BASELINE EMISSIONS INVENTORY

DONEGAL COUNTY COUNCIL

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Comhairle Contae Dhún na nGall
Donegal County Council

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Contents

Glossary of Terms

AR6	Sixth Assessment Report
BEI	Baseline Emissions Inventory
BER	Building Energy Rating
CAP21	Climate Action Plan 2021
CRF	Common Reporting Format
CO_2	Carbon Dioxide
CoR	Certificates of Registration
CSO	Central Statistics Office
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GVA	Gross Value Added
GWP	Global Warming Potential
$ktCO_2e$	Kilotonne Carbon Dioxide Equivalent
LA	Local Authority
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
M&R	Monitoring and Reporting
NAEI	National Atmospheric Emissions Inventory
NFR	Nomenclature for Reporting
NIR	National Inventory Report
NTA	National Transport Authority
SEAI	Sustainable Energy Authority Ireland
SECAP	Sustainable Energy and Climate Action Plan
UNFCCC	United Nations Framework Convention on Climate Change
WFP	Waste Facility Permits

1. Executive Summary

Local Authorities (LA) are taking a leadership role in acting on climate. As part of the National Climate Action Plan, they are developing comprehensive Local Authority Climate Action Plans to address greenhouse gas (GHG) emissions in their administrative areas. These plans will be based on evidence, with the impacts measured over time. Enabling this area Baseline Emissions Inventories (BEI), a key instrument to enable LAs to design their climate plans and measure the impact of its associated actions related to emission reductions across the LA's as operations and varying sectors of society. This report presents the results of a BEI for Donegal County Council, breaking down the county's emissions by sector and providing Donegal-specific context towards the sectors. In addition, the emissions that the Local Authority is directly responsible for are presented.

The calculations for this inventory were made primarily using a dataset for 2019 from the Environmental Protection Agency (EPA) called MapEIre, which is the result of the National Mapping of GHG and non-GHG Emissions Sources project. The project spatially mapped GHG emissions on a square kilometre scale for the entire Irish Exclusive Economic Zone, assigning the emissions to where they were produced. This dataset was the basis for measuring emissions in County Donegal for the sectors Industrial Processes; Waste; Agriculture; Land Use, Land Use Change and Forestry (LULUCF), as well as the direct combustion emissions for the Residential, Commercial Services, and Manufacturing sectors. The latter three sectors also contain electricity consumption emissions which are not included in MapEIre, as MapEIre's spatial methodology assigns all emissions from electricity to the power plant where they are generated.

Therefore, it is necessary for a separate analysis to distribute electricity emissions to the Residential, Commercial Services and Manufacturing categories. The Central Statistics Office (CSO) has metered electricity consumption available at the county level, split between residential and non-residential usage. This consumption data was then converted to carbon dioxide equivalent (CO_2e), the standard measure for measuring the global warming potential of GHGs and assigned to the sectors. Commercial and Manufacturing electricity were split based on an indicator of economic output.

Transport emissions were calculated using the National Transport Authority's (NTA) model and emissions from the local authority's own activities from the Sustainable Energy Authority Ireland's (SEAI) Monitoring and Reporting (M&R) programme. The county's inventory of Fluorinated gases, or F-gases, was also extracted from the MapEIre dataset.

The GHG emissions for County Donegal in 2019 totalled 1,970 $ktCO_2e$, about 3% of the national total. Donegal County Council's emissions are included in the inventory below.

Emissions Caterogy	County Donegal Emissions ($ktCO_2e$)	National Emissions [1] ($ktCO_2e$)
Agriculture	767 (39%)	22,134 (34%)
Commercial services	123 (6%)	4,618 (7%)
Industrial Processes	22 (1%)	2,267 (3%)
LULUCF	287 (15%)	6,657 (10%)
Manufacturing	59 (3%)	6,737 (10%)
Residential	419 (21%)	9,552 (15%)
Transport	255 (13%)	12,196 (19%)
Waste	37 (2%)	991 (2%)
TOTAL	**1,970 (100%)**	**65,152 (100%)**

2.Introduction

Climate Action at the Local Authority level is a crucial component of Ireland's policy agenda, as evidenced by documents such as the National Climate Action Plan 2021 (CAP21) and the Climate Action Charter 2019. Efforts to act against climate change and its negative impacts require urgent action and Local Authorities (LA) are taking a leadership role within their jurisdictions. As part of CAP21, local authorities are to develop Local Authority Climate Action Plans, which will consist of targeted actions informed by evidence. It is, therefore, necessary to have a comprehensive understanding of current emissions and to identify which emission sources the Action Plan should target and how.

The European Union aims to be climate-neutral by 2050 as part of its commitment to combating climate change. The 2020 Climate and Energy package and the 2030 Climate and Energy Framework[1], intend to set the EU on the path to achieving the transformation towards a low-carbon economy as detailed in the 2050 low-carbon roadmap and set the key climate and energy targets for Europe[2].

As part of Ireland's climate action planning framework, Donegal County Council is taking the necessary steps towards contributing to the state's climate goals and to take action to adapt and mitigate the effects of climate change by working as an implementing body with local communities, businesses, and the national government. To inform these actions, Donegal County Council has developed a Baseline Emissions Inventory (BEI) report. The BEI report measures the amount of greenhouse gases 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 BEI report is to calculate the emissions in the Local Authority area and analyse the sources. This will provide an evidence base for the LA to further calibrate mitigation objectives and targets. A thorough understanding of local energy use and greenhouse gas emission circumstances will serve as the foundation for developing the Local Authority's climate action plan. The BEI report is based on local and national data from 2019, on energy production and consumption and other GHG emissions in County Donegal and contains insights into Donegal County Council's emissions. The GHG emission figures are based primarily on MapEIre, metered electricity data provided by the CSO and NTA data for Transport. The national emission reduction target of 51% by the end of 2030 is based on the greenhouse gas emissions reported for the end of 2018[3], in the national greenhouse gas emissions inventory. Accordingly, the collation of data to inform the local authority BEI should be relative to the baseline year of 2018, or as close to 2018 as possible. The closest year to 2018 for the primary dataset for this BEI, MapEIre, is 2019, thus all calculations were made for 2019.

[1] https://climate.ec.europa.eu/eu-action/climate-strategies-targets_en

[2]National data drawn from https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/EPA-Ireland's-Provisional-GHG-Emissions-1990-2021_July-2022v3.pdf; but with category "Energy Industries" distributed to Residential, Commercial and Manufacturing categories using same methodology as for the Local Authority Inventory

[3] https://www.eea.europa.eu/ims/greenhouse-gas-emissions-from-energy

3. Methodology

3.1 National Emissions Inventory

The EPA has overall responsibility for the national greenhouse gas inventory in Ireland's national system and compiles Ireland's national greenhouse gas emission inventory on an annual basis. Ireland's legal reporting obligations require that we submit data for the period 1990-2021 in January, March and April 2023 to the European Commission and the United Nations Framework Convention on Climate Change (UNFCCC).

In response to climate governance and legislative advancements in 2021, the EPA published the provisional inventory data in July 2022 for the period 1990-2021[4]. The provisional estimates of Ireland's greenhouse gas figures for the years 1990-2021 are based on interim energy balances provided by the SEAI in June 2022 and the latest available data from other data providers such as the Central Statistics Office and the Department of Agriculture, Food, and the Marine (DAFM). These are compiled using methodologies following UNFCCC reporting guidelines. Verified emissions data from installations within the EU's Emissions Trading Scheme (ETS) are included. As the baseline year for this report is 2019, the 2019 national values are shown below. However, the most recent year is 2021 and this provisional data can be found here. Additionally, it should be noted that the EPA recalculate inventories from previous years as inventory capacity is increased and better data become available.

In 2019, total emissions in Ireland were 64,220 ktCO_2 equivalent.[5] It is important to note that this figure differs from the national total mentioned at the bottom of the table on page 4 of this report, with an approximate difference of 100 kt. The disparity is attributed to various factors, such as emissions in the EPA energy industries category that are not solely related to electricity. Another factor to consider is the potential use of different Global Warming Potentials (GWPs) between the AR4 and AR6 assessment reports, which contributes to the discrepancy. These emissions are then broken down into the following categories: Energy Industries, Residential, Manufacturing Combustion, Commercial Services, Transport, Industrial Processes, F-Gases, Waste, and Land Use/Land Use Change/Forestry (LULUCF). Note that the 'Energy Industries' category is not represented as its own category in the final Local Authority inventory and thus the individual categories are not directly comparable.

[4]https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Ireland_NIR-2021_cover.pdf

[5]https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Ireland_NIR-2021_cover.pdf

Category	Description
Energy Industries	Includes emissions from fuel combustion in power plants as well as from the extraction, production and distribution of fossil fuels
Residential	Includes emissions from space and water heating in households.
Manufacturing Combustion	Includes emissions from the combustion of fuels used in manufacturing processes, such as food processing.
Commercial Services	Includes emissions from space and water heating in commercial buildings.
Transport	Includes emissions from domestic road, rail, air and maritime transport.
Industrial Processes	Includes emissions from various industrial processes such as in cement production
F-Gases	Includes emissions of fluorinated gases, potent GHGs used in refrigeration, air conditioning and other industrial processes.
Agriculture	Includes emissions from livestock, fertilizer use and agricultural soils.
Waste	Includes emissions from the disposal and treatment of waste.
LULUCF	Includes both emissions and removals of GHGs associated with land use, land-use change, and forestry activities, such as the loss, gain and management of forests, peatlands and grasslands.

Table 1 National Inventory Categories

Agriculture is the largest contributor to the overall emissions in 2019 at 33% of the total. Transport and Energy Industries are the second and third largest contributors at 18% and 14% respectively. Residential and LULUCF emissions account for 10% each. These five sectors accounted for 85% of national total emissions in 2019. The remainder is made up of the Manufacturing Combustion at 7%, Industrial Processes sector at 3%, Waste at 2%, F-Gases at 1% and Commercial Services at 1%. The pie graph below distributes emissions differently from the table in section 1 as it includes an extra category: Energy Industries. Energy industries, within the context of baseline emissions, encompass various sectors involved in energy production, transformation, and distribution. This includes activities like fossil fuel extraction, power generation (including renewable sources), transmission and distribution of electricity, energy transformation and conversion, energy storage, and energy services and distribution. In the summary table above, these activities were measured and reflected per sector.

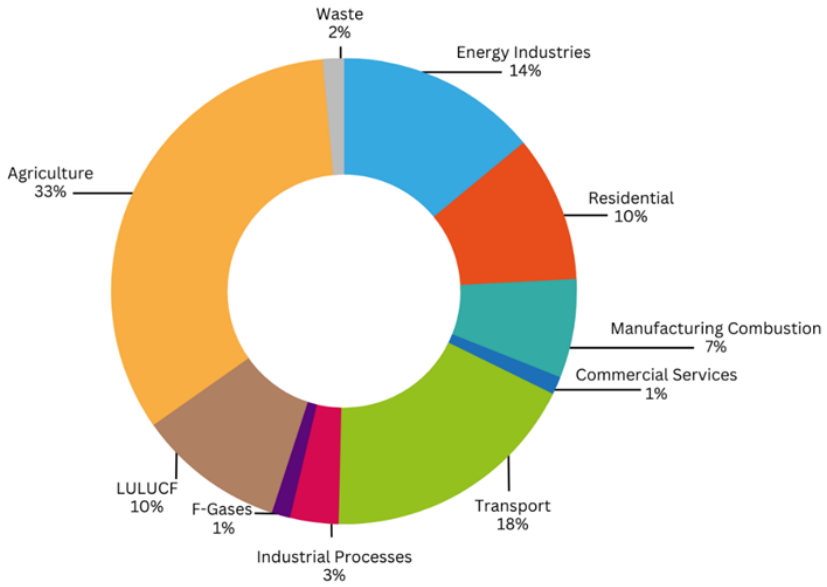


Figure 1: National Emissions Inventory (2019)

3.1.1 Reported Greenhouse Gases

Emissions data for the following gases are reported on an annual basis: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Ireland has higher than average emissions of methane and nitrous oxide because Ireland has the highest agriculture emissions contribution from any of the EU member states.

For the inventory, these gas emission quantities are converted to CO_2 equivalent using Sixth Assessment Report (AR6) GWP values for a 100-year time horizon[6] by multiplying the mass of the emissions by the gas' corresponding GWP. GWPs compare the global warming impacts by measuring how much energy the emissions of 1 tonne of gas will absorb over some time.

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	29.8
Nitrous Oxide (N_2O)	273
Sulphur Hexafluoride (SF_6)	25,200
Hydrofluorocarbons (HFCs)	4 - 14,600
Perfluorinated Compounds (PFCs)	6,630 - 11,100
Nitrogen Trifluoride (NF_3)	17,400

Table 2 Greenhouse Gases Global Warming Potential (AR6[7])

Carbon Dioxide

CO_2 is the main greenhouse gas emitted through anthropological activities, causing global warming. It is present in all sectors and easily outweighs the other GHGs in terms of the raw mass of emissions. As the reference gas, the GWP will be 1 regardless of the period used. A 100-year horizon was used for this report. CO2 stays in the atmosphere for hundreds of years.

Methane

CH_4 is the second most impactful gas emitted by activities in County Donegal. It is primarily emitted from agricultural activities and waste. Methane has a GWP of 29.8. It absorbs much more energy than CO2 but stays in the atmosphere for only about 10 years.

Nitrous Oxide

N_2O has a GWP of 273. Agriculture is the main sector emitting N_2O. It stays in the atmosphere for over 100 years.

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

[7] Note: The 2019 EPA Inventory used IPCC Fourth Assessment Report values for Global Warming Potential, which will result in minor differences between this BEI and the EPAs 2019 data.

F-gases

Fluorinated gases trap substantially more heat than CO_2 does per tonne. Sulphur Hexafluoride (SF6) has a GWP of 25,200, Hydrofluorocarbons (HFCs) have a GWP ranging from 4 to 14,600, Perfluorinated compounds (PFCs) range from 6,630 to 11,100 and Nitrogen trifluorides (NF3) has a GWP of 17,400. SF_6 is present in Industrial Processes. In the national inventory, F-gases are grouped as their sector accounting for about 1% of national emissions.

3.2 National Grid Fuel Breakdown

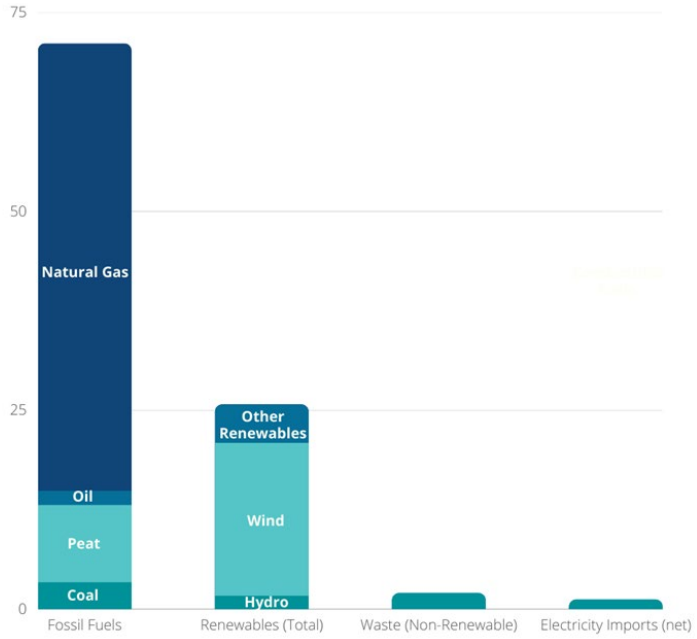


Figure 2 National Grid Fuel Breakdown

The bulk of Ireland's electricity comes from natural gas, which accounted for 56% of the energy input in 2019. Wind energy is second, accounting for 19% of the input. All renewable sources combined made up 26% of the energy inputs to electricity generation. The generation efficiency of Ireland's grid was 54%, meaning 46% of the energy inputs are lost before reaching the final customer. Overall, the CO_2 intensity of Ireland's grid is trending down, from 636 g CO_2/kWh in 2005 to 324 g CO_2/kWh in 2019.[8]

[8] https://www.seai.ie/publications/Energy-in-Ireland-2020.pdf

3.3 The MapEIre Project

Beginning in 2016, the EPA, in cooperation with Aarhus University in Denmark, carried out the National Mapping of GHG and non-GHG Emissions Sources (MapEIre) project[9]. The purpose of this project was to assign a spatial distribution to the national emissions inventory. As such, all greenhouse gas emissions from the Irish emissions inventory are distributed according to a square kilometre grid covering the entire Irish Exclusive Economic Zone, categorised by type of gas and by the subsectors corresponding to the common reporting format (CRF) and Nomenclature for Reporting from the UNFCCC. This dataset can then be used to calculate emissions inventories for a smaller area as well, in this case, a Local Authority 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 in the square kilometre where they are created, and not necessarily where the outputs of the emissions are consumed. For example, transportation emissions reflect the locations of rail lines, road networks and airports. Power plants will heavily influence the spatial emissions of where they are located but would be difficult to see on the map as they would only be reflected in a single grid cell. Below is a sample result from MapEIre's CO_2 inventory. The image on the left depicts CO_2 emissions on a 1km x 1km for all of Ireland, while the image on the right shows what this grid looks like on a local scale.

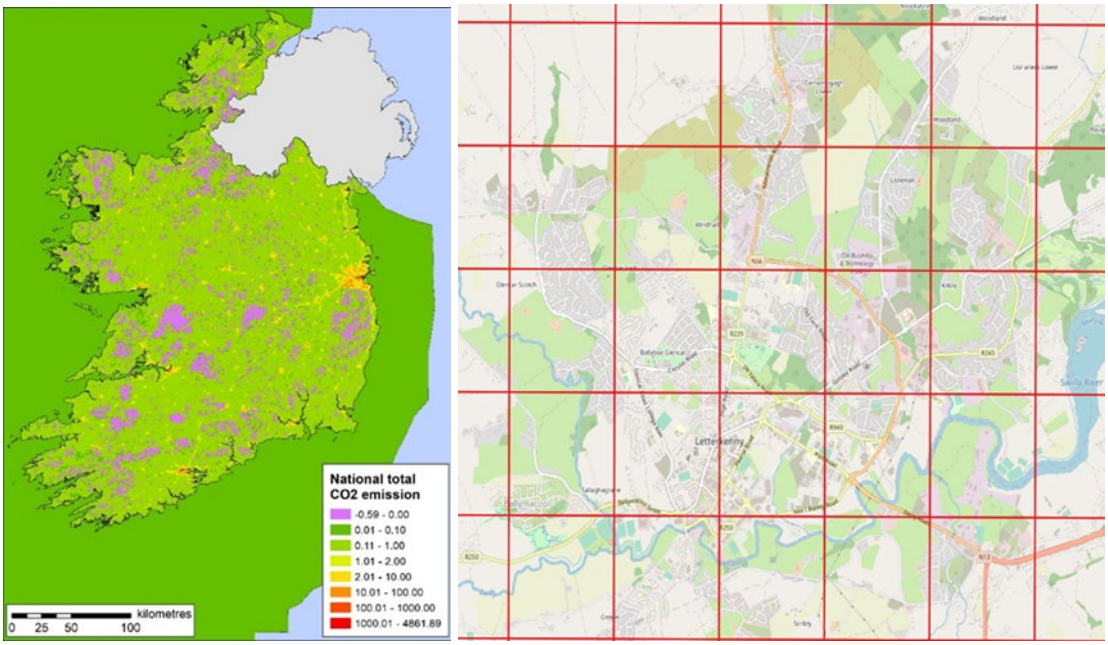


Figure 3 Sample representations of the MapEIre dataset

[9] https://projects.au.dk/mapeire/

3.4 Local Authority Emissions Inventory Approach

The primary approach towards calculating the emissions inventory for the Local Authority's jurisdiction was through using the MapEIre dataset of Spatial GHG emissions by local authorities for 2019. This dataset contains the emissions for each Local Authority in Ireland broken down on a 1 x 1 km scale, with further classifications including the CRF Classification, the NFR codes and the pollutant names. The GHGs included in the local authority MapEIre dataset are CH_4, CO_2, N_2O and SF_6.

