BASELINE EMISSIONS INVENTORY

ARAN ISLANDS DECARBONISATION ZONE

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Comhairle Chontae na Gaillimhe
Galway County Council

CARO

Contents

Glossary of terms

AR6	Sixth Assessment Report
BEI	Baseline Emissions Inventory
BER	Building Energy Rating
CAP23	Climate Action Plan 2023
CFOAT	Comharchumann Fuinnimh Oileáin Árann Teoranta
CRF	Common Reporting Format
CO_2	Carbon Dioxide
CoR	Certificates of Registration
CSO	Central Statistics Office
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GVA	Gross Value Added
GWP	Global Warming Potential
$ktCO_2e$	Kilotonne Carbon Dioxide Equivalent
LA	Local Authority
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
M&R	Monitoring and Reporting
NAEI	National Atmospheric Emissions Inventory
NFR	Nomenclature for Reporting
NIR	National Inventory Report
NTA	National Transport Authority
SEAI	Sustainable Energy Authority Ireland
SECAP	Sustainable Energy and Climate Action Plan
UNFCCC	United Nations Framework Convention on Climate Change
WFP	Waste Facility Permits

1 Executive Summary

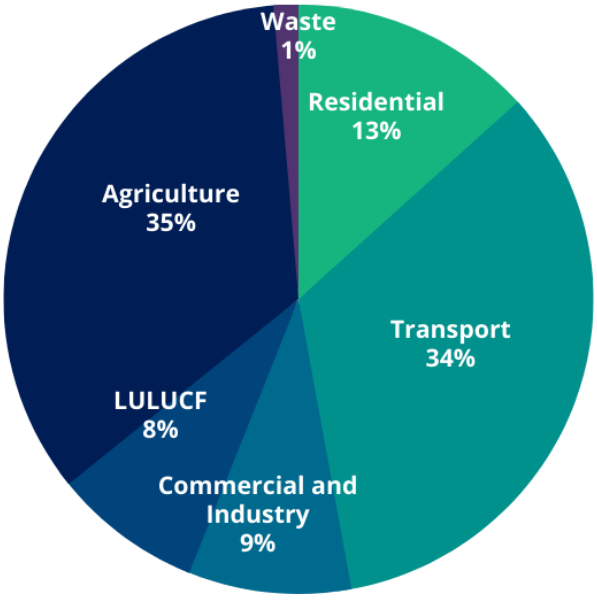
Local Authorities (LAs) can play a significant role in addressing climate change by developing comprehensive Local Authority Climate Action Plans to combat greenhouse gas (GHG) emissions within their jurisdictions. These plans are evidence-based and intended to produce measurable impacts over time. To enable this process, Baseline Emissions Inventories (BEI) serve as a critical tool for LAs, helping them design climate action plans and assess the effectiveness of emission reduction efforts across targeted sectors and their own operations.

Under government directives, each local authority has been tasked with selecting a pilot decarbonisation zone (DZ) to assess the feasibility and scope of decarbonising the economy and society. In this context, Galway County Council has designated the Aran Islands as their DZ.

This report presents the results of the BEI conducted for the Aran Islands DZ on behalf of Galway County Council. It provides a detailed breakdown of emissions by sector within the zone and offers specific contextual information related to these sectors.

The BEI draws from multiple data sources to calculate emissions in various sectors. The Residential, Non-residential, and Transport sectors were assessed using data from the joint 2018 Energy Master Plan (EMP) for Árainn and Inis Meáin, as well as the 2020 EMP for Inis Oírr. Galway County Council is very grateful to the local Sustainable Energy Communities who developed these plans as they have significantly helped in developing this BEI. For the Agriculture and Land Use, Land Use Change, and Forestry (LULUCF) sectors, a dataset from 2019 provided by the Environmental Protection Agency (EPA) called MapEIre was utilised, which spatially mapped GHG emissions across Ireland. Waste sector emissions were determined by employing the MapEIre dataset for waste processed on the islands, supplemented by a conversion factor derived from national waste emissions data for waste processed off the islands. Additionally, F-gas emissions and emissions generated by the Local Authority were inventoried separately to provide a comprehensive overview. The GHG emissions for the Aran Islands DZ for the base year 2019 totalled 15,435 tCO_2e.

Emissions Category	Aran Islands DZ Emissions $ktCO_2e$	County Galway Emissions $ktCO_2e$	National Emissions $ktCO_2e$
Residential	2.15 (13%)	450 (15%)	9,552 (15%)
Transport	5.45 (34%)	478 (15%)	12,196 (19%)
Commercial and Industry	1.44 (9%)	239 (8%)	13,622 (21%)
LULUCF	1.32 (8%)	478 (20%)	6,899 (10%)
Agriculture	5.56 (35%)	1,132 (43%)	22,134 (34%)
Waste	0.22 (1%)	27 (1%)	991 (1%)
Total	16.13 (100%)	2,631 (100%)	65,152 (100%)



This Baseline Emissions Inventory for the Aran Islands Decarbonisation Zone serves as a critical starting point for Galway County Council's efforts to reduce GHG emissions in this pilot area. By quantifying emissions in various sectors and understanding the sources, the council aims to support the local communities through developing a data-driven action plan.

2 Introduction

Climate Action at the Local Authority level stands as a pillar of Ireland's policy landscape, underscored by such documents as the National Climate Action Plan 2023 (CAP23) and the Climate Action Charter 2019. Efforts to act against climate change necessitate immediate action, and Local Authorities (LA) are spearheading initiatives within their jurisdictions. As part of CAP23, local authorities have a mandate to release Local Authority Climate Action Plans, which will consist of evidence-informed targeted actions. For this, it is necessary to have a comprehensive understanding of the current state of emissions in each jurisdiction and identify emission sources the Action Plan should target and how.

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

In Ireland, one element of this plan is the implementation of decarbonisation zones (DZ). In DZs, policy experiments to reduce emissions influenced by local contexts in areas delineated by LAs can be performed and scaled up.[2] The guidelines for developing DZs are broad LAs and allow for strong stakeholder engagement, especially of marginalised groups.

The LAs in County Galway have established a DZ on the Aran Islands, a chain of three inhabited islands situated in the Atlantic Ocean off the western coast of the county with a predominantly Irish-speaking population of 1,226 people. The islands are also a popular tourism destination, with the largest island receiving 250,000 tourists annually.[3]

Galway County Council is taking the necessary steps towards contributing to the state's climate goals and to take action to adapt and mitigate the effects of climate change by working as an implementing body with local communities, businesses, and the national government. To inform these actions, Galway County Council has developed a Baseline Emissions Inventory (BEI) report using the year 2019 for the Aran Islands DZ. The BEI report measures the amount of greenhouse gases emitted in the baseline year and provides a sectoral breakdown of the results. The BEI report is based on local data from GHG emitting activities, such as energy production and consumption statistics as well as other information that reflects local GHG emission conditions.

The purpose of this BEI report is to calculate the emissions in the DZ and analyse the sources. This will provide an evidence base for the LA to further calibrate mitigation objectives and targets. A thorough understanding of local energy use and greenhouse gas emission circumstances will serve as the foundation for developing the Local Authority's climate action plan regarding the DZ. The BEI report is based on local data provided in the Energy Master Plans and the Local Authorities and national data from 2019, on energy production and consumption and other GHG emissions in the DZ and contains insights into Galway County Council's emissions. The national emission reduction target of 51% by the end of 2030 is based on the greenhouse gas emissions reported for the end of 2018, in the national greenhouse gas emissions inventory. Accordingly, the collation of data to inform the local authority BEI should be relative to the baseline year of 2018, or as close to 2018 as possible. The closest year to 2018 for the primary dataset for this BEI, MapEIre, is 2019, thus all calculations were made for 2019.

[1] https://climate.ec.europa.eu/eu-action/climate-strategies-targets_en
[2] https://assets.gov.ie/250052/0c6e5d22-616d-4b19-bfe1-09ae5653af66.pdf
[3] Community Development Framework Guidance

Baseline Emissions Inventory Results

Aran Islands Decarbonisiation Zone

3 Aran Islands Profile

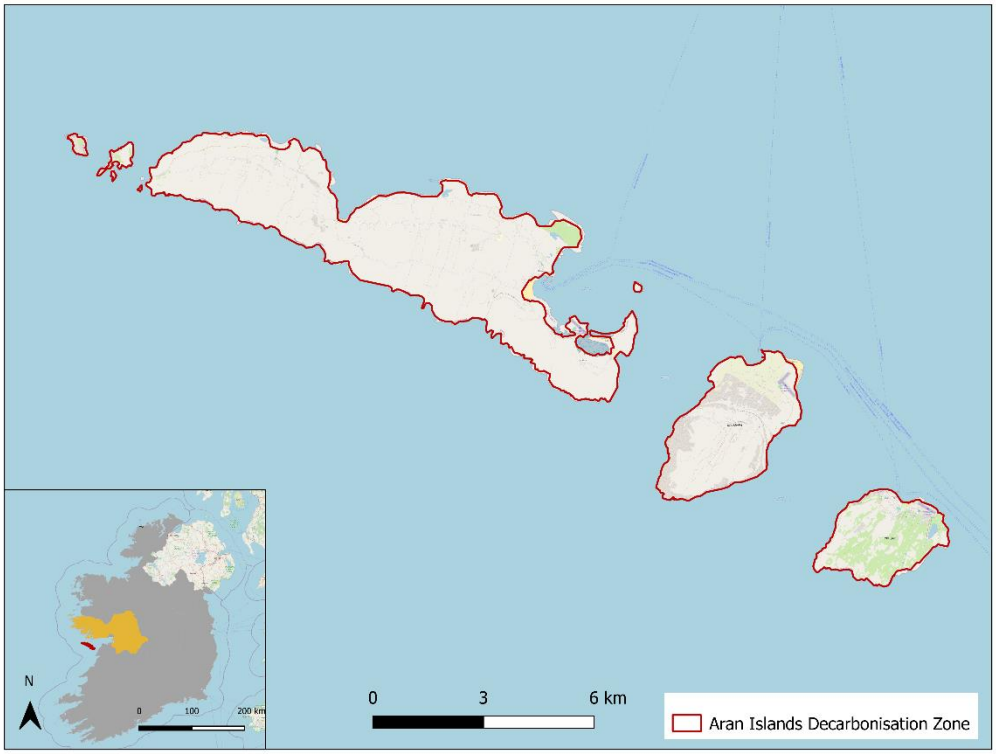


Figure 1 Map of the Aran Islands Decarbonisation Zone

This report presents an analysis of 2019 GHG emissions within the Aran Islands Decarbonisation Zone. The Aran Islands are a group of karst limestone islands located approximately 20 km from the coast of

County Galway in the Atlantic Ocean. They are geographically similar to the Burren region.[4] The group's three constituent islands will be the focus of this report: Árainn (Inis Mór), Inis Meáin, and Inis Oírr. The islands have been inhabited since the Stone Age, and are the site of ruins of forts, graveyards, churches, and other structures. The total population of the islands as of the 2016 census is 1,226, just less than 0.5% of the total county population.[5] The islands have an ageing population: 20% of islanders are over the age of retirement and 12% are under the age of 15.[6] In County Galway, 14.5% of the population is over retirement age and 22.6% is under the age of 15.

The Aran Islands are part of the Galway Gaeltacht, one of several regions in which Irish is the predominant language in everyday life.[7] All three islands promote the use of the Irish language and more than 80% of residents are Irish-speaking.

Many residents of the islands are employed in the tourism industry, with the islands receiving 270,000 to 300,000 tourists annually. Most tourists visit on day trips, in part due to limited available accommodations.[8] There has been a recent shift further away from the traditional industry on the islands of agriculture and fishing towards tourism, especially as year-round tourism gains traction.

