ARUP

Waltham Forest

Waltham Forest Climate Action Plan

Emissions Modelling: Approach and Findings

Reference: T1

1 | 13 September 2022

Job number 288643-00

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1. Methodology

1.1 Base year emissions

The base year emissions inventory for Waltham Forest was taken from BEIS emissions inventory reporting of local authority territorial carbon dioxide emissions estimates within the scope of influence of Local Authorities.[1] Historical data was available from 2015. The most recent year of reported data was 2020 and this was selected as the base year.

1.2 Scenarios

Three scenarios were modelled to illustrate the impact on emissions of various future possibilities, ranging from no further local action, through to council-led action and on to fully engaged widespread action by all stakeholders. These three scenarios are described in the table below.

Table 1 Scenarios of Waltham Forest's future emissions

Scenario	Description
Committed policy	This scenario represents the impact of committed policies by the UK central government. This document was last updated in 2021 and therefore only incorporates the government policies and initiatives legislated up until 2019. This scenario does not include UK government announcements and targets such as gas boiler phase out or the ban on sales of internal combustion engine vehicles.
Strong Council leadership	The second scenario represents the impact that Waltham Forest local authority can have through strong council leadership. This scenario assumes both ambitious actions in areas where Waltham Forest has significant powers (ownership or planning powers for instance) as well as areas beyond the borough's powers (retrofit of owner-occupied homes).
Maximum ambition	This scenario is achieved through a combination of local leadership and supportive action from all stakeholders across the borough, namely central government, citizens and businesses with the intent to be net zero in 2030. This requires strong collaboration and concerted effort to affect immediate and significant emissions reductions.

The 'Committed policy' scenario represents the impact of legislated national policy, described and embedded in the 'Net Zero Strategy Baseline' published in the BEIS Energy and Emissions Projections dataset. Trends from the national emissions data were applied to each sector in the Waltham Forest base year inventory, producing a projection to 2040.

Sector by sector assumptions were developed for the 'Strong council leadership' and 'Maximum ambition' scenarios and these are detailed in the following sections.

1.3 Buildings

The modelling approach focussed on quantifying the impact on emissions of two major decarbonisation strategies: energy efficiency (e.g. building envelope improvements) and fuel switching of heating systems. For the purposes of this study, we assumed all fuel switching involves the replacement of fossil fuel boilers with electric heat pumps. The UK government is still considering the potential for hydrogen-based heating as a low carbon heating solution; however, electric heat pumps present a lower risk and no regret option and should therefore be prioritised before further studies demonstrate the feasibility of hydrogen heating.

The projection of building-related emissions was split according to domestic and non-domestic buildings, and within these, different assumptions were applied for new and existing buildings to capture their different energy consumption characteristics and growth rates.

[1] These emissions exclude large industrial sites, railways, motorways and land-use. Source: https://www.gov.uk/government/collections/uk-local-authority-and-regional-greenhouse-gas-emissions-national-statistics [accessed: 28 July 2022]

Below is a description of sources of key data and assumptions by building category:

Table 2 Buildings – key data and assumptions

Category	Item	Value	Source	Additional notes
Domestic- existing buildings	Number of dwellings in 2019	107,216 dwellings	Waltham Forest Assumption of zero demolition	Data for 2019 - BEIS Sub-national energy consumption
Domestic- existing buildings	Energy consumption in 2019	1,648 GWh	BEIS Sub-national energy consumption database	Data available disaggregated by fuel type
Domestic- existing buildings	Improved heat demand benchmark	50 kWh /m^2	LETI Climate Emergency Retrofit Guide	50kWh/m2 is the LETI standard for best practice achieved heat demand following a deep fabric retrofit. Measures assumed include wall, floor and roof insulation, high performance double glazing and draught proofing
Domestic- new buildings	New dwellings	48,936 dwellings	Waltham Forest for 2020 to 2041	Projection between 2041 and 2050 based on average per year from 2020 to 2041
Domestic- new buildings	Electricity consumption benchmark	25 kWh/m^2	Industry assumption	Represents Future Homes Standard to be introduced in 2025
Domestic- new buildings	Heat consumption benchmark	25 kWh/m^2	Industry assumption	Represents Future Homes Standard to be introduced in 2025 Assumes heating from electric heat pump
Non-domestic- existing buildings	Floorspace in 2019	2,202,068 m^2	Display energy Certificates (DEC) data for public buildings, VOA data for rateable buildings, DfE and NHS.	Assumption that DEC data represents all educational and health facilities in Waltham Forest
Non-domestic- new buildings	Demolished floorspace	116,941 m^2	Waltham Forest	Considers the demolition in various Strategic Industrial Land projects[2]
Non-domestic- existing buildings	Energy consumption in 2019	605.990 GWh	BEIS Sub-national energy consumption	Assumption that data for commercial, industry and public sector can be considered non-domestic buildings Data available disaggregated by fuel type
Non-domestic- existing buildings	Reduction in heat demand	66%	UK government commissioned Building Energy Efficiency Survey (BEES)	66% was an average derived from difference between highest performing and average heat demand in non-domestic buildings across use types[3]
Non-domestic- existing buildings	Reduction in electricity consumption	65%	UK government commissioned Building Energy Efficiency Survey (BEES)	65% was an average derived from difference between highest performing and average heat demand in non-domestic buildings across use types[3]