For this inventory, the data was filtered to only include emissions within County Donegal. Then all emissions were converted to CO_2 equivalent using Sixth Assessment Report (AR6) GWP values for a 100-year time horizon by multiplying the mass of the emissions by the gas' corresponding GWP. GWPs compare the global warming impacts by measuring how much energy the emissions of 1 tonne of gas will absorb over some time. The EPA's NIR used Fourth Assessment Report GWP values for the national inventory, which would result in small differences and should be kept in mind when comparing this inventory with the NIR.

All gases in the MapEIre dataset for County Donegal were converted to CO_2 equivalent. The sum of these values broken down by sectors, subsectors and gas type is the basis of County Donegal's BEI. However, alternative sources were used for the Transport and Energy Industries categories. Transport emissions were calculated with data provided by the National Transport Authority and Energy Industries using data provided by the Central Statistics Office.

In MapEire and the associated BEI report, public sector emissions, including those from local authorities (LA), are allocated across several sectors. Transport-related emissions from the public sector, such as those from public transport services, are assigned to the transport sector. Building-related emissions from public sector buildings, such as schools, hospitals, and government offices, are assigned to the commercial sector. This includes emissions from the heating, cooling, and lighting of these buildings. However, emissions from public lighting, such as street lighting, are typically allocated to the non-residential electricity sector. It is important to note that the allocation of public sector emissions may vary depending on the specific activity and location, and the BEI report is updated regularly to reflect the latest data and methodological approaches.

According to the latest MapEire and the associated BEI report, energy-related agricultural emissions are assigned to the agriculture sector. The MapEire report provides a detailed breakdown of the emissions from various sectors, including agriculture, transport, commercial, and residential. While transport-related emissions are assigned to the transport sector and buildings-related emissions are assigned to the commercial sector, energy-related agricultural emissions are allocated to the agriculture sector. 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.

Emissions are reported by mass using the International System of Units (SI). The Kilogramme (kg) is the base unit. Also used are Tonnes (equal to 1,000 kilogrammes), Kilotonnes (equal to 1,000 tonnes) and Megatonnes (equal to 1 million tonnes). All values have been rounded for display purposes.

3.4.1 Electricity Consumption

There are limitations to the MapEIre data regarding providing actionable information for a Local Authority planning climate action to reach emissions reduction targets. The greatest of these is that emissions from electricity are assigned to the power plants where the electricity is generated, not the homes, businesses, etc., where it is consumed. The inventory derived directly from MapEIre will result in an inventory of emissions broken down into the following sectors: Agriculture, Commercial Services, Energy Industries, Industrial Processes, LULUCF, Manufacturing Combustion, Residential, Transport, and Waste. Under this version of the inventory, all emissions would be Scope 1 emissions, or direct GHG emissions that occur from fuel combustion. This results in all emissions from electricity being assigned to Energy Industries, rather than where the electricity is consumed. However, it is of more value for local authorities to understand where electricity is being consumed than generated to develop appropriate and specific mitigation actions. Therefore, the electricity emissions in this BEI are Scope 2 emissions, which are indirect GHG emissions associated with the purchase of electricity for own use.[10]

Therefore, for this inventory, the Energy Industries category has been removed and replaced with electricity consumption data that have been assigned to the Residential, Manufacturing, and Commercial sectors. The national total of emissions from Public Electricity and Heat Production under the Energy Industries category in 2019, according to the NIR, was 8,985 kt CO_2 (about 14% of the total).

Metered electricity consumption statistics for 2019 are available from the CSO on a county level and divided into categories of 'Residential' and 'Non-Residential.'[11] The emissions factor from Ireland's 2019 grid (0.3245 kg CO_2/kWh) was then used to convert electricity consumption into CO_2 equivalent as depicted below.[12] The Non-Residential emissions were split further into Manufacturing and Commercial sectors using Gross Value Added as a proxy measure for electricity consumption.[13]

On a national level, this methodology results in a 4% difference from the NIR's reported electricity emissions.

[10] The third classification of GHG emissions, Scope 3, goes deeper into the supply chain of emissions and would include emissions from production processes for goods produced outside of County Donegal that are consumed within the county. On a national scale, consumption-based emissions for Ireland are 69% higher than production-based emissions, primarily due to the import of goods for household consumption, according to the Economic and Social Research Institute (Link: https://www.esri.ie/publications/the-global-emissions-impact-of-irish-consumption).

[11] https://www.cso.ie/en/releasesandpublications/er/mec/meteredelectricityconsumption2020/

[12] https://www.seai.ie/publications/Low-Carbon-Heating-and-Cooling-Technologies.pdf

[13] https://www.cso.ie/en/releasesandpublications/er/cirgdp/countyincomesandregionalgdp2019/

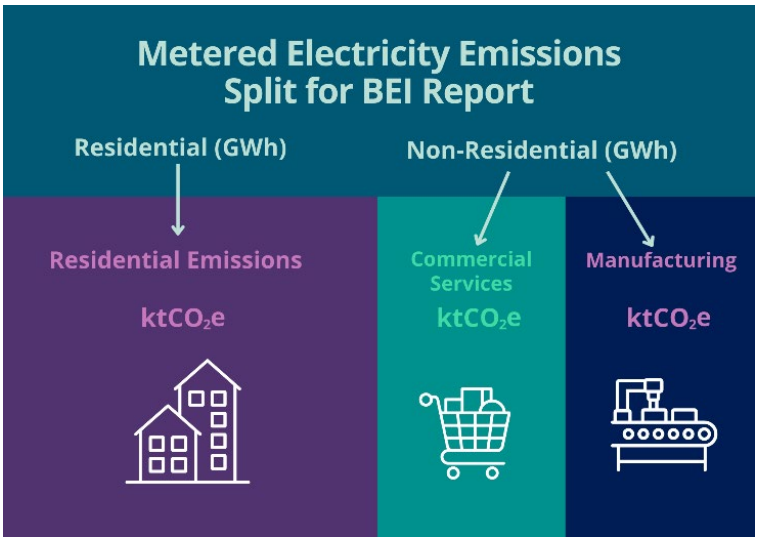


Figure 4 Metered Electricity Emissions Split for BEI Report

There is a significant portion (24%) of national non-residential electricity consumption that is not coded by the CSO for confidentiality reasons, meaning it was not assigned to any county. This consumption is from very large energy users, such as data centres. However, none of this consumption is within the Local Authority area and is therefore not included in this inventory.

Electricity Calculations Summary for the BEI:

• Gwh res (Gigawatt-hours residential) from CSO: obtained the residential electricity consumption data from the Central Statistics Office (CSO).

• Gwh non-res (Gigawatt-hours non-residential) from CSO: Similarly, sourced the non-residential electricity consumption data from the CSO.

• Conversions to CO2e (Carbon dioxide equivalent) for each: To estimate the carbon emissions associated with electricity consumption, the appropriate CO2e conversion factors were applied. These factors were derived from region-specific emission data and represent the amount of carbon dioxide equivalent emissions associated with each unit of electricity consumed.

• Split of non-residential electricity between Commercial and Manufacturing using GVA (Gross Value Added): The allocation of non-residential electricity consumption between the commercial and manufacturing sectors was determined using the Gross Value Added (GVA) methodology. By analyzing GVA data, which quantifies the value of goods and services produced by each sector, the estimated proportion of non-residential electricity consumed by commercial and manufacturing activities was estimated.

3.4.2 Transportation

3.4.2.1 Background and Introduction of MapEIre

MapEIre is a comprehensive dataset that provides a breakdown of transport emissions at the local authority level. The dataset covers a range of transport types, including national navigation (shipping), railways, and Road Transport (heavy-duty vehicles and buses, light-duty vehicles, mopeds & motorcycles, and passenger cars).

The methodology used for estimating road transport emissions in MapEIre is based on traffic count data, which is obtained from the National Road Authority's traffic counters. This methodology uses available mileage data for national roads and estimates the mileage for other roads by subtracting the national road mileage from the total mileage. The method creates a map of all the roads, excluding national roads, by using road width as a measure of mileage. To calculate the number of vehicles on the road, the method uses traffic count data and groups together certain vehicle categories. The residual of the national total mileage is allocated to the remaining roads. In MapEIre, the road network area is used as a proxy for mileage and makes use of population density to approximate emissions accumulation in urban and rural areas.

3.4.2.2 Background and Introduction of National Transport Authority Regional Modelling System Environmental Appraisal Module

The National Transport Authority (NTA) is a statutory non-commercial entity in the Republic of Ireland that operates under the Department of Transport, Tourism and Sport[14].

NTA follows a complex model that requires numerous precise, reliable, and comprehensive datasets to calculate carbon emissions. The organization's carbon emission impact is informed by regional models with full geographic coverage, detailed representations of travel demand, a comprehensive road network, and a public transport network that includes Park & Ride, along with active modes like walking and cycling.

The NTA Model uses various factors such as emission rate calculation coefficients, the National Atmospheric Emissions Inventory 2013, fuel scaling parameters, the fleet split data, degradation factors, and abrasion emissions rates. The NTA Model then calculates emissions based on fleet make-up and vehicle speed for each link in the model. Calculations are carried out by ENEVAL using COPERT 5 emission rates.

The NTA Model outputs emissions data by link, zone, sector, or grid, which allows results to be mapped in GIS. By doing so, the results are presented in a visual format, making it easier for NTA to analyse and interpret the data. This comprehensive methodology enables NTA to accurately assess the carbon emissions produced by various sectors.

The NTA model process estimates greenhouse gases (GHG) such as nitrous oxides, hydrocarbons, methane, carbon monoxide, and carbon dioxide. However, for this BEI, the GHG emissions used by the NTA include only carbon dioxide and methane. To facilitate comparison, the AR6 GWP values were used to convert the current emissions into CO_2 equivalents. It should be noted that nitrous oxide (N_2O) is not measured in the NTA methodology.

[14] https://www.nationaltransport.ie/about-us/

3.4.2.3 Transport Baseline Emission Inventory Methodology

Although the National Transport Agency and MapEIre employ distinct methodologies, the total national CO_2 equivalent calculated using both methods in 2019 is roughly similar. In the EPA National Inventory, the total GHG emissions for 2019, which include Road Transport, Railways System, and Shipping, were 12,219 $ktCO_2$, with Road Transport accounting for 11,371 $ktCO_2$. Meanwhile, the National Transport Agency reported that the Road Transport sector produced 9,503 $ktCO_2$ in the same year. For establishing an accurate Baseline Emission Inventory for the Transport Sector, two methodologies, MapEIre and NTA, are combined to provide a comprehensive picture of transport emissions:

- The MapEIre dataset is used to determine GHG emissions for national navigation (shipping) and railway subsectors. The NTA methodology does not measure the national navigation (shipping) and railway subsector.
- The NTA dataset is used to determine GHG emissions for all vehicles in the road network. This methodology is more robust due to more recent datasets and accuracy with the inclusion of additional factors. Specifically, the NTA methodology includes Degradation Factors NAEI 2013 and Catalytic Converter Failure rates, as well as fleet, split data based on work done in 2012 by SYSTRA and pivoted off 2016 observed fleet data. These additional factors make the NTA methodology more accurate compared to the MapEIre methodology.

By combining these two datasets, a comprehensive and accurate picture of transport emissions can be obtained, which is essential for developing effective strategies to reduce GHG emissions in the transport sector.

3.4.3 Local Authority

Another category of emissions that is included in this report for the Local Authority Baseline Emissions Inventory is the emissions from the Local Authority's activities. This data is required to be reported annually to the SEAI's Monitoring and Reporting system[15]. There are no additional calculations required, but the emissions are presented in this report as an additional category for the Local Authority to consider when planning mitigation activities. It should be noted that these emissions are included in the MapEIre inventory distributed among the various sectors. They are therefore not added to the broader GHG inventory but rather presented in an additional section as a closer look into public sector emissions in County Donegal.

[15] https://www.seai.ie/business-and-public-sector/public-sector/monitoring-and-reporting/

4. GHG Emissions Inventory for County Donegal

4.1 Local Authority Profile

This report measures the GHG emissions for County Donegal in 2019. The county is located in the Northwest Region of Ireland in the province of Ulster. Donegal is the island'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. Donegal has a population of 159,192. The largest town in Donegal is Letterkenny, followed by Buncrana, Ballybofey-Stranorlar and Donegal Town. Over 70% of people in Donegal live in rural areas, according to Census 2016[16].

4.2 County Donegal Scope 1 Emissions

As set out in Sections 3.3 and 3.4, the MapEire dataset contains the emissions for each county in Ireland broken down on a 1 x 1 km scale, with further classifications including the CRF Classification, the NFR codes and the pollutant names.

For this inventory, the data was filtered to only include emissions within County Donegal, with all emissions converted to CO_2 equivalent using Sixth Assessment Report (AR6) GWP values for a 100-year time horizon by multiplying the mass of the emissions by the gas' corresponding GWP.

The inventory derived directly from MapEIre is broken down into the following sectors: Agriculture, Commercial Services, Energy Industries, Industrial Processes, LULUCF, Manufacturing Combustion, Residential, Transport, and Waste.

Under this version of the inventory, all emissions would be Scope 1 emissions, or direct GHG emissions that occur from fuel combustion. Emissions from electricity are assigned to the power plants where the electricity is generated, rather than where the electricity is consumed (homes, businesses, etc.).

The results of the MapEIre inventory for County Donegal are provided in Figure 5 below:

[16]https://wdcinsights.wordpress.com/2017/05/17/rurality-population-density-and-the-urban-population-of-the-western-region/

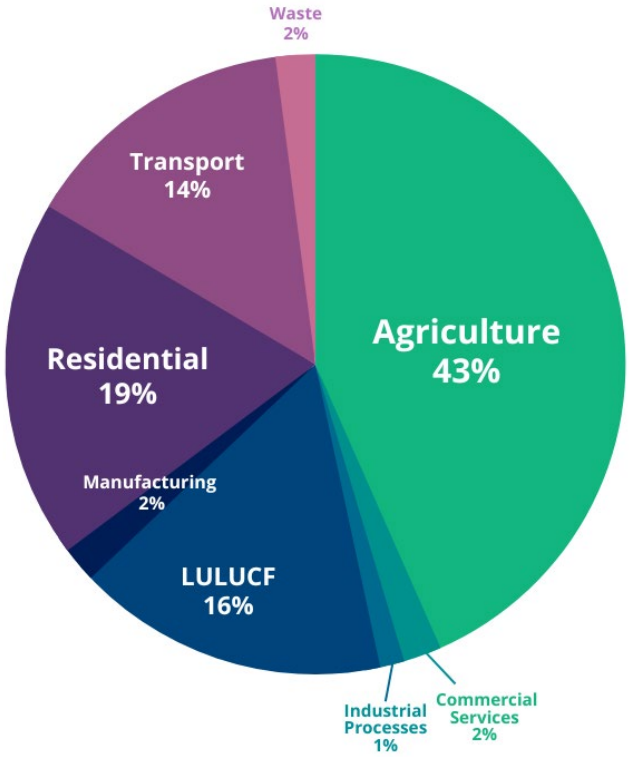


Figure 5 County Donegal Sectoral Breakdown of Scope 1 Emissions (2019)

4.3 County Donegal Emissions Breakdown by Gas Type

The following chart breaks down Donegal GHG emissions by type of GHG emitted, rather than by global warming potential of sector. However, because Energy Industries is removed, this breakdown does not include any emissions from electricity, thus having a smaller overall total than the main inventory.

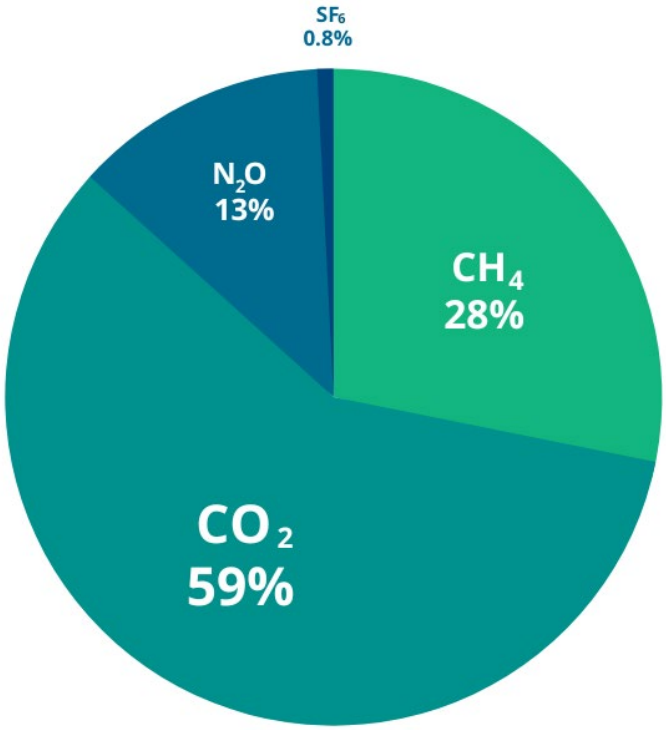


Figure 6. Scope 1 County Donegal Emissions by Gas Type (2019)

4.4 County Donegal Emissions: Sectoral Breakdown

The inventory derived directly from MapEIre provides an inventory of Scope 1 emissions broken down into the following sectors: Agriculture, Commercial Services, Energy Industries, Industrial Processes, LULUCF, Manufacturing Combustion, Residential, Transport, and Waste. All emissions from electricity are assigned to Energy Industries, rather than where the electricity is consumed.

It is of more value for Local Authority Climate Action Plans to understand where electricity is being consumed than generated to develop appropriate and specific local mitigation actions. Therefore, as detailed in Section 3.4.1, the Energy Industries category has been removed from this inventory and replaced with electricity consumption data that have been assigned to the Residential, Manufacturing, and Commercial sectors. Also, as detailed in Section 3.4.2, the transport emissions are based on NTA modelling rather than the methodology used in MapEIre.

