A NET ZERO ROUTEMAP FOR COVENTRY



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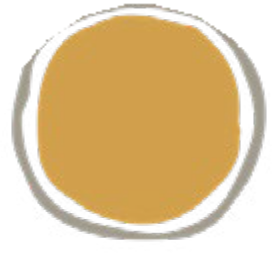
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# Summary



**Coventry’s emissions have fallen by 48%**

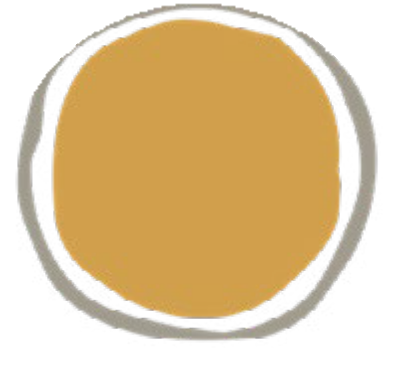
**since 2000**

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.

**Coventry could save**

**£196m a year from its energy bill through measures that would pay for themselves**

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)**

3000

2500

2000

1500

Emissions (ktCO2e)

1000

500

0

2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Waste

Public & Commer cial Industry

Transport Domestic Baseline (BAU)

Baseline (Historic)

## 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)**

Land use 0%

Industry 16%

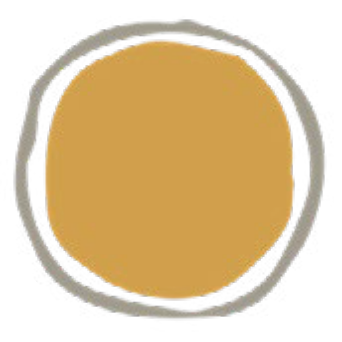
Commercial 15%

Transport 29%

Domestic 30%

Waste 10%

## A Projection of Future Emissions



**Coventry’s emissions are projected to fall by 65% between**

**2000 and 2050**

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)**

450

400

350

300

250

kt CO2e

200

150

100

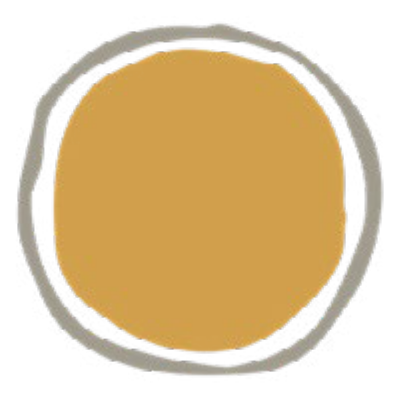
50

0

Domestic Transport Industry Commer cial Waste Land use

2022 2050

## The Importance of Broader, Consumption-based Emissions



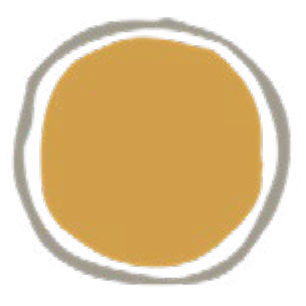
**Coventry should also think about the carbon embedded in its consumption**

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



**Coventry could spend a total of £635 million on energy**

**this year**

## Total Energy Bills

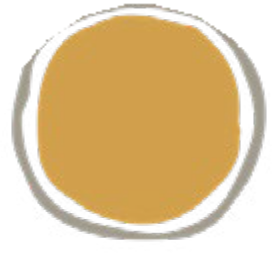
In 2021, Coventry’s total energy bill – covering the cost of all purchases of petrol, diesel, gas and electricity in the city – amounted to an estimated £459m, which rose to £621m in 2022. The cost of energy represents a major drain on the city’s economy and a strain for many households, businesses and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

700

600

Energy Expenditure (millions £)

500

400

300

200

100

0

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Domestic Transport Industry

Agriculture Public & Commercial Baseline (Historic) Baseline (BAU)

