The Kilkenny City Decarbonising Zone

Baseline Emissions Inventory

Final Report November 2023

Kilkenny County Council
Comhairle Chontae Chill Chainnigh

CARO

KPMG Future Analytics

KPMG Sustainable Futures

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01
Executive Summary

1.1 Executive Summary

A map of the Kilkenny City DZ is shown below.

1.1 Executive Summary

A **Decarbonisation Zone (DZ)** is a spatial area identified by the local authority in which a range of climate mitigation, adaptation and biodiversity measures are identified to contribute to meeting the national climate action targets. Action owners are also identified to contribute to meeting national climate action targets. DZs are a demonstration and testbed of what is possible for decarbonisation and climate action at a local and community level. Through a feedback loop of experimentation and evaluation, the DZ enables a flexible, incremental and community-driven approach to ensure that its objectives are delivered.

Kilkenny City has been identified as the DZ for County Kilkenny by Kilkenny County Council based on its socioeconomic and physical environmental characteristics which have been deemed an appropriate fit against a set of defined DZ criteria. The DZ area is shown on the map below.

Once a DZ area is identified and the associated overarching vision and objectives are set, each local authority must kickstart the next stage of the DZ - the development of the DZ area's **Baseline Emissions Inventory (BEI)**.

The BEI is an overview of the area's total carbon emissions at a point in time. It is a key instrument to support and enable a local authority to measure the impact of planned actions relating to emission reductions across its own operations as well as relevant sectors of society.

Kilkenny County Council's BEI for the DZ area is informed by the guidance document Technical Annex C: Climate Mitigation Assessment and Technical Annex D Decarbonising Zones and follows a **Tier 3 approach**, i.e. a 'bottom-up, spatially led' approach. These are national guidance documents produced by the Climate Action Regional Offices (CAROs) and the Department of the Environment, Climate and Communications (DECC), and the DZ process forms part of the Local Authority Climate Action Plans (LACAPs).

2018 is used as the baseline year for the BEI assessment. This year has been purposefully chosen to align with Ireland's national targets which are set against a 2018 baseline year.

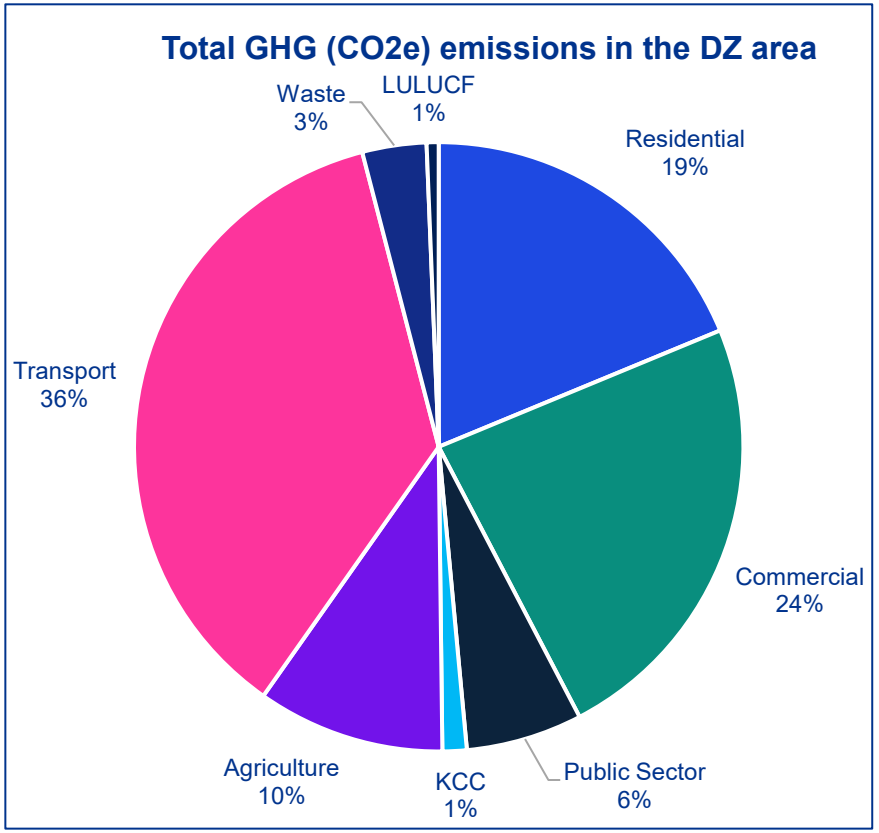
Emissions associated with the following sectors are considered in this BEI assessment due to their relevance in the DZ area: **Residential, Commercial, Public Sector, Transport, Waste, Agriculture, LULUCF, and Kilkenny County Council.**

A summary of the results of the DZ area BEI assessment is provided on the next page.

1.1 Executive Summary (cont..)

The results of the 'bottom-up' Tier 3 assessment are presented on the table and chart below. Total greenhouse gas emissions in the Kilkenny City DZ in 2018 equate to approximately **169,878 tCO_2e**.

	Carbon emissions (tCO_2e)
Residential	31,869
Commercial	40,068
Public Sector	10,492
Kilkenny County Council	2,184
Transport	61,486
Waste	5,783
Agriculture	16,914
Land Use, Land Use Change and Forestry (LULUCF)	1,082
Total carbon emissions	**169,878**
Total carbon emissions per capita (tCO_2e/capita)	**6.17**
*Similar scale urban DZ***	*8.87*



* Source: EU Greenhouse gas emissions per capita 2018

** Source: KPMG

Note: Figures rounded to whole numbers for presentation purposes.

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Introduction

2.1 Global & National Response to Climate Change

Global responses to climate change are accelerating as exemplified by the signing of the COP21 Paris Agreement by 195 countries in 2015. Ireland's climate policies are evolving in line with national and international requirements and aims to "pursue and achieve, by no later than the end of 2050, the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy."

Climate change has become one of the most pressing global public policy challenges facing governments today.

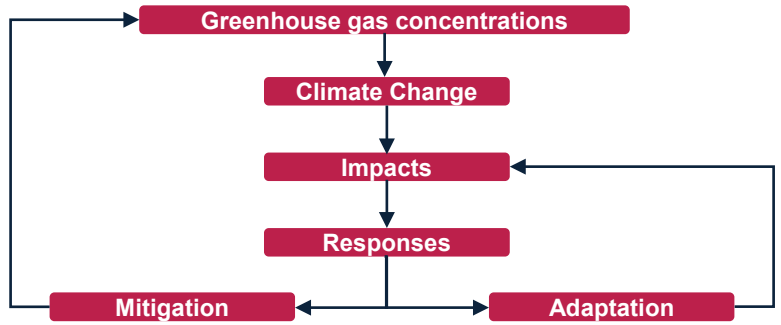
International organisations, national and local governments are increasingly compelled to take ambitious action through mitigation (decreasing emissions that cause climate change) and adaptation (enhancing resilience to climate change impacts and risks).

Ireland's Local Authorities are developing Local Authority Climate Action Plans (LACAPs) to play their part in meeting national emissions objectives and to transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy. These plans need to be underpinned by a robust evidence base detailing sources of emissions as well as the current and future climate-related risks faced by the Local Authority.

In response to the challenges posed by climate change, two complementary approaches are being adopted.

Mitigation: ensuring the impacts of climate change are less severe by preventing or reducing carbon emissions. Mitigation is achieved either by reducing the sources of these gases (e.g. by increasing the share of renewable energies, or establishing a cleaner mobility system), or by enhancing the storage of these gases (e.g. by increasing the size of forests).

Adaptation: anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. Examples of adaptation measures include large-scale infrastructure changes, such as building defences to protect against sea-level rise, as well as behavioural shifts, such as individuals reducing their food waste.



2.1 Global & National Response to Climate Change (cont..)

Paris Agreement, 2015

The Paris Agreement, adopted in 2015 provides an internationally accepted and legally binding global framework to addressing climate change challenges. It has two clearly defined goals aimed at supporting progressive and ambitious climate action to avoid dangerous climate change:

I. holding global average temperature increase to well below 2°C and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (i.e. **mitigation**);

II. increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience (i.e. **adaptation**).

European Climate Law, 2021

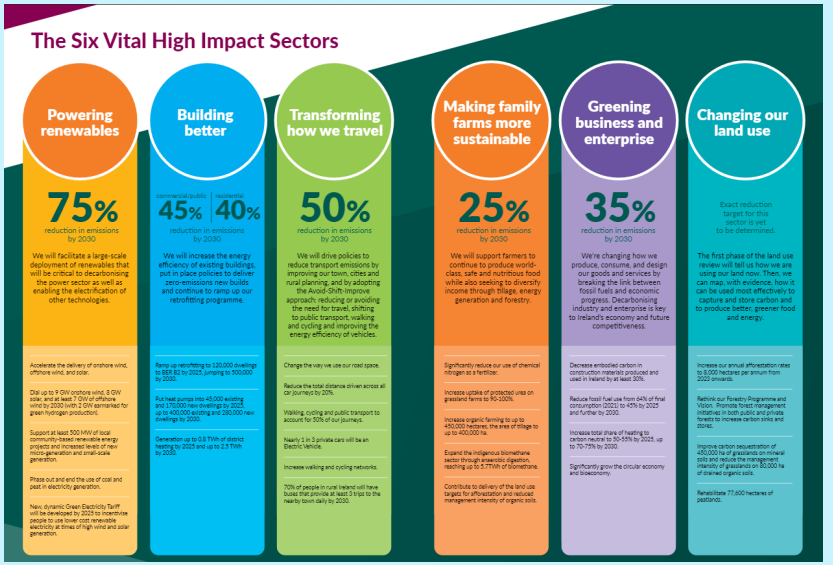
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required by all Member States, and the use of all policy levers and instruments, to fight against the urgent challenge of climate change and to activate leadership efforts to reach climate neutrality by 2050.

Climate Action and Low Carbon Development (Amendment) Act, 2021

Climate policy in Ireland reflects the ambition of the EU and that required to confront the challenges of climate change. The Climate Action and Low Carbon Development (Amendment) Act, 2021 frames Ireland's legally binding climate ambition to delivering a **reduction in greenhouse gas emissions of 51% by 2030**, to achieve climate neutrality by the end of 2050.

Through progressive economy-wide carbon budgets, sectoral ceilings, a suite of strategies devised to promote a **combination of adaptation and mitigation measures**, and robust oversight and reporting arrangements, climate policy is working to scale up efforts across all of society and deliver a step change on ambitious and transformative climate action to 2030 and beyond to 2050.

National Climate Action Plan 2023



Regional & Local Policies:

- Regional Spatial Economic Strategy for the Eastern and Midlands region
- Kilkenny City and County Development Plan 2021-2027
- Kilkenny Local Economic and Community Plan 2023-2028

2.2 Identification of the Decarbonisation Zones

Local Authorities have a key role to play in addressing and driving forward climate change mitigation. In addition to meeting their 2030 and 2050 energy and emission targets, they are well placed to assess, exploit and support opportunities within their administrative areas, in cooperation with each other and with national bodies, and through the involvement and support of local communities.

Action 80 of the Government's Climate Action Plan 2019 states that they will support, monitor and assess Local Authority Climate Action.

Action 165 of the Government's Climate Action Plan 2019, requires Local Authorities to identify and develop plans for one Decarbonising Zone.

A **Decarbonisation Zone (DZ)** is a spatial area, identified by each local authority in Ireland, in which a range of climate change mitigation measures are identified, whilst enhancing and embracing adaptation and biodiversity measures to contribute to reaching wider national climate action targets.

DZs are a demonstration and testbed of what is possible for decarbonisation and climate action at a local and community level. Through a feedback loop of experimentation and evaluation, the DZ enables a flexible, incremental and community-driven approach to ensure that its objectives are delivered.

The criteria for selecting a DZ are:

- Urban areas and agglomerations with a population not less than 5000 persons, **or**
- Rural areas with an area of not less than 4 km^2
- Other location/areas that can demonstrate decarbonisation at a replicable scale.

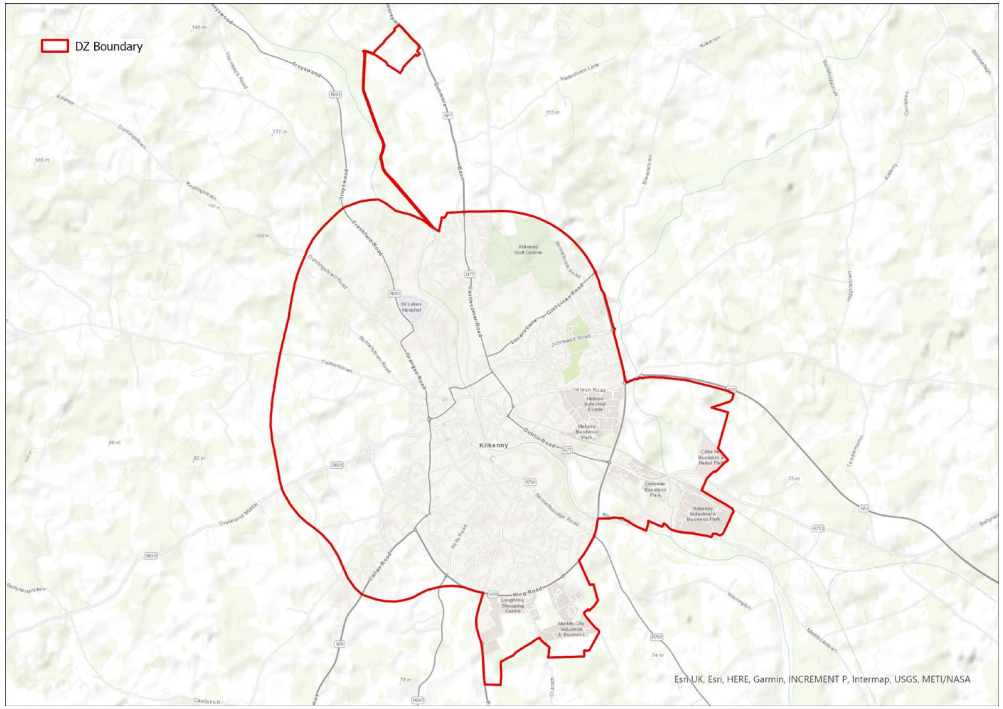
Other considerations come into account when identifying a DZ which include Transport, Buildings, Green spaces and green infrastructure, Complimentary infrastructure, Land use and environmental value, Air quality, Waste management, Co-benefits, Planning policy supports, and Community activation and readiness.

Once a DZ area is identified and the associated overarching vision and objectives are set, each local authority must kickstart the next stages of the DZ, as illustrated on the right.

2.2 Identification of Decarbonising Zones (cont..)

Kilkenny County Council has also set an overarching vison for the area:

"A thriving, green and healthy city for all"



Kilkenny City has been Identified as the spatial area in which a range of climate mitigation, adaptation and biodiversity measures and actions are identified to address local low carbon energy, greenhouse gas emissions and climate needs to contribute to national climate action targets. Its socioeconomic and physical environmental characteristics have been reviewed and identified as an appropriate fit for the defined DZ criteria. In summary:

Administrative Boundary

Kilkenny DZ includes 100 small areas under 4 Electoral Divisions (ED) (as shown within the red line boundary left). The also DZ encompasses the land within the Kilkenny City Development Plan boundary, plus the Dunmore Countryside Park & Civic Amenity Area to the north.

Population

The total population of the Kilkenny DZ area was estimated at 27,539 (2016 Central Statistic Office (CSO) data).

Land Area

Kilkenny DZ has a total land area of approximately 20.09 km^2.

Scalability

Kilkenny City is considered to be an appropriate demonstration area and testbed for urban decarbonisation measures to be adopted in other similar areas as well as scaled up across the county.

2.3 Establishment of the Baseline Emissions Inventory

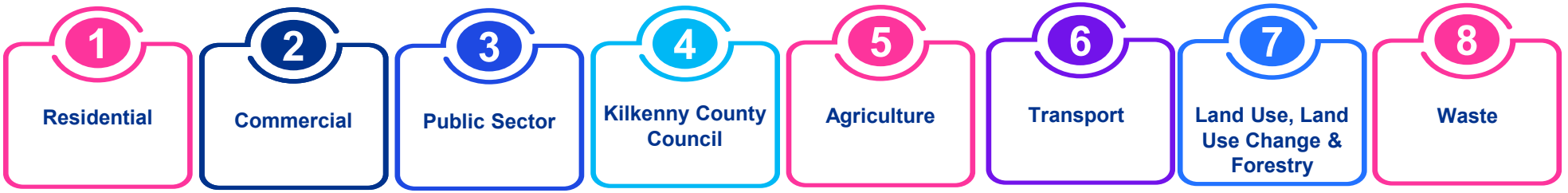
The baseline emissions inventory (BEI) is an overview of an area's or region's total carbon emissions at a point in time. The BEI is a key instrument that enables a local authority to measure the impact of planned actions related to emission reductions across its own operations as well as relevant sectors of society. The BEI represents an evidence-based approach to not only inform appropriate emission reduction actions but also measure progress over time.

The BEI is required to be undertaken for the purpose of informing climate change action planning. The BEI should be treated as a live inventory and regularly updated to assess progress against actions as well as to improve accuracy with the inclusion of new and better datasets as they evolve.

Kilkenny County Council's BEI for the DZ area is informed by the guidance document Technical Annex C: Climate Mitigation Assessment and Technical Annex D Decarbonising Zones. These guidance documents support a robust approach to the assessment and reporting of baseline energy and carbon emissions for all local authorities. 3 approaches to the development of a BEI are outlined – Tier 1, Tier 2 and Tier 3 – each of which allow for local authorities at varying levels of experience and maturity to produce a BEI. This BEI assessment for Kilkenny County Council DZ area follows a Tier 3 approach, i.e. a 'bottom-up, spatially led' approach to BEI development.

2018 is used as the baseline year for the BEI assessment. This year has been purposefully chosen to align with Ireland's national targets which are set against a 2018 baseline year. This BEI assessment provides a snapshot in time of the carbon emissions across all identified sectors of the economy within the boundaries of a specific local authority. The baseline assessment covers both direct and indirect emission sources within the administrative area, as well as the level of control and influence a local authority has over these emissions.

Emissions associated with the following sectors are considered in this BEI assessment, aligning with Ireland's National Emissions Inventory.



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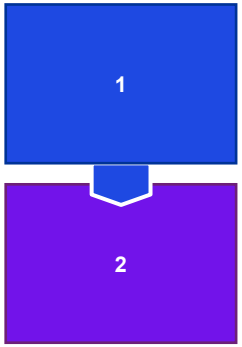
DZ BEI Tier 3 Assessment

3.1 Approach to Assessment

3.1.1 Approach to BEI Assessment

This section of the report sets out the analysis of energy and carbon emissions associated with the main activities, and emissions sources, presented by sector, within the DZ area. Two steps have been undertaken to inform a robust understanding of the energy and carbon emissions within the DZ area, as summarised below:



A ‘top-down’ overview of carbon emissions within the DZ area, informed by data gathered from the Environmental Protection Agency’s (EPA) MapEire database, has been undertaken. This assessment allows for a ‘helicopter’ overview of the magnitude of emissions within the area and the sectoral hotspots. The purpose of this ‘top-down’ assessment is not to override the ‘bottom-up’ assessment outcomes, but rather to provide an additional layer of context to inform decision making. The results of this assessment is contained in the **Appendix**.

This ‘top-down’ overview is followed by the **Tier 3** ‘Bottom-Up’ assessment approach, informed predominantly by spatial data and the use of geographical information systems (GIS) software and processes. This allows for the mapping of data and information within the DZ area, supporting effective communication and engagement with key internal and external stakeholders. The assessment also includes non-spatial data to support the analysis and future action planning.

Although the Tier 3 approach can provide a more robust evidence base on which to inform the action planning, it relies heavily on the quantity, quality, and variety of the data available for analysis. As more datasets and methodologies are made available, BEIs will improve further and better equip local authorities in their decision making and action planning supporting decarbonisation and climate action.

A full list of data sources, assumptions & limitations are included in the **Appendix**.

3.2 BEI Assessment

3.2.1 Summary

3.2.1.1 Summary Results

The results of the 'bottom-up' Tier 3 assessment are presented on the table and chart below. Total greenhouse gas emissions in the Kilkenny City DZ in 2018 equate to approximately **169,878 tCO_2e**. This translates to **6.17 tCO_2e per capita** based on 2016 census population data. In 2018, Ireland's national carbon emissions equated to approximately 12.6 tCO_2e per capita. While the DZ's carbon emissions per capita is lower than the national equivalent, Ireland is higher than the EU average of 8.2 tCO_2e per capita.*

	Carbon emissions (tCO_2e)
Residential	31,869
Commercial	40,068
Public Sector	10,492
Kilkenny County Council	2,184
Transport	61,486
Waste	5,783
Agriculture	16,914
Land Use, Land Use Change and Forestry (LULUCF)	1,082
Total carbon emissions	**169,878**
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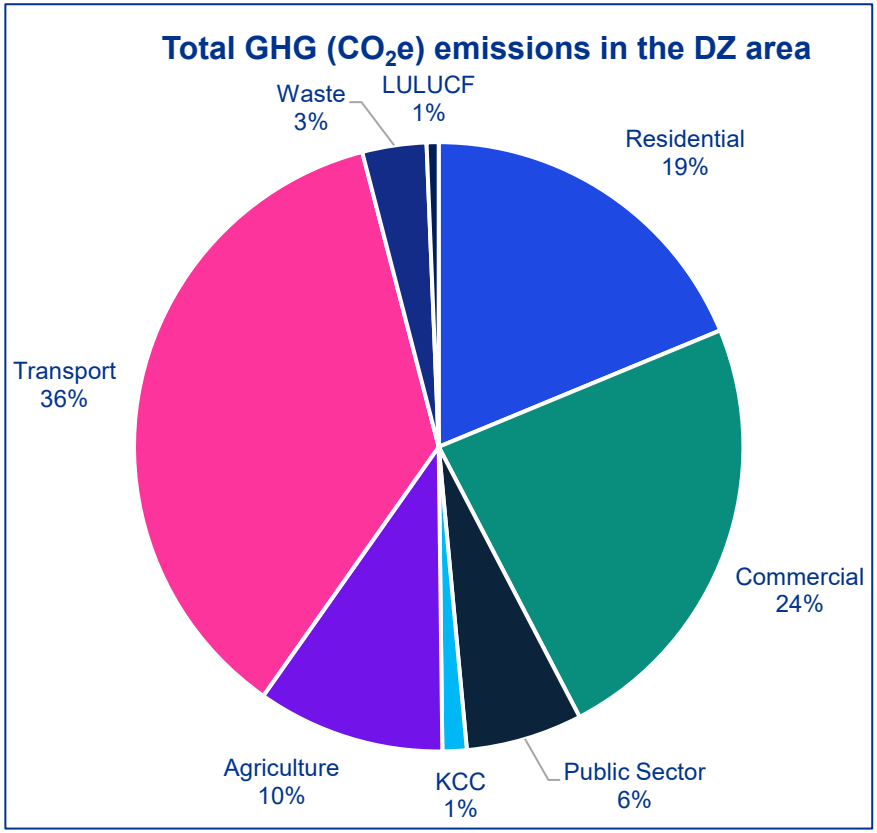

* Source: EU Greenhouse gas emissions per capita 2018

** Source: KPMG

3.2.2 Socio-Economic Context

3.2.2.1 Socio-Economic overview

Overview of the Socio-Economic analysis

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Socio-economic development and decarbonisation are intricately linked, with social and economic activities impacting on carbon emissions, for example, through energy use and land use. Carbon emissions contribute and influence the severity of climate change – climate change has a direct effect on socio-economic development, often contributing to and/or heightening various social issues.

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Socio-economic factors including income, wealth, and industrialisation can contribute significantly to carbon emissions. Addressing these socio-economic factors as part of a holistic approach to decarbonisation and climate change action planning and decision making will result in effective solutions, supporting the shift to a more sustainable and just society.

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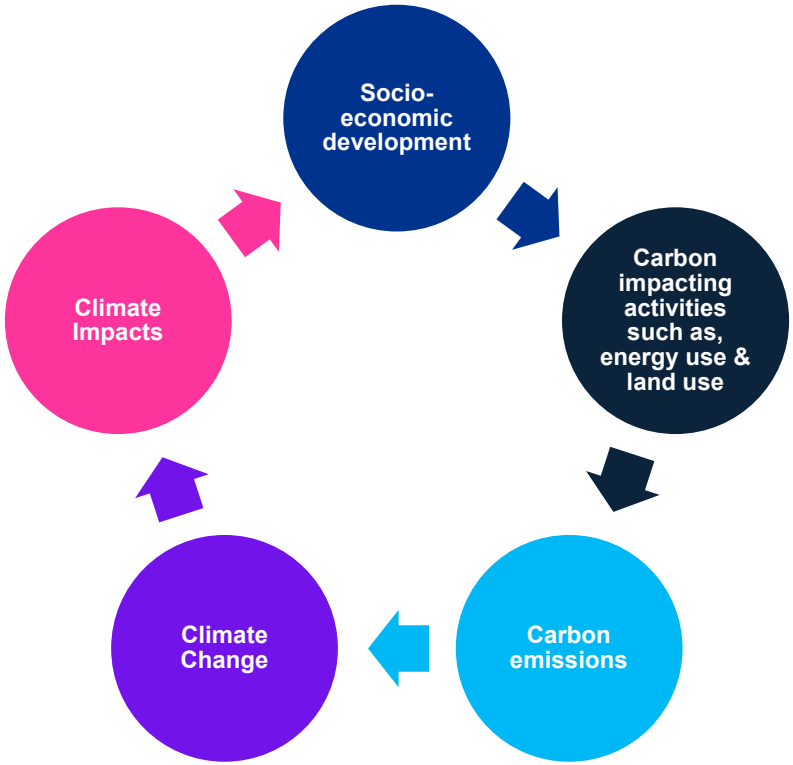
The following pages focus on socio-economic factors including population and zoning associated with the DZ area. This overview is based on data from the 2016 CSO which is considered to be an appropriate proxy for activities in the baseline year of 2018.



3.2.2.2 Socio-Economic context

Socio-Economic snapshot of the DZ area

The population of the DZ area is 27,539. The demographics of the region show a 49% male : 51% female split in gender (based on the 2016 CSO Census data).

The average age is 37.2 with 55.4% of the population being 0-39 years of age.

46.9% of households have children living at home with 19.7% of households shown as retired or ‘empty nests’.

79% of the adult population are married with children.

Average household income within the study is €46,874, 5% higher than the state average of €44,477. Employment rates are in line with the national average of 53.4%, with the study area at a level of 53.5%.

Unemployment within the DZ area is 8.9%, marginally higher than the state figure of 7.9%. 2016 POBAL data highlighted a mixture of deprivation and affluence, with certain areas towards the urban centre noted as ‘Very Disadvantaged’ interspersed with areas of average affluence. More affluent areas are also found in the northern and southern outskirts of the town.

