Appendix 3



Report for Cardiff City Council

Carbon Impact Evaluation Model (CIEM) Summary Report City of Cardiff GHG Emissions Footprint

GEP Environmental Ltd Unit 5, Basepoint Business Centre, 1 Winnall Valley Road, Winchester, SO23 0LD http://www.gepenv.co.uk/

Tel: 01962 600205

Regional Offices: Winchester, Edinburgh, Bedford, Anglesey.

Prepared by: GEP Environmental Email: -Direct: 01962 600205 Cardiff City Council County Hall, Atlantic Wharf, Cardiff, CF10 4UW https://www.cardiff.gov.uk/

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GEP Environmental Ltd Registered Office: Unit 58, Basepoint Business Centre, 1 Winnall Valley Road, Winchester, SO23 0LD. Company Number: 05057066



Contents

Conter	nts	2
1	Cardiff City Council Baseline GHG Emissions	4
2	One Planet Strategy Projects	5
3	National-Level Decarbonisation Activities and Policy	7
4	Annex A – Summary Charts	8

Key Terms & Definitions

The following terms are used in this report. For reference a definition of each term has been provided in the following table.

Key Term/Acronym	Definition
BEIS	Department for Business, Energy, and Industrial Strategy (UK Government Department) which formed from the merger of the DECC (Department for Energy & Climate Change) and BIS (Department for Business, Innovation and Skills) in 2016.
Carbon Dioxide Equivalent (CO ₂ e)	Standard unit of measurement of GHG emissions used to compare relative impacts of different GHG's based upon their global warming potential.
Greenhouse Gas Emissions (GHG emissions)	Greenhouse Gas gases defined as gases which are capable of absorbing infra-red radiation (heat) from the sun, contributing to the Earth's greenhouse gas effect.
Gross Total GHG Emissions (per annum) (tonnes CO ₂ e)	An organisation/entity's annual GHG emissions total before adjustments are applied for sequestration or GHG removals, measured in tonnes CO_2e .
Net Total GHG Emissions (per annum) (tonnes CO ₂ e)	An organisation/entity's annual GHG emissions total after adjustments are applied for sequestration or GHG removals, measured in tonnes $\rm CO_2e$.
Sequestration	Process of physical removal of carbon dioxide from the atmosphere by the biosphere (i.e., trees, plants, oceans, soils) and by anthropogenic means (i.e., carbon capture & storage)
Commercial GHG Emissions (BEIS Category)	GHG emissions from commercial and retail operations located within a local authority area.
Domestic GHG Emissions (BEIS Category)	GHG emissions from domestic housing (private and council) located within a local authority area.
Industry GHG Emissions (BEIS Category)	GHG emissions from industry and large industrial operations located within a local authority area.
LULUCF (BEIS Category) (Land Use, Land Use Change, & Forestry)	Modelled sequestration of GHG emissions resulting from land use, land use change and forestry within a local authority area.
Transport GHG Emissions (BEIS Category)	GHG emissions resulting from transport use of roads, diesel railways, and other modes (i.e., canals) within a local authority area.
Public Sector GHG Emissions (BEIS Category)	GHG emissions from public sector organisations (i.e., Council, NHS, Emergency Services, Government, Civil Services) located within a local authority area.



Advisory Note: The results of GEP's Carbon Impact Evaluation Modelling (CIEM) presented in this report should be treated as advisory. Modelling has been completed based on activity information and modelling assumptions supplied by Cardiff City Council. It is recommended that presented modelling results are used as a basis for the application of detailed studies using verified supporting activity data.

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1 Cardiff City Council Baseline GHG Emissions

A summary the City of Cardiff's baseline GHG emissions for the 2019 reporting year (1st April – 31st March) are presented in the following report sections. GHG emissions calculations have been previously undertaken by BEIS and results are sourced from published GHG emissions inventories for UK Local Authority and Regions (accessed via: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019)

1.1 City of Cardiff GHG Emissions (per annum)

The City of Cardiff's baseline GHG emissions for the 2019 reporting period are **1,626,059 tonnes CO₂e (1,626 kilo-tonnes CO₂e¹)**. Results are presented in units of carbon dioxide equivalent (CO₂e) which includes all six greenhouse gases (GHGs).