[2] Blackhorse Lane, Roxwell Trading Park, Rigg Approach and 1 Lammas Foad

Category	Item	Value	Source	Additional notes
Non-domestic- new buildings	New floorspace	175,165 m^2	Waltham Forest	Based on borough-wide estimates and Blackhorse Lan Strategic Industrial Land redevelopment
Non-domestic- new buildings	Energy consumption	Heating - 44 kWh/m^2 Electricity - 39 kWh/ m^2	UK government commissioned Building Energy Efficiency Survey (BEES)	Representing best performing for each non-domestic building use types[3]

To estimate the fuel consumption over time associated with different heating technologies, we used assumptions on technical performance, as summarised in Table 3 . We have differentiated between two performance levels of heat pumps with a coefficient of performance (COP) of air source heat pumps (ASHP) and higher performance heat pumps such as water source or ground source heat pumps (GSHP); and incorporated improvements in their performance over time from learning and innovation within the industry.

It has been assumed that water and ground source heat pumps represent just 10% of those installed because they require specific conditions (access to water or extensive space) to install. Additionally, we have assumed that hot water requirements are met using an immersion heater to achieve the higher temperatures required for hot water supply.

Table 3 Technical performance assumptions for building heating technologies

Item	Value
Gas boiler efficiency	85%
Electric radiation / boiler / immersion heater COP	1
Air Source Heat Pump in 2019	3
ASHP COP in 2050	4.2
Other HP COP in 2019	3.5
Other HP COP in 2050	4.9

1.3.1 Buildings sector scenario parameters

The table below describes the parameters in the buildings sector that changed between scenarios.

Table 4 Buildings sector scenario parameters

Parameter	Strong council leadership	Max ambition	Current practice
Share of dwellings undergoing deep energy efficiency retrofits	43%	80%	-
	Represents 100% of socially rented and 25% of owner-occupied dwellings	Represents 100% of social rented and privately rented and 50% of owner-occupied	98% of dwellings are rated below EPC B
Share of dwellings run on electric heating	43%	80%	3.5%
	Represents homes switched to heat pump (matching retrofit share)	Represents homes switched to heat pump (matching retrofit share)	3.5% currently heated by electric boilers/radiators or heat pumps

[3] Types included commercial, retail, leisure, hospital, hotel, community spaces and education

Parameter	Strong council leadership	Max ambition	Current practice
Share of non-domestic floorspace undertake deep energy efficiency measures	25%	59%	-
	Represents all educational facilities within council below with rating below EPC B	Represents all educational facilities and 50% of all other non-domestic use types with rating below EPC B	90% of non-domestic rated below EPC B
Share of non-domestic floorspace run on electric heating	25%	59%	20%
	Matching retrofit share	Matching retrofit share	20% currently heated by electric boilers/radiators or heat pumps

1.4 Transport

The transport emissions modelling is based on the borough-level data published in the London Energy and Greenhouse Gas Inventory (LEGGI) and additional data in the London Atmospheric Emissions Inventory (LAEI). The modelling considers the impact of three main strategies: (i) journey reduction, including both shorter trips and overall reduction in annual distance travelled; (ii) mode share shift for resident travel towards sustainable modes; and (iii) electric vehicle (EV) uptake by mode.

The projection of transport emissions is split by mode and fuel type, adjusting annual vehicle kilometres travelled to estimate emissions in each year.