The Pobal data, or Deprivation Index, provides a measurement of the affluence/or deprivation of a given area relative to the national mean at a specific point in time. By comparing Deprivation Index scores for a particular area at two different points in time, Pobal can assess whether it has moved up or down in its position relative to the rest of the country.

Knowledge of these areas of disadvantage and deprivation are vital when planning climate change mitigations. Some socioeconomic groups will need assistance and encouragement to adopt climate mitigations, factors influencing this could include affordability, social isolation, and housing types. While higher socioeconomic groups can afford energy efficient white goods and smart technology, these easily available solutions are financially beyond some groups. Changes in public transportation methods and frequencies also disproportionally affect the socially disadvantaged.

3.2.2.2 Socio-Economic context (cont..)

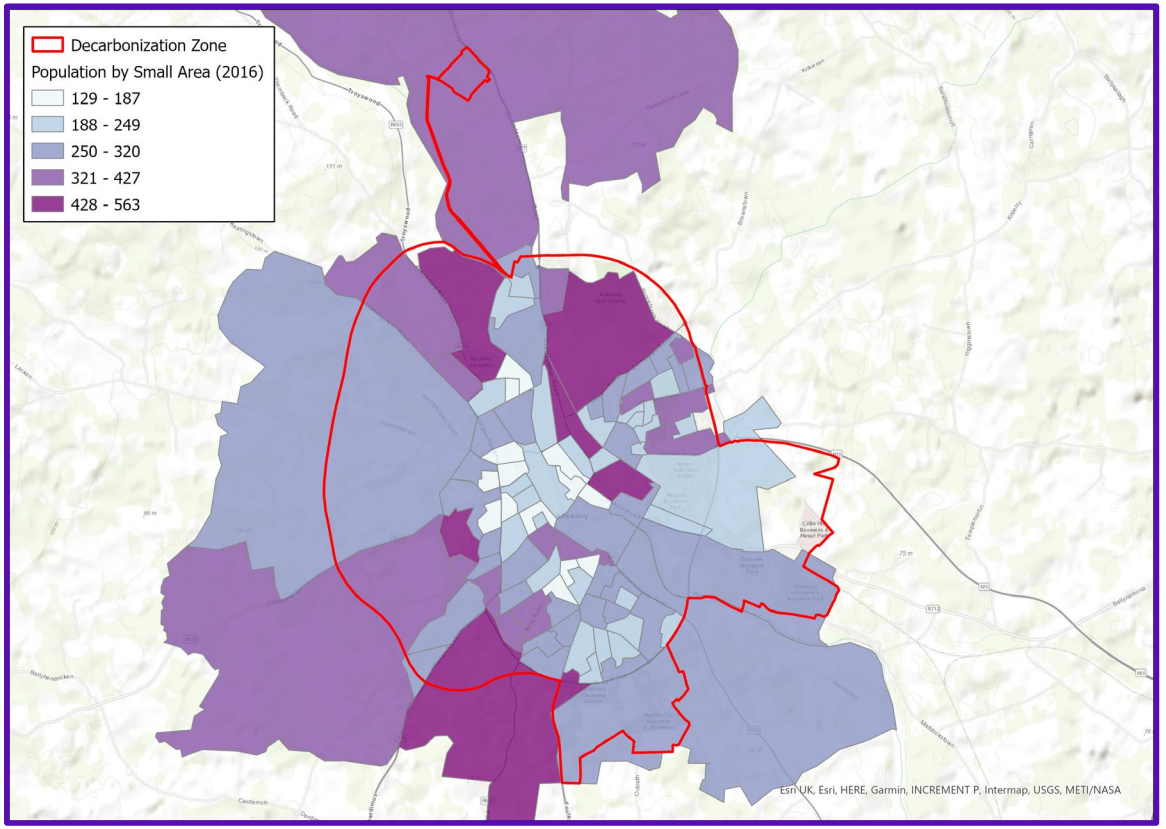
Population Distribution

- The average population in the DZ is c.275 persons per Small Area.

- The small areas with the highest populations can be seen in some of the Northern, North-Eastern and Southern areas of the DZ. The small areas that lie outwards from the urban centre, have much lower population.

- 2016 CSO data indicated that the average household size is 2.6.* This is similar to the state average of 2.65. Two person households are the largest cohort in the study area at 30.4% of total households.

* The methodology for household size is explained here by the CSO



Please note, depending on the data sources available, some information beyond the DZ boundary is included in the maps/data contained within this report.

3.2.2.2 Socio-Economic context (cont..)

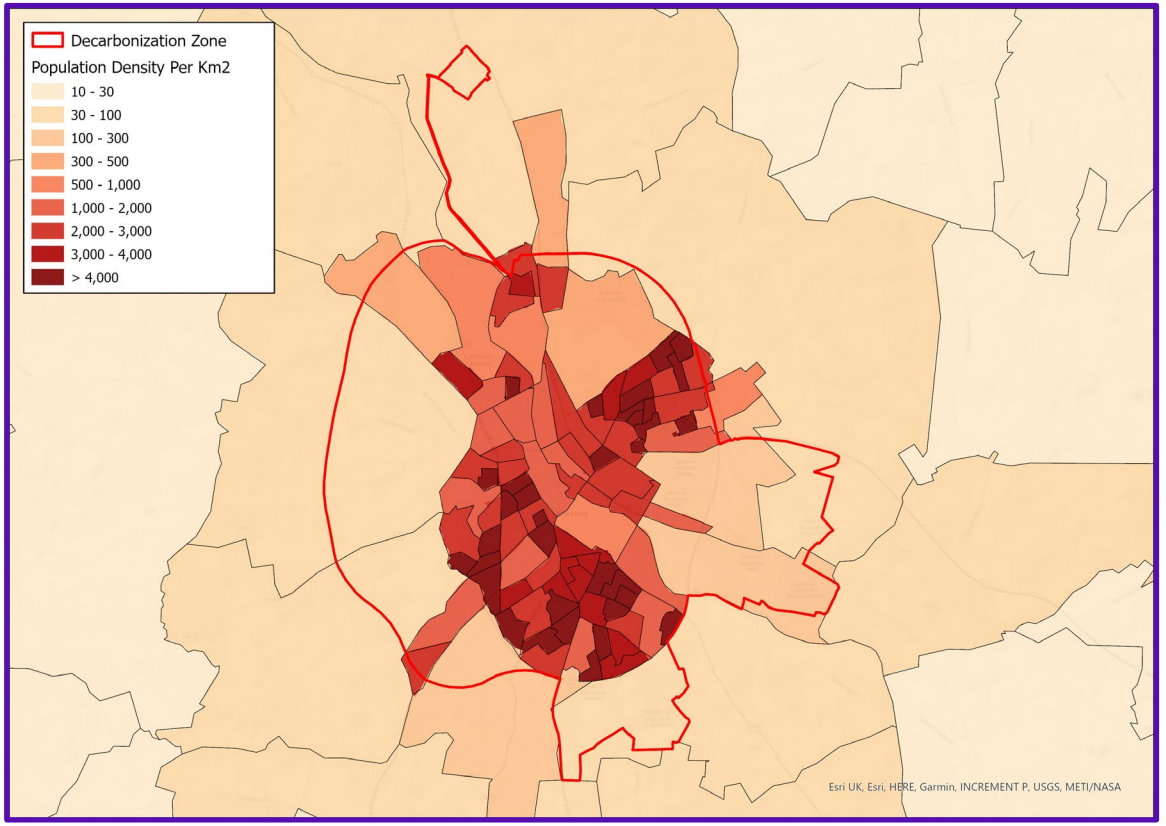
Population Density

- The population density of the DZ area was found to be c.1,371 persons per km^2. The national average population density in urban areas was found to be 2,008 persons per km^{2*}.

- The highest population densities can be seen in some of the Northern, Eastern and Southern areas of the DZ.

- Exploring the feasibility of alternative heating systems such as District Heating, geothermal etc. is another key consideration for the heat sector within the DZ. In line with national policy, the compact growth of the DZ is key to supporting energy-efficient use of land and infrastructure. While district heating might not be suitable for all sectors of the DZ (due to population density), there may be some niche applications of the technology within Kilkenny City DZ at large heat users.

- The population density of the DZ was calculated by dividing the total population of the small areas (27,539) by the area of the DZ (20.09 km2), with the caveat that some of the population may reside outside of the DZ. The total area of the small areas is 46.37 km^2, and dividing the population of the small areas by its total area would give a population density of 594 persons per km^2. However, the map on the right shows that these small areas have lower population densities in comparison to the small areas within the DZ boundary.



Please note, depending on the data sources available, some information beyond the DZ boundary is included in the maps/data contained within this report.

Source: Population density in Ireland

3.2.2.2 Socio-Economic context (cont..)

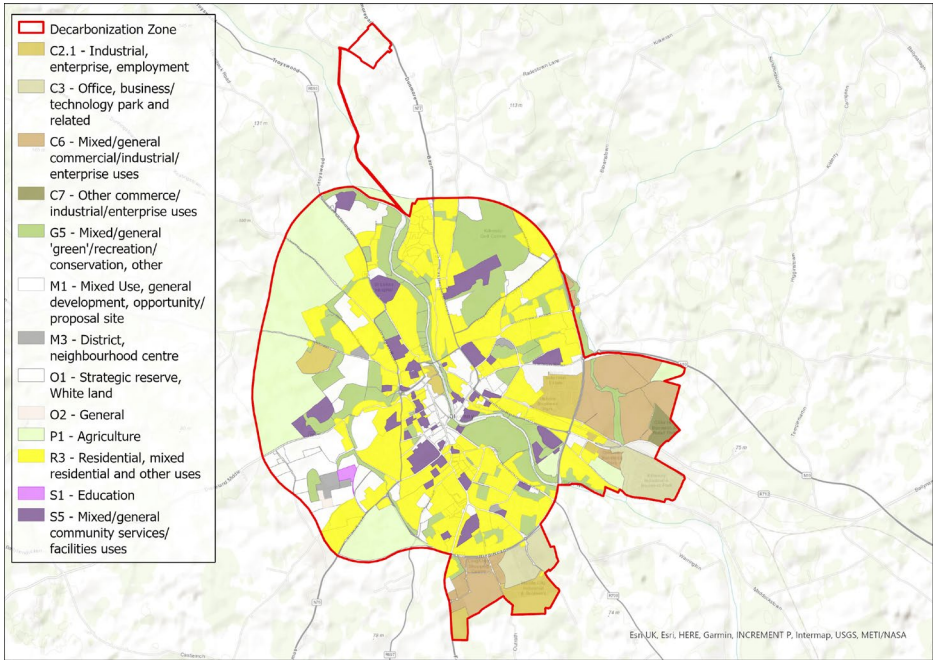
Zoning and Development Profile

- The map to the right sets out the zoning and development profile for the DZ area, identifying the use and/or proposed use of land. Typically land may be designated for residential use; for industrial, commercial, agricultural or recreational use; as open space; or a mixture of those uses. In the DZ area, land zoning is shown for a variety of uses, including commercial and residential uses. Approximately 17.5% of the land within the DZ is zoned for 'Mixed/general 'green'/recreation/conservation, other'. This presents the DZ with a significant opportunity for the increased implementation of nature-based solutions and green infrastructure.

- According to the CSO (2016) data, there are 10,296 occupied dwellings in the Kilkenny DZ, with an additional 732 vacant dwellings. This gives the DZ a vacancy rate of ~6.4%. The national average vacancy rate for urban areas is 3.1% (CSO 2016 data).

- The area also contains 1,356 local authority social housing units which the local authority will have responsibility for retrofitting. These units could be used as a pilot scheme to show the medium to long term benefits of energy efficiency.

Land Use Zoning	% of Total Area
R3 - Residential, mixed residential and other uses	31.01%
G5 - Mixed/general 'green'/recreation/conservation, other	17.46%
P1 - Agriculture	15.72%
O1 - Strategic reserve, White land	7.87%
C6 - Mixed/general commercial/industrial/enterprise uses	7.52%
S5 - Mixed/general community services/facilities uses	5.70%
M1 - Mixed Use, general development, opportunity/proposal site	5.04%
C2.1 - Industrial, enterprise, employment	4.22%
C3 - Office, business/technology park and related	3.81%
M3 - District, neighbourhood centre	0.70%
C7 - Other commerce/industrial/enterprise uses	0.64%
S1 - Education	0.20%
O2 - General	0.12%
Grand Total	**100%**



3.2.3 Residential Sector

3.2.3.1 Residential Sector Overview

Overview of the National Residential Sector

Ireland's domestic properties face a significant decarbonisation challenge. Our housing stock is one of the least energy efficient within the EU while our heating systems have a particularly low level of renewables in the energy mix – the SEAI have indicated that fossil fuels are used as the heat source in 73% of dwellings. The ongoing cost of the energy crisis has highlighted Ireland's dependence on imported fossil fuels, leaving Irish households highly vulnerable to global energy prices.

The residential sector accounted for approximately 10% of Ireland's carbon emissions in the baseline year of 2018 with similar levels seen in the latest reported figures. To achieve Ireland's climate goals, the sector is required to reduce its emissions by 40% by 2030 (compared to a 2018 baseline).

CAP 2023 sets out a number of actions and targets for the residential sector to meet its overarching goal, including:

- All new dwellings designed and constructed to Nearly Zero Energy Building (NZEB) standard by 2025 and Zero Emission Building (ZEB) standard by 2030;
- Equivalent of 120,000 dwellings retrofitted to BER B2 or cost optimal equivalent by 2025, and 500,000 dwellings by 2030;
- Up to 0.8 TWh of district heating installed capacity by 2025, and up to 2.5 TWh by 2030;
- 170,000 new dwellings using heat pumps by 2025, and 280,000 by 2030;
- 45,000 existing dwellings using heat pumps by 2025, and 400,000 by 2030;
- Up to 0.4 TWh of heating provided by renewable gas by 2025, and up to 0.7 TWh by 2030.

To achieve theses highly ambitious targets, the DZ area must significantly reduce its use of fossil fuels, including, coal, peat and oil, and increase dependence on renewables and electricity, to heat existing residential buildings while also optimising and enabling energy efficiency. Retrofit activity must be supported to underpin this reduction, with resulting benefits for homeowners in terms of efficiency, comfort, and health and wellbeing.

The following sections present an overview of the residential sector related activities, energy and emissions within the DZ area. Further detail on data sources, assumptions and limitations is included in the **Appendix**.

3.2.3.2 Residential Summary Results

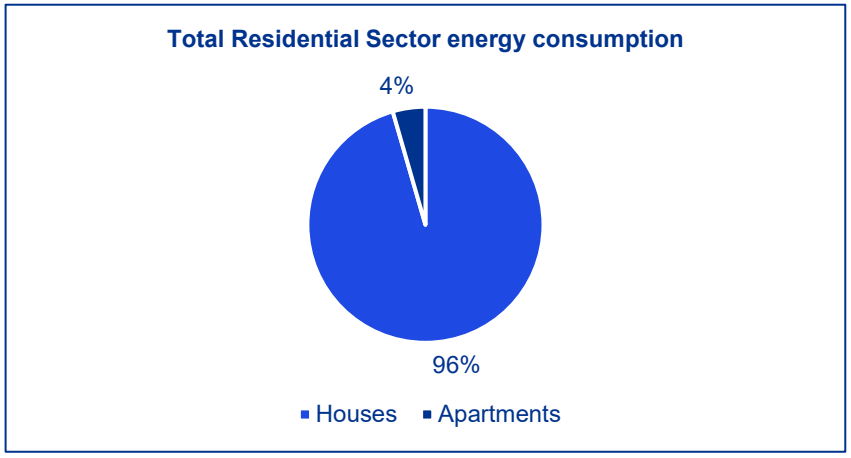
Residential Sector: Summary

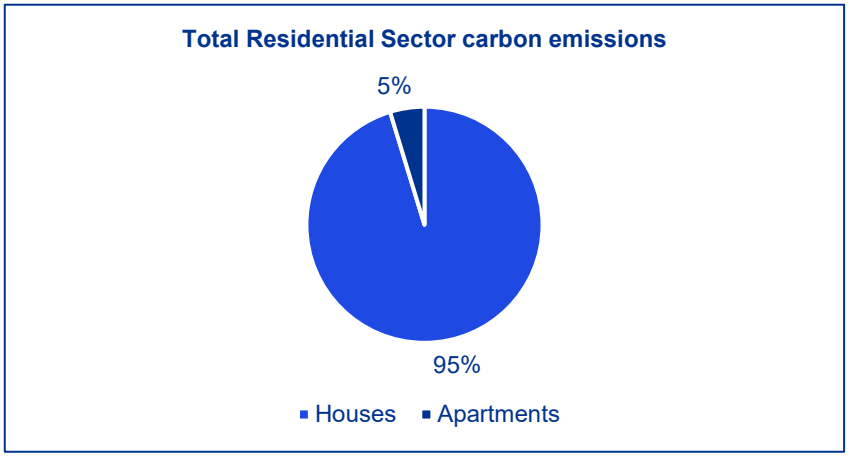
The results of the residential sector assessment are presented in the tables and charts below. The 'Occupied homes' have been included within the assessment. These account for the majority of residential homes in the DZ area.

The total energy consumption of the sector's 10,550 dwellings equates to **133,106 MWh**. The associated carbon emissions of the sector equate to approximately **31,869 tCO_2e**. The 9,321 houses within the DZ area account for ~96% of the sector's energy consumption and ~95% of the sector's total carbon emissions. The 1,319 'apartments' within the DZ area account for ~4% of total residential energy consumption and ~5% of carbon emissions.

	Energy Consumption (MWh)
Houses	127,153
Apartments	5,953
Total Residential Homes	**133,106**

	Carbon emissions (tCO_2e)
Houses	30,369
Apartments	1,501
Total Residential Homes	**31,869**





Note: Figures rounded to whole numbers for presentation purposes.

3.2.3.3 Residential Sector Analysis

Residential Sector: Age of Housing Stock

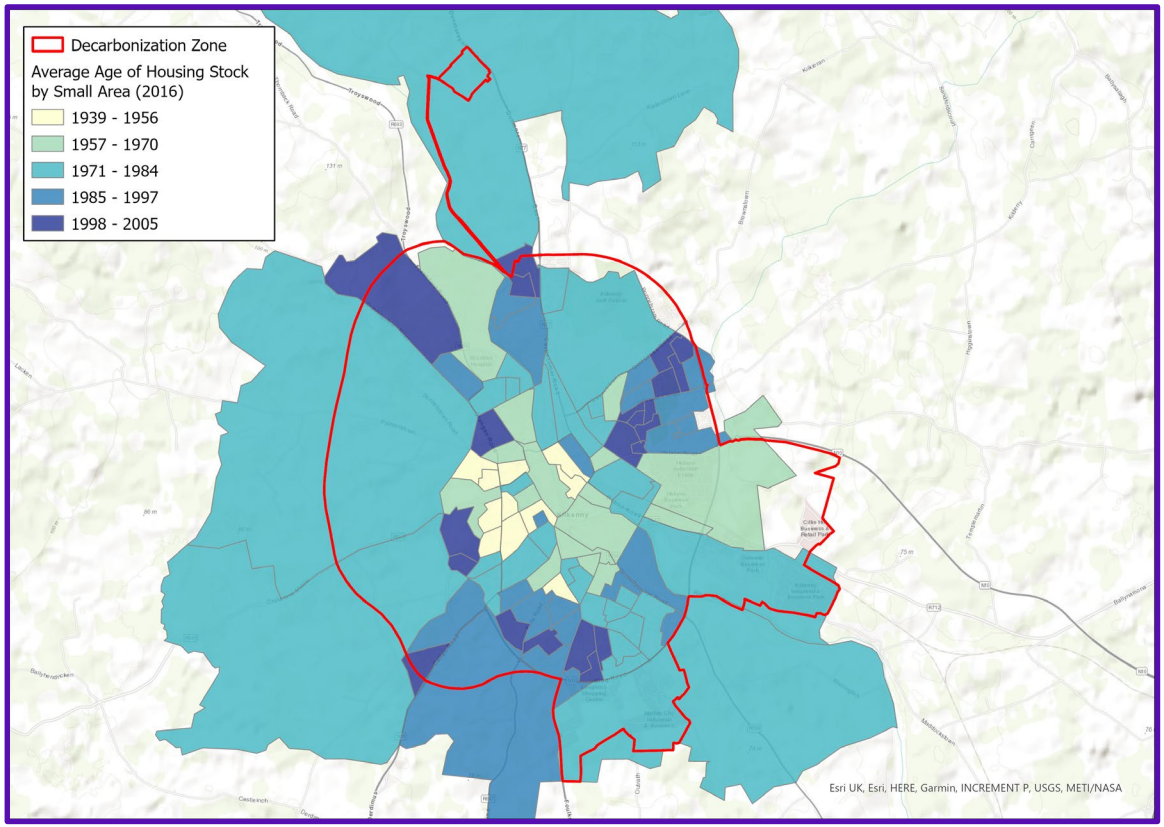
- The age of housing stock in the DZ area has a strong correlation with energy efficiency, consumption and demand, including this DZ area. Energy use is a proxy for carbon emissions and therefore, in general, older housing stock may mean higher carbon emissions.

- Age of construction of residential housing stock ranges from pre-1919 out to the 2000s. The average year of construction is 1981, with approximately ~74% of the housing stock being built since 1970. Approximately ~26% of the residential units have been built pre-1970s. This is summarised on the table below.

- The map on the right provides an overview of the average year of construction of residential housing stock within each SA. This is based on the average year of construction of the housing stock combined with the frequency of each residential housing stock to estimate the average construction year by SA.

- Focussing on the more populated area of Kilkenny City centre, there is a similar trend – the average housing stock for the small areas is dated from 1939 to 1997, indicating an older cluster of housing.

- As the majority of homes within the DZ area were built pre-2000 (~75%), it is likely that their energy efficiency is lower than newer builds, resulting in a greater energy demand and consumption, leading to higher carbon emissions.



Note: *The figures in the map included above have been derived from CSO SA data. This data has been broken out into various bands e.g., 1948-1956". The average of these bands and their frequency within each SA are used to find the average year of the residential housing stock in the SA.*

Average Year of Housing Stock*	
2000+	30%
1971-2000	44%
1919-1970	21%
Pre 1919	5%

3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy Efficiency & BER rating

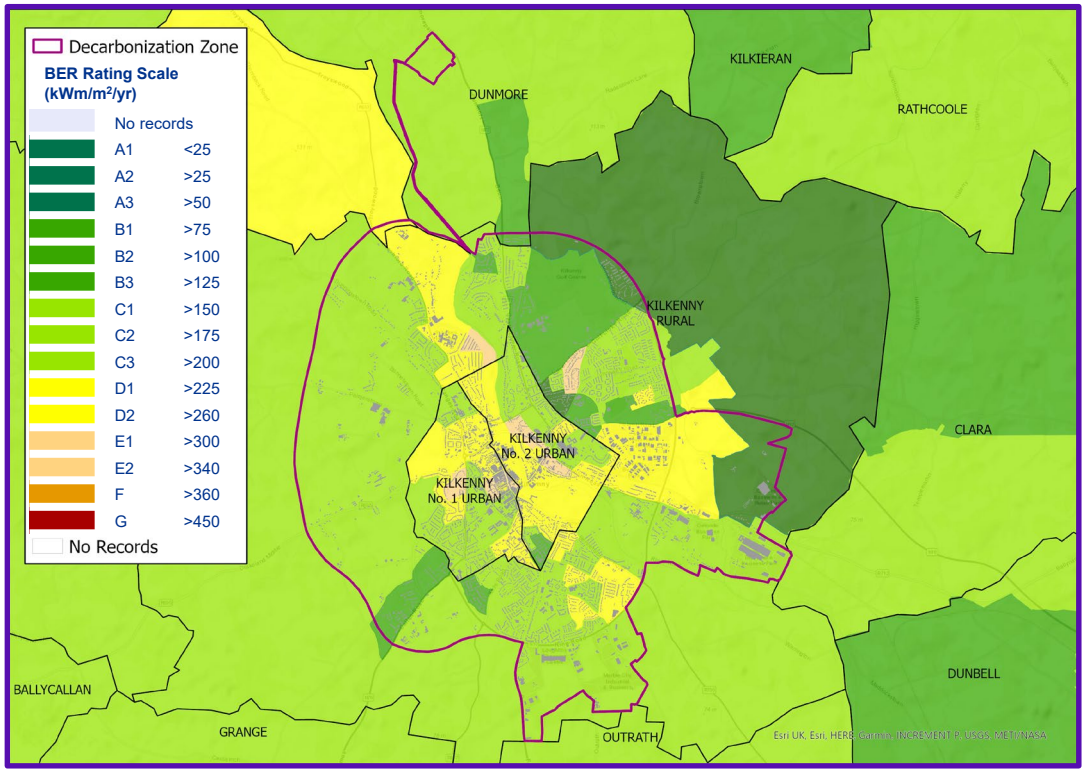
- A Building Energy Rating (BER) Certificate supports the understanding of the energy efficiency of a home. It is a helpful indicator of the likely energy consumption of a home and its associated carbon emissions. It uses a scale of A to G, with A-rated homes being the most energy-efficient and comfortable and G-rated homes the least energy-efficient.

- BER ratings in the Kilkenny DZ area range from A rated buildings to E rated buildings. The map on the right presents the range of BER ratings across the DZ area. Note that these BER ratings are average ratings.

- The table below sets out the average BER rating by residential type, displayed by ED.

- Note that residential BER ratings are only available from the BER Research Tool for 59.9% number of residential dwellings in the DZ. Further information on the dwelling type of the BERs is included in the **Appendix.**

- Energy efficiency opportunities should be explored, including the use of heat pumps and other renewable energy sources to support the decarbonisation of the DZ area as well as to contribute to wider national energy and climate targets.