GHG Emissions Category (BEIS)	GHG Emissions (tonnes CO ₂ e)	Percentage of Total (%)
Transport	669,465	41%
Domestic	439,137	27%
Industry	219,225	13%
Commercial	200,451	12%
Public Sector	99,055	6%
(Gross) Total GHG Emissions (tCO ₂ e)	1,627,336	-
LULUCF (tCO ₂ e) ²	-1,277	-
(Net) Total GHG Emissions (tCO ₂ e)	1,626,059	

Majority of the City's GHG emissions are associated with emissions from transport (41%) activity within the City. This includes the use of motorways, trunk roads, diesel railways, and other modes of transport (e.g., canals).

Emissions from energy use within the City's domestic housing are also significant, accounting for 27% of total emissions for 2019.



Public Sector emissions account for the lowest proportion of the City's baseline GHG emissions footprint. This category factors in operations from all public sector organisations (e.g., NHS, Emergency Services, Civil Service). Negative values in the table above, represent modelled GHG emissions sequestration from land-use and land-use change of land areas within the local authority boundary of Cardiff.

¹ 1 kilo-tonne $CO_2e = 1,000$ tonnes CO_2e

² LULUCF = Land-use, Land use Change, & Forestry. Modelled sequestration of GHG emissions resulting from land use, land use change and forestry within Cardiff.



2 One Planet Strategy Projects

Carbon impact evaluation modelling for the following selected projects from the Council's One Planet Strategy has been undertaken. The results of this modelling should be treated as advisory and are designed to provide an overview as to the potential magnitude of emissions reductions **following implementation**. The following projects have been identified as directly benefitting the City's footprint and are included in the modelling results below:

- Cardiff Heat Network (Future Phases)
- Major Renewable Energy Projects (St Mellons & Wentloog 9.1MW PV Farm)
- Cardiff's Urban Forest (Coed Caerdydd 30% canopy coverage by 2030)

- Private Housing & Council Housing Retrofit (modelled based on project phase with highest annual emissions reduction Phase 4)
- Local Development Plan: Transport White Paper (50% reduction in emissions from A-Roads, Motorways, and Minor Roads in Cardiff)

2.1 City of Cardiff GHG Emissions Reductions (following implementation)

2019 GHG Emissions	Cardiff Heat Network	Major Renewables	Coed Caerdydd	Private Housing Retrofit	Council Housing Retrofit	Transport White Paper	LULUCF Sequestration	Post	GHG Er Redu (Mod	nissions Iction Ielled)	
Baseline (tCO₂e - BEIS Reporting)	GHG Emissions Savings (tCO2e)	GHG Emissions Savings (tCO2e)	GHG Emissions Sequestration (tCO ₂ e)	GHG Emissions Savings (tCO2e)	GHG Emissions Savings (tCO2e)	GHG Emissions Savings (tCO ₂ e)	GHG Emissions per Annum (tCO2e)	Implementation GHG Emissions	Implementation GHG Emissions	GHG Emissions Reductions (Per annum)	Percentage Reduction (%)
1,626,059	9,046	2,977	13,372	2,546	2,455	328,576	-1,277	1,265,809	360,250	-22%	

Results Commentary

- The implementation of identified One Planet strategy projects upon the City's GHG emissions footprint will lead to a 22% reduction in per annum emissions.
- The most significant emissions reductions may be achieved should the Transport White Paper meet its ambition to reduce GHG emissions from road travel by 50% across the City.
- Council Housing is understood to be outside the scope of Cardiff City Council's GHG emissions footprint and so has been included within the City GHG emissions footprint.
- Larger version of summary chart is available from Annex A of this report.