# 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.

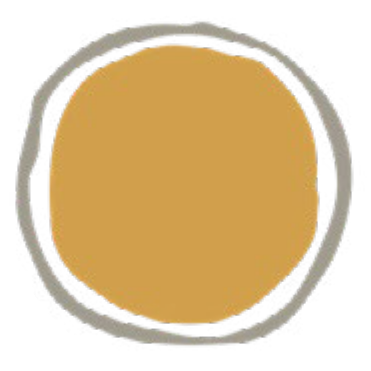
Against this baseline, we assess what Coventry needs to do to stay within its share of the global carbon budget that is consistent with having a good chance of avoiding dangerous climate change. On this basis, we propose science-based targets for Coventry, including a longer-term target and 5-yearly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



**Coventry will use up its share of the global carbon budget within**

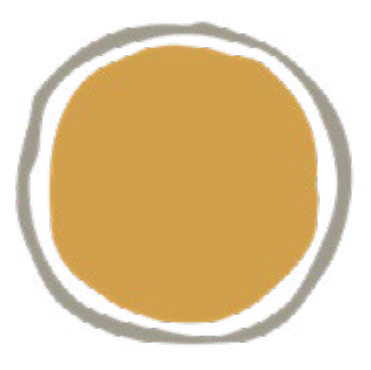
**9 years**

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 1.5oC 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 CO2e). At present, Coventry as a whole is emitting 1.3 Mt of CO2e 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 years1, 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.



**Coventry needs to reduce emissions by 12%**

**year on year**

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)**

3000

2500

2000

Emissions (ktCO2e)

1500

1000

500

0

2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Baseline (Historic) Baseline (BAU) SBT

# Identifying and Evaluating Carbon Reduction Options for Coventry

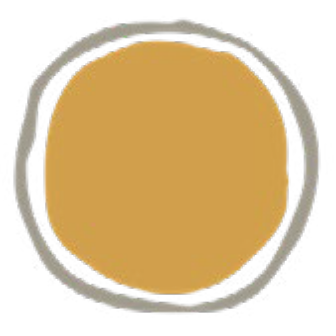
## The Scope of the Work

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 consider the impact that 750 measures could make on Coventry’s carbon footprint**

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.

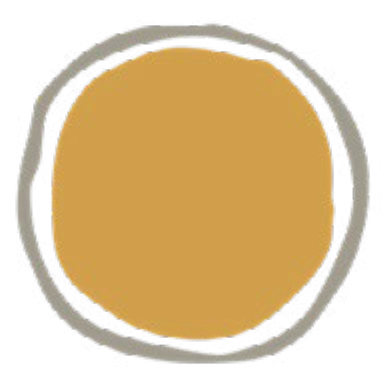
» Level 3 – the technically viable options. This includes all of the options that could be adopted, including those that generate a return on investment, those that break- even and those that do not cover their costs. This scenario incorporates and builds on the cost-neutral and cost-effective scenarios.

» 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



**Coventry could close the gap to net zero in 2050 by 66% using**

**existing options**

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**

3000

2500

Emissions (ktCO2e)

2000

1500

1000

500

0

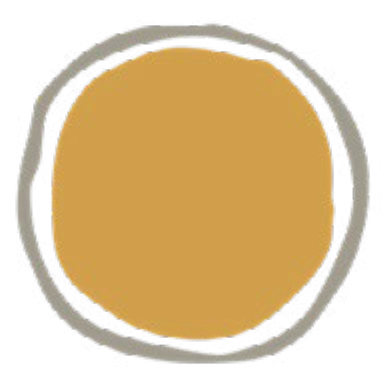
2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Technical Potential Cost Neutral Cost Effective

Baseline (Historic) Baseline (BAU) SBT

» 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**

1800

Tree-Planting Waste Industry

Public & Commercial Transport

Domestic

Net Emissions Baseline (BAU) Stretch Options

1600

1400

1200

1000

Emissions (ktCO2e)

800

600

400

200

0

-200

2015 2020 2025 2030 2035 2040 2045 2050

# 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.

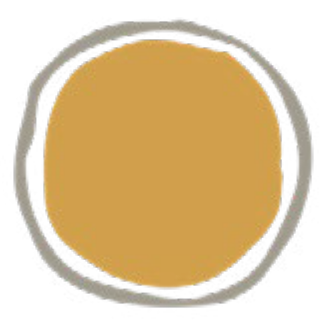
**Table 1: Top Ten List of the Most Carbon-Effective Options**

|  |  |
| --- | --- |
| Measure | Carbon Abatement (kt CO2e) |
| 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



**Domestic energy bills for households in**

**Coventry could be reduced by £188m a year**

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 impacts2 . 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.