3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy Consumption & Heat Demand

- Heat demand maps allow users to explore Ireland's heating and cooling demands. Heat mapping describes the spatial disaggregation of national heat demand into smaller geographic areas. This disaggregation is based on the characteristics of the buildings within each area and include:

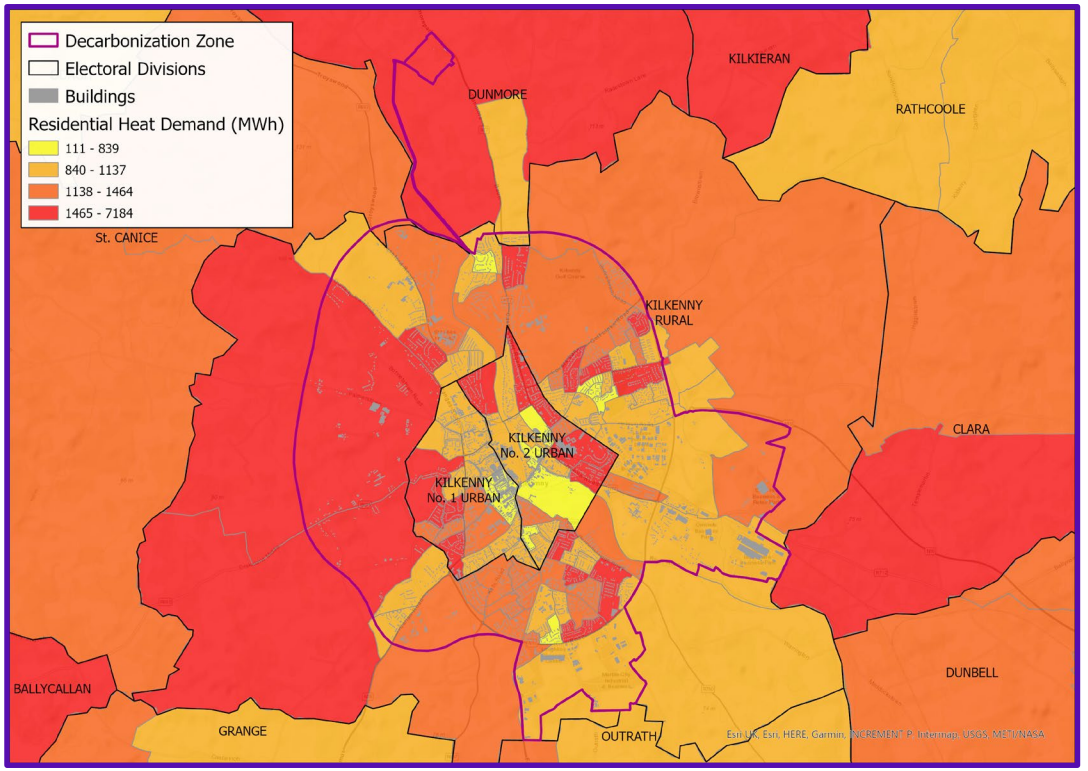
Building type (a residential dwelling, a commercial or public sector building or an industrial site)

Type of fuel used to generate the heat

Other metrics such as the area of buildings, and current and planned energy efficiency measures

- Heat demand in the DZ area follows a similar pattern across the EDs, with higher heat demand observed in and around the more populated region of Kilkenny City centre and the area to the west of the city – these areas should be considered and prioritised with targeted actions to reduce this demand.

- Heat demand is further explored in the Energy & Electricity Sector section.

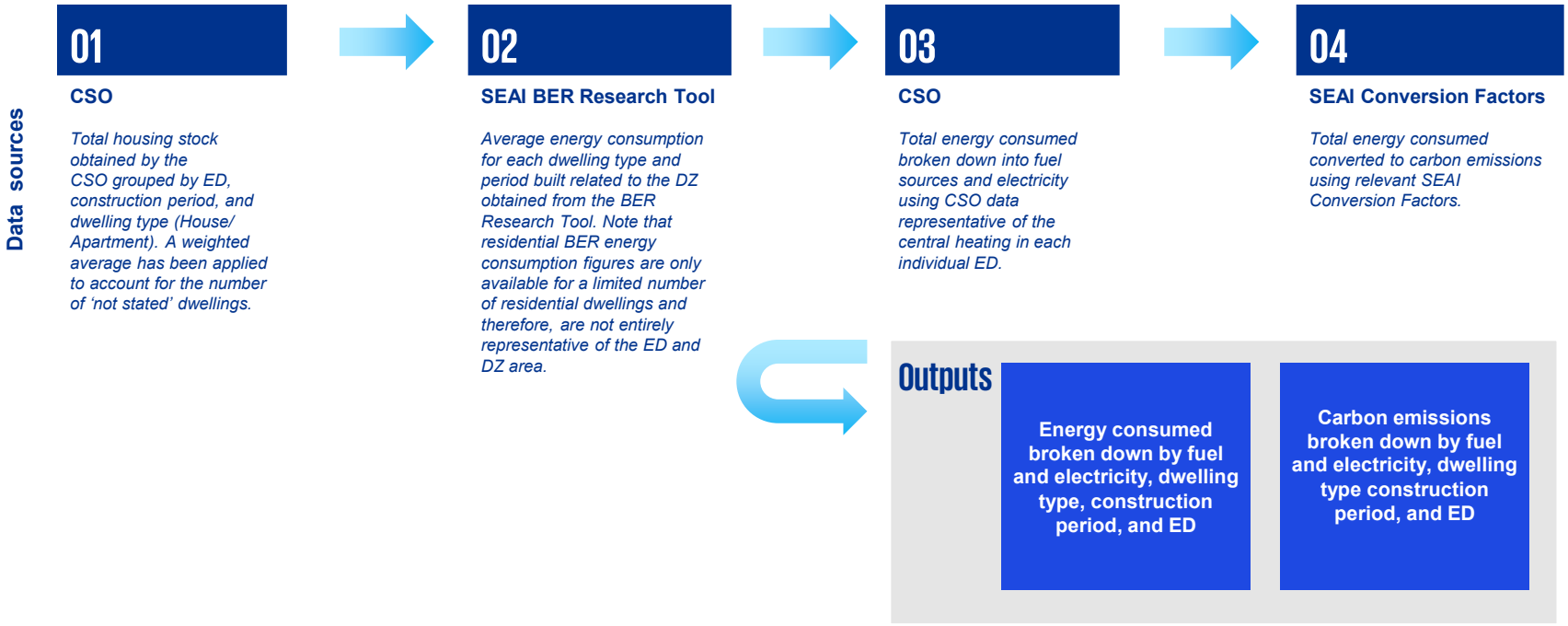


3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy & Carbon Emissions

To estimate residential sector energy consumption and associated carbon emissions within the DZ area, a number of non-spatial data points have been used. 'Occupied' homes, as defined by the 2016 CSO database, account for the majority of residential homes in the DZ area, at 90.15%. These 'Occupied' homes are included in the assessment. 'Other vacant dwellings' (6.41%), 'temporarily absent' (2.88%), and 'unoccupied holiday homes' (0.56%) account for the remaining ~10% of the residential stock – these are excluded from the assessment. An overview of the approach used is outlined below with results of the assessment on the following pages.

Further information on data sources, assumptions and limitations is included in the **Appendix**.



3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy & Carbon Emissions

Total residential sector energy consumption and associated carbon emissions within the DZ area is presented by energy split and residential dwelling type below. Note that as a result of the data available, residential dwelling types have been grouped into 'houses' and 'apartments'. The individual energy split of each ED has been applied to the total energy consumption across all households within each of the EDs.

Natural Gas and Oil account for a combined ~88% and ~83% of the residential sector's energy consumption and associated carbon emissions, respectively. These figures show that the residential stock of the DZ is heavily reliant on fossil fuels and switching to low-carbon/ renewables is a significant opportunity for the sector to reduce it's energy consumption and carbon emissions.

Further information on each ED's energy split is included in the **Appendix**.

	Energy consumption (MWh)		
Energy Source	**Houses**	**Apartments**	**Total**
Coal	4,855	267	**5,123**
Peat	300	19	**319**
Oil	36,306	1,740	**38,046**
LPG	272	8	**280**
Natural Gas	75,326	3,061	**78,387**
Renewables	397	17	**414**
Electricity	8,462	793	**9,255**
Wood	1,235	48	**1,283**
Total	**127,153**	**5,953**	**133,106**

	Carbon emissions (tCO_2e)		
Energy Source	**Houses**	**Apartments**	**Total**
Coal	1,654	91	**1,745**
Peat	107	7	**114**
Oil	9,933	476	**10,409**
LPG	62	2	**64**
Natural Gas	15,419	627	**16,046**
Renewables	-	-	**-**
Electricity	3,175	298	**3,472**
Wood	19	1	**19**
Total	**30,369**	**1,501**	**31,869**

Note: Figures rounded to whole numbers for presentation purposes.

3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy & Carbon Emissions

Total residential sector's energy consumption and associated carbon emissions within the DZ area is presented by ED below.

ED	Energy Consumption (MWh)
Kilkenny No.1 Urban	26,902
Kilkenny No. 2 Urban	18,290
Kilkenny Rural	84,948
Dunmore	2,966
Total	**133,106**

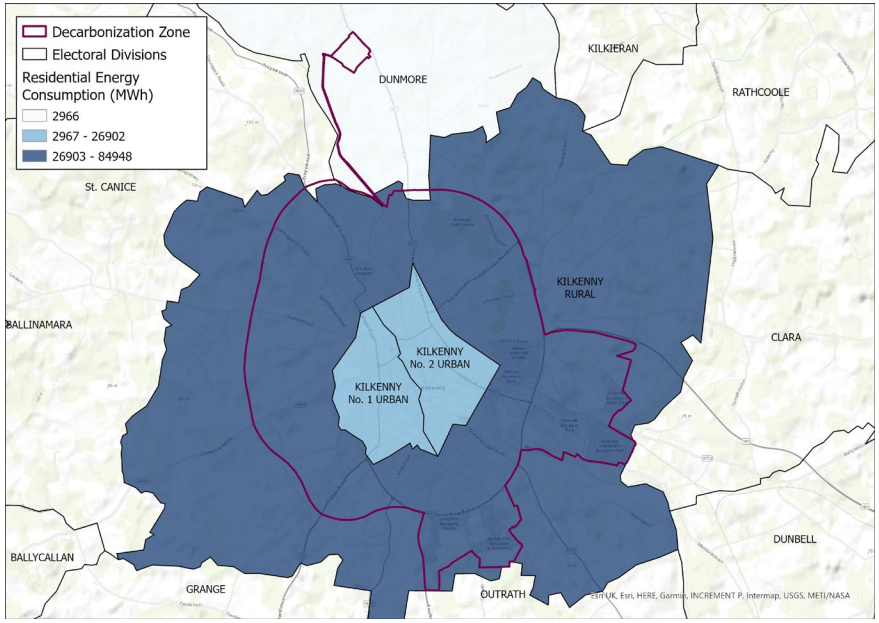
ED	Carbon emissions (tCO_2e)
Kilkenny No.1 Urban	6,641
Kilkenny No. 2 Urban	4,846
Kilkenny Rural	19,660
Dunmore	723
Total	**31,869**

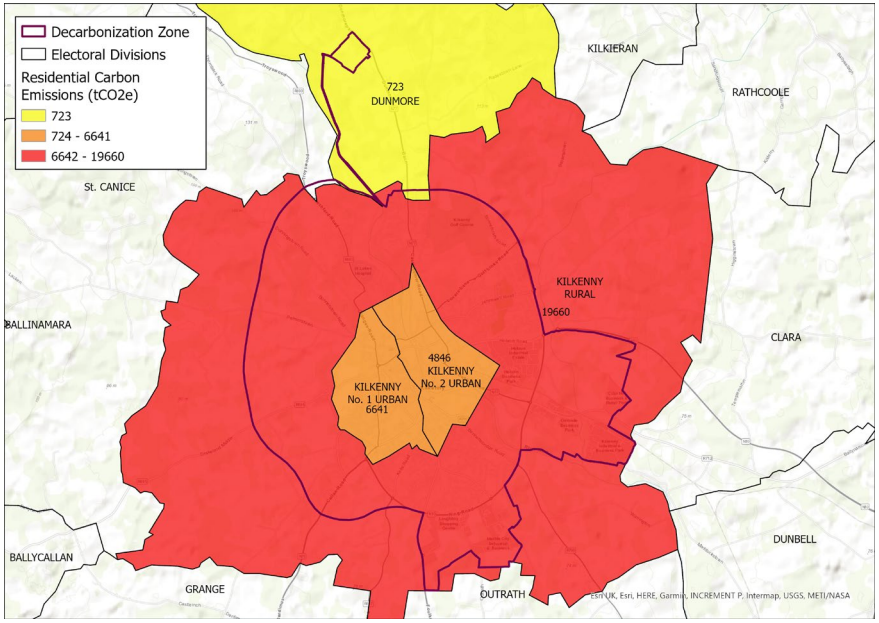
Note: Figures rounded to whole numbers for presentation purposes.

3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: Energy & Carbon Emissions

A visual representation of total residential sector energy consumption and associated carbon emissions within the Kilkenny DZ is presented by ED below.





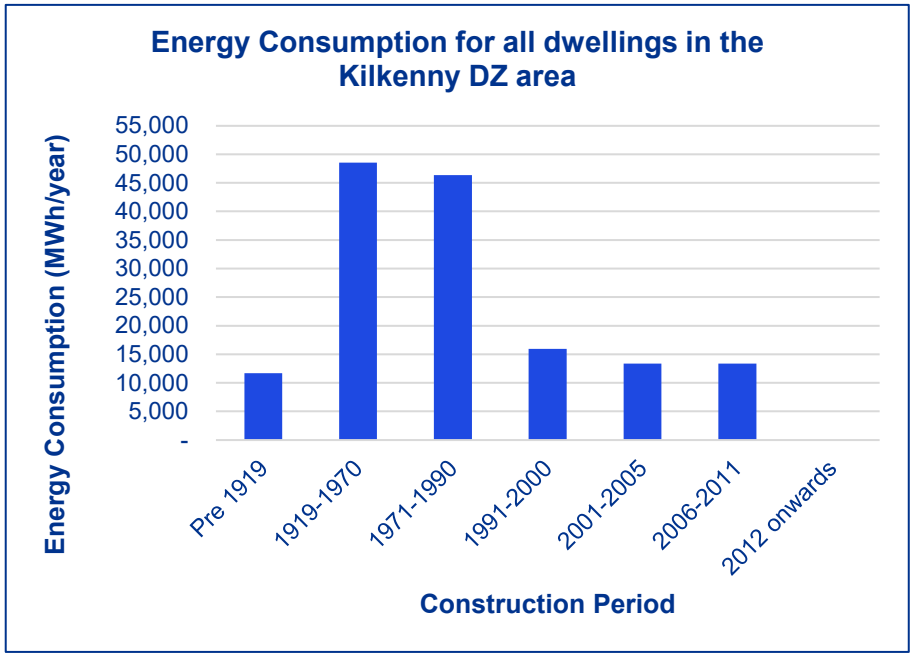
3.2.3.3 Residential Sector Analysis (cont..)

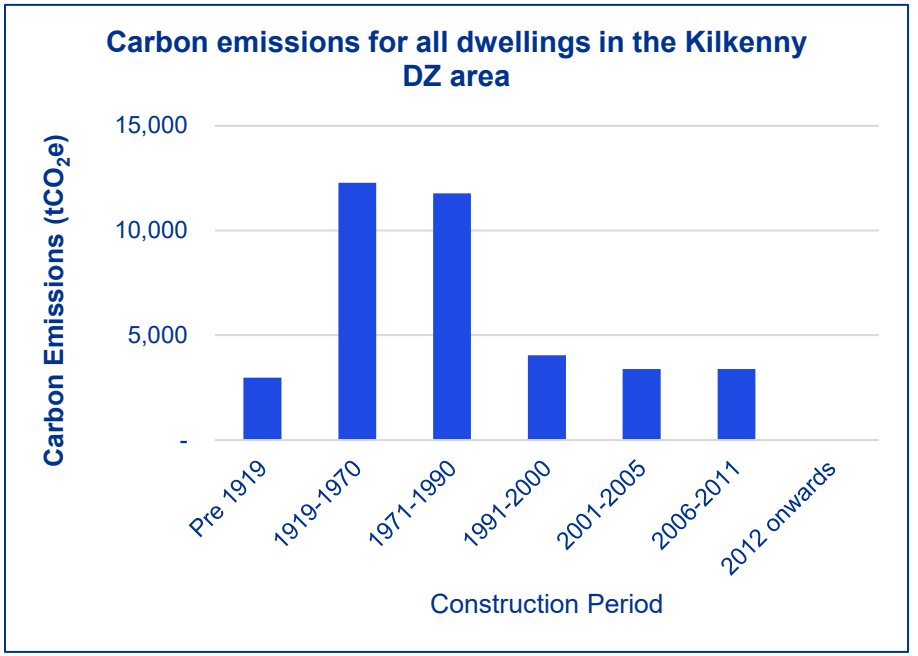
Residential Sector: Energy & Carbon Emissions

Total residential sector energy consumption and associated carbon emissions for all dwelling types within the DZ area, broken down by construction period, are shown on the charts below.

Dwellings built during the periods '1919-1970' and '1971-1990' account for the highest proportions of the DZ's residential energy consumption and carbon emissions at 33% and 31%, respectively. Approximately 48% of dwellings were built during these two periods. This suggests dwellings built during these periods account for a higher proportion of energy consumption and carbon emissions than expected. The older building fabric of these dwellings leads to lower energy efficiency and likely is responsible for their high energy consumption and carbon emissions. Retrofitting the older building stock of the DZ is a potentially effective measure to reduce the area's energy consumption and associated carbon emissions.

*Note the energy consumption and carbon emissions presented in these graphs do not equate to the total energy consumption and carbon emissions of the residential sector presented previously, as the BER Research Tool does not contain energy data on dwellings from the built period '2012 onwards.'





3.2.3.3 Residential Sector Analysis (cont..)

Residential Sector: KCC: Local Authority Social Housing: Energy & Carbon Emissions

Social housing (within the residential sector) energy consumption and associated carbon emissions within the Kilkenny DZ area has also been included in our analysis using a number of non-spatial data points to inform the assessment. The total number of local authority housing units has been provided by Kilkenny County Council – to understand energy consumption and carbon emissions associated with social housing units, Step 2-4 outlined in Section 3.2.3.3 has been applied. Further information on data sources and methodology is included in the **Appendix**.

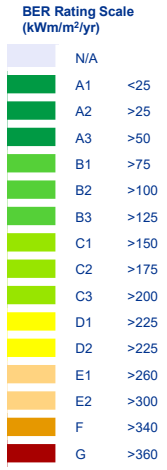
	Local Authority Housing Units
Energy source	**Energy consumption (MWh)**
Coal	960
Peat	60
Oil	7,051
LPG	52
Natural Gas	14,609
Renewables	77
Electricity	1,806
Wood	239
Total	**24,853**

	Local Authority Housing Units
Energy source	**Carbon emissions (tCO_2e)**
Coal	327
Peat	21
Oil	1,929
LPG	12
Natural Gas	2,990
Renewables	-
Electricity	678
Wood	4
Total	**5,961**

The table below sets out the average BER rating for social housing units by dwelling type and ED. Note that BER ratings are only available for a limited number of social housing units (741 out of 1,356 total) and therefore, are not entirely representative of the local authority social housing in the ED and DZ area.

Average BER rating of Local Authority Social Housing Units

Dwelling type	Average BER ($kWm/m^2/yr$)
All Local Authority Social Housing Units	217



The social housing units in the DZ area account for approximately 13.2% of the total residential stock. When compared to the entire DZ area, the social housing units account for approximately 18.7% of total residential energy consumption and 18.7% of total residential carbon emissions. These findings suggest that the social housing sector produces a greater proportion of the total residential energy consumption and carbon emissions within the DZ than expected. Note that energy consumption figures are only available for a limited number of social housing units from the SEAI BER Research Tool and therefore, are not entirely representative of social housing in the DZ area.

3.2.4 Commercial & Public Sector

3.2.4.1 Commercial & Public Sector Overview

Overview of the National Commercial & Public sector

- The built environment comprises the residential, commercial and public sectors, of which the commercial and public sector account for approximately 2% of Ireland's carbon emissions in the baseline year of 2018. The emissions from commercial and public sectors are typically from fuel combustion for space and hot water heating in commercial and public/institutional buildings in Ireland. Emissions from commercial services and public services decreased by 3.0% and 3.8% respectively in 2021 compared to 2020 emissions due to a decrease in natural gas use.

- The sector is required to reduce its emissions by 45% by 2030, compared to the 2018 baseline. Actions and targets to support the achievement of this target are set out in the CAP 2023 and include:
    - decarbonising heating in commercial and public buildings;
    - determining optimum management of property portfolios for decarbonisation;
    - installing rooftop solar PV (e.g. in schools);
    - retrofitting buildings owned by public bodies;
    - promoting and supporting building automation and control optimisation and smart building technologies to increase energy efficiency and monitoring;
    - upgrading existing building energy management systems to high-efficiency and zero-carbon equivalents.

- To achieve this ambitious target, the use of all fossil fuels (coal, natural gas, oil, and peat) to heat our buildings must be reduced and the support for a major expansion in retrofit activity must be realised. The challenge facing the commercial and public sector is that its existing buildings will require the most effort to decarbonise. Technologies such as heat pumps in the residential sector are also suitable for commercial buildings and the scaling-up in deployment of solutions such as district heating and renewable gases will also benefit commercial and public buildings – these will be important levers for the DZ area to consider. This chapter explores the various factors impacting the decarbonisation of commercial and public sector buildings, whilst also considering the constraints associated with protected buildings.

3.2.4.2 Commercial & Public Sector Summary Results

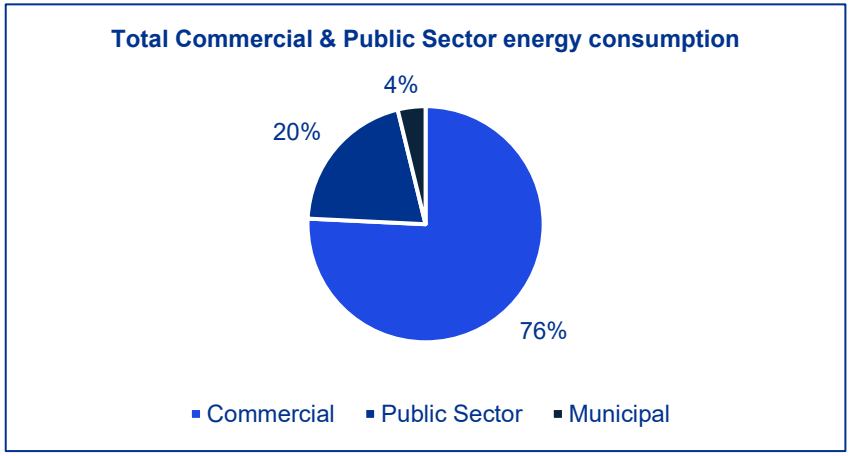
Commercial & Public Sector: Summary

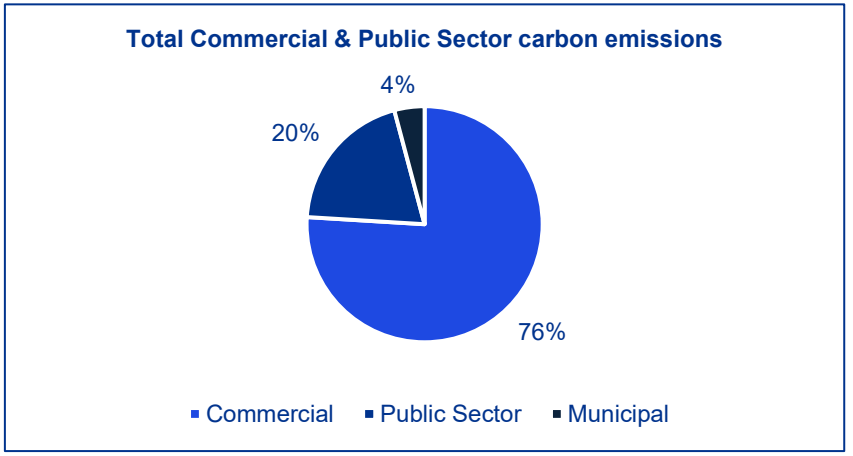
The results of the commercial & public sector assessment are presented on the tables and charts below.

Total energy consumption of the sector equates to **176,173 MWh**. The associated carbon emissions of the sector equate to approximately **52,744 tCO_2e**. Commercial Sector buildings within the DZ area account for ~76% of the sector's energy consumption and ~76% of the sector's total carbon emissions. Public Sector buildings within the DZ area account for ~20% of total commercial & public sector energy consumption and ~20% of carbon emissions. Municipal buildings are estimated to account for ~4% of total commercial & public sector energy consumption and ~4% of carbon emissions

	Energy Consumption (MWh)
Commercial Sector	133,472
Public Sector	35,997
Municipal	6,704
Total Commercial & Public Sector	**176,173**

	Carbon emissions (tCO_2e)
Commercial Sector	40,068
Public Sector	10,492
Municipal	2,184
Total Commercial & Public Sector	**52,744**





3.2.4.3 Commercial & Public Sector Analysis

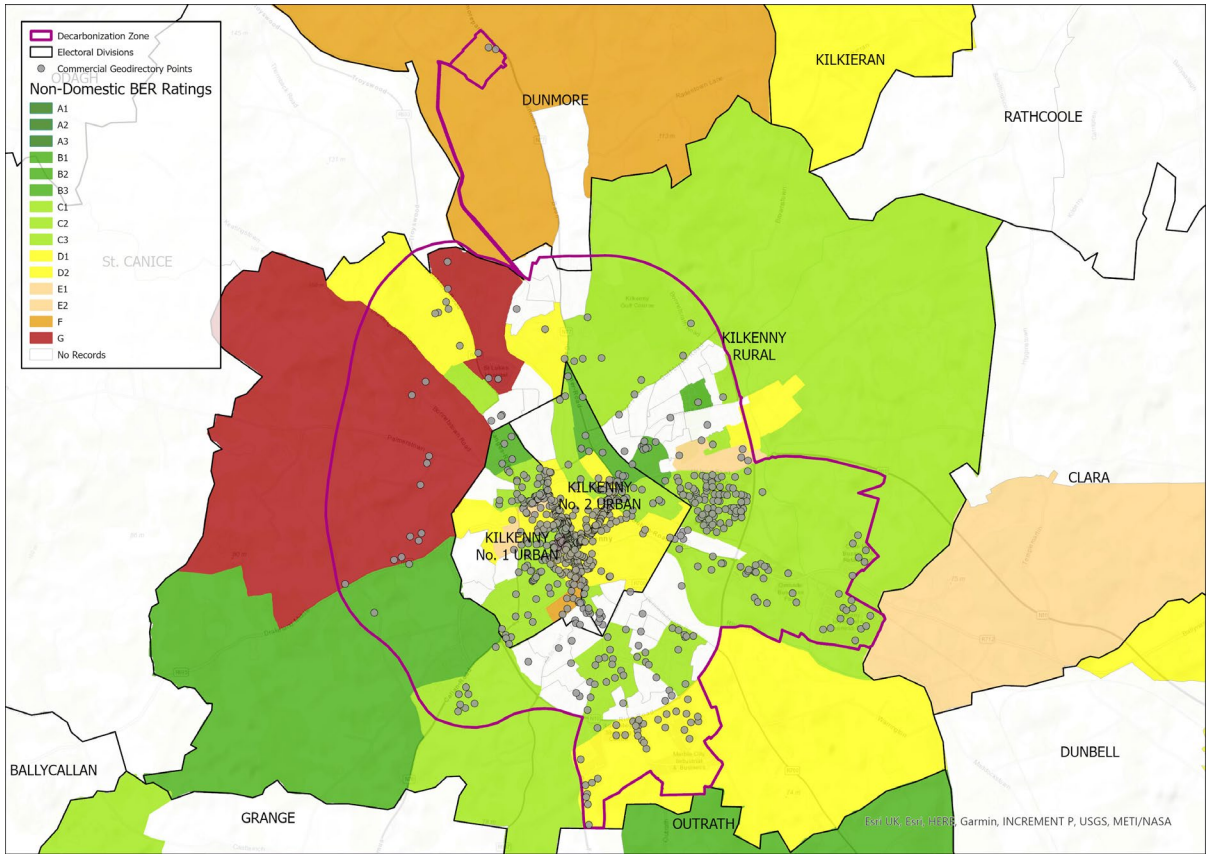
Commercial & Public Sector: Energy Efficiency & BER Rating

- A Building Energy Rating (BER) Certificate supports the understanding of the energy efficiency of buildings. It is a helpful indicator for the likely energy consumption and its associated carbon emissions in commercial and public settings. Similar to residential sector, it uses a scale of A to G, with A-rated buildings being the most energy-efficient and comfortable and G-rated buildings the least energy efficient.