3 City of Cardiff Projected GHG Emissions

Based upon currently available BEIS GHG emissions data (covering 2005-2019) for the City of Cardiff, GEP has undertaken an initial projection of the City's GHG emissions to 2030. Projection is based upon a 'No Action' scenario which assumes that active decarbonisation measures, as well as local policy strategies are not implemented. GHG emissions profile for each GHG emissions category has been developed based upon the average year on year percentage change in emissions between 2005 and 2019. All results are presented in kilo-tonnes CO_2e per annum.

Modelling results for this scenario should be treated as guidance only.

Results Commentary

- Transport and Domestic GHG emissions are likely to continue to account for the majority of the City's annual GHG emissions.
- GHG reductions are expected across all sectors, as result of national level policy drivers, passive decarbonisation of energy grids, and the increasing efficiency of vehicles and transport.
- Public Sector GHG emissions have seen the largest reduction (61%) between 2005 and 2019. This equates to a 4.4% reduction per annum. This is thought to reflect a national trend of estate rationalisation during the period, as well as benefits from decarbonisation of energy grids.
- Sequestration from land-use and forestry across Cardiff is assumed to remain at the same level as 2019 results (1.28 kilo-tonnes CO₂e per annum).
 Scenario assumes that no action will be taken to increase sequestration across the City.
- A larger copy of the summary chart is provided in Annex A of this report.





4 National-Level Decarbonisation Activities and Policy

Selected external decarbonisation factors are outlined below which will impact the City's future GHG emissions footprint.

4.1 Decarbonisation of the National Grid

Decarbonisation of the National Grid will provide passive decarbonisation benefits for the City of Cardiff, as the GHG intensity of electricity supplied progressively decreases with an increase in renewable and low carbon generation sources. Key information sources include:

1) National Grid Future Energy Scenarios

Modelling completed by the National Grid based on a range of Future Energy Scenarios based upon the development of such as low carbon heating technologies (i.e., hydrogen), increasing renewables in the grid's supply mixture, and their uptake by different mechanisms until 2050.

Accessed via: <u>https://www.nationalgrideso.com/future-</u> energy/future-energy-scenarios/fes-2021/documents

2) HM Treasury Green Book

Emissions forecasting published in the UK Government's Green Book (Supplementary Guidance – Table 1) highlights a continued steady decrease in GHG emissions intensity reduction until 2050, and then a consistent intensity until 2100.

Accessed via:

https://www.gov.uk/government/publications/valuationof-energy-use-and-greenhouse-gas-emissions-for-appraisal

4.2 Wider Decarbonisation Policy

Selected policy impacts which may impact the City's future GHG emissions footprint are listed below (not an exhaustive list):

1) Welsh Public Sector Decarbonisation Route Map

Welsh Government has recently published their route map to achieve Net Zero Carbon by 2030, the implementation of which may impact both the Council's and more broadly the City's GHG emissions footprint. (https://gov.wales/sites/default/files/publications/2021-07/a-routemap-for-decarbonisation-across-the-welsh-public-sector.pdf)

2) Decarbonisation of vehicles and public transport

The phasing out of the sale of new petrol and diesel cars by 2030, and the proposed continuing electrification of the National Rail network in South Wales, will lead to reductions in GHG emissions from transport use within the local authority area. In turn this will lead to a reduction (as yet unknown) to future GHG emissions footprint of transport in the Local Authority area.

3) Net Zero Carbon Standard for new builds

Increasing the energy efficiency standards for all new build housing in line with a proposed Net Zero Carbon Standard (under development) as well as replacing gas heating with low carbon/renewable alternatives, will help to reduce additional GHG emissions created by these new builds to the City's footprint.

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5 Annex A – Summary Charts

For ease of reference larger copies of summary charts presented in this report are provided in this annex. Please refer to the Carbon Impact Evaluation Model (Excel document) for further background information.