Below is a description of sources of key data and assumptions:

Table 5 Transport – key data and assumptions

Item	Source	Additional notes
Transport energy consumption and CO2/ CO2e emissions by borough	Table 2.1, LEGGI, GLA (2021)	-
Rail energy use and CO2e emissions	Table 2.5, LEGGI, GLA (2021)	-
Road CO2 emissions by borough	Table 2.6, LEGGI, GLA (2021)	-
CO2 emissions by borough	LAEI, GLA (2021)	LAEI-2019-Emissions-Summary-update-2022-07-25.xlsx
CO2 emissions by borough	LAEI, GLA (2021)	laei-2019-major-roads-vkm-flows-speeds.xlsx
VKM by mode by borough	BEIS (2021)	conversion-factors-2021-full-set-advanced-users.xlsm
Emissions factors for corporate reporting 2021	TAG Data Book	-
Petrol and diesel emission factor projections	FES 2022, National Grid (2022)	Data-workbook2022_V002.xlsx
Electricity emissions factor projections	Road Traffic Forecasts, DfT (2018)	https://www.gov.uk/government/publications/road-traffic-forecasts-2018 scenario 1: reference
Mileage forecasts for London by mode (Reference scenario)	TAG Data Book	Table A 1.3.10a: Forecast Assumed Vehicle Fuel Efficiency Improvements to 2050

1.4.1 Transport sector scenario parameters

The table below describes the parameters in the transport sector that changed between scenarios.

Table 6 Transport sector scenario parameters

Parameter	Strong council leadership	Max ambition	Current practice
Journey reduction	6% (A roads) 24% (Local roads)	30%	-
Car mode share	20%	10%	33%
EV uptake (cars, taxis and LGV)	50% 2,000 WF chargers (1,000 already funded)	90%	<1% (2019)
Zero-emission buses	80%	90%	650 of 9,200 across London

1.5 Waste

The waste emissions modelling uses population and floorspace projections to estimate future waste generation, from which the resulting emissions are calculated. The modelling considers the impact of three main strategies: (i) increasing the recycling rate, including dry and organic waste streams (where applicable); (ii) reducing overall waste volumes; and (iii) decarbonisation of waste management systems.

Below is a description of sources of key data and assumptions:

Table 7 Waste – key data and assumptions

Item	Value	Source	Additional notes
Waste sector emissions in Waltham Forest	88.9 $ktCO_2e$	BEIS Sub-national emissions	Includes solid waste and waste water
Population	276,940	Waltham Forest	https://www.walthamforest.gov.uk/council-and-elections/about-us/statistics-about-borough
Non-domestic floor area	2,202,068 m^2	Buildings analysis	-
Waste sector emissions breakdown	82% solid waste 18% waste water	6th Carbon Budget, Climate Change Committee	https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Waste.pdf
Recycling data by local authority	-	Local Authority Collected Waste Statistics - Local Authority data, 2020-21	https://www.gov.uk/government/statistics/local-authority-collected-waste-management-annual-results
Waste management by local authority	-	Local Authority Collected Waste Statistics - Local Authority data, 2020-21	https://www.gov.uk/government/statistics/local-authority-collected-waste-management-annual-results
Waste composition	22% organic 60% dry 18% other	London Environment Strategy (2018)	https://www.london.gov.uk/sites/default/files/waste.pdf
Waste sector emissions breakdown	82% solid waste 18% waste water	6th Carbon Budget, Climate Change Committee (2020)	https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Waste.pdf

1.5.1 Waste sector scenario parameters

The table below describes the parameters in the waste sector that changed between scenarios.

Table 8 Waste sector scenario parameters

Parameter	Strong council leadership	Max ambition	Current practice
Residential recycling rate	50%		32% (20% dry, 12% organic)
Non-residential recycling rate			23%
Residential waste reduction	10%		-
Non-residential waste reduction			-
Solid waste processing decarbonisation	10%		-
Waste water processing decarbonisation	21%		-

1.6 Power decarbonisation

The decarbonisation of grid-supplied electricity is an important external driver, particularly for buildings and transportation. The emissions intensity projection for grid-supplied electricity was taken from two sources:

- 2019-2020: Consumption-based emissions intensities for commercial users from the HM Treasury Green Book tables.
- 2021-2050: Generation-based emissions intensities for the 'Leading the Way' scenario from the National Grid Future Energy Scenarios 2022 (FES). An additional transmission component was added using the difference in each year between consumption and generation data in the HM Treasury Green Book.

The FES 'Leading the Way' scenario was selected as it "sets out credible ways that the UK can achieve Net Zero by 2050, as well as the UK Government's commitment to a decarbonised electricity system by 2035".

