofits in office buildings	48

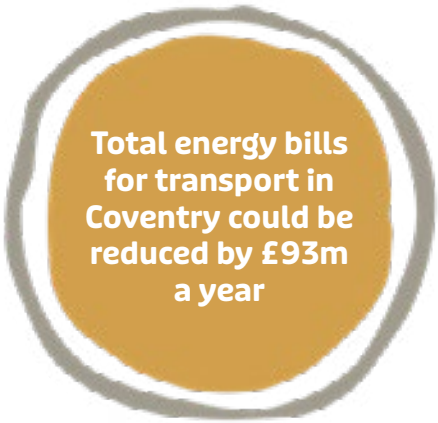
Table 6: Most Cost-Effective Options in Public and Commercial Buildings

Commercial Sector	Cost per tonne (£)
Electrical circuitry efficiency upgrades in retail buildings	-938
AC upgrades in community centres	-922
AC upgrades in healthcare buildings	-920
AC upgrades in education buildings	-913
AC upgrades in hotels	-913
Electrical circuitry efficiency upgrades in office buildings	-906
AC upgrades in non-retail buildings	-906
AC upgrades in office buildings	-905
Highly efficient air cooling system in retail buildings	-874
AC upgrades in retail buildings	-851

Figure 9: Coventry's Carbon Reduction Potential: Public and Commercial Buildings



Results by Sector: Transport



Under a business as usual scenario, which includes ongoing decarbonisation of grid electricity, a continuation of background trends that are gradually improving the energy efficiency of the transport sector in Coventry, and forecast growth in the floorspace of public and commercial buildings in Coventry, we project that this sector's carbon emissions will decrease by 73% by 2050.

- Level 1 – the cost-effective options: With investments of £22 million a year for the next 15 years, emissions from the transport sector in the city could be reduced by 62% by 2050. These investments would reduce the total energy bill for the transport sector by £84 million a year by 2050
- Level 2 – As transport includes some measures that over their lifetimes are highly cost-effective (e.g. mode shift and EVs) and some that generate significant wider benefits but are not directly cost-effective (e.g. public transport), there are no cost-neutral measures included in the analysis
- Level 3 – the technically viable options: With investments of £32 million a year for the next 15 years, emissions from the transport sector in the city could be reduced by 90% by 2050. These investments would reduce the total energy bill for the transport sector by £93 million a year by 2050

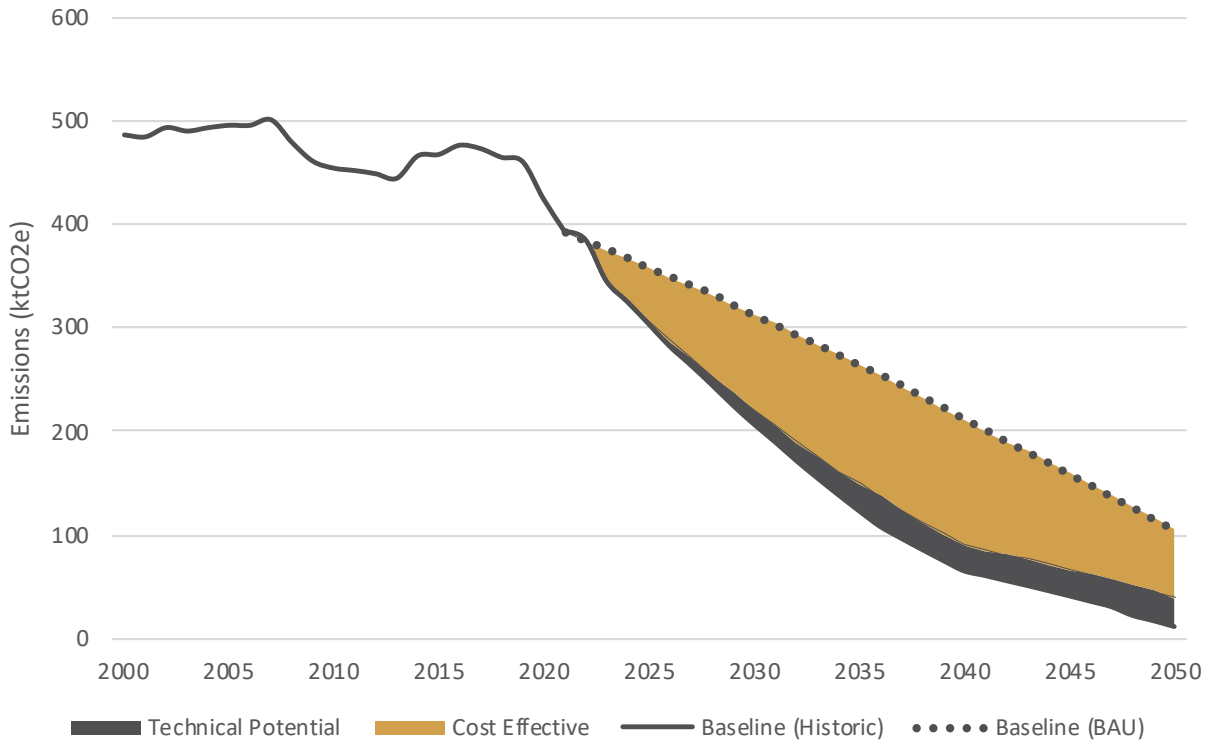
Table 7: Most Carbon-Effective Options for the Transport Sector

Transport Sector	Carbon Abatement (kt CO_2e)
Diesel light goods vehicles to electric light goods vehicles	87
Small petrol car journeys to electric train journeys	51
Large petrol car journeys to electric train journeys	48
Medium petrol car journeys to electric train journeys	47
Diesel bus journeys to electric bus journeys	27
Diesel light ordinary goods vehicle to electric ordinary goods vehicle	15
Diesel heavy ordinary goods vehicle to electric ordinary goods vehicle	13
Small petrol car journeys to bicycle journeys	11
Small petrol car journeys to walking journeys	11
Large petrol car journeys to bicycle journeys	11

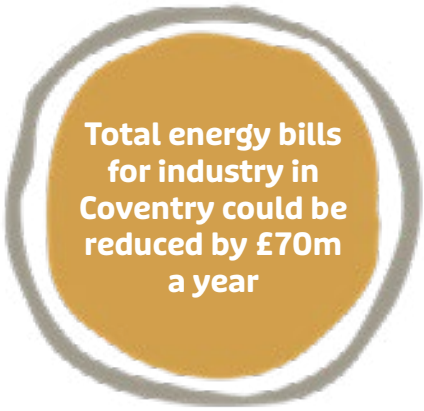
Table 8: Most Cost-Effective Options for the Transport Sector

Transport Sector	Cost per tonne (£)
Large petrol car journeys to electric bus journeys	-3315
Medium petrol car journeys to electric bus journeys	-3214
Small petrol car journeys to electric bus journeys	-3110
Large petrol car journeys to diesel bus journeys	-2493
Medium petrol car journeys to diesel bus journeys	-2144
Large diesel car journeys to electric train journeys	-1921
Small petrol car journeys to diesel bus journeys	-1459
Medium diesel car journeys to electric train journeys	-1228
Medium diesel car journeys to bicycle journeys	-1034
Small diesel car journeys to bicycle journeys	-1011

Figure 10: Coventry's Carbon Reduction Potential: Transport



Results by Sector: Industry



Under a business as usual scenario, which includes ongoing decarbonisation of grid electricity, a continuation of background trends that are gradually improving the energy efficiency of the industrial sector in Coventry, and forecasted growth in the sector, we project that this sector's carbon emissions will decrease by 35% by 2050.