Summary Chart 1 – City of Cardiff GHG Emissions Baseline (2019)

Percentage split between GHG emissions sources – adapted from BEIS 2019 data (<u>https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019</u>)













Summary Chart 3 – National Grid Future Energy Scenarios Summary

Sourced from the National Grid's Future Energy Scenarios 21 (FES) Summary Report – details the overall modelled impact of different scenarios for decarbonisation of the National Grid (both electricity and natural gas), compared against the UK's national carbon budgets (labelled CB in chart below).

Accessed via: https://www.nationalgrideso.com/document/202851/download



GEP Environmental Ltd

Unit 5, Basepoint Business Centre, 1 Winnall Valley Road, Winchester, SO23 0LD 64a Queen Street, Edinburgh, EH2 4NA Suite A, 18 Grove Place, Bedford, MK40 3JJ Smart Zone 5, Tredomen Innovation Centre, Tredomen Park, Ystrad Mynach, Hengeod, Caerphilly, CF82 7FN M-Sparc, Parc Gwyddoniaeth Menai, Gaerwen, Anglesey, LL60 6AG 11 Market Square, Bromyard, Herefordshire, HR7 4BP

T: 01962 600205 http://www.gepenv.co.uk/



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3	National-Level Decarbonisation Activities and Policy	8
4	Annex A – Summary Charts	9

Key Terms & Definitions

The following terms are used in this report. For reference a definition of each term has been provided in the following table.

Key Term/Acronym	Definition
BEIS	Department for Business, Energy, and Industrial Strategy (UK Government Department) which formed from the merger of the DECC (Department for Energy & Climate Change) and BIS (Department for Business, Innovation and Skills) in 2016.
Carbon Dioxide Equivalent (CO ₂ e)	Standard unit of measurement of GHG emissions used to compare relative impacts of different GHG's based upon their global warming potential.
Greenhouse Gas Emissions (GHG emissions)	Greenhouse Gas gases defined as gases which are capable of absorbing infra-red radiation (heat) from the sun, contributing to the Earth's greenhouse gas effect.
Gross Total GHG Emissions (per annum) (tonnes CO ₂ e)	An organisation/entity's annual GHG emissions total before adjustments are applied for sequestration or GHG removals, measured in tonnes CO_2e .
Net Total GHG Emissions (per annum) (tonnes CO ₂ e)	An organisation/entity's annual GHG emissions total after adjustments are applied for sequestration or GHG removals, measured in tonnes CO_2e .
Land-use Sequestration	Process of physical removal of carbon dioxide from the atmosphere by the biosphere (i.e., trees, plants, oceans, soils) and by anthropogenic means (i.e., carbon capture & storage)
Scope 1 GHG Emissions (Direct)	GHG emissions arising from the operation of buildings and vehicles owned by a reporting organisation (excluding electricity)
Scope 2 GHG Emissions (Energy Indirect)	GHG emissions arising from the generation or purchased electricity and district heating used in a reporting organisation's buildings/sites.
Scope 3 GHG Emissions (Other Indirect)	GHG emissions arising from wider operations of a reporting organisation, including procurement, business travel, grey fleet travel, water, waste, and leased assets.

Advisory Note: The results of GEP's Carbon Impact Evaluation Modelling (CIEM) presented in this report should be treated as advisory. Modelling has been completed based on activity information and modelling assumptions supplied by Cardiff City Council. It is recommended that presented modelling results are used as a basis for the application of detailed studies using verified supporting activity data.



1 Cardiff City Council Baseline GHG Emissions

A summary Cardiff City Council's baseline GHG emissions for the 2019-2020 reporting year (1^{st} April – 31^{st} March) are presented in the following report sections. GHG emissions have been calculated following the methodology set out within the Welsh Public Sector Net Zero Reporting Guidance (May 2021) published by the Welsh Government.

Council GHG emissions are presented both including and excluding Procurement, to provide an overview as to the relative magnitude of Procurement emissions versus the Council's other direct emissions sources.

1.1 Council GHG Emissions (excluding Procurement)

Cardiff City Council's baseline GHG emissions for the FY 2019/20 reporting period are **30,551.10 tonnes CO₂e.** These results represent the Council's footprint excluding Procurement.