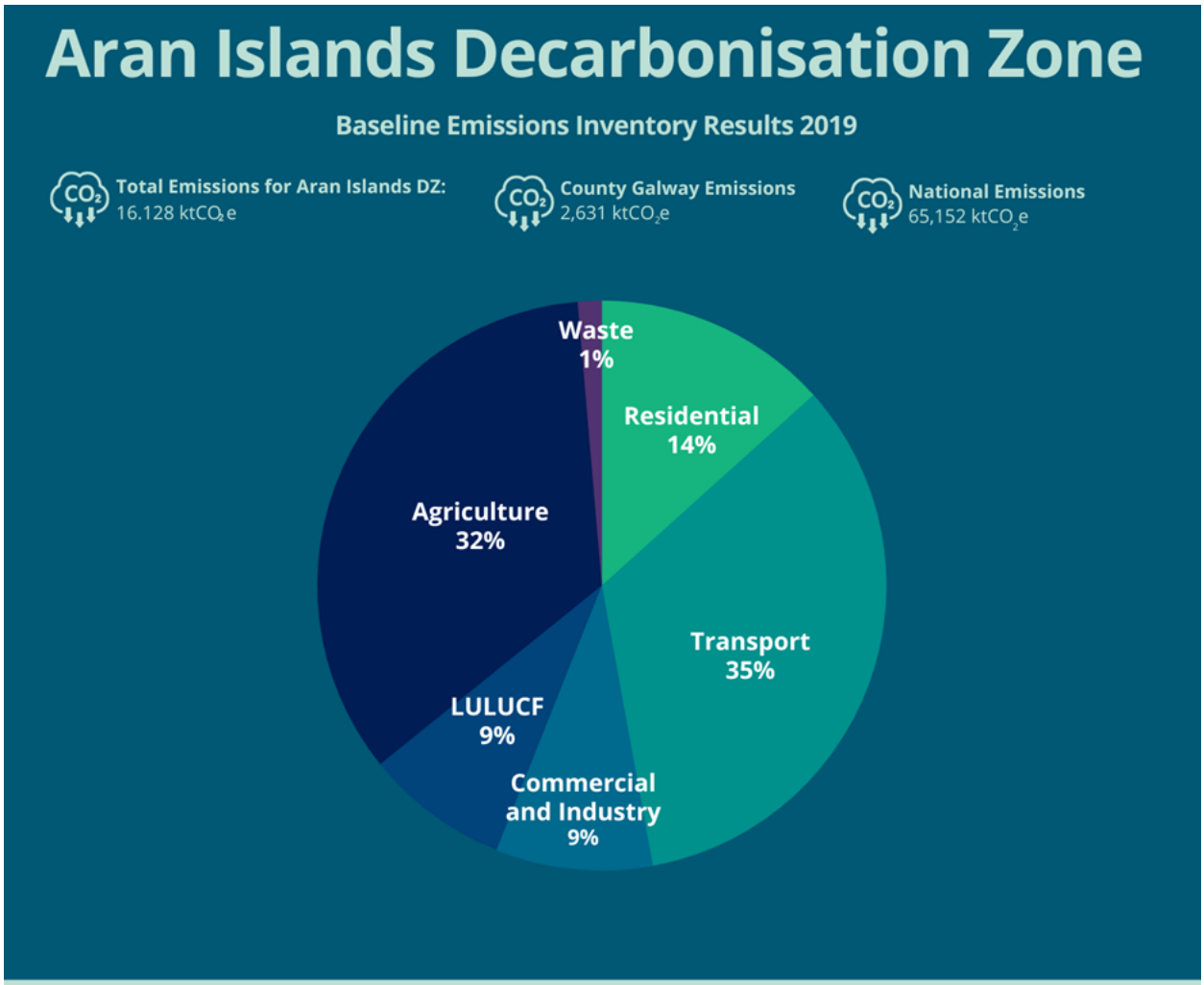
The Aran Islands hold Natura 2000 status, and 75% of their land area is designated as Special Areas of Conservation.[9] This designation signals that there is landscape sensitivity and places limits on development but does make allowances to meet local housing needs.

The islands are home to Comharchumann Fuinnimh Oileáin Árann Teoranta (CFOAT), a community-owned energy cooperative. CFOAT aims to stabilise and increase the population of the islands; maintain their cultural heritage and language; protect and enhance the local environment; and increase the comfort, energy efficiency, and sustainability, of island homes and transportation.[10]

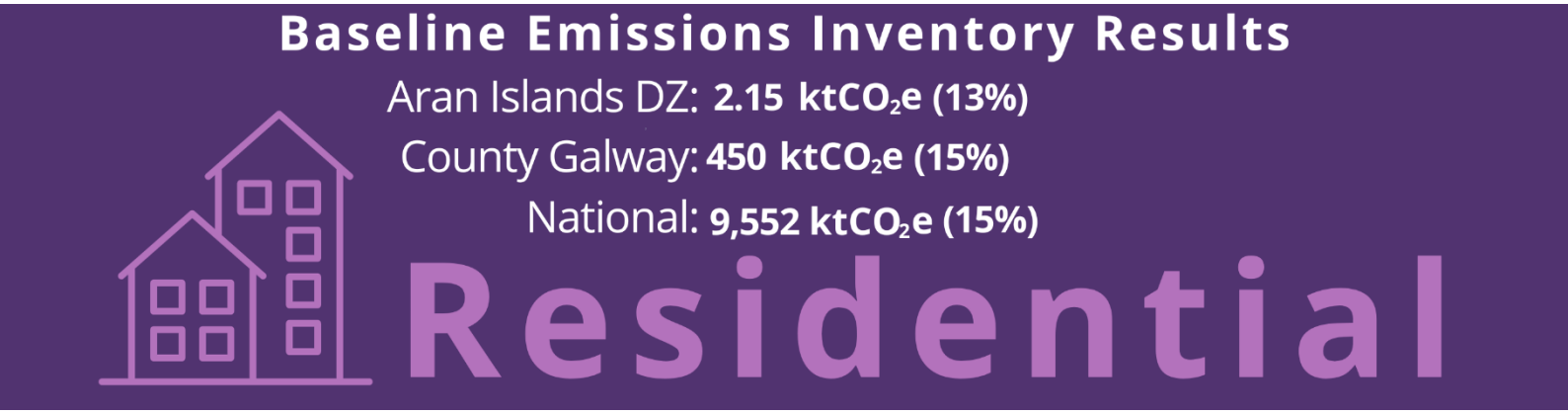
[4] Community Development Framework Guidance (provided by Local Authorities)
[5] https://visual.cso.ie/?body=entity/ima/cop/2016&boundary=C03736V04484&guid=4c07d11e-0118-851d-e053-ca3ca8c0ca7f&theme=all
[6] Community Development Framework Guidance
[7] https://udaras.ie/en/our-language-the-gaeltacht/the-gaeltacht/galway/#facts
[8] Community Development Framework Guidance
[9] https://webgate.ec.europa.eu/life/publicWebsite/project/details/3897#:~:text=Three%20Natura%202000%20sites%20the,I%20of%20the%20Habitats%20Directive and Community Development Framework Guidance
[10] https://www.aranislandsenergycoop.ie/aims-and-objectives/

4 Aran Islands Decarbonisation Zone Emissions: Sectoral Breakdown

The focus of the inventory is Scope 1 emissions in the Residential, Non-residential, Transport, Agriculture, LULUCF, and Waste sectors as well as Scope 2 emissions in the Residential and Non-residential sectors of electricity usage.



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



4.1 Residential

4.1.1 Sector Description

The Residential sector is comprised of emissions from household activities. At the national scale, the Residential sector is responsible for approximately 15% of total emissions linked to energy usage. The average dwelling emits 5 tCO_2 annually.[11] Included in this average are emissions from space and water heating, as well as from electricity consumption. Non-energy emissions come from sources including cooking, waste management, and other household-related activities. While emissions tied to energy play a substantial role in the Residential sector's overall environmental footprint, both energy and non-energy emissions should be factored into the calculations to assess the environmental impact of the sector more thoroughly.

4.1.2 Baseline Data

In the Aran Islands DZ, heating accounted for 75% of Residential sector emissions and electricity consumption for 25%. As a point of reference, the county-level and national splits are both roughly 76% heating through direct fuels and 24% electricity.

Existing Housing Stock

Usage Type	tCO_2e
Heating	1,613
Electricity	538
Total	1,439

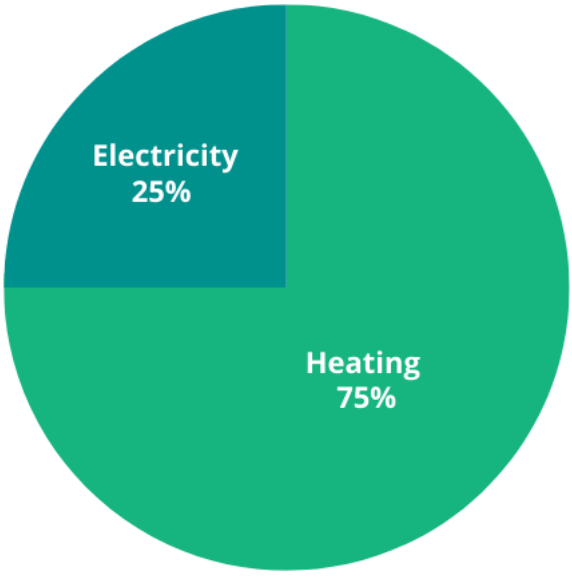


Figure 2 Residential Emissions Split between Heating and Electricity in 2019 from the Energy Master Plans

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

4.1.3 Supporting Information

4.1.3.1 Local Authority Area Housing Stock

From the Small Area 2016 Census data, there are 783 total housing units in the DZ.[12] 38% of households consist of one person and an additional 25% have two people. Of the total housing stock, 22.1% is vacant compared to a 17.7% vacancy in County Galway and 12.3% nationally during the same census. The majority of homes (325 homes) use oil as a heating fuel, and the second most common is coal (89 homes). Oil is also the dominant heating fuel at the county level, but coal is less common at that level and peat is the second most utilised fuel source. It is important to note that the CSO does not always use the same totals for different aspects of housing, so there are some discrepancies between the different tables.

Oil	Natural gas	Electricity	Coal	Peat	LPG	Wood	Other
325	1	38	89	3	1	1	6
68.13%	0.21%	7.79%	18.66%	0.63%	0.21%	0.21%	1.26%

Table 1 Central Heating Fuel Sources in the Aran Islands DZ in 2016 from CSO Small Area Data

Household size and housing stock characteristics hold considerable influence over the amount of energy consumed in homes for heating, cooling, and electricity. This information can help to contextualise the residential emissions in a Local Authority's district.

