



**CARLOW**  
COUNTY COUNCIL  
COMHAIRLE CHONTAE CHEATHARLACH

# Tier 2 Baseline Emission Inventory

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## GLOSSARY OF TERMS

**Baseline Year** – the period for which the data is used to ascertain the GHG emissions for each sector

**BER** - Building Energy Rating

**CCC** - Carlow County Council

**CIBSE** - Chartered Institution of Building Energy Services Engineers

**CNG** - Compressed Natural Gas

**CO<sub>2</sub>** - Carbon Dioxide

**CSO** - Central Statistics Office

**eq** - equivalent

**F-gases** – Fluorinated gases

**GHG** – Greenhouse Gas Emissions

**kt** - Kilotons

**ktoe** - kiloton of oil equivalent

**kWh** - Kilowatt Hour

**LPG** - Liquid Petroleum Gas

**LULUCF** – Land Use, land use change, and forestry

**M&R** – monitoring and Reporting

**MWh** - Megawatt-hour

**National Baseline Period** – National Baseline for Ireland is 2018, as set out in the Climate Action Plan 2021

**NFR** - Nomenclature for Reporting

**PSVs** – Public Service Vehicles

**Public Sector Baseline Period** – Public Sector baseline, including for Carlow County Council is 2016-2018, as set out in the Climate Action Plan 2021

**SEAI** - Sustainable Energy Authority of Ireland

**TFC** - Total Final Consumption

**WWTP** - Wastewater Treatment Plant

## EXECUTIVE SUMMARY

The national carbon reduction targets set out in the Climate Action and Low Carbon Development (Amendment) Act 2021 are 51% reduction by 2030, compared to 2018 levels.

Carlow County Council is required, under Section 16 of the Climate Action and Low Carbon Development (Amendment) Act 2021, to prepare a Local Authority Climate Action Plan (CAP). The CAP will outline the pathway for Carlow County Council to reduce its Greenhouse Gas Emissions (GHG) by the required 51% by 2030. This is compared to GHG emission levels from 2016-2018, which has been set as the baseline, see Figure 1.

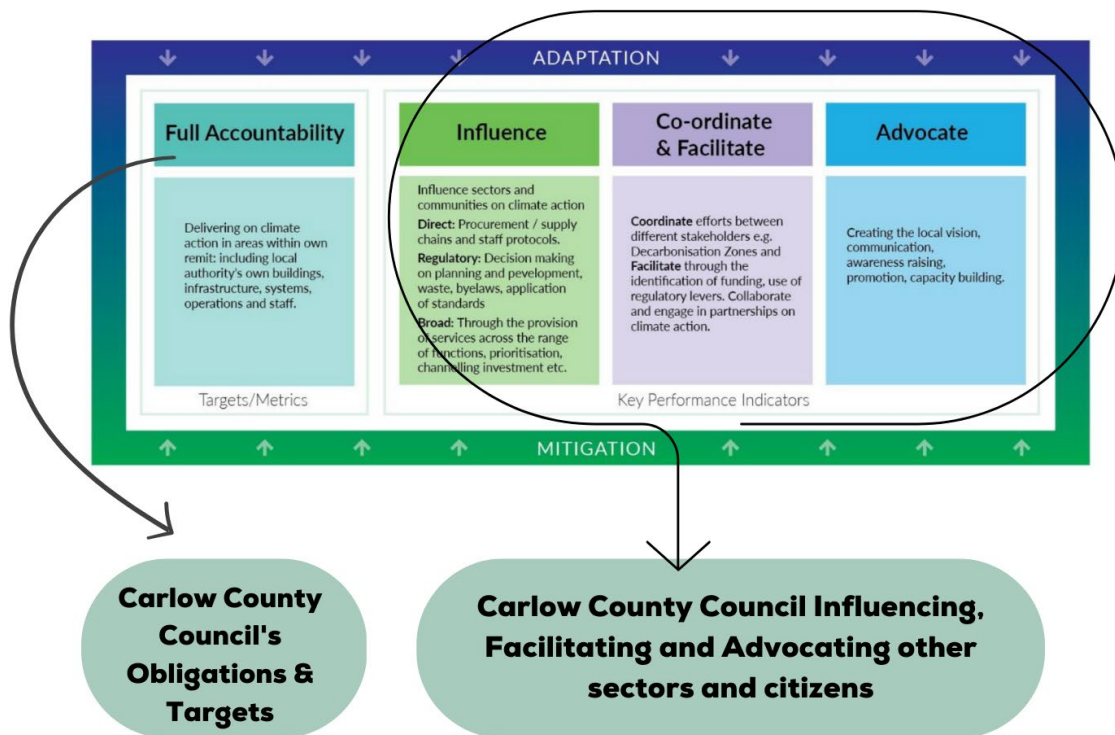
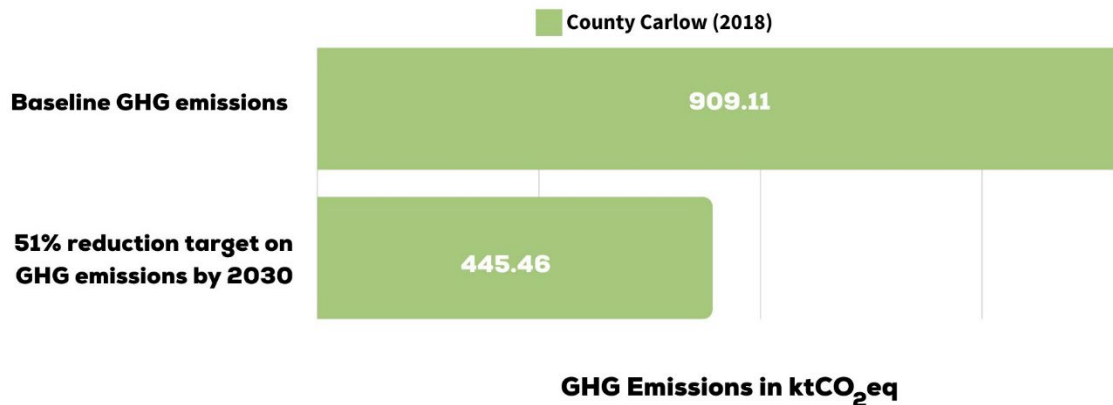
***The National Climate Action Plan 2023, Section 10 requires all public sector bodies including local authorities to calculate their baseline GHG's for 2018 using an average of years 2016-2018. This average is referred to as the 2018 baseline.***

For the purpose of this report and the data analysis, all GHG are converted and reported as CO<sub>2</sub>equivalent emissions, or CO<sub>2</sub>eq. Some emissions are actual carbon dioxide (CO<sub>2</sub>), some are methane (CH<sub>4</sub>) and some are Nitrous Oxide (N<sub>2</sub>O). All emissions are converted into CO<sub>2</sub>eq.

The quantitative Baseline Emission Inventory was prepared in accordance with the methodology provided in “Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines” (DECC, 2023). These guidelines outlined the Tier 2 approach to be taken by the Local Authorities in the development of the Baseline Emissions Inventory at County Level. Tier 2 is the bottom-up approach for data analysis, which takes national datasets and local-scale datasets together to look at county wide GHG emissions across various sectors which include:

- Residential
- Manufacturing & Commercial
- Industrial Processes
- Agriculture
- Transport
- Land Use Change and Forestry (LULUCF)
- Waste
- F-gases

The LACAP will outline the specific target Carlow County Council and, therefore, included in this BEI is the extraction of Carlow County Councils direct GHG emissions from the above sectors. Carlow County Councils data is reported as a separate sector in this report. Carlow County Council has full accountability and obligations to reduce its own GHG emissions by 51% by 2030, and can influence, co-ordinate, facilitate and advocate for all other sectors to reduce their own GHG emissions by the same 51% by 2030. The BEI, therefore, outlines the 2018 baseline data for County Carlow as a whole, which includes Carlow County Councils 2018 data. However, for Carlow County Councils own targets, the 2016-2018 baseline period has been used, as outlined in the Climate Action Plan 2021. Both sets of data are reported in Chapter 4.



**51%** Reduction in GHG emissions by 2030



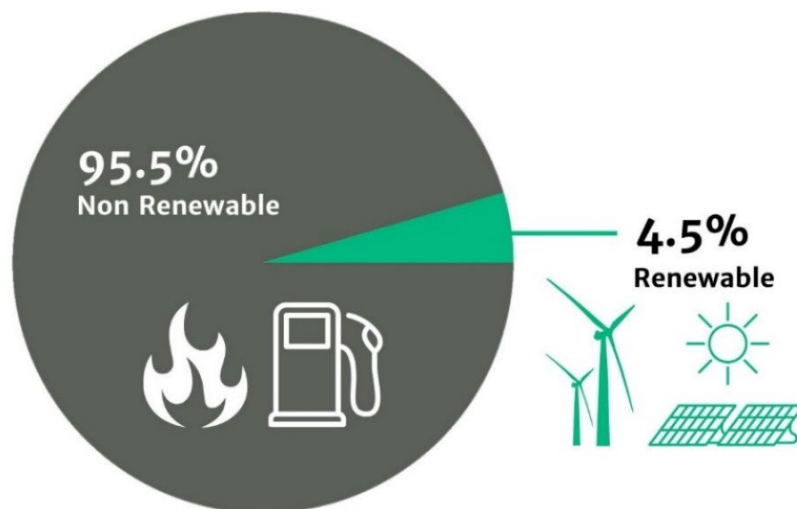
**Figure 1. Local Authority Scope on Climate Action (source CCMA/CARO)**

This Tier 2 Baseline Emissions Inventory (BEI) outlines the GHG figures for 2018, in order to establish the absolute GHG emissions target for 2030 for County Carlow.

Documents outlining the data collection process, the sources of data, assumptions or projections made, and the calculation methodology are available in the “Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines”.

In order to ascertain the GHG emissions per sector, the energy consumption has also been analysed and is reported alongside the GHG data in this report.

Energy consumption in 2018 for County Carlow is 1,661.25 Gigawatt hours (GWh). It should be noted that energy from renewables only contributed to 4.5% of the total fuel mix, see Figure 2.



**Figure 2. County Carlow Energy from Renewable Sources**

The breakdown of GHG emissions and energy consumption per sector for the baseline year is as follows, see Figure 3:

#### **Carlow County Council**

- Total final emissions produced by Carlow County Council in County Carlow in the year 2018 was 2.56 ktCO<sub>2</sub>eq.
- Total final energy used in the year 2018 was 8.16 GWh
- Total average GHG emissions produced by Carlow County Council in the 2018 baseline<sup>1</sup> was 2.81 ktCO<sub>2</sub>eq.
- Average final energy used in 2016-2018 baseline was 8.10 GWh

<sup>1</sup> The National Climate Action Plan 2023 , Section 10 requires all public sector bodies including local authorities to calculate their baseline GHG’s for 2018 using an average of years 2016-2018. This average is referred to as the 2018 Baseline.



### **Residential**

- Total residential emissions were 103.74 kt of CO<sub>2</sub>eq in 2018
- Total delivered energy for the residential sector for 2018 was 352.36 GWh

### **Manufacturing and Commercial**

- Total emissions in 2018 were 134.96 kt of CO<sub>2</sub>eq;
- Total final energy used in 2018 was 510.41 GWh

### **Industrial Processes**

- Total emissions from industrial processes were 48.39 ktCO<sub>2</sub>eq.

### **Agriculture**

- Total emissions in 2018 were 353.64 ktCO<sub>2</sub>eq.
- Total final energy used in 2018 was 81.02 GWh

### **Transport**

- Total final emissions from transport were 187.63 ktCO<sub>2</sub>eq.
- Total final Energy for Transport sector was 709.31GWh

### **Land Use Change and Forestry (LULUCF)**

- Total emissions from LULUCF sector were 66.61 ktCO<sub>2</sub>eq in 2018

### **Waste**

- Total emissions from waste sector were 11.57 ktCO<sub>2</sub>eq in 2018

### **F-Gases**

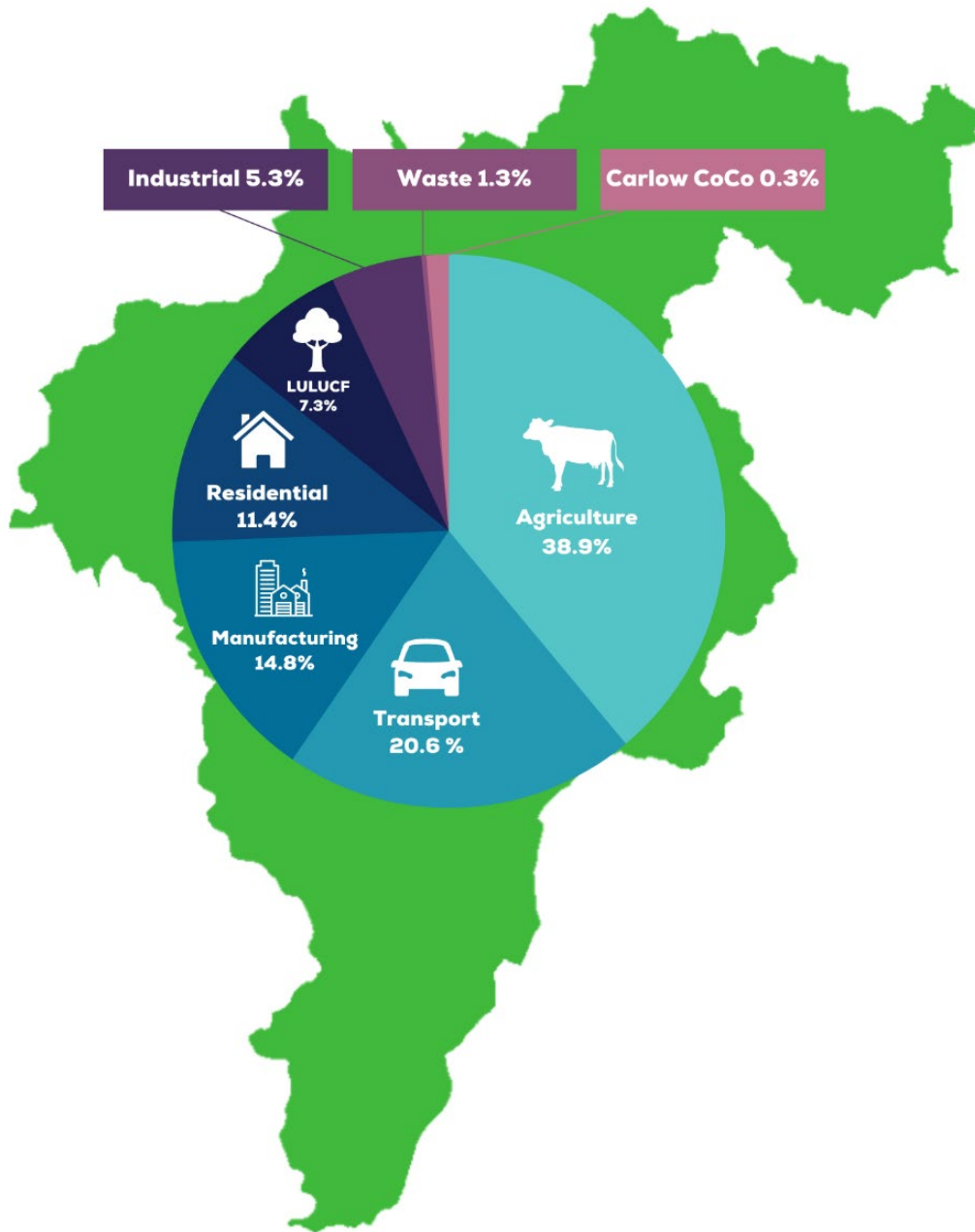
- In County Carlow there were no emission accounted for by F-gases

**Baseline GHG emissions for County Carlow were  
909.11kt of CO<sub>2</sub>eq.**

Agriculture is the highest GHG emitter, with 38.9% of the County GHG emissions.

Transport is second with 20.6% and Manufacturing & Commercial follows with 14.8% of the GHG emissions.

**Baseline GHG emissions for Carlow County Council were  
2.81kt of CO<sub>2</sub>eq.**



**Figure 3. Share of Total Emissions in County Carlow 2018**



# 1.0 INTRODUCTION

The 2030 Emission Reduction Target as set out in the Climate Action and Low Carbon Development (Amendment) Act 2021 is a 51% absolute reduction in overall greenhouse gas emissions by 2030 and setting us on a path to reach net-zero emissions by no later than 2050, as committed to in the Program for Government (Government of Ireland, 2021).