- Level 1 – the cost-effective options: With investments of £7 million a year for the next 15 years, emissions from the industrial sector in the city could be reduced by 9% by 2050. These investments would reduce the total energy bill for the industrial sector by £36 million a year by 2050.

- Level 2 – the cost-neutral options: With investments of £40 million a year for the next 15 years, emissions from the industrial sector in the city could be reduced by 19% by 2050. These investments would reduce the total energy bill for the industrial sector by £38 million a year by 2050.

- Level 3 – the technically viable options: With investments of £158 million a year for the next 15 years, emissions from the industrial sector in the city could be reduced by 50% by 2050. These investments would reduce the total energy bill for the industrial sector by £70 million a year by 2050.

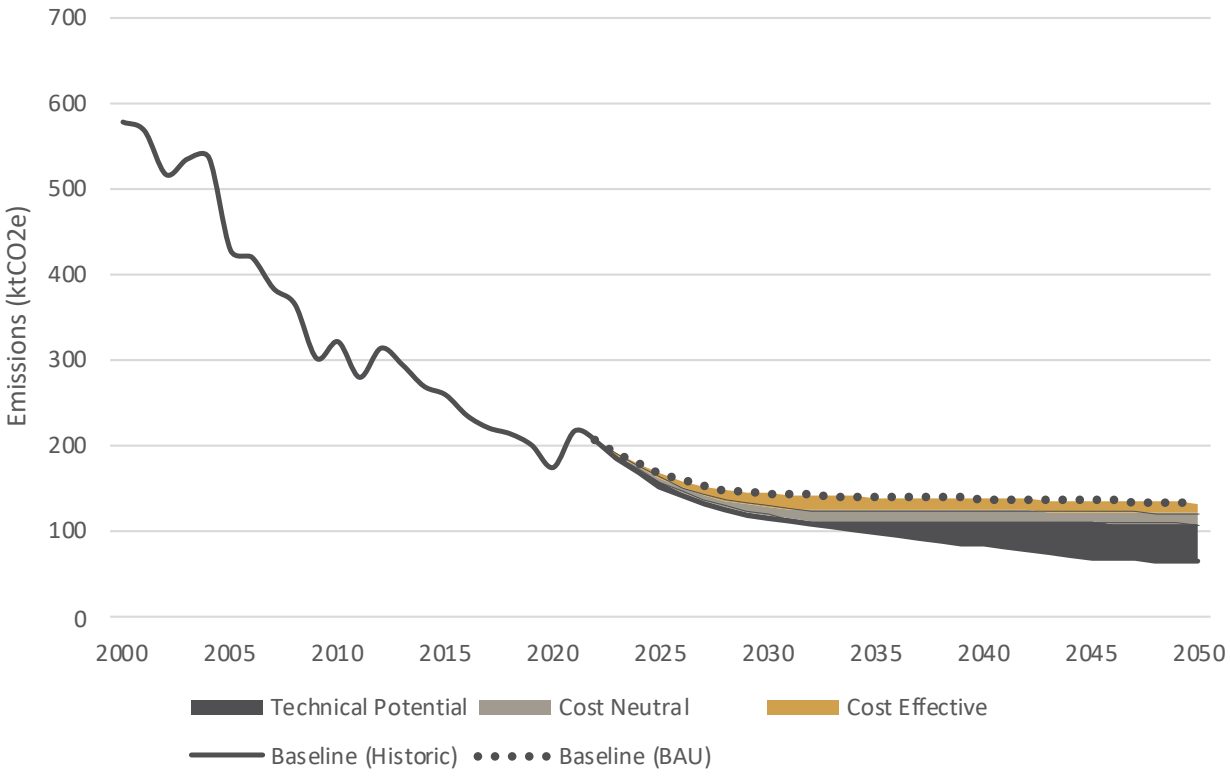
Table 9: Most Carbon-Effective Options in Industry

Industrial Sector	Carbon Abatement (kt CO_2e)
Condensing and insulation measures to boilers and steam piping in industry	533
Improving efficiency of boilers and steam piping in industry	371
Pump upgrades, repairs and maintenance in industry	144
Compressed air systems in industry	118
Fan correction, repairs, and upgrades in industry	111
Furnace efficiency and heat recovery mechanisms in industry	66
Compressors and variable speed systems in industry	65
Refrigeration efficiency and technical upgrades in Industry	24

Table 10: Most Cost-Effective Options in Industry

Industrial Sector	Cost per tonne (£)
Furnace efficiency and heat recovery mechanisms in industry	-536
Condensing and insulation measures to boilers and steam piping in industry	-53
Refrigeration efficiency and technical upgrades in Industry	16
Improving efficiency of boilers and steam piping in industry	98
Compressors and variable speed systems in industry	220
Fan correction, repairs, and upgrades in industry	307
Pump upgrades, repairs and maintenance in industry	580
Compressed air systems in industry	617

Figure 11: Coventry's Carbon Reduction Potential: Industry



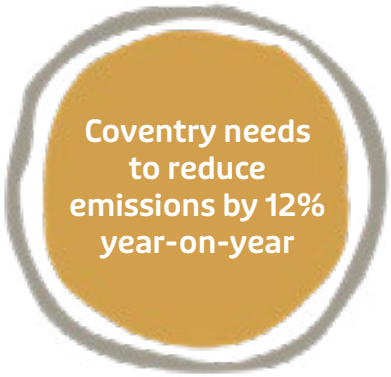
Next Steps for Coventry

Accept the Need for High Levels of Ambition

Coventry has to take ambitious actions to reduce its carbon emissions if it is to stay within its share of the global carbon budget consistent with avoiding dangerous climate change. Although Coventry's emissions have fallen by 48% since 2000, it needs to accelerate and intensify its decarbonisation efforts if it is to meet its science-based targets. The good news is that the analysis shows that it is possible for Coventry to reach its goal of net zero emissions by 2050.

Across the different sectors, focusing on the Level 1 (cost-effective) and Level 2 (cost-neutral) options will require substantial investment, but the potential is there to cut the city's projected emissions in 2050 by 32% at no net cost to the city. Adopting these options will also create nearly 1,442 jobs for the next two decades and a range of wide social, economic and environmental co-benefits in the city. However, Coventry needs to go further to explore the Level 3 (technically viable) options that do not pay for themselves directly, even if they do generate significant co-benefits in the form of reduced fuel poverty, reduced congestion, improved air quality and enhanced comfort. Even then there will still be a need to explore the potential of Level 4 (stretch) options – indeed some of these more innovative options may have lower costs and higher benefits and co-benefits than some of the more established options. There may be some limited potential for Level 5 (off-setting) options, but the level of tree-planting required to compensate for the residual emissions even after all of the other options have been exploited shows that off-setting cannot be relied upon to make a substantial difference to Coventry's emissions.