Existing Housing Stock

Housing Stock	Holiday Homes	Other Vacant	Temporarily Absent	% Vacancy
783	92	173	27	22%

Table 2 Existing Housing Stock for the Aran Islands DZ in 2016 from CSO Small Area Data

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

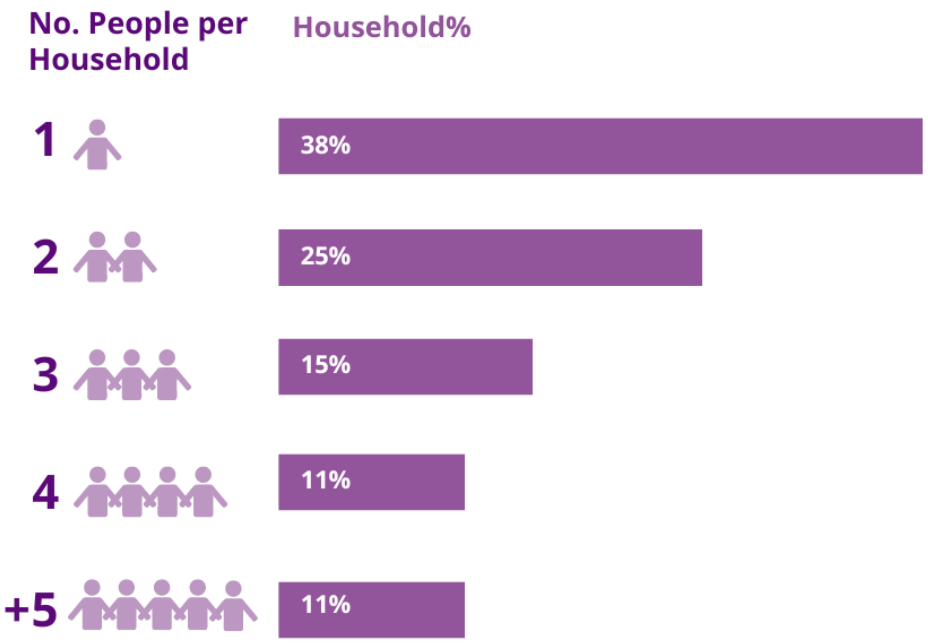


Table 3 Share of Households by Number of People in the Aran Islands DZ in 2016 from CSO Small Area Data

Housing tenure and occupancy type can help supply the context behind residential emissions. One of the most prominent of these exists in the split incentives of rented homes, where maintenance such as energy retrofitting is the responsibility of the owner, but the benefits are reaped by the tenant through energy savings and improved living conditions.

	Households	Household %
Owned with mortgage or loan	66	13.84%
Owned outright	318	66.67%
Rented from private landlord	49	10.27%
Rented from local authority, voluntary, or co-op housing	11	2.31%
Occupied free of rent	26	5.45%
Not stated	7	1.47%

Table 4 Household Occupancy in the Aran Islands DZ in 2016 from CSO Small Area Data

There are inconsistent totals in the data. The CSO uses total housing stock for several attributes but only occupied housing for others.

4.1.3.2 Building Energy Ratings

Building Energy Ratings (BERs) measure the energy performance of a given home. They are measured on a scale from A1 to G, where A1 is the most efficient and G is the least. The level is calculated based on the amount of energy required to heat, cool, ventilate, and light a building according to SEAI-registered BER assessors. One of the goals laid out in the National Climate Action Plan is to retrofit 500,000 homes to a minimum BER of B2. Below is a distribution of the most recent BER ratings in the

Aran Islands DZ. Roughly 10% of the housing stock in the Aran Islands DZ has been assessed for a BER so the distribution may not be representative of the total housing stock.[13]

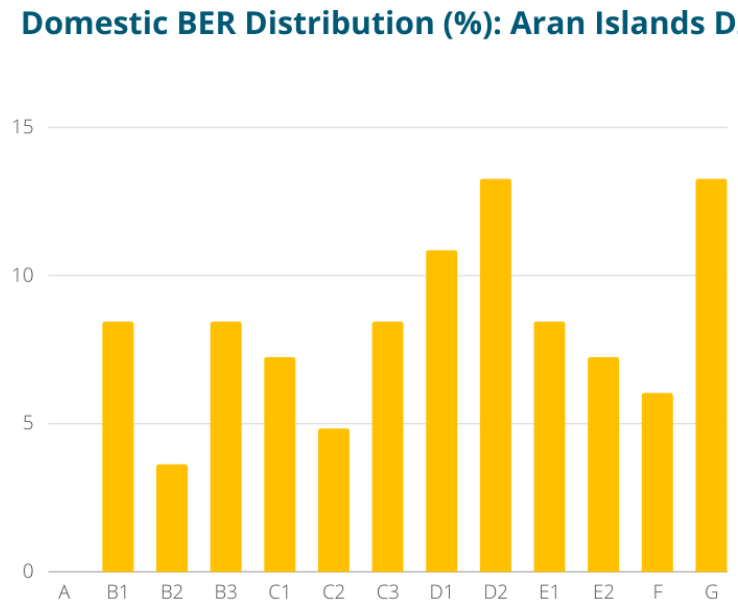


Figure 3 Distribution of BERs for evaluated residential buildings in the Aran Islands DZ as of 2023 from the BER Map. Roughly 10% of possible buildings in the DZ have been evaluated.

4.1.3.3 Social Housing

There is a small number of social houses in the Aran Islands DZ. When this BEI was prepared, they had not been retrofitted, and will require eventual retrofitting to reduce emissions.

4.1.3.4 National Context

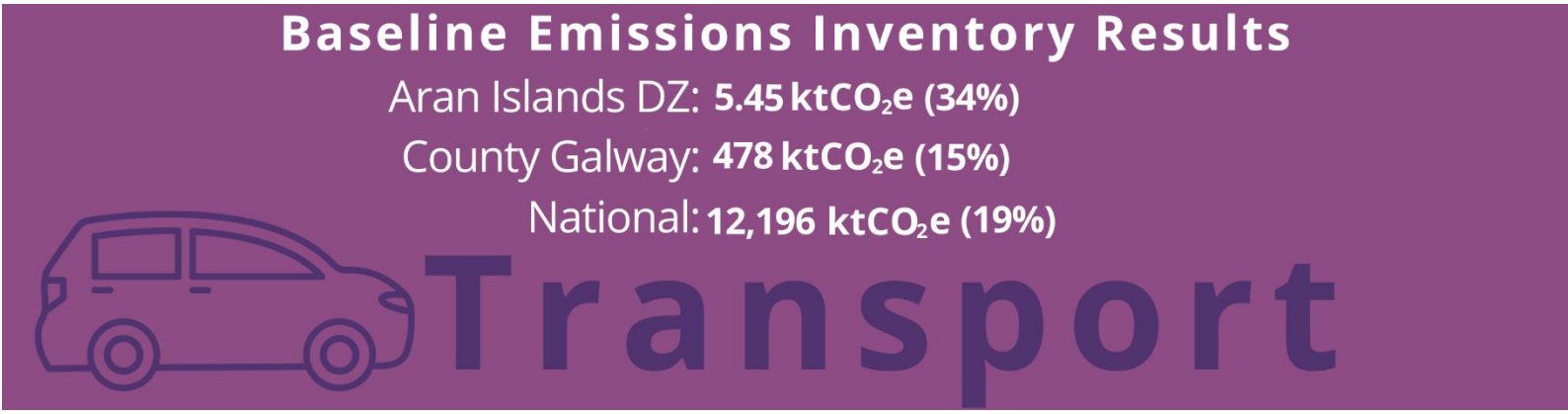
One of the crucial strategies within the overarching CAP23 for diminishing residential emissions is the implementation of a comprehensive retrofit program. The primary goal of the National Residential Retrofit Plan is to complete retrofits of approximately 500,000 homes to attain BER ratings of B2, or higher when cost-optimal or carbon equivalent. The plan also aims to install about 400,000 heat pumps in existing structures, replacing outdated and less efficient heating systems, by 2030. In 2020, 18,400 home retrofits were completed. Of these, only 4,000 reached the B2 standard and there were 1,600 heat pumps installed. The initiation of the Social Housing National Retrofitting Programme in 2021 to retrofit properties was a necessary step towards meeting the BER B2 or equivalent target.

According to the SEAI, the Residential sector in Ireland had an estimated installed solar PV capacity of 17.7 megawatts in 2018. Moreover, the use of renewable ambient energy from heat pumps accounted for approximately 44kt of oil equivalent.[14]

4.1.4 Open Points

An important outstanding point for the Residential sector is the limited BER coverage. This data is useful for understanding which homes need retrofits and gaining a more thorough understanding of emissions in this sector. The digital twinning project currently taking place in Árainn can aid progress on this point.

[13] https://gis.seai.ie/ber/
[14] https://www.seai.ie/publications/2020-Renewable-Energy-in-Ireland-Report.pdf



4.2 Transport

4.2.1 Background

In 2019, approximately 19% of Ireland's greenhouse gas emissions, equivalent to 11 $MtCO_2e$, were attributed to the transportation sector.[15] The vast majority, constituting 94%, stemmed from road transport. These emissions primarily result from the combustion of diesel and petrol in various engine types, including passenger cars, light-duty vehicles, heavy-duty vehicles, and buses. This combustion process generates harmful air pollutants that have adverse effects on both human health and the environment.

From 1990 to 2019, greenhouse gas emissions from the transport sector in Ireland surged by a staggering 112%, rising from 5,143 $ktCO_2e$ in 1990 to 10,915 $ktCO_2e$ in 2019.[16] Specifically, emissions from road transport experienced a notable 115% increase. Among all sectors, transport exhibited the most significant rise in emissions during this period. This uptick in emissions up until 2007 can be attributed, in part, to overall economic prosperity and a growing portion of the population heavily relying on private vehicle transportation. Additionally, road freight transport also witnessed substantial growth during this time.

This sector accounts for emissions from fuel combustion across all transportation modes, encompassing domestic aviation, road, railway, water-based navigation, and other forms of transportation (which includes gas pipeline transportation). Road transportation emissions remained steady between 2015 and 2019 at an average of 11.6 $MtCO_2eq$ with a dip in 2020 to 9.7 $MtCO_2eq$ due to the influence of the COVID-19 pandemic on travel patterns.[17]

Domestic aviation emissions are included in the national inventory but contribute less than 1% to the sector total. International aviation and maritime navigation are not included in Ireland's national emissions total but are reported to the UNFCCC and the EU for informational purposes.

Transport has been the sector in Ireland most sensitive to economic shocks in Ireland. The consumption of transport energy and associated CO_2 emissions peaked in 2007, followed by a sharp decline during the financial crisis.[18] The sector rebounded in 2013 but by 2019 energy usage was still 8.5% lower than the 2007 peak. This decrease can be attributed to heavy goods vehicles, which remained 31% below 2007 levels.

[15] CAP2023
[16] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/
[17] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/
[18] https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

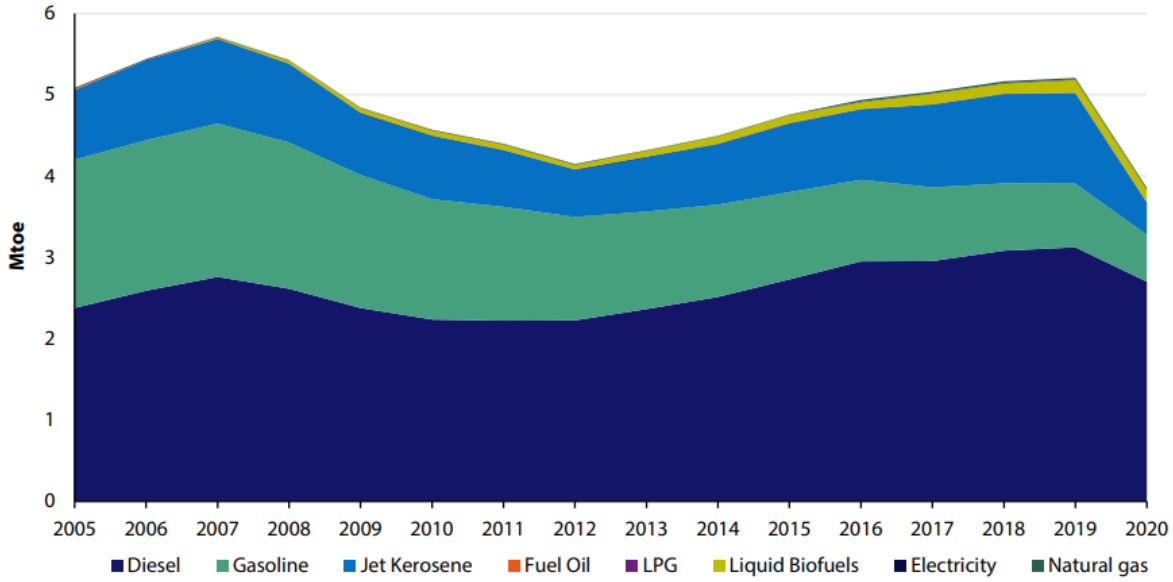


Figure 4 Transport Fuel Usage Over Time in Ireland 2005-2020 from SEAI Energy in Ireland

An important aspect of the Transportation sector is its almost exclusive reliance on fossil fuels, specifically oil-based products. In 2019, nationally only 4% of the energy mix in transport came from renewables. This is low especially compared to other European countries.[19]

There has been minimal progress in transitioning the sector to a lower-carbon fuel mix resulting in emissions remaining closely tied to energy consumption. National 2019 Transport CO_2 emissions were the same as 2005 emissions.