Reporting Scope	GHG Emissions (tonnes CO ₂ e)	Percentage of Total (%)
Scope 1 (Direct) GHG Emissions	14,745.19	41.9%
Scope 2 (Energy Indirect) GHG Emissions	11,373.08	32.3%
Scope 3 (Other Indirect) GHG Emissions	9,087.67	25.8%
(Gross) Total GHG Emissions (tCO ₂ e)	35.205.94	-
Land-use Sequestration (tCO ₂ e)	-4,654.84	-
(Net) Total GHG Emissions (tCO ₂ e)	30,551.10	

Majority of emissions are associated with energy consumption across the Corporate Estate (includes schools), and fuel used by the Council's vehicle fleet.

The Council's direct Scope 3 GHG emissions footprint includes:

- Employee commuting (cars, public transport)
- Council business travel (grey fleet, public transport, hire cars)
- Transmission & distribution of grid electricity
- Well-to-Tank (GHG emissions from production of fuels and energy used by the Council)



Cardiff City Council Baseline GHG Emissions (01 Apr 2019 - 31 Mar 2020 - split by Reporting Scope)

Employee commuting accounts for the majority of the Council's direct Scope 3 GHG emissions footprint.

Negative values in the summary chart and in the table above, represent modelled GHG emissions sequestration from land-use and land-use change of the Council's land assets.



1.2 Council GHG Emissions (including Procurement)

Cardiff City Council's baseline GHG emissions for the FY 2019/20 reporting period (including Procurement – Scope 3) are **189,559.36 tonnes CO₂e.** These results represent the combined results of the Council's direct and indirect emissions footprint. GHG emissions from the Council's procurement activities account for 86% of the Council's combined footprint. The impact of Procurement emissions can be seen in the comparison chart below.

Reporting Scope	GHG Emissions (tonnes CO ₂ e)	Percentage of Total (%)
Scope 1 (Direct) GHG Emissions	14,745.19	41.9%
Scope 2 (Energy Indirect) GHG Emissions	11,373.08	32.3%
Scope 3 (Other Indirect) GHG Emissions	163,441.10	86.2%
(Gross) Total GHG Emissions (tCO ₂ e)	189,559.36	-
Land-use Sequestration (tCO ₂ e)	-4,654.84	-
(Net) Total GHG Emissions (tCO₂e)	184,904.52	





2 One Planet Strategy Projects

Carbon impact evaluation modelling for the following selected projects from the Council's One Planet Strategy has been undertaken. The results of this modelling should be treated as advisory and are designed to provide an overview as to the potential magnitude of emissions reductions **post implementation**. The following projects have been identified as directly benefitting the Council's footprint and included in the modelling results below:

- Cardiff Heat Network (Phases 1 & 2 only)
- Council Fleet Transition to EV (all implementation phases)

- Strategic Estates Retrofit, Schools Estate Retrofit
- Streetlighting Upgrade to LED

2.1 Scope 1 & Scope 2 Combined GHG Emissions Reductions

CHC Emissions	Reporting Scope	FY 19/20 Baseline GHG Emissions (tCO₂e)	Post Implementation GHG Emissions (tCO ₂ e)	GHG Emissions Reduction (Modelled)		
Source				GHG Emissions	Percentage Reduction	
				Reductions (tCO ₂ e)	(%)	
Natural Gas – Corporate Estate	Scope 1	10,063	8,360	1,704	-17%	
Electricity – Corporate Estate	Scope 2	8,795	7,864	931	-11%	
Council Vehicle Fleet	Scope 1	4,640	1,893	2,746	-59%	
Electricity - UMS	Scope 2	2,578	1,825	754	-29%	
Heating Oil	Scope 1	42	42	-	0%	
Total Scope 1 & 2 GHG Emissions (tCO ₂ e/per annum)	-	26,118	19,983	6,135	-23%	

