BASELINE EMISSIONS INVENTORY

FALCARRAGH AND GORTAHORK DECARBONISATION ZONE

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Comhairle Contae Dhún na nGall
Donegal County Council

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Contents

Glossary of terms

AR6	Sixth Assessment Report
AU	Aarhus University
BEI	Baseline Emissions Inventory
BEP	Building Energy Performance
BER	Building Energy Rating
CAP23	Climate Action Plan 2023
CRF	Common Reporting Format
CO_2	Carbon Dioxide
CSO	Central Statistics Office
DEC	Display Energy Certificate
DZ	Decarbonisation Zone
EEZ	Exclusive Economic Zone
ENVS	Department of Environmental Science, Aarhus University
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GWP	Global Warming Potential
$ktCO_2e$	Kilotonne Carbon Dioxide Equivalent
LA	Local Authority
LED	Light Emitting Diodes (Light)
LULUCF	Land Use, Land Use Change and Forestry
NTA	National Transport Authority
PSV	Passengers Service Vehicles
SAP	Small Area Population Statistics
SEAI	Sustainable Energy Authority Ireland
SON	High-Pressure Sodium (Light)
SOX	Low-Pressure Sodium (Light)
UNFCC	United Nations Framework Convention on Climate Change

1 Executive Summary

Local Authorities (LA) are taking a leadership role in acting on climate and as part of the National Climate Action Plan are developing comprehensive Local Authority Climate Action Plans to mitigate greenhouse gas (GHG) emissions in their administrative areas. These plans will be based on calculations, with the impacts measured over time. Baseline Emissions Inventories (BEI) are a key instrument to enable LAs to design their climate plans and measure the impact of their associated actions related to emission reductions across the LA's operations as well as varying sectors of society.

This report presents the results of the BEI for the Falcarragh and Gortahork Decarbonisation Zone (DZ) located within the Donegal County Council, providing specific data and context towards Residential, Transport, Industrial and Non-residential, Agriculture, LULUCF, and Waste sectors. The BEI report measures GHG emissions in a baseline year (2019) and provides a sectoral breakdown of emissions. It is based on local data and national data on energy production, consumption, and other GHG-emitting activities.

The DZ of Falcarragh and Gortahork, located in the north-west of Ireland, encompasses an area of 55.48 km^2 and it includes the two small towns of Falcarragh and Gortahork and their rural surroundings.

The report emphasises Ireland's commitment to reducing 50% of carbon emissions by 2030, starting from a local-based approach, through the use of a Place-Based Approach called the DZ approach within the framework of the National Climate Plan 2023 (CAP23). Achieving these ambitious goals solely through a top-down approach, where emissions are calculated at a national level, may not be sufficient. Hence, the DZ approach, based on local and more accurate data for CO_2 sources and emissions is considered more accurate and effective. The DZ approach emphasizes a place-based approach, considering local conditions and promoting collaboration among stakeholders to develop tailored policies and solutions.

The data used in this report took into consideration the local dataset on population, household characteristics, transport patterns and vehicle ownership, local business localisation, land use and waste production. Emissions factors convert GHGs into CO_2 equivalent. When the local data were unavailable or incomplete, the calculations were supported by national-level data provided by MapElre for the Agriculture and Industrial sectors, to be able to obtain the total CO_2 emissions.

The DZ of Falcarragh and Gortahork presented specific boundaries that didn't allow direct retrieval of data from the National Census; therefore, some assumptions were set to provide the best level of data accuracy. In other cases, where data were incomplete or insufficient other datasets or information filled in knowledge gaps.

The GHGs emissions for Falcarragh and Gortahork DZ totalled 39.17ktCO_2e, the sectoral breakdown is shown in the following page and detailed and explained in the report.

In summary, the DZ approach is a localized strategy to meet Ireland's emission reduction targets and emphasise the role of Local Authorities to meet these targets. The BEI report serves as a critical foundation for developing climate action plans within the DZs by understanding local emissions and energy use.

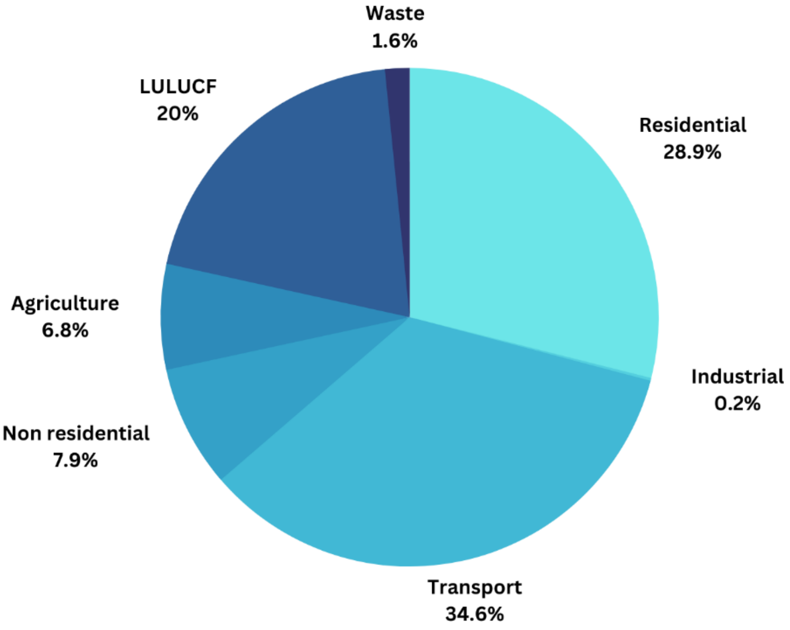

Figure 1 DZ emissions sectoral breakdown. 2019

Table 1 Emissions breakdown at DZ, Donegal County and National level. 2019

Emissions Category	DZ Emissions ($ktCO_2e$)	County Donegal Emissions ($ktCO_2e$)	National Emissions ($ktCO_2e$)
Residential	11.33 (28.9%)	419 (21%)	9,552 (15%)
Non residential and Industry	3.18 (8.1%)	204 (10%)	13,622 (21%)
Transport	13.55 (34.6%)	255 (13%)	12,196 (19%)
Waste	0.62 (1.6%)	37 (2%)	991 (1%)
Agriculture	2.68 (6.8%)	767 (39%)	22,134 (34%)
LULUCF	7.82 (20%)	287 (15%)	6,899 (10%)
Total	**39.17 (100%)**	**1,970 (100%)**	**65,152 (100%)**

2 Introduction

As an EU-member state, Ireland has pledged to reduce carbon emissions as a response to the commitment to the National Climate Plan 2023 (CAP23), demanding decisive action to halve the country's emissions by 2030 and reach complete neutrality by 2050. To reach such an ambitious goal it is necessary to analyse and account for the GHG emissions produced at a county level, as each county requires a different approach to tackle these emissions.

Following such reasoning, local authorities are taking a leadership role within their jurisdictions to achieve these goals and are developing their own Local Authority Climate Action Plans which will then be translated into targeted and local actions. Therefore, it becomes imperative to gain a comprehensive understanding of the emissions and their sources that should be tackled by the Action Plan.

Action 80 of the National Climate Action Plan 2021 seeks to '*Support, monitor and assess Local Authority Climate Action*' and integrates the development of Decarbonisation Zones (DZs) within each county. The DZs consist of a place-based approach that aims to provide locally based solutions to reduce carbon emissions. Accordingly, each local authority will incorporate its DZ into its local authority climate action plan.

DZs vary in terms of their nature, size, shape, geographical location, as well as natural and built characteristics. They offer a broad range of opportunities and potential to pursue and deliver effective climate action with the support and engagement of key stakeholders including local communities. A DZ is commonly defined as a spatial area identified by the local authority in which a range of climate mitigation, adaptation and biodiversity measures and action owners are identified to address local low-carbon energy, greenhouse gas emissions, and climate needs to contribute to national climate action targets.

The identification, design, and development of the DZ is motivated primarily to deliver outcomes capable of meeting the **national emission reduction targets of 51% by 2030** and net zero by the end of 2050, from the baseline year of 2019[1].

The place-based approach will bring together the findings of a robust evidence base, context-specific conditions, and the promotion of wider collaboration by stakeholders to create tailored policies to deliver the outcomes required. This stimulates a systems-thinking approach that promotes exploration, co-creativity, innovation, and new learning in the transition to climate neutrality.

In this context, DZs are test beds to not only demonstrate what can be done and accelerate learning for other areas but also to help understand the scale of the challenge in decarbonising the economy and wider society. At a practical level, DZs are a mechanism that harnesses a portfolio of actions, projects, technologies, and interventions to deliver on the national climate objective at a local level through responses that include mitigation, adaptation, and biodiversity actions[2].

This report will be dedicated to an analysis of the DZ of an area clustered around the towns of Falcarragh and Gortahork, in Donegal County. This area will be subject to actions dedicated to

[1]https://www.gov.ie/pdf/?file=https://assets.gov.ie/250052/0c6e5d22-616d-4b19-bfe1-09ae5653af66.pdf#page=null
[2]https://www.gov.ie/pdf/?file=https://assets.gov.ie/250052/0c6e5d22-616d-4b19-bfe1-09ae5653af66.pdf#page=null

mitigating and adapting to climate change by working as an implementing body with local communities, businesses, and the national government. To inform these actions, this Baseline Emissions Inventory report has been developed. The BEI report measures the amount of greenhouse gases (GHGs) emitted in the baseline year and provides a sectoral breakdown of the results.