- BER ratings in the DZ area range from G rated buildings to A. Generally, the less-efficient buildings are located towards the west of the Kilkenny DZ, with newer, more efficient buildings located in the urban centre and the southwest outskirts. This is with the exception of a larger F-rated block to the east of the DZ.

- Note that BER ratings are available for a large number of commercial & public sector buildings (~96%). Further information on the breakdown of the BERs is included within the **Appendix.**

- Energy efficiency opportunities should be explored, including the use of heat pumps and other renewable energy sources to support the decarbonisation of the DZ area as well as to contribute to wider national energy and climate targets.



3.2.4.3 Commercial & Public Sector Analysis (cont..)

Commercial & Public Sector: Energy Consumption & Heat Demand

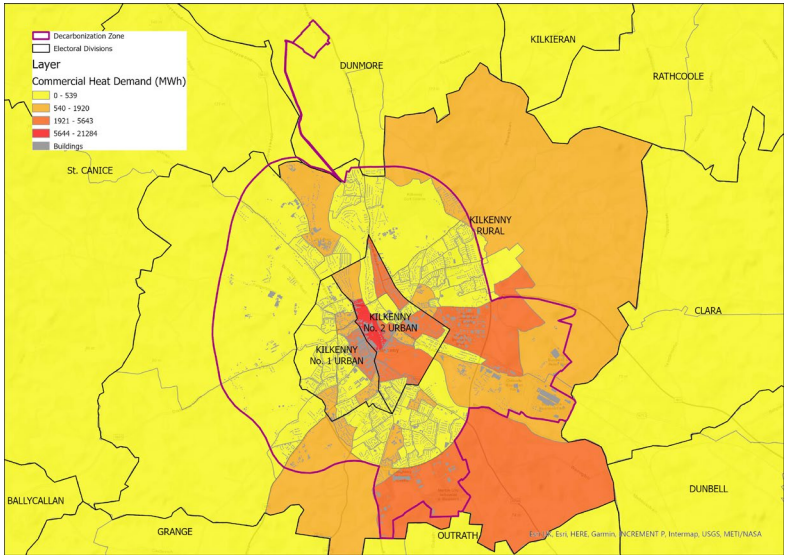
Heat demand maps allow users to explore Ireland's heating and cooling demands. Heat mapping describes the spatial disaggregation of national heat demand into smaller geographic areas. This disaggregation is based on the characteristics of the buildings within each area and include:

- Building type (a residential dwelling, a commercial or public sector building or industrial site),
- The type of fuel used to generate the heat,
- Other metrics such as the area of the buildings, and current planned energy efficiency measures

- Heat demand in the Kilkenny DZ follows a similar pattern across the SAs, with higher heat demand observed in and around the more populated region of Kilkenny City centre, as well as towards the east/southeast – these areas should be considered and prioritised with targeted actions to reduce this demand.

- The maps provided here provide a visualisation of heat demand across the DZ area.

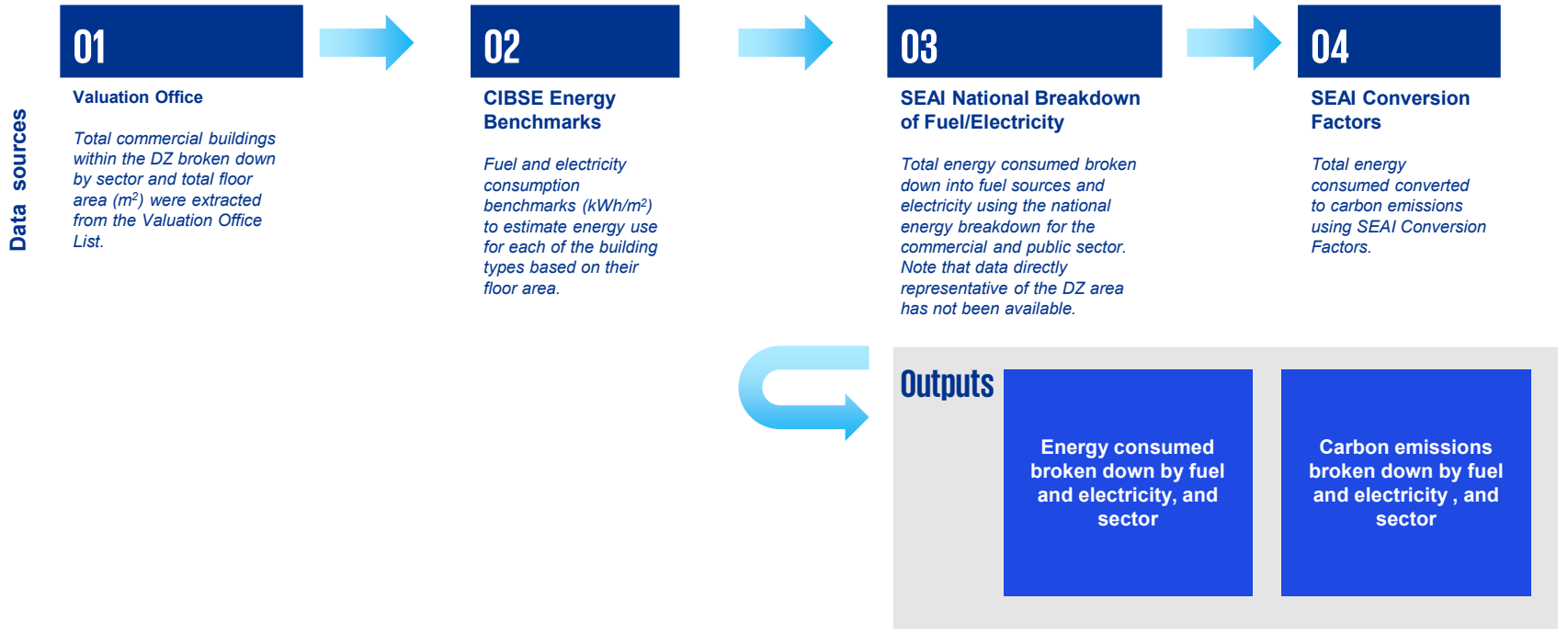
- Heat demand is further explored in the Energy & Electricity Sector section.



3.2.4.3 Commercial & Public Sector Analysis (cont..)

Commercial Sector: Energy & Carbon Emissions

To estimate commercial sector energy consumption and associated carbon emissions within the DZ area, a number of non-spatial data points have been used. An overview of the approach used is outlined below. Further information on data sources, assumptions and limitations is included in the **Appendix**.



3.2.4.3 Commercial & Public Sector Analysis (cont..)

Commercial Sector: Energy & Carbon Emissions

The energy consumption of the Commercial Sector was calculated using Valuation Office data on commercial buildings within the DZ. Total commercial sector energy consumption and associated carbon emissions within the DZ area is presented by building type and energy split below. As noted, energy split assumed for this analysis is representative of the national energy split for the commercial and public sector and may not reflect the actual energy split within the DZ area. This analysis shows that fossil fuels account for a combined ~43% (56,761 MWh) of the total energy consumed by the commercial sector, with renewables accounting for less than 3% (3,927 MWh).

Energy Source	Energy consumption by energy source (MWh)									
	Health	Leisure	Retail (Shops)	Retail (Warehouse)	Fuel/ Depot	Hospitality	Industrial Uses	Office	Misc.	Total
Coal	0	1	15	4	0	10	17	5	0	52
Oil	31	331	7,136	1,725	93	4,721	7,819	2,104	24	23,985
Natural Gas	42	452	9,736	2,354	127	6,442	10,668	2,870	32	32,724
Renewables	5	54	1,168	282	15	773	1,280	344	4	3,927
Electricity	41	527	51,224	2,242	809	6,976	7,936	2,996	34	72,784
Total	**120**	**1,365**	**69,280**	**6,608**	**1,045**	**18,922**	**27,720**	**8,319**	**94**	**133,472**

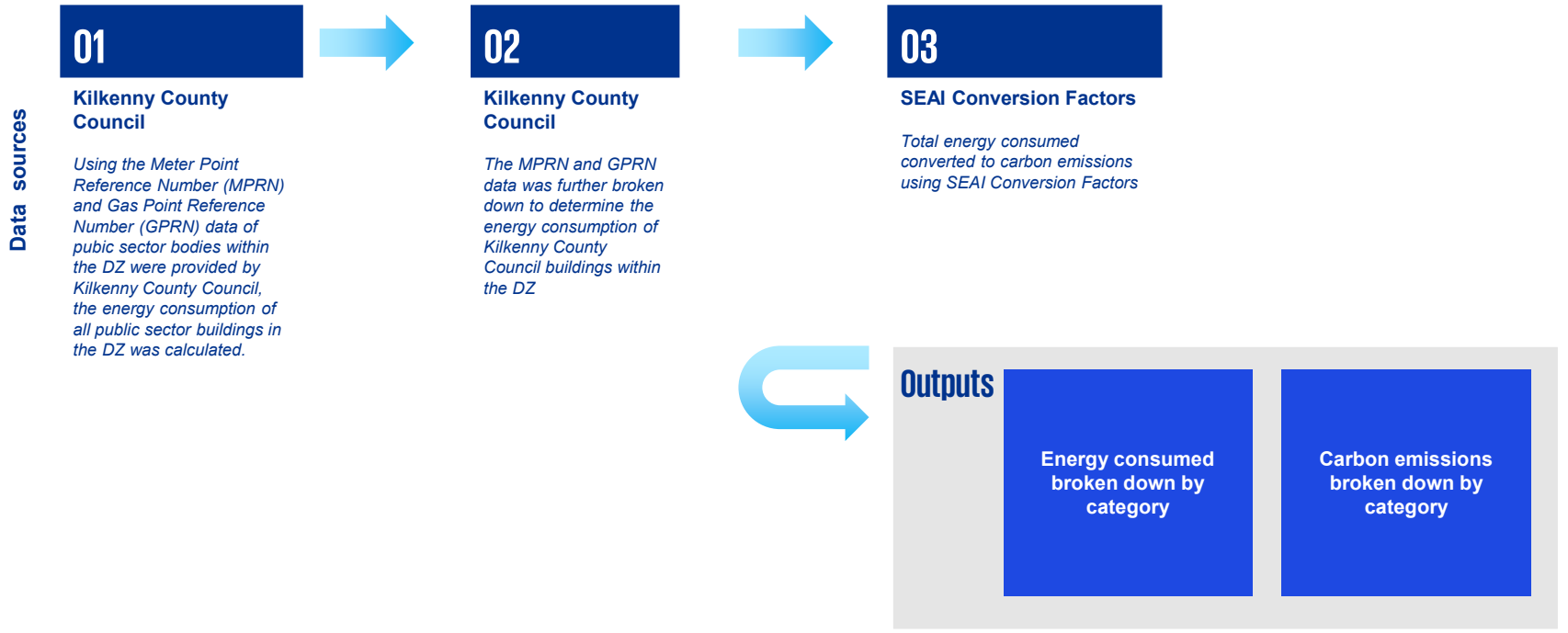
Energy Source	Carbon emissions by energy source (tCO2e)									
	Health	Leisure	Retail (Shops)	Retail (Warehouse)	Fuel/ Depot	Hospitality	Industrial Uses	Office	Misc.	Total
Coal	0	0	5	1	0	3	6	2	0	18
Oil	8	83	1,798	435	24	1,190	1,970	530	6	6,043
Natural Gas	9	93	1,993	482	26	1,319	2,184	587	7	6,699
Renewables	-	-	-	-	-	-	-	-	-	-
Electricity	15	198	19,219	841	303	2,617	2,978	1,124	13	27,309
Total	**32**	**374**	**23,015**	**1,759**	**353**	**5,129**	**7,137**	**2,243**	**25**	**40,068**

Note: Figures rounded to whole numbers for presentation purposes

3.2.4.3 Commercial & Public Sector Analysis (cont..)

Public Sector & Municipal: Energy & Carbon Emissions

To estimate public sector and municipal energy consumption and associated carbon emissions within the DZ area, a number of non-spatial data points have been used. An overview of the approach used is outlined below. Further information on data sources, assumptions and limitations is included in the **Appendix**.



Note: The Local Authority Fleet is included within the Transport Sector

3.2.4.3 Commercial & Public Sector Analysis (cont..)

Public Sector (excluding Kilkenny County Council): Energy & Carbon Emissions

Total energy consumption and associated carbon emissions for public sector buildings within the DZ area, presented by GPRN and MPRN, are shown on the tables below. Note that Kilkenny County Council buildings are not contained within the public sector energy consumption and associated carbon emissions figures presented below. A further breakdown of the organisations within each category is included within the **Appendix.**

Source	Energy consumption by consumption category (MWh)															
	Education Building	Healthcare Building	IW Pumping / Water Treatment	IW Wastewater Treatment	Office Building	Other	Other Building	Other Processing	Public Lighting (Metered	Public Lighting (Un Metered)	Pumping / Water Treatment	Transport Buildings	Unknown	Waste Processing	Wastewater Treatment	Total
GPRN	5,476	6,093	-	-	3,945	424	1,533	146	-	-	-	54	-	-	-	**17,671**
MPRN	2,322	2,424	-	-	9,134	45	1,501	60	55	-	1,283	155	3	-	1,344	**18,326**
Total	**7,798**	**8,517**	**-**	**-**	**13,079**	**469**	**3,034**	**206**	**55**	**-**	**1,283**	**209**	**3**	**-**	**1,344**	**35,997**

Source	Carbon emissions by consumption category (tCO_2e)															
	Education Building	Healthcare Building	IW Pumping / Water Treatment	IW Wastewater Treatment	Office Building	Other	Other Building	Other Processing	Public Lighting (Metered	Public Lighting (Un Metered)	Pumping / Water Treatment	Transport Buildings	Unknown	Waste Processing	Wastewater Treatment	Total
GPRN	1,121	1,247		-	808	87	314	30	-	-	-	11	-	-	-	**3,618**
MPRN	871	909	-	-	3,427	17	563	23	20	-	481	58	1	-	504	**6,874**
Total	**1,992**	**2,156**	**-**	**-**	**4,235**	**104**	**877**	**53**	**20**	**-**	**481**	**69**	**1**	**-**	**504**	**10,492**

3.2.4.3 Commercial & Public Sector Analysis (cont..)

Municipal: Energy & Carbon Emissions

Total energy consumption and associated carbon emissions for Kilkenny County Council buildings and public lights within the DZ area, presented by GPRN and MPRN, are shown on the tables below. Note that the Local Authority Fleet is included within the Transport Sector and not presented below.
The category labelled 'Other' includes the City's Christmas lighting and public toilets. A detailed breakdown of the local authority buildings contained within each category is included within the **Appendix.**

Source	Energy consumption by consumption category (MWh)															
	Library/ Training Building	Healthcare Building	IW Pumping / Water Treatment	IW Wastewater Treatment	Office Building	Other	Other Building	Other Processing	Public Lighting (Metered	Public Lighting (Un Metered)	Pumping / Water Treatment	Transport Buildings	Unknown	Waste Processing	Wastewater Treatment	Total
GPRN	328	-	-	-	840	28	747	-	-	-	-	-	-	-	-	**1,943**
MPRN	110	-	-	-	598	10	1,517	-	285	2,206	-	-	-	36	-	**4,761**
Total	**438**	**-**	**-**	**-**	**1,438**	**38**	**2,264**	**-**	**285**	**2,206**	**-**	**-**	**-**	**36**	**-**	**6,704**

Source	Carbon emissions by consumption category (tCO_2e)															
	Library/ Training Building	Healthcare Building	IW Pumping / Water Treatment	IW Wastewater Treatment	Office Building	Other	Other Building	Other Processing	Public Lighting (Metered	Public Lighting (Un Metered)	Pumping / Water Treatment	Transport Buildings	Unknown	Waste Processing	Wastewater Treatment	Total
GPRN	67	-	-	-	172	6	153		-	-	-	-	-	-	-	**398**
MPRN	41	-	-	-	224	4	569		107	828	-	-	-	13	-	**1,786**
Total	**108**	**-**	**-**	**-**	**396**	**10**	**722**	**-**	**107**	**828**	**-**	**-**	**-**	**13**	**-**	**2,184**

3.2.5 Transport Sector

3.2.5.1 Transport Sector Overview

Overview of the National Transport sector

- Despite the growing focus on achieving Ireland's climate ambitions, Ireland's road transport emissions are increasing. In 2018, the transport sector accounted for approximately 17% of Ireland's total carbon emissions. Although the impact of COVID-19 supported the decrease in transport related emissions, 2021 saw a 6.1% increase in emissions over 2020 levels, largely driven by the cessation of public health restrictions that had artificially reduced transport demand.

- Ireland's transport sector must reduce its emissions by 50% by 2030. The actions and targets outlined in CAP 23 are pivotal in encouraging a shift to 'active travel' and overcoming the challenges deeply embedded through our settlement patterns, policies, and mindsets which favour private car usage over more sustainable transport modes. These targets will require a transformational shift in how we travel, as well as investment and innovation efforts into electric vehicles (EVs), increased charging facilities, and alternative fuels. Achieving a shift to transport modes with zero- or low-carbon emissions, such as active travel (walking and cycling) and public transport, will require unprecedented levels of public buy-in and engagement.

- The following pages present an overview of the transport sector related activities and associated energy and carbon emissions within the DZ area.

3.2.5.2 Transport Sector Analysis

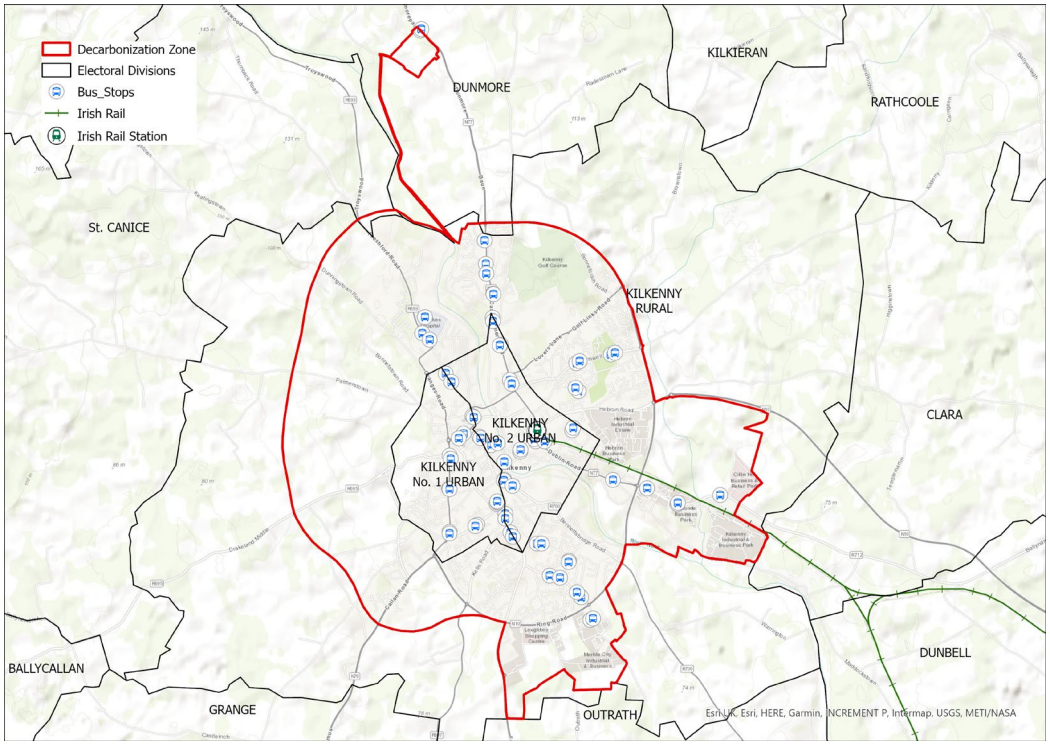
Transport Sector: Public Transport

- The map shown here provides a visual of the locations of the Irish Rail line, a train stop and bus stops within and passing through the DZ area.

- Commuting patterns in the DZ area show a ~64% reliance on private car with almost one third of commuting journeys using public transport, cycling or walking. This is discussed further later in this section.

- Improving the attractiveness of sustainable transport modes such as bus, rail, cycling and walking to shift away from car use is key to the successful decarbonisation of the DZ area.
- Combining this with an increased proportion of Electric Vehicles (EV) in the vehicle fleet as well as electrifying freight and public transport will decrease reliance on fossil fuels and, in turn, reduce carbon emissions.

Bus Operators	% of Bus Stops
City Direct	66%
Buggy	9%
Bkavanagh	5%
Mkilbride	4%
SRO	4%
Bus Eireann	3%
Dublin Coach	3%
Kenneallys	2%
Sbloom	2%
Grand Total	**100%**



3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Energy & Carbon Emissions

To estimate transport sector energy consumption and associated carbon emissions within the DZ area, a number of non-spatial data points have been used. An overview of the approach used is outlined below. Note that this approach reflects vehicles owned and licenced within the area and does not reflect all transport movements within the DZ area. Further information on data sources, assumptions and limitations is included in the **Appendix**.

Data sources

01

Transport Omnibus

Number of vehicles licenced by end of 2018 in Kilkenny. These numbers have been proportioned down to the DZ area based on population.

02

SEAI National Energy Balance

Total energy consumed per transport mode broken down into fuel sources and electricity, supported by the SEAI National Energy Balance.

03

SEAI Conversion Factors

Total energy consumed per transport mode converted to carbon emissions using SEAI Conversion Factors.

Outputs

- **Energy consumed broken down by fuel and electricity source, and transport mode**
- **Carbon emissions broken down by fuel and electricity source, and transport mode**

3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Energy & Carbon Emissions

Total transport sector related energy consumption and associated carbon emissions within the DZ area, broken down by transport mode and energy type are shown below. As mentioned on the previous page, energy consumption and carbon emissions presented below reflect vehicles owned and licenced within the DZ area based on the entire Kilkenny area, factored down by population in the DZ area. Although this approach does not provide total energy consumption and associated carbon emissions of all transport movements in the DZ area in the baseline year, it provides a useful overview of vehicle ownership in the DZ area and impact of their usage.

Private cars account for the highest carbon emissions. Petrol and diesel are the most common sources of fuel with just a small proportion relying on electricity.

Total carbon emissions result in approximately 61,486 tCO_2e which equates to approximately 2.23 tCO_2e per DZ area resident.

Transport mode	Total energy consumption by transport mode in the DZ area (MWh)				
	Oil	Natural Gas	Renewables	Electricity	Total
Road Freight	64,497	2.7	2,765	-	**67,264.7**
Road Light Goods Vehicle	28,012	-	1,201	-	**29,213**
Road Private Car	135,021	-	3,820	72	**138,913**
Public Passenger Services	7,472	-	305	-	**7,777**
Total	**235,002**	**2.7**	**8,091**	**72**	**243,167.7**

Transport mode	Total carbon emissions by transport mode in the DZ area (tCO_2e)				
	Oil	Natural Gas	Renewables	Electricity	Total
Road Freight	17,021	0.6	-	-	17,021.6
Road Light Goods Vehicle	7,392	-	-	-	7,392
Road Private Car	35,078	-	-	27	35,105
Public Passenger Services	1,967	-	-	-	1,967
Total	**61,458**	**0.6**	**-**	**27**	**61,485.6**

Note: Figures rounded to whole numbers for presentation purposes

3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Energy & Carbon Emissions

A further breakdown of the total transport sector-related energy consumption and associated carbon emissions within the DZ area, broken down by transport mode and energy type is shown below. Private cars account for the highest carbon emissions. In addition, gasoline (petrol) and diesel are the most common sources of fuel within the DZ and account for a combined ~96% and ~100% of transport-related energy consumption and carbon emissions, respectively. Increased electrification and the further use of renewable fuels present significant opportunities for Kilkenny Cities' transport sector to decarbonise.