An absolute reduction means that regardless of activity in the county, the total GHG emissions across the County by 2030 must be 51% less than the total GHG emissions in the baseline year, which in this case is 2018. For example, if the GHG emissions in 2018 were 100 ktCO<sub>2</sub> equivalent, then the total allowable GHG emissions by 2030 is 49kt CO<sub>2</sub> equivalent. The absolute target must be met regardless of growth or changes within the Counties sectors.

Although the National targets are set against a 2018 baseline, Local Authorities are required, in accordance with Department Guidelines on the preparation of a Climate Action Plan, to use the data average of 2016-2018 as their baseline period. Therefore, throughout this report, when Carlow County Councils baseline data is outlined, it is for the 2016-2018 baseline period. All other sectors data included in this report use 2018 period for their baseline.

This County Wide Baseline Emissions Inventory (BEI) therefore outlines the 2018 baseline data for County Carlow as a whole, which includes Carlow County Councils 2018 data. However, for Carlow County Councils own targets, the 2016-2018 baseline period has been used, as outlined in the Climate Action Plan 2021. Both sets of data are reported in Chapter 4.

Carlow County Council (CCC) requested the Southeast Energy Agency (SEEA) to prepare Tier 2 Baseline Emissions Inventory (BEI) for County Carlow to serve as an evidence-base for mitigation planning in County Carlow, and to inform the development of the 5-year County Carlow Climate Action Plan.

The following report outlines the results and the methodology used to calculate County Carlow's energy consumption and GHG emissions per sector for 2018. The methodology and Tier 2 approach for the County Wide GHG emissions inventory was outlined in the "Technical Annex C: Climate Mitigation Assessment" of the Local Authority Climate Action Plan Guidelines" published in March 2023 (pages 24-30) (DECC, 2023).

This baseline report aims to raise awareness of climate change and the impact that different sectors in County Carlow have on Ireland's overall carbon emissions and energy use. It provides Carlow County Council with the necessary information to make decisions on climate change actions to lower the carbon emissions in their own direct emissions, which is the emissions they have responsibility and accountability for.

The methodology used for the analysis was developed using MapEire<sup>2</sup> and EPA data, and other publicly available local sources including:

- Electricity metered consumption data<sup>1</sup>

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<sup>2</sup> <https://projects.au.dk/mapeire>

- Central Statistics Office's household census, agricultural census and transport Omnibus<sup>2</sup>
- SEAI's latest Energy in Ireland report<sup>3</sup>, emission factors for fuels and grid electricity<sup>4</sup>
- M&R system and National Building Energy Rating Database<sup>5</sup>
- Valuation Office data on commercial buildings<sup>6</sup>
- CIBSE energy benchmarks (Guide F and TM46)
- Agricultural energy and emissions benchmarks from sources such as Teagasc, Dept. Agriculture, Food and Marine, and the Carbon Trust

MapElre is the state-of-the-art integrated model system to map emissions for Ireland's emission inventories of air pollutants and greenhouse gases. Based on a variety of spatial and statistical data, the MapElre model produced detailed spatial emissions at a resolution of 1 km × 1 km (Plejdruk, 2018).

The MapElre dataset was used to establish the BEI for the county. As there is currently no publicly available actual energy consumption data for every sector in County Carlow, the GHG dataset in combination with individual data sourced was used to calculate the energy consumption in the county.

<sup>1</sup>[Metered Electricity Consumption 2020 - CSO - Central Statistics Office](#)

<sup>2</sup>[Introduction and Overview of Results - CSO - Central Statistics Office](#)

<sup>3</sup>[Energy in Ireland 2019 Report \(seai.ie\)](#)

<sup>4</sup><https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/>

<sup>5</sup><https://ndber.seai.ie/BERResearchTool/ber/search.aspx>

<sup>6</sup><https://opendata.valoff.ie/api/>

## 2.0 SCOPE OF REQUIREMENTS

The following elements for the Baseline Emissions Inventory (BEI) were required by Carlow County Council, as outlined in Annex C<sup>3</sup> of the Local Authority Climate Action Plan Guidelines (DECC, 2023).

- A calculation of the Greenhouse Gas (GHG) emissions resulting from activity within the geographical boundary of the Carlow County Council area.
- Visual representation of the resulting GHG emissions baseline, broken down as far as possible into sub-sectors.
- A ranking of sectors and sub-sectors contributing the largest GHG emissions.
- A detailed report outlining the methodology, assumptions and all data sets used to formulate the BEI, and an executive summary customised for a non-technical audience.
- A calculation of the emissions reduction required, based on the baseline, to meet the national climate action plan 2030 targets.
- Any other outputs resulting from the BEI analysis that will add to the evidence-base for mitigation planning in the Local Authority administrative area.
- Presenting the findings to Carlow County Council Climate Action Team.

The GHG Protocol Corporate Standard categorise greenhouse gas emissions as Scope 1, Scope 2, and Scope 3 emissions. This report analyses Scope 1 emissions, which are direct emissions associated with the direct consumption and activity. This does not include emissions associated with the purchase of energy (Scope 2) or indirect emissions from the value chain (Scope 3).

- **Scope 1 emissions** – This covers the GHG emissions that are made directly – for example running boilers and vehicles
- **Scope 2 emissions** – This covers the GHG emissions that are produced indirectly – like buying electricity or energy it buys for heating and cooling buildings
- **Scope 3 emissions** – This covers the GHG emissions associated not with the organisation itself, but that the organisation is indirectly responsible for in the supply chain – for example when we use products from suppliers

The Scope 1 emissions included in this report includes all emissions locally produced from the following sectors:

- Large Industries
- Buildings (residential and commercial)
- Industrial processes
- Waste
- Transport
- Agriculture
- Fluorinated gases and land-use

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<sup>3</sup> <https://assets.gov.ie/250051/e165c6b5-3eed-487d-b4ec-1db46dcec7e1.pdf>

## 3.0 METHODOLOGY

The methodology on how to complete the Climate Mitigation Assessment is outlined in “Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines” published in September 2022 (pages 24-30) (DECC, 2023).

The Baseline Emissions Inventory (BEI) is a key instrument that will enable Carlow County Council to measure the impact of all actions related to emission reductions across its own operations as well as varying sectors of society. The BEI represents an evidence-based approach to not only inform appropriate emission reduction actions, but also measure progress overtime.

### 3.1 CARLOW COUNTY COUNCILS DIRECT GHG EMISSIONS

Carlow County Council maintains responsibility to deliver its own targets for emission reductions and establishing the baseline is a necessary starting point. Data for the Local Authorities direct energy-based emissions are reported annually to the SEAI under the mandatory Monitoring & Reporting system<sup>4</sup>. The M&R system is the tool that tracks the public sectors progress towards the 2030 targets, based on the annual submission of energy data. The methodology for reporting Carlow County Councils data to the SEAI via the Monitoring & Reporting system is set out by the SEAI. Carlow County Council have reported using this system since 2012, and all data has been verified and accepted by SEAI, and is published in the Annual Report on Public Sector Energy Efficiency Performance (see most recent 2021 report - Sustainable Authority of Ireland, 2021<sup>5</sup>)

It is necessary that Carlow County Council addresses its own GHG emissions and clearly identifies the sources and level of emissions and energy use from across the range of activities performed. The required data extracted from the local authority’s M&R system provides an energy and carbon based BEI distinct to Carlow County Council. This BEI should be used to inform the development of targeted and specific actions to further reduce the local authority’s own emissions.

The National Climate Action Plan 2023 , Section 10 requires all public sector bodies including local authorities to calculate their baseline GHG’s for 2018 using an average of years 2016-2018. This average is referred to as the 2018 Baseline.

### 3.2 COUNTY WIDE GHG EMISSIONS

This report focuses on energy use and GHG emissions from different sectors which align with the sectors addressed by the National Emissions Inventory (Environmental Protection Agency, 2020).

The sectors are:

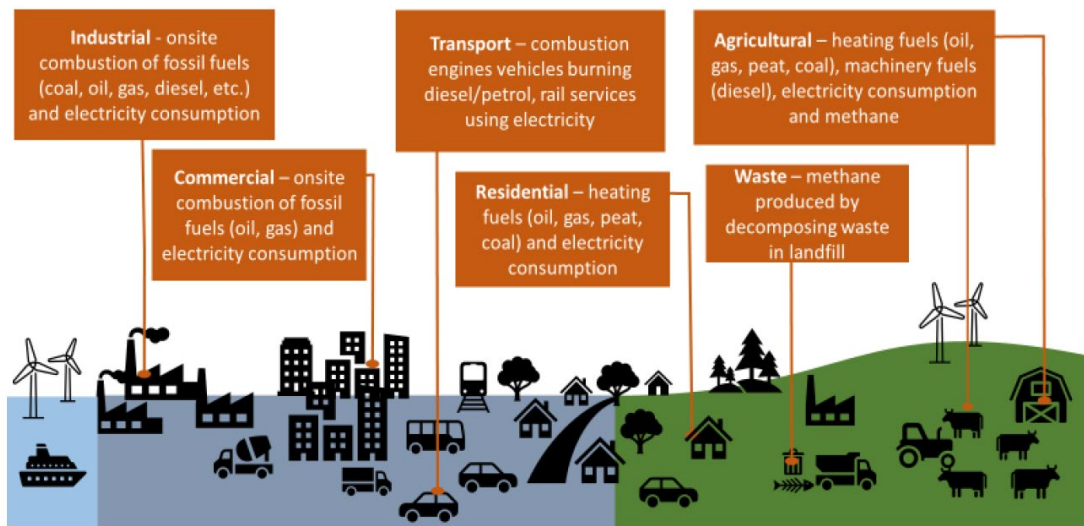
1. Residential
2. Manufacturing & Commercial

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<sup>4</sup> <https://psmr.seai.ie/Account/LogOn?ReturnUrl=%2f>

<sup>5</sup> <https://www.seai.ie/publications/Public-Sector-Annual-Report-2021.pdf>

3. Industrial Processes
4. Agriculture
5. Transport
6. Waste
7. Land Use Change and Forestry (LULUCF)
8. Fluorinated Gases (F-Gases)



**Figure 4. Representative Sectoral Sources of GHG Emissions (Source: Codema)**

The Local Authority’s own emissions are captured within the Manufacturing & Commercial and Transport sectors datasets provided by MapElre. For this report Carlow County Councils data is reported separately and have been extracted from the data reported for the Manufacturing & Commercial sector to avoid ‘double-counting’. The transport emissions attributed to Carlow County Council are also extracted from the general Transport data and reported under Carlow County Council direct emissions.

The analysis focused on the current energy demand and fuels that used to provide energy, and the associated CO<sub>2</sub>eq emissions and GHG emissions related to activities within County Carlow. Non-energy related emissions were also reported where available and are mainly outlined in the Waste, LULUCF and Agriculture sections.

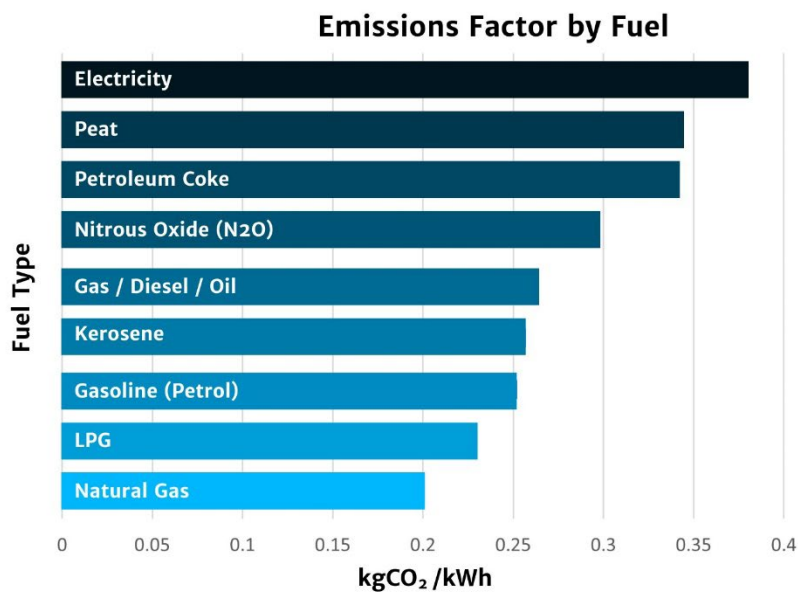
### 3.3 EMISSIONS SCOPE

The emissions accounted for in the MapElre data source includes both ‘emissions trading scheme’ (ETS) and ‘non-emissions trading scheme’ (non-ETS) sectors and emissions. This includes all emissions locally produced from sectors, those produced by large industries, buildings (residential and commercial), industrial processes, waste, transport, agriculture and land-use. Domestic aviation is also accounted for however, it does not include emissions from intra-EU aviation as those are not considered part of Ireland’s total reportable greenhouse gas emissions. More detail can be found in the EPA 2022 Report (EPA, 2022).

- **Emissions Trading Scheme (ETS)** – This means that GHG from certain sectors are treated as a commodity or product that can be traded on the EU carbon market. This includes emissions from large industries, electricity generators, and the aviation industry.
- **Non Emissions Trading Scheme (Non-ETS)** – This means that GHG from sectors that cannot be traded on the EU carbon market. Non-ETS emissions include greenhouse gas emissions from homes, cars, small businesses and agriculture.

### 3.4 EMISSION FACTORS

Emission factors are used to convert energy use to CO<sub>2</sub>eq emissions. Emissions factors for different fuel types are published by SEAI annually and the 2018 factors were used for this report as the baseline year is 2018<sup>6</sup>. The emission factors are dependent on the type of fuel used, as different fuels have different emission factors. Figure 5 below illustrates the emission factors for different fuel types. It should be noted that Peat has the highest emission factor, as it has the highest emissions in kgCO<sub>2</sub>eq for every 1 kWh of energy use.



**Figure 5. Emission Factors for Different Fuel Types**

### 3.5 CARBON-OFFSETTING

Calculations on ‘carbon offsetting’ are not included in this analysis as currently offsetting cannot be used to meet the public sector’s mandatory emissions and energy targets. Carbon offsetting is a practice which involves an organisation removing or offsetting the same amount of carbon emissions from the atmosphere to compensate for the carbon emissions that it emits.

<sup>6</sup> <https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/>



Large renewable energy projects like wind and solar farms that are connected to the national electricity grid contribute to the reduction of emissions at a national level and are reflected in reduced emissions intensity of electricity generation. Therefore, the associated reductions cannot be counted separately at a local level, as this would be ‘double-counting’ the emission reduction.

## 3.6 ASSUMPTIONS

It is important to note that there are assumptions used in all methodologies for local level emissions baseline. These are required as it is impossible to create a completely accurate picture of all emissions.

All data from the Central Statistics Office is from the Census 2016 data set. The Census 2022 data was not fully available at time of analysis. This is as per the Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines” (DECC, 2023).

### Residential

- Average energy use per dwelling from SEAI’s Energy in Ireland Annual Report (SEAI, 2019) is used. The average energy use per dwelling in 2018 was 18,208 kWh, equating to 5.1 tonnes of CO<sub>2</sub>eq.
- Census provides information on the main source of heating fuel used per dwelling, which is used to calculate a percentage breakdown of energy consumption at County level – this comes from the Private Households in Permanent Housing Units 2011-2016<sup>7</sup>.

### Manufacturing and Commercial

- There are no energy benchmarks available in Ireland for commercial properties, so a CIBSE UK Guide was used; this was based on numerous surveys in the UK for different commercial property types (CIBSE, 2008).
- All offices are taken on ‘naturally ventilated open plan’, as described by CIBSE (CIBSE, 2008).
- The CIBSE benchmarks only split energy consumption averages for buildings between thermal and electricity. Therefore, the National breakdown of thermal and electricity in the Manufacturing & Commercial sector had to be used instead of the individual fuel types such as heating oil, natural gas etc.