The BEI report is based on local data from GHG emitting activities, such as energy production and consumption statistics as well as other information that reflects local GHG emission conditions. The purpose of this DZ report is to calculate the emissions of the specific boundaries of the DZ developed around the towns of Falcarragh and Gortahork and analyse the sources of such emissions.

3 Methodology

This section outlines and discusses the methodology followed to calculate the mass of CO_2 emissions and CO_2 equivalent emissions for each relevant sector of the DZ in Falcarragh and Gortahork. Firstly, the main datasets used for the calculations are presented and explained, consequently, the methodology and assumptions are defined.

3.1 The MapEIre Dataset

The project "National mapping of GHG and non-GHG emissions sources" (MapEIre) was carried out by the Department of Environmental Science (ENVS) at Aarhus University (AU), Denmark, in cooperation with the Irish EPA (Environmental Protection Agency)[3]. The MapEIre project developed two models to account for greenhouse gas emissions for all sector-specific activities and all pollutants with both a temporal and a spatial resolution, respectively. The spatial as well as temporal models will be based on input data from the current inventories to ensure consistency of the national total emissions in the national emission inventory. National stakeholders and inventory experts were involved in the project contributing to knowledge of spatial properties for the activities concerned.

All GHG emissions from the Irish emissions inventory are distributed according to a square kilometre grid covering the entire Irish Exclusive Economic Zone (EEZ) and are categorised by type of gas and by the subsectors corresponding to the Common Reporting Format (CRF) and nomenclature for reporting from the United Nations Framework Convention on Climate Change (UNFCCC). This dataset can then be used to calculate emissions inventories for smaller areas as well as, in this case, a preselected part (the so-called Decarbonisation zone – DZ) of a county area. It should be noted that the methodology used by the MapEIre project varied among the subsectors and some may have been mapped more robustly than others. This methodology accounts for emissions emitted based on activities that occur in the square kilometre analysed. The dataset used collects GHG emissions on a 1km x 1km grid for all of Ireland. The MapEIre dataset constituted the baseline for the calculation of emissions for the DZ for the top-down approaches.

The GHG taken into consideration and modelled in the MapEIre dataset are CH_4, CO_2, N_2O, NH_3 and NOx. For this inventory, the data was clipped in a GIS environment overlaying the DZ boundaries. Then all emissions were converted to CO_2 equivalent by using the Sixth Assessment Report (AR6) Global Warming Potential (GWP) values for a 100-year time horizon[4]. The GWP value of the gas analysed was multiplied by the gas's mass to obtain the final CO_2 equivalent mass. GWPs compare the global warming impacts by measuring how much energy the emissions of 1 tonne of gas will absorb over a specific period.

This approach was applied to the calculation of emissions for Industrial, Agriculture and LULUCF sectors. In the other cases, and owed to data availability, a bottom-up approach was preferred starting from other datasets and assumptions.

[3] https://projects.au.dk/MapEIre
[4] https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf

3.2 CSO SAPS

The Central Statistics Office (CSO) is Ireland's national statistical office, and its purpose is to impartially collect, analyse and make available statistics about Ireland's people, society, and economy[5]. Small Area Population Statistics (SAPS)[6] are census statistics produced for a range of geographical levels from state to small areas. There are two ways to access SAPS information: through the Interactive Mapping Tool (SAPMAP) or by downloading tables and shapefiles.
The main data retrieved from the 2016 Census regarded the number of households in the DZ (Theme 1), the type of fuel used for heating for each cluster of households (Theme 6) and the ownership of private motorcars (Theme 8).
Due to the imprecise overlap between the DZ boundaries and the small area extension, some adjustments were made to obtain coherent data. The adopted assumptions to obtain such adjustments for each sector are explained in the following sections.

3.3 Residential emissions

The Residential sector accounts for emissions from domestic activities. This includes emissions from electricity consumption and space and water heating. The emissions a household generates vary significantly depending on the type of household, occupancy level, and source of heating (type of fuel).

Energy consumption from electricity

The CSO 2016 census provided information about the total number of households within the DZ and, therefore, within each small area in the DZ.

The exact number of households inside the DZ was validated using the Geodirectory dataset[7]. Having defined the number of households, the SEAI BER map[8] dataset provided the mean Building Energy Rating (BER) for the households in each small area. This rating represents the mean electricity consumption[9] for each household in the small area analysed. Once the mean consumption was multiplied by the number of households per small area, it was converted into ktCO_2 equivalent[10]. Finally, the masses were summed up for all areas in the DZ, obtaining the total CO_2 emissions from electricity.

Energy consumption from heating

The CSO 2016 census also provides the number of households utilising each fuel source for space heating in each small area. After identifying the number of households within the DZ, the total number of dwellings per fuel was obtained. Finally, the number of households was multiplied by the average energy consumption per household for space heating[11] and its corresponding emission factor for the

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[5] https://www.cso.ie
[6] https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics/
[7] https://www.geodirectory.ie/
[8] https://gis.seai.ie/ber/
[9]https://www.cso.ie/en/releasesandpublications/ep/p-hecber/householdelectricityconsumptionbybuildingenergyratings2021/keyfindings/
[10]https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/
[11] https://www.seai.ie/data-and-insights/national-heat-study/heating-and-cooling-in-ir/

fuel source[12]. The total CO_2 emissions from heating was obtained by summing up all the partials' masses.

The total $ktCO_2$ emissions from the residential sector were obtained by summing the emissions from both electricity and heating.

3.3.1 Supporting documentation

To understand the energy efficiency of a building or a house the most used indicator to assess this is the Building Energy Rating. It measures the running costs and carbon emissions associated with heating the home to a comfortable level[13]. The BER rates the home on a scale from A to G. A-rated homes are the most cost-saving and energy-efficient, and G-rated ones are the least cost-efficient and energy-efficient. There are various ways to calculate the BER of a house, such assessments can follow two calculation trajectories: the first one is based on the dwelling, and the second one, on the other hand, considers the number of occupants[14]. Generally, a BER is calculated based on the amount of energy a house requires for space and hot water heating, ventilation, and lighting. The calculation system for the BER in Ireland, defined as DEAP[15] is the official method used across the country.

3.4 Transport emissions

Transport in 2019 accounted for approximately 19% of Ireland's GHG emissions which is equivalent to 11 Mt CO_2e, with road transport responsible for 94% of those GHG emissions. The emissions coming from the transport sector are primarily sourced by the burning of diesel and petrol in combustion engines (passenger cars, light-duty vehicles, heavy-duty vehicles, buses, and machinery vehicles) and are also directly responsible for a range of air pollutants that negatively impact both human health and the environment.

Calculating transport emissions at a local level poses various challenges in determining which and how travel should be accounted for. In the scope of this BEI, a bottom-up approach was used to calculate those emissions generated by any travel inside the DZ whose final destinations could also be placed outside of the DZ's boundaries. To process these calculations, it would be ideal to obtain a fine level of data acquisition accuracy-travels matrixes with the origin and destination of the travel and the type of transportation used. Due to the lack of this type of dataset, the following methodology was applied.

Private cars

Emissions from private cars were calculated by multiplying the total number of kilometres driven by cars[16] owned in the DZ[17], subdivided by fuel split[18] (petrol, diesel, hybrid and electric) times the emissions factors[19] for each fuel type.

[12] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/
[13] https://www.seai.ie/home-energy/building-energy-rating-ber/understand-a-ber-rating/
[14] https://www.seai.ie/home-energy/building-energy-rating-ber/understand-a-ber-rating/
[15] https://www.seai.ie/home-energy/building-energy-rating-ber/support-for-ber-assessors/software/deap/
[16] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[17] https://visual.cso.ie
[18]https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/vehiclelicensingandregistrations/
[19] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

Motorcycles

All motorcycles were considered petrol-powered. The emissions from motorcycles were calculated by multiplying the total number of kilometres driven by motorcycles owned in the DZ (obtained by relation it to the number of motorcars in the county[20] and the population in the DZ) per the emission factor of petrol motorcycles[21].

Good vehicles

A goods vehicle is defined as a motor vehicle used or constructed primarily for the carriage of goods, as opposed to the transportation of passengers. The definition of a goods vehicle in Ireland encompasses a range of commercial vehicles used for transporting goods, such as trucks, vans, lorries, and delivery vehicles.

All good vehicles were considered diesel-powered[22]. The emissions from good vehicles were calculated by multiplying the total number of kilometres driven by good vehicles[23] in the DZ (calculated by multiplying the number of goods vehicles in the county[24] by the proportion of the total county population in the DZ) per the emission factor of diesel trucks and vans[25].

Tractors and heavy machinery

Tractors and heavy machinery are vehicles and equipment used in various industries, primarily for agricultural, construction, and industrial purposes.

All tractors and heavy machinery were considered diesel-powered. The emissions from tractors and heavy machinery were calculated by multiplying the total number of kilometres driven by this type of vehicle[26] in the DZ (calculated by multiplying the number of tractors and heavy machinery in the county[27] by the proportion of the DZ area) per the emission factor[28] of diesel engines.