Transport mode	Total energy consumption by transport mode in the DZ area (MWh)							
	Oil			Natural Gas	Renewables		Electricity	Total
	Gasoline	LPG	Gasoil/ Diesel/ DERV		Biodiesel	Bioethanol		
Road Freight	-	-	64,497	2.7	2,765	-	-	67,264.7
Road Light Goods Vehicle	-	-	28,012	-	1,201	-	-	29,213
Road Private Car	45,798	126	89,098	-	3,820	1,517	72	138,913
Public Passenger Services	368	-	7,104	-	305	12	-	7,777
Total	**46,165**	**126**	**188,712**	**2.7**	**8,090**	**1,529**	**72**	**243,167.7**

Transport mode	Total carbon emissions by transport mode in the DZ area (tCO2e)							
	Oil			Natural Gas	Renewables		Electricity	Total
	Gasoline	LPG	Gasoil / Diesel /DERV		Biodiesel	Bioethanol		
Road Freight	-	-	17,021	0.6	-	-	-	17,021.6
Road Light Goods Vehicle	-	-	7,392	-	-	-	-	7,392
Road Private Car	11,536	29	23,513	-	-	-	27	35,105
Public Passenger Services	93	-	1,875	-	-	-	-	1,967
Total	**11,629**	**29**	**49,801**	**0.6**	**-**	**-**	**27**	**61,485.6**

Note: Figures rounded to whole numbers for presentation purposes

3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Commuting & Carbon Emissions

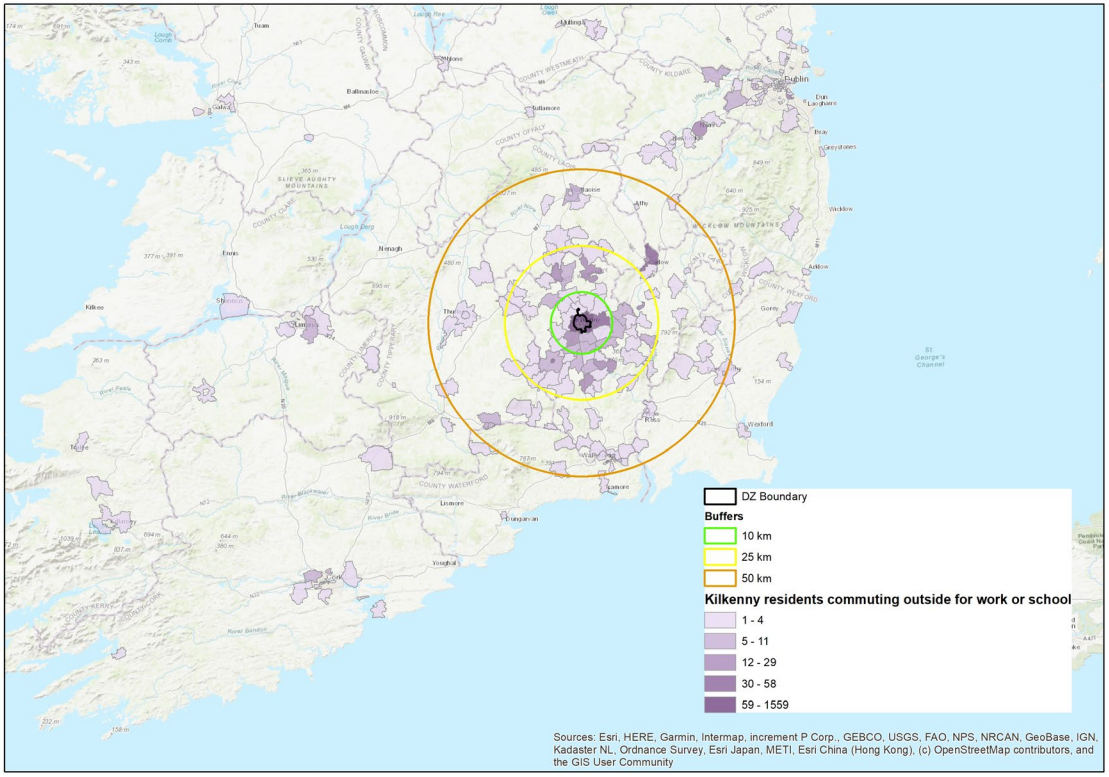
Using POWSCAR data about commuters to the DZ area and from the DZ area to attend work, college or school on a daily basis from within the DZ area and from surrounding areas has been explored. Carbon emissions associated with these commuting patterns are estimated using distances taken from POWSCAR and assumptions on transport modes used in the DZ area – this results of which are shown on the next pages.

71% of these commutes are made in a car, while 22% are made using public transport, bicycle or on foot. The remaining commuters take a van or motorcycle with some ‘telecommuting’ (i.e. work from home). In addition, within the DZ area, approximately 45% of households own a car, approximately 34% own two cars or more and approximately 20% of households do not own a car. Comparative figures for the state indicate that c.41% households own at least one car, and similarly c.41% also own two or more cars, while c.15% households have no car.

Note that although these commuting patterns focus on commuters travelling in and out of the DZ area, the impact of which are not entirely associated with the DZ area boundary itself, it is important to understand opportunities for decarbonisation through both control and influencing mechanisms available to the Council.

3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Commuting & Carbon Emissions



- The map on the left provides an illustration of commuters leaving the DZ area and travelling to surrounding EDs on a daily basis.
- For the purposes of this assessment, the starting point for all commuters is assumed to be Kilkenny (No.1) Urban ED. In addition, commuters travelling to the top 90% of EDs are included in this assessment, with an uplift applied to the resulting carbon emissions to represent 100%.
- It is estimated that these daily commuter trips leaving the DZ area, and assumed to then return, contribute approximately **7,026.61 tCO_2e** on an annual basis.
- Further information on data sources, assumptions and limitations included in the **Appendix**.

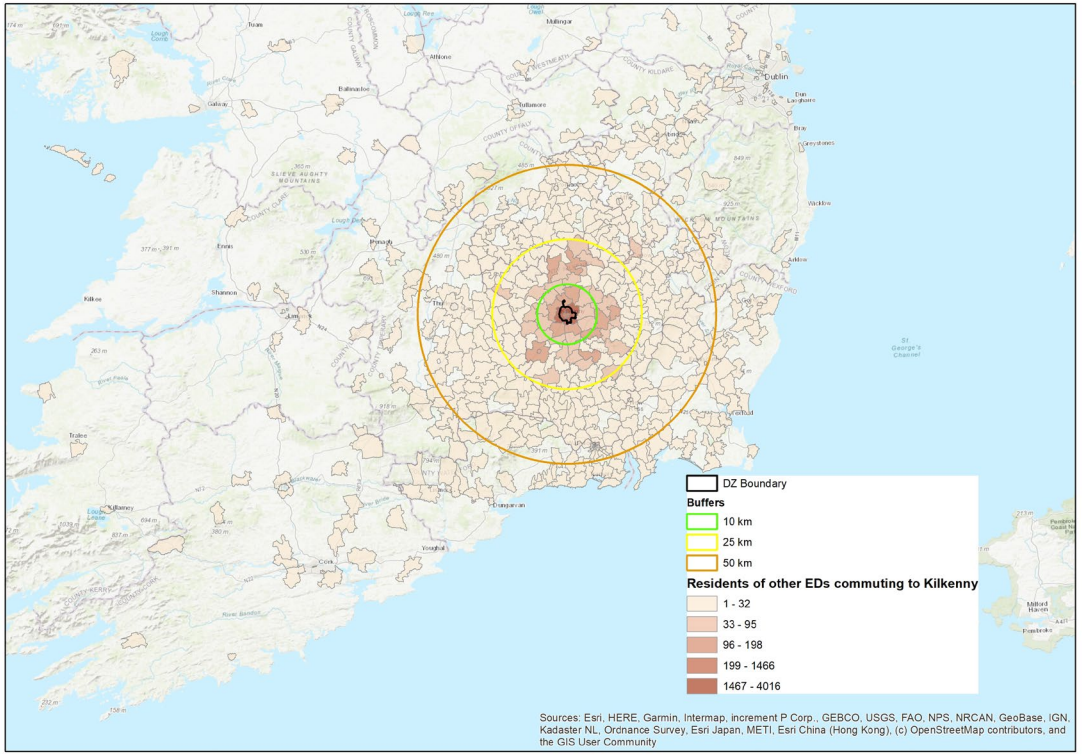
Emissions source	Total per year (return journey)
Total carbon emissions (tCO_2e) associated with commuter travel out of the DZ area to surrounding EDs	**7,026.61**

3.2.5.2 Transport Sector Analysis (cont..)

Transport Sector: Commuting & Carbon Emissions

- The map on the right provides an illustration of commuters travelling into the DZ area from surrounding EDs on a daily basis.
- For the purposes of this assessment, the end point for all commuters is assumed to be Kilkenny (No.1) Urban ED. In addition, commuters travelling from the top 90% of EDs are included in this assessment, with an uplift applied to the resulting carbon emissions to represent 100%.
- It is estimated that these daily commuter trips travelling into the DZ area, and assumed to then return, contribute approximately **19,857.39 tCO_2e** on an annual basis.
- Further information on data sources, assumptions and limitations included in the **Appendix**.

Emissions source	Total per year (return journey)
Total carbon emissions (tCO_2e) associated with commuter travel into the DZ area from surrounding EDs	**19,857.39**



3.2.6 Waste Sector

3.2.6.1 Waste Sector Overview

Overview of the National Waste sector

- Waste emissions are predominantly associated with methane emissions arising from disposal to landfill. The waste sector accounts for approximately 1% of Ireland's annual carbon emissions. Waste emissions per head of population are lower in Ireland compared to the EU average and carbon emissions have decreased since 2005. Minimising waste generation, and improving segregation, reuse and recycling will lead to a continued reduction in carbon emissions.

- A number of targets and goals have been set in Ireland to meet both its climate and circular economy objective – for example, Ireland has set a plastic recycling target of 55% by 2030, with a 90% collection target for beverage containers.
- Ireland has made significant progress in managing waste streams, particularly in improving recycling rates and diversion from landfill but substantial change is needed to pivot towards a more circular economy in Ireland. Businesses and households play a vital role in enabling this change by influencing and facilitating sustainable consumer behaviour.

- A number of initiatives outlined in CAP 2023 will be beneficial for the DZ area to consider, including:
    - Deposit and return schemes for plastic and aluminium beverage containers;
    - Promotion of trials for better public recycling opportunities on street and at Bring Centres;
    - Improvement of segregation and collection performance to increase recycling and reduce contamination.

- This section presents an overview of the waste sector related activities and emissions within the DZ area.

3.2.6.2 Waste Sector Analysis

Waste Sector: Locations & Carbon Emissions

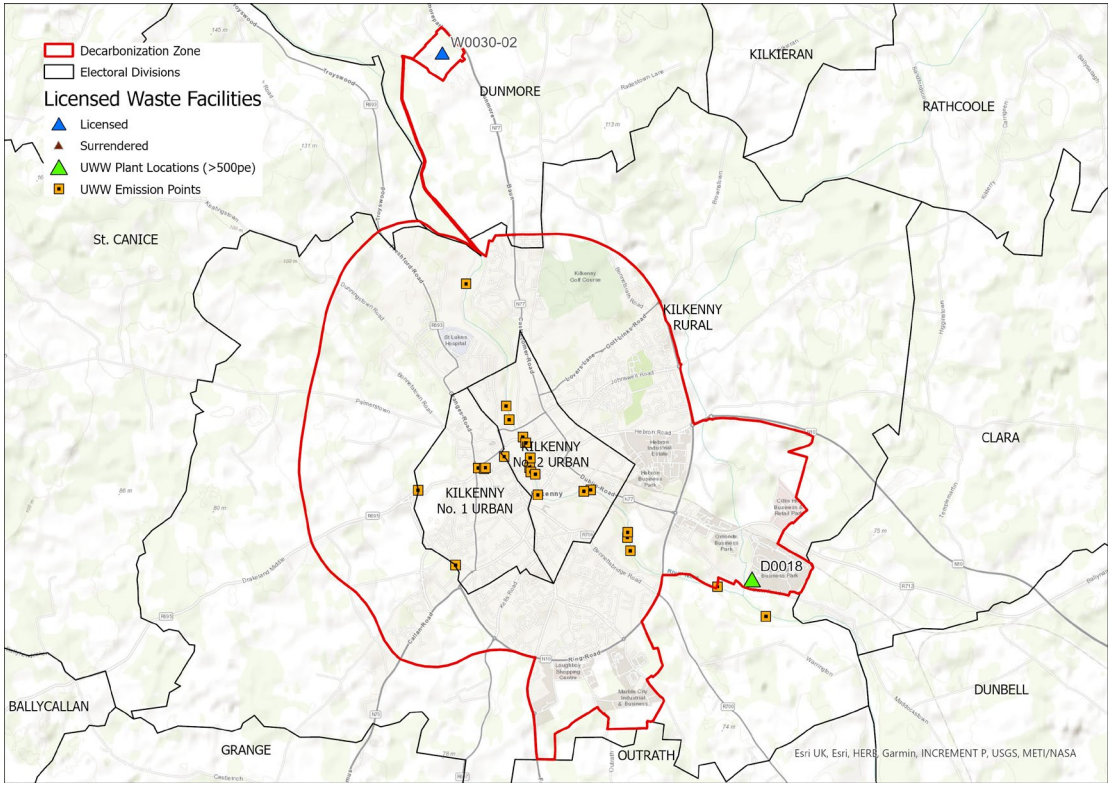
- There is one licensed waste facility located in the north of Kilkenny DZ area, Dunmore Recycling and Waste Disposal Centre. There is also a wastewater treatment plant to the east and several discharge points in the DZ, and close to the boundary.

- The EPA's Pollutant Release & Transfer Register (PRTR) has been reviewed to understand carbon emissions associated with the waste facility. No emissions data has been found here.

- Similarly, continuous emissions associated with activities at the Purcellsinch wastewater treatment plant (managed by Uisce Eireann) are publicly available in the annual environmental report for this particular site, however these are gas migration sample emissions.

- Using a benchmark for waste related carbon emissions of 0.21 tCO_2e/head of population*, it can be estimated that waste related carbon emissions within the boundary of DZ area is approximately **5,783.19 tCO_2e**.

* Benchmark is estimated using 2018 national waste sector emissions divided by national population (2016 CSO data). This benchmark is then multiplied by total population of the DZ area (27,539).



UWW: Urban Waste Water

3.2.7 Agriculture Sector

3.2.7.1 Agriculture Sector Overview

Overview of the National Agriculture sector

- As Ireland's largest contributor to national carbon emissions, agriculture is a key sector to decarbonise whilst maintaining food availability and affordability. Over the last decade emissions in the sector have increased by 19% - largely related to the expansion of the dairy sector.

- Agricultural carbon emissions come from a variety of activities and are responsible for a proportion of national carbon emissions each year:
  - Enteric fermentation, i.e. methane emissions from the digestive systems of ruminant livestock such as cattle and sheep, contributed approximately 61% of total agriculture related carbon emissions in 2018 at a national level;
  - Agricultural soils, including nitrogen fertiliser use, contributed approximately 22% of total agriculture related carbon emissions in 2018 at a national level;
  - Manure management contributed approximately 12% of total agriculture related carbon emissions in 2018 at a national level;
  - Fuel combustion and electricity use associated with agricultural machinery and buildings contributed approximately 2.6% of total agriculture related carbon emissions in 2018 at a national level;
  - Liming and urea application contributed approximately 2.4% of total agriculture related carbon emissions in 2018 at a national level.

- As part of Ireland's response to climate change, the agriculture sector is required to reduce its emissions by 25% by 2030 with key measures to achieve this target set out in the CAP 23. These measures include: a reduction in nitrogen fertiliser use to a maximum of 300,000 tonnes, earlier finishing of beef cattle and improved animal breeding focusing on low methane traits. The CAP 23 also sets out a target to support land use diversification options for livestock farmers, such as anaerobic digestion, forestry and tillage to incentivise voluntary livestock reductions - whilst not a direct cap, it signals the ambition to reduce herd numbers.
- Measures set out at a national level can be considered by the DZ area.

- Although agriculture sector emissions encompass the emissions sources outlined above, there are close synergies with other sectors, including LULUCF sector which is explored further in the next section. Decarbonisation measures must consider these synergies to ensure an effective plan is developed.

- The following sections present an overview of agriculture related activities, energy and emissions within the DZ area.

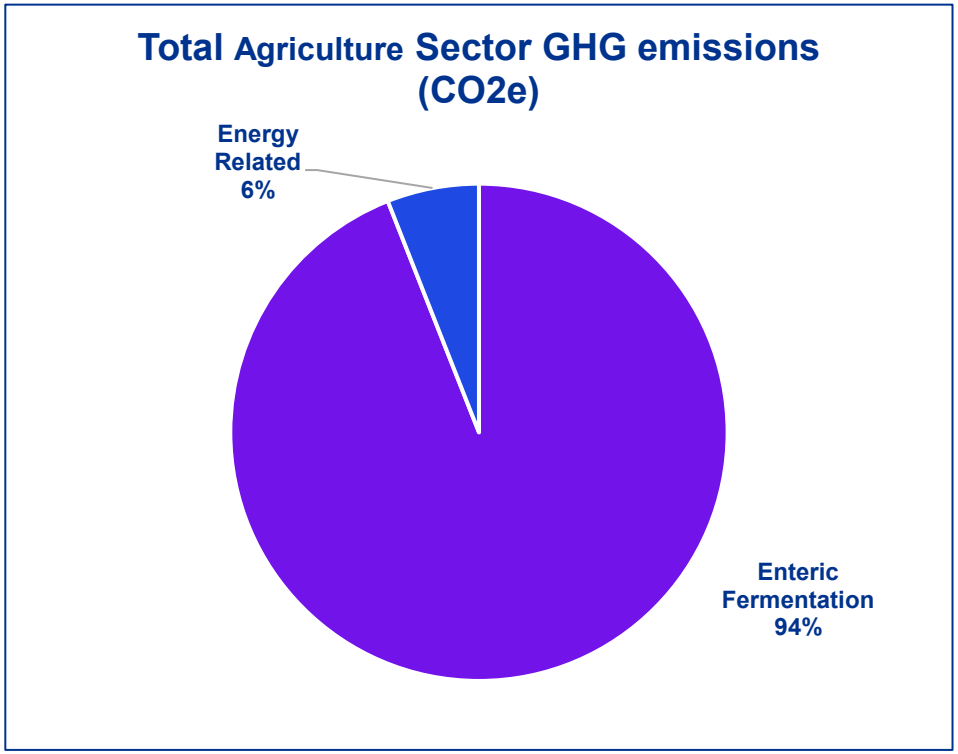
Further supporting information on agriculture sector can be found in Appendix 5.5

3.2.7.2 Agriculture Sector Summary Results

Agriculture Sector: Summary

The results of the agriculture sector assessment are presented in the table and chart below. A number of activities contribute to the agriculture sector's carbon emissions, including enteric fermentation (which takes place in the digestive system of livestock) agricultural soils, including nitrogen fertiliser use, manure management and on-farm fuel combustion and electricity use. Total GHG emissions (as CO2e) of the sector within the DZ for the 2018 baseline year equate to approximately **16,914 tCO_2e**. Note that a mix of benchmarks and robust assumptions have been used to understand the impact of the agriculture sector within the DZ area.

Agricultural sector emissions sources	Carbon emissions (tCO_2e)
Enteric fermentation	15,903
Agriculture energy related	1,011
Total	**16,914**



Further supporting information on agriculture sector can be found in Appendix 4.5

3.2.7.3 Agriculture Sector Analysis

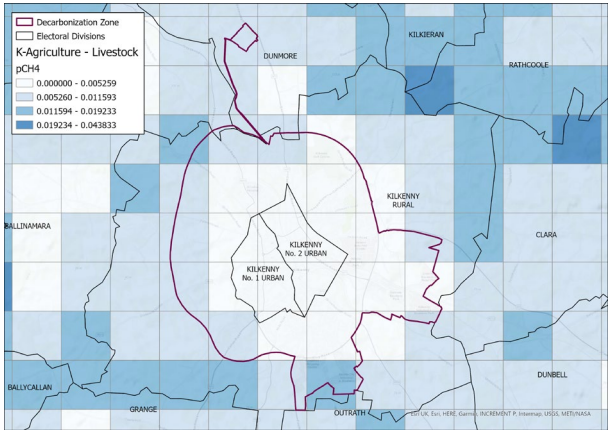
Agriculture sector: Carbon Emissions

According to the EPA's MapEire database, in the baseline year of 2018, the agricultural sector accounts for 10% of DZ area's total carbon emissions. *Note that this is based on the MapEire database which adopts a 'top-down' assessment approach.*

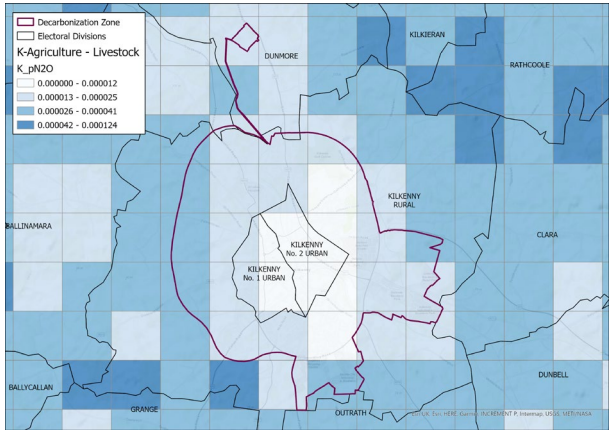
The majority of the DZ area's agriculture carbon emissions are attributed predominantly to ruminant livestock related emissions (methane emissions resulting from enteric fermentation and manure management and nitrous oxide emissions associated with manure management).

The remaining proportion of emissions are attributed to energy related emissions, largely associated with farming machinery use and carbon dioxide emissions associated with on-farm fuel combustion and electricity use.

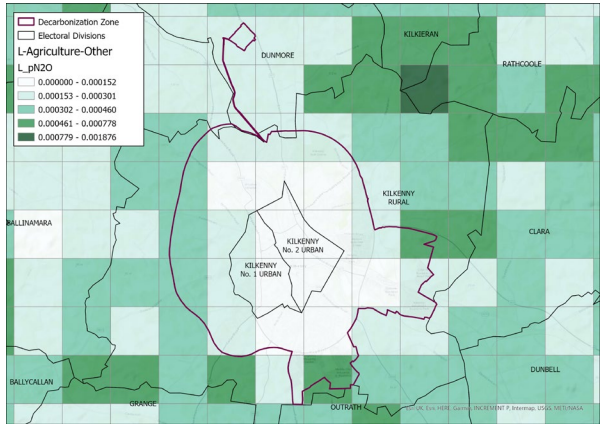
The maps to the right provide an overview of agriculture related activities, presented by 'livestock' related methane (CH_4) and nitrous oxide (N_2O) emissions and 'other' related carbon dioxide (CO_2) and nitrous Oxide (N_2O).



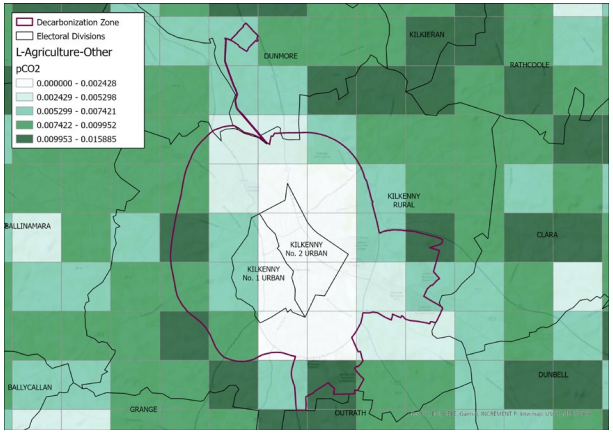
Methane emissions predominantly associated with livestock in the DZ area



Nitrous oxide emissions associated with livestock in the DZ area



Nitrous oxide emissions associated with agriculture activities, excluding livestock, in the DZ area



Carbon dioxide emissions associated with agriculture activities, excluding livestock, in the DZ area

3.2.7.3 Agriculture Sector Analysis (cont..)

Agriculture Sector: Energy & Carbon Emissions

To estimate the agriculture sector's energy consumption and associated carbon emissions within the DZ area, a number of non-spatial data points have been used. As discussed previously, there are a number of emissions sources within the agriculture sector, including enteric fermentation, agricultural soils, including nitrogen fertiliser use, manure management and fuel combustion associated with agricultural machinery. These have been explored as far as possible using the approach outlined below.

Data sources

01

CSO & Department for Agriculture, Food and the Marine (DAFM)

Livestock numbers in the DZ area, split by livestock type

02

Various sources

Benchmarks to measure the impact of enteric fermentation and on-farm energy use:

- *Methane emissions per dairy cow;*
- *Methane emissions per beef cattle;*
- *On-farm diesel consumption per dairy cow;*
- *On-farm diesel consumption per beef cattle;*
- *On-farm electricity consumption per dairy cow.*

03

SEAI Conversion Factors

Total on-farm energy consumed per livestock converted to carbon emissions using SEAI Conversion Factors

Outputs

- **On-farm energy consumed broken down by diesel and electricity and livestock**
- **Energy related carbon emissions presented by livestock**
- **Enteric fermentation related carbon emissions presented by livestock**

Note that the quantification of the impact of agricultural soils, manure management, liming and urea application on carbon emissions is complex and requires an understanding of the various elements included as part of these activities. For example, to understand the impact of fertiliser use on carbon emissions, the annual amount of synthetic fertiliser applied to soils and the annual amount of animal manure applied to soils, amongst a number of other data points. For the purposes of this baseline assessment, an estimate of these emissions sources has been excluded.

Further supporting information on agriculture sector can be found in Appendix 4.5

3.2.7.3 Agriculture Sector Analysis (cont..)

Agriculture sector: Livestock Numbers

- Beef and dairy farming are the most common livestock agricultural activities within the DZ area. According to CSO and DAFM data sources, there is no sheep farming activity in the DZ area.

- Beef cattle and dairy cows account for approximately 65% and 35%, respectively, of total livestock reviewed.

- Farming activities are present in two EDs of the DZ, Dunmore and Kilkenny Rural.

	Number of Livestock			
ED	**Beef cattle**	**Dairy cows**	**Sheep**	**Total**
Dunmore	932	529	-	**1,461**
Kilkenny No. 1 Urban	-	-	-	**-**
Kilkenny No. 2 Urban	-	-	-	**-**
Kilkenny Rural	2,870	1,554	-	**4,424**
Total	**3,802**	**2,083**	**-**	**5,885**

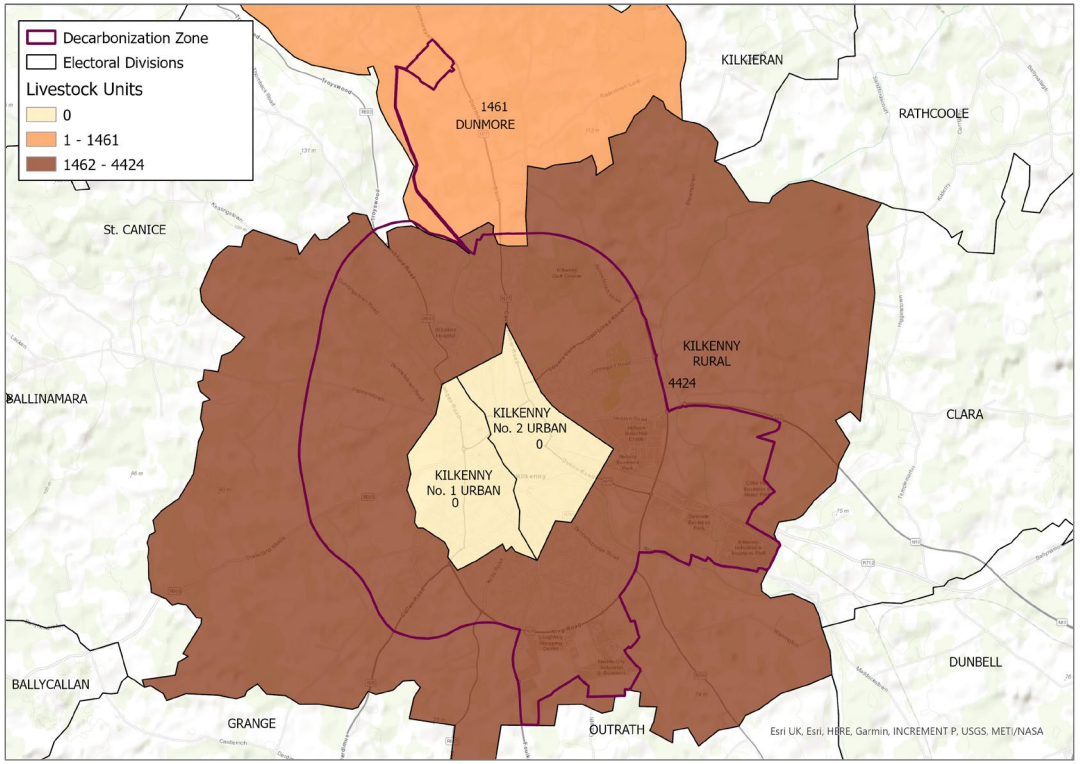
3.2.7.3 Agriculture Sector Analysis (cont..)