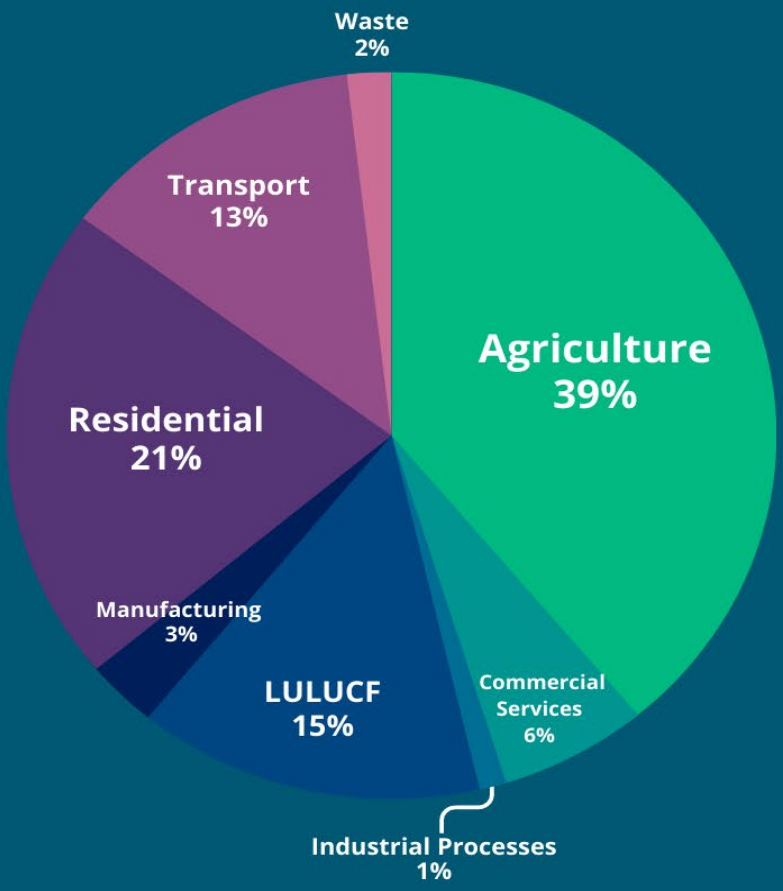
The resulting output is the Baseline Emission Inventory for County Donegal which will be used to inform the development of the Local Authority Climate Action Plan for County Donegal. A full-page summary can be found on the next page.

County Donegal

Baseline Emissions Inventory Results 2019

Total Emissions: 1,970 $ktCO_2$ equivalent (3% of national total)

National Emissions 65,152 $ktCO_2$ equivalent



767 $ktCO_2e$ **Agriculture**	**287** $ktCO_2e$ **LULUCF**	**59** $ktCO_2e$ **Manufacturing**	**419** $ktCO_2e$ **Residential**
255 $ktCO_2e$ **Transport**	**37** $ktCO_2e$ **Waste**	**123** $ktCO_2e$ **Commercial Services**	**22** $ktCO_2e$ **Industrial Processes**

Note: Energy industry emissions have been allocated to the categories where they are consumed.

4.5 Residential

4.5.1 Category Description

The Residential sector accounts for emissions from activities in people's homes. On a national level, the Residential sector accounts for about 15% of total emissions, with the average dwelling emitting 5 tCO_2 per annum[17]. This includes emissions from space and water heating, as well as from electricity consumption.

4.5.2 Baseline Data

In County Donegal, heating accounted for 79% of emissions in the Residential sector, while electricity consumption accounted for 21%. The national split is 76% direct fuels and 24% electricity.

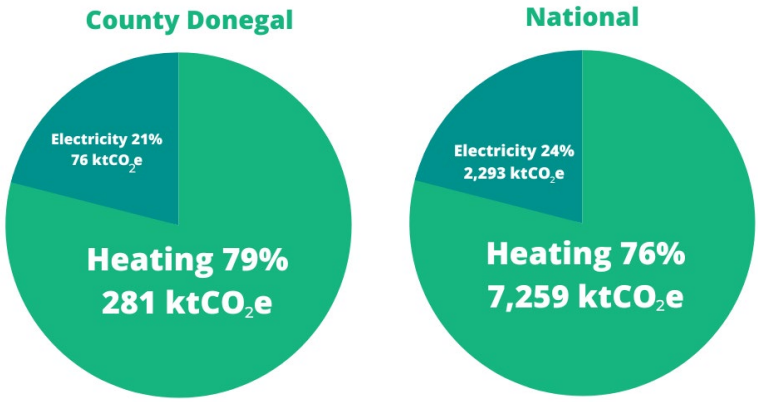


Figure 7 County and National split of household energy usage

The majority of homes (63%) in Donegal are built before 2000 and 90% of the residential houses use oil, coal, or peat as the main central heating fuel.[18] The following table shows the GHG breakdown of Residential emissions from direct fuels only. Direct fuels refer to Scope 1 fuels burned on-site, such as for heating purposes. As the electricity emissions were calculated with a different dataset to include them as Scope 2, the GHG breakdown is not available.[19]

The following table shows the GHG breakdown of Residential emissions from direct fuels only. Direct fuels refer to Scope 1 fuels (e.g. oil, gas, solid fuel) burned on-site, such as for heating purposes.

[17] https://www.seai.ie/publications/Energy-in-Ireland-2020.pdf
[18] https://council.ie/donegals-decarbonising-journey/
[19] https://www.seai.ie/publications/Energy-in-Ireland-2020.pdf

However, Figure 2 on page 10 shows the breakdown in primary energy supply for electricity generation broken out by fuel type and energy source at a national level.

GAS	$ktCO_2e$
CO_2	12
N_2O	319
SF_6	1
Total	332

Table 3 Gas Breakdown of Residential Sector Scope 1 Emission

4.5.3 Supporting Information

4.5.3.1 Local Authority Area Housing Stock

According to Census 2022 data, there are 86,489 units in County Donegal.[20] Of these, 11% were vacant in 2022.[13] The main central heating fuel is oil (37,239 households) followed by coal (8,535) and peat (6,638).[21] Further insights into County Donegal housing are presented in the tables below, it has to be noted that not all available housing stock hold information on the type of fuel used As the 2022 Census has not been fully published as of this report's writing, these tables are from Census 2016.

Oil	Natural gas	Electricity	Coal	Peat	LPG	Wood	Other
37,239	621	1,427	8,535	6,638	230	1,045	545

Table 4 Central Heating Fuel in Occupied Private Households (Census 2016)

Housing stock and household size statistics are important factors that influence the amount of energy used for heating, cooling and electricity in homes. This information can provide insights into the residential emissions in the Local Authority area and the context as to why they occur.

Existing Housing Stock

County	Housing Stock	Holiday Homes	Other Vacant	Temporarily Absent	% Vacancy
Donegal	83,931	11,288	11,704	1,975	28%

Table 5 Existing Housing Stock (Census 2016)

[20] https://data.gov.ie/dataset/fp012-preliminary-housing-stock-and-vacant-dwellings/resource/a6cf240e-d11a-4958-a4bf-2945843b7b81

[21] https://www.cso.ie/en/releasesandpublications/ep/p-copep/thecensusofpopulationfromanenvironmentperspective2011and2016/mainresults/

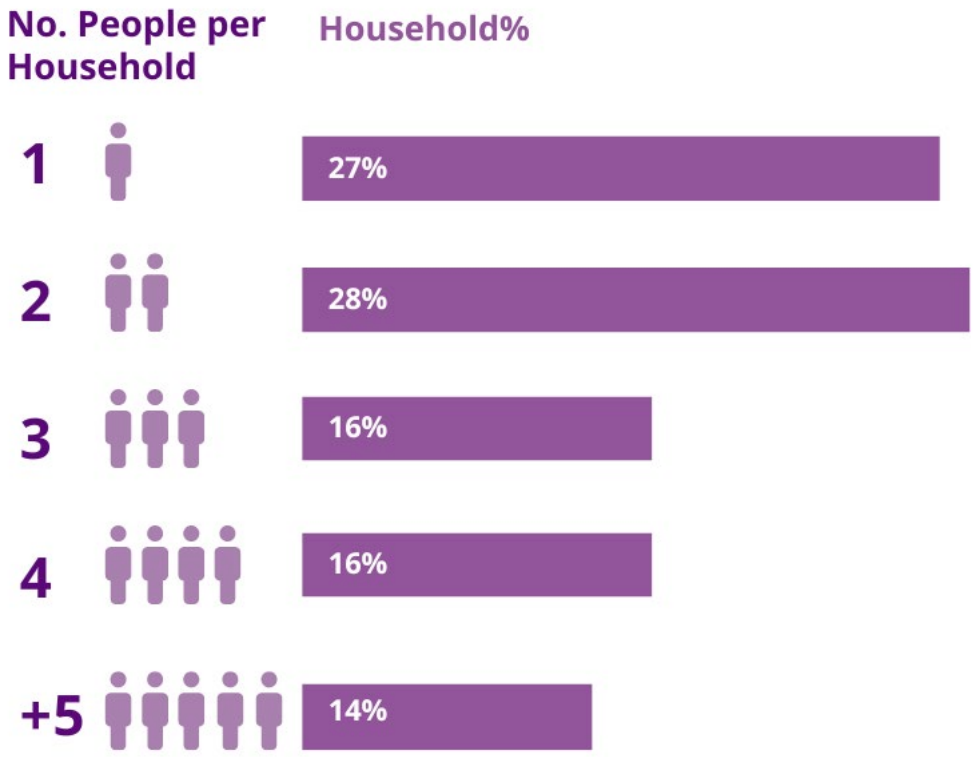


Table 6 Household Size Cohorts

Housing tenure and occupancy type also give valuable insights into residential emissions, as shown in Table 6. For example, rented houses carry a split incentive regarding energy efficiency improvements where the landlord may be responsible for upgrades and renovations, but the tenant would be the one benefitting from the resulting energy savings. It should be noted that the CSO uses different source data for different tables- hence the inconsistent totals. For instance, some tables include total housing stock, others include only occupied housing stock.

Housing Tenure

	Households	Persons	Household %	Persons%
Social Housing	2,996	7,161	5%	6%
Rented (Privately)	7,830	18,159	13%	14%
Owner Occupied (All)	42,220	97,864	72%	77%

Table 7 Housing Tenure (Census 2016)

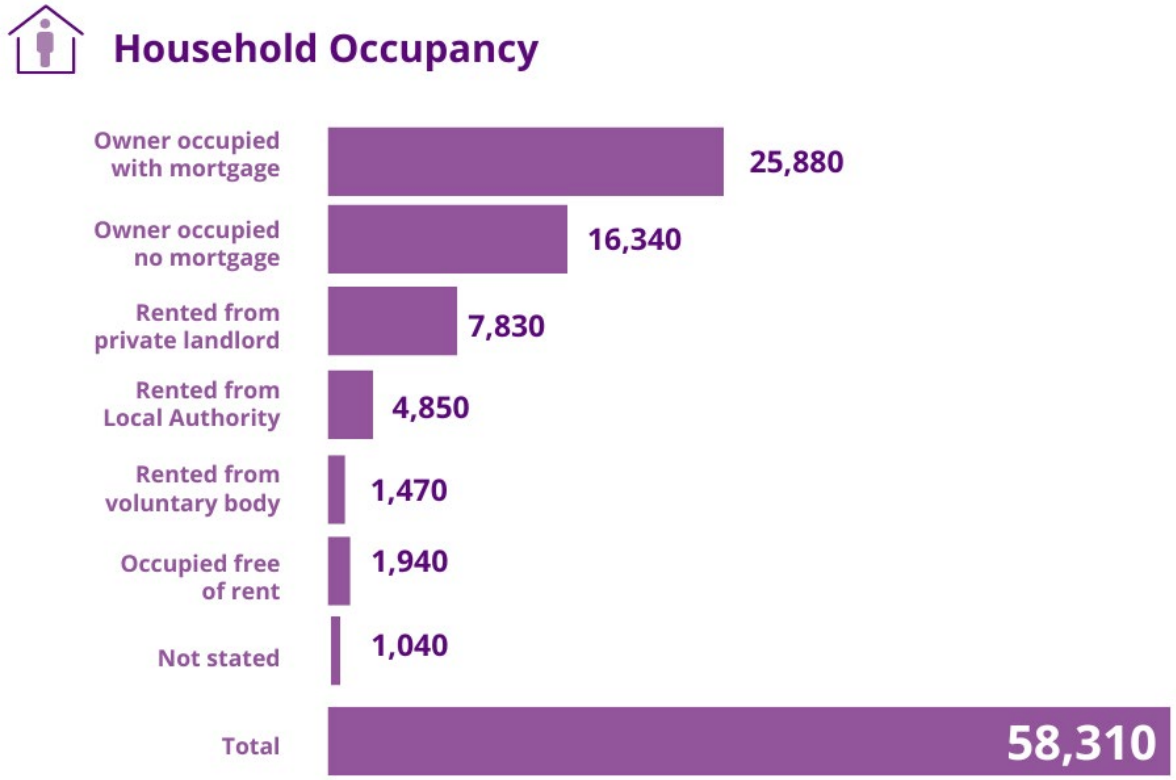


Table 8 Household Occupancy

4.5.3.2 Building Energy Ratings

5 A BER measures the energy performance of a home. They range from A1 (most efficient) to G (least efficient). They are calculated based on the energy required by the building for heating, cooling, ventilation and lighting by SEAI registered BER assessors. The national Climate Action Plan aims to retrofit 500,000 homes to a B2 BER or better. Below is the current distribution for County Donegal. It should be noted that not all homes have undergone a BER assessment, and the distribution may not be representative of the entire housing stock. The CSO has applied weightings to the national BER sample (700,000 homes or 39%) to scale it and found a slight skew towards better BER grades. County Donegal has 31,404 (37% of total) domestic buildings with BERs as of Q3 of 2022[22].

[22] https://www.cso.ie/en/releasesandpublications/ep/p-dber/domesticbuildingenergyratingsquarter32022/

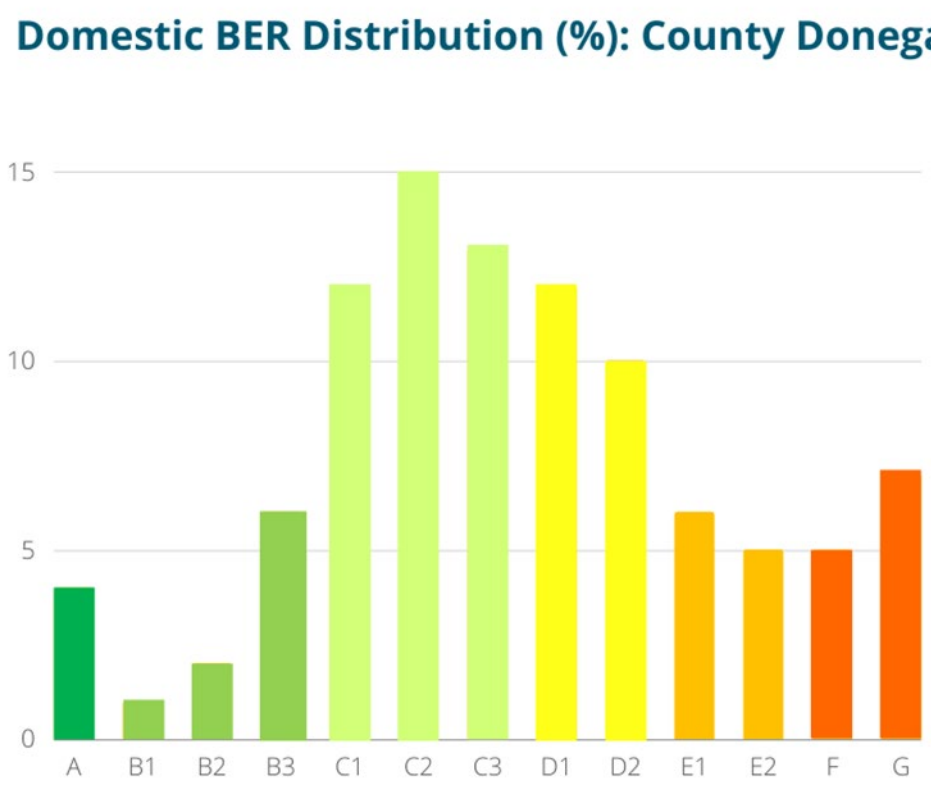


Figure 8 Domestic BER Distribution (%): County Donegal

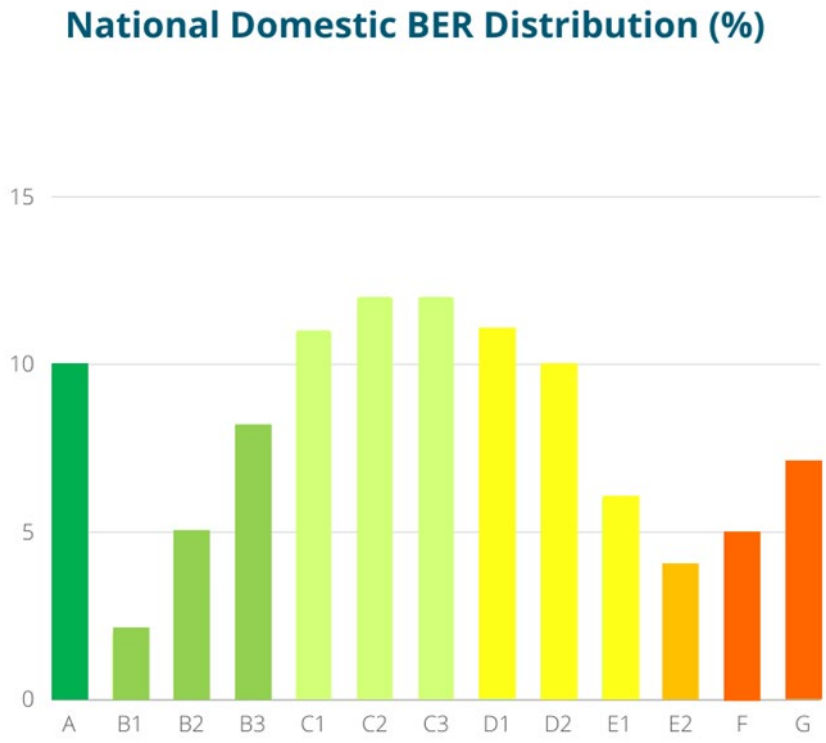


Figure 9 National Domestic BER Distribution (%)

The following map depicts the spatial distribution for County Donegal of median BER rating by small area.[23]

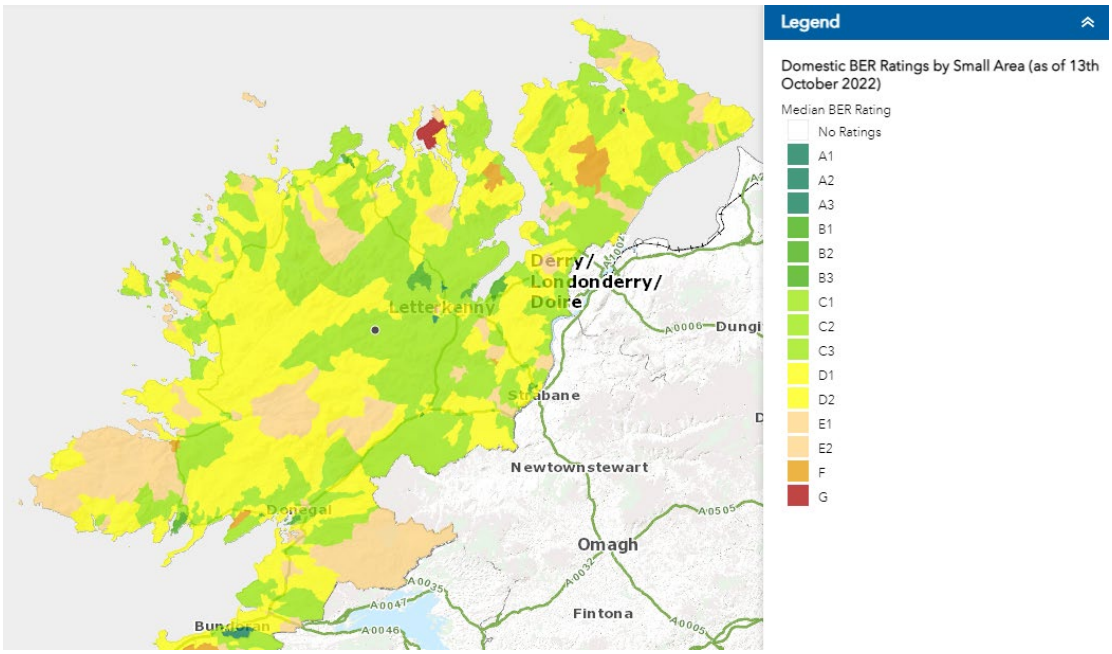


Figure 10 Median Domestic BER Ratings by Small Area- October 2022

4.5.3.3 Social Housing in County Donegal

There are 5,047 social housing dwellings in County Donegal, 74% of which have measured BERs[24]. Emissions from social housing are not a part of the emissions reported to the SEAI under the M&R system. Their BER distribution can be found below.