Small and medium PSV

Small and Medium Passenger Service Vehicles (PSV) are categories of vehicles used for public transportation of passengers. In Ireland, the classification of Small Public Service Vehicles (PSVs) is regulated by the National Transport Authority (NTA).

Small PSVs are typically associated with vehicles that can carry up to eight passengers including the driver for hire or reward. It covers vehicles like taxis, limousines, and some smaller minivans used for passenger transportation.

Medium PSVs encompass vehicles with a seating capacity ranging from 17 to 30 passengers, including the driver. These vehicles are larger than small PSVs and are often used for slightly larger-scale public transportation, such as local bus routes, school buses, and tourist transportation. They are designed to accommodate more passengers than small PSVs but are still smaller than full-sized buses.

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[20] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[21] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
[22] https://www.acea.auto/files/ACEA-report-vehicles-in-use-europe-2022.pdf
[23] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[24] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[25] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
[26] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[27] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[28] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

All the PSVs were considered diesel-powered[29]. The emissions from PSVs were calculated by multiplying the total number of kilometres driven by PVS[30] in the DZ (obtained by relation to the number of PSVs[31] in the county and the area of the DZ) per the emission factor[32] of passenger service vehicles.

The total ktCO_2 emissions from the transport sector were obtained by summing the share from each type of vehicle.

3.5 Non-residential and Industrial emissions

Within this sector are included the emissions not related to the residential sector, there are two main categories: Commercial buildings and schools (non-residential), and Industrial Processes. Each category encompasses a unique set of activities and processes that contribute to greenhouse gas emissions.

3.5.1 Industrial

The data for the industrial processes emissions was retrieved from the MapEIre dataset by transforming the principal GHGs into CO_2 according to their GWP,[33] after clipping the National Dataset with the DZ boundaries, according to the % of each MapEIre cell falling inside the DZ's area.

3.5.2 Non-Residential

The emissions from commercial buildings in the DZ were calculated by locating and counting the commercial activities presented in the area. This was done by using the Geodirectory[34] dataset, locating the building on the DZ and then obtaining the corresponding Non-Domestic BER rating[35]. The average BER classification for each area was multiplied by the mean electricity consumption[36] by Energy Rating. The corresponding consumption was then multiplied by the electricity emission factor[37] to obtain the kgCO_2 equivalent. CO_2 emissions from schools in the DZ were retrieved from the National Public Sector Energy Efficiency Performance Report 2022[38] where data was available.

3.5.2.1 Supporting documentation

In Ireland, the Non-Domestic Building Energy Rating (BER)[39] system uses an A to G scale, with A being the most energy-efficient and G being the least. This rating is based on an assessment of a building's energy performance, considering factors such as insulation, heating systems, ventilation, and renewable energy sources for residential properties.

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[29] https://www.acea.auto/files/ACEA-report-vehicles-in-use-europe-2022.pdf
[30] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[31] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/
[32] https://www.carbonindependent.org/20.html
[33] https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf
[34] https://www.geodirectory.ie/
[35] https://gis.seai.ie/ber/
[36] https://www.cso.ie/en/releasesandpublications/ep/p-ndecber/non-domesticelectricityconsumptionbybuildingenergyratings2021/
[37] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/
[38] https://www.seai.ie/business-and-public-sector/public-sector/monitoring-and-reporting/public-sector-results/
[39] https://www.seai.ie/home-energy/building-energy-rating-ber/

For non-residential buildings, energy performance is often evaluated through the Building Energy Performance (BEP) regulations and may involve different metrics and requirements compared to residential buildings. These regulations are designed to promote energy efficiency and reduce carbon emissions in non-residential buildings.

Non-residential buildings may also use Display Energy Certificates (DECs) to indicate their energy performance. DECs provide a visual representation of a building's energy efficiency and are typically required for the public sector and larger non-residential buildings.

In summary, while Ireland has a well-defined BER rating system for residential buildings, non-residential buildings are typically evaluated and regulated separately through mechanisms like BEP regulations and DECs, which focus on energy efficiency but may not use the same A to G rating scale as the BER system for residential properties. The specific requirements and assessment methods for non-residential buildings can vary based on the building type, size, and purpose.

3.6 Agriculture emissions

Agriculture emissions are greenhouse gases (GHG) released into the atmosphere during farming activities, including livestock rearing, crop production, and land use change. These emissions are primarily composed of methane (CH_4) and nitrous oxide (N_2O), which have significantly higher global warming potentials than carbon dioxide (CO_2). Agriculture emissions are responsible for a considerable portion of global GHG emissions, and the sector has a crucial role to play in addressing climate change. Agriculture emissions can be measured by the use of emission factors, which quantify emissions per unit of activity, such as per acre of land or head of livestock. These factors are often specific to different agricultural practices, including livestock management, crop cultivation, and fertilizer application. Due to a lack of local data on agricultural activities within the DZ, it was not possible to use a bottom-up calculation.
In the scope of this BEI, the inventory of emissions provided by the data set of MapEIre was used to calculate the CO_2 equivalent by converting GHGs into CO_2 according to their GWP[40] after clipping the National Dataset with the DZ boundaries, according to the % of each MapEIre cell falling inside the DZ's area.
MapEIre dataset includes energy-related agricultural emissions. This includes emissions from the use of energy-intensive machinery and equipment in farming, as well as energy consumed in the production of fertilizers and other agricultural inputs, summing up with the direct emissions coming from harvesting and farming.

3.7 LULUCF emissions

Land Use, Land Use Change and Forestry (LULUCF) is responsible for emissions as well as carbon sinks, related to land use change and forestry. It involves the emissions and removals from land use, land use change and forestry, including forest land, cropland, grassland, wetlands, settlements, and other land types, as well as through the harvesting of wood products.
In the scope of this BEI, the inventory of emissions provided by the data set of MapEIre was used to calculate the CO_2 equivalent by converting GHGs into CO_2 according to their GWP[41] after clipping the National Dataset with the DZ boundaries.

[40]https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf
[41]https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf

The informing of these results was obtained by observing the National Land Cover for the DZ, to show the potential area of CO_2 retention, in this case forests or grasslands.

The different land uses were represented through the Land Cover data in the DZ. From this data, a map was created showing potential areas of CO_2 retention as a result of biological carbon sequestration. In this case, coniferous forests, forests, and woodlands are those providing sequestration opportunities to the DZ. The larger the share of coverage from these land uses, the higher sequestration can be achieved.

3.8 Waste Emissions

The Waste sector includes emission estimates from solid waste disposal, composting, waste incineration (excluding waste to energy), open burning of waste and wastewater treatment and discharge. Household waste includes residual waste, recyclable waste and organic waste collected directly from households and waste brought by householders to waste collection centres such as banks, civic amenity sites, and pay-to-use compactors. The largest of these sources is solid waste disposal on land (landfills) where methane (CH_4) is the gas concerned. Ireland generated approximately 1.57 million tonnes (t) of household waste in 2019[42].
Knowing the average tonnes of waste produced by each household in Ireland (0.924), it was possible to calculate the total quantity of waste generated in the DZ by multiplying that by the total number of households in the DZ.
The EPA of Ireland published the total kilotons of CO_2 produced by the treatment of waste by biological treatment, landfill processes, and incineration[43]. This data was used to calculate the emission factor for every ton of waste managed.
The total emissions for waste were obtained by multiplying the emission factor per the total waste generated in the DZ. This number reflects the emissions of CO_2 equivalent produced for the waste generated inside the DZ but that might be processed outside the DZ boundaries.

3.9 Local Authority's Emissions

Local Authorities (LAs) typically operate a range of infrastructure, including administrative buildings, road and transportation facilities, educational buildings, and recreational spaces. Therefore, energy consumed by this infrastructure, for heating, cooling, lighting, and electric appliance usage, contributes to the GHG emissions accounted for LAs.
For the DZ, LAs emissions were determined from the energy consumption of public lighting, due to limited availability of data of energy use from other facilities.

Data was obtained containing the number and type of streetlights in the DZ. Furthermore, the annual average power capacity for each type of streetlight was identified from literature[44].

- iLED streetlight average power capacity is 192W per year.
- SOX (Low-Pressure Sodium) streetlight average power capacity was set to 346W per year.
- SON (High-Pressure Sodium) streetlight average power capacity was set to 768W per year.

The total energy consumption for each individual streetlight was obtained by multiplying the average streetlight power capacity by the hours of darkness in Ireland (3840 hours). Once the yearly

[42] https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/household/
[43] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/waste/
[44] https://www.seai.ie/publications/SEAI-Energy-Efficient-LED-Lighting-Guide.pdf

consumption per type of streetlight was determined, the total consumption was obtained by multiplying the partial consumption by the quantity of LED, SOX or SON streetlights in the DZ. The result was then converted into CO_2 equivalent.

3.10 F-gases

Fluorinated gases (F-gases) are man-made gases used in a range of industrial applications[45]. The EU is taking regulatory action to control F-gases as part of its policy to fight climate change. F-gases are powerful greenhouse gases, with a global warming effect up to 25,000 times greater than CO_2[46]. Hydrofluorocarbons (HFCs) are by far the most relevant F-gas group from a climate perspective, although they are relatively short-lived. The other two F-gas groups, perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) can remain in the atmosphere for thousands of years. There are also many less-prominent F-gases, such as NF_3.