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

Source: SEAI

Figure 5 National Transport Data from 2005 to 2020 from SEAI

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

One of the primary goals of the National Planning Framework is to achieve greater sustainability in transportation. This involves reducing energy consumption and greenhouse gas emissions by encouraging the use of eco-friendly modes of travel, such as walking and cycling, as well as electric vehicles. Additionally, the framework aims to increase the utilisation of public transportation. Another key focus of the National Planning Framework for Transport is to improve regional accessibility within Local Authorities.

To measure progress towards these sustainability goals, the national target for Transport emissions in 2030 is set at 6 million metric tons of CO_2 equivalent. The negative impacts of road transport, including noise, accidents, and traffic congestion, have a detrimental effect on people's quality of life. These issues not only discourage active forms of travel but also result in significant economic costs, amounting to hundreds of millions of euros wasted in unproductive time.

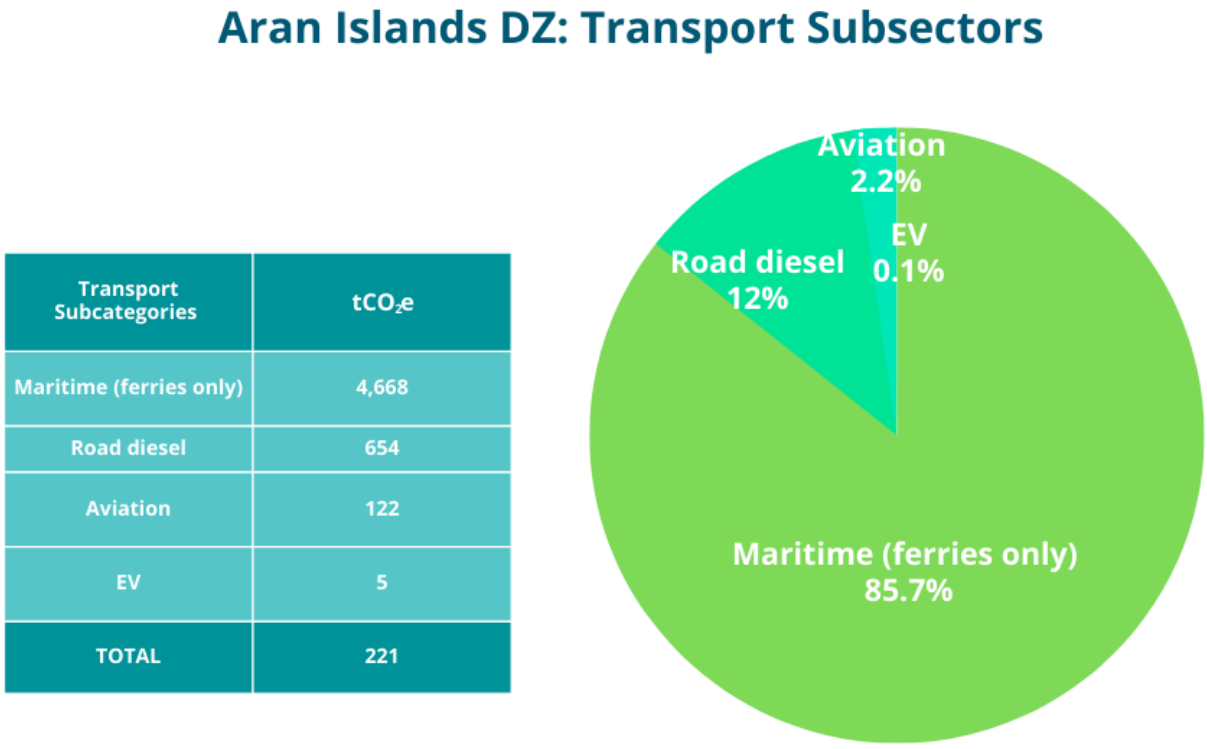
Considering these challenges, fostering a shift in behaviour towards cleaner, safer, and more sustainable modes of mobility is essential for effective climate policy. This transition not only contributes to environmental goals but also presents an opportunity to enhance public health, improve overall quality of life, cater to the needs of rapidly growing urban areas, and strengthen connections between rural, urban, and suburban communities. The recently updated CAP23 outlines specific targets for reducing carbon emissions in the transport sector, summarized in the following table.

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

Table 5 National Required Level of Decarbonisation for Transport for 2030 Targets from the 2023 Climate Action Plan[20]

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

4.2.2 Aran Islands DZ: Baseline Inventory for Transport



Transport Subcategories	tCO_2e
Maritime (ferries only)	4,668
Road diesel	654
Aviation	122
EV	5
TOTAL	221

Figure 6 Emissions from Transport Subsectors in Aran Islands DZ for 2017 due to data availability from the Energy Master Plans

The Transport sector of the Aran Islands accounted for 5,449 tCO_2eq, 35% of the zone's emissions. It is the second largest emitting sector following agriculture. As a point of comparison, the Transport sector makes up 15% of total emissions at the county level and, as previously stated in the background section, 19% at the state level. Within the sector, the highest emitting subsector is Maritime emissions (this includes ferries only). The graph above shows the breakdown of transport. While there are EVs on the Aran Islands (Arainn only), there is only a very small number of such vehicles present and they account for less than 0.1% of emissions in the transport sector.

4.2.3 Supporting Information

To reach the Aran Islands, residents and visitors must either take a ferry or a flight from Mainland Ireland.[21] Usage is restricted during periods of extreme weather.[22] Once on the islands, public transport consists of minibuses and bikes. Private vehicles are also owned by residents, as is broken down in the figure below. An estimate of 449 private cars between the three islands was calculated using data from the Small Area Census with the assumptions that households reporting 4+ cars have 4 cars and that households that did not provide data on car ownership have 0.[23]

[21] Energy Master Plan for Árainn and Inis Meáin provided by Local Authorities
[22] Community Development Framework
[23] https://visual.cso.ie/?body=entity/ima/cop/2016&boundary=C03736V04484&guid=4c07d11d-f4d3-851d-e053-ca3ca8c0ca7f

No cars	One Car	Two Cars	Three Cars	Four or More Cars	None Stated
161	185	100	16	4	11

Table 6 Car Ownership by Household in the Aran Islands DZ in 2016 from CSO Small Area Data[24]

The three main sources of fuel used in the transportation sector are road diesel, ferry diesel, and aviation gasoline (AVGAS).[25] The most complete and recent set of data is from 2017, so the data in this report comes from that year.

CFOAT was instrumental in a 3-year pilot project in partnership with SEAI that involved the use of EVs on Árainn.[26] The EVs used in the pilot have since been removed, though there are currently ten EVs privately owned on Árainn as well as eight e-bicycles for hire.

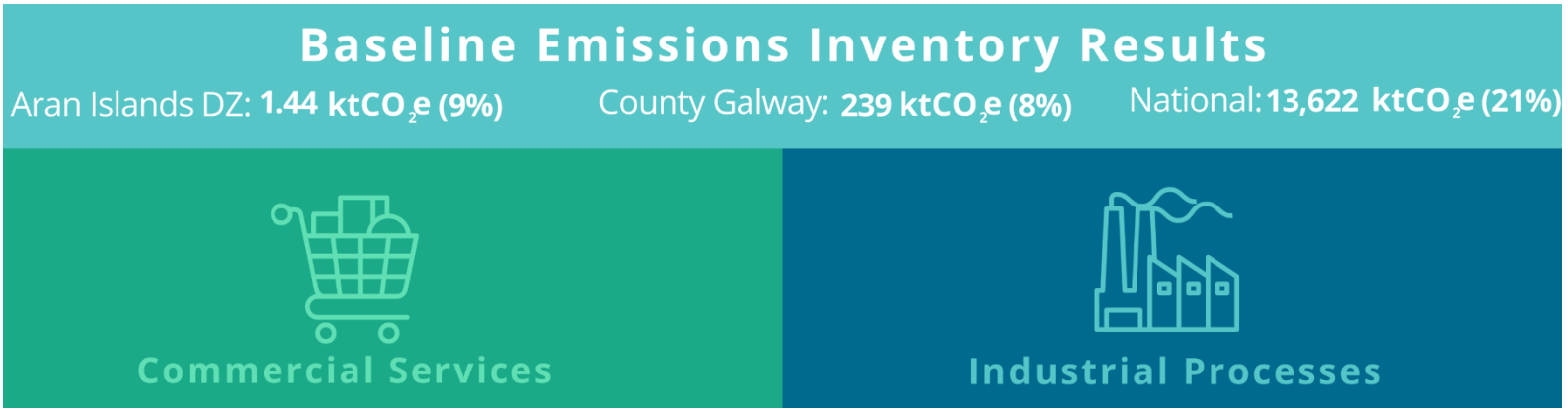
4.2.4 Open Points

There is limited data available on fuel used by ferries, so as more becomes available it would be useful to update the calculations to improve the accuracy of the assessment.

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

[25] Energy Master Plan for Árainn and Inis Meáin

[26] Energy Master Plan for Árainn and Inis Meáin



4.3 Commercial and Industry

4.3.1 Background

Broadly within the non-residential emissions sector, there are three main categories: Commercial, Manufacturing, and Industrial Processes. Each category encompasses a unique set of activities and processes that contribute to greenhouse gas emissions. In the case of the Aran Islands, these emissions come from Commercial and Industrial Processes. Emissions from Utilities are also included in this sector.

Commercial emissions come from commercial entities such as businesses, offices, and industrial complexes. These entities require large amounts of energy to operate, and as significant contributors to greenhouse gas emissions, tend to be a major focus of efforts in emission reductions. They often use fossil fuels as a source of energy. In the commercial sector, energy consumption comes from activities such as heating, cooling, ventilation, lighting, cooking, and refrigeration.

Industrial process emissions include emissions from processes such as cement production, lime production, ceramics, solvent use, and processes in the food and beverage industry. These emissions are calculated from non-energy uses of fossil fuels and GHG use in products. This category of emissions is separate from emissions related to combustion or space and water heating.

Each of these categories is treated as separate entities due to their unique sources and contributions to the overall greenhouse gas emissions landscape of the country. However, in the specific case under examination, these three categories are consolidated into a broader classification known as "non-residential emissions." This classification encompasses emissions generated by commercial activities, emissions from manufacturing combustion, and emissions from industrial sources that are not linked to residential activities.

Within the non-residential sector, two types of emissions, namely activity emissions and electricity emissions, are aggregated and calculated together. This amalgamation is justified by the fact that non-residential activities often necessitate a substantial amount of electricity for their functioning. Consequently, it is essential to incorporate the emissions associated with this electricity consumption into the overall emissions from these activities.

The computation of electricity emissions relies on precise metered consumption data. Essentially, the quantity of greenhouse gas emissions attributed to electricity usage is determined based on the actual amount of electricity consumed, as accurately measured by a meter. The emissions stemming from the generation of this electricity are then allocated to the end-use sector in accordance with this consumption data.