The Energy Efficiency scheme launched in 2013 made capital funding available to improve the standard and overall quality of local authority social housing stock. Phase 1 of the programme provided funding targeted at the less intrusive cavity wall/attic insulation works while Phase 2 focused on fabric upgrade works to dwellings. During the course of 2013 – 2020, Donegal County Council completed Energy Efficiency Phase 1 works to circa 3,000 social housing dwellings respectively. The Phase 1 and Phase 2 approach to retrofitting was withdrawn by the DHLGH in 2021 with the introduction of the Energy Efficiency Retrofitting Programme (EERP).

The new 10-year programme reflects a significant upscaling from 'shallow' to 'deeper retrofit' and calls for the 'retrofit' of 500,000 homes to a B2/Cost Optimal Equivalent (BER) standard by 2030, of which, approximately 36,500 are expected to be local authority owned homes. Works eligible under the EERP include attic/cavity wall insulation or external wall insulation where required, windows and doors replacement, heat pump installation and ancillary and associated works.

The Cost Optimal Equivalent level typically requires attic insulation, wall insulation and the installation of a heat pump to replace inefficient boilers. Local authorities are urged to choose a mix of properties across a range of BERs so as to allow for homes which need significant expenditure to be balanced out by those needing lesser spend so as to achieve the overall average cost per dwelling.

[23] https://gis.seai.ie/ber/

Local authorities are also required to invite energy suppliers (from SEAI's list of Obligated Parties) to participate in and assist with the execution of the EERP.

When selecting dwellings to undergo the EERP, a number of factors are to be taken into account and include:

- Dwellings built after 2008 are generally not suitable for EERP as they are constructed to TGD Part L 2008 or TGD Part L 2011 advanced performance requirements.
- Initially concentrating on dwellings within housing developments in order to maximise the number of dwellings in any one locality.
- Geographical area of the selected housing developments – need to rotate EERP works between DCC Municipal Districts in order to achieve a fair and even distribution of the works.
- Extent of the scope of works required for the dwellings, and the costs associated with same, taking into account the grant funding limitations.
- Number of dwellings at construction stage at any one time, and the supervision of same, must be controlled and at an acceptable level.

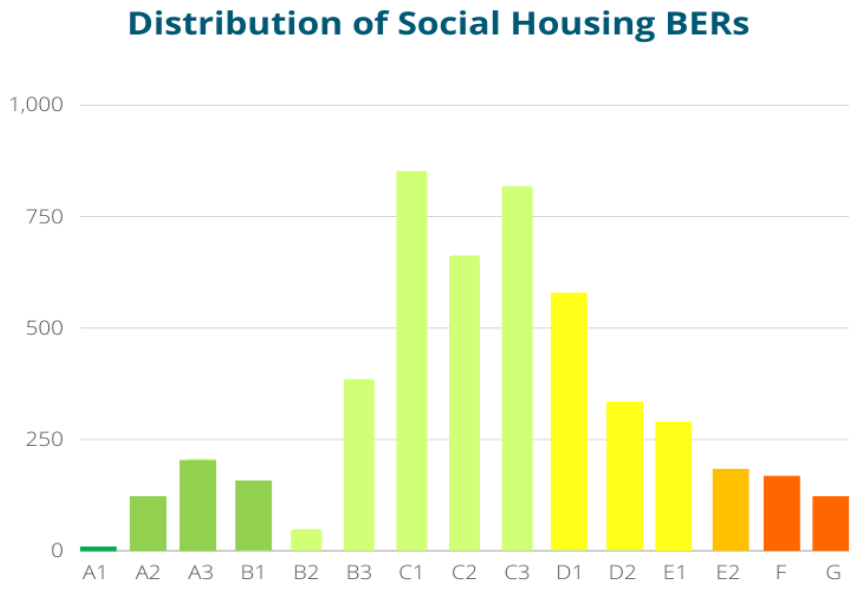


Figure 11 Distribution of Social Housing BERs

The current status of the EERP in Donegal County Council is as follows:

	Location	Tender Stage	Pre-works BER	Post-works BER
2013 EEP Phase 1	All 5 Electoral Areas incl. 3 Town Councils	Completed 234 Units	G to D1	C1
2014 EEP Phase 1	All 5 Electoral Areas incl. 3 Town Councils	Completed 513 Units	G to D1	C1

2015 EEP Phase 1	All 5 Municipal Districts	Completed 447 Units	G to D1	B
2016 EEP Phase 1	All 5 Municipal Districts	Completed 380 Units	G to D1	B
2017 EEP Phase 1	All 5 Municipal Districts	Completed 483 Units	G to D1	B
2019 EEP Phase 1	All 5 Municipal Districts	Completed 462 Units	G to D1	B
2020 EEP Phase 1	All 5 Municipal Districts	Completed 511 Units	G to D1	B
2021 EERP	52 units in 1 estate in Stranorlar/Lifford MD	Completed 52 Units	D1 to C3	B2
2022 EERP	141 units in 8 estates over 4 Municipal Districts	Completed 141 Units	G to C1	B2
2023 EERP (in progress)	227 units in 11 estates over 5 Municipal Districts	Tender process	G to C1	B2 (estimated)
	TOTAL	**3449 Units**		

Table 9: EERP Status

4.5.3.4 National Context

A comprehensive retrofit programme is a key measure in the CAP23 to reduce Residential emissions. The National Residential Retrofit Plan aims to achieve the equivalent of 500,000 homes retrofitted to a Building Energy Rating of B2/cost optimal or carbon equivalent[25]. Another aim is the installation of 400,000 heat pumps in existing premises to replace older, less efficient heating systems by 2030. A total of 18,400 home retrofits were completed in 2020. However, just 4,000 were to a B2 standard and 1,600 installed a heat pump[26]. Rollout of the Social Housing National Retrofitting Programme in 2021 with retrofitted properties was required to reach BER B2 or equivalent.

The SEAI estimates 17.7 MW of installed solar PV capacity in the Residential sector in Ireland in 2018 and that 44kt oil equivalent of renewable ambient energy from heat pumps was used.[27]

The national emissions ceiling for 2030 for residential buildings is 4MtCO_2 equivalent. For electricity, of which residential consumption made up 31% in 2019[28], the ceiling is 3 MtCO_2 equivalent.

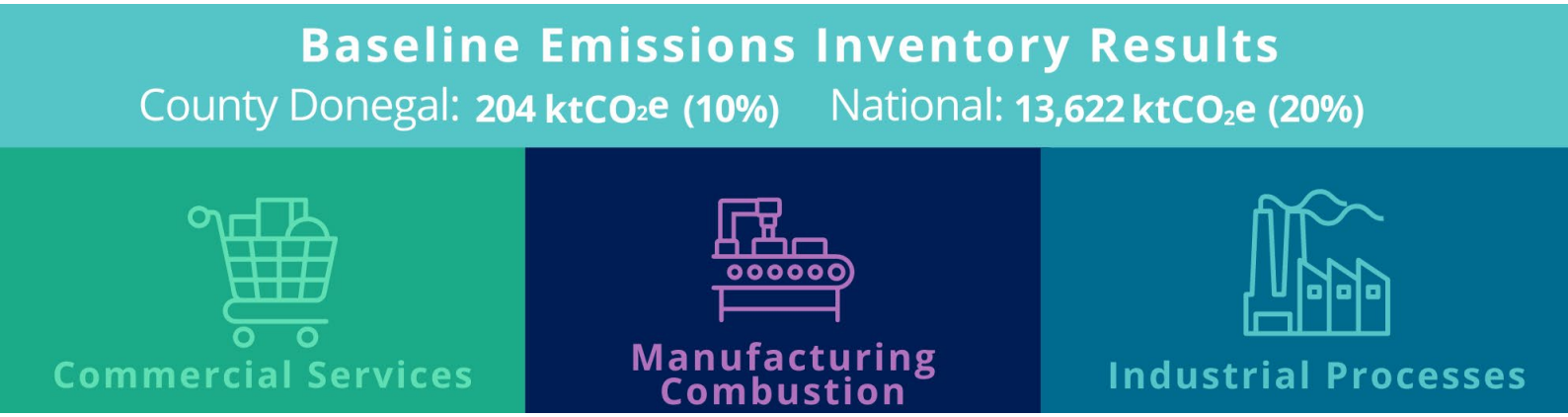
[25] https://www.oireachtas.ie/en/debates/question/2023-04-18/167/

[26] https://www.friendsoftheearth.ie/assets/files/pdf/blockages_to_retrofitting_and_heat-pump_installation_in_ireland.pdf

[27] https://www.seai.ie/publications/2020-Renewable-Energy-in-Ireland-Report.pdf

[28] https://www.cso.ie/en/releasesandpublications/ep/p-mec/meteredelectricityconsumption2021/

5.1 Non-residential Emissions: Commercial, Manufacturing Combustion, Industrial Processes



5.1.1 Background

Within the Non-residential emissions sector, there are three main categories: Commercial, Manufacturing, and Industrial Processes. Each category encompasses a unique set of activities and processes that contribute to greenhouse gas emissions.

Commercial emissions are a significant contributor to greenhouse gas emissions and are often a major focus of efforts to reduce carbon footprints. Commercial entities such as businesses, offices, and industrial complexes require a lot of energy to operate, which often comes from fossil fuels. The burning of these fossil fuels releases greenhouse gases such as carbon dioxide, methane, and nitrous oxide, which trap heat in the atmosphere and contribute to climate change. In the commercial sector, energy consumption is largely driven by activities such as heating, cooling, ventilation, lighting, cooking, and refrigeration.

Manufacturing Combustion processes involve a range of activities, such as heating, cooling, and processing materials, and often require the use of large machinery and equipment. These processes can consume significant amounts of energy and produce large quantities of emissions, particularly in industries such as iron and steel, non-ferrous metals, and chemicals.

The **Industrial Processes** sector estimates GHG emissions occurring from industrial processes, from the use of GHG in products and from non-energy uses of fossil fuel carbon. These processes include, but are not limited to, cement production, lime production, ceramics, solvent use, as well as the food and beverage industry. The emissions in this category are from Industrial Processes rather than combustion. It is important to note that the GHG emissions estimated in the Industrial Processes sector are not related to space or water heating.

In the Irish national inventory, commercial emissions, manufacturing processes, and industrial processes are three separate categories that are accounted for individually[29]. These categories represent different sources of greenhouse gas emissions and are reported separately to provide a detailed understanding of the country's emissions profile. However, in this particular case, these categories are being combined into a broad non-residential category. Emissions from commercial, manufacturing combustion, and industrial sources that are not related to residential activities are being reported together under this category.

[29]https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Ireland_NIR-2021_cover.pdf

In the non-residential sector, activity emissions and electricity emissions are added and calculated together. This is because non-residential activities often require a significant amount of electricity to operate, and the emissions associated with that electricity consumption must be included in the overall emissions from those activities.

The electricity emissions are based on metered consumption. This means that the amount of greenhouse gas emissions associated with electricity consumption is calculated based on the amount of electricity used as measured by a meter. The emissions associated with generating that electricity are allocated to the end-use sector based on this consumption data.

By splitting the measured non-residential electricity consumption in County Donegal based on an economic indicator (see section 3.4.1), it has been estimated that the combined commercial and manufacturing sectors produce approximately 66 kt CO_2 and 48 kt CO_2 of electricity emissions, respectively. This amounts to a total of approximately 114 kt CO_2 of non-residential electricity emissions for both sectors

5.1.2 County Donegal: Baseline Inventory for Non-Residential Emissions

The Non-residential sector in Donegal County is a significant source of greenhouse gas (GHG) emissions. To better understand the sector's emissions profile,

Figure 12 displays both activity and electricity emissions, providing a comprehensive overview of the total GHG emissions for the sector. The data shows that the Commercial Services subsector is responsible for the largest proportion of emissions at 60%, followed by Manufacturing combustion and Industrial Processes. The Industrial Processes category contains no electricity element.

Breaking down the data further, Figure 12 shows emissions exclusively from the activity of the Non-residential sector, excluding electricity emissions. This information can be useful in identifying specific sources of emissions within the sector and guiding targeted reduction strategies.

Similarly, Figure 13 displays the emissions attributed solely to electricity consumption within the Non-residential sector, excluding activity emissions. Understanding the proportion of emissions from electricity consumption can help develop effective energy management and efficiency strategies.

Total Non-Residential Emissions (Activity emissions + Electricity emissions)

Sectors	$ktCO_2e$
Commercial Services	123
Manufacturing Combustion	60
Industrial Processes	22
Total	205

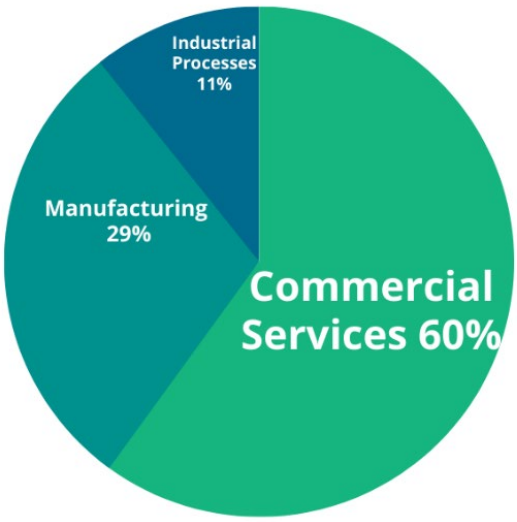


Figure 12 Total Non-Residential Emissions (Activity emissions + Electricity emissions)

Activity emissions

Sectors	$ktCO_2e$
Commercial Services	35
Manufacturing Combustion	33
Industrial Processes	22
Total	90

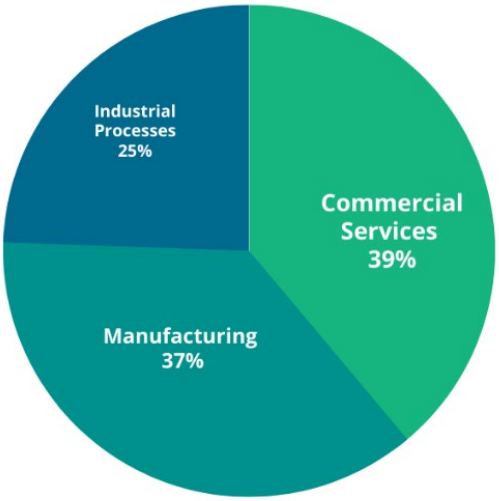


Figure 13 Activity- only emissions (no electricity)

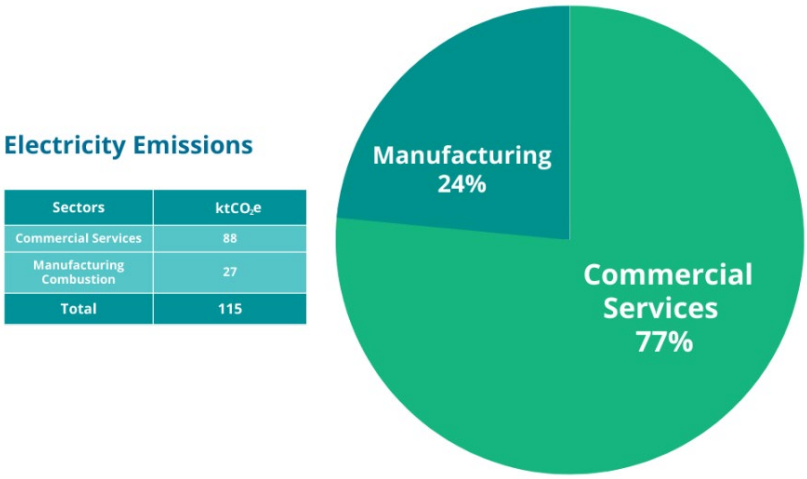


Figure 14 Electricity Emissions

Subcategories from MapEire for Commercial, Manufacturing and Industrial Processes

The subsectors of each of the non-residential emission sectors - commercial, manufacturing combustion, and industrial processes - are shown below. This information has been acquired through MapEIre and provides a more detailed breakdown of the sources of GHG emissions within the county. Analysing these subsectors can help identify areas for improvement and develop targeted strategies to reduce emissions. These are Scope 1 emissions only and therefore do not include emissions from electricity consumption.

Commercial Services

Subsectors for Activity Emissions	$ktCO_2e$
Commercial/institutional: Stationary	35

Table 10 Commercial Subsectors Emission

Manufacturing

Subsector	$ktCO_2e$
Chemicals	5
Food processing, beverages and tobacco	11
Iron and steel	0
Non-ferrous metals	2.3
Other	7.9
Pulp, Paper and Print	0.2
Non-metallic minerals	6
Total	32.4

Table 11 Manufacturing Subsector Emissions

Industrial Processes

Subsector	$ktCO_2e$
Ceramics	0
Domestic solvent use including fungicides	1.4
Food and beverages industry	0.7
Lubricant use	1
Other product use (please specify in the IIR)	1.3
Other solvent use (please specify in the IIR)	0.4
Paraffin wax use	0.8
Not assigned	17
Total	22.6

Table 12 Industrial Processes Subsector Emissions

5.1.3 Supporting Information

Non-residential emissions largely align with economic trends. National emissions have remained relatively stable in recent years. Fuel switching from more carbon-intensive oil and coal to lower-carbon natural gas has been one of the drivers for the reduction in this area[30].