In the scope of this BEI, the inventory of emissions provided by the MapEIre dataset was used to calculate the total mass of F-gases in the DZ. After clipping the National Dataset with the DZ boundaries for the Industry sector, the above-mentioned gases were looked up and summed for the whole DZ.

Table 2 summarises the main data source for each sector used in this BEI report.

Table 2 Main dataset used in this BEI for each sector for DZ emissions.

Category	Main data Sources
Agriculture	MapEire
LULUCF	MapEire & National Land Cover Map 2023
Waste	European Environment Agency and Environmental Protection Agency (EPA)
Residential Heating	Central Statistics Office (CSO) and Sustainable Energy Authority of Ireland (SEAI)
Residential Electricity	Central Statistics Office (CSO) and Local Authority provided Data
Transport	Central Statistics Office (CSO), CarbonIndepent.org, UK Government Greenhouse gas reporting
Non residential and Industrial	Central Statistics Office (CSO), Sustainable Energy Authority of Ireland (SEAI), and MapEire
Local Authority own emissions	Local Authority provided data
F - Gases	MapEire

[45]https://www.eea.europa.eu/help/faq/what-are-f-gases-and#:~:text=Fluorinated%20gases%20(F%2Dgases),damage%20the%20atmospheric%20ozone%20layer

[46] https://climate.ec.europa.eu/eu-action/fluorinated-greenhouse-gases/overview_en

4 Falcarragh & Gortahork Decarbonisation Zone Profile

This section introduces the selected area for the analysis of the baseline emissions inventory. The area, named the Decarbonisation Zone (DZ), lies among the towns of Falcarragh ("An Fhál Carrach" in Irish) and Gortahork ("Gort a' Choirce" in Irish) in Donegal County. The DZ boundaries are shown in Figure 2.

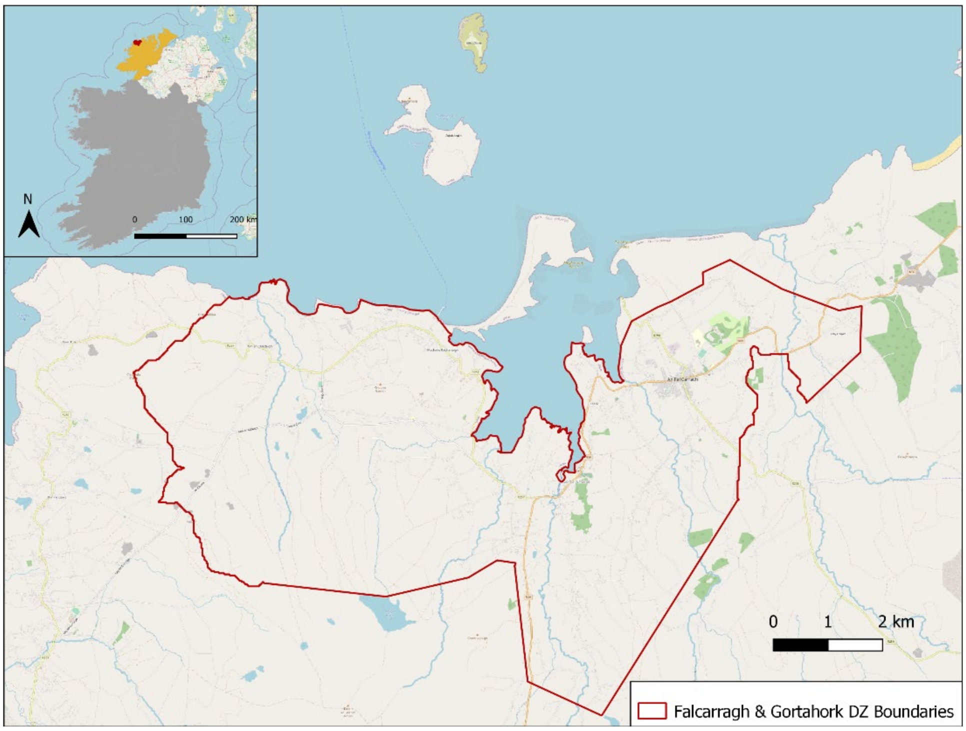


Figure 2 Boundaries and Localization of the DZ within Donegal County

Donegal is Ireland's northernmost county and the largest county in the province of Ulster while being the second-largest county in Ireland in terms of size and area. Due to the geographical segregation, County Leitrim is the only direct neighbour county in the Republic of Ireland, while the remaining border is shared with three counties of Northern Ireland. The county has a population density of 34.2 people per square kilometre, making it the fifth least urbanised county in Ireland, over 70% of people living in Donegal County live in rural areas.

Falcarragh and Gortahork are located in the northwest of County Donegal in the parish of Cloughaneely. Falcarragh has a population of approximately 860 people and Gortahork, has a population of 185 inhabitants. It is important to mention that there are other townlands inside the DZ, these being, Killult, Carrowcanon, Ballyness, Greenes Homes, Margheraroarty, Meenlaragh, and Dunmore. Thus, the total population in the DZ area (as of the 2016 census) is 3,324 inhabitants, representing just 2% of the total Donegal County population[47].

The total density in the DZ is of 59 people per square kilometre. The majority of the population in the DZ falls between the age of 50 and 70 years old. Finally, the DZ territory is mainly rural, with large peatlands and some agricultural land. For this reason, the population is not as dense in the settlements respective to the DZ.

[47] https://www.cso.ie/en/census/census2016reports/

5 Decarbonisation Zone Emissions: Sectoral Breakdown

This section introduces and presents the total mass of CO_2 equivalent emissions for each sector evaluated. The results calculated follow the methodology introduced in Section 3 and are shown in kilotons or kt of CO_2 equivalent.

5.1 Falcarragh and Gortahork Decarbonisation Zone Emissions

The sectoral breakdown within this Baseline Emission Inventory serves as a vital tool for gaining insights into the source of greenhouse gas (GHG) emissions within the DZ. This breakdown categorizes emissions sources, offering a detailed view of which activities generated the most GHGs. By dissecting sectors such as residential, industry, agriculture, transportation, waste, and commercial activities, LA can identify trends, pinpoint critical areas for emissions reduction, and develop informed strategies to address climate change challenges. This comprehensive breakdown empowers the Local Authorities to make data-driven decisions that will steer the region toward a more sustainable and resilient future. As the location of where electricity is consumed is more useful to the Local Authorities than the location where said electricity is generated, the Energy Industries category has been removed from this inventory and replaced with electricity consumption data for the Residential, Industrial, Commercial and Public buildings sectors.

The resulting output is the Baseline Emission Inventory for the DZ that will be used to inform the development of the Local Authority Climate Action Plan. A full-page summary can be found on the next page.