Agriculture sector: Livestock Numbers

- Livestock farming occurs in 2 EDs, with largest numbers in Kilkenny Rural.

- Beef cattle is the primary livestock in the DZ area, with a total of 3,801 beef cattle in the DZ. There are also 2,083 dairy cattle in the DZ.

Note: The agricultural data analysed in this report is only available at the ED-level scale, therefore, livestock numbers from outside the DZ boundary may be included, resulting in a potential overcalculation As shown on the map to the right, out of the total area covered by the EDs (57.50 km^2), ~35% (20.09 km^2) lies within the DZ and ~65% (37.41 km^2) is outside of it.



3.2.7.3 Agriculture Sector Analysis (cont..)

Agriculture sector: Beef Cattle, Dairy Cows & Sheep enteric fermentation

- As previously discussed, methane emissions produced by livestock enteric fermentation is one of the main contributors to agriculture's total carbon emissions.
- As the majority of livestock in the DZ area are beef cattle and dairy cows, to provide for a meaningful and proportionate assessment, these livestock have been focussed on.
- To estimate carbon emissions associated with beef cattle and dairy cows within the DZ area, benchmarks (gCH_4/livestock/day) have been used and are presented below.
- Estimated carbon emissions related to enteric fermentation in beef cattle and dairy cows are shown on the tables to the right.

	tCH_4/year for all beef cattle	tCO_2e/year for all beef cattle****
Total	319	8,903

	tCH_4/year for all dairy cows	tCO_2e/year for all dairy cows****
Total	251	7,000

	tCH_4/year for all sheep	tCO_2e/year for all sheep****
Total	-	-

**** Note that methane emissions (CH_4) have been converted to carbon dioxide equivalent (CO_2e) using IPCC conversion factors contained within **Appendix 5.5.2**.

Benchmarks

	gCH_4/livestock/day
Beef cattle*	6,651,543
Dairy cow**	4,772,790
Sheep***	935,410

Summary

	Beef cattle (tCO_2e)	Dairy cows (tCO_2e)	Sheep (tCO_2e)
Enteric fermentation related carbon emissions	**8,903**	**7,000**	**-**
Total	**15,903**		

Source: https://www.teagasc.ie/environment/climate-change--air-quality/methane/; https://www.teagasc.ie/news--events/daily/sheep/measuring-methane-from-sheep-systems.php

*For the purpose of this assessment, beef cattle related methane emissions benchmark is assumed for a '500kg Beef animal on a high concentrate diet'

** For the purpose of this assessment, dairy cow related methane emissions benchmark is assumed for a '550kg Dairy cow grazing on pasture'

*** For the purpose of this assessment, sheep related methane emissions benchmark is assumed for 'ewe lambs on a grass silage based diet'

3.2.7.3 Agriculture Sector Analysis (cont..)

Agriculture sector: Beef Cattle, Dairy Cows & Sheep energy related emissions

- As previously discussed, on-farm fuel combustion and electricity use contributes to national agriculture carbon emissions.
- As the majority of livestock in the DZ area are beef cattle and dairy cows, to provide for a meaningful and proportionate assessment, these livestock have been focussed on.
- To estimate carbon emissions associated with beef cattle and dairy cows within the DZ area, benchmarks (kWh/livestock/year) have been used and are presented below.
- Estimated carbon emissions related to energy consumption in beef cattle and dairy cows presented by ED are shown on the tables to the right.

	Energy consumption (kWh) for all beef cattle	Carbon emissions (tCO_2e) for all beef cattle
Total	1,721,853	454

	Energy consumption (kWh) for all dairy cows	Carbon emissions (tCO_2e) for all dairy cows
Total	1,822,625	556

	Energy consumption (kWh) for all sheep	Carbon emissions (tCO_2e) for all sheep
Total	-	-

*** Note that methane emissions (CH_4) have been converted to carbon dioxide equivalent (CO_2e) using IPCC conversion factors included within the **Appendix.**

Benchmarks

	kWh/livestock/year
Beef cattle	453
Dairy cow	875
Sheep	19

Summary

	Beef cattle (tCO_2e)	Sheep (tCO_2e)	Dairy cows (tCO_2e)
Energy related carbon emissions	**454**	**-**	**556**
Total	**1,010**		

Source: Department for Environment, Food & Rural Affairs (DEFRA)

3.2.8 Land Use, Land Use Change & Forestry (LULUCF) Sector

3.2.8.1 LULUCF Sector Overview

Overview of the National LULUCF sector

- At a national level, the 'Land Use, Land-use Change and Forestry (LULUCF)' sector accounts for the following categories of land use types: Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested Wood products.
- Ireland's LULUCF sector is an outlier in the European Union – in each year between 1990 to 2021, the sector was reported to be a net source of carbon emissions, rather than a net sink. In addition, the sector's emissions are projected to increase significantly by 2030.
- Trends in Ireland's LULUCF emissions are largely associated with grasslands and wetlands – these land use types are shown to be sources of emissions predominantly due to the drainage of organic soils. In addition, croplands fluctuate between being a small net sink in some years and a small source of emissions in others.
- Note that estimates of whether or not land use types in Ireland (and in all regions) are 'carbon sinks' (i.e. absorbs carbon from the atmosphere) or result in net emissions are highly complex as a result of the complex synergies and dynamics between land use types, biomass and soils.

- The agriculture and LULUCF sectors are closely linked – the management of agricultural ecosystems, such as grasslands and peatlands, has a direct impact on whether or not it acts as a net carbon sink or net emitter of carbon emissions.
- The LULUCF chapter of the National Climate Action Plan 2023 outlines the role of forestry in climate action with a key aim to support new plantations, and sustainable forest management. Support measures include the promotion of agroforestry and 'neighbourfoods' and the Teagasc 'Native Woodland Scheme'.

- The following pages present an overview of the LULUCF and associated emissions within the DZ area.

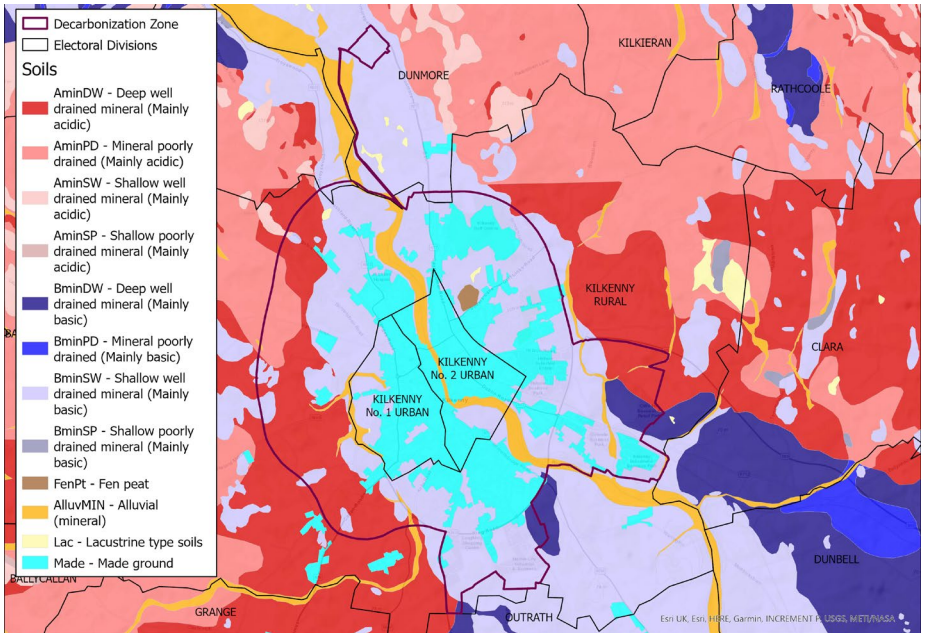
3.2.8.2 LULUCF Sector Analysis

LULUCF Sector: Soil types

- Soils (beneath grasslands, peatlands, for example) have the potential to act as vast carbon sinks if managed and utilised in an effective manner.

- As displayed below, 'shallow, well-drained mineral soils' occupy ~33% of the Kilkenny DZ area. The remaining land is predominantly underlain by 'made ground', as well as 'deep well-drained mineral soils'. With better management of soils (i.e., not over-fertilising or over-working agricultural soils), especially as part of agricultural activities, the DZ area has the potential to sequester and store carbon and ultimately act as a carbon sink.

- To understand baseline carbon stocks and carbon sequestration rates in the DZ area, soil carbon sampling and monitoring should be undertaken. In addition, current Teagasc research is focusing on establishing Irish specific emission factors for soil carbon sequestration for inclusion in the national inventory.



DZ Area Soil Types	Area (Hectares)	% of Total Area
Alluvial (mineral)	102.2881	5%
Deep well drained mineral (Mainly acidic)	316.0907	16%
Deep well drained mineral (Mainly basic)	40.18424	2%
Fen peat	7.15861	0%
Lacustrine type soils	2.670833	0%
Made ground	664.194	33%
Mineral poorly drained (Mainly acidic)	47.1332	2%
Shallow well drained mineral (Mainly acidic)	0.555784	0%
Shallow well drained mineral (Mainly basic)	828.4724	41%
Total	**2008.7478**	**100.0%**

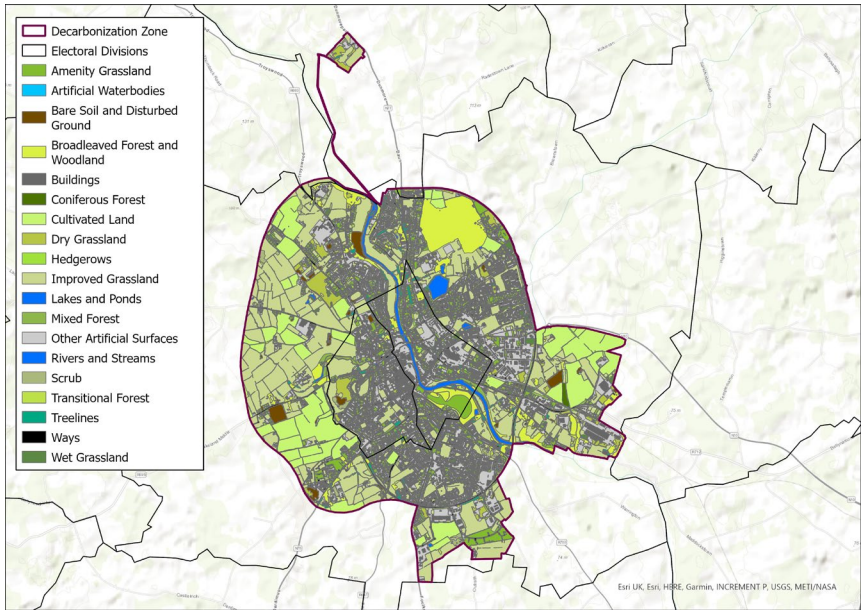
3.2.8.2 LULUCF Sector Analysis (cont..)

LULUCF Sector: Land Use types

- As shown below, artificial surfaces (buildings, roads, other artificial surfaces etc.) make up c.33% of land area within the Kilkenny DZ*. This type of land cover is reflective of the urban nature of the DZ and offers limited opportunity for large-scale transformation into carbon sinks when compared to areas such as peat bogs or a forest. Nonetheless, a significant proportion of the urban area in the DZ includes green spaces, green infrastructure, private gardens, hedgerows etc - all of which have the potential to be enhanced for carbon storage and biodiversity enhancement

- Potential for carbon storage and carbon sequestration across the DZ area is heavily dependent on the land and soil types present as well as their management and utilisation. For example, grasslands (which make up c.35% of the land area) are a substantial source of carbon (approximately 1.5-4 tCO_2/hectare/year)**. This is because soil types associated with grassland maintain a large stock of carbon (approximately 440 tCO_2/hectare).

- As an example, if the entire area of Kilkenny DZ area lies on this land and soil type, it would emit an estimated 8.0 $ktCO_2$/year.



DZ Area Land Use Types	Area (Hectares)	% of Total Area
Improved Grassland	543.73	27.06%
Other Artificial Surfaces	373.54	18.59%
Cultivated Land	232.02	11.55%
Amenity Grassland	167.13	8.32%
Buildings	156.11	7.77%
Ways	136.41	6.79%
Broadleaved Forest and Woodland	129.35	6.44%
Hedgerows	79.30	3.95%
Dry Grassland	42.79	2.13%
Scrub	33.86	1.69%
Treelines	32.65	1.62%
Rivers and Streams	27.36	1.36%
Bare Soil and Disturbed Ground	23.48	1.17%
Lakes and Ponds	10.28	0.51%
Wet Grassland	9.38	0.47%
Mixed Forest	8.92	0.44%
Coniferous Forest	2.27	0.11%
Artificial Waterbodies	0.51	0.03%
Transitional Forest	0.27	0.01%
Grand Total	**2,009.34**	**100.00%**

* Source: The National Land Cover map (Tailte) provided under agreement by KKCoCo.

- Source: Teagasc: Soil Carbon Sequestration

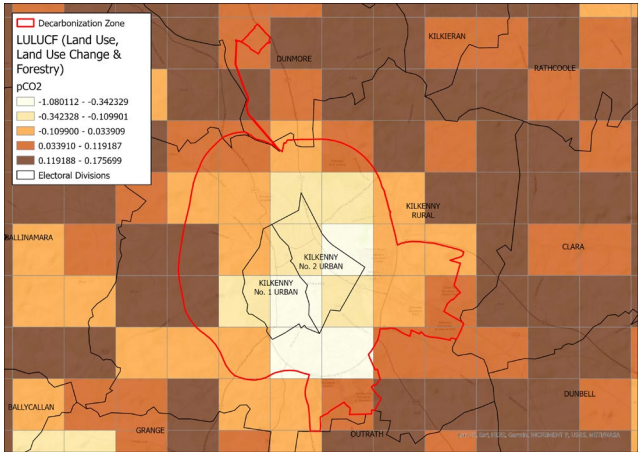
3.2.8.2 LULUCF Sector Analysis (cont..)

LULUCF Sector: Carbon Emissions

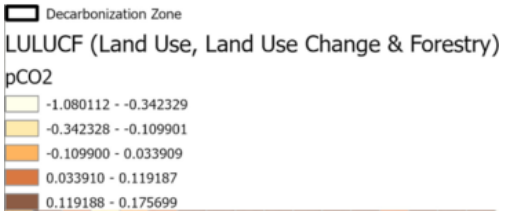
- According to the EPA's MapEire database, the DZ area is a net sink of carbon emissions, i.e. it absorbs more carbon emissions than it emits (darker colours), largely as a result of the type of land cover.

- In the baseline year of 2018, the LULUCF sector accounted for approximately -1,082 tCO_2e, equating to approximately -1% of total carbon emissions in the DZ area. **Note that this is based on the MapEire database which adopts a 'top-down' assessment approach.*

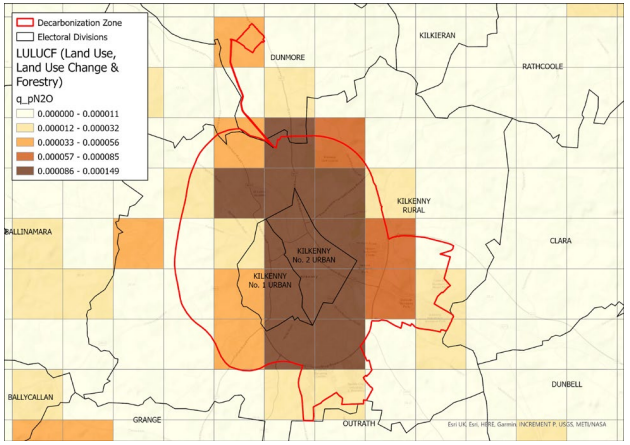
- The maps provided here provide an overview of the carbon emissions associated with land use and forestry across the Kilkenny DZ area, broken down into carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).



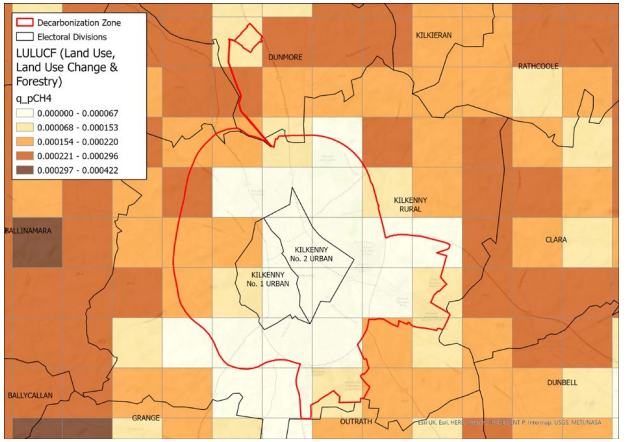
Carbon dioxide emissions associated with land use in the DZ area



Enlarged legend from above map to demonstrate the emissions/sequestration factors



Nitrous oxide emissions associated with land use in the DZ area



Methane emissions associated with land use in the DZ area

3.2.9 Energy & Electricity Sector

3.2.9.1 Energy & Electricity Sector Overview

Overview of National Energy & Electricity sector

- Considerable progress has been made in decarbonising the electricity sector over the last decade, resulting in electricity emissions falling by 45% between 2005 and 2020. This has been possible through the deployment of renewables and their successful integration into the power grid, and the increased use of higher-efficiency gas turbines. The deployment of renewable energy has enabled emissions reductions during a period of increased demand, with electricity accounting for just 14.4% of Ireland's carbon emissions in 2021.

- Since 2021, there have been significant increases in prices in the international oil and gas markets, due to increased demand as the post-COVID 19 recovery continues and the disruption to traditional energy supplies following the Russian invasion of Ukraine. The resultant sharp increase in energy prices underlines the importance for Ireland to eliminate our dependency on fossil fuels and that an increase in renewable energy generation, along with supporting flexibility and demand management measures, is necessary for our future energy security.

- Targets and actions outlined in CAP 2023 focus on an acceleration towards renewable energy generation, with the aim of renewables accounting for at least 75% of energy demand by 2030. Key to the success of decarbonising the energy sector will be increased flexibility during Ireland's transition to a renewable electricity grid. The development of dynamic tariffs to incentivise consumers to move their demand to times of high renewable penetration will reduce the strain on the network at peak times.

- In particular, of relevance to the DZ area is the CAP 2023 measure (Section 12.1.4) which looks to support at least 500 MW of local community-based renewable energy projects and increased levels of new micro-generation and small-scale generation.

- The following section presents an overview of the potential opportunities for the DZ area in terms of energy efficiency and reduction as well as opportunities to support national energy decarbonisation targets.

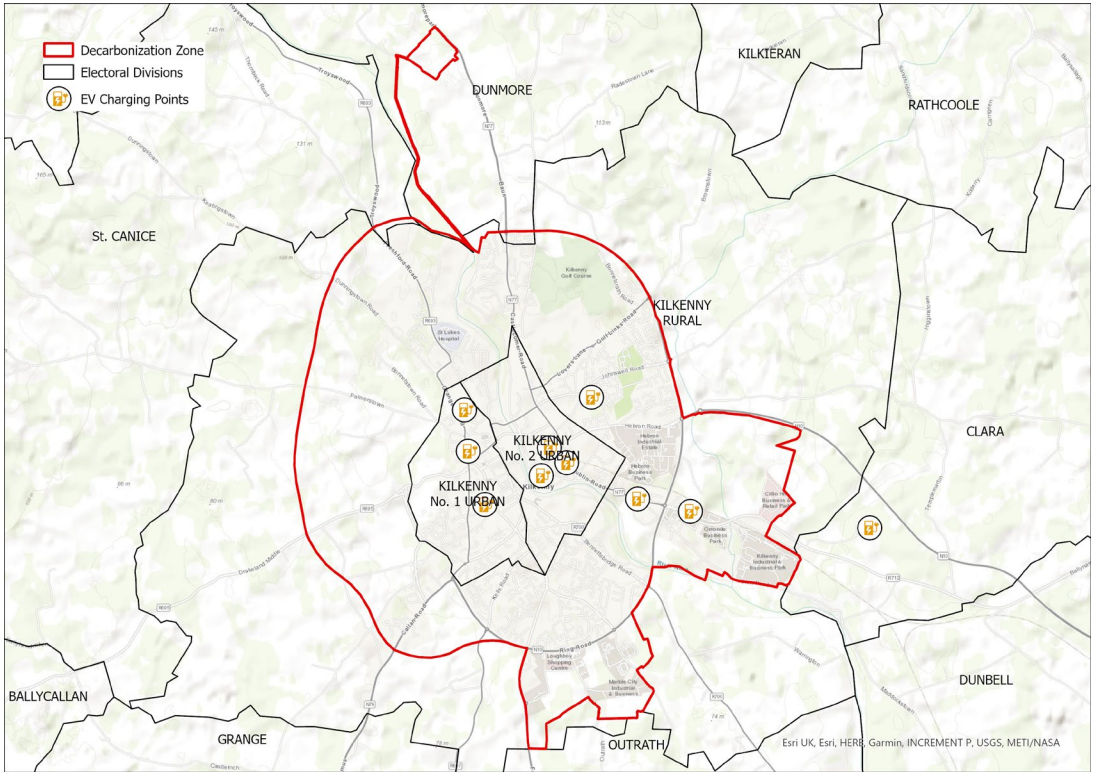
3.2.9.2 Energy & Electricity Sector Analysis

Energy & Electricity Sector: Electric Vehicle charging points

- As previously mentioned, to support the decarbonisation of the transport sector, an increased proportion of EVs in the vehicle fleet as well as the electrification of freight and public transport is required to shift away from fossil fuels.

- The current level of EV charging infrastructure is shown on the map to the right, with 9 charging points in total present. Kilkenny City centre has 6 EV charging points located relatively close to each other. These charging points are conveniently located close to main commuting points, such as train and bus stations, allowing commuters going further afield to charge their vehicles while in transit.

- In order to expand the roll-out of EV infrastructure in this region, a strong grid connection with broad coverage of substations are needed. The next page provides an overview of grid connections and substations in the area.



3.2.9.2 Energy & Electricity Sector Analysis (cont..)

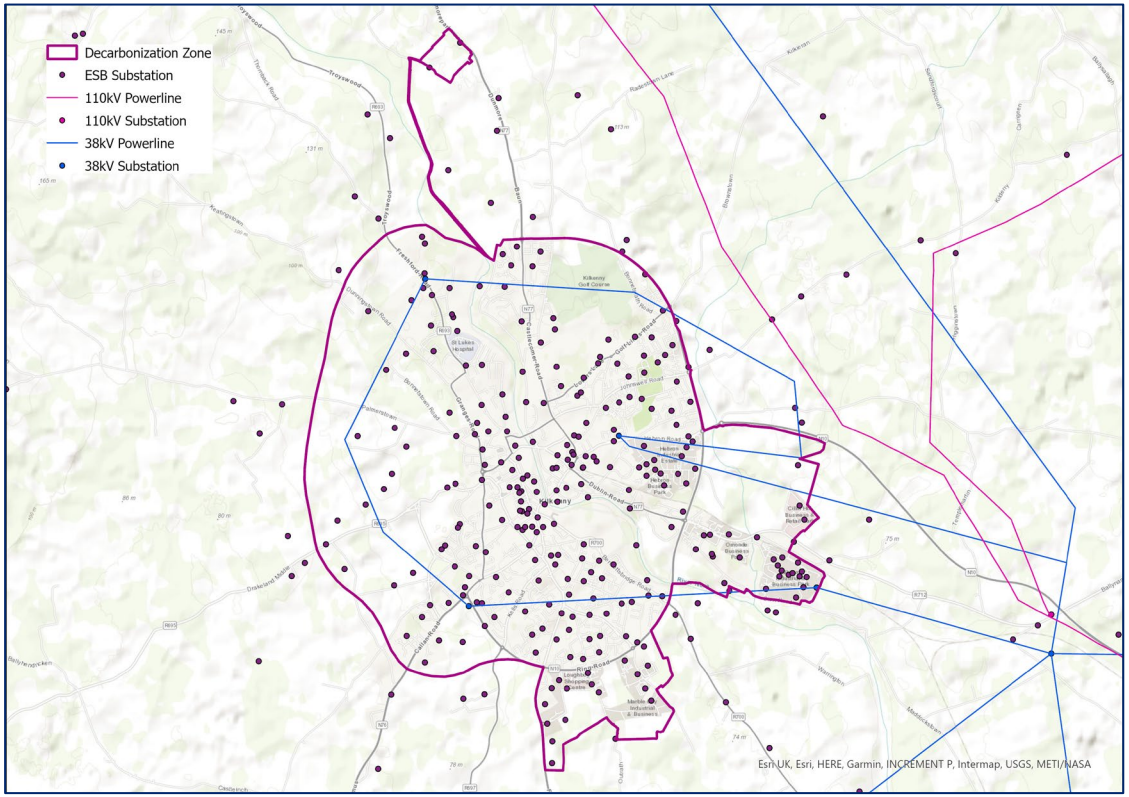
Energy & Electricity Sector: Power Line & Substation Locations

- The DZ area is serviced by a 38kV power line that runs around the perimeter and into the centre of the DZ area as shown on the map to the right. Four 38kV substations anchor the powerlines.

- There is a high density of 38 kV ESB substations in the DZ area with a less-dense area located in the northern periphery of the boundary. The locations of these are displayed on the map, showing there is a strong grid connection should electricity upgrades be explored.

- A 100kV powerline and substation is located within close proximity outside of the DZ to the east.

- In order to expand the production of renewable energy and enable electrification in the region, there will be a requirement to have strong grid connections and sub stations.
- Based on the current infrastructure, there is strong electricity infrastructure in the DZ at present, however further assessment may be required to determine if further expansion is needed for renewable energy growth in the DZ. A grid feasibility study could be carried out to assess the requirements.



3.3 Conclusions and Recommendations

3.3.1 Conclusions and Recommendations

Carbon emissions within an area, such as the DZ area, generally reflect trends such as the level of economic activity, energy use and potentially growth. The challenge for the DZ area (and other areas) is to allow for continued growth and improvement whilst reducing carbon emissions in a just and meaningful manner.