### Agriculture

- The agricultural sector in Ireland has very little non energy related GHG data publicly available and as such, approximate energy use was based on the best available data. Livestock data was extracted from Central Statistics Office Census of Agricultural<sup>8</sup>
- MapElre database was used for non-energy related emissions (AARHUS University, 2022)

Energy benchmarks developed by Teagasc (Teagasc, 2019) are the only Irish energy in agriculture benchmarks. Therefore, the UK Carbon Trust and the UK’s Department of the Environment, Food

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<sup>7</sup> <https://data.cso.ie/table/E1005>

<sup>8</sup> <https://data.cso.ie/table/AVA28>

and Rural Affairs (DEFRA) in Britain, were used as a comparison and representation of Irish agriculture



# SECTORAL GHG EMISSIONS 2018

This section of the report outlines the GHG emissions associated with the individual sections highlighted above, the methodology and results of each and summarises the emissions from each sector in 2018. They are presented in the following order:

- Carlow County Council
- Energy Industries
- Residential
- Manufacturing & Commercial
- Industrial Processes
- Agriculture
- Transport
- Waste
- Land Use Change and Forestry (LULUCF)
- Fluorinated Gases (F-Gases)

## 4.0 CARLOW COUNTY COUNCIL

Carlow County Council (CCC) is responsible for the energy use and emissions from its buildings and facilities, its public lighting, and its vehicle fleet.

This Chapter outlines both the 2018 data for Carlow County Council and the average 2016-2018 public sector baseline period.

The 2018 data is used in the overall County Wide final figures and 2030 target, and the 2016-2018 data is used for Carlow County Councils own 2030 target.

### 4.1 METHODOLOGY

In Ireland, public sector bodies are required to report on their annual energy use to the Sustainable Energy Authority of Ireland (SEAI). This is done through the Monitoring and Reporting system<sup>9</sup> (M&R), which is used to track the local authorities progress towards 2030, compared to the baseline year. The baseline year for Carlow County Council's energy efficiency targets is 2009. The National Climate Action Plan 2023, Section 10 requires all public sector bodies including local authorities to calculate their baseline GHG's for 2018 using an average of years 2016-2018. This average is referred to as the 2018 baseline.

The methodology for reporting Carlow County Councils data to the SEAI via the Monitoring & Reporting (M&R) system is set out by the SEAI<sup>10</sup>. Carlow County Council have reported using this system since 2012, and all data has been verified and accepted by SEAI, and is published in the Annual Report on Public Sector Energy Efficiency Performance (see most recent 2021 report - Sustainable Authority of Ireland, 2021<sup>11</sup>).

From the M&R system, the 2018 energy & CO<sub>2</sub> emissions data for Carlow County Council was extracted and is broken down by fuel type:

- Electricity – imports from national grid
- Electricity - generated by on-site PV
- Natural Gas
- LPG
- Kerosene
- Gasoil
- Petrol
- Road Diesel
- Marked Diesel

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<sup>9</sup> <https://psmr.seai.ie/Account/LogOn?ReturnUrl=%2f>

<sup>10</sup> <https://www.seai.ie/business-and-public-sector/public-sector/monitoring-and-reporting/supports/MR-2030-Methodology-Guidance.pdf>

<sup>11</sup> <https://www.seai.ie/publications/Public-Sector-Annual-Report-2021.pdf>

The fuel types are categorised by energy use:

1. Electricity
2. Thermal
3. Transport

To outline where the energy and GHG emissions are coming from within Carlow County Council, the energy use was then broken down into three categories for reporting GHG emissions in this BEI. This will allow for targeted projects within the LA Climate Action Plan to reduce GHG emissions most effectively:

- Local Authority Buildings/Facilities
- Public Lighting
- Transport

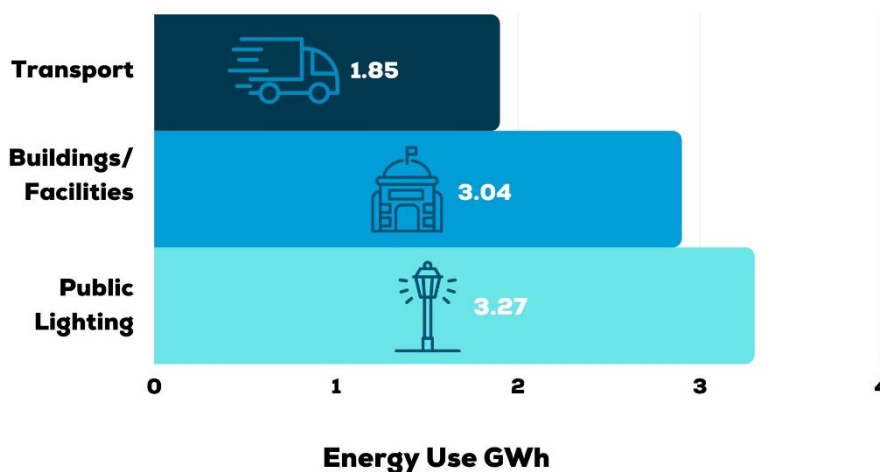
## 4.2 RESULTS

### 4.2.1 ENERGY RESULTS – 2018 COUNTY WIDE BEI DATA

From the results obtained from the M&R system, Carlow County Councils energy consumption in 2018 was 8.16 GWh, see Figure 7.

- Public Lighting was the highest energy consumer, accounting for 3.27 GWh of the total energy consumption (40%)
- Building and Facilities accounted for 3.04 GWh (37%)
- Transport accounted for 1.85 GWh(23%)

The fuel type breakdown is provided in Table 1.

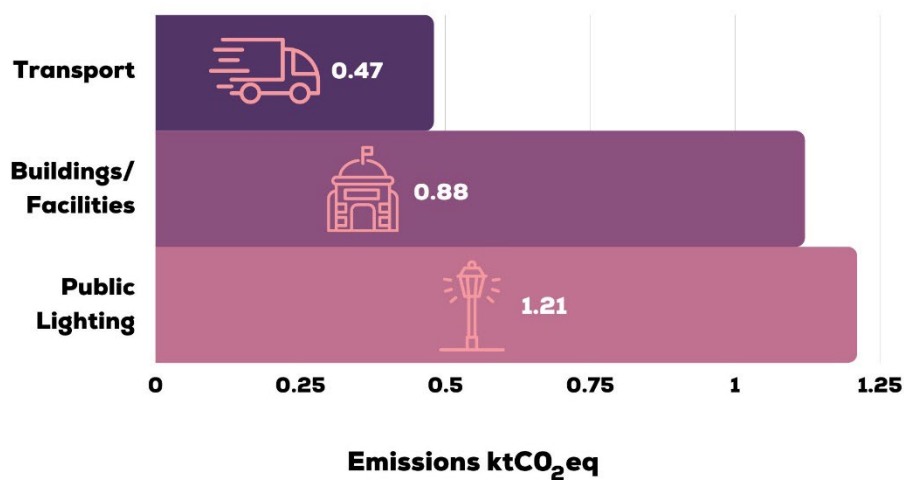


**Figure 6. Energy Use in County Carlow grouped by Category**

## 4.2.2 GHG EMISSIONS RESULTS – 2018 COUNTY WIDE BEI DATA

When energy use was converted into emissions, Carlow County Council’s total emissions amounted to 2.56 ktCO<sub>2</sub>eq – see Figure 8.

- Public Lighting was the highest contributor, accounting for 1.21ktCO<sub>2</sub>eq (40%) of these total emissions.
- Building and Facilities contributing 0.88ktCO<sub>2</sub>eq (37%)
- Transport 0.47ktCO<sub>2</sub>eq (23%) to the council’s CO<sub>2</sub>eq emissions, respectively.



**Figure 7. Emissions in ktCO<sub>2</sub>eq by sector in County Carlow**

## 4.2.3 ENERGY RESULTS – CARLOW Co Co 2016-2018 DATA

From the results obtained from the M&R system, Carlow County Councils annual average energy consumption for the period 2016-2018 was 8.1 GWh, see Figure 9.

- Public Lighting was the highest energy consumer, accounting for 3.3 GWh of the total energy consumption (40%)
- Building and Facilities accounted for 2.9 GWh (36%)
- Transport accounted for 1.9 GWh (24%)



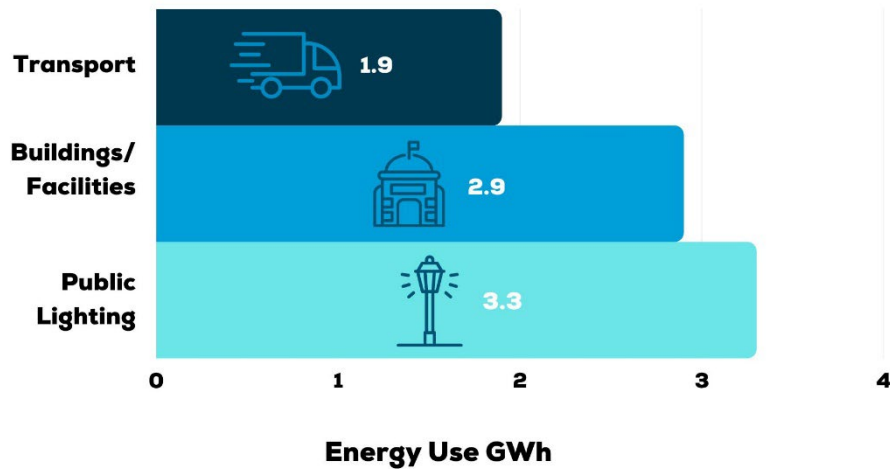


Figure 8. Carlow Co Co 2016-2018 Energy consumption by Category

#### 4.2.4 GHG RESULTS – CARLOW Co Co 2016-2018 DATA

When energy use was converted into emissions, Carlow County Council’s average annual emissions for the 2016-2018 period amounted to 2.81 ktCO<sub>2</sub>eq, see Figure 10.

- Public Lighting was the highest contributor, accounting for 1.21ktCO<sub>2</sub>eq (43%) of these total emissions.
- Building and Facilities contributing 1.12ktCO<sub>2</sub>eq (40%)
- Transport 0.48ktCO<sub>2</sub>eq (17%) to the council’s CO<sub>2</sub>eq emissions, respectively.

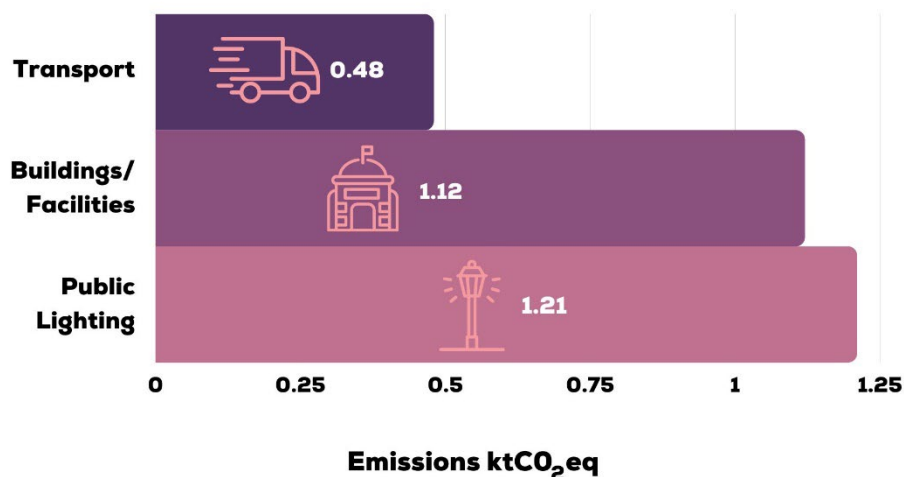


Figure 9. Carlow Co Co 2016-2018 GHG Emissions in ktCO<sub>2</sub>eq by Category

## 4.3 KEY FINDINGS

The key findings from Carlow County Council emissions are summarised below.

- Total final energy used in 2018 county wide BEI was 8.16 GWh
- Total final energy for Carlow Co Co 2030 targets, based on average 2016-2018 was 8.10GWh
- Total final GHG emissions produced by Carlow County Council in County Carlow in 2018 were 2.56 ktCO<sub>2</sub>eq.
- Total GHG emissions for Carlow Co Co 2030 targets, based on average 2016-2018 was 2.81 ktCO<sub>2</sub>eq.

Carlow County Council	Electricity	Fossil Fuels					Renewable Energies		Total
		Thermal			Transport		Electricity	Transport	
		Natural Gas	Heating Oils	LPG	Road Diesel	Petrol	Solar PV	Biofuel	
Building/ Facilities (GWh)	1.26	1.32	0.25	0.18			0.03		3.04
Public Lighting (GWh)	3.27	-	-			-			3.27
Transport (GWh)					1.76	0.04			0.06
<b>Total Energy (GWh)</b>	<b>4.53</b>	<b>1.32</b>	<b>0.25</b>	<b>0.18</b>	<b>1.76</b>	<b>0.04</b>	<b>0.03</b>	<b>0.06</b>	<b>8.16</b>
Buildings / Facilities (ktCO <sub>2</sub> eq)	0.50	0.27	0.07	0.04			-	-	0.88
Public Lighting (ktCO <sub>2</sub> eq)	1.21	-	-			-	-		1.21
Transport (ktCO <sub>2</sub> eq)					0.46	0.01			0.47
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	<b>1.71</b>	<b>0.27</b>	<b>0.07</b>	<b>0.04</b>	<b>0.46</b>	<b>0.01</b>	<b>-</b>	<b>-</b>	<b>2.56</b>

**Table 1. Carlow County Council 2018 County Wide BEI data, Energy and CO<sub>2</sub>eq Emissions**

## 5.0 RESIDENTIAL

This section looks at the emissions arising from the residential sector. In Ireland, the residential sector is the second largest energy user after transportation (SEAI, 2019), thus monitoring energy use and emissions in this sector is crucial.

### 5.1 METHODOLOGY

Domestic dwellings are responsible for emissions from the use of energy for space heating, hot water and electricity. This methodology is based on five main data sources:

- Central Statistics Office’s Census 2016<sup>12</sup> (CSO, 2016)
- EPA’s national emissions inventories - MapEire (AARHUS University, 2022)
- SEAI BER research tool (SEAI, 2021)
- Central Statistics Office’s Metered Electricity Consumption data
- Central Statistics Office’s Natural Gas Consumption data

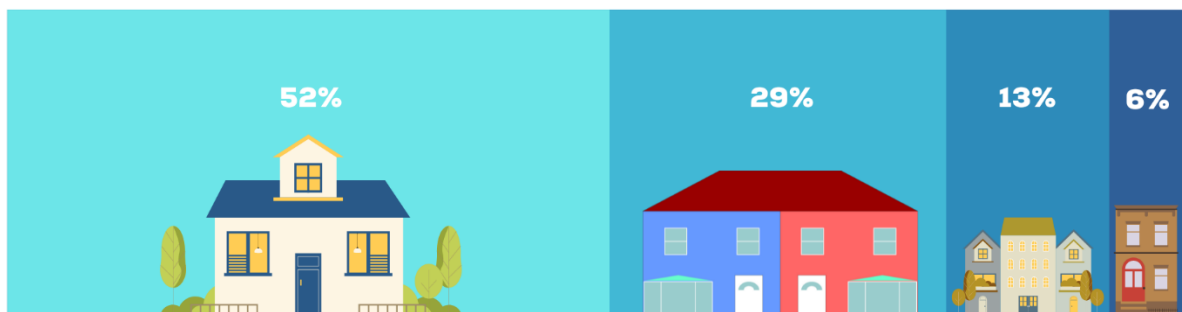
Firstly, the total number of houses in County Carlow is obtained from the Census data. This is split by category, which was simplified into 4 main house types:

- Semi-detached
- Detached
- Terraced
- Apartment

The Census 2016 data shows that there are 20,465 residential properties in Carlow, see Figure 11, of which:

- 52% is Detached house,
- 29% is Semi-Detached house,
- 13% are Terraced house and
- 6% are Apartments.