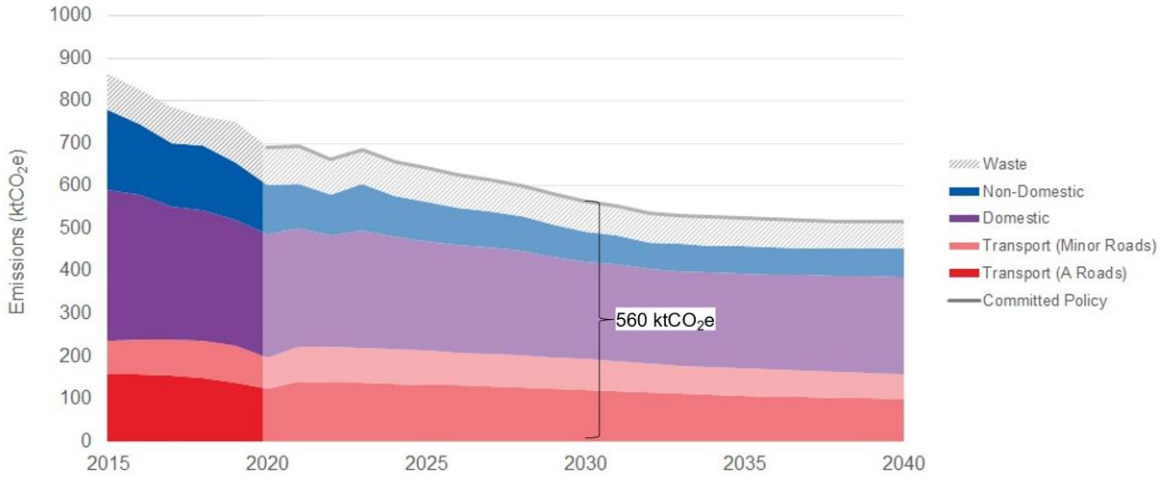
This emissions intensity projection was applied to each of the three scenarios.

2. Results

2.1 Committed policy scenario

The committed policy scenario shows a steady decline in emissions from 2025 driven by existing policy and grid decarbonisation. The residual emissions are 560 ktCO2e in 2030, representing 19% reduction between 2020-2030.

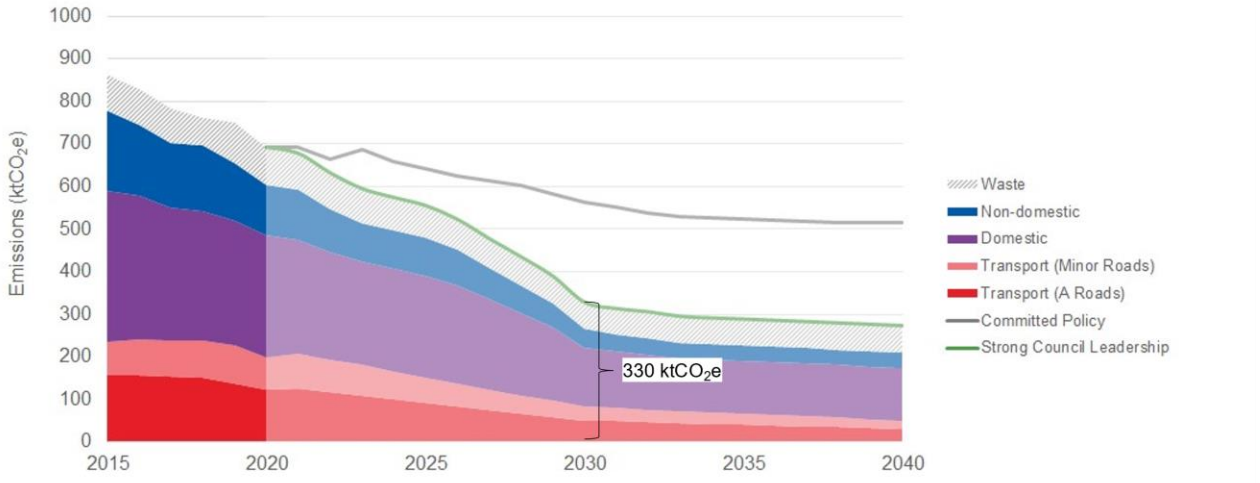
Figure 1 Committed policy scenario emissions



2.2 Strong council leadership scenario

The strong council leadership scenario identifies a significant opportunity to reduce emissions beyond the committed policy scenario. Emissions in buildings and transportation reduce, resulting in residual emissions between 330 ktCO2e in 2030, representing 52% reduction between 2020-2030.

Figure 2 Strong council leadership scenario emissions



2.3 Maximum ambition scenario

The maximum ambition scenario drives rapid and deep emissions reduction. The residual emissions are 140 ktCO2e in 2030, representing 80% reduction between 2020-2030. Residual emissions are predominately in domestic buildings (due to the size of the sector) and waste (due to the challenge in changing behaviours).

Figure 3 Maximum ambition scenario emissions