Through a methodological approach that involves segmenting the measured non-residential electricity consumption in County Galway using an economic indicator (as outlined in section 3.4.1), it has been estimated that the combined sectors of commercial and manufacturing contribute approximately 66 $ktCO_2$ and 48 $ktCO_2$ of electricity emissions, respectively. This cumulative figure amounts to approximately 114 $ktCO_2$ of non-residential electricity emissions when considering both sectors together. Notably, this constitutes 30% of the total greenhouse gas emissions within the non-residential sector.

4.3.2 DZ: Baseline Inventory for Commercial and Industry Emissions

The Commercial and Industry sector in the Aran Islands DZ is a significant source of greenhouse gas (GHG) emissions. To gain a more comprehensive understanding of the emissions characteristics within this sector, the figure below shows data on both activity-based emissions and electricity-related emissions. This visual representation offers a holistic view of the sector's overall greenhouse gas (GHG) emissions. The information depicted in the graph highlights that the Commercial Services subsector is the primary contributor, accounting for 59% of the total emissions. The Utilities sector makes up just over one third of sector emissions at 36% of the total, and Industrial Processes make up the smallest position at 5%. It is worth noting that the Industrial Processes category does not include any electricity-related emissions.

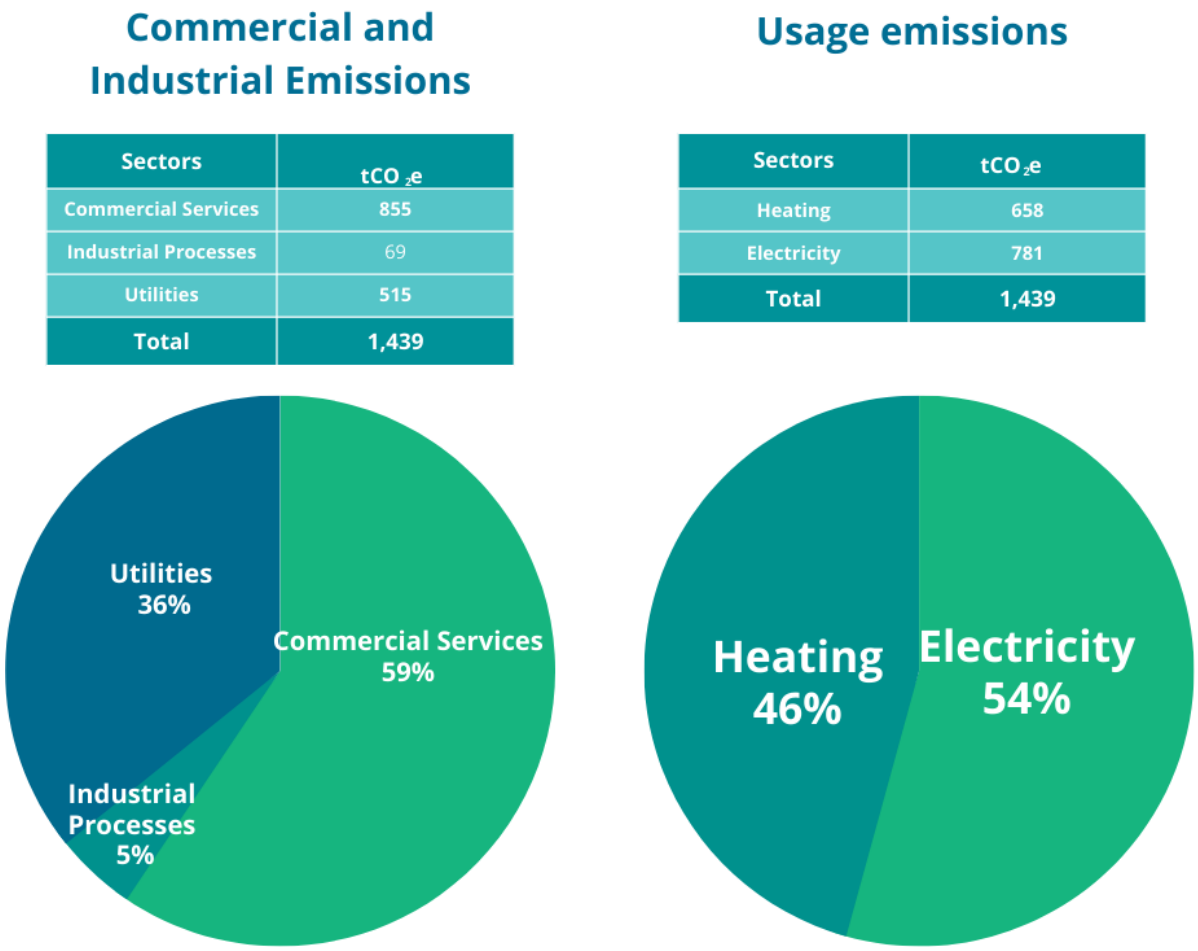


Figure 7 Total Non-Residential Emissions by sector and usage in the Aran Islands DZ in 2019 from the Energy Master Plans

4.3.3 Supporting Information

Emissions from non-residential sources closely mirror economic trends, following a notable degree of alignment. On a national scale, emissions have exhibited relative stability in recent years. A significant contributing factor to this trend has been the shift from higher-carbon oil and coal to the comparatively lower-carbon natural gas, thereby driving reductions in emissions within this domain.

As previously discussed, the emissions associated with electricity consumption in the Commercial Services sector have been assessed using Building Energy Ratings (BER). These ratings provide a measure of a building's energy efficiency, ranging from A1 (highly efficient) to G (less efficient). They are determined based on the energy required for heating, cooling, ventilation, and lighting, assessed by certified BER assessors registered with the Sustainable Energy Authority of Ireland (SEAI).

In the Aran Islands DZ, no non-residential buildings that have had their BERs calculated possess a B2 BER or higher, not aligning with the national average of 8%.[27] However, a total of five non-residential buildings throughout the DZ have had BERs calculated, so this data may not be accurate. Within the jurisdiction of the Local Authority, there are a total of 102 exclusively commercial buildings, alongside 798 residential ones and 125 mixed commercial and residential, with an additional 2 classified as unknown.[28]

4.3.4 Open Points

As is the case with the residential sector, there is limited data available for BERs of non-residential sector. Similarly, the Digital Twinning Project in progress on Árainn could aid in enhancing coverage.

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

[28] GeoDirectory data for the Aran Islands provided by Local Authorities

4.4 Agriculture

4.4.1 Background

The Agriculture sector of emissions encompasses the release of greenhouse gases (GHGs) into the atmosphere during farming activities, which encompass livestock rearing, and crop cultivation. These emissions primarily consist of methane (CH_4) and nitrous oxide (N_2O), both of which have considerably higher global warming potentials than carbon dioxide (CO_2).[29]

Within Ireland, agriculture takes the lead as the highest emitting sector, contributing to 34% of the nation's total GHG emissions in 2019. The principal source of emissions within this sector is methane emissions from livestock, accounting for approximately 63% of the overall agricultural emissions.[30] Livestock, including cows, sheep, and pigs, generate methane through a process known as enteric fermentation, occurring during the digestion of feed in their stomachs.[31]

Furthermore, the use of nitrogen-based fertilisers and the management of animal manure are other substantial sources of agricultural emissions in Ireland.[32] The application of nitrogen fertilisers and the handling of animal waste can lead to the release of nitrous oxide, an exceptionally potent greenhouse gas that has over 300 times the warming potential of CO_2.[33]

Mitigating agricultural emissions presents a significant challenge for Ireland, given the sector's pivotal role in the country's economy. Agriculture is a cornerstone of Ireland's economy, contributing 8% to the nation's gross value added and supplying employment for over 8.5% of the national workforce in 2019.[34] To address this challenge, Ireland has set ambitious targets for its agriculture sector, aiming to achieve a 25% reduction in GHG emissions by 2030. The national emissions limit for Agriculture in 2030 is capped at 17.25 million metric tons of CO_2 equivalent.

Recent trends in agriculture at the national level have seen a decrease in the use of synthetic fertiliser and increases in the number of dairy cows.[35] Between 2012 and 2022, the dairy herd increased in size by 42.5%, in this same period dairy production increased by 68.6%. Also, during this time, the number of sheep in Ireland increased by 14.7%.

[29] https://www.fao.org/3/cb3808en/cb3808en.pdf
[30] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8420985/pdf/vfab037.pdf
[31] https://www.europarl.europa.eu/RegData/etudes/STUD/2021/695482/IPOL_STU(2021)695482_EN.pdf
[32] https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/
[33] https://www.teagasc.ie/media/website/publications/2014/Rural_Economic_Development_in_Ireland.pdf
[34] https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/f
[35] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/agriculture/

4.4.2 Aran Islands DZ: Baseline Inventory for Agricultural Emissions

The sector's emissions primarily come from livestock. The livestock sector was split into cattle, producing 71% of sector emissions, and sheep, producing an additional 2%. Emissions from goats were measured as well and accounted for one additional tonne of CO_2e; this amount makes up too small of a proportion of the agricultural emissions that it is not visible on the sectoral emissions split below. The remaining emissions are estimated from the MapEIre dataset and include all other associated emissions found geospatially in the DZ for the sector.

Agriculture emissions

Subsector	tCO_2e
Cattle	3,934
Sheep	113
Goats	1
Other	1,504
Total	5,552

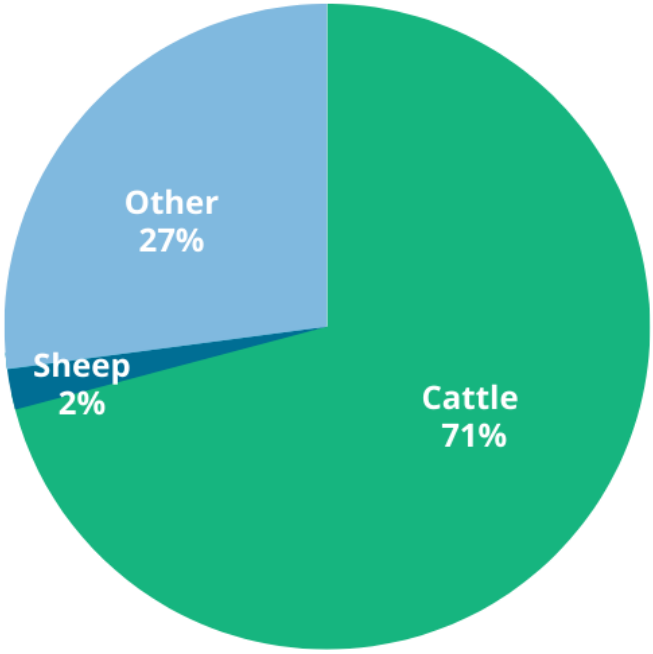


Figure 8 Breakdown of Agriculture Emissions by Subsector in the Aran Islands DZ in 2016 (livestock) and 2019 (other) from CSO Small Area Data (livestock) and MapEIre (other). High resolution data was not available for a single year.