■ Detached House ■ Semi-Detached House ■ Terraced House ■ Apartments



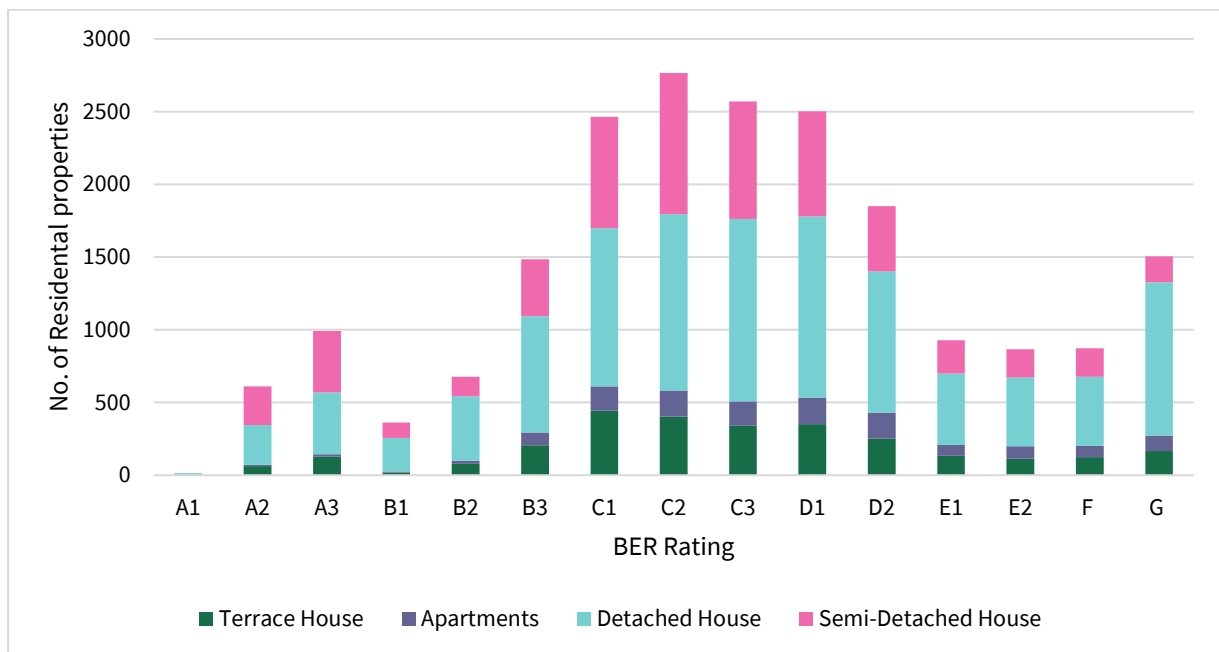
**Figure 10. Percentage % of Residential Dwelling Types in County Carlow, Census 2016**

<sup>12</sup> Census 2022 not available at time of analysis. Preliminary data published post analysis

These simplified house types allows for comparison with the breakdown provided by the Building Energy Rating Certificates (BER) data, so that the same house type categories are used for the analysis. The BER data is downloaded from SEAI BER research tool<sup>13</sup>. The database does not provide exact addresses, however the BER data provided the number of houses with BER ratings. All houses constructed after 2018 were removed from the BER data set. The BER data provides a breakdown of BER rating (A1 – G) for each house type categorised above.

Additional data from published Building Energy Rating Certificates (BER) helped further inform the breakdown of emissions based on the average BER rating of the homes across County Carlow. The BERs were filtered per County for County Carlow, and information is available on theoretical energy demand and emissions from those dwellings. The data provides us with detailed information for each BER rating. The average BER rating per house type is then applied to the total domestic dwellings across the County.

Figure 12 below shows the number of published BERs in 2018 for each BER rating for County Carlow, which totaled 13,735 houses, or 67% of the total housing stock in County Carlow.



**Figure 11. BER ratings of Residential Sector, County Carlow**

The BER data was used to calculate the average energy demand for each house type at each BER rating (A1-G). This average demand was then applied to the total number of dwellings of each house type and each BER rating in each category. This gave a total energy and emissions for the residential sector in County Carlow.

The average consumption per house type and BER rating is shown in Table 2 below.

<sup>13</sup> <https://ndber.seai.ie/BERResearchTool/ber/search.aspx>

BER	Detached (kWh)	Semi-Detached (kWh)	Terraced (kWh)	Apartments (kWh)
A1	2,453	-	-	-
A2	1,975	757	837	306
A3	3,900	792	1,008	740
B1	11,510	3,226	4,915	2,214
B2	14,408	5,698	3,597	4,432
B3	15,067	6,378	5,488	4,112
C1	15,673	7,681	6,894	4,803
C2	16,232	8,449	7,523	5,600
C3	16,765	9,807	8,223	5,609
D1	17,522	10,865	9,093	5,209
D2	19,504	13,045	10,963	5,844
E1	21,156	16,807	13,546	7,428
E2	24,323	18,259	13,540	7,022
F	26,641	19,089	16,870	6,891
G	33,665	24,930	26,217	12,672

**Table 2. Average Consumption per House and BER type**

The total energy consumption for residential sector is then broken down into electricity (non-thermal) & thermal. Using the SEAI Energy in Residential Sector 2018 (SEAI, 2018), the average % of household energy consumption was

- Space heating – 61%
- Water heating – 19%
- Lighting/Appliances/Cooking – 20%

Therefore, the average figure of 80% thermal and 20% electricity was applied to the domestic data.

The electricity and natural gas data comes directly from the Central Statistics Office's Metered Electricity Consumption data<sup>14</sup> and Natural Gas Consumption data<sup>15</sup>.

The Central Statistics Office Energy Balance (2018) was used to get a national average breakdown between the remaining thermal fuel types. The average % breakdown was used to calculate the breakdown of the remaining thermal fuel for County Carlow residential sector.

To summarise, the total thermal energy consumption was found from the BER data. This was assumed to be equivalent to 80% of the total residential energy consumption. The thermal breakdown, in terms of what fuel is used to heat a home, was calculated using the actual metered gas data and the national average fuel mix breakdown from the Residential Fuel Mix in 2018<sup>16</sup> taken from the CSO data.

The remaining 20% was non-thermal electricity.

<sup>14</sup> <https://www.cso.ie/en/statistics/energy/meteredelectricityconsumption/>

<sup>15</sup> <https://www.cso.ie/en/statistics/energy/networkedgasconsumption/>

<sup>16</sup> <https://data.cso.ie/table/SEI01>

All energy data was then converted into equivalent GHG emissions using the CO<sub>2</sub>eq. conversion factors for each fuel type.

MapElre data set provides additional emissions produced in the form of Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O) by residential sectors, i.e. in addition to CO<sub>2</sub> emissions from the combustion of fossil fuels such as natural gas, heating oil, coal, etc. These emissions are converted into CO<sub>2</sub>eq using the conversion factors provided by EPA (EPA, 2023)

## 5.2 RESULTS

The total number of houses in County Carlow from the 2016 Census data was 20,456. The BER ratings for County Carlow showed that 13,736 houses had a BER rating – this is equal to 67% of the total domestic dwellings.

The breakdown of heating fuel types for houses is shown in Table 3 and Figure 13. This shows that 54% of homes in County Carlow use heating oils to heat their homes. A total of 87% of homes use fossil fuels to heat their homes.

Type of Central Heating	No of Houses	% of homes
No central heating	253	1.2%
Oil	11,121	54.3%
Natural Gas	4,838	23.6%
Electricity	1,003	4.9%
Coal (incl. anthracite)	1,651	8.1%
Peat (incl. turf)	189	0.9%
Liquid Petroleum Gas (LPG)	102	0.5%
Wood (incl. wood pellets)	630	3.1%
Other fuels	155	0.8%
Not stated	523	2.6%

**Table 3. Thermal Fuel Sources for Houses, County Carlow**



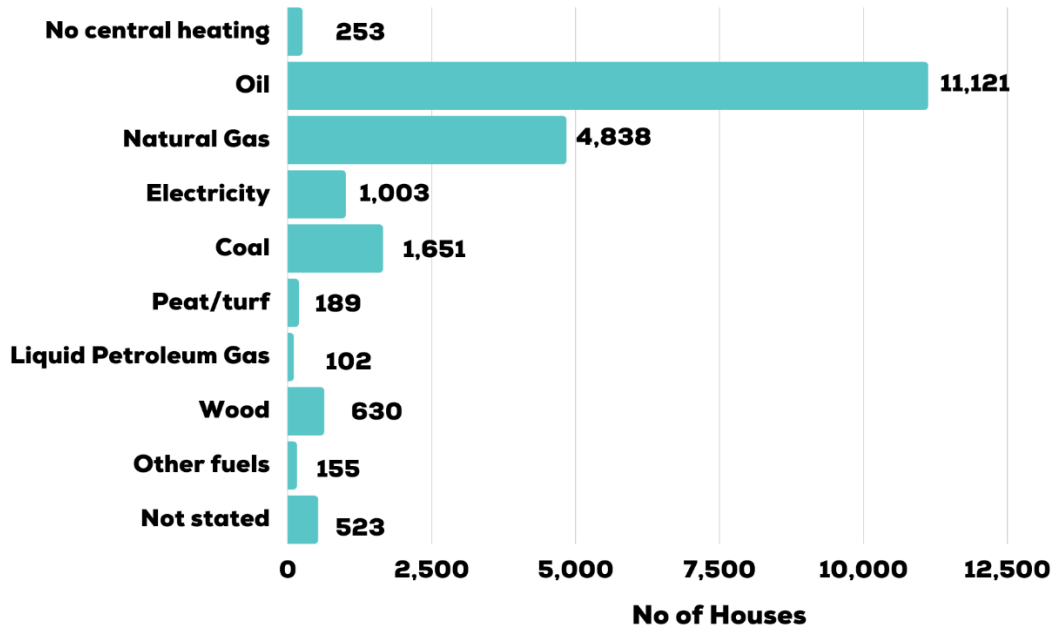


Figure 12. Thermal Fuel Sources for Houses in County Carlow

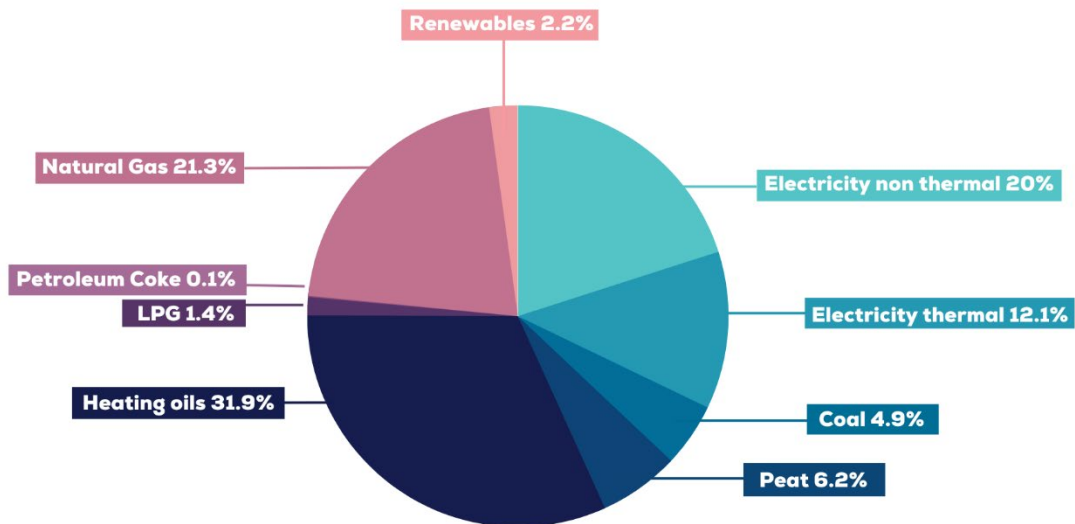
## 5.2.1 ENERGY RESULTS

Total energy use in the residential sector was **352.3 GWh**. The residential fuel split is shown in Table 4 and Figure 14, and mainly comes from:

- Electricity - making up 32.1% of the fuel mix
- Heating Oils accounts for 31.9%
- Natural Gas accounts for 21.3% of the fuel mix.
- Total renewable fuels only accounted for 2.2% of the final energy consumption. The majority of this came from biomass sources (mainly wood).

Total Consumption GWh	GWh	%
Electricity (non-thermal)	70.5	<b>20.0%</b>
Electricity (thermal)	42.5	<b>12.1%</b>
Coal	17.2	<b>4.9%</b>
Peat	21.8	<b>6.2%</b>
Heating Oils	112.4	<b>31.9%</b>
LPG	4.8	<b>1.4%</b>
Petroleum Coke	0.4	<b>0.1%</b>
Natural Gas	75.0	<b>21.3%</b>
Renewables	7.6	<b>2.2%</b>
<b>Total Energy Consumption</b>	<b>352.33</b>	

**Table 4. Breakdown of Energy Consumption by Fuel Type**



**Figure 13. Share of Total Energy Demand in the Residential Sector by Fuel Mix**

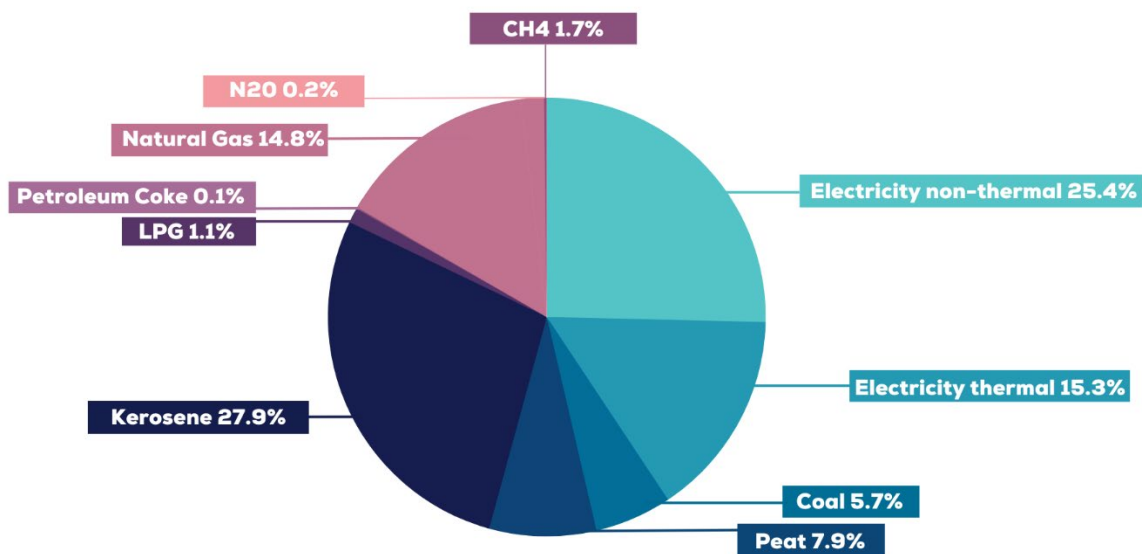
## 5.2.2 GHG EMISSION RESULTS

The GHG emissions from methane (CH<sub>4</sub>), and nitrous Oxide (N<sub>2</sub>O) obtained from the MapElre data equates to 1.9 ktCO<sub>2</sub>eq. When energy use was converted into GHG emissions, the total GHG emissions in 2018 for the Residential Sector in County Carlow was **103.74 ktCO<sub>2</sub>eq.**

Figure 15 below shows the total emissions for the residential sector in County Carlow by fuel type. The highest emissions in the residential sector come from electricity and heating oils, which contribute 40.7% and 27.9% respectively.

Total GHG Emissions	ktCO <sub>2</sub> Eq	%
Electricity (non-thermal)	26.4	0.254
Electricity (thermal)	15.9	0.153
Coal	5.9	0.057
Peat	8.2	0.079
Kerosene	28.9	0.279
LPG	1.1	0.011
Petroleum Coke	0.1	0.001
Natural Gas	15.4	0.148
Renewables	0	0
CH <sub>4</sub> to CO <sub>2</sub> eq	1.7	0.017
N <sub>2</sub> O to CO <sub>2</sub> eq	0.2	0.002
<b>Total GHG Emissions</b>	<b>103.74</b>	

**Table 5. Breakdown of GHG emissions**



**Figure 14. Share of Total Emissions (%) in the Residential Sector by Fuel Type**

## 5.3 KEY FINDING - 2018

- Total energy consumed by residential sector in 2018 was 352.3 GWh
- 32.1% of the residential fuel mix was made up electricity followed by 31.9% heating oil and 21.3% natural gas
- Total residential emissions were 103.74 ktCO<sub>2</sub>eq in 2018
- 40.7% of residential emissions came from electricity, 27.9% from heating oil and 14.8% from natural gas

Residential Sector					Total
	Electricity	Fossil Fuels	Renewable Energies	CH <sub>4</sub> /N <sub>2</sub> O	
<b>Total Energy (GWh)</b>	113	231.6	7.6	0.0	<b>352.4</b>
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	42.3	59.51	0	2.0	<b>103.7</b>

**Table 6. County Carlow Residential Inventory; Energy and CO<sub>2</sub>eq Emissions**

## 6.0 MANUFACTURING & COMMERCIAL

Manufacturing & Commercial data is reported as one sector as outlined in “Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines” (DECC, 2023).