Results Commentary

- If all projects are implemented, the Council's combined Scope 1 and Scope 2 per annum GHG emissions footprint is modelled to reduce by 23% (6,135 tonnes CO₂e).
- Cardiff Heat Network (Phases 1 & 2) is modelled to have the largest impact upon GHG emissions (62% reduction compared to baseline); reducing reliance of the Corporate Estate upon mains gas.
- Transition of the Council vehicle fleet to EV/hybrid will significantly reduce tailpipe GHG emissions (modelled as a 59% reduction) if transition phases 1-3 are implemented.
- The Council may achieve further reductions through passive decarbonisation of the National Grid (particular for Scope 2 GHG emissions sources). This impact has not been modelled in this scenario.
- Larger version of chart is provided in Annex A of this report.



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2.2 Scope 1 GHG Emissions Reductions

The results in the table and chart below focus upon the Council's Scope 1 GHG emissions. Scope 1 GHG emissions sources are those for which the Council owns or is in direct control of, such as fuel used for heating across the Corporate Estate (including schools) and fuel used by the Council vehicle fleet.

CHC Emissions	FY 19/20 Baseline GHG Emissions (tCO ₂ e)	Doct Implementation	GHG Emissions Reduction (Modelled)		
Sourco		CHC Emissions (tCO-o)	GHG Emissions	Percentage	
Source			Reductions (tonnes CO ₂ e)	Reduction (%)	
Natural Gas – Corporate Estate	10,063	8,360	1,704	-17%	
Council Vehicle Fleet	4,640	1,893	2,746	-59%	
Heating Oil	42	42	-	0%	
Total Scope 1 GHG Emissions (tCO ₂ e/per annum)	14,745	10,295	4,450	-29%	

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Results Commentary

- If all projects are implemented, then the Council could achieve a modelled reduction of 29% (4,450 tonnes CO₂e) in Scope 1 GHG emissions.
- As previously identified, natural gas consumption accounts for most of the Council's Scope 1 GHG emissions per annum. Reducing the reliance on natural gas for heating in the Corporate Estate will significantly reduce GHG emissions per annum.
- Results are calculated based upon a static GHG emissions factor (based on 2020 BEIS Conversion Factors) for natural gas and for fuels (petrol, diesel, heating oil). This does not therefore account for potential decarbonisation of fuels between baseline and 2030.
- Please treat these results as advisory. It is recommended that detailed trajectory modelling is undertaken to accurately model GHG emissions reduction potential.





2.3 Scope 2 GHG Emissions Reductions

The results in the table and chart below focus upon the Council's Scope 2 GHG emissions. Scope 2 GHG emissions sources are those which are associated with the offsite generation of electricity consumed by the Council's buildings. In future Scope 2 will also include the generation of district heating from the Cardiff Heat Network.

CUC Emissions	Reporting Scope	FY 19/20 Baseline GHG Emissions	Post Implementation GHG Emissions	GHG Emissions Reduction (Modelled)		
				GHG Emissions	Percentage Reduction	
				Reductions (tonnes CO ₂ e)	(%)	
Grid Electricity – Corporate Estate	Scope 2	8,795	7,864	931	-11%	
Grid Electricity – Unmetered Supplies (UMS)	Scope 2	2,578	1,825	754	-29%	
Total Scope 2 GHG Emissions (tCO ₂ e/per annum)	-	11,373	9,689	1,685	-13%	

Results Commentary

- If all projects are implemented, then the Council could achieve a modelled reduction of 13% (1,685 tonnes CO₂e) in Scope 2 GHG emissions.
- Grid electricity from the Corporate Estate accounts for most of the Council's Scope 2 GHG emissions footprint. Improvements made to the energy efficiency of buildings within the Corporate Estate (Schools and Strategic Estates) via their respective retrofit programmes will help to reduce GHG emissions.
- Upgrade of streetlighting to LED will help to achieve a 29% reduction (754 tCO₂e) in emissions from unmetered supplies.
- Further GHG reductions may be achieved through passive decarbonisation of the National Grid between now and 2030. This is not currently factored into high level analysis completed for this study.