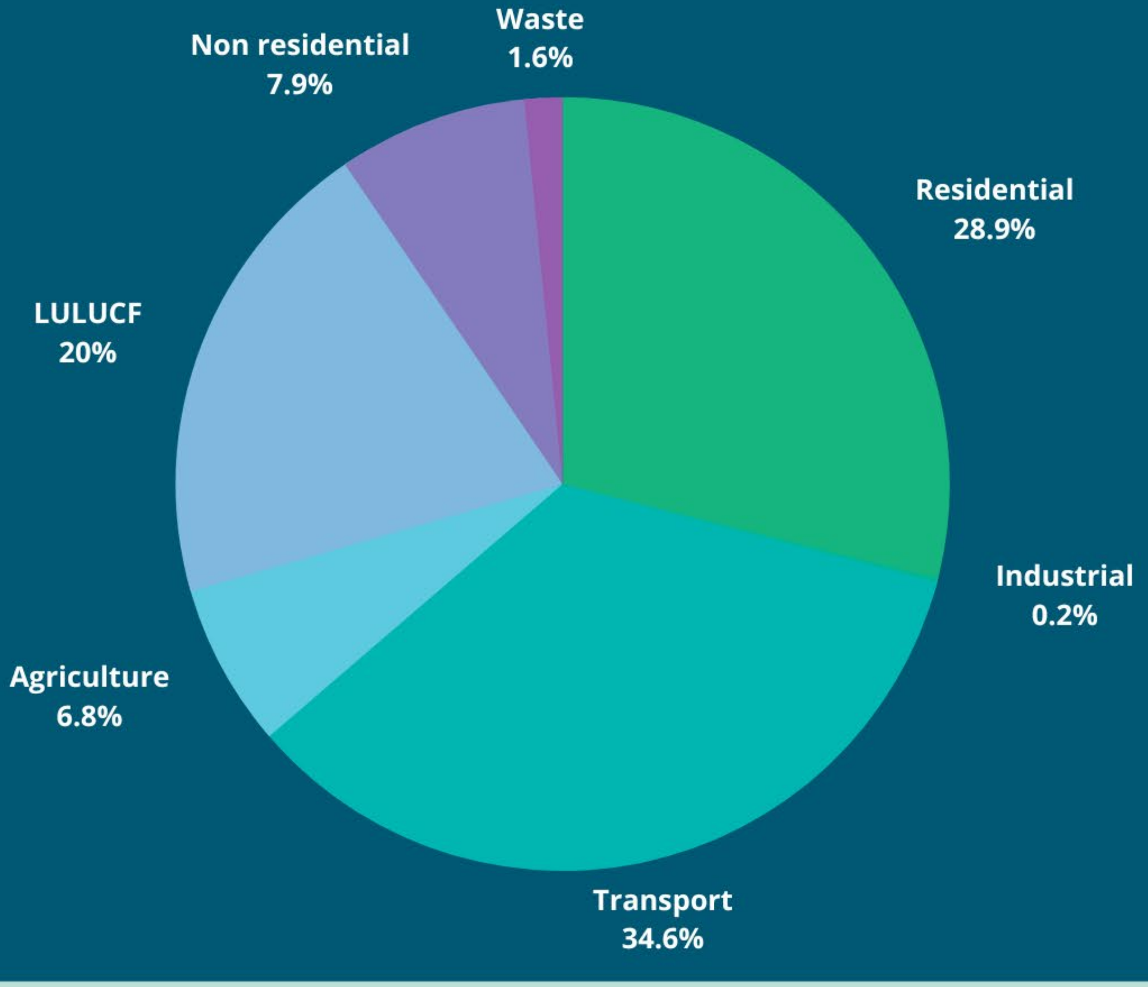
Falcarragh & Gortahork DZ

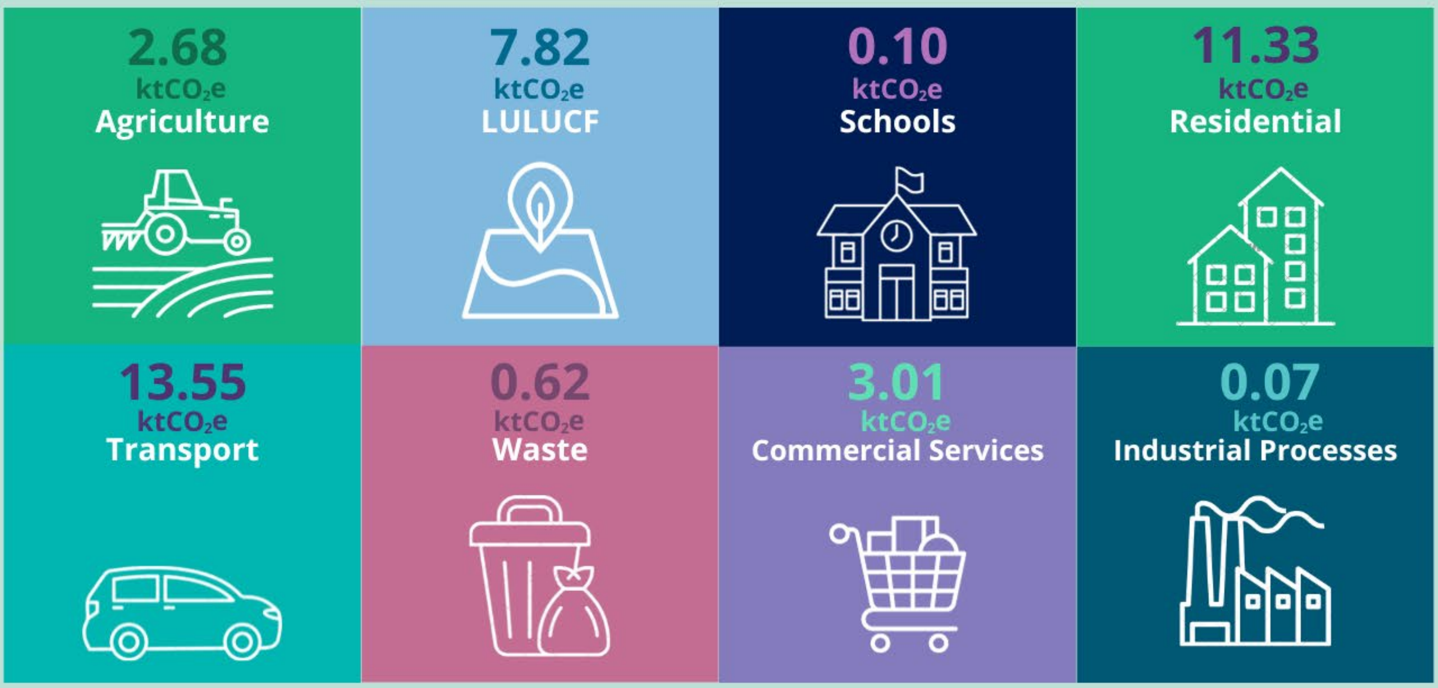
Baseline Emissions Inventory Results

Total Emissions Falcarragh & Gortahork DZ : 39.17 $ktCO_2$ eq

County Donegal Emissions 1,969 $ktCO_2$ eq

Natinal Emissions: 64,220 $ktCO_2$ eq





5.2 Residential

5.2.1 County-level context

At a county level, the Residential sector accounts for approximately 21% of the total CO_2 emissions. As detailed in the methodology section, conversion factors were used to transform the electricity and heating consumption into CO_2 equivalent.

5.2.2 Sectoral Emissions Description

The Residential sector is comprised of emissions from household activities. In the DZ, the total amount of emissions for the Residential sector represents 28.9% of the total emissions. The emissions from electricity consumption accounted for 22.9% of the total 11.33 kt of CO_2 equivalent. This indicates that the majority of emissions in the DZ's households come from space heating (8.06 kt of CO_2 equivalent). At a county and national scale, space heating is also the primary source of emissions in the Residential sector, following the same proportion of the DZ. The Residential emissions for the DZ, Donegal County, and national levels are shown in Figure 3.

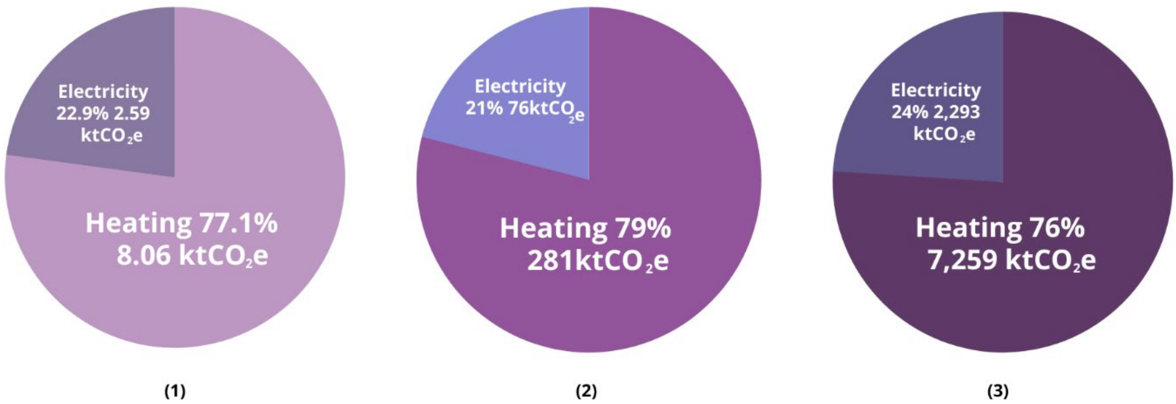


Figure 3 Decarbonisation Zone (1), County Donegal (2) and National split (3) of Residential energy CO_2 emissions. 2019

5.2.2.1 Supporting Information

From the 2016 Census data, it was possible to determine that there is a total of 1,387 households in the DZ.[48] The household size and housing stock characteristics hold significant influence over the amount of energy consumed for space heating and cooling, and electricity. The majority of households use oil and peat as fuel sources for space heating. Specifically, 44% of all households in the DZ have oil-fired boilers and 37% use peat.

5.2.2.2 Building Energy Ratings

Building Energy Ratings (BERs) measure the energy performance of a given home. They are measured on a scale from A1 to G, where A1 is the most efficient and G is the least. The level is calculated based on the amount of energy required to heat, cool, ventilate, and light a building according to SEAI-registered BER assessors. Figure 5 shows the distribution of the most recent BER ratings in the DZ per small area and Figure 4 indicates this distribution of the average in the DZ.