Focus on the Main Priorities

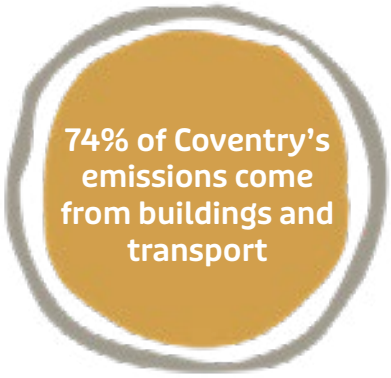


Although change will be required across the city, it will also be important to focus and to identify priorities for action. 74% of Coventry's carbon footprint comes from buildings (including homes and public and commercial buildings) and transport. It therefore makes sense for Coventry to focus the bulk of its decarbonisation efforts on these areas. Key initiatives in the buildings sector should be based on ambitious and accelerated retrofit schemes for existing homes and buildings, and the highest energy efficiency standards for new homes and buildings. Key initiatives in the transport sector should include clear plans for demand management and active travel such as walking and cycling, and proactive policies to promote the wider use of public transport. The switch from internal combustion engines to electric vehicles should also be encouraged.

Take a Joined-Up Approach to Change

Although it is important to prioritise, the change necessary to deliver Coventry's climate and wider priorities requires a joined-up or 'whole-system' approach. This recognises the connections that exist between different sectors like housing, transport, and energy, the overlapping barriers to change within and between these sectors, and the opportunity and need to involve all stakeholders in delivering maximum positive outcomes for all. It requires a shift in mindset away from delivering individual projects in isolation, toward understanding the connections between them as a way of driving momentum and increasing value for money. This involves longer-term planning, in parallel with (not at the expense of) getting on with quick wins. Managing this type of change within the Council and across the city will involve deliberate shifts in culture and working arrangements to support capacity building and deeper collaboration.

Understand Roles and Share Responsibilities

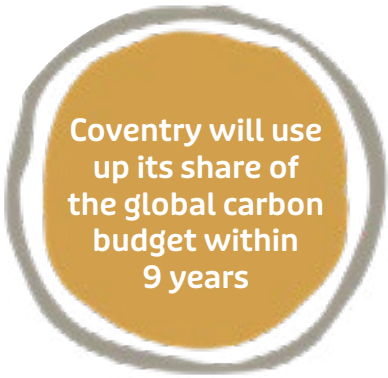


Change is required across the city if Coventry is to realise its ambitions on climate change. Of course, the Council has to be a central part of the process – through its efforts to decarbonise its estate and its vehicle stock, through its use of its powers in policy and planning, and through its ability to convene conversations and catalyse change. Research suggests that local councils can directly affect 2-10% of emissions in their locality, but have clear influence over an additional 30% of emissions, and play an important role encouraging action over a further 30% of emissions. Determining where the Council has leverage to directly and indirectly to affect emissions can help to shape the way Council approaches taking action and maximise the use of Council resources. To extend its influence, the Council should build partnerships with other public sector bodies and with businesses, third sector organisations and communities across the city. Only by building a sense of shared responsibility and collective action can the far reaching and cross cutting changes required be delivered.

Develop a Positive Vision

It will be very hard to deliver the changes required if they are somehow at odds with the city's broader priorities or with people's own aspirations. As the wider case for climate action is developed it will be important to use that case to develop a positive overarching vision of how cutting carbon can support a thriving city. Ambitious climate actions can also enhance comfort, cut fuel bills, generate jobs, tackle fuel poverty, enhance business productivity and resilience, address congestion and improve air quality. With a positive vision climate change can be mainstreamed into key areas of city development relating to economic development, housing, transport, health, planning and so on.

Build Legitimacy

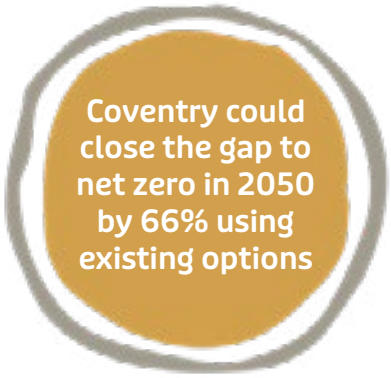


Cross-cutting climate actions will depend on political, public and business support. Change will be much easier with stable, cross-party political support. More broadly, it is vitally important that the people and businesses of Coventry feel that they have been involved in the process and will benefit from the outcomes of decisions relating to climate change. Establishing an open, inclusive, cross-community and cross-sectoral climate commission could help to secure active buy-in. Running a Citizens Jury to actively engage with diverse communities and perspectives from across the city can help to ensure that all voices are heard and that a sense of legitimacy is built and maintained.

Assess Readiness and Build a Pipeline

This report has set out an evidence base on the technical and economic viability of a wide range of decarbonisation options for Coventry. Clearly though the mere presence of the opportunities does not mean that they will actually be taken. Coventry should assess how ready it is to adopt the different options – considering not only technical but also policy, social, financial and institutional readiness. Where the city is fully ready, action can be initiated immediately – but any blockers preventing progress should be identified so that targeted actions can be introduced to build readiness over time. Where the blockers can be easily addressed then near-term actions can be planned, but where there are more structural barriers to change longer-term processes of capacity building or lobbying of national government may be required. In this way, a pipeline of actions can be developed that can form the basis of a short, medium and longer term action plan.

Explore Business Models and Build Capabilities for Programme Development

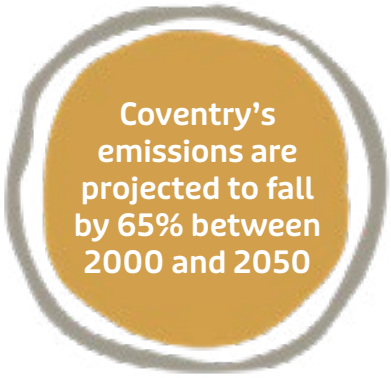


As the investment needs associated with especially the more challenging levels of action are significant, it will be important to understand financing options and business models, and to build capacities for innovative approaches that can stimulate investment. Integrating climate change into key policy and planning decisions that incentivise investments that help the city to decarbonise – or that disincentivise decisions that do the opposite – can also reduce the need for climate finance. Mainstreaming climate considerations into existing flows of investment in the city – especially relating to housing, regeneration and transport – will substantially lower the need for explicit climate investment. This is as important for businesses and households across the city as it is for the Council itself.

The relationships between different actors – those financing action, those being paid to take actions or develop projects, and those who are managing projects and procuring work – will be different for different climate actions. In the transport sector, for example, the way projects are developed and financed for public transport, bike lanes and electric vehicle charging will each be unique. Mapping different business model options and carefully considering their merits will be important to determining the best approaches.

Building capacities or platforms for programme and project development will also be crucial. Such a platform should identify innovations and emerging initiatives, consolidate and de-risk them and help to develop appropriate business and delivery models so that they can be turned into investable initiatives. Coventry is not alone in doing this – there is much to be gained through collaboration and the transfer of best practice from other localities.

Evaluate and Learn from Progress



Having capacity to evaluate and learn from the initiatives already underway within Coventry – and also more broadly – can help to ensure that best practice develops and spreads across the city. It is vital though that Coventry monitors and openly presents data charting its progress towards its carbon targets. As important as it is to be positive, actions are often driven by transparency and accountability, and early feedback can help Coventry to ensure that it stays on track as it moves towards net zero.