The data provided for the Baseline Emissions Inventory (BEI) has Carlow County Councils data included within this sector (EPA, 2022). Carlow County Council’s data is presented and analysed separately in this report (see Section 4). Therefore, the data presented in this section is for the Manufacturing & Commercial sector only, without the Local Authority data, which has been extracted from this data set.

These sectors are responsible for emissions from the operation of manufacturing plants as well as space heating, water heating, cooking and laundry involved in commercial services. The main data sources for these sectors are MapElre<sup>17</sup>, CSO non-residential metered consumption data<sup>18</sup>, CSO Energy Balance<sup>19</sup> and Valuation Office<sup>20</sup> data set.

### 6.1 METHODOLOGY

The CSO data and the data provided from the Valuations Office form the foundation of data collection for this sector.

The Valuation Office (VO) provides data on number of businesses in County Carlow and the associated floor area of each. The properties are categorised by the Valuation Office as follow:

- **Industrial Uses** includes (Warehouse, Workshops, Factory, Livestock Mart, Showrooms, workshop offices)
- **Office** includes (Business parks, industrial offices, studio)
- **Retail (Warehouse)** includes (Garden Yard, Motor showroom Yard)
- **Hospitality** includes (Pubs, Night Clubs, Guesthouse, Funeral homes, Caravan parks, Hostel, Hotels)
- **Health** includes (Nursing home, Clinic, Surgery centers, Surgery office)
- **Fuel/Depot** includes (Oil/Fuel Depot store, Service station, Motorway service station, Oil/Fuel Depot yard)
- **Miscellaneous** includes (Crèche, Car park, Advertising station)
- **Retail (Shops)** includes (retail shops, Supermarket, Restaurant, Post Office, Department store, Café, Bank, ATM, Pharmacy)
- **Leisure** includes (Clubhouse, Community hall, Stable, Stadium, Swimming Pool, Gymnasium/Fitness Centre, Cinema, Equestrian Centre, Theatre)
- **Minerals** includes (Quarries)

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<sup>17</sup> <https://projects.au.dk/mapeire/spatial-results/download>

<sup>18</sup> <https://www.cso.ie/en/statistics/energy/meteredelectricityconsumption/>

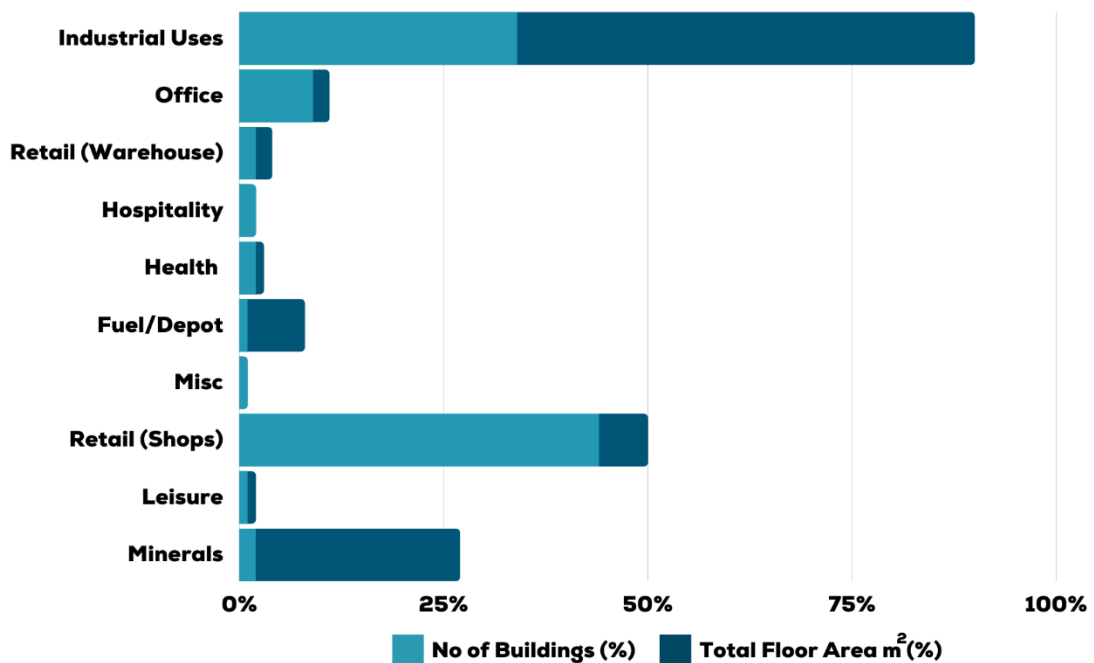
<sup>19</sup> <https://data.cso.ie/table/SEI01>

<sup>20</sup> <https://maps.valoff.ie/maps/VO.html>

Table 7 shows the total number of businesses and the associated floor area for each category. Almost 80% of the commercial properties can be categorised as industrial uses and retail outlets, with 9% accounting for office, see Figure 16.

	No. of Buildings	Total Floor Area (m <sup>2</sup> )
Industrial Uses	1,726	1,321,252
Office	476	39,370
Retail (Warehouse)	106	52,522
Hospitality	111	24
Health	101	14,944
Fuel/Depot	70	162,724
Miscellaneous	75	7,721
Retail (Shops)	2,212	130,879
Leisure	67	25,571
Minerals	93	597,296
<b>TOTAL</b>	<b>5,037</b>	<b>2,352,303</b>

**Table 7. Number of Properties & Floor Area of Manufacturing & Commercial Businesses**



**Figure 15. County Carlow Commercial Properties by Category**

The Chartered Institute for Building Service Engineers (CIBSE, 2008) produce benchmarks, given in kilowatt-hours per meter squared floor area (kWh/m<sup>2</sup>) for heat and electricity, in each building category.

	kWh/m <sup>2</sup>	CO <sub>2</sub> Eq
Industrial Uses	195	49.7
Office	215	75.1
Retail (Warehouse)	195	49.7
Hospitality	435	120.5
Health	270	76.5
Fuel/Depot	195	49.7
Miscellaneous	70.39	112.6
Retail (Shops)	165	90.8
Leisure	1375	349.5
Minerals	195	49.7

**Table 8. CIBSE Benchmarks used for each Manufacturing & Commercial Category**

The advantage of using CIBSE energy benchmarks is that they are based on a large sample set, and as Irish building regulations follow the UK regulations, the energy figures are applicable in the Irish context. The relevant benchmarks can be matched by property type and multiplied by the floor areas from the Valuation Office for all Manufacturing & Commercial businesses in the County.

The CSO Natural Gas Consumption data<sup>21</sup> and the Electricity Metered Data<sup>22</sup> for non-residential buildings was obtained from CSO data. The Local Authority data was also used and subtracted from the electricity and thermal data to obtain the split between thermal and electrical consumption for the Manufacturing & Commercial sector.

MapElre data set provides additional emissions produced in the form of Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O) by Manufacturing & Commercial sector. These emissions are converted into CO<sub>2</sub>eq using the conversion factors provided by EPA (EPA, 2023)

## 6.2 RESULTS

### 6.2.1 ENERGY RESULTS

Total energy use in the Manufacturing & Commercial sector in 2018 was **510.4 GWh**. The energy demand mainly comes from thermal consumption, which accounts for 358.9 GWh (70%) of the energy. 151.5 GWh (30%) is electricity, see Figure 17.

<sup>21</sup> <https://www.cso.ie/en/statistics/energy/networkedgasconsumption/>

<sup>22</sup> <https://www.cso.ie/en/statistics/energy/meteredelectricityconsumption/>

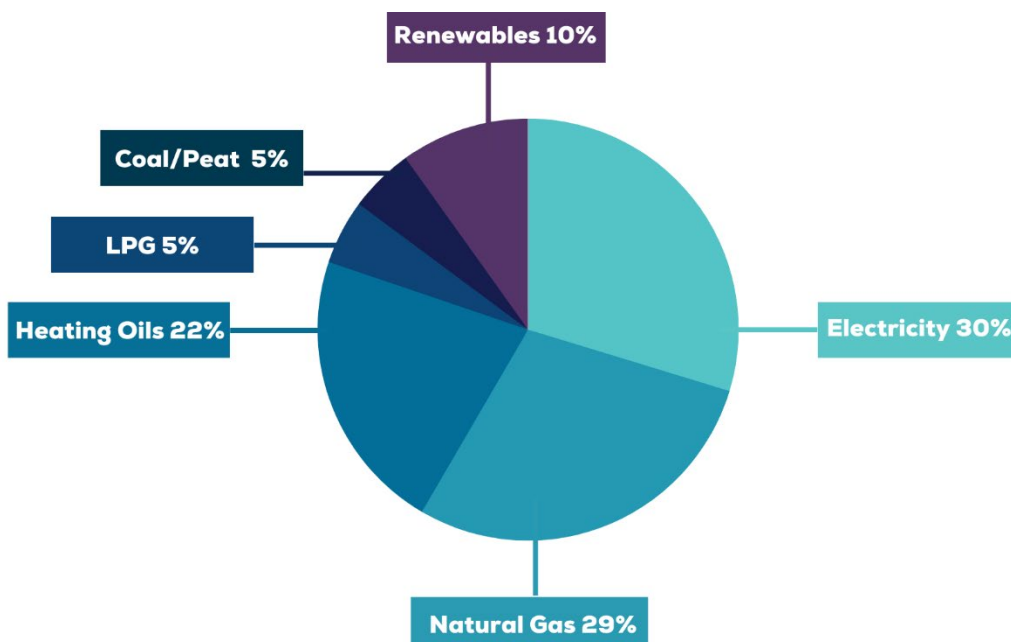


The breakdown of thermal fuel was found to be:

- Natural gas
- Electricity
- Heating Oils
- LPG
- Coal/Peat
- Renewables

Fuel Type	Energy GWh
Electricity	151.5
Natural Gas	147.7
Heating Oils	114.2
LPG	24
Coal/Peat	24
Renewables	49.1
<b>TOTAL</b>	<b>510.4</b>

**Table 9. Breakdown of Consumption by Fuel Type**

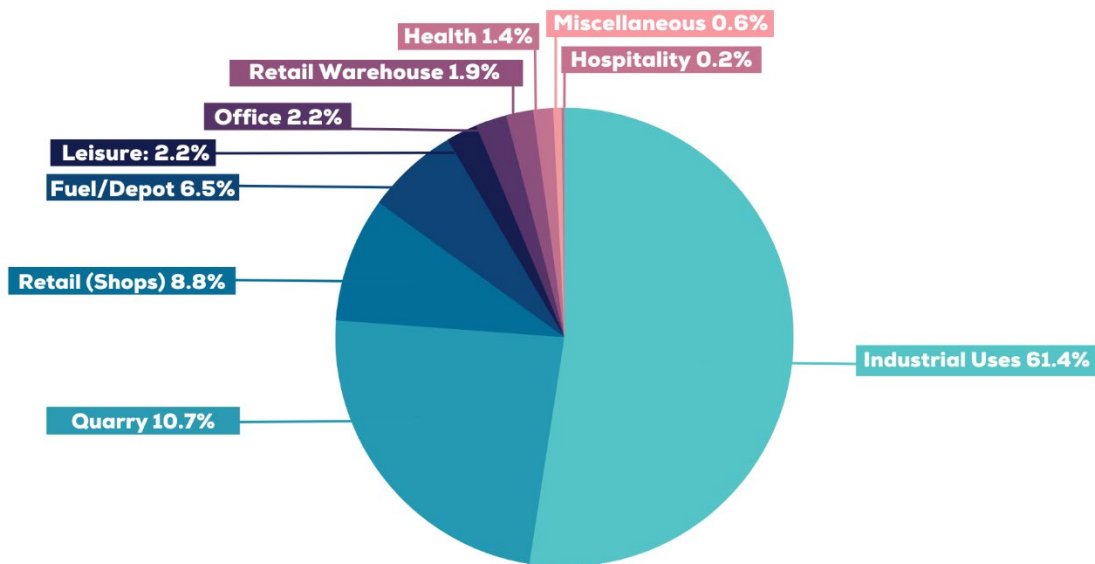


**Figure 16. Breakdown of Consumption % by Fuel Type**

## 6.2.2 GHG EMISSION RESULTS

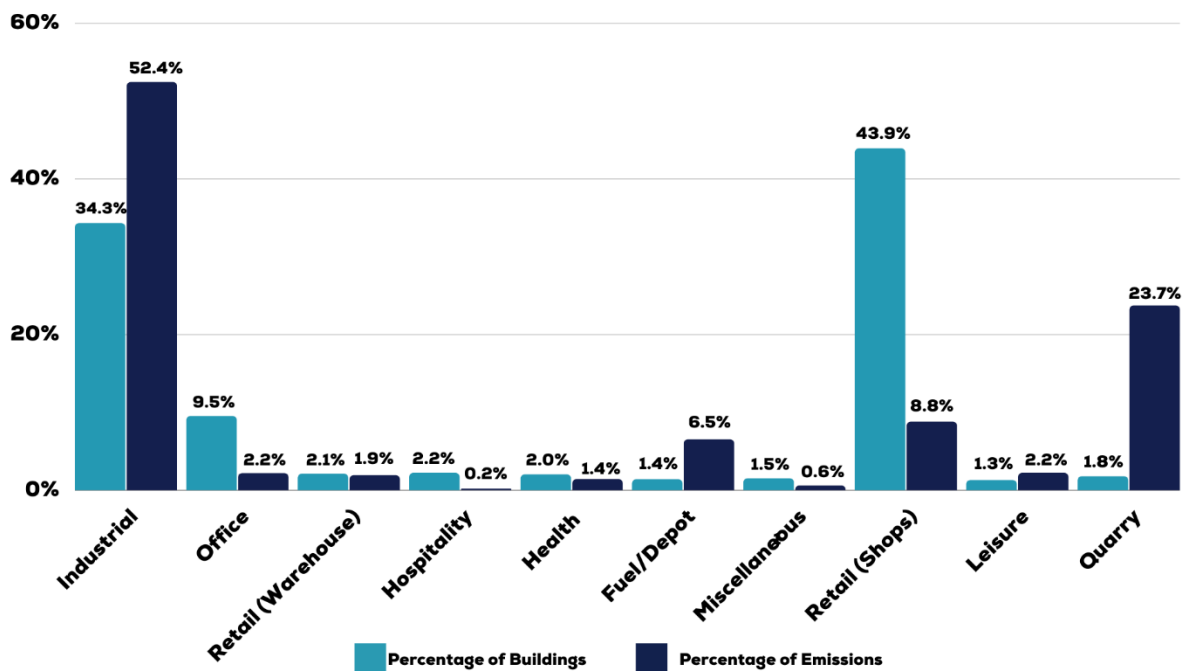
When energy use was converted into GHG emissions, total emissions from the Manufacturing & Commercial sector in 2018 was calculated at 135.0 ktCO<sub>2</sub>eq. As can be seen from Figure 18, the commercial properties that produced the most emissions were:

- Industrial uses (Manufacturing & Engineering buildings): 70.69 ktCO<sub>2</sub>eq (52.4%)
- Minerals: 31.96 ktCO<sub>2</sub>eq (23.7%)
- Retail (Shops): 11.88 ktCO<sub>2</sub>eq (8.8%)
- Fuel/Depot: 8.71 ktCO<sub>2</sub>eq (6.5%)



**Figure 17. Manufacturing & Commercial Emissions by Property Category**

Figure 19 below gives an indication of emissions in comparison to the number of buildings for different commercial properties in the region.



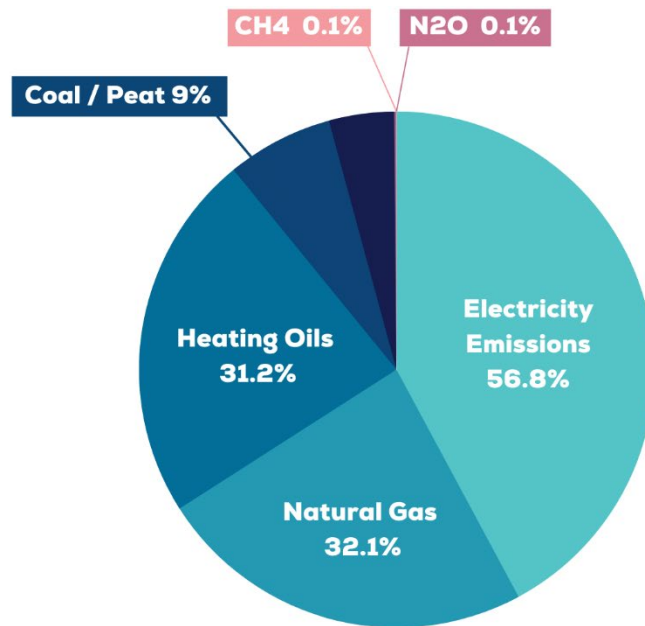
**Figure 18. Share of Total Emissions and Number of Commercial Properties in County Carlow**

Industrial uses, Minerals and Retail (Shops) are the main CO<sub>2</sub>eq emitters, as altogether they make up 85% of the commercial sector’s total emissions. From this analysis, these three categories should be the main targets of energy and emission reduction initiatives within the commercial sector.