- Please treat these results as advisory. It is recommended that detailed trajectory modelling is undertaken to accurately model GHG emissions reduction potential.



3 National-Level Decarbonisation Activities and Policy

Selected external decarbonisation factors are outlined below which will impact the Council's future GHG emissions footprint.

3.1 Decarbonisation of the National Grid

Decarbonisation of the National Grid will provide passive decarbonisation benefits for Cardiff Council, as the GHG intensity of electricity supplied progressively decreases with an increase in renewable and low carbon generation sources. Key information sources include:

1) National Grid Future Energy Scenarios

Modelling completed by the National Grid based on a range of Future Energy Scenarios based upon the development of such as low carbon heating technologies (i.e., hydrogen), increasing renewables in the grid's supply mixture, and their uptake by different mechanisms until 2050.

Accessed via: <u>https://www.nationalgrideso.com/future-</u> energy/future-energy-scenarios/fes-2021/documents

2) HM Treasury Green Book

Emissions forecasting published in the UK Government's Green Book (Supplementary Guidance – Table 1) highlights a continued steady decrease in GHG emissions intensity reduction until 2050, and then a consistent intensity until 2100.

Accessed via:

https://www.gov.uk/government/publications/valuationof-energy-use-and-greenhouse-gas-emissions-for-appraisal

3.2 Selected National and Council Policy Impacts

Selected National and Council policy impacts which may impact the Council's future GHG emissions footprint (not an exhaustive list) are listed below:

1) Welsh Public Sector Decarbonisation Route Map

Welsh Government has recently published their route map to achieve Net Zero Carbon by 2030, the implementation of which will impact both the Council's and more broadly the City's GHG emissions footprint. (https://gov.wales/sites/default/files/publications/2021-07/a-route-map-for-decarbonisation-across-the-welsh-publicsector.pdf)

2) Net Zero Carbon Standard for new build

Increasing the energy efficiency standards for all new build schools and corporate estate buildings, in line with a proposed Net Zero Carbon Standard (under development) as well as replacing gas heating with low carbon/renewable alternatives, will help to reduce additional GHG emissions created by these new builds to the Council's GHG emissions footprint.









4 Annex A – Summary Charts

For ease of reference larger copies of summary charts presented in this report are provided in this annex. Please refer to the Carbon Impact Evaluation Model (Excel document) for further background information.

Summary Chart 1 – Cardiff City Council Baseline GHG Emissions (excluding Procurement split by reporting Scope)





Summary Chart 2 – Cardiff City Council Baseline GHG Emissions (including Procurement split by reporting Scope)





Summary Chart 3 – Impact of selected One Planet Strategy Projects on Scope 1 & 2 Emissions Baseline





Summary Charts 4 & 5 – Impact of selected One Planet Strategy Projects on Scope 1 & Scope 2 GHG Emissions









Summary Chart 6 – National Grid Future Energy Scenarios Summary

Sourced from the National Grid's Future Energy Scenarios 21 (FES) Summary Report – details the overall modelled impact of different scenarios for decarbonisation of the National Grid (both electricity and natural gas), compared against the UK's national carbon budgets (labelled CB in chart below).

Accessed via: https://www.nationalgrideso.com/document/202851/download



GEP Environmental Ltd

Unit 5, Basepoint Business Centre, 1 Winnall Valley Road, Winchester, SO23 0LD 64a Queen Street, Edinburgh, EH2 4NA Suite A, 18 Grove Place, Bedford, MK40 3JJ Smart Zone 5, Tredomen Innovation Centre, Tredomen Park, Ystrad Mynach, Hengeod, Caerphilly, CF82 7FN M-Sparc, Parc Gwyddoniaeth Menai, Gaerwen, Anglesey, LL60 6AG 11 Market Square, Bromyard, Herefordshire, HR7 4BP

T: 01962 600205 http://www.gepenv.co.uk/