Celebrate and Build on Success

One of the most effective ways of building momentum is to raise awareness of the wide-range of climate-related initiatives that are already underway across the city. Some of these will be explicitly focused on climate and decarbonisation, but many others will have integrated a climate dimension into a broader project or initiative. Collating a suite of case studies and success stories can help to create a sense of positivity. Looking forward, drawing together a list of the range of commitments already made and of the projects and programmes that are planned can be crucial in establishing momentum.

Appendix 1: Overall List of Most Carbon-Effective Options for Coventry

Sector	Measure	Carbon Abatement (kt CO_2e)
Domestic buildings	External wall insulation in domestic buildings	1010
Domestic buildings	Whole house retrofits in domestic buildings	882
Domestic buildings	Heat pumps in domestic buildings	624
Domestic buildings	Internal wall insulation in domestic buildings	570
Industry	Condensing and insulation measures to boilers and steam piping in industry	533
Domestic buildings	Solar PV in domestic buildings	520
Industry	Improving efficiency of boilers and steam piping in industry	371
Public/Commercial buildings	Fabric improvements in industrial buildings/warehouses	312
Domestic buildings	Loft insulation in domestic buildings	287
Public/Commercial buildings	Passivehaus standards in new retail buildings	280
Domestic buildings	Passivehaus standards in new domestic buildings	270
Domestic buildings	Gas combi-boilers in domestic buildings	221
Domestic buildings	Reduce household heating by 1 C in domestic buildings	207
Public/Commercial buildings	Air tightness in retail buildings	191
Domestic buildings	Cavity wall insulation in domestic buildings	161
Domestic buildings	Floor insulation in domestic buildings	148
Industry	Pump upgrades, repairs and maintenance in industry	144

Sector	Measure	Carbon Abatement (kt CO_2e)
Public/Commercial buildings	Air source heat pumps in retail buildings	134
Public/Commercial buildings	Passivehaus standards in new office buildings	132
Public/Commercial buildings	Area-based commercial retrofits in retail buildings	121
Industry	Compressed air systems in industry	118
Industry	Fan correction, repairs, and upgrades in industry	111
Public/Commercial buildings	Area-based commercial retrofits in industrial buildings/warehouses	89
Transport	Diesel light goods vehicles to electric light goods vehicles	87
Public/Commercial buildings	Passivehaus standards in new in industrial buildings/warehouses	74
Industry	Furnace efficiency and heat recovery mechanisms in industry	66
Industry	Compressors and variable speed systems in industry	65
Public/Commercial buildings	Air source heat pumps in office buildings	61
Transport	Small petrol car journeys to electric train journeys	51
Public/Commercial buildings	Area-based commercial retrofits in office buildings	48
Transport	Large petrol car journeys to electric train journeys	48
Transport	Medium petrol car journeys to electric train journeys	47
Domestic buildings	Triple glazing in domestic buildings	47
Domestic buildings	Top-up loft insulation in domestic buildings	46
Public/Commercial buildings	Passivehaus standards in new non-retail buildings	40
Domestic buildings	Low energy lighting in domestic buildings	38
Domestic buildings	Lowering thermostats in domestic buildings	37

Sector	Measure	Carbon Abatement (kt CO_2e)
Public/Commercial buildings	Heat recovery in retail buildings	37
Domestic buildings	Solar thermal in domestic buildings	36
Transport	Diesel bus journeys to electric bus journeys	27
Public/Commercial buildings	Area-based commercial PV installations in industrial buildings/warehouses	25
Industry	Refrigeration efficiency and technical upgrades in Industry	24
Public/Commercial buildings	Passivehaus standards in new healthcare buildings	20
Public/Commercial buildings	Replace single with double glazing in office buildings	18
Domestic buildings	Tank insulation in domestic buildings	18
Public/Commercial buildings	Passivehaus standards in new hotels	17
Public/Commercial buildings	Air tightness in office buildings	15
Public/Commercial buildings	Passivehaus standards in new education buildings	15
Transport	Diesel light ordinary goods vehicle to electric ordinary goods vehicle	15
Public/Commercial buildings	High efficiency boilers in retail buildings	14
Domestic buildings	A++ rated cold appliances in domestic buildings	13
Public/Commercial buildings	Area-based commercial PV installations in retail buildings	13
Transport	Diesel heavy ordinary goods vehicle to electric ordinary goods vehicle	13
Public/Commercial buildings	Air source heat pumps in non-retail buildings	13
Public/Commercial buildings	LED lighting upgrades in office buildings	13
Public/Commercial buildings	Passivehaus standards in new in community centres	12
Transport	Small petrol car journeys to bicycle journeys	11
Transport	Small petrol car journeys to walking journeys	11
Public/Commercial buildings	Area-based commercial retrofits in non-retail buildings	11

Sector	Measure	Carbon Abatement (kt CO_2e)
Public/Commercial buildings	Fan efficiency upgrades in retail buildings	11
Transport	Large petrol car journeys to bicycle journeys	11
Transport	Large petrol car journeys to walking journeys	11
Transport	Medium petrol car journeys to bicycle journeys	10
Transport	Medium petrol car journeys to walking journeys	10
Public/Commercial buildings	Area-based commercial PV installations in office buildings	10
Transport	Small diesel car journeys to walking journeys	10
Transport	Large diesel car journeys to walking journeys	9
Transport	Medium diesel car journeys to walking journeys	9
Public/Commercial buildings	Heating controls in retail buildings	9
Public/Commercial buildings	Warm air blowers in industrial buildings/warehouses	9
Public/Commercial buildings	High efficiency boilers in industrial buildings/warehouses	9
Public/Commercial buildings	LED conversions in office buildings	8
Public/Commercial buildings	Air tightness in industrial buildings/ warehouses	8
Domestic buildings	Tank thermostats in domestic buildings	8
Public/Commercial buildings	Fabric improvements in retail buildings	8
Transport	Small diesel car journeys to bicycle journeys	8
Domestic buildings	Reduce heating for washing machines in domestic buildings	8
Domestic buildings	Draught proofing in domestic buildings	8
Domestic buildings	District heating networks in domestic buildings	7
Transport	Small diesel car journeys to electric train journeys	7
Transport	Large diesel car journeys to bicycle journeys	7

Sector	Measure	Carbon Abatement (kt CO_2e)
Transport	Medium diesel car journeys to bicycle journeys	7
Transport	Large diesel car journeys to electric train journeys	7
Transport	Medium diesel car journeys to electric train journeys	7
Public/Commercial buildings	Heating controls in industrial buildings/ warehouses	7
Public/Commercial buildings	External shading in office buildings	6
Public/Commercial buildings	High efficiency boilers in office buildings	6
Public/Commercial buildings	Highly-efficient air cooling system in retail buildings	6
Public/Commercial buildings	LED in non-retail buildings	5
Public/Commercial buildings	Heating controls in office buildings	5
Public/Commercial buildings	New LED system in office buildings	5
Public/Commercial buildings	Water-cooling beams in office buildings	5
Public/Commercial buildings	Area-based commercial PV installations in non-retail buildings	5
Public/Commercial buildings	LED conversions in non-retail buildings	5
Domestic buildings	Thermostatic radiator valves in domestic buildings	4
Public/Commercial buildings	Heat recovery in office buildings	4
Public/Commercial buildings	LED conversions in retail buildings	4
Public/Commercial buildings	Air source heat pumps in community centres	4
Public/Commercial buildings	Air source heat pumps in healthcare buildings	4
Public/Commercial buildings	Daylight sensing lighting upgrades in office buildings	4
Public/Commercial buildings	Area-based commercial retrofits in healthcare buildings	3
Public/Commercial buildings	Electrical circuitry efficiency upgrades in retail buildings	3
Public/Commercial buildings	Air source heat pumps in education buildings	3
Public/Commercial buildings	Area-based commercial retrofits in community centres	3