Figure 20 below shows the electricity and types of fossil fuel consumption of commercial buildings by category. These figures are representative of the CIBSE energy benchmark. Electricity and natural gas account for the highest share of use (42.1%) and (23.8%) respectively. CIBSE only breaks down fuel use into fossil fuels and electricity. Therefore, CSO energy balance 2018 was used to take a national average use by fuel type to calculate the emissions.

Fuel Type	ktCO <sub>2</sub> eq emissions
Electricity	56.8
Natural Gas	32.1
Heating Oils	31.2
LPG	5.5
Coal/Peat	9.0
Renewables	-
CH <sub>4</sub>	0.1
N <sub>2</sub> O	0.1
<b>TOTAL</b>	<b>135.0</b>

**Table 10. Manufacturing & Commercial Emissions by Fuel Type**



**Figure 19. Manufacturing & Commercial Emissions by Fuel Type**

## 6.3 KEY FINDINGS

- Total energy consumed by Manufacturing & Commercial sector in 2018 was 510.4 GWh
- 30% of the energy was electricity, 29% was natural gas and 22% was Heating Oils. 10% was from Renewable energy systems
- Total Manufacturing & Commercial emissions were 135.0 ktCO<sub>2</sub>eq in 2018
- 56.8% of the emissions came from electrical consumption, 32.1% from natural gas and 31.2% from heating oils
- 52.4% of emissions came from the industrial uses category, 23.7% from Minerals and 8.8% from Retail (shops)

Manufacturing and Commercial Sector				Total
	Electricity	Thermal	CH4 & N2O	
<b>Total Energy (GWh)</b>	151.5	358.9		<b>510.4</b>
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	56.8	77.9	0.2	<b>135.0</b>

**Table 11: County Carlow Manufacturing & Commercial Inventory; Energy and CO<sub>2</sub>eq Emissions**

## 7.0 INDUSTRIAL PROCESSES

The industrial processes sector estimates greenhouse gas emissions occurring from industrial processes, from the use of greenhouse gases in products, and from non-energy uses of fossil fuel carbon (EPA). For example, emissions caused by the processes that convert raw materials to a range of chemical, mineral or metal products like cement and fertilisers. These are a mix of energy related and non-energy related GHG emissions.

Industrial Processes differs from industrial uses outlined in Section 6 in that industrial uses includes the GHG emissions that come from energy consumption and the manufacturing and delivery of services.

The emission sources relating to this sector include cement production, ceramics, lime production, uses of carbonates, and solvent use.

### 7.1 METHODOLOGY

As per the methodology provided on page 28 of Technical Annex C: Climate Mitigation Assessment” of the Local Authority Climate Action Plan Guidelines” (DECC, 2023). MapElre provides emission data for industrial processes across County Carlow.

GHG emissions from the processing of cement, lime and other solvents is split by MapElre into main categories including:

- Lime Production
- Ceramic
- Lubricant use
- Paraffin wax use
- Food and Beverages Industry
- Domestic solvent use
- Other solvent use

The non-energy related GHG emissions include Methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O), sulfur Hexafluoride (SF<sub>6</sub>). These are all converted into CO<sub>2</sub>eq using the conversion factors from EPA<sup>23</sup>

GHG	CO <sub>2</sub> eq/kg
CO <sub>2</sub>	1
CH <sub>4</sub>	25
N <sub>2</sub> O	298
SF <sub>6</sub>	228000

**Table 12. CO<sub>2</sub>eq. Conversion Factors for Various GHG Emissions**

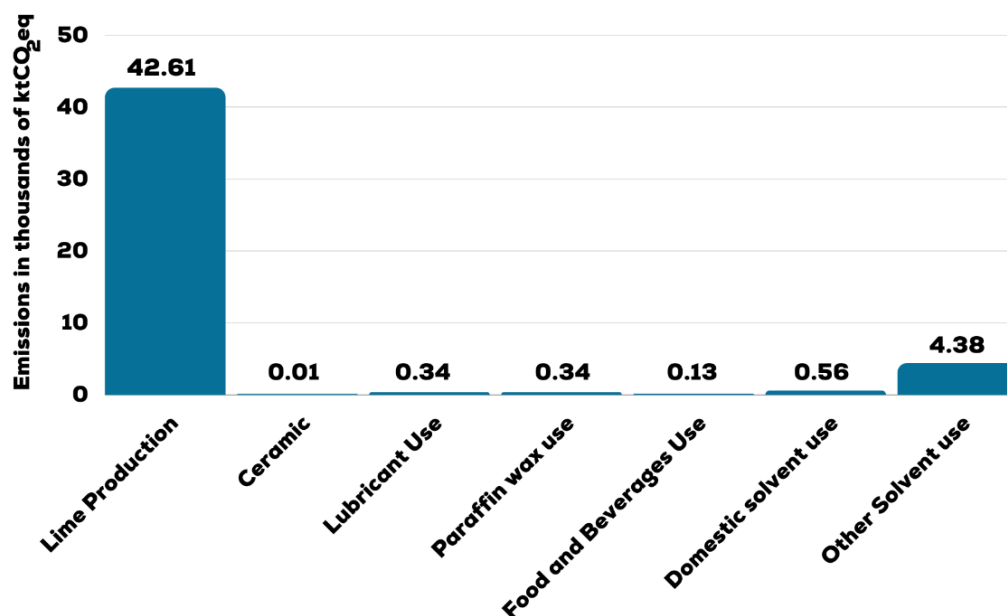
<sup>23</sup> <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>

## 7.2 RESULTS

Using the methodology outlined in the Technical Annex C: Climate Mitigation Assessment (EPA, 2023), the CO<sub>2</sub>eq emissions from the industrial processes are **48.39ktCO<sub>2</sub>eq**.

Figure 21 below shows non-energy related emissions = 48.39 ktCO<sub>2</sub>eq

- Lime Production: 42.64 ktCO<sub>2</sub>eq
- Ceramic: 0.01 ktCO<sub>2</sub>eq
- Lubricant use: 0.34 ktCO<sub>2</sub>eq
- Paraffin wax use: 0.34 ktCO<sub>2</sub>eq
- Food and Beverages Industry: 0.13 ktCO<sub>2</sub>eq
- Domestic solvent use: 0.56 ktCO<sub>2</sub>eq
- Other solvent use: 4.38 ktCO<sub>2</sub>eq



**Figure 20. CO<sub>2</sub> Emissions from the Industrial Processes, ktCO<sub>2</sub>eq**

## 7.3 KEY FINDINGS

- Total emissions from industrial processes are 48.39 ktCO<sub>2</sub>eq.
- 42.64 ktCO<sub>2</sub>eq (88%) emissions were from lime production
- The remaining 5.75 ktCO<sub>2</sub>eq emissions were from ceramics, lubricant use, paraffin wax use, solvents and food industry

Industrial Process Sector	Lime Production	Ceramics	Lubricant Use	Paraffin Wax Use	Food Industry	Solvent Use	Total
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	<b>42.64</b>	<b>0.01</b>	<b>0.34</b>	<b>0.34</b>	<b>0.13</b>	<b>4.93</b>	<b>48.39</b>

**Table 13: County Carlow Industrial Processes CO<sub>2</sub>eq emissions**

## 8.0 AGRICULTURE

This sector's emissions are from both energy and non-energy related actions.

The non-energy related emissions come from a range of sources, including, livestock units (dairy cows, sheep, horses, poultry, fisheries), enteric fermentation, manure management, agricultural soils, liming, and use of fertilisers and urea

Energy related emissions are for electricity and fuels used within the agricultural sector.

Transport related emissions from the Agricultural sector are reported under the Transport Sector, as per the methodology outlined page 28 of the Technical Annex C: Baseline Mitigation Assessment.

### 8.1 METHODOLOGY

MapElre data provides a breakdown of emissions within this sector covering a wide range of categories, including:

- Agriculture/ Forestry/ Fisheries: Stationary
- Dairy Cattle
- Non-dairy Cattle
- Sheep
- Swine
- Horses
- Mules and asses
- Manure management - Dairy Cattle
- Manure management - Non-Dairy Cattle
- Manure management - Sheep
- Manure management - Swine
- Manure management - Horses
- Manure management - Mules and asses
- Liming
- Inorganic N-fertilizers
- Animal manure applied to soils
- Sewage sludge applied to soils
- Urine and dung deposited by grazing animals
- Crop residues applied to soils
- Mineralization
- Atmospheric deposition
- Nitrogen leaching and run-off
- Urea application

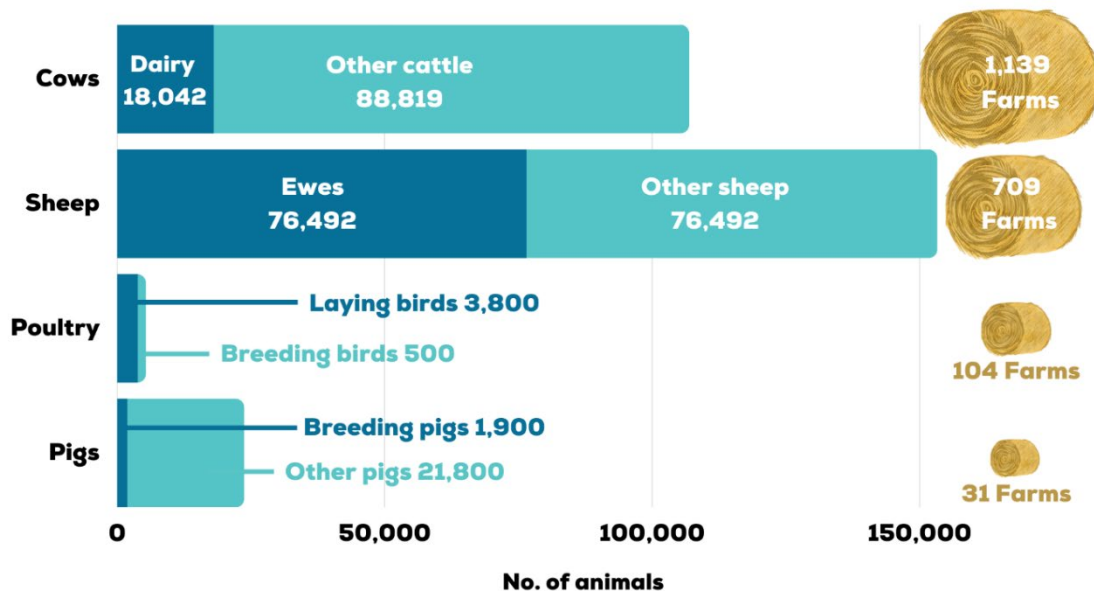
The data from MapElre categorized as ' off-road vehicles' has been removed from this data set and is reported under the Transport Data (Section 9 of this report). This is reported under the Tractors & Machinery heading.



MapElre data set provides emissions produced in the form of Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O). These emissions are converted into CO<sub>2</sub>eq using the conversion factors provided by EPA<sup>24</sup>. This data is for both energy and non-energy related emissions.

For the energy related emissions, additional data from CSO Census of Agriculture is broken down to County level and gives information on the number of farms, the number of livestock units (dairy cow, sheep, pig, poultry etc.), and the crops grown (Central Statistics Office, 2020), (EPA, 2022), see Figure 22. In County Carlow there are a total of:

- 106,861 cows of which 18,042 dairy cows, and 88,819 other cattle in 1,139 farms.
- 153,237 sheep of which 76,492 are Ewes in 709 farms.
- 4,300 poultry of which 3,800 are laying birds, 500 breeding birds in 104 farms.
- 23,700 pigs of which 1,900 are breeding pigs and 21,800 are other pigs over 20 kgs in 31 farms.



**Figure 21. Breakdown of Livestock Units and a Number of Farms in County Carlow**

Benchmarks from Teagasc were used to estimate energy and non-energy related emissions (Teagasc, 2017). These provide benchmarks in formats such as kWh electricity/dairy, cow/year, methane/dairy, cow/year, kWh. This methodology allows a detailed breakdown of agricultural emissions. Average energy consumption in the agriculture sector, by livestock, in Ireland are:

- 350 kWh of energy per cow
- 280 kWh of energy by sheep
- 10.7 kWh of energy by poultry
- 6.55 kWh of energy by pigs

<sup>24</sup> <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>

The energy related emissions calculated from the CSO data and Teagasc benchmarks is subtracted from the total emissions provided by MapEire to give energy and non-energy related GHG emissions for the agricultural sector.

## 8.2 RESULTS

### 8.2.1 ENERGY RESULTS

Using the Teagasc Benchmarks and the number of different livestock from the CSO data, as outlined above, the total Energy related emissions associated with the Agriculture sector in County Carlow in 2018 was 81.02GWh. 53% of this is associated with sheep and 46% associated with cattle. Although cattle have a much higher energy intensity than sheep, there are more sheep in County Carlow.

	Electrical GWh	Thermal GWh	Total	%
<b>Cattle</b>	37.4	-	37.4	46%
<b>Sheep</b>	42.91	-	42.91	53%
<b>Poultry</b>	0.01	0.04	0.05	0%
<b>Pigs</b>	0.65	0.01	0.66	1%
<b>TOTAL</b>	80.96	0.05	81.02	

**Table 14. Energy Related Energy Consumption Associated with the Livestock in County Carlow**

### 8.2.2 GHG EMISSION RESULTS

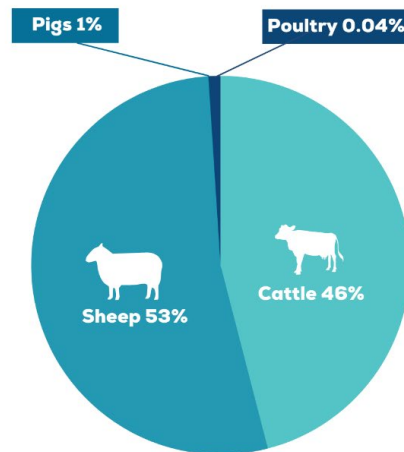
The GHG emissions are split between energy related and non-energy related emissions.

The energy related emissions associated with the 81.02GWh outlined above are calculated using the electricity and thermal conversion factors.