4.4.3 Supporting Information

Traditionally, agriculture has played a big role in the culture and economy of the Aran Islands, though in recent years employment has shifted towards the tourism industry.[36] Due to the nature of island farms, individual farms tend to be small and require high amounts of labour to function.[37] Fields are surrounded by distinctive stone walls that were originally built to remove stone from farmland and now also protect soil and livestock from wind and wind erosion.[38]

From the 2020 Agricultural Census data, there are 1,553 cows and 253 sheep.[39] There are also goats on the islands, however data on herd size was not available at time of writing and goat emissions were calculated geospatially with MapEIre data. The area farmed on the island is 2,460 hectares, with an average holding size of 12.2 acres, in line with traditionally smaller farms found in the island communities.[40] The average age of landholders on the islands is 65, this is in line with the general

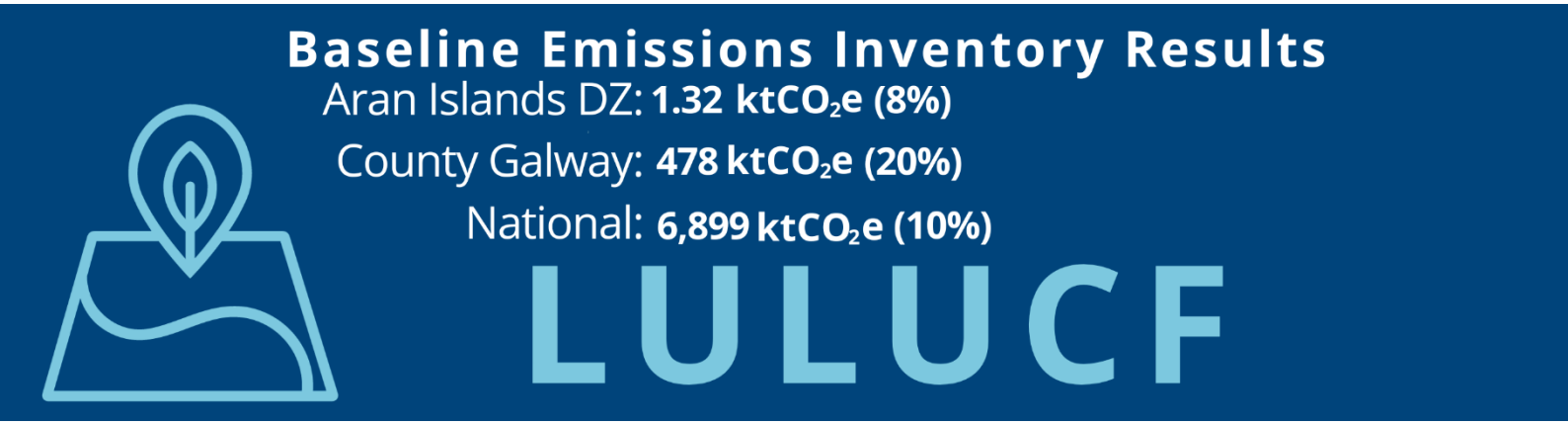
[36] Energy Master Plan for Árainn and Inis Meáin
[37] https://www.teagasc.ie/environment/biodiversity--countryside/research/completed-projects/aran-life/
[38] https://www.heritagecouncil.ie/content/files/high_nature_value_programme_aran__islands_burren-farming_2010_106mb.pdf
[39] https://visual.cso.ie/?body=entity/ima/coa&boundary=C03904V04656&guid=2AE19629236913A3E055000000000001
[40] https://visual.cso.ie/?body=entity/ima/coa&boundary=C03904V04656&guid=2AE19629236913A3E055000000000001

demographic breakdown of the island with a higher rate of retirement-age residents than at the national level and a movement in recent years away from the agriculture industry.[41]

4.4.4 Open Points

A more accurate calculation of the emissions from livestock would be possible with a more detailed breakdown of the cattle herd by breed. Additionally, more information on local farming practices and additional types of livestock could increase the accuracy and level of detail for agriculture emissions outside of livestock emissions.

[41] Community Development Framework Guidance



4.5 Land Use, Land Use Change, and Forestry

4.5.1 Background

Land Use, Land Use Change, and Forestry (LULUCF) encompasses both emissions and carbon sinks linked to alterations in land use and forestry practices. It encompasses the emissions and removals arising from shifts in land use, land use change, and forestry activities, which encompass forest land, cropland, grassland, wetlands, settlements, and other land types. This category also covers the impact of wood product harvesting. Effective land management plays a pivotal role in addressing climate change. Ireland boasts robust and diverse ecosystems, such as grasslands, hedgerows, and forests, which capture and absorb carbon dioxide (CO_2).

LULUCF differs from Agriculture in its focus on land use and forestry practices aimed at increasing carbon sequestration and decreasing emissions. In contrast, Agriculture relates to crop and livestock production and encompasses emissions and removals associated with activities such as enteric fermentation, manure management, and soil maintenance.

Since 1990, Ireland has expanded its forest area by roughly 300,000 hectares.[42] These growing and maturing forests function as crucial CO_2 sinks and long-term repositories of carbon in biomass and soil. However, the lower rates of forest planting in recent times pose a potential future risk to the continued role of the national forest estate as a significant carbon sink. In 2019, the LULUCF sector recorded 3,073 kilotonnes of CO_2 equivalent removed and 9,979 kilotonnes of CO_2 equivalent emitted, resulting in a net national emission of 6,906 kilotonnes of CO_2.

Land use and changes in land use have a substantial impact on global greenhouse gas emissions. Processes like deforestation and the conversion of natural ecosystems to agricultural use release CO_2 into the atmosphere, contributing to the greenhouse effect and subsequent climate change.

Conversely, land use and management practices also offer considerable potential for emissions reduction. Activities tied to the land can contribute to carbon sequestration, involving the removal of CO_2 from the atmosphere and its storage within soil, vegetation, and other organic matter. For instance, afforestation and reforestation efforts act as natural sinks for greenhouse gases by sequestering carbon from the atmosphere. Furthermore, sustainable agricultural practices like conservation tillage, agroforestry, and cover cropping can bolster soil health, increase carbon sequestration in soil, and decrease greenhouse gas emissions.

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

4.5.2 Aran Islands DZ: Baseline Inventory for LULUCF Emissions

LULUCF is responsible for 9% of the total GHG emissions in the Aran Islands DZ with 1,317 tCO_2 equivalents emitted using emissions factors derived from the National Emissions Inventory. This is lower than the 16% of total emissions from LULUCF in County Galway overall. Emissions from exposed surface area are not included in the final calculation as they emit very little CO_2e, further information is provided in the supporting information section.

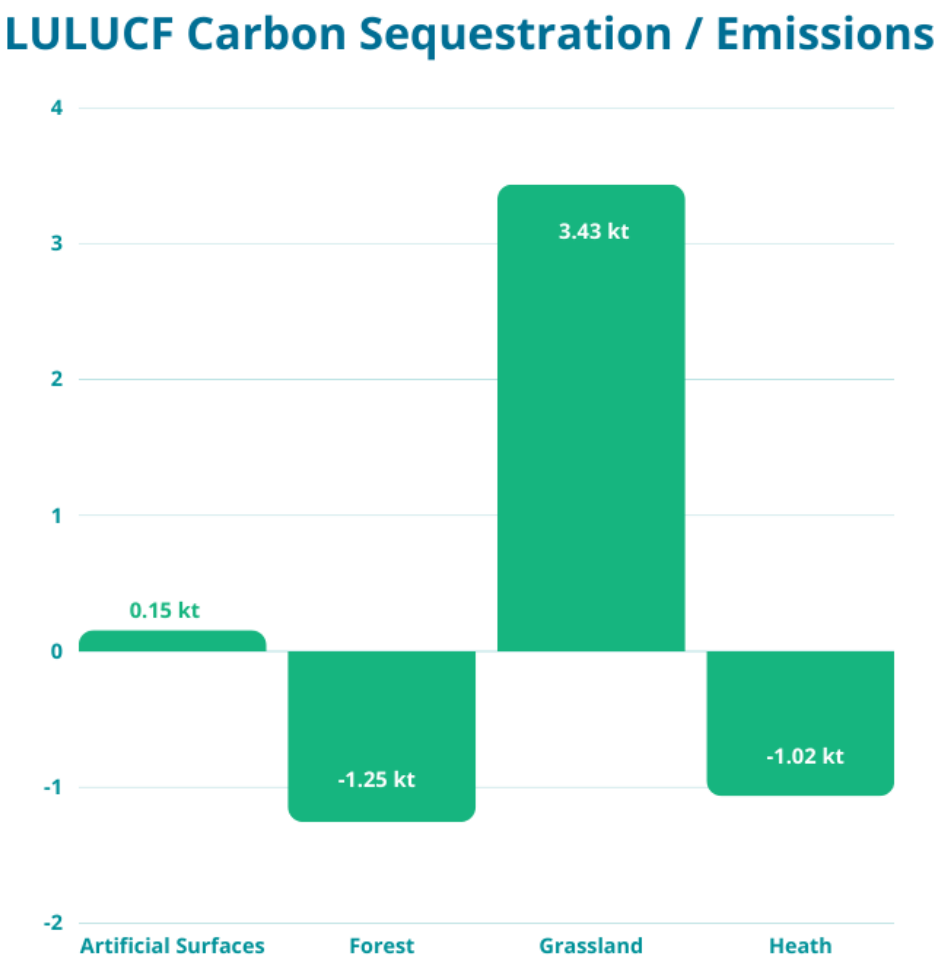


*Figure 9 Total Emissions and Sequestrations from LULUCF Excluding Exposed Surfaces in the Aran Islands DZ in *NATIONAL MAP COVER DATA YEAR* from the National Land Cover Map*

4.5.3 Supporting Information

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

The land cover found in the Aran Islands DZ can be split into categories detailed below. The area for each of the following sectors was calculated using data from the National Land Cover Map.[43] The two categories with the largest share of cover are dry grasslands and exposed rock and sediments.

[43] https://www.epa.ie/our-services/monitoring--assessment/assessment/mapping/national-land-cover-map/

Land Cover Type

Category	Area (ha)
Grassland, Saltmarsh, and Swamp	2,165
Artificial Surfaces	147
Exposed Surfaces	2,226
Forest, Woodland, and Scrub	207
Heath and Bracken	457
Water	15

Table 7 Land Cover by Type in the Aran Islands DZ in 2023 from the National Land Cover Map

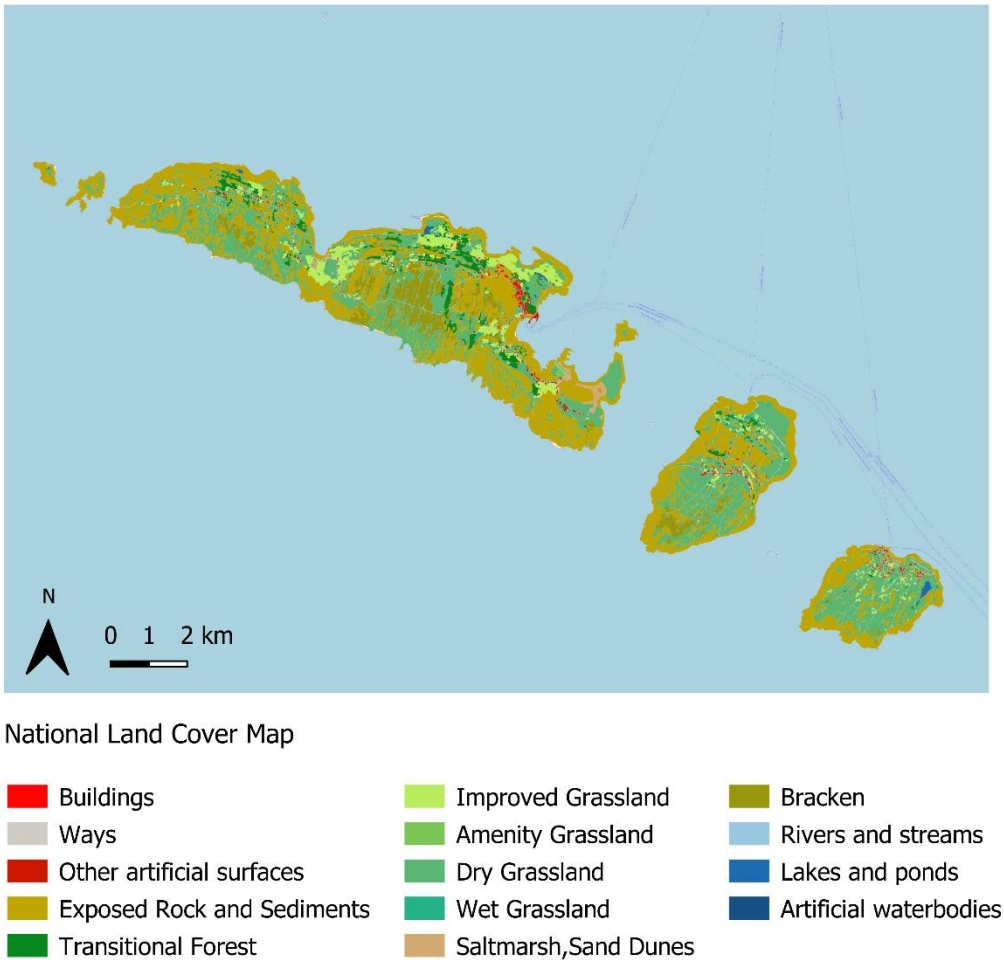


Figure 10 Map of Aran Islands Decarbonisation Zone in 2023 from the National Land Cover Map

The combined forest, woodland, and scrub category can be identified by the presence of trees, shrubs, or brambles as the dominating sources of vegetation.[44] Areas with a primary cover of trees and a

[44] https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

distinct canopy are classified as woodlands. Scrub areas are transitional woodlands with lower canopies than are found in woodlands, as well as a greater presence of shrubs and brambles. Hedgerows are strips of woodlands with widths of less than four meters. This category of land cover sequesters CO_2.