Sector	Measure	Carbon Abatement (kt CO_2e)
Public/Commercial buildings	Area-based commercial retrofits in education buildings	3
Public/Commercial buildings	Solar thermal in retail buildings	2
Public/Commercial buildings	Heat recovery in non-retail buildings	2
Transport	Small petrol car journeys to diesel bus journeys	2
Public/Commercial buildings	New LED system in industrial buildings/ warehouses	2
Public/Commercial buildings	Air-cooling beams in office buildings	2
Public/Commercial buildings	LED conversions in industrial buildings/ warehouses	2
Transport	Large petrol car journeys to diesel bus journeys	2
Public/Commercial buildings	Water-cooling beams in non-retail buildings	2
Transport	Medium petrol car journeys to diesel bus journeys	2
Public/Commercial buildings	LED lighting upgrades in education buildings	2
Domestic buildings	A rated ovens in domestic buildings	2
Public/Commercial buildings	LED in community centres	2
Public/Commercial buildings	New LED system in retail buildings	2
Transport	Small diesel car journeys to diesel bus journeys	2
Public/Commercial buildings	Air source heat pumps in hotels	2
Domestic buildings	A+ rated wet appliances in domestic buildings	2
Transport	Large diesel car journeys to diesel bus journeys	2
Public/Commercial buildings	LED conversions in office buildings	2
Transport	Medium diesel car journeys to diesel bus journeys	2
Public/Commercial buildings	95% efficiency boilers in non-retail buildings	2
Public/Commercial buildings	New LED system in non-retail buildings	2
Transport	Small diesel car journeys to EV journeys	2
Public/Commercial buildings	Solar thermal in office buildings	2

Sector	Measure	Carbon Abatement (kt CO_2e)
Transport	Small petrol car journeys to EV journeys	2
Public/Commercial buildings	Area-based commercial PV installations in healthcare buildings	2
Transport	Large diesel car journeys to EV journeys	1
Transport	Medium diesel car journeys to EV journeys	1
Transport	Large petrol car journeys to EV journeys	1
Transport	Medium petrol car journeys to EV journeys	1
Transport	Small petrol car journeys to electric bus journeys	1
Public/Commercial buildings	LED lighting upgrades in healthcare buildings	1
Public/Commercial buildings	AC upgrades in retail buildings	1
Public/Commercial buildings	Area-based commercial PV installations in community centres	1
Public/Commercial buildings	Area-based commercial retrofits in hotels	1
Transport	Large petrol car journeys to electric bus journeys	1
Public/Commercial buildings	LED conversions in healthcare buildings	1
Transport	Medium petrol car journeys to electric bus journeys	1
Public/Commercial buildings	LED lighting upgrades in hotels	1
Public/Commercial buildings	High efficiency AC system in retail buildings	1
Public/Commercial buildings	Air-cooling beams in non-retail buildings	1
Domestic buildings	Turn unnecessary lighting off in domestic buildings	1
Transport	Small diesel car journeys to electric bus journeys	1
Domestic buildings	Induction hobs in domestic buildings	1
Transport	Large diesel car journeys to electric bus journeys	1

Sector	Measure	Carbon Abatement (kt CO_2e)
Domestic buildings	Reduced standby consumption in domestic buildings	1
Transport	Medium diesel car journeys to electric bus journeys	1
Public/Commercial buildings	Area-based commercial PV installations in education buildings	1
Public/Commercial buildings	Movement sensing lighting upgrades in industrial buildings/warehouses	1
Public/Commercial buildings	Heating controls in non-retail buildings	1
Public/Commercial buildings	LED conversions in community centres	1
Public/Commercial buildings	Electrical circuitry efficiency upgrades in office buildings	1
Public/Commercial buildings	Electrical circuitry efficiency upgrades in industrial buildings/warehouses	1
Public/Commercial buildings	Movement sensing lighting upgrades in retail buildings	1
Public/Commercial buildings	Solar thermal in non-retail buildings	1
Public/Commercial buildings	Movement sensing lighting upgrades in office buildings	1
Public/Commercial buildings	Water-cooling beams in healthcare buildings	1
Public/Commercial buildings	AC upgrades in office buildings	1
Public/Commercial buildings	LED conversions in education buildings	1
Public/Commercial buildings	Area-based commercial PV installations in hotels	1
Public/Commercial buildings	Fan efficiency upgrades in office buildings	1
Public/Commercial buildings	AC upgrades in non-retail buildings	1
Public/Commercial buildings	Heat recovery in community centres	1
Public/Commercial buildings	Daylight sensing lighting upgrades in non-retail buildings	1
Public/Commercial buildings	New LED system in healthcare buildings	1
Public/Commercial buildings	Highly efficient air cooling system in office buildings	1

Sector	Measure	Carbon Abatement (kt CO_2e)
Domestic buildings	Integrated digital TVs in domestic buildings	1
Public/Commercial buildings	Heat recovery in healthcare buildings	1
Public/Commercial buildings	Water-cooling beams in community centres	1
Public/Commercial buildings	New LED system in community centres	1
Public/Commercial buildings	95% efficiency boilers in healthcare buildings	1
Public/Commercial buildings	Heat recovery in education buildings	1
Public/Commercial buildings	95% efficiency boilers in community centres	1
Public/Commercial buildings	Water-cooling beams in education buildings	0.5
Public/Commercial buildings	95% efficiency boilers in education buildings	0.4
Public/Commercial buildings	External shading in non-retail buildings	0.4
Transport	Small petrol car journeys to diesel train journeys	0.4
Public/Commercial buildings	New LED system in education buildings	0.4
Transport	Large petrol car journeys to diesel train journeys	0.4
Transport	Medium petrol car journeys to diesel train journeys	0.4
Public/Commercial buildings	Heat recovery in hotels	0.3
Public/Commercial buildings	Air-cooling beams in healthcare buildings	0.3
Transport	Small diesel car journeys to diesel train journeys	0.3
Public/Commercial buildings	Air-cooling beams in education buildings	0.3
Public/Commercial buildings	Heating controls in healthcare buildings	0.3
Public/Commercial buildings	Water-cooling beams in hotels	0.3
Transport	Large diesel car journeys to diesel train journeys	0.3
Public/Commercial buildings	Air-cooling beams in community centres	0.3