This report highlights the carbon hotspots within the DZ area: Residential Sector, Commercial and Public Sector and Transport Sector. The waste sector, although a smaller impact in comparison to those just mentioned, should also be focussed on given its transboundary nature and the level of influence the local authority can have on its impact on carbon emissions.

A range of sectoral-specific measures to reduce carbon emissions can be explored by Kilkenny County Council during the next stages of the DZ development, including stakeholder engagement and a register of opportunities for action planning. Examples of key measures specific to these sectors to consider are set out on the following pages.

In addition to sectoral-specific measures, local authorities can also engage with relevant government departments to develop and resource programmes which will directly, and indirectly, provide the necessary tools to enable an effective transition to a low-carbon economy. These include but are not limited to:

- Citizen engagement and awareness raising to promote behavioural change across the DZ area;
- Internal capacity building to equip employees with the knowledge and skills to promote decarbonisation;
- Support for external initiatives such as innovation and knowledge-sharing hubs.

3.3.1 Conclusions and Recommendations (cont..)

Residential (including Social Housing):

Achieving a low-carbon housing stock is an important part of the DZ area successfully achieving national carbon reduction targets.

Targeting existing and proposed residential developments with suitable measures to optimise energy efficiencies and carbon emissions reductions is a key part of decarbonising the residential sector.

As the majority of homes within the DZ area were built pre-2000, their energy efficiency is lower than newer builds, resulting in a greater energy demand and consumption, leading to higher carbon emissions. Retrofitting the older building stock of the DZ is an effective measure to reduce the sector's energy consumption and associated carbon emissions. National, government-resourced programmes to incentivise the retrofit of private and social housing will be critical. The government has committed to providing increased funding to accelerate retrofitting, including free upgrades for low-income households.

Roll-out of energy management systems and smart meters to council-owned buildings, such as social housing is an effective measure to manage and understand energy use and trends in demand.

A National Heat Study has estimated that district heating is a technology that could provide up to 50% of building heat demand in Ireland. As such, exploring the feasibility of alternative heating systems such as District Heating, geothermal etc. is another key consideration for this sector within the DZ. Although the population density of the DZ area is ~46% (637 persons per km^2) lower than the national average population density in urban areas, the population of Kilkenny City is projected to increase to 31,477 by 2031 representing an uplift of ~12% (3,641 persons) from 2016. In line with national policy, the compact growth of the DZ is key to supporting energy-efficient use of land and infrastructure.

While district heating might not be suitable for all sectors of the DZ (due to population density), there may be some niche applications of the technology within Kilkenny City DZ at large heat sources.

Natural Gas and Oil account for a combined ~88% and ~83% of the residential sector's energy consumption and associated carbon emissions, respectively. These figures show that the residential stock of the DZ is heavily reliant on fossil fuels and switching to low-carbon/ renewables is a significant opportunity for the sector to reduce its energy consumption and carbon emissions. Potential for renewable energy heat sources is also encouraged by the CAP, including the installation of heat pumps at existing residential units as well as new developments and the use of renewable gas (i.e., biomethane).

For proposed and new residential developments, National Building Standards revision will be required to reach net zero targets.

There is also the opportunity to explore the use of nature-based solutions within the residential sector to sequester carbon dioxide from the atmosphere, mitigate the urban heat island effect, reduce energy consumption, and increase a building's resilience to climate change.

As outlined in this report, the vacancy rate of the DZ is 6.4%, which is higher than the national average of 3.1% for urban areas (CSO 2016 data). Addressing urban vacancy is critical to reducing the extraction of raw materials required for new builds and other associated carbon emissions. An audit of the vacant building stock within the DZ would be beneficial.

Source: SEAI National Heat Study

3.3.1 Conclusions and Recommendations (cont..)

Commercial Sector:

Similar to the residential sector, optimising the energy efficiency of existing commercial buildings is key to meeting national carbon targets. The 1,504 commercial buildings within the DZ account for ~24% of the DZ's total carbon emissions.

The CAP provides an overview of key potential measures to drive decarbonisation across the commercial sector. For example:

- A retrofitting programme to upgrade existing buildings could optimise the energy efficiency of the current building stock which ranges between C1 BER-rated to G BER-rated buildings.
- In addition, opportunities for the use of renewable energy are also encouraged including the use of heat pumps and renewable gas for commercial buildings.

Municipal:

The Kilkenny City DZ will act as a testbed for urban decarbonisation measures to be adopted in other similar areas as well as scaled up across the county.

Although Kilkenny City Council buildings and public lights account for ~1% of total emissions within the DZ, Kilkenny County has an important leadership and advocacy role in the transition of the area to a sustainable future. Buildings and land under the council's remit can act as exemplar projects.

Public Sector:

CAP envisages the public sector playing a leading role in meeting Ireland's climate ambition and its decarbonisation targets.

There are a significant number of public sector buildings in the DZ including Kilkenny County Council, HSE, OPW, ETB, Department of Agriculture, Intellectual Property Office of Ireland, and voluntary schools. The public sector (excl. Kilkenny County Council) accounts for ~6% of the DZ's total carbon emissions. Decarbonisation solutions such as district heating and the use of renewables may be suitable for a large proportion of these buildings.

The CAP provides an overview of key potential measures to drive decarbonisation across the public sector. For example:

- Public sector buildings can avail of SEAI supports promoting energy efficiency including the 'Gap to Target' tool as well as the Building Pathfinder Programme which supports building retrofits.
- In addition, public sector buildings can avail of supports for the installation of solar PV.
- Appropriate knowledge and skills are required to enable energy efficiency improvements in protected buildings – to understand, specify and install appropriate retrofitting within these protected buildings, specialists are required.
- Leveraging the public procurement process can embed low-carbon, sustainable criteria at the earliest stages of new public sector building developments.

3.3.1 Conclusions and Recommendations (cont..)

Transport:

A shift to active travel and increased uptake of public transport is key to the achievement of Ireland's national carbon targets.

A key focus of the CAP and also mentioned in the National Planning Framework (NPF) is sustainable mobility. The provision of sustainable modes of travel such as public transport, walking and cycling will contribute towards reducing greenhouse gas emissions.

As highlighted in the report, the DZ area acts as a public transport centre with a number of bus stops, a train stop and an Irish rail line passing through.

A number of measures could be considered here, such as extension in public transport provision, increased frequency of train services, dynamic parking management, park and strides/rides, demand response services (particularly for those with reduced mobility and has been suggested from train to city centre), multi-modal hubs, cargo deliveries, bike libraries, shared schemes, enhancement of active travel environment, delivery of cycle networks with segregation where possible, car-pooling apps, workplace mobility plans, school mobility plans, among others.

In addition, gasoline (Petrol) and diesel are the most common sources of fuel within the DZ and account for a combined ~96% and ~100% of transport-related energy and carbon emissions, respectively. Investment in electric vehicles (EVs), and increased charging facilities are part of the solution. The Regional EV Infrastructure Strategy (in preparation) will inform the rollout of EV infrastructure in the DZ.

Waste & Circular Economy:

Local authorities can play a key role in minimising waste and embracing circular economy principles. Kilkenny County Council can consider the implementation of targeted initiatives to reduce waste-related emissions and embrace circular economy principles, including:

- Deposit and return schemes for plastic and aluminium beverage containers;
- Promotion of trials for better public recycling opportunities on street and at Bring Centres;
- Improvement of segregation and collection performance to increase recycling and reduce contamination.

In addition, capacity building will play a key role in closing Ireland's circularity gap at a local level. Current measures in place to support this include the Local Authority Prevention Network (LAPN), which involves cooperation between the EPA and local authorities to build local authority expertise and capacity in waste prevention and circular economy at the local level.

3.3.1 Conclusions and Recommendations (cont..)

Agriculture:

As presented in this BEI assessment, agricultural activities in the DZ area account for a small proportion of total carbon emissions.

Kilkenny County Council, within the scope of its regulatory and strategic functions, can engage with the agricultural sector to support the reduction in agricultural emissions. A number of actions within the scope of the LACAPs have been identified in the latest CARO Review of Climate Targets and Actions for the Agriculture Sector (2023), including:

- Facilitate the preparation of feasibility studies on AD in conjunction with groups of farmers, agri-business, and other stakeholders.
- Offer sites in local authority ownership with grid and or gas connections where suitable for the development of AD facilities and subject to licencing and logistical considerations.
- Provide a future market for biogas by preparing a conversion plan for fleet.
- Offer feedstock from grass cuttings and other organic waste from council-owned lands.

Kilkenny County Council will review all of the findings and recommendations of the CARO Review of Climate Targets and Actions for the Agricultural Sector (2023), and take action on the most relevant ones for the Kilkenny City DZ.

Kilkenny County Council could further explore the bioeconomy potential of the DZ. The first National Policy Statement on the Bioeconomy was published in 2018, and a National Bioeconomy Action Plan has been in development since 2022. There are several linkages between the agricultural sectors and the bioeconomy, including feedstock for bioenergy. It is noted, however, that local authorities have a limited range of functions in relation to agriculture.

LULUCF:

Approximately 15% of the land within the DZ comprises of land use including broadleaved forest and woodland, hedgerows, scrub, treelines, rivers and streams, wet grassland, mixed forest etc., all of which have potential for enhanced carbon storage and biodiversity enhancement. This is a significant opportunity for the City as much of this land could be enhanced for carbon storage and biodiversity enhancement without significant capital investment.

In addition, 17.5% of the land within the DZ is zoned for ‘Mixed/general 'green'/recreation/conservation, other’. This presents the DZ with a significant opportunity for the increased implementation of nature-based solutions and green infrastructure.

Kilkenny County Council are in the process of developing a recreational and biodiversity park at the site of the now-closed municipal landfill at Dunmore. The 17-acre site, located 5km north of Kilkenny city centre will provide multiple benefits for the residents of the DZ and beyond including the provision of trails for walking, running, cycling and orienteering, and multiple educational opportunities. In addition, the park will allow the enhancement of natural heritage and biodiversity.

The local authority can lead by example and identify surplus land in its ownership suitable for planting and habitat creation. An audit of council-owned lands within the DZ would benefit this measure.

The development of a Kilkenny City Tree Strategy/Master Plan is recommended. The rollout of this scheme would allow for a strategic approach to biodiversity enhancement within the DZ.

04

Appendices

4.1: Socio-Economic

4.1.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Socio-economic	Unemployment 2016	https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics	Number of unemployed by small area	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.
	POBAL Deprivation 2016	https://www.pobal.ie/research-analysis/open-data	Deprivation Index 2016 by ED	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.
	Population Density	https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics	Total Population per Small Area	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.
	Zoning	https://viewer.myplan.ie	Kilkenny County Development Plan 2021 – 2027	No limitation in data set.

4.2: Residential Sector

4.2.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Residential	Housing Stock	https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics	Average Built Year of Housing Stock by Small Area	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.
	BER Ratings	https://gis.seai.ie/server/services	Domestic BER Ratings	No limitation in data set. Additional information on the data source can be found here: Understand BER Ratings | Home Energy | SEAI
	Annual Heat Demand	https://gis.seai.ie/server/services	Residential Sector – Annual Heat Demand	No limitation in data set. Additional information on the data source can be found here: Map Of Heat Demand In Ireland | SEAI GIS Maps | SEAI

4.2.2 Data Sources, Assumptions & Limitations: Non-Spatial Data

Sector	Data source name & description	Data source link	Data assumption	Data limitation	Overview of methodology used
Residential	CSO	https://data.cso.ie/	No. of housing units in the DZ area	Data used is representative of 2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018	CSO data on number of residential buildings has been combined with BER Research Tool data to estimate total energy consumption
	SEAI BER Research Tool	https://ndber.seai.ie/BERResearchTool/ber/search.aspx	The average energy consumption per dwelling type and built period	The research tool does not contain total delivered energy consumption of all houses in the DZ area but can be considered a good proxy.	
	CSO	https://data.cso.ie/	Fuel breakdown of the residential sector within the DZ	CSO data reflective of 2016 has been used to inform fuel type breakdown within the residential sector. This data is reflective of the DZ area residential sector activities.	
	SEAI Conversion Factors	https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/	Carbon intensity factors for each energy source	The SEAI conversion factors represent some of the most robust carbon benchmarks for fuel types in Ireland and would be considered a strong proxy for carbon calculations in the DZ	
	Kilkenny County Council	Kilkenny County Council	No. of social housing units in the DZ	No limitation in data set	Local authority housing stock has been provided by Kilkenny County Council.

4.2.3 Supporting Data: Residential Sector

Residential Sector: Energy & Carbon Emissions

Calculation of average energy consumption for housing units grouped by dwelling type and built period (BER Research Tool).

	Number							
Dwelling type	All years	Before 1919	1919 to 1970	1971 to 1990	1991 to 2000	2001 to 2005	2006 to 2011	2012 onwards
All households	12,681	23,134	20,866	15,036	7,993	8,026	8,026	-
House/Bungalow	13,784	-	-	-	-	-	-	-
Flat/Apartment	4,517	-	-	-	-	-	-	-

Summary of Residential Energy Consumption, grouped by ED and built period

ED	Unit	Pre 1919	1919-1970	1971-1990	1991-2000	2001-2005	2006-2011	2012 onwards	Total
Kilkenny No.1 Urban	MWh/year	4,293	18,562	5,482	2,548	1,875	1,875	-	**34,634**
Kilkenny No. 2 Urban	MWh/year	4,062	10,947	5,685	1,274	1,210	1,210	-	**24,390**
Kilkenny Rural	MWh/year	2,873	18,398	34,208	11,940	9,935	9,935	-	**87,289**
Dunmore	MWh/year	457	653	989	175	323	323	-	**2,920**
Total	MWh/year	**11,685**	**48,560**	**46,364**	**15,937**	**13,343**	**13,343**	**-**	**149,232**

Summary of Carbon Emissions of the Eds in the DZ, grouped by built period and %

Built period	Unit	Total	%
Before 1919	tCO2	2,970	8%
1919-1970	tCO2	12,282	32%
1971-1990	tCO2	11,770	31%
1991-2000	tCO2	4,034	11%
2001-2005	tCO2	3,380	9%
2006-2011	tCO2	3,380	9%
2012 onwards	tCO2	-	0%
Total	tCO2	37,815	100%

4.2.3 Supporting Data: Residential Sector

Residential Sector: Social Housing: Energy & Carbon Emissions

Number of dwellings in the DZ, grouped by ED and dwelling type (CSO 2016). ***Note that a weighted average has been applied to the CSO data extracted to account for 'Not stated' dwellings. This data has been used to inform the residential calculations.***

	Number				
Dwelling type	**Kilkenny No.1 Urban**	**Kilkenny No. 2 Urban**	**Kilkenny Rural**	**Dunmore**	**Total**
All households	2,246	1,578	6,499	227	**10,550**
House/Bungalow	1,812	1,207	6,002	210	**9,321**
Flat/Apartment	434	371	497	17	**1,319**

Number of dwellings in the DZ, grouped by ED and year built (CSO 2016). ***Note that a weighted average was applied to the CSO data extracted to account for 'Not stated' dwellings. In addition, a number of house/bungalow & flat/apartment by construction period is not available from the CSO.***

	Number				
Year of Construction	**Kilkenny No.1 Urban**	**Kilkenny No. 2 Urban**	**Kilkenny Rural**	**Dunmore**	**Total**
All years	**2,246**	**1,578**	**6,209**	**226**	**10,259**
Pre 1919	186	176	105	20	486
1919 to 1970	891	525	746	31	2,193
1971-1990	365	379	1,925	66	2,735
1991-2000	319	160	1,264	22	1,765
2001-2005	234	151	1,048	40	1,473
2006-2011	234	151	1,048	40	1,473
2012 onwards	17	37	73	7	135

4.2.3 Supporting Data: Residential Sector

Residential Sector: Social Housing: Energy & Carbon Emissions

CSO 2016 central heating energy source split of homes across EDs within the DZ. ***Note that the total % of heating type shown on the table below is the total number of each energy source over the total number of households in the DZ area.***

Energy Source	Kilkenny No.1 Urban	Kilkenny No. 2 Urban	Kilkenny Rural	Dunmore	Total
Coal	4%	5%	4%	3%	**4%**
Peat	<1%	<1%	<1%	0%	**<1%**
Oil	22%	29%	29%	59%	**35%**
LPG	<1%	<1%	<1%	0%	**<1%**
Natural Gas	59%	45%	63%	27%	**49%**
Renewables	<1%	<1%	<1%	2%	**<1%**
Electricity	13%	20%	2%	4%	**10%**
Wood	<1%	<1%	<1%	5%	**2%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

CSO 2016 CSO Occupancy of homes across EDs within the DZ.

Occupancy	Kilkenny No.1 Urban	Kilkenny No. 2 Urban	Kilkenny Rural	Dunmore	Total	%
Occupied	2,256	1,586	6,228	226	**10,296**	**90%**
Temporarily absent	76	62	185	6	**329**	**3%**
Unoccupied holiday homes	30	19	14	1	**64**	**<1%**
Other vacant dwellings	241	200	278	13	**732**	**7%**
Total	**2,603**	**1,867**	**6,705**	**246**	**11,421**	**100.00%**

Note: Figures rounded to whole numbers for presentation purposes

4.2.3 Supporting Data: Residential Sector

Residential Sector: Social Housing: Energy & Carbon Emissions

Number of social housing units in the DZ area

	Number
Electoral District	Social Housing units
All EDs	1,356

Number of social housing units in Kilkenny City has been provided by Kilkenny County Council

Calculation of average energy use for all social housing units in the DZ (BER Research Tool)

	kWh/year
Dwelling type	All years
All households	18,341

SEAI carbon emission conversion factors

Energy source	gCO_2/kWh
Coal	340.6
Peat	355.9
Residual Oil	273.6
LPG	229.3
Natural Gas	204.7
Renewables	0
Electricity	375.2
Wood	15.1

4.2.3 Supporting Data: Residential Sector

Breakdown of residential units with BERs in the DZ area

Dwelling Type	Number
Apartment	24
Basement Dwelling	2
Detached house	1272
End of terrace house	800
Ground-floor apartment	423
House	96
Maisonette	120
Mid-floor apartment	227
Total	**6,615**

Note: BER Ratings represent both occupied and unoccupied dwellings. Due to the dataset's limitations, it is not possible to determine the percentage of each dwelling type's BER status.

4.3 Commercial & Public Sector

4.3.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Commercial & Public	BER Ratings	https://gis.seai.ie/server/services	Non-Domestic BER Ratings	No limitation in data set. Additional information on the data source can be found here: Understand BER Ratings | Home Energy | SEAI
	Annual Heat Demand	https://gis.seai.ie/server/services	Commercial and Public Sector – Annual Heat Demand	No limitation in data set. Additional information on the data source can be found here: Map Of Heat Demand In Ireland | SEAI GIS Maps | SEAI
	Buildings Number and Locations	Kilkenny County Council	Geodirectory Building Use Locations	2022 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2022 data is deemed a reasonable proxy for 2018.

4.3.2 Data Sources, Assumptions & Limitations: Non-Spatial Data

Sector	Data source name & description	Data source link	Data assumption	Data limitation	Overview of methodology used
Commercial	Valuation Office	https://www.valoff.ie/en/check-property-valuation-online/	Number of commercial buildings by sector in the DZ area reflecting the 2018 baseline year	The Valuation Office dataset is considered a strong proxy for non-spatial data pertaining to commercial building types across Ireland, however a potential limitation could be the that the VO data is generated manually. The data was filtered for any negative or very large floor area figures.	The VO data combined with CIBSE benchmarks has been used to calculate the estimated energy consumption for each of the building types in the DZ area. National commercial and public sector energy split (%) has been applied to energy consumption and converted to carbon emissions.
	CIBSE (energy benchmarks for building types)	https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/benchmarking-registration#:~:text=CIBSE's%20Energy%20Benchmarking%20Tool%20is,of%20energy%20use%20in%20buildings.	CIBSE benchmarks are assumed to be representative of same building types in the DZ	CIBSE benchmarks are a UK data source based on energy consumption data gathered in the UK. The benchmarks do not reflect actual energy consumption in the DZ area but are considered a good proxy.	
	SEAI (national energy breakdown for commercial and public sector)	https://www.seai.ie/publications/Previous-Energy-Balances.xlsx	National fuel energy split was used, in conjunction with local knowledge and energy SME input to decide on the most relevant energy split for the commercial and public sector in Kilkenny DZ	The national energy split reflects energy consumption of the commercial and public sector at a national level. Although not an actual reflection of energy consumption at the DZ area level, it is a considered to be a good proxy.	
	SEAI Conversion Factors	https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/	Carbon intensity factors for each energy source	The SEAI conversion factors represent some of the most robust carbon benchmarks for fuel types in Ireland and would be considered a strong proxy for carbon calculations in the DZ	

4.3.2 Data Sources, Assumptions & Limitations: Non-Spatial Data

Sector	Data source name & description	Data source link	Data assumption	Data limitation	Overview of methodology used
Public Sector & KCC	MPRN & GPRN	Kilkenny County Council	Number of commercial buildings by sector in the DZ area reflecting the 2018 baseline year	MPRN and GPRN data for public sector buildings within the DZ was provided by KCC. A potential limitation could be the that the MPRN and GPRN data does not account for energy from other sources	The MPRN and GPRN data has been used to calculate the estimated energy consumption for each of the public sector buildings in the DZ area. SEAI Conversion Factors were used to convert these energy consumption figures to carbon emissions.
	SEAI Conversion Factors	https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/	Carbon intensity factors for each energy source	The SEAI conversion factors represent some of the most robust carbon benchmarks for fuel types in Ireland and would be considered a strong proxy for carbon calculations in the DZ	

4.3.3 Supporting Data: Commercial & Public Sector

Commercial & Public Sector: Energy & Carbon Emissions

Breakdown of commercial building types in the DZ area

Sector	Sum of area (m2)	Number
Health	579	11
Leisure	4,961	9
Retail (Shops)	109,095	575
Retail (Warehouse)	42,910	66
Fuel/ Depot	2,093	29
Hospitality	9,679	40
Industrial Uses	215,609	408
Office	35,251	363
Misc.	397	3
Total	**420,574**	**1,504**

Breakdown of BER of commercial buildings in the DZ area

Commercial building BER rating status	Number
No rating	56
BER rating	1,432
Total	**1,588**

4.3.3 Supporting Data: Commercial & Public Sector

Commercial & Public Sector: Energy & Carbon Emissions

Breakdown of public sector organisations (excluding Kilkenny County Council) in the MPRN data provided by Kilkenny County Council, broken down by consumption category

Organisation Name
Education Building
• GAELSCOIL OSRAI
• GORESBRIDGE NS
• Kilkenny & Carlow Education & Training Board
• Kilkenny College
• Kilkenny Education Centre
• KILKENNY MIXED N S
• KILKENNY SCHOOL PROJECT N.S.
• Loreto Secondary School Granges Road
• Meánscoil na mBráithre Criostaí
• MOTHER OF FAIR LOVE SPEC SCHOOL
• PRESENTATION CONVENT NATIONAL SCHOOL
• RehabGroup
• SCOIL MHUIRE PRESENTATION CONVENT
• SCOIL NAOMH EOIN DEA
• SOS Kilkenny Ltd.
• ST CANICE'S CO-ED N S
• ST JOHNS JUNIOR NS
• ST JOHNS SENIOR NS
• St Kierans College
• St. Senan's National School
• Waterford Institute of Technology
Healthcare Building
• Enable Ireland
• HSE
• Irish Wheelchair Association
• RehabGroup
• St. Patrick's Centre Kilkenny

Organisation Name
Office Building
• Allied Irish Banks plc
• Citizens Information Board
• Coillte Teoranta
• Courts Service
• Department of Agriculture, Food & the Marine
• Department of Culture, Heritage & the Gaeltacht
• Department of Employment & Social Protection
• Department of Enterprise, Trade and Employment
• Design & Crafts Council Ireland
• Health & Safety Authority
• Heritage Council
• HSE
• Legal Aid Board
• National Council for Special Education
• Office of Public Works
• Ordnance Survey Ireland
• Pobal
• Probation Service agency of Dept of Justice & Equality
• RehabGroup
• Revenue Commissioners
• SOS Kilkenny Ltd.
• Teagasc
• Voluntary Health Insurance Board.