As discussed before, Building Energy Ratings measure the energy performance of a building. They range from A1 (most efficient) to G (least efficient). They are calculated based on the energy required by the building for heating, cooling, ventilation, and lighting by SEAI-registered BER assessors. Only 10% of non-domestic buildings in County Donegal that have been BER assessed have a B2 BER or better, though this is slightly higher than the national average of 8%.

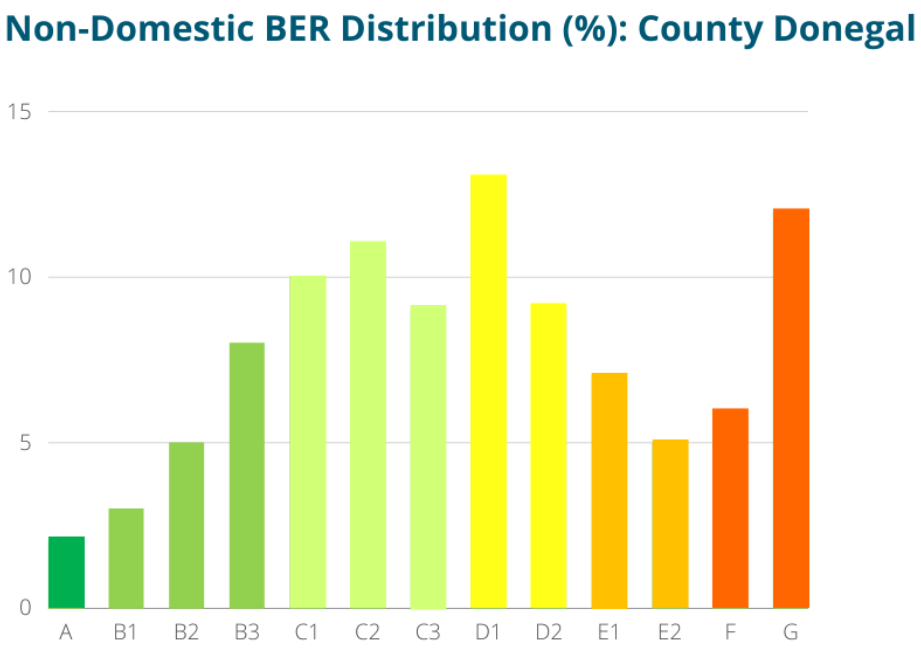


Figure 15: Regional Non-domestic Building BER Distribution (%): County Donegal

[30] https://www.iea.org/reports/co2-emissions-in-2022

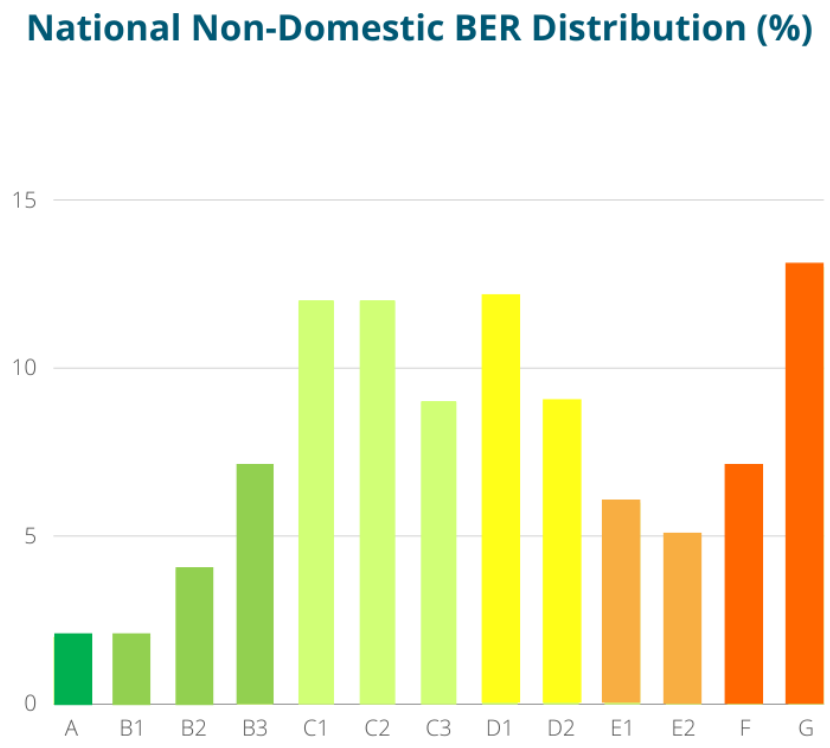


Figure 16: National Non-Domestic BER Distribution (%)

The following table presents the Carbon Dioxide (CO_2) Emissions by Type of Building for Donegal County in the year 2019. The emission values are measured in kilogrammes of CO_2 per square meter per year ($kgCO_2/m2/year$). They show how many kilogrammes Non-Domestic Buildings are emitted per square meter in a year. It is noticed that retail buildings, offices and restaurants are the highest emitting non-residential buildings by area, while hospitals and schools are the lowest emitting non-residential buildings.

County	Retail	Office	Restaurant	Hotel	Warehouses	Workshops	Industrial
DONEGAL	223	141	223	148	170	182	131

County	Hospitals	Community centre	Nursing home	Schools	Sports facilities	Other	All
DONEGAL	38	88	100	36	173	146	158

Table 13: Carbon Dioxide Emissions ($kgCO_2/m2/year$) by Building Type (non-residential)[31]

[31] https://www.cso.ie/en/releasesandpublications/er/ndber/non-domesticbuildingenergyratingsq12022//

Commercial services:

The following table shows the GHG breakdown of Commercial emissions from direct fuels only. Direct fuels refer to Scope 1 fuels burned on-site, such as for heating purposes. As the electricity emissions were calculated with a different dataset to include them as Scope 2, the GHG breakdown is not available.

Gas	$ktCO_2e$
CH_4	0.2
CO_2	35
N_2O	0
Total	**35.2**

Table 14: Commercial Sector Emissions from Direct Fuels by Gas Type

Manufacturing Combustion:

The county boasts a remarkable diversity of thriving industries that have solidified its reputation for excellence across multiple sectors. Its strong economic growth and stability can be attributed to its prowess in various fields such as manufacturing, healthcare, engineering, food processing, and textiles. However, this prosperity comes at a cost, as the emission of gases into the atmosphere remains a pressing concern. See the table below:

GAS	$ktCO_2e$
CH_4	0.1
CO_2	32.2
N_2O	0.1
Total	**32.4**

Table 15: Manufacturing Sector Emission from Direct Fuels by Gas Type

Industrial Processes

The average industrial process building in County Donegal releases 131 $kgCO_2/m^2$/year. The national average is 154 kg CO_2/m2/year. The industrial output and processes in County Donegal and generally of Border counties in Ireland are relatively low compared to the counties located in East Ireland.[32] As of 2017, the Industrial sector in County Donegal employed 8,791 people, representing 15.1 % of

[32]https://www.cso.ie/en/releasesandpublications/er/ciprcd/censusofindustrialproduction-localunitsregionalandcountydata2017/

employed employees in the County.[33] However, due to the initial stage of the industrial scene in Donegal, the emissions from Industrial Processes only account for 22.4 $ktCO_2$ or 1% of the total GHG emissions emitted within County Donegal. The most dominant greenhouse gas emitted in the industrial sector is Sulphur Hexafluoride gas (SF_6).

Gas	$ktCO_2e$
CH_4	4.2
CO_2	1.2
N_2O	17
Total	22.4

Table 16: Industrial Processes Sector Total Emissions by Gas Type

[33] https://westerndevelopment.ie/policy/our-region/donegal-county-analysis/

5.2 Transport

5.2.1 Background

Transport in 2019 accounted for approximately 19% of Ireland's greenhouse gas (GHG) emissions which is equivalent to 11 Mt CO_2e, with road transport responsible for 94% of those GHG emissions. [34]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 and buses) and are also directly responsible for a range of air pollutants that negatively impact both human health and the environment.

Between 1990 and 2019, Transport shows the greatest overall increase in GHG emissions at 112%, from 5,143 ktCO_2e in 1990 to 10,915 ktCO_2e in 2019, with road transport increasing by 115%.[35] The increase in emissions up to 2007 can be attributed to general economic prosperity and increasing population with a high reliance on private car travel, as well as rapidly increasing road freight transport.

This sector accounts for emissions from the combustion of fuel for all transport activity, including domestic aviation, road, railway, water-borne navigation, and other transportation (which includes gas pipeline transportation). Emissions from road transport were relatively stable for the period 2015-2019, at an average of 11.6 Mt CO_2eq but reduced to 9.7 Mt CO_2eq in 2020 due to the COVID-19 implications.[36] Domestic aviation emissions are included in the national inventory but make up less than 1% of transport emissions. International aviation and maritime navigation are reported as "memo items" in the national emission inventory. This means they are not counted as part of Ireland's national total emissions but are reported by Ireland to the UNFCCC and EU for information purposes.

Transport has been the sector most responsive to changes in economic growth in Ireland. Transport energy use and CO_2 emissions peaked in 2007, before falling sharply during the recession[37]. It returned to growth in 2013, but by 2019 total Transport energy use was still 8,5% below the 2007 peak, mostly due to heavy goods vehicles remaining 31% below 2007 levels (see Figure 17 below).

[34] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/
[35] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/
[36] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/
[37] https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

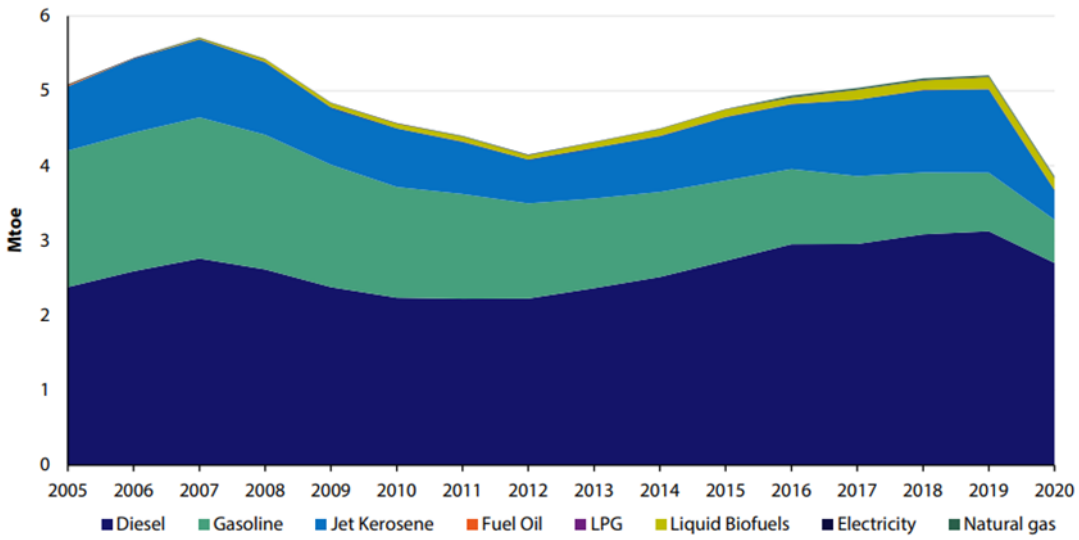


Figure 17 Transport Fuel Usage over Time in Ireland

Fuel consumption in Transport is often closely aligned to the mode used: jet kerosene is used for air transport, and fuel oil for shipping, while petrol and LPG are almost exclusively used for road transport. Diesel consumption is used for road transport, navigation, and rail. The most important point to note is that Transport remains almost completely dependent on fossil fuels, particularly oil products. This lack of fuel diversity is unique among the energy-using sectors. Renewables made up just 4% in 2019, which scores very low in comparison with other European Countries[38].

This has meant that there has been very little decarbonisation of the Transport fuel mix to date, with Transport CO_2 emissions remaining tightly coupled to energy use. In 2019, Transport CO_2 emissions were the same as they had been in 2005.

	2020		2005		2019-2020		2015-2020		2005-2020	
	Quantity (ktoe)	Share (%)	Quantity (ktoe)	Share (%)	Absolute change (ktoe)	Overall change (%)	Overall change (%)	Average annual change (%)	Overall change (%)	Average annual change (%)
Private car	1,637	42%	1,891	37%	-443	-21.3%	-24.1%	-5.4%	-13.5%	-1.0%
HGV	725	19%	1,112	22%	-65	-8.2%	15.7%	3.0%	-34.8%	-2.8%
LGV	301	8%	0	0%	-33	-9.8%	-20.3%	-4.4%	-	-
Domestic aviation	2	0%	27	1%	-4	-59.7%	-53.3%	-14.1%	-90.9%	-14.8%
International aviation	396	10%	832	16%	-714	-64.3%	-53.0%	-14.0%	-52.4%	-4.8%
Public passenger	117	3%	157	3%	-21	-15.3%	-11.9%	-2.5%	-25.4%	-1.9%
Rail	36	1%	45	1%	-8	-19.0%	-8.8%	-1.8%	-20.1%	-1.5%
Navigation	104	3%	50	1%	15	16.4%	45.5%	7.8%	109.2%	5.0%
Gas pipeline	15	0%	2	0%	15	-	-	-	588.7%	13.7%
Fuel tourism	80	2%	387	8%	80	-	-	-	-79.2%	-9.9%
Unspecified	461	12%	581	11%	461	-	-	-	-20.6%	-1.5%
Total	**3,875**	**100%**	**5,084**	**100%**	**-1,359**	**-26.0%**	**-19.0%**	**-4.1%**	**-23.8%**	**-1.8%**

Source: SEAI

Figure 18 National Transport Data Through the Years

[38] https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

A core objective of the National Planning Framework is the need for more sustainable forms of Transport to reduce energy demand and greenhouse gas emissions, such as active modes of travel, and electric vehicles and increase the usage of public transportation. The National Planning Framework for Transport also places a strong emphasis on enhanced regional accessibility in Local Authorities[39]. The national emissions ceiling for Transport for 2030 is 6 $MtCO_2e$.

The levels of noise, accidents, and congestion associated with road transport reduce the quality of life, deter active travel, and costs society hundreds of millions of euros per annum in wasted time.

Behavioural change and promoting cleaner, safer, and more sustainable mobility are critical for climate policy, and it also represents an opportunity to improve our health, boost the quality of our lives, meet the needs of our growing urban centres, and connect our rural, urban and suburban communities.

The recently revised CAP21 sets out the required level of decarbonisation for transport in quantitative terms as summarised in Table 16 below:

2018 Emission $MtCO_2e$	Indicative Target for 2025 Emission $MtCO_2e$	Indicative Target % Reduction for 2025 $MtCO_2e$	2021 Emissions $MtCO_2e$	% Increase (+)/ Reduction (-) to date $MtCO_2e$
12	10	20%	11	-11

Table 17 Required Level of Decarbonisation for Transport[40]

[39]https://www.donegalcoco.ie/services/planning/developmentplansbuiltheritageincludinggrants/county%20donegal%20development%20plan%202018-2024/

[40] https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/

5.2.2 County Donegal: Baseline Inventory for Transport

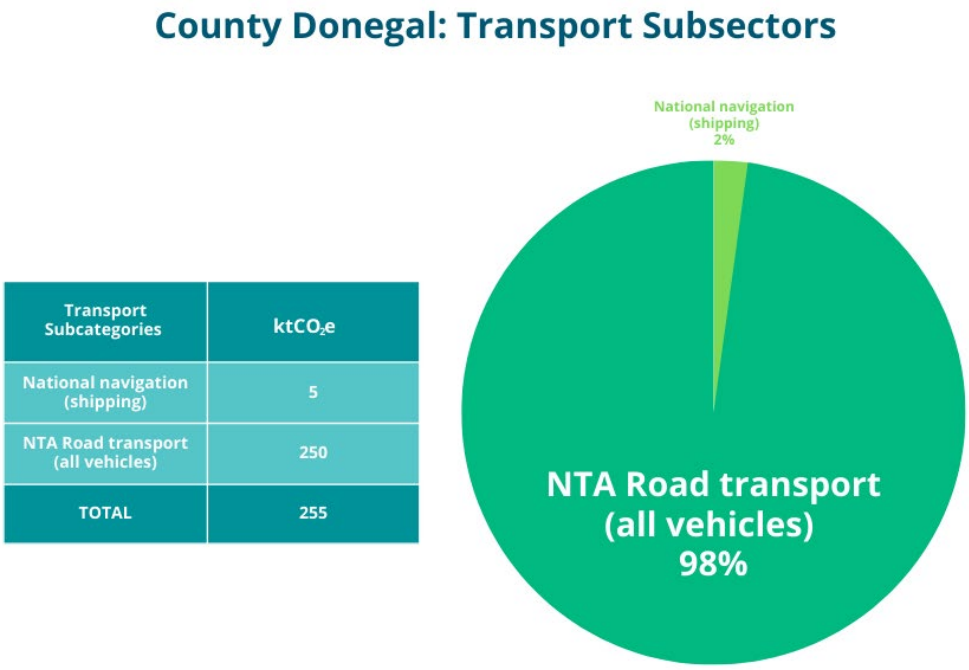


Figure 19 National Road Transport Emissions

The Transport sector in County Donegal accounted for 255 $ktCO_2eq$, which makes 13% of the total County's emissions. The final number of transport emissions consists of all road transport data from NTA and the National Navigation (shipping) data from the MapEIre methodology. As seen in Figure 20, the emissions from passenger cars are the highest emitting subcategory in the transport sector. The graph below shows the breakdown of road transport for County Donegal between different types of vehicles.