Sector	Measure	Carbon Abatement (kt CO_2e)
Transport	Medium diesel car journeys to diesel train journeys	0.3
Public/Commercial buildings	Heating controls in community centres	0.3
Public/Commercial buildings	95% efficiency boilers in hotels	0.3
Public/Commercial buildings	High efficiency AC system in non-retail buildings	0.3
Public/Commercial buildings	High efficiency AC system in office buildings	0.2
Public/Commercial buildings	Solar thermal in healthcare buildings	0.2
Public/Commercial buildings	Heating controls in education buildings	0.2
Public/Commercial buildings	Daylight sensing lighting upgrades in healthcare buildings	0.2
Public/Commercial buildings	External shading in healthcare buildings	0.2
Public/Commercial buildings	New LED system in hotels	0.2
Public/Commercial buildings	External shading in community centres	0.2
Public/Commercial buildings	LED conversions in hotels	0.2
Public/Commercial buildings	External shading in education buildings	0.2
Public/Commercial buildings	Daylight sensing lighting upgrades in education buildings	0.2
Public/Commercial buildings	Solar thermal in community centres	0.2
Public/Commercial buildings	Daylight sensing in community centres	0.2
Public/Commercial buildings	Highly efficient air cooling system in non-retail buildings	0.2
Public/Commercial buildings	AC upgrades in healthcare buildings	0.1
Public/Commercial buildings	Fan efficiency upgrades in non-retail buildings	0.1
Public/Commercial buildings	External shading in hotels	0.1
Public/Commercial buildings	AC upgrades in education buildings	0.1
Public/Commercial buildings	Air-cooling beams in hotels	0.1
Public/Commercial buildings	Solar thermal in education buildings	0.1
Public/Commercial buildings	AC upgrades in hotels	0.1
Public/Commercial buildings	AC upgrades in community centres	0.1

Sector	Measure	Carbon Abatement (kt CO_2e)
Public/Commercial buildings	Movement sensing lighting upgrades in non-retail buildings	0.1
Public/Commercial buildings	Heating controls in hotels	0.1
Public/Commercial buildings	High efficiency AC system in healthcare buildings	0.1
Public/Commercial buildings	Fan efficiency upgrades in healthcare buildings	0.1
Public/Commercial buildings	High efficiency AC system in community centres	0.05
Public/Commercial buildings	Highly efficient air-cooling system in community centres	0.05
Public/Commercial buildings	Solar thermal in hotels	0.05
Public/Commercial buildings	Daylight sensing lighting upgrades in hotels	0.05
Public/Commercial buildings	AC upgrades in industrial buildings/ warehouses	0.05
Public/Commercial buildings	Fan efficiency upgrades in education buildings	0.04
Public/Commercial buildings	High efficiency AC system in education buildings	0.04
Public/Commercial buildings	Fan efficiency upgrades in community centres	0.04
Public/Commercial buildings	Highly efficient air-cooling system in healthcare buildings	0.03
Public/Commercial buildings	High efficiency AC system in hotels	0.02
Public/Commercial buildings	Fan efficiency upgrades in hotels	0.02
Public/Commercial buildings	Movement sensing lighting upgrades in healthcare buildings	0.02
Public/Commercial buildings	Movement sensing lighting upgrades in education buildings	0.02
Public/Commercial buildings	Movement sensing lighting upgrades in community centres	0.02
Public/Commercial buildings	Highly efficient air-cooling system in education buildings	0.01
Public/Commercial buildings	Highly efficient air-cooling system in hotels	0.01
Public/Commercial buildings	Movement sensing lighting upgrades in hotels	0.01

Appendix 2: Overall List of Most Cost-Effective Options for Coventry

Sector	Measure	Cost per tonne (£)
Domestic buildings	Reduced standby consumption in domestic buildings	-12248
Transport	Large petrol car journeys to electric bus journeys	-3315
Transport	Medium petrol car journeys to electric bus journeys	-3214
Transport	Small petrol car journeys to electric bus journeys	-3110
Transport	Large petrol car journeys to diesel bus journeys	-2493
Transport	Medium petrol car journeys to diesel bus journeys	-2144
Transport	Large diesel car journeys to electric train journeys	-1921
Transport	Small petrol car journeys to diesel bus journeys	-1459
Domestic buildings	Turn unnecessary lighting off in domestic buildings	-1341
Domestic buildings	Reduce heating for washing machines in domestic buildings	-1341
Transport	Medium diesel car journeys to electric train journeys	-1228
Transport	Medium diesel car journeys to bicycle journeys	-1034
Transport	Small diesel car journeys to bicycle journeys	-1011
Transport	Large diesel car journeys to bicycle journeys	-995
Public/Commercial buildings	Electrical circuitry efficiency upgrades in retail buildings	-938
Transport	Medium petrol car journeys to walking journeys	-925
Public/Commercial buildings	AC upgrades in community centres	-922
Public/Commercial buildings	AC upgrades in healthcare buildings	-920
Transport	Small petrol car journeys to walking journeys	-914
Public/Commercial buildings	AC upgrades in education buildings	-913
Public/Commercial buildings	AC upgrades in hotels	-913

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Electrical circuitry efficiency upgrades in office buildings	-906
Public/Commercial buildings	AC upgrades in non-retail buildings	-906
Public/Commercial buildings	AC upgrades in office buildings	-905
Transport	Medium petrol car journeys to bicycle journeys	-899
Transport	Large petrol car journeys to walking journeys	-890
Transport	Small petrol car journeys to bicycle journeys	-883
Public/Commercial buildings	Highly efficient air-cooling system in retail buildings	-874
Transport	Large petrol car journeys to bicycle journeys	-872
Public/Commercial buildings	AC upgrades in retail buildings	-851
Public/Commercial buildings	Fan efficiency upgrades in retail buildings	-850
Transport	Medium diesel car journeys to walking journeys	-845
Transport	Small diesel car journeys to walking journeys	-832
Transport	Large diesel car journeys to walking journeys	-805
Public/Commercial buildings	Highly efficient air-cooling system in office buildings	-794
Transport	Medium petrol car journeys to EV journeys	-756
Transport	Large petrol car journeys to EV journeys	-746
Public/Commercial buildings	New LED system in office buildings	-729
Transport	Small petrol car journeys to EV journeys	-724
Public/Commercial buildings	High efficiency AC system in retail buildings	-719
Public/Commercial buildings	New LED system in healthcare buildings	-692
Public/Commercial buildings	LED conversions in office buildings	-681
Public/Commercial buildings	New LED system in education buildings	-668
Public/Commercial buildings	New LED system in community centres	-667

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	High efficiency AC system in community centres	-657
Public/Commercial buildings	Electrical circuitry efficiency upgrades in industrial buildings/warehouses	-656
Public/Commercial buildings	Daylight sensing lighting upgrades in office buildings	-621
Public/Commercial buildings	New LED system in hotels	-614
Public/Commercial buildings	High efficiency AC system in hotels	-605
Public/Commercial buildings	High efficiency AC system in education buildings	-604
Domestic buildings	Low energy lighting in domestic buildings	-592
Public/Commercial buildings	Highly efficient air-cooling system in education buildings	-577
Domestic buildings	District heating networks in domestic buildings	-577
Public/Commercial buildings	High efficiency AC system in healthcare buildings	-576
Public/Commercial buildings	New LED system in non-retail buildings	-568
Public/Commercial buildings	High efficiency AC system in non-retail buildings	-568
Public/Commercial buildings	High efficiency AC system in office buildings	-566
Public/Commercial buildings	Highly efficient air-cooling system in non-retail buildings	-537
Industry	Furnace efficiency and heat recovery mechanisms in industry	-536
Public/Commercial buildings	Highly efficient air-cooling system in community centres	-534
Public/Commercial buildings	Highly efficient air-cooling system in hotels	-523
Public/Commercial buildings	Highly efficient air-cooling system in healthcare buildings	-516
Domestic buildings	Biomass boilers in domestic buildings	-515
Transport	Medium diesel car journeys to EV journeys	-488
Transport	Large diesel car journeys to EV journeys	-479
Domestic buildings	Tank insulation in domestic buildings	-475