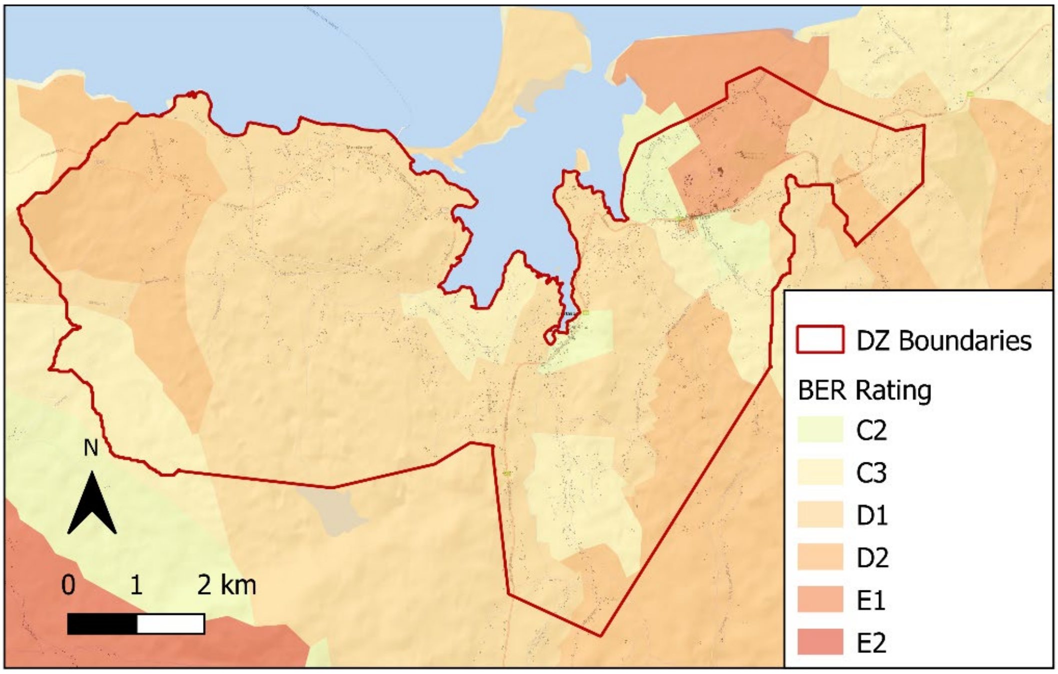


Figure 4 Average Residential BER rating per small area in the DZ

48 https://visual.cso.ie/?body=entity/ima/cop/2016&boundary=C03736V04484&guid=4c07d11d-f4d3-851d-e053-ca3ca8c0ca7f

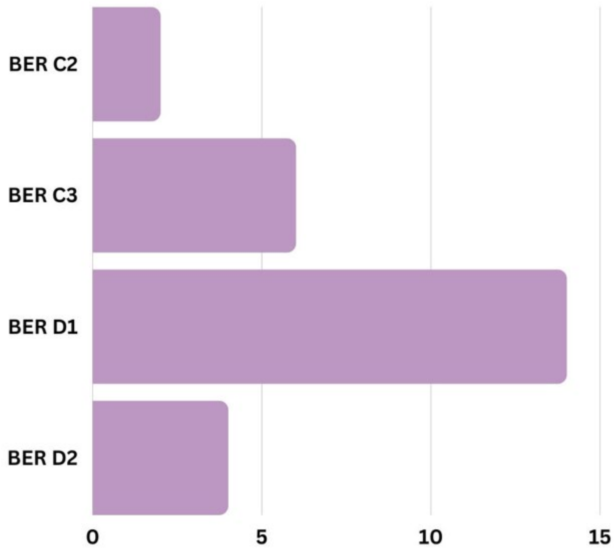


Figure 5. Domestic BER Distribution

As is possible to see from Figures 4 and 5, the BER rating for the small areas in the DZ is predominantly low, ranging from D2 to C2.

5.3 Transport

Baseline Emissions Inventory Results

Falcarragh and Gortahork DZ : **13.55 ktCO_2e (34.6%)**

County Donegal: **255 ktCO_2e (13%)**

Transport

5.3.1 County-level context

The Transport sector in County Donegal accounted for 255 ktCO_2e, corresponding to 13% of the total County's emissions. When compared to the national level, in 2019, the transport sector accounted for approximately 19% of Ireland's greenhouse gas (GHG) emissions (equal to 11 Mt CO_2e), with road transport responsible for 94% of those GHG emissions[49]. The emissions coming from the transport sector are primarily sourced by the combustion of diesel and petrol in engines (passenger cars, light-duty vehicles, heavy-duty vehicles, and buses) and are also directly responsible for a range of air pollutants that negatively impact both human health and the environment.

5.3.2 Sectoral Emission Description

Transportation emissions within the DZ include emissions from private cars, goods vehicles, motorcycles, heavy machines and PSVs. Figure 6 and Table 3 show the final results from the emissions calculation in the DZ. In general, the Transport sector accounts for 34.6% (13.55 ktCO_2eq) of the total CO_2 emissions in the DZ. In Figure 6, the emissions breakdown per vehicle type is shown. From the results, it can be seen that goods vehicles contribute the highest proportion of emissions in the sector at 63.6% of emissions, followed by private cars with 32.9%. Table 3 shows the mass corresponding to the values shown in Figure 6.

[49] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/

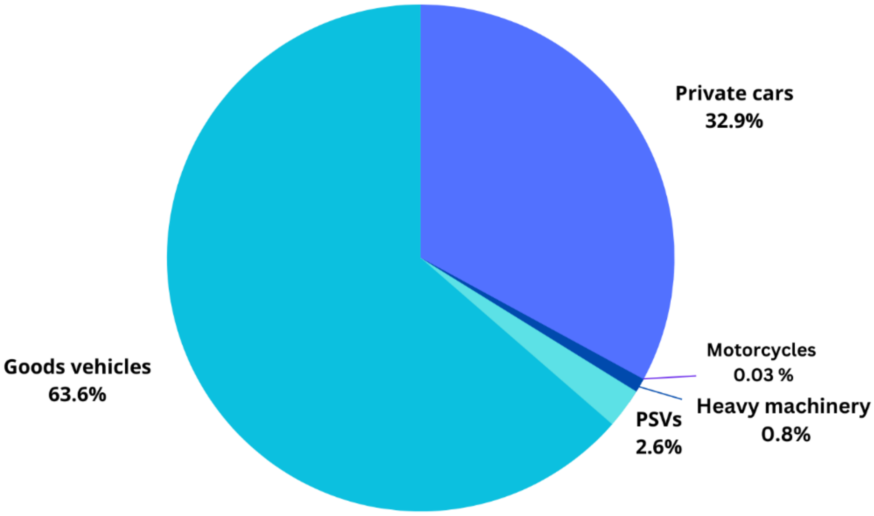


Figure 6 Breakdown of Transport emissions for each type of vehicle

Table 3. CO_2 equivalent emissions for each vehicle in the DZ

Type of Vehicle	Emissions in $ktCO_2$
Private Cars	4.34
Motorcycles	0.005
Heavy Machinery	0.11
PSVs	0.33
Goods Vehicles	8.38
TOTAL	13.17

The low value of emissions from PSVs is due to the relatively short service coverage in the DZ. The share of the route distance covered by buses within the DZ is low when compared to the entire route. Moreover, private cars remain the main means of transportation for the inhabitants in the DZ.

The data gathered in this analysis results from a bottom-up approach to capture the emissions that took place within the DZ boundaries by the various transport modes. As stated in the methodology, these results encompass emissions that are also generated outside the DZ but include travels whose origins, destinations or purposes happened inside the DZ's boundaries.

5.3.2.1 Supporting Information

As mentioned, the DZ is a car-centric area. This is reflected in Table 4, which shows the number of vehicles in the DZ and the average distance driven for each vehicle type in County Donegal. There is a total of 1,535 private cars, corresponding to 46% car ownership. In Figure 7, the fuel source breakdown for these vehicles is shown. In the DZ, 87.3% of all vehicles are diesel- and petrol-powered, and only 3.1% are electric. This demonstrates that there is an opportunity for electrification of transportation within the DZ.

Table 4 Number of vehicles and average km driven per type of car in the DZ. 2016

Type of vehicle	Number of vehicle	Average km driven per vehicle
Private Car	1535	17,534
Motorcycles	16	2,786
Heavy Machinery	37	18,130
Goods vehicle	303	19,823
PSVs	11	36,254

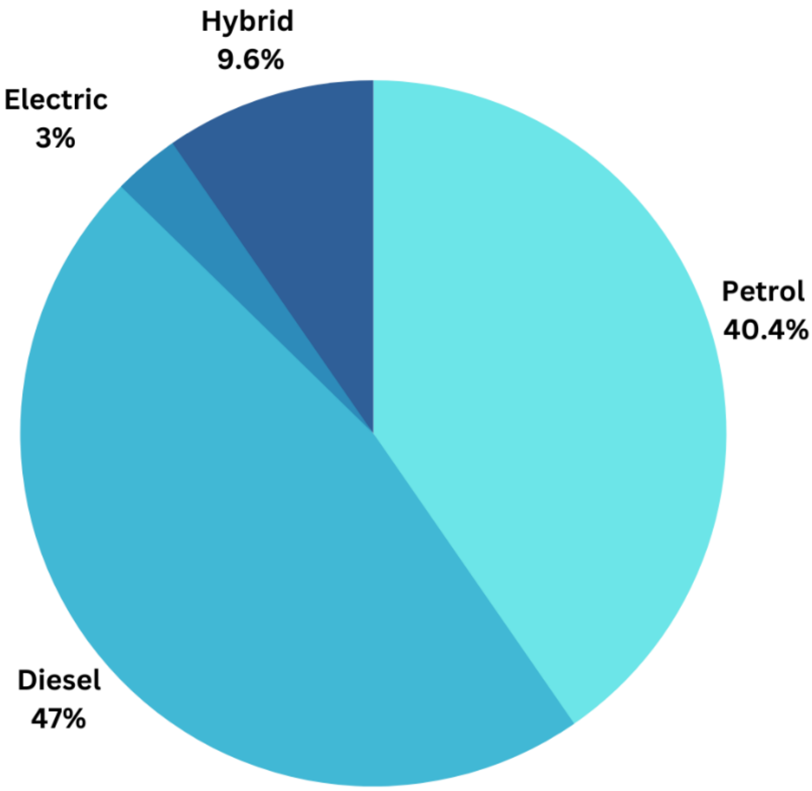


Figure 7 Private cars breakdown by type of fuel in the DZ. 2016

5.4 Non-residential and Industrial

5.4.1 County-level context

At a county level, non-residential emissions are composed of commercial, manufacturing, and industrial processes. When evaluating the emissions contribution from each category, the commercial services subsector is responsible for the largest proportion of emissions at 60%, followed by Manufacturing at 29%, and Industrial Processes at 11%. In total, the non-residential sector generates 204 kt CO_2 e, which corresponds to only 10% of all county emissions.