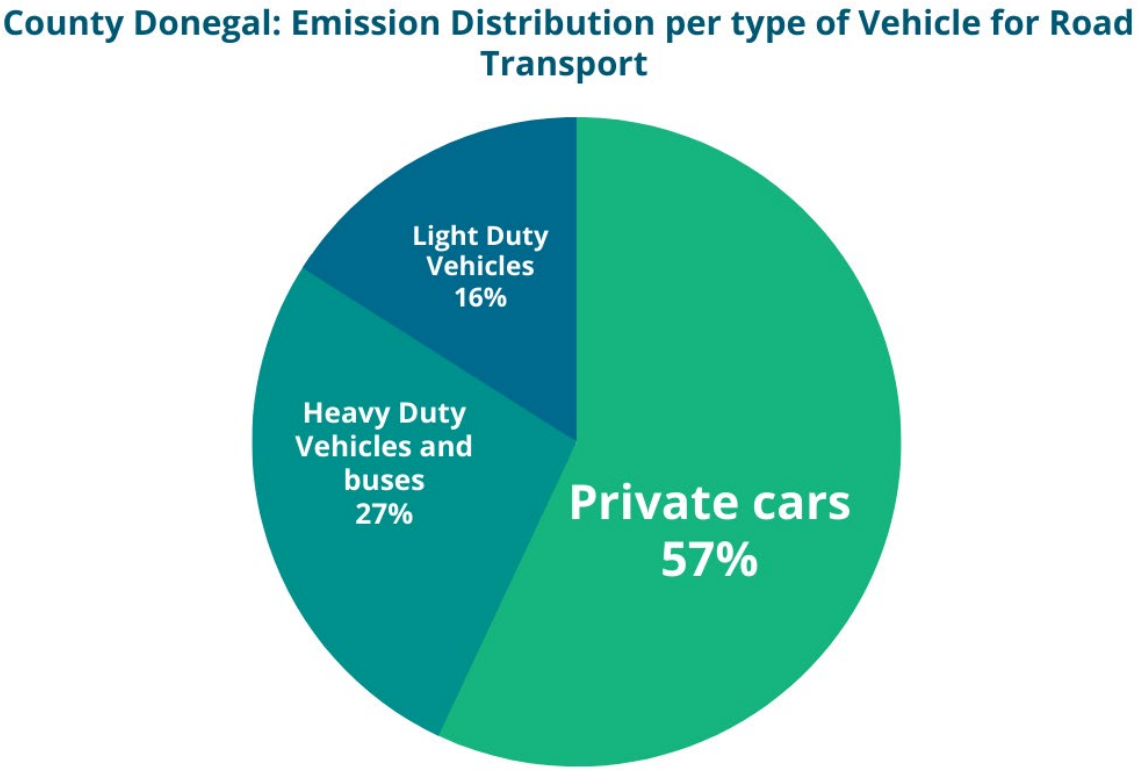


Figure 20 Road Transport Emission Distribution per Type of Vehicle

5.3.3 Supporting Information

Donegal, being located and isolated in the northwestern part of the country, has bigger challenges in terms of establishing its local transport infrastructure and possible connections towards the remaining country or even internationally. The county has a dispersed settlement pattern and a low population density of 34.2 people per sq. km, compared to the national average (70 people per sq. km). The county has a national airport that connects with the city of Dublin twice a day. The transportation options in County Donegal are also constrained by the lack of railway system, which leaves car or bus travel as the only practical means of moving in and out of the county.

Responding to the National Planning Framework goals will demand immediate action from County Donegal. The situation is about to change in the upcoming years as investments are being made to improve the quality of the transport infrastructure in the County Donegal was awarded a funding package of €35 m in 2022 for Donegal´s Roads and Infrastructure. In combination with the Transport Infrastructure Ireland (TII) funding of €29.5m last December and the funding of €5.6m confirmed by the National Transport Authority in January, County Donegal can count on a total of €70 m for the county's development towards sustainable transportation.[41]

[41]https://data.oireachtas.ie/ie/oireachtas/libraryResearch/2020/2020-02-09_donegal-constituency-profile_en.pdf

Based on the National Travel Survey in 2019, 76.6% of the inhabitants of the Border-region chose private cars as their mode of travel. Only 1.3% of commuters in the Border-region use public transportation, compared to the national average of 9.3%.[42]

The available MapEIre dataset gives an overview of the GHG emissions emitted, per type of vehicle and mode of transportation. County Donegal Transport emissions reflect the County's Transport characteristics. The yearly travel average for passenger cars is 17,540 km travelled/ year. The emissions coming from passenger cars account for 58% of the total Transport emissions, with 142 kt of CO_2 emitted in 2019. The second highest number of CO_2 emissions in the Transport sector for 2019 comes from the Heavy-Duty vehicles and buses which account for 67kt CO_2 and 27% of the total Transport share. The table derived from CSO presents the road traffic volumes of the national fleet by county and vehicle type for 2019, the exact number of vehicles, kilometres driven in total per type of vehicle and the average kilometres travelled per vehicle. The County's route length in 2019 was 303 km of one-way road[43].

Private cars	km (million)	Average km
66,327	1,163	17,540
Heavy Duty vehicles and buses	**km (million)**	**Average km**
15,155	300	19,823
Mopeds & Motorcycles	**km (million)**	**Average km**
775	2	2,786
Tractors & Machinery	**km (million)**	**Average km**
3,289	60	18,130
Small PSVs	**km (million)**	**Average km**
359	15	40,987

Table 18 Road Traffic Volumes of National Fleet by County of Owner and Vehicle Type in County Donegal, 2019 CSO

County Donegal, being a car-centric rural area reflects the low levels of public transport usage in comparison with private car travel. In 2019, the County had 124 licensed bus operators, which is above the average bus operator numbers in Ireland.[44]

[42] https://www.cso.ie/en/statistics/transport/

[43]https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadsafetyandroadlengths/

[44] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/publictransport/

Emissions are categorised per type of fuel in vehicles and type of vehicles.

To add value and bring County Donegal's representatives a step closer to taking effective climate action, the emissions per type of fuel in Donegal's registered vehicles and type of vehicles were assessed by using local and international data, to make certain assumptions which are explained in detail in the Methodology sector. The two types of vehicles that were broken down considering this approach are the private cars and the goods vehicles, as they are responsible for emitting the largest amount of carbon emissions in the transportation sector. Table 18 shows the amount of diesel and petrol cars registered in County Donegal.

Fuel Type	Private car
Diesel	44,131
Petrol	21,095

Fuel Type	Goods Vehicles
Diesel	15,125
Petrol	20

Table 19 Data on vehicles and fuel type for County Donegal

Based on the methodology followed, it was found that a diesel private car in County Donegal emits 3.2 tons of CO_2 per year, while a petrol car emits 3 tons of CO_2 per year. Please see Table 19 below:

Type of fuel	Average Consumption per 100km	CO_2 emitted per private car per km	Average km driven per year	CO_2 emitted per private car in a year
Diesel	6.8 l	179.5 grams CO_2 per km	17,540 km	3.2 tCO_2
Petrol	7.7 l	184 gram CO_2 per km	17,540 km	3 tCO_2

Table 20 CO_2 Emissions per Type of Fuel for Private Cars

In 2019 there were 44,131 Diesel cars in County Donegal, assuming from the calculations that a single diesel private car emitted 3 t/CO_2, diesel private cars were responsible for emitting 132,393 t/CO_2. Furthermore, in 2019 there were 21,095 petrol cars registered in Donegal which were responsible for emitting 63,285 t/CO_2.

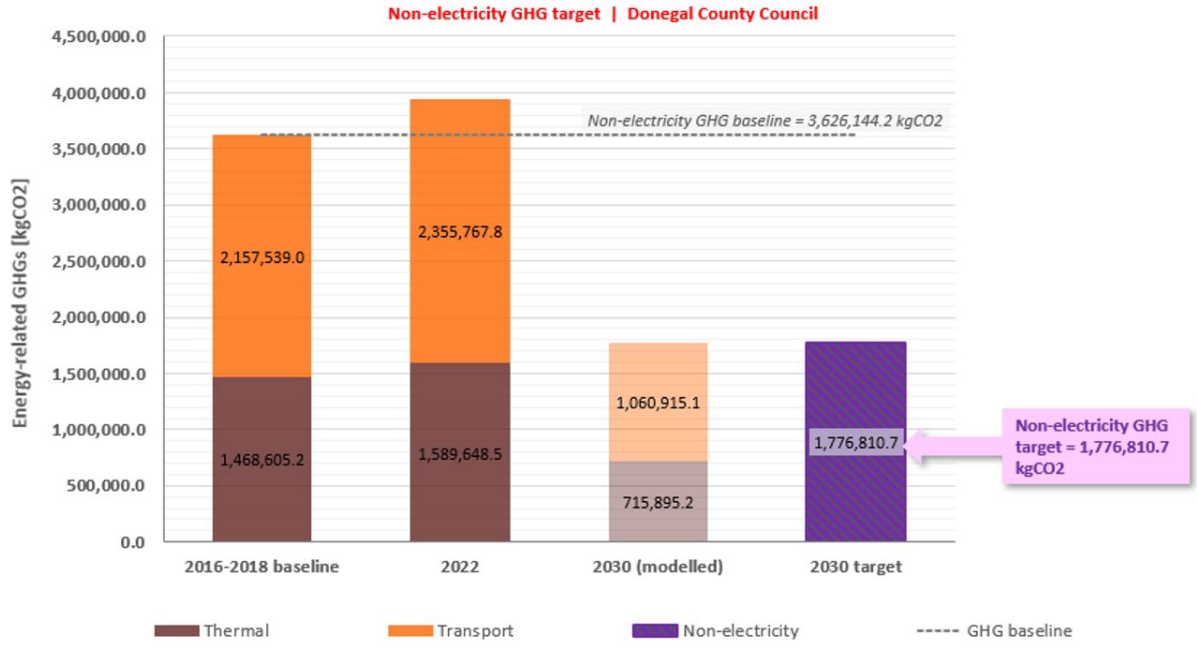
Based on the same methodology it was found that a diesel goods vehicle emits on average 14.4 tonnes of CO_2 in a year, while a petrol goods vehicle emits an average of 15.1 tonnes, as displayed below:

Type of fuel	Average Consumption per 100km	CO_2 emitted per private car per km	Average km driven per year	CO_2 emitted per private car in a year
Diesel	28	729 grams CO_2 per km	19,800 km	15 tCO_2
Petrol	32	761 gram CO_2 per km	19,800 km	15 tCO_2
Hybrids	21	564 gram CO_2 per km	19,800 km	11 tCO_2

Table 21 CO_2 Emissions per Type of Fuel for Goods Vehicle

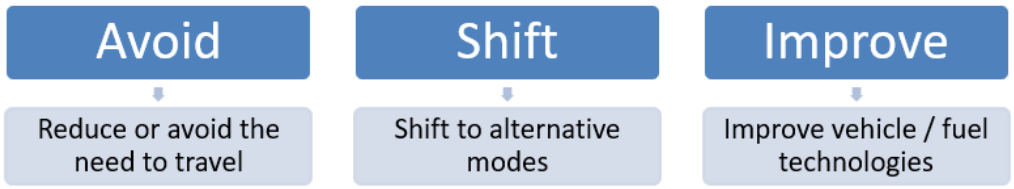
5.3.3.1 Donegal County Council Own Transportation Fleet

The graph below shows the provisional non electricity GHG targets for Donegal County Council. GHG emissions for transport in 2022 rose by 9.1% to 2,356 kt CO_2 pa. A targeted figure of approximately 1,060 kt CO_2 for 2030 will mean a reduction of 1,200 kt CO_2 will be required from transport from 2022 levels to meet the county's obligations.



A pathway to achieving this decarbonization of LA fleet is featured in an Early Interventions report by the CCMA in June 2022. Recommendations from this report on setting up teams, management systems and training have been progressed by Donegal County Council.

A development strategy of Avoid / Shift / Improve has also been recommended. This is significant challenge whilst also being obliged to meet existing and growing demand for service provision.



The table below presents a comparative breakdown of County Donegal's fleet numbers between 2014 and 2023. It highlights notable changes within specific categories, indicating significant increases in Road Fleet Numbers, Water and Environment (WEE) Fleet, Housing Fleet, and Marine Fleet. However, it is worth mentioning that Uisce Éireann Fleet numbers have shown a decrease over the same period.

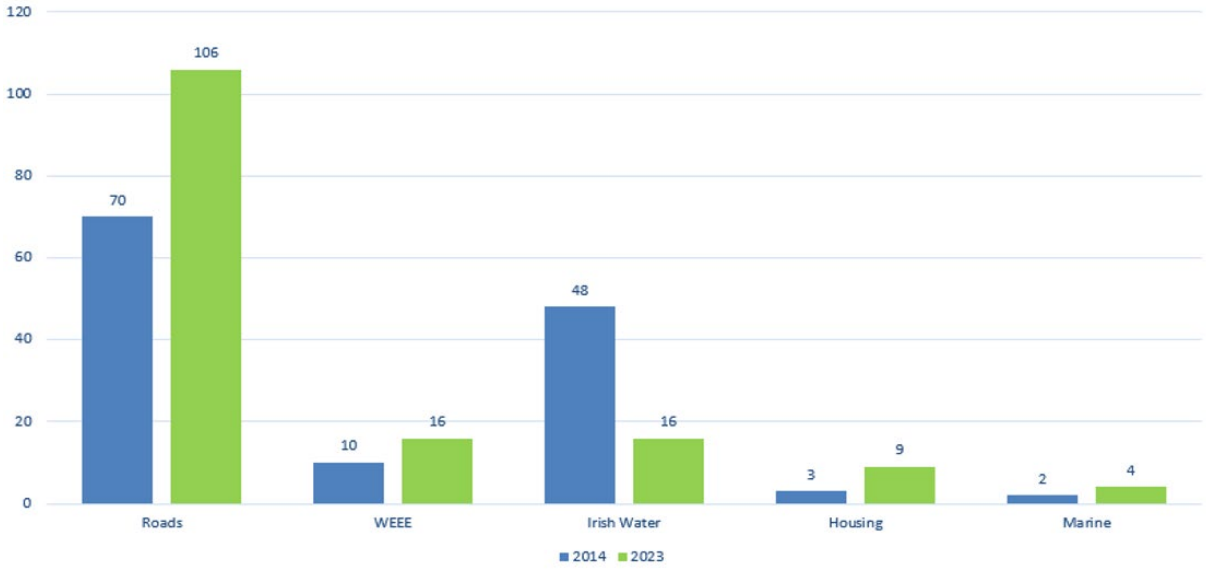


Figure 21: County Donegal's fleet numbers between 2014 and 2023

The table provided presents diesel usage for Donegal County Council (DCC), excluding Uisce Éireann Plant, Surface Dressing Plant, and Winter Maintenance Plant. Fuel consumption poses a significant challenge for transportation in general, and within DCC's fleet, the larger Heavy Goods Vehicles (HGVs) account for 45% of the total fuel consumption, predominantly relying on diesel fuel. This emphasizes the importance of addressing fuel efficiency and exploring sustainable alternatives to mitigate the environmental impact and costs associated with diesel usage.

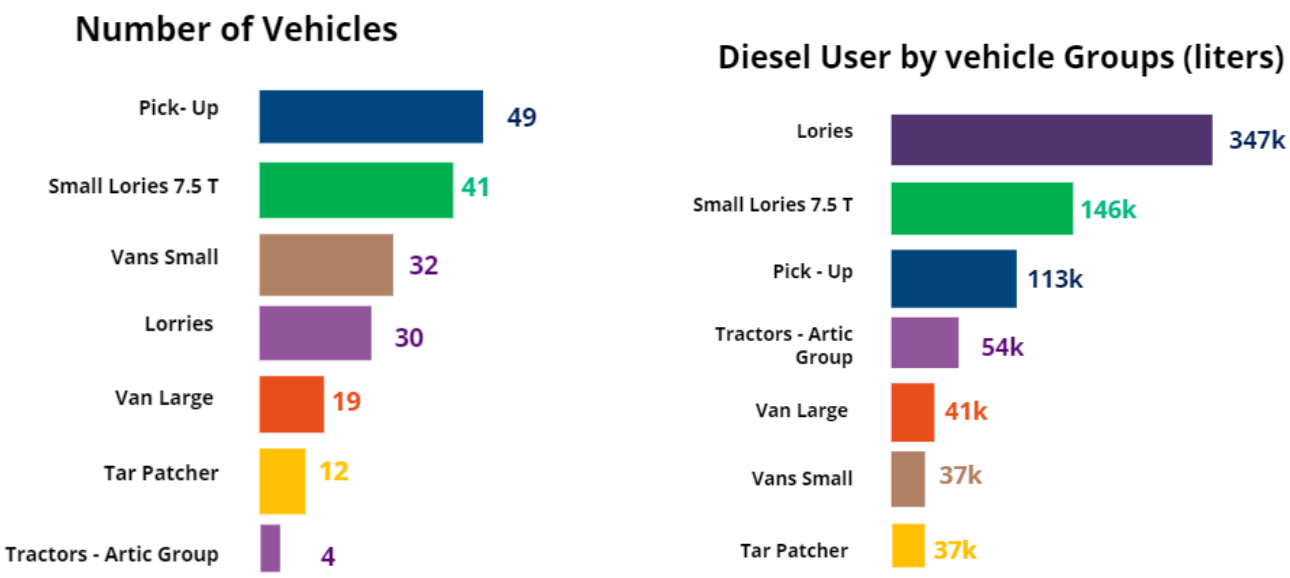


Figure 22: DCC's number of vehicles and diesel use

5.3 Waste

5.3.1 Background

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. The largest of these sources is solid waste disposal on land (landfills) where methane (CH_4) is the gas concerned. In contrast with the other sectors, the greenhouse emissions coming from Waste have been decreasing rapidly throughout the years due to the improved management of landfill activities, including increased recovery of landfill gas utilised for electricity generation and flaring is a core driver in decreased emissions from the Waste sector. This can be seen in the figure below:

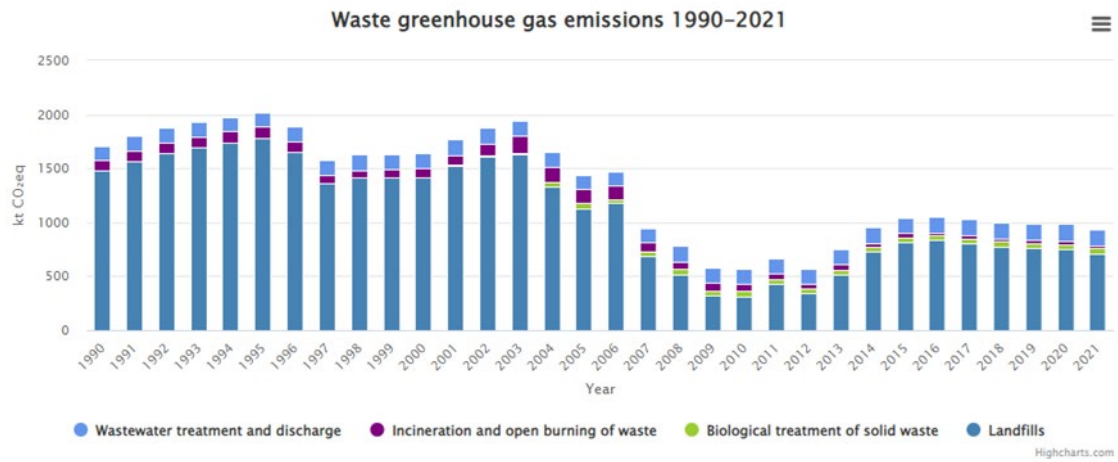


Figure 23 Waste greenhouse gas emissions from EPA [45]

Waste emissions per head are lower in Ireland compared to the EU average and emissions have fallen since 2005[46]. Ireland has made significant progress in managing waste streams, particularly in improving recycling rates and diversion from landfill.

5.3.2 County Donegal: Baseline Inventory for Waste

As seen below, most of the Waste Emissions come from the Biological Treatment of Waste- Solid waste disposal on Land, which account for 81% of the total Waste Emissions. This is followed by the emissions caused by domestic wastewater handling, which accounts for roughly 17% of the total Waste Emissions sector.