Organisation Name
Other
• An Garda Síochána
• Enable Ireland
• Ervia (Business Services)
• Gas Networks Ireland
• Kilkenny County Council
Other Building
• An Post
• Defence Forces
• Electricity Supply Board
• Enable Ireland
• Fáilte Ireland
• Kilkenny College
• Office of Public Works
• SOS Kilkenny Ltd.
• Other Processing
• An Post
Public Lighting (Metered)
• IDA Ireland
Transport Buildings
• Iarnród Éireann / Irish Rail
Unknown
• Irish Water
Wastewater Treatment
• Irish Water

4.3.3 Supporting Data: Commercial & Public Sector

Commercial & Public Sector: Energy & Carbon Emissions

Breakdown of public sector organisations (excluding Kilkenny County Council) in the GPRN data provided by Kilkenny County Council, broken down by consumption category

Organisation Name
Education Building
• GAELSCOIL OSRAI
• Kilkenny & Carlow Education & Training Board
• Kilkenny College
• Kilkenny Education Centre
• KILKENNY MIXED N S
• KILKENNY SCHOOL PROJECT N.S.
• Loreto Secondary School Granges Road
• Meánscoil na mBráithre Criostaí
• S N PADRAIG NAOFA DE LA SALLE
• School of the Holy Spirit Special School
• SCOIL IOGNAID DE RIS
• SCOIL MHUIRE PRESENTATION CONVENT
• SCOIL NAOMH EOIN DEA
• SOS Kilkenny Ltd.
• ST JOHNS JUNIOR NS
• ST JOHNS SENIOR NS
• St Kierans College
• ST PATRICKS SCHOOL
• Waterford Institute of Technology
Healthcare Building
• HSE
• St. Patrick's Centre Kilkenny

Organisation Name
Office Building
• Allied Irish Banks plc
• An Garda Síochána
• Courts Service
• Department of Agriculture, Food & the Marine
• Department of Culture, Heritage & the Gaeltacht
• Department of Employment & Social Protection
• Department of Enterprise, Trade and Employment
• Heritage Council
• Kilkenny & Carlow Education & Training Board
• Legal Aid Board
• National Council for Special Education
• Office of Public Works
• Ordnance Survey Ireland
• Probation Service agency of Dept of Justice & Equality
• RehabGroup
• Revenue Commissioners
• Teagasc
• Voluntary Health Insurance Board.
Other
• Defence Forces
• SOS Kilkenny Ltd.
Other Building
• Citizens Information Board
• Enable Ireland
• HSE
• Kilkenny College
• Office of Public Works

Organisation Name
Other Processing
• An Post
Transport Building
• Iarnród Éireann / Irish Rail

4.3.3 Supporting Data: Commercial & Public Sector

Commercial & Public Sector: Energy & Carbon Emissions

Breakdown of public sector organisations (excluding Kilkenny County Council) in the MPRN data provided by Kilkenny County Council, broken down by consumption category

Organisation Name
Education Building
• BRANCH LIBRARY KILKENNY STREET BRANCH LIBRARY N/A
• COUNTY LIBRARY JOHN STREET N/A
• LIBRARY PREMISES LOUGHBOY SHOPPING CENTRE N/A
• THE LIBRARY JOHNS QUAY N/A
• THE TRAINING CENTRE HEBRON ROAD N/A
• TRAINING CENTRE WETLANDS HALTING SITE N/A
• Unit 1 Library Ferrybank Shopping Centre, KK
IW Pumping/ Water Treatment
• Booster Pump at IDA, Loughboy
• DRAKELANDS PUMP STATION N/A
• Firhouse, Wallslough, Co. Kilkenny.
• Hebron Industrial Estate
• PUMPHOUSE MAUDLIN STREET N/A
• PUMPHOUSE OUTRATH N/A
• Pumphouse Ring Road KK
• Pumphouse, Ashley Court, Callan Rd
• PUMPING STATION CANAL WALK N/A
• Troyswood, Freshford Rd.
• Water Pump, Lios na Si, Foulkstown
• WATER TREATMENT WORKS TROYSWOOD N/A

Organisation Name
IW Wastewater Treatment
• DRAINAGE SCHEME PURCELLSINCH SION ROAD N/A
• Kiosk for Pumping Station, Sion Rd KK
• MARKET YARD
• Pumphouse Springfields, Waterford Rd
• Pumping Station Johns Quay
• SEWAGE PUMPING STATION TALBOTSINCH VILLAGE N/A
• SEWER PUMP LOUGHBOY N/A
• SEWERAGE PUMP, Sion Road
• Waterford Road, Kilkenny (Pumphouse on Green)
Office Building
• 1 DEAN STREET N/A
• 13 Jacob St
• 42 Parliament St
• 5 Dean St
• Butts Green
• City Hall, High Street
• COUNTY HALL JOHN STREET N/A
• Johns Green House
• SHEE ALMS HOUSE ROSE INN ST KILKENNY
• The Maltings Unit 13 Tilbury Place Kilkenny

Organisation Name
Other
• Christmas Lighting Butter Slip High St Kilkenny Co. Kilkenny
• Christmas Lighting Butter Slip Kieran St Kilkenny Co. Kilkenny
• Christmas Lighting Carrig Donn High St Kilkenny Co. Kilkenny
• Christmas Lighting Parliament Street Kilkenny Co. Kilkenny
• Christmas Lighting; Opp Argus High St Kilkenny Co. Kilkenny
• Christmas Lights Marble City Br Kieran Street Kilkenny Co. Kilkenny
• HALTING SITE HEBRON ROAD HEBRON ROAD N/A
• Old Swimming Pool
• PAVILION NEWPARK LOWER N/A
• Public Toilet Block Low Street Thomastown Co. Kilkenny
• St. MARYS CATHEDRAL
• Unit1 Hebron Industrial Estate 59 Hebron Road Kilkenny Co. Kilkenny
• WETLANDS HALTING SITE WETLANDS N/A
Other Building
• 1 Johns Green, Kilkenny
• 11 Gaol Road
• 29 Kieran's Street
• 75 JOHN STREET N/A

Organisation Name
Other Building (cont..)
• 76 JOHN STREET LOWER N/A
• CIVIL DEFENCE STORE WOLFE TONE STREET N/A
• County Council Yard St Joesphs Rd
• Evans Home Green House
• Events The Parade Kilkenny Co. Kilkenny
• FIRE STATION FAIRSTATION FAIR GREEN N/A
• Freshford, Fire Station
• Kiosk, The Parade
• MACHINERY YARD HEBRON INDUSTRIAL ESTATE MACHINERY YARD N/A
• OLD FIRE STATION MAUDLIN STREET N/A
• St Francis Abbey Brewery Parliament Street Kilkenny Co. Kilkenny
• St Mary's Hall
• Stores-Gaol Road
• UNIT 2 59 HEBRON ROAD HEBRON ROAD
• Unit B Purcellsinch Industrial Estate Kilkenny Co. Kilkenny
• Watergate Theatre
• WaterShed Leisure Centre
• Weights & Measures Market Yard
• Workshop St Joesphs Rd
Public Lighting (Metered)
• Multiple locations

Organisation Name
Public Lighting (Un-metered)
• Multiple Locations
Waste Processing
• DUNMORE LANDFILL DUNMORE VILLAGE N/A
• Dunmore Recycling Wast. Disp. Ctr. Dunmore

4.3.4 Supporting Data: Commercial & Public Sector

Commercial & Public Sector: Energy & Carbon Emissions

Energy benchmarks used for commercial buildings types in the DZ area

Building type	Typical practice fossil fuels (kWh/m2)	Typical practice electricity (kWh/m2)
Retail	108	287
Office	151	85
Restaurant/ public house	1250	730
Hotel	400	140
Warehouses	169	67
Workshops/ maintenance depot	311	39
Industrial process building	96	0
Hospitals and primary health care	267	113
Community/ day centre	139	47
Nursing residential homes and hostels	337	83
Schools and colleges	111	41
Sports facilities	598	152
Church	150	20
Sports ground changing facility	216	164
Police Station	164	143
Fire station	173	83
Town Hall	159	101
Car Park (enclosed)	0	15
Other	333	162
Department Stores	248	294
Banks and building societies	98	101
Cinema	620	160
Courts (combined County/Crown)	122	82
Library	106	69
Post offices	210	70
Ambulance station	460	70
Museum	109	72
Theatre	237	202

National Commercial and Public Sector energy consumption breakdown

Fuel split in commercial sector	Commercial/Public Services	%	% fossil fuel only
Coal	0.52	0.03%	0.09%
Oil	240.87	14.27%	39.52%
Natural Gas	328.62	19.47%	53.92%
Renewables	39.43	2.34%	6.47%
Electricity	1,078.74	63.90%	-
Total	**1,688.18**	**100.00%**	**100.00%**

Carbon emissions factors

Energy source	gCO_2/kWh
Oil	274
Coal	341
Natural Gas	205
Electricity	375
Renewables	0

4.4 Transport

4.4.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Transport	Transport Carbon Emissions	https://projects.au.dk/mapeire/spatial-results/download	MapEire modelled transport carbon emissions	No limitation in data set. Additional information on the data source can be found here: https://projects.au.dk/mapeire/spatial-results
	POWSCAR (Place of Work, School or College)	Census 2016 Place of Work, School or College - Census of Anonymised Records (POWSCAR) - CSO - Central Statistics Office	Commuting and Carbon Emissions	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.
	Bus Stops	Data.gov.ie	Bus stops Locations	No limitation in data set.

4.4.2 Data Sources, Assumptions & Limitations: Non-Spatial Data

Sector	Data source name & description	Data source link	Data assumption	Data limitation	Overview of methodology used
Transport	Transport Omnibus	https://www.cso.ie/en/statistics/transport/transportomnibus/	Number of vehicles licenced by end of 2018 in Kilkenny.	Number of vehicles for Kilkenny County have only been made available. To estimate number of vehicles in the DZ area, total numbers have been proportioned down based on population.	To estimate transport emissions in the DZ area number of vehicles by vehicle type has been combined with transport energy split provided by SEAI to understand energy consumption by transport mode. This energy consumption has then been converted into carbon emissions using robust SEAI factors. Note that this assessment accounts for vehicles owned and licenced within the area and does not reflect all transport movements within the DZ area.
	SEAI National Energy Balance	https://www.seai.ie/publications/Previous-Energy-Balances.xlsx	Total energy consumed per transport mode presented by energy source	Representative of national data rather than the DZ area.	
	SEAI Conversion Factors	https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/	Carbon intensity factors for each transport energy source	n/a	
	POWSCAR (Place of Work, School or College)	Census 2016 Place of Work, School or College - Census of Anonymised Records (POWSCAR) - CSO - Central Statistics Office	Commuting patterns into and out of the DZ area to surrounding EDs for work, school and college. Trips are assumed to be daily, single trips.	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.	To estimate carbon emissions associated with commuting patterns in the DZ area, POWSCAR data has been relied upon to understand distances travelled from start to end point by residents travelling in and out of the DZ area. Distances have been applied to the travel mode split typical of the DZ area. Total distances by travel mode have then been converted into carbon emissions using robust UK Government factors.
	CSO	https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics	Travel modes for work, school and college for residents of the DZ area	2016 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2016 data is deemed a reasonable proxy for 2018.	
	CSO	https://www.cso.ie/en/releasesandpublications/er/vlftm/vehicleslicensedforthefirsttimedecemberandyear2018/	Private car fuel split	n/a	
	UK Government Conversion Factors	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715426/Conversion_Factors_2018_-_Full_set__for_advanced_users__v01-01.xls	Carbon intensity factors for each transport mode	n/a	

4.4.3 Supporting Data: Transport Sector

Transport Sector: Energy & Carbon Emissions

Licenced vehicles in the DZ area in 2018

Licenced vehicles categories (Transport Omnibus)	DZ area (number)*	Kilkenny county council (number)
Road Freight	31	110
Road Light Goods Vehicle	3,942	14,205
Road Private Car	12,531	45,152
Public Passenger Services	157	567
Total	**16,661**	**60,034**

**~28% of Kilkenny county council residents reside in the DZ area. Numbers of licenced vehicles in the DZ area have been estimated by multiplying Kilkenny county council licenced vehicles (made available by the CSO Transport Omnibus) by 28% to reflect likely licenced vehicles numbers in the DZ area.*

Carbon emissions factors

Energy source	gCO_2/kWh
Gasoline	251.9
Gasoil / Diesel /DERV	263.9
LPG	229.3
Natural Gas	204.7
Electricity	375.2

National Transport Energy consumption broken down by transport mode and energy source. ***Note that 'Oil' is a sum of 'Gasoline', 'LPG', 'Gasoil/Diesel/DERV' and 'Renewables' is a sum of 'Biodiesel' and 'Bioethanol'. These 'sub-categories' are included in italics below for completeness.***

	Energy consumption (MWh)									
Transport mode	**Oil**	***Gasoline***	***LPG***	***Gasoil / Diesel /DERV***	**Natural Gas**	**Renewables**	***Biodiesel***	***Bioethanol***	**Electricity**	**Total**
Road Freight	8,182,762	-	-	*8,182,762*	346	350,788	*350,788*	-	-	8,533,895
Road Light Goods Vehicle	3,828,407	-	-	*3,828,407*	-	164,120	*164,120*	-	-	3,992,528
Road Private Car	23,129,880	*7,845,370*	*21,540*	*15,262,970*	-	914,095	*654,310*	*259,785*	12,389	24,056,364
Public Passenger Services	1,537,385	*75,657*	-	*1,461,728*	-	65,168	*62,663*	*2,505*	-	1,602,553
Total	**36,678,434**	***7,921,027***	***21,540***	***28,735,867***	**346**	**1,494,171**	***1,231,881***	***262,290***	**12,389**	**38,185,340**

4.4.5 Supporting Data: Transport Sector

Transport Sector: Energy & Carbon Emissions

DZ area energy consumption broken by transport mode and energy source. ***Note that 'Oil' is a sum of 'Gasoline', 'LPG', 'Gasoil/Diesel/DERV' and 'Renewables' is a sum of 'Biodiesel' and 'Bioethanol'. These 'sub-categories' are included in italics below for completeness.***

	Energy consumption (MWh)									
Transport mode	**Oil**	***Gasoline***	***LPG***	***Gasoil / Diesel /DERV***	**Natural Gas**	**Renewables**	***Biodiesel***	***Bioethanol***	**Electricity**	**Total**
Road Freight	64,497	-	-	*64,497*	2.7	2,765	*2,765*	-	-	67,264.7
Road Light Goods Vehicle	28,012	-	-	*28,012*	-	1,201	*1,201*	-	-	29,213
Road Private Car	135,021	*45,798*	*126*	*89,098*	-	5,336	*3,820*	*1,517*	72	140,429
Public Passenger Services	7,472	*368*	-	*7,104*	-	317	*305*	*12*	-	7,789
Total	**235,002**	***46,166***	***126***	***188,712***	**2.7**	**9,619**	***8,091***	***1,529***	**72**	**244,695.7**

DZ area carbon emissions broken by transport mode and energy source. ***Note that 'Oil' is a sum of 'Gasoline', 'LPG', 'Gasoil/Diesel/DERV' and 'Renewables' is a sum of 'Biodiesel' and 'Bioethanol'. These 'sub-categories' are included in italics below for completeness.***

	Carbon emissions (tCO_2e)									
Transport mode	**Oil**	***Gasoline***	***LPG***	***Gasoil / Diesel /DERV***	**Natural Gas**	**Renewables**	***Biodiesel***	***Bioethanol***	**Electricity**	**Total**
Road Freight	17,021	-	-	*17,021*	0.6	-	-	-	-	17,022
Road Light Goods Vehicle	7,392	-	-	*7,392*	-	-	-	-	-	7,392
Road Private Car	35,078	*11,536*	*29*	*23,513*	-	-	-	-	27	35,105
Public Passenger Services	1,968	*93*	-	*1,875*	-	-	-	-	-	1,967
Total	**61,459**	***11,629***	***29***	***49,801***	**0.6**	**-**	**-**	**-**	**27**	**61,487**

4.4.6 Supporting Data: Transport Sector

Transport Sector: Energy & Carbon Emissions

Transport mode to work or school in the DZ area in 2018

Transport Mode	Total %
On foot	14%
Bicycle	1%
Bus minibus or coach	6%
Train DART or LUAS	1%
Motorcycle or scooter	1%
Car driver (made up of below)	71%
Diesel	45%
Petrol	21%
Plug-in Hybrid Electric Vehicle	4%
Battery Electric Vehicle	1%
Hybrid	0%
Van	4%
Work mainly at or from home	2%
Total	100%

Carbon emissions factors

Transport Mode	Carbon factor (kg CO_2e/pass.km or kg CO_2e/km)
On foot	-
Bicycle	-
Bus minibus or coach	0.10
Train DART or LUAS	0.04
Motorcycle or scooter	0.12
Diesel	0.18
Petrol	0.18
Plug-in Hybrid Electric Vehicle	0.12
Battery Electric Vehicle	0.07
Hybrid	0.13
Van: Diesel	0.26

Bus operators & total bus stops

Bus Operators	Total Bus Stops
City Direct	63
Buggy	9
Bkavanagh	5
Mkilbride	4
SRO	4
Bus Eireann	3
Dublin Coach	3
Kenneallys	2
Sbloom	2
Grand Total	**95**

Private car fuel type, national data

Fuel type	Petrol	Diesel	Electric	Hybrid	Other	Total
% of private cars using fuel type	29%	64%	1%	6%	0%	100%

4.5 Agriculture

4.5.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Agriculture	Agriculture Carbon Emissions	https://projects.au.dk/mapeire/spatial-results/download	MapEire modelled agriculture carbon emissions	No limitation in data set. Additional information on the data source can be found here: https://projects.au.dk/mapeire/spatial-results

4.5.2 Data Sources, Assumptions & Limitations: Non-Spatial Data

Sector	Data source name & description	Data source link	Data assumption	Data limitation	Overview of methodology used
Agriculture	CSO & Department for Agriculture, Food and the Marine (DAFM)	https://data.gov.ie/dataset/dafm-2020-average-beef-and-dairy-herds-per-electoral-division?package_type=dataset https://data.cso.ie/	Number of Livestock broken down by livestock type	2020 data is used to reflect 2018 baseline year. This is due to no 2018 specific data being made available. 2020 data is deemed a reasonable proxy for 2018	Total livestock numbers have been combined with: • Teagasc's methane emissions benchmarks to estimate enteric fermentation related emissions in the DZ area • Defra estimated energy consumption benchmarks
	Teagasc	https://www.teagasc.ie/environment/climate-change--air-quality/methane/	Methane emissions benchmarks representing beef cattle and dairy cow enteric fermentation (gCH_4/beef cattle/day & gCH_4/dairy cow/day)	n/a	
	Defra	n/a	Carbon dioxide emissions benchmarks representing beef cattle and dairy cow on-farm diesel consumption and electricity use (kWh/beef cattle/month, kWh/dairy cow/month, litres/beef cattle/month, litres/dairy cow/month)	n/a	
	Ireland's Provisional Greenhouse Gas Emissions, EPA	https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/GHG_Final-emissions-data_1990-2021_AR5_Web.xlsx	National carbon emissions breakdown for agricultural by emissions source	n/a	The EPA's 2018 annual carbon emissions data has been used to understand the % contribution of each agriculture emissions source to total national agriculture carbon emissions. This % contribution has been used to uplift emissions in the DZ area to estimate total carbon emissions in the DZ area.
	SEAI Conversion Factors	https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/	Carbon intensity factor for electricity grid	n/a	This energy consumption has then been converted into carbon emissions using robust SEAI and UK Government carbon factors.
	UK Government Conversion Factors	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715426/Conversion_Factors_2018_-_Full_set__for_advanced_users__v01-01.xls	Carbon intensity factor for diesel use	n/a	
	Global Warming Potentials (GWPs) over 100 Year time period	https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_07_Supplementary_Material.pdf	GWP is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given period of time, relative to the emissions of 1 tonne of carbon dioxide. It allows for comparisons of global warming impacts of different greenhouse gases.	n/a	IPCC GWP100 conversion factors have been applied to methane emissions to convert to carbon dioxide equivalent.

4.5.3 Supporting Data: Agricultural Sector

Agricultural Sector: Enteric fermentation related emissions

Dairy Cows (CH4)

ED	Dairy Cattle	High	High g CH4/Year	High t CH4/Year	High tCO2e
Dunmore	529	174,570	63,718,050	64	1,778
Kilkenny No. 1 Urban	-	-	-	-	-
Kilkenny No. 2 Urban	-	-	-	-	-
Kilkenny Rural	1,554	512,820	187,179,300	187	5,222
Total	**2,083**	**687,390**	**250,897,350**	**251**	**7,000**

Dairy Cows benchmarks (550kg Dairy cow grazing on pasture)

	gCH4/day
Low	320
High	330

Source: https://www.teagasc.ie/environment/climate-change--air-quality/methane/

4.5.4 Supporting Data: Agricultural Sector

Agricultural Sector: Enteric fermentation related emissions

Beef Cattle (CH4)

ED	Beef Cattle	g CH4/day	g CH4/year	t CH4/year	tCO2e
Dunmore	932	214,245	78,199,425	78	2,182
Kilkenny No. 1 Urban	-	-	-	-	-
Kilkenny No. 2 Urban	-	-	-	-	-
Kilkenny Rural	2,870	659,985	240,894,525	241	6,721
Total	**3,802**	**874,230**	**319,093,950**	**319**	**8,903**

Beef Cattle benchmarks (500kg Beef animal on a high concentrate diet)

	gCH4/day
Low	230

Source: https://www.teagasc.ie/environment/climate-change--air-quality/methane/

4.5.6 Supporting Data: Agricultural Sector

Agricultural Sector: Energy related emissions

Dairy Cows (CO2)

ED	Dairy Cattle	kWh electricity	kWh mobile machinery	Total kWh	Electricity related carbon emissions tCO2e	Mobile machinery related carbon emissions tCO2e	Total carbon emissions tCO2e
Dunmore	529	171,925	290,950	462,875	65	77	142
Kilkenny No. 1 Urban	-	-	-	-	-	-	-
Kilkenny No. 2 Urban	-	-	-	-	-	-	-
Kilkenny Rural	1,554	505,050	854,700	1,359,750	189	226	415
Total	**2,083**	**676,975**	**1,145,650**	**1,822,625**	**254**	**303**	**556**

Dairy Cows energy benchmarks

Agricultural Benchmarks	Unit	Electricity	Heat	Mobile Machinery	Total	Country	Source	Year
Dairy Cows	kWh/livestock/yr	325	0	550	875	UK	DEFRA	2010

4.5.7 Supporting Data: Agricultural Sector

Agricultural Sector: Energy related emissions

Beef Cattle (CO2)

ED	Beef Cattle	kWh mobile machinery	Mobile machinery related carbon emissions tCO2e
Dunmore	932	421,970	111
Kilkenny No. 1 Urban	-	-	-
Kilkenny No. 2 Urban	-	-	-
Kilkenny Rural	2,870	1,299,884	343
Total	**3,802**	**1,721,854**	**454**

Beef Cattle energy benchmarks

Agricultural Benchmarks	Unit	Electricity	Heat	Mobile Machinery	Total	Country	Source	Year
Beef Cattle	kWh/livestock/yr	0	0	453	453	UK	DEFRA	2007

4.6 : LULUCF

4.6.1 Supporting Data: LULUCF

LULUCF Soil Types (CORINE)

DZ Area Soil Types	Area (Hectares)	% of Total Area
Shallow well drained mineral (Mainly basic)	828.72	41.24%
Made ground	664.39	33.07%
Deep well drained mineral (Mainly acidic)	316.19	15.74%
Alluvial (mineral)	102.32	5.09%
Mineral poorly drained (Mainly acidic)	47.15	2.35%
Deep well drained mineral (Mainly basic)	40.20	2.00%
Fen peat	7.16	0.36%
Lacustrine type soils	2.67	0.13%
Shallow well drained mineral (Mainly acidic)	0.56	0.03%
Total	**2009.34**	**100.00%**

LULUCF land cover Types (National Land Cover Map)

DZ Area Land Use Types	Area (Hectares)	% of Total Area
Improved Grassland	543.73	27.06%
Other Artificial Surfaces	373.54	18.59%
Cultivated Land	232.02	11.55%
Amenity Grassland	167.13	8.32%
Buildings	156.11	7.77%
Ways	136.41	6.79%
Broadleaved Forest and Woodland	129.35	6.44%
Hedgerows	79.30	3.95%
Dry Grassland	42.79	2.13%
Scrub	33.86	1.69%
Treelines	32.65	1.62%
Rivers and Streams	27.36	1.36%
Bare Soil and Disturbed Ground	23.48	1.17%
Lakes and Ponds	10.28	0.51%
Wet Grassland	9.38	0.47%
Mixed Forest	8.92	0.44%
Coniferous Forest	2.27	0.11%
Artificial Waterbodies	0.51	0.03%
Transitional Forest	0.27	0.01%
Grand Total	**2009.34**	**100.00%**

4.7 : Energy & Electricity

4.7.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Energy & Electricity	Total Heat Demand with Building Use	https://gis.seai.ie/server/servicesl	Heat Demand and Geodirectory Building Use Locations	No limitation in data set. Additional information on the data source can be found here: Map Of Heat Demand In Ireland | SEAI GIS Maps | SEAI
	Power Lines and Substations Locations	https://gis.seai.ie/server/services	Power Lines and Substations Locations	No limitation in data set.
	Electric Vehicle Charging Points	Data.gov.ie	Electric Vehicle Charging Points	No limitation in data set.

4.8: Waste

4.8.1 Data Sources, Assumptions & Limitations: Spatial Data

Sector	Data source	Data source link	Data assumption	Data limitation
Waste	Waste Facilities and Wastewater Treatment Plants	https://gis.epa.ie/arcgis/services	Waste Facilities and Wastewater Treatment Plants	No limitation in dataset.

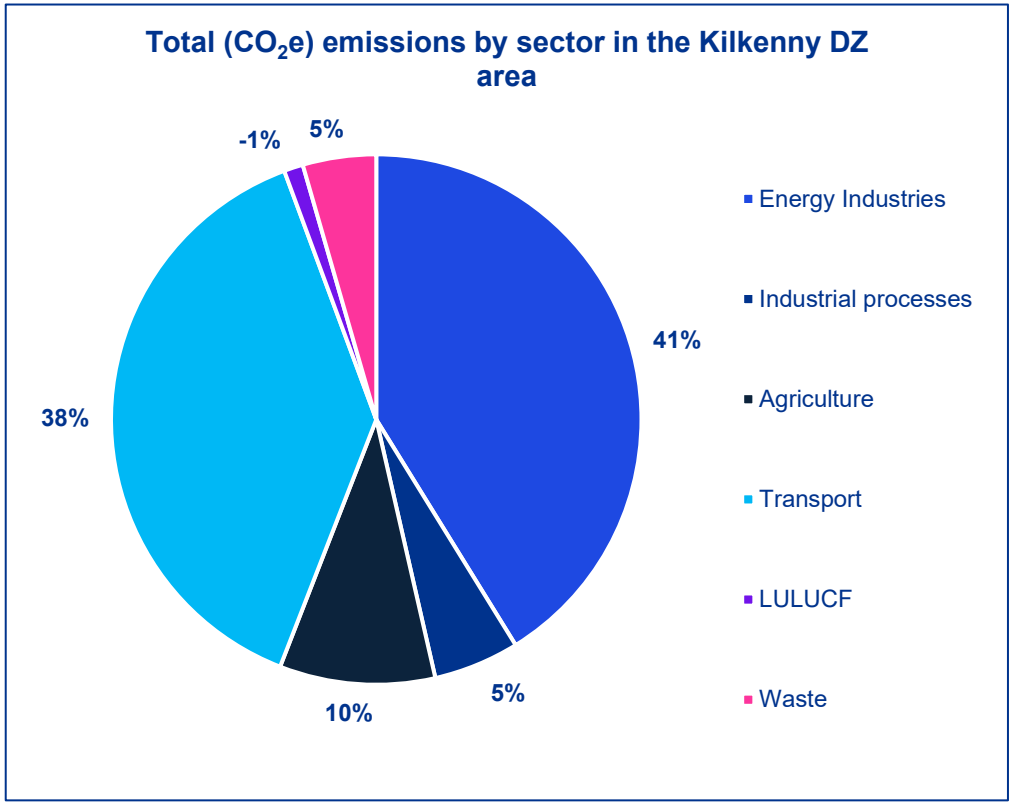
4.9 : 'Top-down' Assessment Results

4.9.1 Supporting Data: 'Top-down' Assessment Results

Top-Down Assessment of the DZ area

The EPA's MapEire database has been used to inform a 'top-down' assessment of carbon emissions within the DZ area – the results of this 'top-down' analysis are shown on the chart and table below.

Note that the MapEire database does not include analysis of residential and commercial and public sector. Note that the majority of emissions associated with Energy Industries are associated with electricity generation rather than consumption of energy.



Sector	Total tCH_4	Total tCO_2	Total tN_2O	Total tCO_2e
Energy Industries	495	37,560	84	**38,140**
Industrial processes	14	4,597	233	**4,844**
Agriculture	6,015	217	2,552	**8,783**
Transport	44	35,208	352	**35,604**
LULUCF	95	-1,659	482	**-1,082**
Waste	2,458	0	1,683	**4,141**
Total	**9,120**	**75,922**	**5,387**	**90,430**