Subcategory	Area (ha)
Broadleaf Forest and Woodland	0.6
Hedgerow	0.1
Scrub	206.6
Total Forest, Woodland, and Scrub Area	207.4

Grasslands are categorised by land cover of less than 25% by shrubbery, and broadly into the categories of improved, semi-improved, and unimproved.[45] Improved grasslands are species-poor and managed intensively. They are the most common type of grassland and are frequently reseeded, fertilised, and heavily grazed, and they do not have much conservation value. Amenity grassland is improved grassland that is managed for reasons unrelated to grass production. Dry grassland is unimproved or semi-improved and often features low-intensity agriculture. Old permanent pastures such as those found in the DZ would be classified in this way. Wet grasslands are poorly draining grasslands. Sand dune systems are made up of different types of dunes identified by characteristics including position, stability, and vegetation cover. More specific data on dunes was not available. The field patterns found on the islands come from traditional island farming practices; this land cover is included in the Dry Grassland subcategory.[46]

Subcategory	Area (ha)
Amenity Grassland	54.7
Dry Grassland	1,780.3
Improved Grassland	282.8
Sand Dunes	39.5
Wet Grassland	8.3
Total Grassland, Saltmarsh, and Swamp Area	2,165.5

Areas classified as Heath can be characterised by open vegetation and at least 25% shrub cover.[47] Dry heath has shallow peat present if there is peat present at all. Dense bracken is often associated with dry heath. Heath makes up a small but not insignificant proportion of land cover in the DZ.

Subcategory	Area (ha)
Bracken	40.4
Dry Heath	416.2
Total Heath	456.6

One of the largest shares of LULUCF land cover is exposed surface area. The exposed rock and sediments category encompasses any naturally or artificially uncovered rock except coastal sediments,

[45] https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

[46] Community Development Framework

[47] https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

sea cliffs, and built stone structures.[48] This type of surface area was not accounted for in the National Emissions Inventory, and it does not emit much carbon.[49] The carbon that is emitted comes from chemical weathering as part of the geological carbon cycle.[50] Rising sea levels can increase the rate of weathering.

Subcategory	Area (ha)
Costal Sediments	70.9
Exposed Rock and Sediments	2,154.8
Total Exposed Surface Area	2,225.7

The following table shows the DZ area covered by the built surface. This includes buildings, roads and paths, and other human-built surface covers.

Subcategory	Area (ha)
Buildings	17.0
Ways	71.3
Other	58.6
Total Built Surfaces	147.0

[48] https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

[49] https://english.rvo.nl/sites/default/files/2018/04/Arets-et-al-2018-LULUCF-WOt-technical-report-113-2018.pdf

[50] https://www.environmental-research.ox.ac.uk/article/carbon-dioxide-from-crumbling-coasts-rock-weathering-as-a-carbon-source

4.6 Waste

4.6.1 Background

The Waste sector encompasses estimates of emissions originating from diverse waste management activities, including solid waste disposal, composting, waste incineration (excluding waste-to-energy processes), open burning of waste, and wastewater treatment and discharge. The primary contributor among these sources is the disposal of solid waste on land, particularly in landfills, where the main concern is the emission of methane (CH_4).

Unlike other sectors, greenhouse gas emissions stemming from the Waste sector have been consistently declining over the years. This decline is attributed to enhanced management practices associated with landfills. One important development in this field has been an increase in the recovery of landfill gas for electricity generation, and controlled burning (flaring) of this gas has played a pivotal role in driving down emissions from the Waste sector. This trend can be seen in the figure below. There have also been significant decreases in the fraction of waste landfilled. Approximately 15% of waste was landfilled in 2019, following a downward trajectory of 58% of waste landfilled in 2010 and 80% in 2001.[51] Following the Landfill Directive, the 2035 target for landfilling fraction is 10% or less of municipal waste.

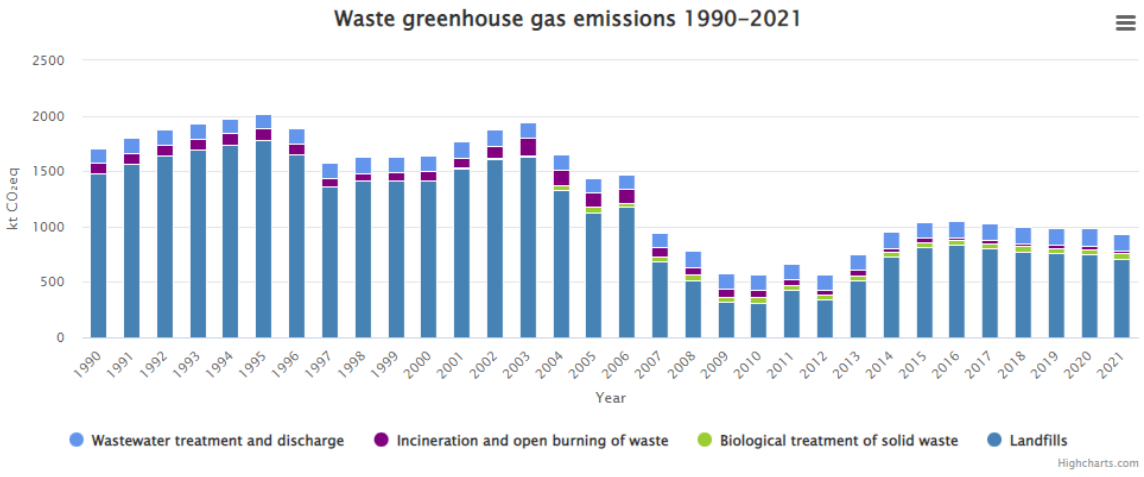


Figure 11 National Waste Greenhouse Gas Emissions from EPA[52]

[51] https://www.epa.ie/publications/monitoring--assessment/waste/national-waste-statistics/EPA_Nat_Waste_Stats_Report_2019_web.pdf

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

Waste emissions per capita in Ireland are lower than the average in the European Union (EU), and these emissions have been on a downward trajectory since 2005. Ireland has made significant strides in waste management, particularly in augmenting recycling rates and diverting waste away from landfills.[53]

4.6.2 Aran Islands DZ: Baseline Inventory for Waste Emissions

Most waste emissions come from the waste that is sent to a waste-to-energy plant off-island, at approximately 55% of the sectoral emissions. The remaining emissions come from waste that is processed on the islands in a recycling centre (31%) and emissions associated with wastewater and wastewater processing (14%).

Waste Emissions

Sector	tCO_2e
On-Island Processing	76
Waste to Energy	115
Wastewater	29
Total	220

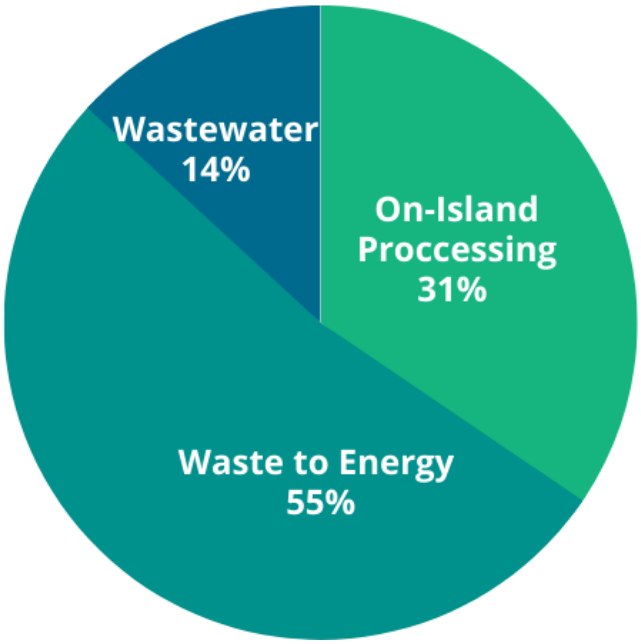


Figure 12 Waste Emissions Split between recycling, waste to energy, and wastewater associated emissions in 2019 from MapEIre, Local Authority data, and National Waste Emissions Data

4.6.3 Supporting information

The majority of waste produced in the Aran Islands DZ is managed on the island, about 20% cannot be processed in facilities within the DZ and is sent to the mainland.[54] Waste that cannot be processed using the facilities present in the Aran Islands DZ is shipped to Mainland Ireland where it is sent to a waste-to-energy plant.[55] Waste-to-energy plants reduce waste to ash in combustion chambers at temperatures above 850°C.[56] This process reduces the volume of the waste by about 80% and heats water in steel tubes that is converted into superheated steam. The steam then moves to a steam turbine that provides power to the National Grid. Emissions are released through tall flue stacks and the remaining ash is collected and taken to recycling plants. The locally-run recycling centre that serves

[53] https://www.europarl.europa.eu/RegData/etudes/STUD/2017/581913/EPRS_STU(2017)581913_EN.pdf
[54] Energy Master Plan for
[55] Data on waste processing provided by Local Authorities.
[56] https://www.dublinwastetoenergy.ie/waste-to-energy/

the islands has found success managing the majority of the waste produced.[57] The following table is a detailed breakdown of the mass of different types of waste generated on the islands.[58]

Waste Types

Type	Mass (kg)
Waste to Energy	236,450
Food	109,530
Paper Cardboard	68,460
Glass	84,160
Metal and Cans	39,350
Plastic	20,460
Electrical	10,500
Timber	8,920
Skip Hire	13,880
Public Bins	14,300
Monthly Collection	18,780
Clothes	1,640
Tyres	1,740
Mattresses	1,500
Inis Oirr Water Works	2,040
Total	**220**

Table 8 Detailed Split of Types of Waste generated in the Aran Islands DZ in 2022 (Galway County Council)

4.6.4 Open Points

Emissions for the recycling centre were calculated using the MapEIre data, so a more bottom-up approach may be more accurate and useful for understanding mitigation needs. In addition, limited data is available for waste-to-energy emissions, as well as the emissions required to move waste from the Aran Islands to the mainland. Further investigation into these emission sources would also improve the accuracy of these sectoral emissions and likely lower the total.