[45] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/waste/
[46] https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690580/EPRS_BRI(2021)690580_EN.pdf

Sector	$ktCO_2e$
Composting	0.530
Solid Waste	29.546
Wastewater	6.108
Open Burning	0.382
Total	36.567

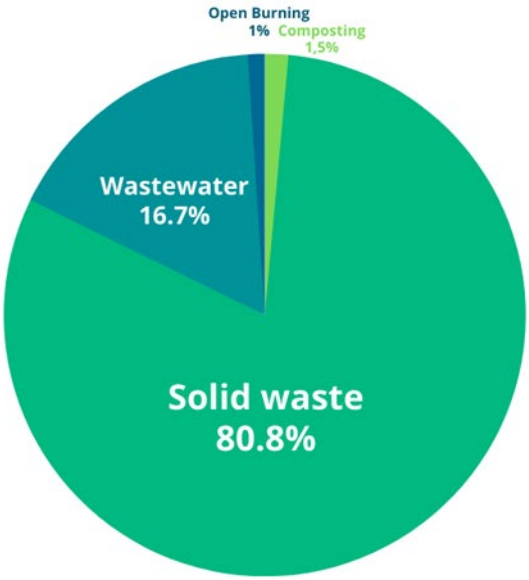


Figure 24 Waste Subsector Emissions in County Donegal from MapEIre

5.3.3 Supporting Information

5.3.3.1 Donegal Context

Emissions from the waste sector accounted only for 1.8% of the total emissions in County Donegal. The waste sector emitted a total of 36,56 kilotonnes of CO2. County Donegal has currently 46 wastewater treatment plants. There are 6 Local Authority owned recycling centres that provide a service for a wide range of domestic municipal waste types that are collected for recycling or disposal depending on the waste type.

GAS	$ktCO_2e$
CH_4	34,606
CO_2	0.3
N_2O	1,602
Total	36,208

Table 22 Waste greenhouse gas emissions type [47]

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

5.4 Agriculture

5.4.1 Background

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.

In Ireland, agriculture is the highest emitting sector, contributing to 33% of the country's total GHG emissions in 2019. The primary source of emissions is methane from livestock, which accounts for about 63% of the total agriculture emissions. Livestock such as cows, sheep, and pigs produce methane through enteric fermentation, a digestive process that breaks down feed in their stomachs, leading to the production of methane gas. The use of nitrogen fertilizers and manure management is another significant source of agriculture emissions in Ireland[48]. The application of nitrogen fertilizers and the handling of animal manure can lead to the release of nitrous oxide, a potent greenhouse gas that is over 300 times more powerful than CO_2.

Reducing agriculture emissions is a critical challenge for Ireland, given the sector's importance to the country's economy. Agriculture is a vital part of Ireland's economy, generating 8% of the country's gross value added and providing over 8.5% of national employment in 2019[49]. To address the challenge, ambitious targets have been set for Irish agriculture to reduce GHG emissions by 25% by 2030. The national emissions ceiling for 2030 is 17,25 $MtCO_2$ equivalent for Agriculture.[50]

5.4.2 County Donegal: Baseline Inventory for Agriculture

This sector's emissions range from enteric fermentation, manure management, agricultural soils, liming, and the use of fertilisers and urea. MapEIre data provides a breakdown of emissions within this sector, covering a wide range of sub-categories. According to the latest MapEIre and the associated BEI report, energy-related agricultural emissions are assigned to the agriculture sector. The MapEIre report provides a detailed breakdown of the emissions from various sectors, including agriculture, transport, commercial, and residential. While transport-related emissions are assigned to the transport sector and buildings-related emissions are assigned to the commercial sector, energy-related agricultural emissions are allocated to the agriculture sector. This includes emissions from the use of

[48] https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/
[49] https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/
[50]https://www.gov.ie/en/press-release/dab6d-government-announces-sectoral-emissions-ceilings-setting-ireland-on-a-pathway-to-turn-the-tide-on-climate-change/

energy-intensive machinery and equipment in farming, as well as energy consumed in the production of fertilizers and other agricultural inputs such as off-road Agriculture Transport.

The MapEIre dataset breaks down the Agriculture sector into several sub-sectors, which have been grouped further for ease of understanding. A visual depiction of this is provided below:

Subsector	$ktCO_2e$
Livestock Enteric Fermentation	452
Soil Applications	101
Inorganic fertilizer	46
Soil processes	60
Cultivation of organic soils	8
Manure management	57
Machinery and Vehicles	43

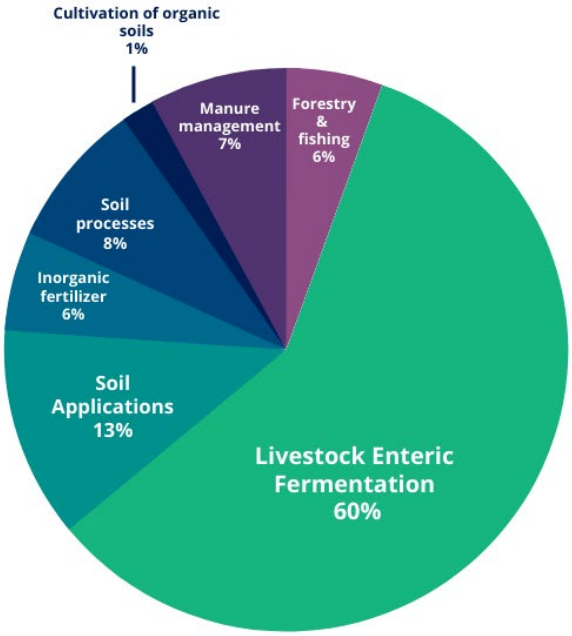


Figure 25 Breakdown of Agriculture Emissions by Subsector

Raw Subcategories

SUBCATEGORY	$ktCO_2e$
Livestock	
Dairy cattle	77
Goats	.05
Horses	1
Sheep	103
Swine	0
Mules and asses	0.1
Non-dairy cattle	270
Urine and dung deposited by grazing animals	43
Manure Management	
Manure management - Dairy cattle	8
Manure management - Goats	0.02
Manure management - Horses	0.3
Manure management - Mules and asses	0.02
Manure management - Non-dairy cattle	37
Manure management - Other poultry	0
Manure management - Sheep	11
Manure management - Swine	0
Cultivation of organic soils	
Cultivation of organic soils	8

SUBCATEGORY	$ktCO_2e$
Machinery and vehicles	
National fishing	0.1
Off-road vehicles and other machinery	26
Stationary	2
Agriculture	15
Inorganic fertilizer	
Inorganic N-fertilizers (includes also urea application)	46
Soil Processes	
Liming	23
Mineralization	0.4
Nitrogen leaching and run-off	21
SOIL APPLICATIONS	
Urea application	2
Sewage sludge applied to soils	0.2
Animal manure applied to soils	51
Atmospheric deposition	16
Crop residues applied to soils	4
TOTAL	**767**

Table 23 Emissions by Subcategory extracted from MapEIre dataset for County Donegal

5.4.3 Supporting Information

5.4.3.1 National Context

Climate change is one of the biggest challenges facing the Agriculture sector over the next decade. Agriculture accounts for 33% of GHG emissions in Ireland, the primary source being methane from livestock, and nitrous oxide due to the use of nitrogen fertiliser and manure management, which makes Agriculture the highest GHG-emitting sector in Ireland with vast increasing rates.

Agriculture is a vital part of Ireland's Economy, and it generates 8% of gross value added and provides over 8.5% of national employment.[51] Ambitious targets have been set for Irish Agriculture between now and 2030, to reduce GHG emissions by between 22-30%.[52] The national emissions ceiling for 2030 is 17,25 $MtCO_2$ equivalent for Agriculture. Climate change is challenging for Irish Agriculture both in the context of greenhouse gas emissions and the need for adaptation of farming practices to be more resilient to the impacts of climate change. The emissions in the Agriculture sector without intervention, are projected to increase with the expansion of animal numbers. However, technologies to reduce emissions in the Agricultural sector are maturing and offering promising results.

5.4.3.2 County Context

Donegal is a rural county with the geographical isolation as the northernmost county. In combination with the mentioned challenges in transportation infrastructure County Donegal has a long history of reliance on the primary sector, where Agriculture plays a crucial role in the economic and social development of the County. Most of the farming occurs in the river valleys and the rolling lowlands of east and south Donegal. The predominant enterprises are beef and sheep farms, whereas oats, barley,

[51] https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/
[52] https://www.gov.ie/en/publication/6223e-climate-action-plan-2021

potatoes and tillage farming (103 specialised tillage farmers in the county) account for the main crop production in the county. Barley has become a viable alternative based on local initiatives to the traditional animal feed crops, now serving as spring malting barley for distilleries and brewing facilities.[53] It is important to highlight the key importance of potato production for the county. During the last decade, Donegal was the 5th largest potato-producing county in Ireland having around 240 farms in Donegal. On the other hand, the area under the seed of potatoes is consistently being reduced due to poor profitability and lack of demand.

The Census of Agriculture 2020[54] provides significant information on the impact of the Agriculture sector. Farm animals in County Donegal are directly responsible for almost 59% of the carbon emitted over the whole sector. The highest emitting subsector within the county is the non-dairy cattle which is responsible for 35% of the total carbon emissions. Furthermore, the census indicates the number of farms in the county was 9,347, with most of the farms ranging between 10 and 50 hectares[55] (10-20 hectares is the largest segment with 2,382 farms).

Animals are present in most of the county farms, with almost 50% of the farms specialised in sheep farming. Donegal has the most sheep in Ireland with 541,063 sheep in 2021[56].

However, data from `The Donegal Local Economic Plan & Community Plan 2016-2022´ show that traditionally the county has a significant presence of other farm animals. The number of dairy cows increased between 2017 and 2021 by more than 10%.

Furthermore, data collection from Teagasc[57] provides further insight into the sector's emissions of the entire Border region, helping to further inform on the development of suitable actions. The total number of agriculture livestock for dairy cows, suckler cows and sheep is depicted in Table 23. The Census of Agriculture 2020 indicates that since the previous census of 2010, the number of farms in the Region has fallen from 17,478 to 16,973, a decrease of 2.9%. Throughout the Border region, 6 farms have been identified for the Signpost programme that aims at reducing gaseous emissions from Irish agricultural activities.

Due to the high number of farm animals in the County, manure management and the process of applying animal manure to fertilise the soils accounts for 14% of the total carbon emitted in the agriculture sector, with manure management emitting 56,570 $ktCO_2$, and with manure application to fertilise the soils emitting 51,338 $ktCO_2$.

In addition, current farming technology used for the Agriculture sector in County Donegal seems to have a significant impact on carbon emissions. The MapElre dataset shows that inorganic nitrogen fertilisers are responsible for 45,795 $ktCO_2$ emitted, which makes up 6% of the total emissions in the sector. Overall, these data explain why the Agriculture Sector is leading in terms of emissions with 39% (766,88 $ktCO_2e$) of the total emission in the county. The most dominant greenhouse gas emitted in the Agriculture sector is methane, followed by nitrous oxide.

[53]https://www.teagasc.ie/media/website/publications/2021/Tillage---Excitement-returning-to-Donegal-tillage.pdf

[54] https://www.cso.ie/en/statistics/agriculture/censusofagriculture/

[55]https://www.cso.ie/en/releasesandpublications/ep/p-coa/censusofagriculture2020-preliminaryresults/farmstructure/

[56] https://www.agriland.ie/farming-news/sheep-census-donegal-has-highest-sheep-population/

[57]https://www.teagasc.ie/media/website/about/farm-advisory/Sligo---Leitrim---Donegal-Regional-Review-2021.pdf

Type of Cattle	Value
Cows	93,300
Dairy cows	18,400
Other cows	74,900
Bulls	2,900
Cattle: 2 years and over	32,800
Cattle: 1-2 years	67,400
Cattle: under 1 year	82,200
Total cattle: male	86,200
Total cattle: female	192,400

Table 24 Livestock figures for the county

Type of Farm	Number of Farms
Suckler Cow Farms	6,362
Dairy Cow Farms	309
Sheep Farms	4,906

Table 25 Farm figures for the county

With over 279.319 hectares of agriculture area used for farming purposes by Donegal in 2019, the county is well-established in Irish farming and agribusiness.

The most dominant greenhouse gas emitted in the agriculture sector is Methane (CH_4), followed by Nitrous Oxide (N_2O), as shown below:

GAS	$ktCO_2e$
CH_4	497
CO_2	51
N_2O	218
Total	**766**

Table 26 Agricultural Sector Emissions by Gas Type

5.5 Land Use, Land Use Change and Forestry

5.5.1 Background

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. Land management has a key role in the response to climate change. Ireland has significant and healthy biosystems, including grassland, hedgerows, and forests, which sequester or absorb carbon dioxide (CO_2). This is a separate category from Agriculture because while LULUCF primarily deals with land use and forestry practices to enhance carbon sequestration and mitigate emissions, Agriculture involves the production and management of crops and livestock, and includes emissions and removals associated with agricultural activities such as enteric fermentation, manure management, and soil management.

Since 1990, Ireland's forest area has expanded by approximately 300,000 ha[58]. As these forests grow and mature, they represent an important CO_2 sink and long-term carbon store in biomass and soil. However, low forest planting rates in recent years are a future risk in terms of national forest estate continuing to act as a significant carbon sink. In 2019 the LULUCF sector accounted for 3,210 $ktCO_2$ equivalent removed and 9,867 $ktCO_2$ equivalent emitted [59]. In 2019, the national net emissions for LULUCF accounted at 6,657 kt CO_2.

Land use and land-use change contribute significantly to global greenhouse gas emissions. Deforestation, conversion of natural ecosystems to agriculture, and other land use changes result in the release of carbon dioxide (CO2) into the atmosphere, which contributes to the greenhouse effect and climate change.

On the other hand, land use and management practices can also offer significant potential for reducing emissions. Land-based activities can contribute to the sequestration of carbon, or the removal of CO2 from the atmosphere and its storage in soil, vegetation, and other organic matter. For example, reforestation and afforestation efforts can help sequester carbon from the atmosphere, acting as a natural sink for greenhouse gases. In addition, sustainable agriculture practices such as conservation tillage, agroforestry, and cover cropping can improve soil health, increase soil carbon sequestration, and reduce greenhouse gas emissions.

[58] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/lulucf/
[59] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/lulucf/

5.5.2 County Donegal: Baseline Inventory for LULUCF

LULUCF is responsible for 15% of the total GHG emissions in County Donegal, with 287 ktCO2 equivalent emitted. As seen in Figure 24, County Donegal's Cropland, Forestland and Harvested Wood Product serve as a store of carbon and were responsible for the sequestration of 367 $ktCO_2e$ of emissions, whilst the areas of Grassland, Settlements, Wetlands and Other Land were responsible for emitting 654 kt CO_2 equivalent of emissions:

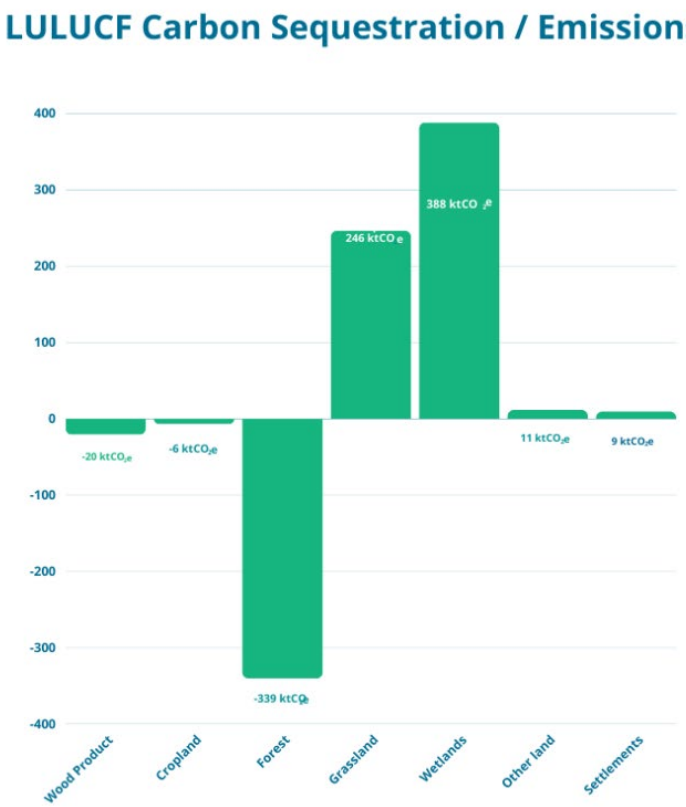


Figure 26 Carbon Sequestration and Emissions from LULUCF

5.5.3 Supporting Information

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.[60]

Land management has a key role in the response to climate change. Ireland has significant and healthy biosystems, including grassland, hedgerows, and forests, which sequester or absorb carbon dioxide (CO_2). Mineral soils and peat make up a large portion of Ireland's land areas and have high carbon content. These need to be protected through land management schemes.[61]

Land use and land-use change contribute substantially to global greenhouse gas emissions. However, they also offer significant potential to reduce emissions. The natural environment plays a crucial role in absorbing and storing carbon. The tables below show how the land is used in Donegal.

Subcategory	Area (ha)
Pastures	133,781
Natural Grasslands	5,746
Non-irrigated arable land	4,075
Land principally occupied by agriculture, with significant areas of natural vegetation	41,466
Total Agricultural Land	**185,068**

Table 27 LULUCF Subcategories CO_2 Equivalent Emissions

The Forest land category includes coniferous forest, broad-leaved forest, and mixed forest. The Forest Land in County Donegal is responsible for sequestering 339 $ktCO_2e$ and emitting none. Below is information about the different types of Forest land in County Donegal and the corresponding area covered in hectares. The table below outlines the area for forest land.

Subcategory	Area (ha)
Coniferous	26,682
Broad-leaved forest	3,304
Mixed forest	1,755
Transitional Woodland	21,446
Moors and heathland	26,264
Total Forest Land	**79,451**

[60] https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf
[61] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/lulucf/

Table 28 Forest Land Use Distribution[41]

The Wetland category includes peat bogs, inland marshes, transitional woodland – shrub, salt marshes, estuaries, and coastal lagoons. The Wetland areas in County Donegal are responsible for sequestering 0 $ktCO_2$ and emitting 388 $ktCO_2e$. Below is information about the different types of wetlands in County Donegal and the corresponding area covered in hectares. The table below outlines the area for wetlands. Due to its diverse topography, geology, hydrology, climate, and soil composition, Donegal boasts a remarkable array of habitats, with a particular highlight being Glenveagh National Park, a significant portion of land under the State's management. Within this region, alongside other notable areas like the Donegal Peatlands and various wetlands, lies a crucial nature-based solution: these habitats hold the highest volume of carbon per unit area. Notably, peat-forming plants such as sphagnum moss and sedges play a pivotal role in this process by actively removing carbon from the atmosphere. In fact, on a global scale, these ecosystems store an immense quantity of carbon, surpassing even the combined carbon content of all the world's forests, making them an invaluable natural resource.