The total energy related emissions are 30.39ktCO<sub>2</sub>eq, see Figure 23.

	ktCO <sub>2</sub> eq	%
<b>Cattle</b>	14	46%
<b>Sheep</b>	16.1	53%
<b>Poultry</b>	0.01	0.04%
<b>Pigs</b>	0.2	1%
<b>TOTAL</b>	<b>30.4</b>	

**Table 15. Energy Related GHG Emissions Associated with the Livestock in County Carlow**

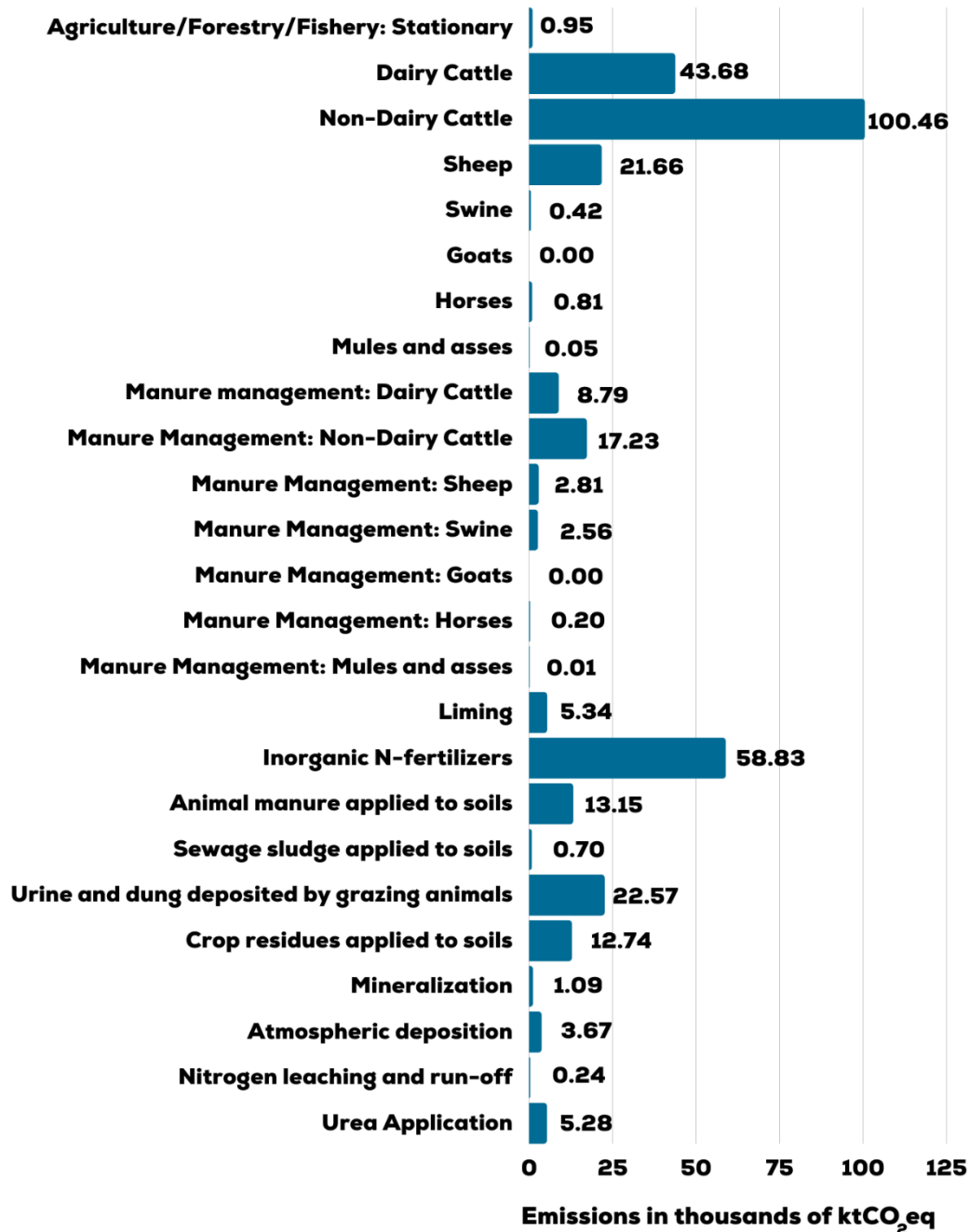


**Figure 22. Energy Related GHG Emissions Associated with the Livestock in County Carlow**

The non-energy related emissions calculated using the MapElre data and the energy related emissions above, gave a total of 323.25 ktCO<sub>2</sub>eq, see Figure 24.

NFR_Code	NFR Name	ktCO <sub>2</sub> eq4
1A4ci	Agriculture/ Forestry / Fishers: Stationary	0.95
3A1a	Dairy Cattle	43.68
3A1b	Non-dairy Cattle	100.46
3A2	Sheep	21.66
3A3	Swine	0.42
3A4e	Horses	0.81
3A4f	Mules and asses	0.05
3B1a	Manure management - Dairy Cattle	8.79
3B1b	Manure management - Non-Dairy Cattle	17.23
3B2	Manure management - Sheep	2.81
3B3	Manure management - Swine	2.56
3B4e	Manure management - Horses	0.2
3B4f	Manure management - Mules and asses	0.01
3G	Liming	5.34
3Da1	Inorganic N-fertilizers	58.83
3Da2a	Animal manure applied to soils	13.15
3Da2b	Sewage sludge applied to soils	0.7
3Da3	Urine and dung deposited by grazing animals	22.57
3Da4	Crop residues applied to soils	12.74
3Da5	Mineralization	1.09
3Db1	Atmospheric deposition	3.67
3Db2	Nitrogen leaching and run-off	0.24
3H	Urea application	5.28
	<b>Total</b>	<b>323.25</b>

**Table 15 - Non-Energy Related Emissions from the Agriculture sector in County Carlow**



**Figure 23. Non-Energy Related Emissions from the Agriculture sector in County Carlow by Category**

Therefore, the total emission from agriculture is 353.64 ktCO<sub>2</sub>eq in 2018.

## 8.3 KEY FINDINGS

- Energy Consumption from agriculture sector accounts for 81.02 GWh
- Non-energy related GHG emissions totaled 323.25 ktCO<sub>2</sub>eq
- Total emissions from agriculture sector accounts for 353.64 ktCO<sub>2</sub>eq

Agriculture Sector				Total
	Electricity	Thermal	CH4 & N2O	
<b>Total Energy (GWh)</b>	80.96	0.05		<b>81.00</b>
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	30.38	0.01	323.25	<b>353.64</b>

**Table 16. County Carlow Agriculture Sector CO<sub>2</sub>eq emissions**

## 9.0 TRANSPORT

Transport is a complicated sector to develop an accurate baseline for an area due to the number of different transport modes and movement across boundaries.

This section does not include Carlow County Councils direct transport emissions, which is presented separately in Section 4 of this report. This data was subtracted from the total transport emissions for this sector to avoid 'double-counting'.

The Central Statistics Office (CSO) published 'Census 2018, Commuting in Ireland', which shows that commuting has increased nationally, and is in line with the changes and growth in the Irish economy (SEAI, 2019).

Comparing 2016<sup>25</sup> and 2011 census data, the number of people commuting to work increased by 11%. Nationally, commuting by car increased by 8%, public transport rose by 21%, walking by 3%, and cycling was up by 43% in 2018.

Significant improvements have been made to the sustainability of the transport system in recent years at national levels. The national vehicle road tax system was revised, and as of July 2008, the system moved away from assessing vehicles based on their engine size to one that is based on CO<sub>2</sub>eq emissions per kilometer (CSO- transport, 2018).

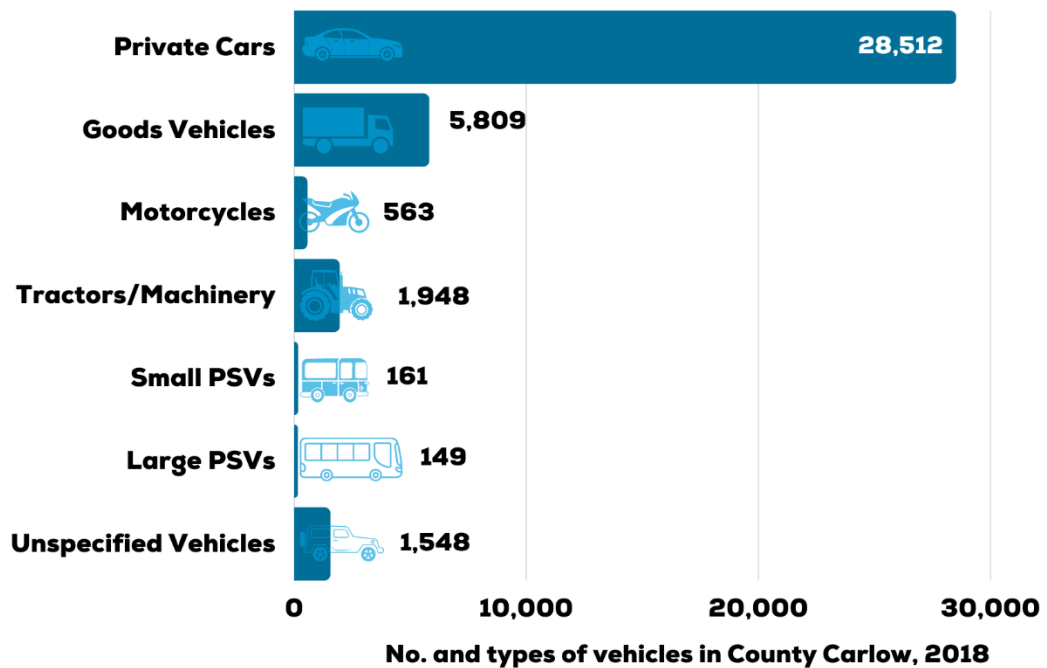
### 9.1 METHODOLOGY

The primary source of the Transport sector's GHG emissions come from the burning of diesel and petrol in combustion engines. MapEire data and CSO Transport Omnibus (CSO- transport, 2018) data both provide a breakdown of transport emissions at a County wide level, covering a range of vehicle type categories as outlined below. As seen in Figure 25, County Carlow had a total number of vehicles of 37,142 in 2018, of which:

- 28,512 are private cars
- 5,809 are goods vehicles
- 563 motorcycles
- 1,948 tractors and machinery
- 161 small PSVs (Public Service Vehicle)
- 149 large PSVs
- 1,548 Unspecified Vehicles

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<sup>25</sup> Census 2022 not available at time of analysis. Preliminary data published post analysis



**Figure 24. Number and Types of Vehicles in County Carlow in 2018**

*\*A public service vehicle is a vehicle that carries passengers for a fee. Small PSV is defined as vehicle that carries up to 8 passengers, and large PSV is defined as more than 8 passengers<sup>26</sup>.*

The SEAI’s ‘Energy in Ireland 2019’ (SEAI, 2019) includes the section on the share of emissions in Transport and gives a breakdown of average fuel use in Ireland in 2018 for Transport Vehicles. The 2018 fuel mix from this report was used to find an average national fuel type associated with energy use from transportation. The national dataset shows that an average of 1% of transport fuel is related to Compressed Natural Gas (CNG). Without data specific to County Carlow, this national average has been used to estimate the fuel mix breakdown. It is not known if there is any actual CNG vehicles in County Carlow.

This data was then combined with vehicular efficiency and GHG emissions data from the SEAI report on ‘Energy in Transport 2014’ (SEAI, 2014) as well as average age of private cars to estimate the overall average energy usage and fuel breakdown for each vehicle type and therefore the Transport Sector as a whole across County Carlow. Carbon emission factors for transport fuels was then used to convert energy to GHG emissions in 2018 for the Transport sector.

For public transport, providers of public transport differ in each county. Public Service Vehicles are reported as above, and MapElre provides for rail emissions as a subcategory.

<sup>26</sup> Road Safety Authority [https://www.rsa.ie/road-safety/road-users/special-purpose-vehicles/small-public-service-vehicles-\(spsv\)#:~:text=What%20is%20a%20small%20public,Yes](https://www.rsa.ie/road-safety/road-users/special-purpose-vehicles/small-public-service-vehicles-(spsv)#:~:text=What%20is%20a%20small%20public,Yes).



The transport data associated with Carlow County Council as reported in Section 4 of this report was subtracted from the total Transport data to avoid ‘double-counting’.

## 9.2 RESULTS

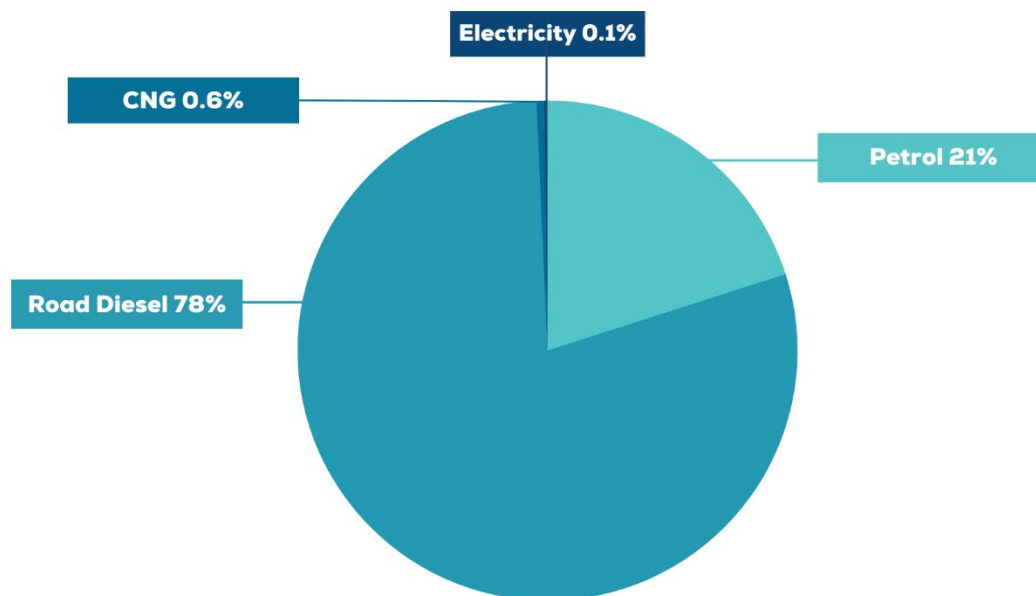
### 9.2.1 ENERGY RESULTS

The total energy consumption related to Transport in 2018 for County Carlow was **709.31 GWh**.

As seen in Figure 26, road diesel was the main fuel source for both public and private transport, accounting for 78.4% of fuel consumption. This was followed by petrol at 20.9%.

Fuel Type	GWh	%
<b>Petrol</b>	148.49	21%
<b>Road Diesel</b>	555.77	78%
<b>CNG</b>	4.14	0.6%
<b>Electricity</b>	0.9	0.1%
<b>TOTAL</b>	<b>709.31</b>	

**Table 17. County Carlow Total Energy Consumption Related to Transport in 2018**



**Figure 25. County Carlow Transport Energy Use %**

## 9.2.2 GHG EMISSION RESULTS

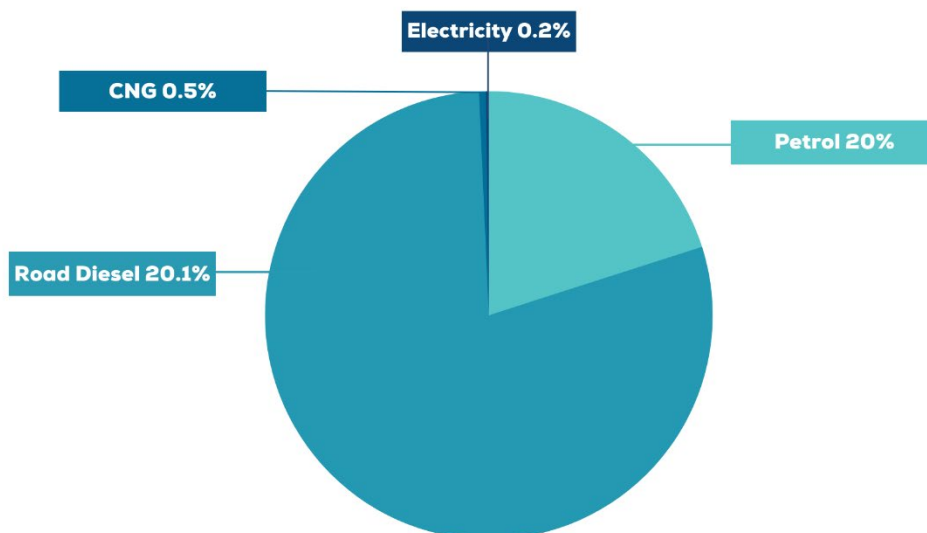
The total energy related emissions from Transport in 2018 were the equivalent of 185.26 ktCO<sub>2</sub>eq of which:

- 105.2 ktCO<sub>2</sub> from private vehicles
- 41.9 ktCO<sub>2</sub> from goods vehicles
- 0.2 ktCO<sub>2</sub> from motorcycles
- 10.1 ktCO<sub>2</sub> from tractors and machinery
- 2.1 ktCO<sub>2</sub> from small PSVs
- 2.8 ktCO<sub>2</sub> from large PSVs
- 21.9 ktCO<sub>2</sub> from Unspecified vehicles
- 1.6 ktCO<sub>2</sub> from railways
- 5.1 ktCO<sub>2</sub> from National Navigation

As seen in Figure 27, the split of emissions from the different fuel types is

Fuel Type	ktCO <sub>2</sub> eq	%
<b>Petrol</b>	37.41	20%
<b>Road Diesel</b>	146.67	79%
<b>CNG</b>	0.85	0.5%
<b>Electricity</b>	0.34	0.2%
<b>TOTAL</b>	<b>185.26</b>	

**Table 18. Split of Transportation Emissions from different fuel types**



**Figure 26. Split of Transportation Emissions from different fuel types %**

The GHG emissions from methane (CH<sub>4</sub>), and nitrous Oxide (N<sub>2</sub>O) obtained from the MapEire data equates to 2.35 ktCO<sub>2</sub>eq.