1. 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 CO2e) |
| 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 build- ings | -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**

800

700

600

Emissions (ktCO2e)

500

400

300

200

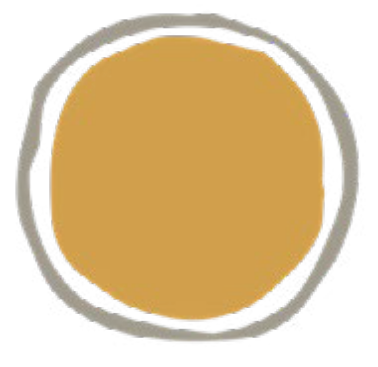
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2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Technical Potential Cost Neutral Cost Effective Baseline (Historic) Baseline (BAU)

## Results by Sector: Public and Commercial Buildings



**Total energy bills for businesses in Coventry could be reduced by £46m a year**

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 CO2e) |
| 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**

700

600

500

Emissions (ktCO2e)

400

300

200

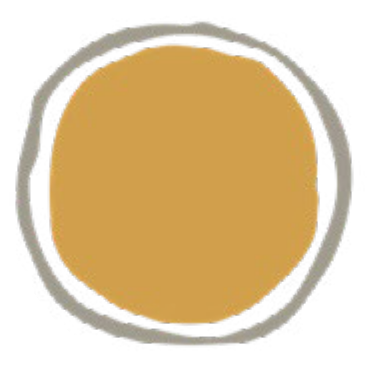
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2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Technical Potential Cost Neutral Cost Effective Baseline (Historic) Baseline (BAU)

## Results by Sector: Transport



**Total energy bills for transport in Coventry could be reduced by £93m a year**

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 CO2e) |
| 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**

600

500

400

Emissions (ktCO2e)

300

200

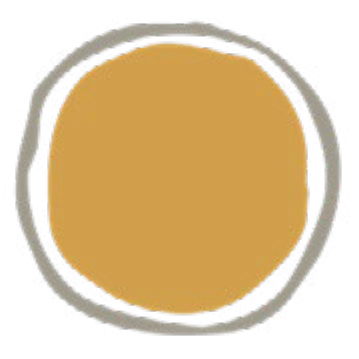
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2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Technical Potential Cost Effective Baseline (Historic) Baseline (BAU)

## Results by Sector: Industry



**Total energy bills for industry in Coventry could be reduced by £70m a year**

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 CO2e) |
| 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 pip- ing 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**

700

600

500

Emissions (ktCO2e)

400

300

200

100

0

2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

Technical Potential Cost Neutral Cost Effective Baseline (Historic) Baseline (BAU)

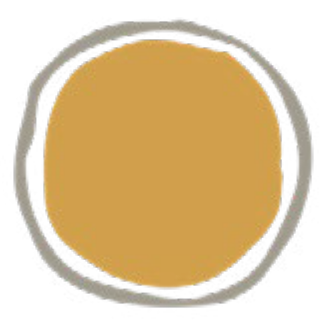
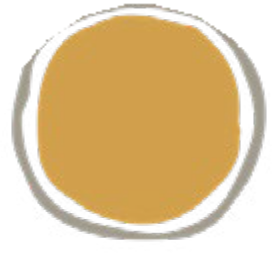
# Next Steps for Coventry

## 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



**Coventry needs to reduce emissions by 12% year-on-year**

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.