Subcategory	Area (ha)
Peat Bogs	182,902
Inland marshes	436
Salt Marshes	222
Estuaries	727
Water courses	329
Water bodies	5,503
Total Wetland	**190,119**

Table 29 Wetland Land Use Distribution[62]

[62] https://gis.epa.ie/GetData/Download

The Other Land Uses category includes the rest of the land use in County Donegal. Below is information about the different types of Other Land Uses in County Donegal and the corresponding area covered in hectares.

Subcategory	Area (ha)
Discontinuous urban fabric	5,558
Industrial units	239
Sport and leisure facilities	1,091
Road and rail networks	123
Airports	47
Burnt areas	469
Bare rocks	612
Sparsely vegetated areas	10,659
Intertidal flats	1,317
Beaches, dunes, sands	3,511
Complex cultivation patterns	6,420
Port areas	43
Mineral extraction sites	183
Total Other land use	**30,272**

Table 30 Other Land Use [42]

The most dominant greenhouse gas emitted in the LULUCF sector is carbon dioxide (CO_2), followed by methane (CH_4), shown in the table below:

GAS	$ktCO_2e$
CH_4	34,606
CO_2	0.3
N_2O	1,602
Total	**36,208**

Table 31 Land Use, Land Use Change and Forestry Emissions by Gas Type

5.5.3.1 County Context

County Donegal is the most mountainous region in Ulster but still possesses a wide variety of habitats that host over half of Ireland's plant and animal species. Naturally, the varying topography, geology, hydrology, climate and soil presence strongly contribute to that fact. Interestingly, Teagasc in 2014 tested that only 6% of the County Soils achieved a good overall fertility status.[63]

The agricultural land use is mostly Grassland, Rough Grazing and Commonage. Blanket bogs and wetlands cover an extensive area in the County and are concentrated in the western and upland regions[64]. On a per unit-area basis, they hold the greatest volume of carbon and therefore are an important nature-based solution. When peatlands and wetlands are drained and damaged, carbon is released into the atmosphere.

Forests are probably the most familiar nature-based solution for climate change and can contribute both by reducing emission sources and increasing carbon sinks. Globally, forestry and soils absorb about 30% of atmospheric carbon emissions, partially through forest productivity and restoration[65]. Forestry offers the greatest amount of cost-effective mitigation opportunities, comprising about two-thirds of all nature-based climate solutions.

In 2017, the 3rd National Forest Inventory estimated that the Donegal Forest Area is 55.53 ha covering 11.4% of the county. Over the last years, the Irish forest sector was evolving and strongly contributed to rural economies, leading to 40 ha of forestry planted in Donegal in 2020.[66] Furthermore, County Donegal has over 190 kha of wetlands, which make up roughly 30% of the land surface and were responsible for emitting over 388,73 kt of GHG emissions.

5.5.3.2 MapEIre Subsectors

As a result of such land composition, LULUCF is responsible for 15% of the total GHG emissions in County Donegal, with 287 $ktCO_2$ equivalent emitted. As seen in Table 30, County Donegal's Cropland, Forestland and Harvested Wood Product (a wood product that is harvested creates a magnifying effect where greenhouse gases are sequestered even further as forestry land is replaced and new trees absorb carbon dioxide) were responsible for the removal of 367,396 $ktCO_2$ equivalent of emissions, whilst the areas Grassland, Settlements, Wetlands and Other Land were responsible for emitting 654,592 $ktCO_2$ equivalent of emissions.

[63] https://www.teagasc.ie/media/website/crops/soil-and-soil-fertility/Donegal.pdf
[64] https://www.wildatlanticnature.ie/project-areas-donegal/
[65] https://climate.nasa.gov/news/2927/examining-the-viability-of-planting-trees-to-help-mitigate-climate-change/
[66] https://www.teagasc.ie/media/website/crops/forestry/advice/Forest-Statistics-Ireland-2020.pdf

5. Other Inventories

5.1 Fluorinated Gases

Fluorinated gases are artificially produced gases used in a range of industrial applications. They are often used to substitute gases that deplete the ozone, as they do not damage the atmospheric ozone layer. However, they are greenhouse gases with high GWPs, thus contributing to climate change. They were not included as their sector in the Chapter 3 Inventory (present in Industrial Processes) but are added here.

Hydrofluorocarbons are typically found in applications such as refrigeration, air-conditioning, aerosols, and foams.[67] SF_6, however, is used primarily in the electricity and electronics supply industries, e.g. the semiconductor industry, where it is used as an electronic insulator due to its inertness[68].

F-gases in Ireland are controlled by European Regulation (EC) No. 517/2014. This Regulation aims to cut EU emissions of F-gases by two-thirds of 2014 levels by 2030. It is a legal requirement in Ireland that all businesses that install, maintain or service stationary refrigeration, stationary fire protection systems and extinguishers, air conditioning and heat pump equipment containing or designed to contain F-Gas refrigerants, obtain an F-Gas Company Certificate[69].

5.1.1 County Donegal: Baseline inventory for F-gases

Using MapEIre's CRF Geospatial Dataset (a different dataset than the local authority specific one used for the activity-based inventory), two types of F-gases were identified in County Donegal: hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6). The CO_2 equivalent of the SF_6 is included in the 3.1.1 results section as part of the overall GHG emissions. However, the CO_2 equivalent of the HFCs is not included in the overall GHG emissions. The NRF MapEIre GIS files were used to inform the data for the Fluorinated gases. The total mass of both is listed below:

GAS	$ktCO_2e$
CH_4	37
CO_2	220
N_2O	30
Total	287

Table 32 Total Mass of Fluorinated Gases in County Donegal

[67] https://www.ccacoalition.org/fr/slcps/hydrofluorocarbons-hfcs
[68] https://library.wmo.int/index.php?lvl=categ_see&id=10223#.Y3-3eXaZOUk
[69]https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/EPA-GHG-Inventory-Report-Final.pdf

5.2 Local Authority own Emissions

All public bodies in Ireland must achieve a 51% reduction in energy related GHG emissions and a 50% improvement in energy efficiency by 2030. This is tracked through the SEAI's Monitoring and Reporting (M&R) system, in which each public sector organisation reports the following:

- Annual energy consumption for all energy types.
- Annual value that quantifies the level of activity undertaken by the organisation each year. This is referred to as the activity metric.
- Details of energy saving projects implemented and planned.
- Summary of the approach adopted for reviewing the organisation's energy management programme.

As of 2020, public bodies have saved €1.8 billion and 6 million tonnes of CO_2 emissions through avoided energy use between 2009 and 2020. The public sector is 34% more energy efficient than in 2009 and exceeded its 33% energy efficiency target for 2020[70]. In 2019 approximately two thirds of LA electricity consumption was for Public Lighting. The remaining third was primarily used in LA buildings.

The total emissions from the public sector in Donegal are 10,668 $ktCO_2$ equivalent. This represents less than 1% of the total emissions for County Donegal. These emissions are not separated from the broader MapEIre inventory, but rather provide a closer look at the emissions the LA is directly responsible for. Electricity consumption represents the bulk of the LA's emissions reported to the SEAI M&R system, followed by Heating and Transport emissions.

Electricity emissions come entirely from imports, the largest fuel source for Heating are heating oils, and the largest fuel source for the Transport fleet is road diesel.

Energy Management in Donegal County Council

Donegal County Council has implemented an energy management system (EnMS) to efficiently manage the energy consumption throughout the organization. The EnMS allows the Council to gather detailed information on energy usage, providing insights into specific areas where energy is consumed.

Energy management follows a systematic approach aimed at improving energy performance. It focuses on reducing energy usage primarily by improving behavioural practices and implementing simple controls. Subsequently, energy reduction projects are undertaken to further minimize consumption. While the integration of renewable energy sources is considered, the emphasis is placed on energy conservation. The objective is to minimize energy use without compromising service levels for citizens or staff.

In the table below, you will find information regarding the electricity usage for PSC's (Public Service Centres) and County House:

Year	kWh Consumption	% Reduction

[70] https://www.seai.ie/business-and-public-sector/public-sector/monitoring-and-reporting/introduction-to-mr/

2015	1,044,302	Base Year
2016	1,013,309	-2.97%
2017	911,407	-12.73%
2018	847,701	-18.83%
2019	794,848	-23.89%
2020	770,985	-26.17%
2021	837,227	-22.01%
2022	542,085	-67.61%

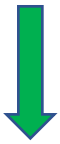


Table 33: electricity usage for PSC's (Public Service Centres) and County House

County Donegal has implemented various projects from different perspectives to reduce energy consumption and emissions. The following list highlights some of these initiatives undertaken to address this issue since 2020:

Energy Reduction Projects planned and currently being carried out since 2020:

*** County House – LED Lighting Upgrades**
*** County House – Solar PV Phase 2**
*** Milford PSC – Heating Upgrades**
*** Milford PSC – Solar PV & Cavity Insulation**
*** Machinery Yard – EV Charge Points**
*** Energy Awareness Campaigns**
*** Letterkenny PSC – Heating Upgrades**
*** Letterkenny PSC – Solar PV & Cavity Insulation**
*** Regional Cultural Centre – LED Lighting Upgrades**
*** An Grianán Theatre – Solar PV & Battery Storage**
*** An Grianán Theatre – Cavity & Ceiling Insulation**
*** Regional Cultural Centre – Solar PV & Battery Storage**
*** County Museum – Solar PV & Cavity & Ceiling Insulation**
*** Letterkenny PSC – Thermal glazing upgrade**

Targets are established at an organizational level and are further reinforced by specific actions undertaken by each SEU (Strategic Energy Use) owner and the Energy Management Team (EMT). These targets are effectively managed through the Register of Opportunities, which includes a dedicated section for selected actions. The following outlines past and current targets set for the key SEUs within the organization.

SEU	2016	2017	2018	2019	2020	2021	2022

Libraries & Cultural Services Buildings Electricity	5%	5%	4%	4%	4%	4%	2%
PSC & County House Electricity	5%	10%	4%	4%	4%	4%	2%
PSC & County House Thermal	5%	10%	4%	2%	2%	2%	2%
Fire Stations Electricity	5%	5%	4%	4%	4%	4%	2%
Public Lighting Electricity	5%	5%	4%	10%	10%	10%	2%
Machinery Yard Transport Fuel	3%	3%	4%	4%	4%	1%	0.5%

In the breakdown of electricity usage in DCC for the year 2021, public lighting accounts for 68% of the total electricity consumption. See Figure below.

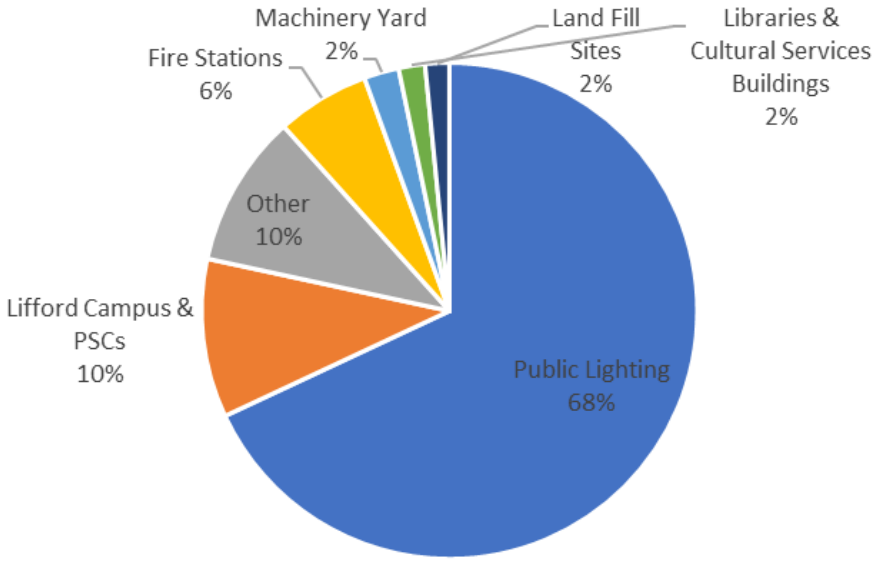


Figure 27 Breakdown of electricity usage in DCC (2021)

Donegal County Council Own Emissions

Energy	Energy Category	Energy Type	$kgCO_2$
Electricity			4,135,701
	Electricity		4,135,701
		Net Electricity Imports (MPRN data)	4,135,701
		Net Electricity Imports (non-MPRN data)	0
		Onsite Generation by Non-Fuel Renewables or Landfill Gas	0
		Offsite Charging of Electric Vehicles	0
Heating			1,696,748
	Heating Oils		1,641,969
		Kerosene	1,025,562
		Gasoil	616,407
	Gas		54,779
		LPG (purchased by volume)	52,669
		LPG (purchased by weight)	2,111
	Wood fuels & solid biomass		0
		Wood Chips (35% moisture)	0
	District Heating		0
Transport			4,835,772
	Transport Fuels (Mineral Oil Fuels)		2,195,182
		Petrol (excl. blended bioethanol)	10,54
		Road Diesel (DERV) (excl. blended biodiesel)	1,875,343
		Marked Diesel (non-thermal)	309,296
	Transport Biofuels		0
		Biodiesel (incl. all blended biodiesel)	0
		Bioethanol(incl.all blended bioethanol)	0
	Other Transport Fuels		2,640,589
		Marked Diesel provided by Plant Hire Contractors	2,640,589
Total CO2 Emissions			10,668,220

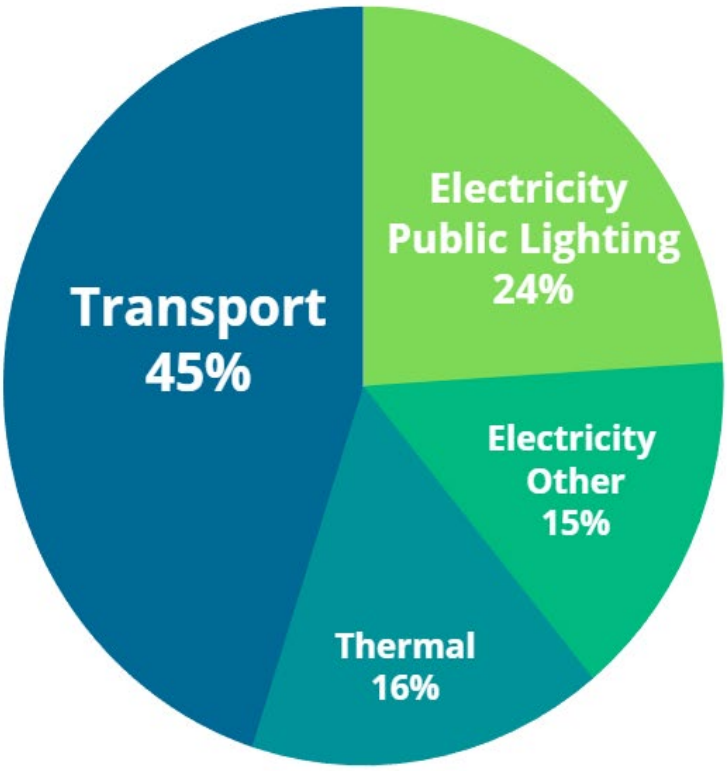
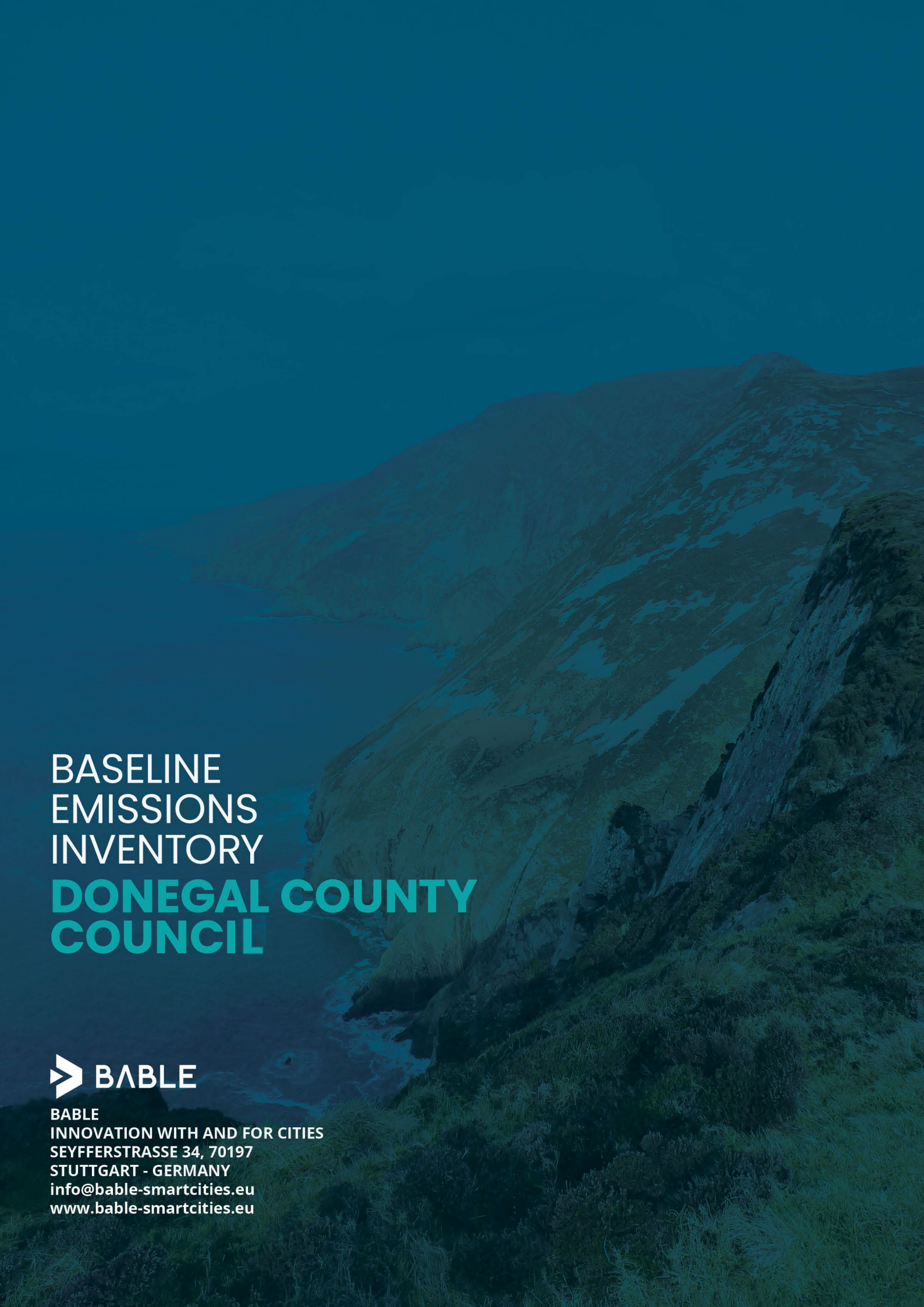


Figure 28 Donegal County Council CO_2 Emissions from Electricity, Heating and Transport (2019)



BASELINE EMISSIONS INVENTORY

DONEGAL COUNTY COUNCIL

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