5.4.2 Sectoral Emissions Description

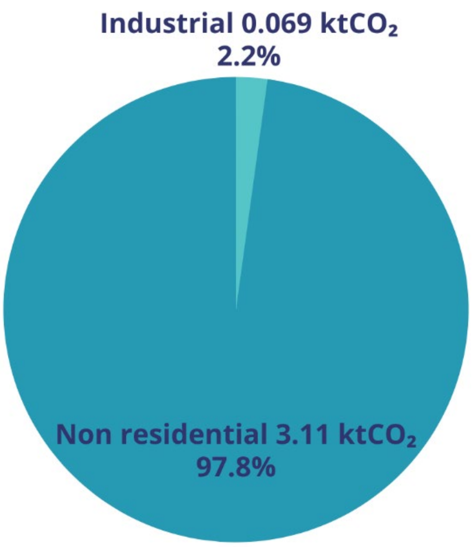


Figure 8 Non-residential and Industrial emissions in the DZ. 2019

In Figure 8 the results of the calculation of the GHG emissions for the DZ's Industrial and non-residential sectors are shown. As opposed to the county-level results, emissions only accounted for industrial, commercial and academic activities. Figure 8 shows that industrial activities only contribute 2.2% to the sector emissions. Thus, the majority of emissions stem from commercial activities and educational activities. In total, approximately 3.17kt CO_2 of Industrial and non-residential emissions for both sectors.

In Table 5, the breakdown of the different GHGs produced in the Industrial sector is shown. The values shown correspond only to the mass of the gas without converting it to CO_2 equivalent.

Table 5 Industrial emissions per GHGs in the DZ. 2019

Gas	Total kt	Conversion factor	$ktCO_2$ eq	Total
CH_4	0.0000043	28.9	0.00012	0.07 $ktCO_2e$
CO_2	0.0684932	1	0.06849317	
NOx	0.0000757	0.02	0.0000015	
N_2O	0.0000006	273	0.00016506	
NH_3	0.0000026	7	0.000018	

5.4.2.1 Supporting Information

As explained in the methodology, the calculation of the emissions for commercial buildings was done through the BER rating, showing the average energy consumption Figure 9 shows the majority of commercial buildings have either a D1 or an E2 energy rating.

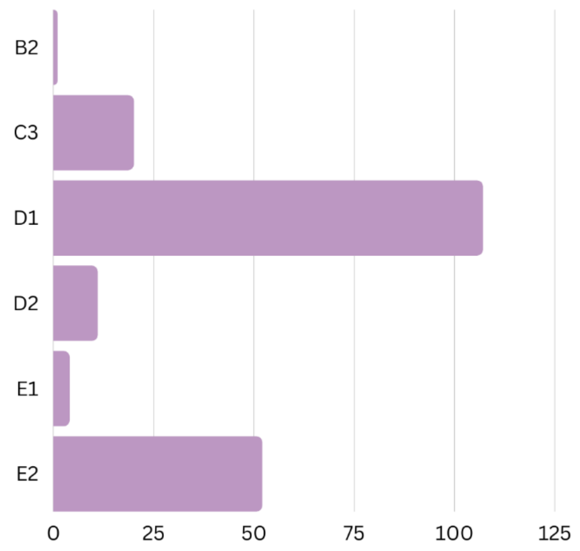


Figure 9. Distribution of commercial buildings depending on BER rating in the DZ

Finally, in Table 6 the mass of CO_2 e is shown for both commercial buildings and schools. Educational institutions contribute only 0.1 kt CO_2 e to the total emissions from this category.

Table 6 Non-residential emissions breakdown in the DZ. 2019

Source	$ktCO_2e$
Commercial buildings	3.01
Schools	0.10
TOTAL	3.11

5.5 Agriculture

Baseline Emissions Inventory Results

Falcarragh and Gortahork DZ: **2.68 ktCO_2e (6.8%)**

County Donegal: **767 ktCO_2e (39%)**

Agriculture

5.5.1 County-level context

The agriculture sector in County Donegal accounted for a total of 767 kt CO_2 e which accounts for 39% of the total County's emissions. When compared to the national level, agriculture contributed to approximately 34% of Ireland's greenhouse gas (GHG) emissions (equivalent to 22 Mt CO_2e), with a primary source of methane from livestock, nitrous oxide due from the use of nitrogen fertiliser, and manure management. When compared to other sectors, agriculture is the highest GHG-emitting sector in Ireland.

5.5.2 Sectoral Emissions Description

In the DZ, the agricultural sector is responsible for 2.68 kt CO_2e or 6.8% of the total CO_2 eq. emissions. Compared to the county and national levels, the DZ contributes a smaller percentage of emissions from agriculture due to a lower proportion of arable land.

The sources of emissions from agriculture are from livestock and agriculture activities were obtained from the "AgriLivestock" and "AgriOther" datasets in MapEIre. Figure 10 below shows the breakdown of emissions deriving from agriculture. Livestock emissions were retrieved and accounted for a total of 1.42 ktCO_2e, equivalent to 53% of the total agricultural emissions in the DZ. Emissions named "Other", representing emissions from machinery and vehicles, inorganic fertilisers, soil processes and applications, amounted to a total of 1.26 kt CO_2e or 47% of the total sector emissions.

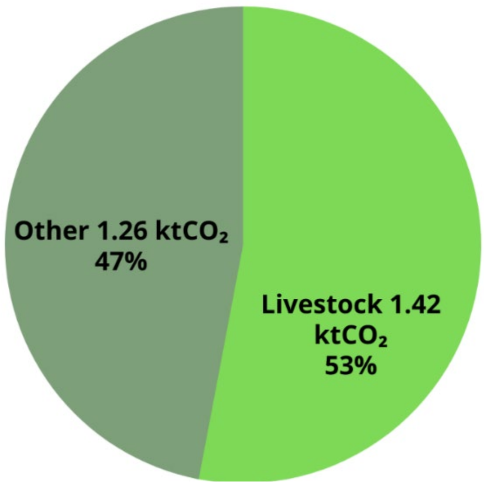


Figure 10 Agricultural emissions breakdown in the DZ. 2019

5.5.3 Supporting Information

Informing MapElre data with local information about the actual number of Livestock in the DZ would be a useful insight to better estimate the emissions from cattle and sheep. Due to the difficulty in retrieving this data, the Agricultural emissions inventory does not perfectly reflect the DZ emissions related to this sector, but it can present an overall picture of how much it affects the overall BEI.

The most dominant greenhouse gas emitted in the Agriculture sector is methane (CH_4), followed by nitrous oxide (N_2O), as Table 7 shows below.

Table 7. Agricultural Sector Emissions by Gas Type and by type of agricultural activity in the DZ. 2019

Gas	Livestock $ktCO_2e$	Other $ktCO_2e$
CH_4	1.22	-
CO_2	-	0.28
NOx	0.000002	0.00011
N_2O	0.17	0.79
NH_3	0.02	0.17

5.6 Land Use, Land Use Change, and Forestry

5.6.1 County-level context

At a county level, LULUCF accounted for 15% of the total emissions, equivalent to 287 kt CO_2e. LULUCF registers the emissions caused by land use and forestry practices.

5.6.2 Sectoral Emissions Description

In the DZ, LULUCF is responsible for 20% of the total emissions, with 7.82 kt CO_2e emitted. When compared to county-level results, the DZ reveals a higher share of total emissions from LULUCF overall.

5.6.3 Supporting Information

As mentioned, the DZ has a higher emissions contribution than the county level. In Figure 12, a land cover map is shown of the DZ. From the map, it can be seen that there is a high area of peatland in the southern part of the DZ.