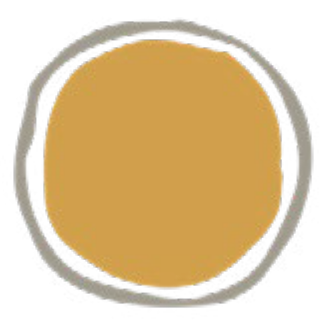
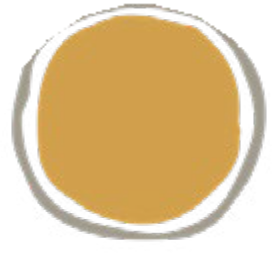
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## Take a Joined-Up Approach to Change

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

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**74% of Coventry’s emissions come from buildings and transport**

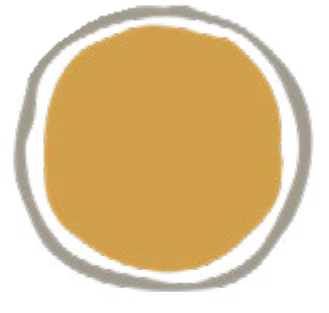
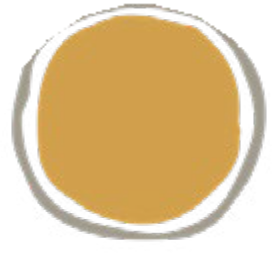
Change is required across the city if Coventry is to realise its ambitions on climate change. Of course, the Council has to be a central part of the process – through its efforts to decarbonise its estate and its vehicle stock, through its use of its powers in policy and planning, and through its ability 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

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**Coventry will use up its share of the global carbon budget within**

**9 years**

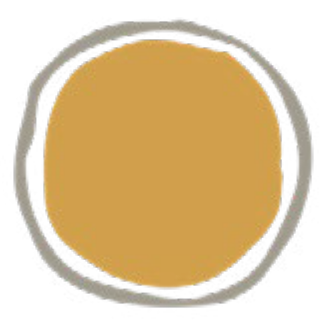
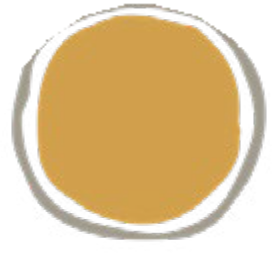
Cross-cutting climate actions will depend on political, public and business support. Change will be much easier with stable, cross-party political support. More broadly, it is vitally important that the people and businesses of Coventry feel that they have been involved in the process and will benefit 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

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**Coventry could close the gap to net zero in 2050 by 66% using existing options**

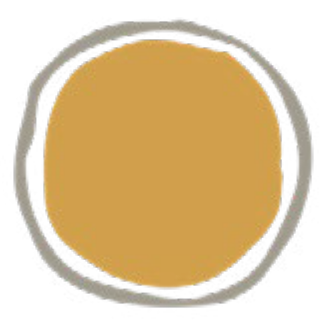
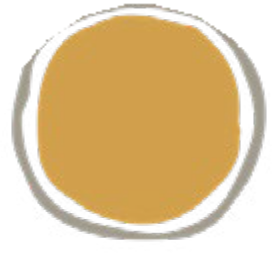
As the investment needs associated with especially the more challenging levels of action are significant, it will be important to understand financing options and business models, and to build capacities for innovative approaches that can stimulate investment. Integrating climate change into key policy 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

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**Coventry’s emissions are projected to fall by 65% between**

**2000 and 2050**

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 CO2e) |
| 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 domes- tic 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 domes- tic 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 CO2e) |
| 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 build- ings/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/ware- houses | -72 |
| Public/Commercial buildings | External shading in education buildings | -72 |
| Public/Commercial buildings | High efficiency boilers in industrial buildings/ware- houses | -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 healthcare 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/warehouses | 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 education buildings | 1832 |
| Public/Commercial buildings | Area-based commercial PV installations in non-retail buildings | 1886 |
| Public/Commercial buildings | LED conversions in retail buildings | 1913 |
| Public/Commercial buildings | Area-based commercial PV installations in community 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 CO2e 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

**CO2** – Carbon Dioxide

**CO2e** - 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



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.

**About Your Climate Strategy**

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.

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