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	AC upgrades in industrial buildings/warehouses	-459
Transport	Small diesel car journeys to EV journeys	-458
Public/Commercial buildings	Fan efficiency upgrades in office buildings	-452
Transport	Small diesel car journeys to electric train journeys	-404
Transport	Diesel bus journeys to electric bus journeys	-397
Public/Commercial buildings	Area-based commercial retrofits in office buildings	-372
Transport	Large petrol car journeys to electric train journeys	-342
Public/Commercial buildings	LED conversions in office buildings	-339
Transport	Large diesel car journeys to electric bus journeys	-322
Domestic buildings	Lowering thermostats in domestic buildings	-322
Public/Commercial buildings	LED conversions in community centres	-315
Domestic buildings	Loft insulation in domestic buildings	-313
Domestic buildings	Reduce household heating by 1 C in domestic buildings	-296
Domestic buildings	Cavity wall insulation in domestic buildings	-287
Public/Commercial buildings	LED conversions in education buildings	-279
Domestic buildings	Tank thermostats in domestic buildings	-263
Domestic buildings	Top-up loft insulation in domestic buildings	-261
Public/Commercial buildings	Heat recovery in retail buildings	-237
Domestic buildings	Draught proofing in domestic buildings	-236
Transport	Medium petrol car journeys to electric train journeys	-229
Public/Commercial buildings	Passivehaus standards in new in industrial buildings/warehouses	-228
Public/Commercial buildings	LED conversions in non-retail buildings	-226
Transport	Diesel light goods vehicles to electric light goods vehicles	-199

Sector	Measure	Cost per tonne (£)
Transport	Diesel light goods vehicles to electric light goods vehicles	-199
Domestic buildings	Floor insulation in domestic buildings	-195
Transport	Medium diesel car journeys to electric bus journeys	-191
Public/Commercial buildings	Daylight sensing in community centres	-174
Public/Commercial buildings	LED conversions in healthcare buildings	-146
Public/Commercial buildings	Daylight sensing lighting upgrades in non-retail buildings	-133
Public/Commercial buildings	LED conversions in hotels	-125
Transport	Small petrol car journeys to electric train journeys	-115
Public/Commercial buildings	Air tightness in retail buildings	-112
Public/Commercial buildings	Air tightness in office buildings	-108
Public/Commercial buildings	Daylight sensing lighting upgrades in education buildings	-106
Public/Commercial buildings	High efficiency boilers in retail buildings	-105
Public/Commercial buildings	Daylight sensing lighting upgrades in healthcare buildings	-85
Public/Commercial buildings	Fabric improvements in industrial buildings/warehouses	-72
Public/Commercial buildings	External shading in education buildings	-72
Public/Commercial buildings	High efficiency boilers in industrial buildings/warehouses	-60
Transport	Small diesel car journeys to electric bus journeys	-58
Public/Commercial buildings	Daylight sensing lighting upgrades in hotels	-53
Industry	Condensing and insulation measures to boilers and steam piping in industry	-53
Public/Commercial buildings	Area-based commercial retrofits in industrial buildings/warehouses	-51
Transport	Diesel light ordinary goods vehicle to electric ordinary goods vehicle	-50

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Area-based commercial retrofits in retail buildings	-46
Transport	Diesel heavy ordinary goods vehicle to electric ordinary goods vehicle	-44
Public/Commercial buildings	High efficiency boilers in office buildings	-36
Domestic buildings	Internal wall insulation in domestic buildings	13
Industry	Refrigeration efficiency and technical upgrades in Industry	16
Public/Commercial buildings	95% efficiency boilers in hotels	32
Transport	Large diesel car journeys to diesel bus journeys	39
Public/Commercial buildings	Heating controls in industrial buildings/warehouses	40
Public/Commercial buildings	95% efficiency boilers in non-retail buildings	62
Public/Commercial buildings	95% efficiency boilers in education buildings	68
Public/Commercial buildings	External shading in hotels	72
Public/Commercial buildings	External shading in non-retail buildings	74
Public/Commercial buildings	Heating controls in retail buildings	82
Public/Commercial buildings	95% efficiency boilers in healthcare buildings	83
Domestic buildings	Thermostatic radiator valves in domestic buildings	84
Public/Commercial buildings	Heating controls in office buildings	93
Public/Commercial buildings	95% efficiency boilers in community centres	95
Industry	Improving efficiency of boilers and steam piping in industry	98

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	External shading in healthcare buildings	153
Domestic buildings	A++ rated cold appliances in domestic buildings	162
Domestic buildings	External wall insulation in domestic buildings	182
Public/Commercial buildings	External shading in community centres	215
Industry	Compressors and variable speed systems in industry	220
Public/Commercial buildings	Air tightness in industrial buildings/warehouses	224
Public/Commercial buildings	Warm air blowers in industrial buildings/warehouses	281
Public/Commercial buildings	Air source heat pumps in retail buildings	286
Domestic buildings	Gas combi-boilers in domestic buildings	302
Industry	Fan correction, repairs, and upgrades in industry	307
Public/Commercial buildings	Heating controls in community centres	316
Public/Commercial buildings	Heat recovery in office buildings	319
Domestic buildings	Solar PV in domestic buildings	342
Public/Commercial buildings	Heat recovery in community centres	418
Public/Commercial buildings	Heating controls in education buildings	423
Public/Commercial buildings	Heat recovery in healthcare buildings	440
Public/Commercial buildings	Heating controls in non-retail buildings	440
Public/Commercial buildings	Replace single with double glazing in office buildings	442
Public/Commercial buildings	Area-based commercial retrofits in education buildings	443
Domestic buildings	Whole house retrofits in domestic buildings	466
Public/Commercial buildings	Heating controls in healthcare buildings	490
Public/Commercial buildings	Passivehaus standards in new hotels	506

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Fan efficiency upgrades in non-retail buildings	525
Public/Commercial buildings	Heat recovery in hotels	526
Public/Commercial buildings	Heating controls in hotels	533
Public/Commercial buildings	Heat recovery in non-retail buildings	563
Industry	Pump upgrades, repairs and maintenance in industry	580
Public/Commercial buildings	Heat recovery in education buildings	585
Public/Commercial buildings	Fan efficiency upgrades in hotels	586
Public/Commercial buildings	Fan efficiency upgrades in education buildings	591
Industry	Compressed air systems in industry	617
Public/Commercial buildings	Air source heat pumps in office buildings	643
Public/Commercial buildings	Area-based commercial retrofits in healthcare buildings	644
Public/Commercial buildings	Fan efficiency upgrades in healthcare buildings	651
Public/Commercial buildings	External shading in office buildings	654
Public/Commercial buildings	Area-based commercial retrofits in non-retail buildings	687
Public/Commercial buildings	Area-based commercial retrofits in community centres	720
Public/Commercial buildings	Area-based commercial retrofits in hotels	800
Public/Commercial buildings	Air source heat pumps in hotels	818
Public/Commercial buildings	LED lighting upgrades in education buildings	838
Domestic buildings	Heat pumps in domestic buildings	847
Public/Commercial buildings	Air source heat pumps in healthcare buildings	860