This gives a total GHG emissions for the Transport Sector of **187.63 ktCO<sub>2</sub>eq.**

### 9.3 KEY FINDINGS

- Total energy use in transport was 709.31 GWh
- Total final emissions from transport were 187.63 ktCO<sub>2</sub>eq
- Transport emissions came from diesel (79%), Petrol (20%)

Transport Sector	Fossil Fuels			Other Emissions		Total
	CNG	Road Diesel	Petrol	CH <sub>4</sub>	N <sub>2</sub> O	
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	<b>0.85</b>	<b>146.67</b>	<b>37.41</b>	<b>0.15</b>	<b>2.2</b>	<b>187.63</b>

**Table 19. County Carlow Transport Inventory, ktCO<sub>2</sub>eq Emissions**

## 10.0 LAND USE, LAND USE CHANGE & FORESTRY (LULUCF)

Land Use, Land-use Change and Forestry covers the following categories: Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested Wood products (EPA, 2022). The emissions associated with LULUCF is determined by the CO<sub>2</sub>eq emissions from Grassland and Wetlands, due to drainage of organic soils. This is offset somewhat by Forest Land and harvested wood products, which acts as a carbon sinks. (EPA, 2022).

### 10.1 METHODOLOGY

MapElre<sup>27</sup> provides data on the level of emissions and carbon sinks on a County wide level including forest land, cropland, wetlands, settlements as well as for harvested wood products (EPA, 2022). The data is taken directly from this data source.

The non-energy related GHG emissions include Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O).

### 10.2 RESULTS

#### 10.2.1 ENERGY RESULTS

There are no energy related results in this Section. GHG emissions in this sector are all non-energy related.

#### 10.2.2 GHG EMISSION RESULTS

CO<sub>2</sub> emissions from LULUCF sector is 57.4 kt. CH<sub>4</sub> and N<sub>2</sub>O emissions from LULUCF sector is 9.2kt CO<sub>2</sub>eq. This is equivalent to total emissions from LULUCF sector of **66.6ktCO<sub>2</sub>eq.**

See Figure 28, emissions from different sectors in LULUCF account for the following:

- Grassland accounts for 108.6 ktCO<sub>2</sub>eq.
- Wetlands accounts for 8.2 ktCO<sub>2</sub>eq.
- Settlements accounts for 3.3 ktCO<sub>2</sub>eq.
- Cropland accounts for -3.5 ktCO<sub>2</sub>eq.
- Harvested wood products accounts for -8.3 ktCO<sub>2</sub>eq.
- Forest land accounts for -41.8 ktCO<sub>2</sub>eq.

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<sup>27</sup> <https://projects.au.dk/mapeire/spatial-results/download>

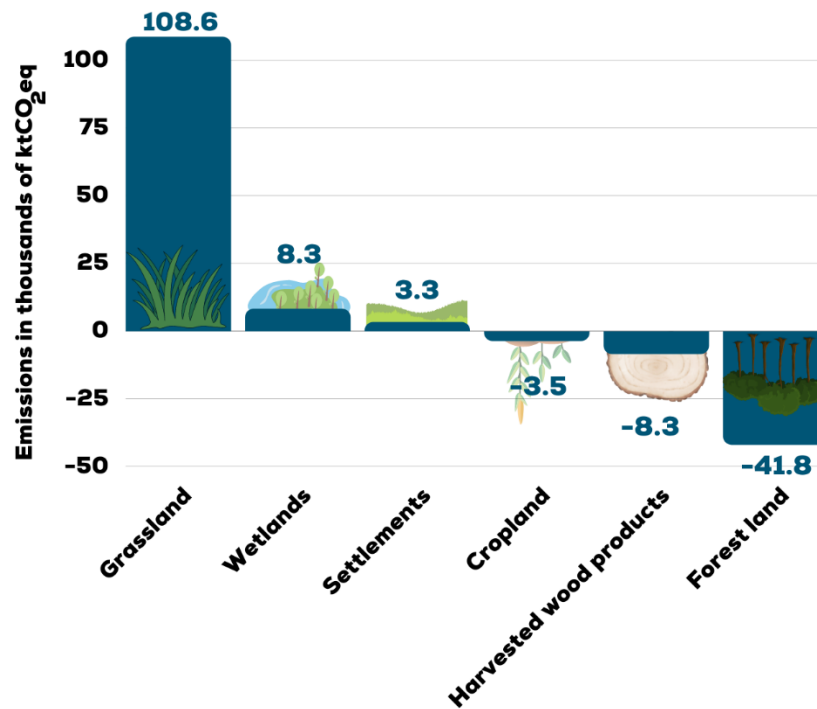


Figure 27. Emissions From Different Sectors in LULUCF

**Negative emissions accounts for that the amount for CO<sub>2</sub>eq absorbed by the forests, crops and harvested woods.**

### 10.3 KEY FINDINGS

- Total emissions from LULUCF sector accounts for 66.6 ktCO<sub>2</sub>eq.

LULUCF Sector	Grasslands	Wetlands	Settlements	Croplands	Harvested Wood Products	Forest land	Total
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	108.6	8.2	3.3	-3.5	-8.3	-42.8	66.6

Table 20. County Carlow LULUCF sector CO<sub>2</sub>eq emission

## 11.0 WASTE

This sector is responsible from handling of waste, incineration of waste (without energy utilisation), composting, and wastewater handling (EPA, 2022). This sector accounts for non-energy related emissions. Energy related emissions for waste services is covered under Manufacturing & Commercial emissions reported in Section 7 of this report (under industrial uses).

### 11.1 METHODOLOGY

MapElre provides data on the emission levels within this sector (EPA, 2022). For County Carlow the data is split into GHG emissions related to the following waste categories:

- Composting
- Solid waste disposal on land
- Open burning of waste
- Domestic waste-water handling

Additional data collection such as number of landfills and wastewater treatment plants provides further breakdown of emissions within this sector.

The National Waste Collection Permit Office (NWCPO) grant waste collection licenses for providers in each County. In 2018, there was one provider in County Carlow who has a permit for waste collection.

The Pollutant Release and Transfer (PRTR)<sup>28</sup> shows that in 2018 there were 2 facilities reporting under waste and wastewater management.

## 11.2 RESULTS

### 11.2.1 ENERGY RESULTS

There are no energy related emissions for Waste covered in this section. Energy related emissions for waste services is covered under Manufacturing & Commercial emissions reported in Section 7 of this report (under industrial uses).

### 11.2.2 GHG EMISSION RESULTS

The total emissions from the waste sector accounts for 11.57 ktCO<sub>2</sub>eq of this:

- 9.53 ktCO<sub>2</sub>eq from solid waste disposal on land
- 1.8 ktCO<sub>2</sub>eq from domestic wastewater handling
- 0.16 ktCO<sub>2</sub>eq from composting and the remaining
- 00.08 ktCO<sub>2</sub>eq from open burning of waste

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<sup>28</sup> <https://gis.epa.ie/EPAMaps/PRTR>

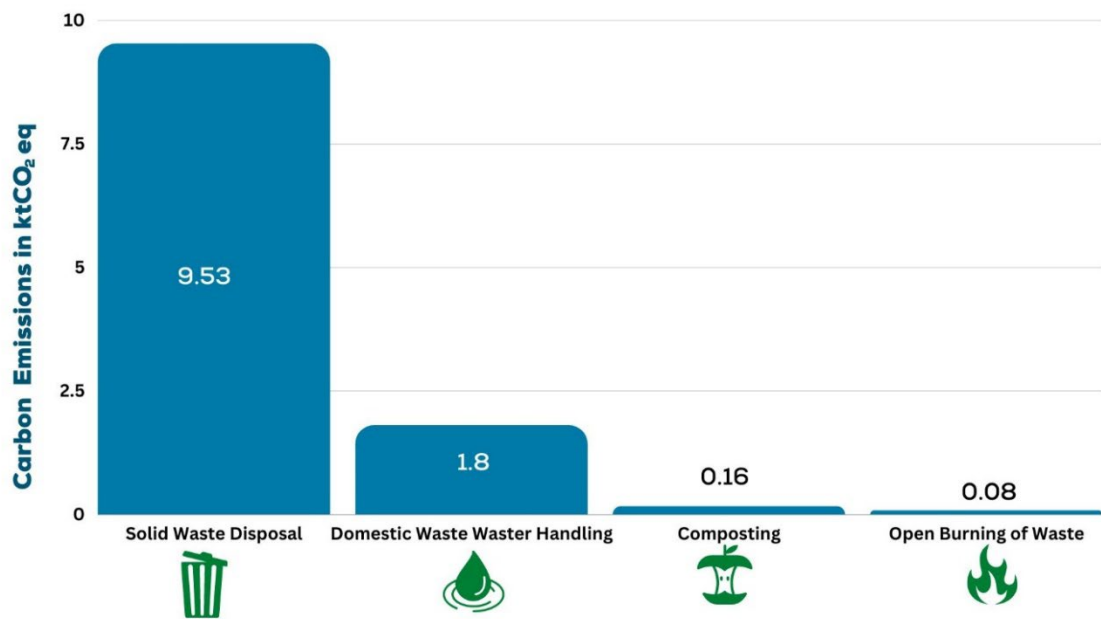


Figure 28. Waste GHG emissions by category, County Carlow, 2018

## 11.3 KEY FINDINGS

- Total emissions from waste sector accounts for 11.57 ktCO<sub>2</sub>eq.

Waste Sector	Solid Waste Disposal	Domestic Wastewater Handling	Composting	Open Burning of Waste	Total
<b>Total Emissions (ktCO<sub>2</sub>eq)</b>	<b>9.53</b>	<b>1.8</b>	<b>0.16</b>	<b>0.08</b>	<b>11.57</b>

Table 21: County Carlow Waste sector CO<sub>2</sub>eq emission



## 12.0 F-GASES

These gases comprise of HFCs (Hydrofluorocarbons), PFCs (Perfluorocarbons), SF<sub>6</sub> (Sulphur Hexafluoride) and NF<sub>3</sub> (Nitrogen Trifluoride). They are much more potent than the naturally occurring greenhouse gas emissions. These were extracted from MapEire dataset for the local authority area and is presented as CO<sub>2</sub>eq (EPA, 2022).

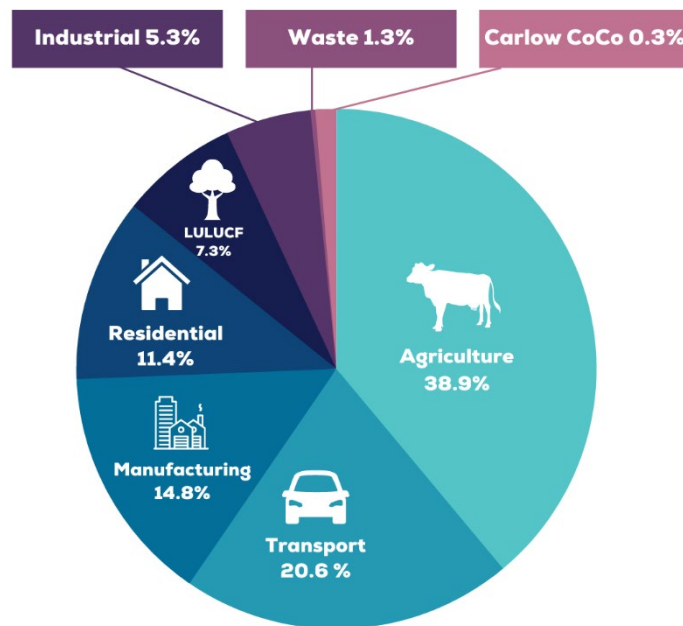
**For County Carlow there are no emissions from these gases. The only recorded producers of these emissions in Ireland are in Limerick city and county, and Kildare County**

## 13.0 RESULTS SUMMARY

This section examines total emission from the different carbon emitting sectors in County Carlow, as outlined in Chapters 4 – 13.

The total baseline GHG emission for 2018 for County Carlow is **909.11kt CO<sub>2</sub>eq.**

At 38.9%, agriculture accounted for the greatest percentage of total emissions in the County. This was followed by Transport (20.6%), Manufacturing & Commercial (14.8%) and Residential (11.4 %). Figure 30 below illustrates the total emissions by sector.



**Figure 29. Share of Total Emission in County Carlow**

County Carlow													Total
	Electricity	Fossil Fuels							CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	SF <sub>6</sub>	
		Natural Gas	Heating Oil	Diesel	Gasoline	LPG	Coal	Peat					
Carlow County Council (ktCO <sub>2</sub> eq)	1.71	0.27	0.07	0.46	0.01	0.04							2.56
Residential (ktCO <sub>2</sub> eq)	42.26	15.35	28.89			1.11	5.98	8.18	1.74	0.24			103.74
Manufacturing and Commercial (ktCO <sub>2</sub> eq)	56.83	32.17	31.24			5.50	8.90	0.08	0.08	0.14			134.96
Industrial Processes (ktCO <sub>2</sub> eq)										0.59	44.20	3.60	48.39
Agriculture (ktCO <sub>2</sub> eq)	30.38		0.01						206.78	116.46			353.64
Transport (ktCO <sub>2</sub> eq)	0.34	0.85		146.67	37.41				0.15	2.22			187.63
LULUCF (ktCO <sub>2</sub> eq)									4.95	4.27	57.39		66.61
Waste (ktCO <sub>2</sub> eq)									10.42	1.08	0.07		11.57
<b>Total Emissions (ktCO<sub>2</sub>)</b>	<b>131.52</b>	<b>48.65</b>	<b>60.21</b>	<b>147.13</b>	<b>37.41</b>	<b>6.66</b>	<b>14.88</b>	<b>8.26</b>	<b>224.12</b>	<b>125.01</b>	<b>101.66</b>	<b>3.60</b>	<b>909.11</b>

**Table 22. BEI Table for County Carlow, 2018**

## 14.0 CONCLUSION

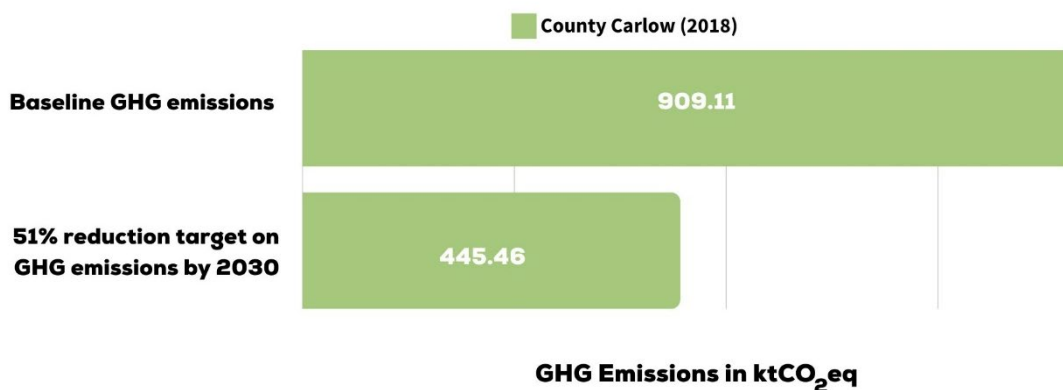
The total baseline GHG emission for 2018 for County Carlow is **909.11 ktCO<sub>2</sub>eq.**

The 2030 target for GHG emissions by 2030 is 51% reduction from the baseline year of 2018.

Therefore, the allowable GHG emissions in 2030 is **445.46kt CO<sub>2</sub>eq.**

The average GHG emissions for Carlow County Council in 2016-2018 was **2.81ktCO<sub>2</sub>eq.**

The National Climate Action Plan 2023, Section 10 requires all public sector bodies including local authorities to calculate their baseline GHG's for 2018 using an average of years 2016-2018. This average is referred to as the 2018 baseline.



**Figure 30. Carlow County & County Council Emission Baseline and 2030 Targets**

Carlow County Council is required, under the Climate Action and Low Carbon Development (Amendment) Act 2021 and by the National Climate Action Plan 2023 to reduce its Greenhouse Gas Emissions (GHG) by the required 51% by 2030.

The resulting Climate Action Plan for County Carlow must define and outline a clear pathway to achieve this reduction. As part of the Climate Action Plan the individual local authority will be responsible for reducing greenhouse gas emissions from across its own assets and infrastructure, whilst also taking on a broader role of influencing and facilitating others to meet their own targets. This is necessary to ensure the environmental, social and economic benefits that come with climate action can be fully realised.

Carlow County Council must demonstrate alignment with the key principles of the Local Authority Climate Action Planning Guidelines to ensure that the local authority climate action plan is: **Ambitious, Action-focused, Evidence-based, Participative and Transparent.**

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