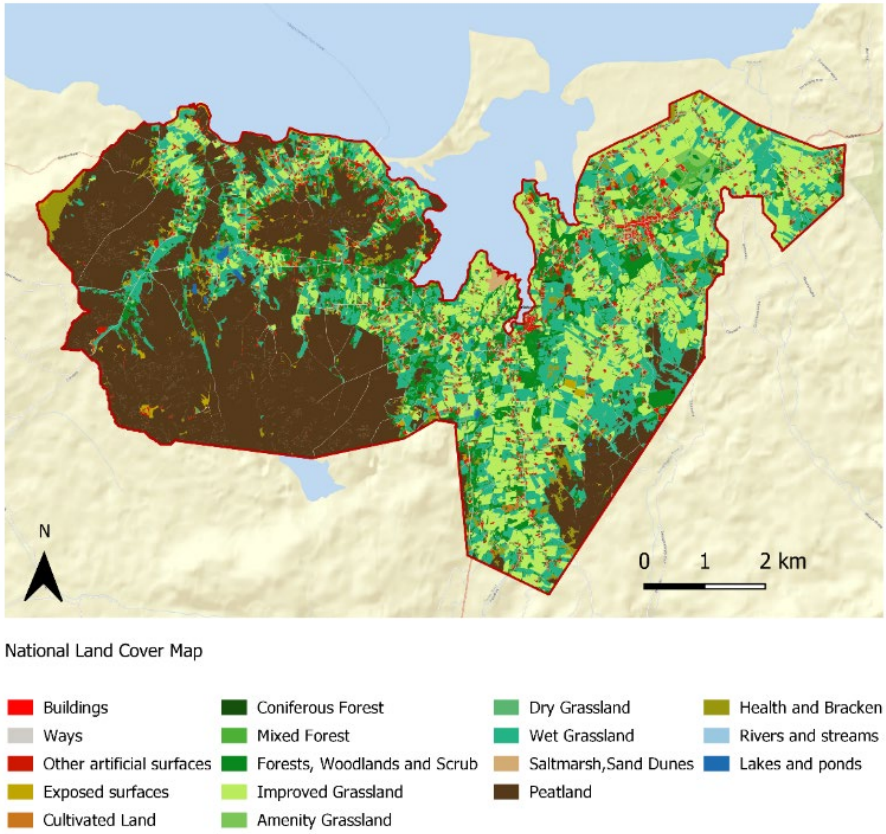


Figure 11 Land Cover for DZ. 2019

It is important to determine the predominant land use within the Decarbonisation Zone to make sense of the emissions originating from LULUCF. Land use and land-use change contribute substantially to global greenhouse gas emissions. However, they also offer significant potential to reduce emissions, through carbon sequestration (removing CO_2 from the atmosphere and storing it within soil, vegetation, and other organic matter).

In Figure 13, the proportion of the land uses in the DZ is shown. As mentioned, there is a predominance of peatland, with 37.8%. However, there is also a high share of grassland, salt marsh and swamp, with 40.3%. These types of land cannot sequestrate CO_2 emissions, thus promoting a higher presence and production of GHG emissions. Finally, there is only 11.5% of forest, woodland and scrub in the DZ, which is the type of land type that has CO_2 sequestration ability.

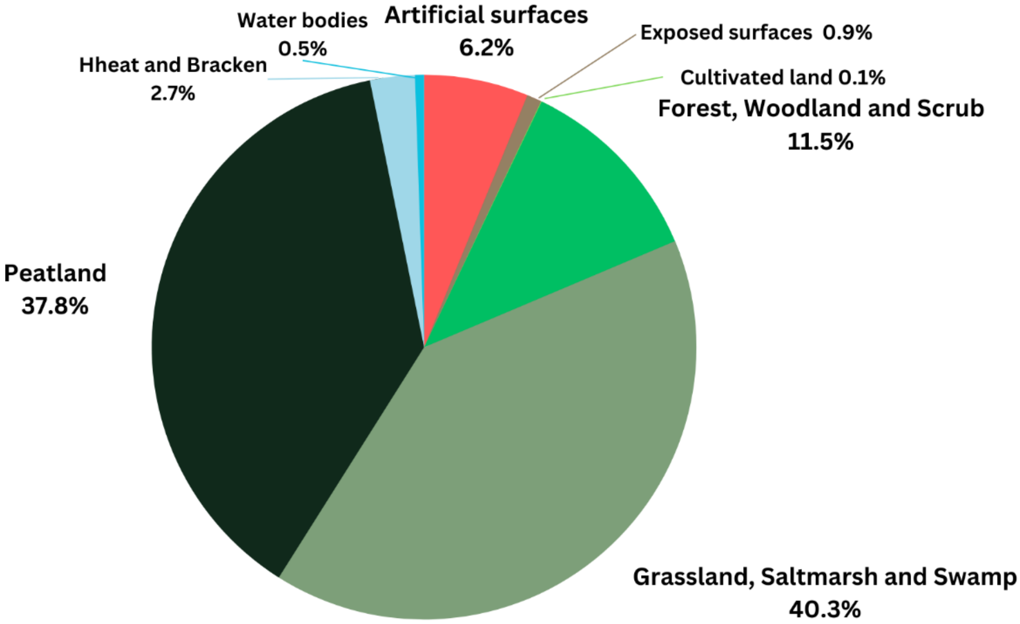


Figure 12 Land use area in the DZ. 2019

The most dominant greenhouse gas emitted in the LULUCF sector is carbon dioxide (CO_2), followed by methane (CH_4), as shown in Table 8.

Table 8 Land Use, Land Use Change and Forestry Emissions by Gas Type in the DZ. 2019

Gas	Total kt	Conversion factor	$ktCO_2$ eq	Total
CH_4	0.012990218	28.9	0.3754173	7.82 $ktCO_2e$
CO_2	7.27212187	1	7.27212187	
NOx	0	0.02	0	
N_2O	0.000623253	273	0.170148083	
NH_3	0	7	0	

5.7 Waste

Baseline Emissions Inventory Results

Falcarragh and Gortahork DZ: **0.62 ktCO_2e (1.6%)**

County Donegal: **37 ktCO_2e (2%)**

Waste

5.7.1 County-level context

At a County level, waste accounted for 2% of total emissions, corresponding to 37 ktCO_2e.

5.7.2 Sectoral Emissions Description

In the Decarbonisation Zone, the total amount of emissions coming from waste resulted in 0.62 kt of CO_2e, representing 1.6% of the total DZ emissions. Based on the methodology presented, the total amount of waste produced in the DZ is equal to 1,282 tonnes annually, calculated for a total of 1,387 households.

Table 9 Total waste produced in the DZ and associated CO_2 emissions. 2019

Waste produced	1281 tonnes
ktCO2e	0.62

5.7.3 Supporting information

As reported by the EPA, most of the waste emissions at the county level are produced from biological treatment of waste and solid waste disposal. In the county, solid waste disposal on land accounts for 81% of the total waste emissions[50]. On a national level, the second most important emissions process in waste management is domestic wastewater handling, which accounts for roughly 17% of the total waste emissions. In the DZ, however, the majority of the wastewater is treated locally, as most of the households are not connected to the sewage system network. Therefore, in the scope of this analysis, the emissions coming from the treatment of domestic wastewater were not included in the emission factor calculation. Domestic wastewater treatment systems are installed underground and have very low emission seepage. It is worth mentioning that there are no urban wastewater or solid waste treatment sites within the DZ. Emissions related to incineration or landfill treatment refer to processes occurring outside of the DZ.

[50] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/waste/

6 Other Inventories

6.1 F-gases

Inventory of F-gases can further help to inform other sources of GHGs. As mentioned in the methodology, the MapEIre dataset was used to detect and calculate any F-gases in the above-described sectors. Hydrofluorocarbons (HFCs), a type of F-gas, was the only one found in all datasets from the DZ. HFC was identified in the industry sector with a total of 0.52 kt CO_2e.

6.2 Emissions by Local Authorities

Emissions of the Local Authorities in the DZ reflect the emissions produced from those assets controlled by LA’s. Based on data availability, the Local Authority emissions were calculated only from the energy consumption for public lighting.

In total, 859 streetlights are located within the DZ, 576 being LED bulbs, 232 SON and 51 SOX bulbs. As explained in Section 3, an average annual electricity consumption per streetlight was considered to calculate the total electricity consumption of all streetlights. This average value considered the proportion of LED lamps to non-LED lamps of the DZ.

The total amount of emissions derived from public lighting is equal to 0.10 ktCO_2 e.

7 Concluding remarks

This Baseline Emissions Inventory has evaluated the emissions for the Decarbonisation Zone across the towns of Falcarragh and Gotarhork. The analysis identified the current emissions landscape across the sectors of Residential, Non-residential, Agriculture, Transport, LULUC, Waste, F-gases and Local Authorities emissions.

From the final results it can be seen that the residential, LULUCF, and transport sectors are the main contributors of carbon emissions. Specifically for the residential sector, space heating is an activity that have the highest decarbonisation potential. Currently there are many heating systems still running on fossil fuels and with low efficiency. Furthermore, emissions from the transport sector can be reduced by increasing the percentage of electric vehicles in the DZ. Currently, less than 3% of vehicles are electric.

By segmenting emissions data into these key sectors, the report allows for targeted interventions and policy-making tailored to meet the mitigation targets. However, the efficacy and precision of such interventions hinge critically on the accuracy and granularity of the underlying data. Although there were challenges in data procurement, given the specific boundaries of the DZ, the integration of both local and national datasets underscores a comprehensive approach to emission calculations. With a clear focus on both global and regional commitments, the Place-Based DZ approach allows for a more nuanced, collaborative, and targeted roadmap towards Ireland's ambitious goal of halving carbon emissions by 2030.

For results that truly reflect on-ground realities and to formulate strategies that yield tangible decarbonisation outcomes, it is imperative to continuously source, update, and refine local data. Integrating more granular data, such as more updated household-level energy consumption, farm-specific agricultural practices, or micro-mobility patterns, can amplify the precision of this report's insights. Such accuracy in data not only empowers to design of pinpointed interventions but also fosters a participatory approach where local communities play an active role in the decarbonisation journey and the local stakeholder engagement in achieving sustainability goals.

BASELINE EMISSIONS INVENTORY

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