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Air source heat pumps in community centres	864
Public/Commercial buildings	Fan efficiency upgrades in community centres	894
Public/Commercial buildings	LED lighting upgrades in office buildings	901
Public/Commercial buildings	Air source heat pumps in non-retail buildings	935
Public/Commercial buildings	Area-based commercial PV installations in office buildings	979
Public/Commercial buildings	Passivehaus standards in new retail buildings	1034
Public/Commercial buildings	Area-based commercial PV installations in industrial buildings/warehouses	1036
Domestic buildings	Solar thermal in domestic buildings	1181
Public/Commercial buildings	Air source heat pumps in education buildings	1217
Public/Commercial buildings	Passivehaus standards in new healthcare buildings	1282
Public/Commercial buildings	LED lighting upgrades in healthcare buildings	1292
Public/Commercial buildings	Solar thermal in retail buildings	1321
Public/Commercial buildings	Water-cooling beams in hotels	1366
Public/Commercial buildings	LED in non-retail buildings	1378
Public/Commercial buildings	Passivehaus standards in new education buildings	1414
Public/Commercial buildings	Water-cooling beams in office buildings	1435
Public/Commercial buildings	Area-based commercial PV installations in retail buildings	1460
Public/Commercial buildings	Passivehaus standards in new office buildings	1466
Public/Commercial buildings	Water-cooling beams in healthcare buildings	1493

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Area-based commercial PV installations in health-care buildings	1495
Public/Commercial buildings	Water-cooling beams in education buildings	1514
Public/Commercial buildings	LED conversions in industrial buildings/warehouses	1529
Public/Commercial buildings	Water-cooling beams in non-retail buildings	1533
Public/Commercial buildings	Water-cooling beams in community centres	1534
Public/Commercial buildings	Solar thermal in education buildings	1558
Public/Commercial buildings	LED in community centres	1575
Public/Commercial buildings	New LED system in industrial buildings/warehous-es	1609
Public/Commercial buildings	LED lighting upgrades in hotels	1644
Public/Commercial buildings	Solar thermal in office buildings	1645
Public/Commercial buildings	Solar thermal in community centres	1689
Public/Commercial buildings	Area-based commercial PV installations in hotels	1719
Public/Commercial buildings	Solar thermal in non-retail buildings	1728
Public/Commercial buildings	Solar thermal in healthcare buildings	1737
Transport	Medium diesel car journeys to diesel bus journeys	1744
Public/Commercial buildings	Solar thermal in hotels	1758
Public/Commercial buildings	Area-based commercial PV installations in educa-tion buildings	1832
Public/Commercial buildings	Area-based commercial PV installations in non-re-tail buildings	1886
Public/Commercial buildings	LED conversions in retail buildings	1913
Public/Commercial buildings	Area-based commercial PV installations in commu-nity centres	1990

Sector	Measure	Cost per tonne (£)
Public/Commercial buildings	Passivehaus standards in new in community centres	2092
Public/Commercial buildings	New LED system in retail buildings	2138
Domestic buildings	Triple glazing in domestic buildings	2156
Public/Commercial buildings	Passivehaus standards in new non-retail buildings	2263
Transport	Small diesel car journeys to diesel bus journeys	2443
Domestic buildings	A rated ovens in domestic buildings	2478
Public/Commercial buildings	Air-cooling beams in education buildings	2917
Public/Commercial buildings	Air-cooling beams in healthcare buildings	3051
Public/Commercial buildings	Air-cooling beams in hotels	3139
Public/Commercial buildings	Air-cooling beams in non-retail buildings	3206
Domestic buildings	Passivehaus standards in new domestic buildings	3480
Public/Commercial buildings	Air-cooling beams in community centres	3649
Public/Commercial buildings	Air-cooling beams in office buildings	3712
Transport	Large petrol car journeys to diesel train journeys	3742
Domestic buildings	A+ rated wet appliances in domestic buildings	3810
Domestic buildings	Induction hobs in domestic buildings	3845
Public/Commercial buildings	Movement sensing lighting upgrades in office buildings	3858
Public/Commercial buildings	Movement sensing lighting upgrades in industrial buildings/warehouses	4274
Domestic buildings	Integrated digital TVs in domestic buildings	4497
Public/Commercial buildings	Fabric improvements in retail buildings	5330
Transport	Medium petrol car journeys to diesel train journeys	6111
Transport	Large diesel car journeys to diesel train journeys	6203
Transport	Small petrol car journeys to diesel train journeys	7899
Public/Commercial buildings	Movement sensing lighting upgrades in retail buildings	9053
Transport	Medium diesel car journeys to diesel train journeys	10792

Sector	Measure	Cost per tonne (£)
Transport	Small diesel car journeys to diesel train journeys	12923
Public/Commercial buildings	Movement sensing lighting upgrades in community centres	16604
Public/Commercial buildings	Movement sensing lighting upgrades in non-retail buildings	18542
Public/Commercial buildings	Movement sensing lighting upgrades in education buildings	18891
Public/Commercial buildings	Movement sensing lighting upgrades in hotels	20273
Public/Commercial buildings	Movement sensing lighting upgrades in healthcare buildings	21902

Appendix 3: Glossary

Carbon budget – Maximum cumulative amount of CO_2e able to be emitted while remaining within a certain temperature threshold
Cold appliances – Refrigerators and freezers
Cost-effective – Measures which save more money than they cost over their lifetime
Cost-neutral - Measures which are equal in costs and savings over their lifetime
Offsets – Balancing carbon emissions in one area/sector by sequestering carbon elsewhere
Passivhaus/Passive House – Very highly-efficient building standards to minimise energy demand
Rebound effects - Where the expected gains from efficiency improvements are partially or fully offset through behavioural changes or increased usage
Scope 1 emissions – Direct emissions from sources within the local authority
Scope 2 emissions - Indirect emissions from heat and electricity used within the area of analysis, from production facilities outside the area of analysis
Scope 3 emissions - Indirect emissions emitted from outside of the area of analysis, during the production and transport of goods and services
Technical potential - Measures which cost more money than they save over their lifetime
Wet appliances – Dishwashers, washing machines
Whole house retrofit – Comprehensive, in-depth approach to improving energy efficiency in energy-intensive homes

Acronyms

CO_2 – Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
EV – Electric Vehicle
ICE – Internal Combustion Vehicles
IPCC – Intergovernmental Panel on Climate Change
Kt – Kilotonne (1,000 tonnes)
LULUCF – Land-Use, Land-Use Change and Forestry
Mt – Megatonne (1,000,000 tonnes)
SBTs – Science-Based Targets

About Your Climate Strategy

We are an impact-driven consultancy run by experienced professionals who understand both the need for ambitious climate actions and the challenges that are often faced in delivering them.

Our team have worked on all sides and at all stages in the process of designing and delivering ambitious climate strategies. We have worked with local authorities, regional development agencies, businesses and communities across the UK and all over the world.

We understand the challenges in turning a complex, systemic problem like climate change into practicable, fundable, deliverable projects and programmes, and the need to mobilise resources and build capacities to enable real-world implementation.

For further information contact us at **info@yourclimatestrategy.com**