Wastewater emissions rely on MapEIre data processed for the County Galway BEI as higher resolution data on wastewater emissions was not available. This data also does not account for emissions from septic tanks, which can be estimated at 0.05 kg CH_4 for every kilogram of biological oxygen demand (BOD).[59]

[57] https://www.irishtimes.com/news/environment/aran-islands-co-op-recycling-project-wins-top-award-1.4064868

[58] Provided by the Galway County Council

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

4.7 F-Gases

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

Hydrofluorocarbons are typically found in applications such as refrigeration, air-conditioning, aerosols, and foams.[60] SF_6, however, is used primarily in the electricity and electronics supply industries, e.g., the semiconductor industry, where it is used as an electronic insulator due to its inertness.[61]

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

4.7.1 Aran Islands DZ: Baseline Inventory for F-gases

Using the MapEIre CRF Geospatial Dataset, hydrofluorocarbons were the only F-gas identified in the Aran Islands DZ. Perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6) were also measured but not detected. The CO_2 equivalent of the HFCs is not included in the emissions calculations of the other sectors, so it should be included in the total emissions of the DZ. The total mass and CO_2 equivalent values are listed below. F-gases are not included in the general inventory because they make up a very small portion of the total emissions and available data relies heavily on assumptions. Further data collection can improve the accuracy of this inventory.

F-gas	$ktCO_2e$
HFCs	0.2

[60] https://www.ccacoalition.org/fr/slcps/hydrofluorocarbons-hfcs
[61] https://library.wmo.int/index.php?lvl=categ_see&id=10223#.Y3-3eXaZOUk

5 Other Inventories

5.1 Emissions by Local Authority

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

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

As of 2020, public institutions have achieved significant savings, totalling €1.8 billion, and have successfully prevented the emission of 6 million tonnes of CO_2 between 2009 and 2020 by reducing their energy consumption. Notably, the public sector has enhanced its energy efficiency by 34% compared to the levels observed in 2009, surpassing the targeted 33% increase in energy efficiency set for the year 2020.[62]

The total emissions from the public sector in the Aran Islands DZ are 475 tCO_2e. This represents about 2.7% of the total emissions for the Aran Islands DZ. These emissions are not separated from the other sectors within the inventory but provide insight into the emissions that the LA is directly responsible for. Heating of public buildings accounts for the majority of the LA's emissions, followed by electricity use in public buildings and public lighting.

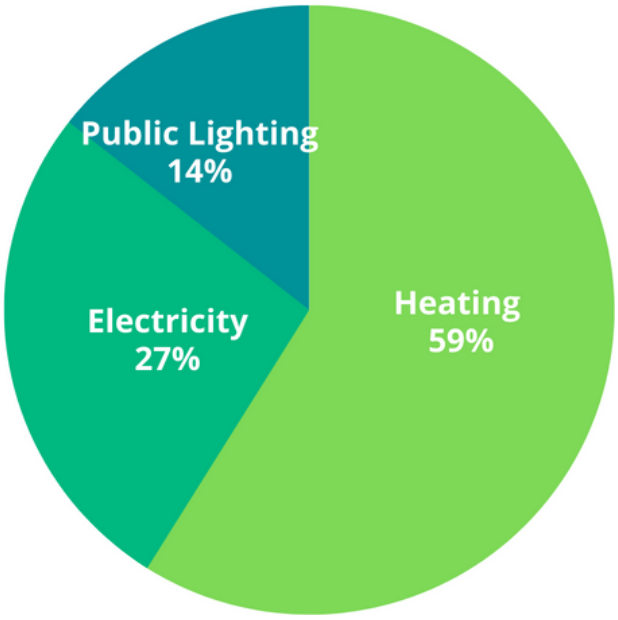


Figure 13 Aran Islands DZ Local Authorities' Own Emissions from Electricity and Heating in 2019 from Energy Master Plans and information provided by Local Authorities

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

6 Next Steps

The formation of baseline emissions inventories is a significant and essential step for addressing the needs and responsibilities of the public sector in the fight against climate change, as well as the impact that climate change already has across different aspects of Ireland, including the continuation of agricultural practices and biodiversity especially through LULUCF practices.[63] The North Atlantic Ocean reached record-high surface temperatures in 2023 as the oceanic warming phenomenon known as El Niño has reached full-strength.[64] The current rate of sea level rise, about 3.6 mm on average per year from 2006 to 2015, as well as changing weather patterns with an increase in extreme weather events that can leave the islands disconnected from the mainland, is especially notable and urgently forces mitigation and adaptation measures for island communities.[65]

BEIs provide a structured map of emissions in a specific area using a data-based approach to calculate and analyse the area's emissions profile. They are viewed as trustworthy sources of evidence on which to build a foundation for beginning a green transformation tailored to an area's needs and preexisting structures. With the results of this BEI, County Galway in tandem with the local communities on the Aran Islands can develop a comprehensive Climate Action Plan for the area, outlining specific strategies and targets for emission reductions. The Aran Islands can serve as a test location for ambitious pilot solutions to be replicated and scaled up on a regional level. Even more so than the rest of Ireland, Transport, the highest-emitting sector, shows potential as a place for reductions in marine fuel. This sector generally is the most reliant on fossil fuels and has the lowest percentage of renewables in its fuel mix.[66] There are a limited number of EVs on the islands, but there is an emphasis on biking for visitors especially. The Aran Islands are already making great strides towards reaching emission abatement goals, with one especially notable case in the waste management sector through the community-run recycling centre. Continuing on this path of high community engagement and continued awareness-raising through organisations including CFOAT, the Aran Islands are an important case for understanding successful implementation of decarbonisation processes.

[63] https://www.agriland.ie/farming-news/climate-change-may-threaten-sustainability-of-irish-farms-report/ and https://www.buzz.ie/news/irish-news/bird-species-declining-ireland-wildlife-28105283

[64] https://climate.copernicus.eu/record-breaking-north-atlantic-ocean-temperatures-contribute-extreme-marine-heatwaves

[65] https://www.epa.ie/environment-and-you/climate-change/what-impact-will-climate-change-have-for-ireland/#:~:text=All%20major%20cities%20in%20Ireland,damage%20to%20property%20and%20infrastructure.

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

7 Appendix: Methodology

7.1 National Emissions Inventory

The EPA is responsible for completing a national greenhouse gas inventory, which it compiles for Ireland annually. Ireland was legally obligated to submit data from 1990 through 2021 in January, March, and April 2023 to the European Commission and the United Nations Framework Convention on Climate Change (UNFCCC).

In response to developments in climate governance and legislation in 2021, the Environmental Protection Agency (EPA) released provisional inventory data in July 2022, covering the period from 1990 to 2021. These provisional estimates of Ireland's greenhouse gas emissions for the years 1990 to 2021 are based on interim energy balances provided by the Sustainable Energy Authority of Ireland (SEAI) in June 2022. They also incorporate the most recent data from other sources, including the Central Statistics Office and the Department of Agriculture, Food, and the Marine (DAFM). These calculations adhere to methodologies aligned with reporting guidelines outlined by the United Nations Framework Convention on Climate Change (UNFCCC). Emissions data verified from installations within the European Union's Emissions Trading Scheme (ETS) are included.

In 2019, Ireland's total emissions amounted to 64,220 kilotonnes of CO_2 equivalent.[67] It's important to highlight that this figure differs slightly from the national total mentioned in the report's table on page 4, with an approximate variance of 100 kilotonnes. Various factors contribute to this difference, including emissions in the EPA energy industries category that encompass more than just electricity-related emissions. Another factor is the potential utilisation of different Global Warming Potentials (GWPs) between the Assessment Reports 4 (AR4) and 6 (AR6), contributing to this variance. These emissions are categorised as follows: Energy Industries, Residential, Manufacturing Combustion, Commercial Services, Transport, Industrial Processes, F-Gases, Agriculture, Waste, and Land Use/Land Use Change/Forestry (LULUCF). It's important to note that the 'Energy Industries' category is not presented as a standalone category in the final Local Authority inventory, as the emissions are allocated at the point of consumption of the electricity.

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

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

Table 9 National Inventory Categories from 2019 National Inventory

In 2019, agriculture stood out as the leading source of national emissions, making up 33% of the total. Following closely, transport and the energy industries ranked as the second and third significant contributors, comprising 18% and 14% of the emissions, respectively. Residential and LULUCF emissions each accounted for 10%. Together, these five sectors represented a substantial 85% of the country's total emissions in 2019. The remainder was distributed among Manufacturing Combustion (7%), Industrial Processes (3%), Waste (2%), F-Gases (1%), and Commercial Services (1%).

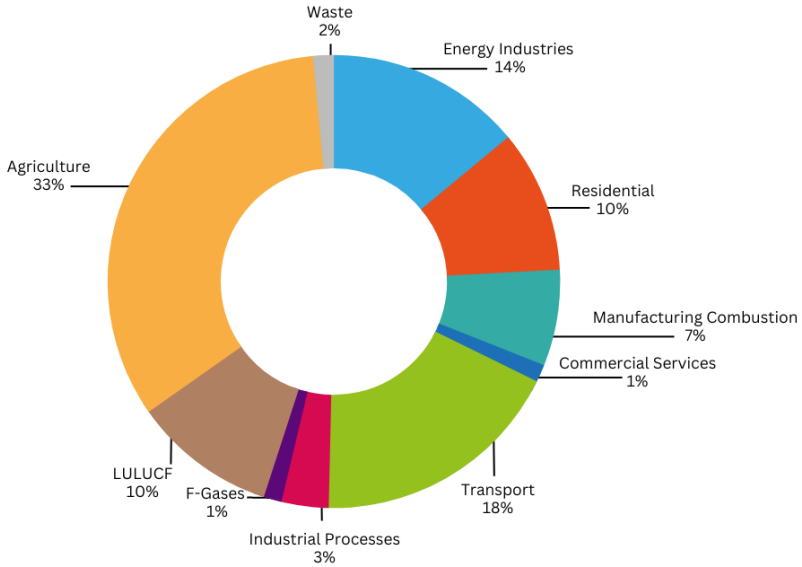


Figure 14 National Emissions Inventory (2019)

7.1.1 Reported Greenhouse Gases

Emissions data for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) are reported on an annual basis. Ireland has relatively high methane and nitrous oxide emissions compared to other EU member states, which can be explained by the fact that Ireland has the highest relative agriculture emissions contribution within the EU.

All gas emission quantities were converted to CO_2 equivalents using the Sixth Assessment Report (AR6) Global Warming Potential (GWP) values over a 100-year time horizon.[68] This conversion was done by multiplying the mass of gas emissions by each gas's corresponding GWP. GWPs assess climate change effects by quantifying the amount of energy that emissions from one tonne of gas will trap over a specific period. There are minor differences between data from the 2019 EPA data and the county- and DZ-level BEIs as the EPA data uses conversion factors from the IPCC Fourth Assessment Report.

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

Table 10 Greenhouse Gases Global Warming Potential (IPCC Sixth Assessment Report Values)

7.1.1.1 Carbon Dioxide

CO_2 is the most common greenhouse gas emitted due to anthropological activities. Due to its presence in all emissions sectors and abundance in comparison to other GHGs, it is used as a reference gas and given a GWP of 1 (regardless of the period used for calculations). A 100-year time horizon was used in making this report; however, CO_2 stays in the atmosphere for hundreds of years.

7.1.1.2 Methane

CH_4 is another commonly found GHG, primarily emitted in the Agriculture and Waste sectors. The GWP for methane used in this report is 29.8. It absorbs more energy than CO_2 but has a much shorter residence time in the atmosphere at roughly ten years.

7.1.1.3 Nitrous Oxide

N_2O has an assigned GWP of 273 in this report. It is primarily emitted by the Agriculture sector and stays in the atmosphere for more than 100 years.

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

7.1.1.4 F-gases

Fluorinated gases, also known as F-gases, trap much more heat per tonne than CO_2 does. The GWP values used in this report are as follows: Sulphur Hexafluoride (SF_6) has a GWP of 25,200, Hydrofluorocarbons (HFCs) have a GWP ranging from 4-14,600, Perfluorinated compounds (PFCs) range from 6,630 to 11,100, and Nitrogen trifluorides (NF_3) are assigned a GWP of 17,400. SF_6 is mostly present in the Industry sector. In the national inventory, there is an F-gases sector that accounts for about 2% of emissions.

7.2 National Grid Fuel Breakdown

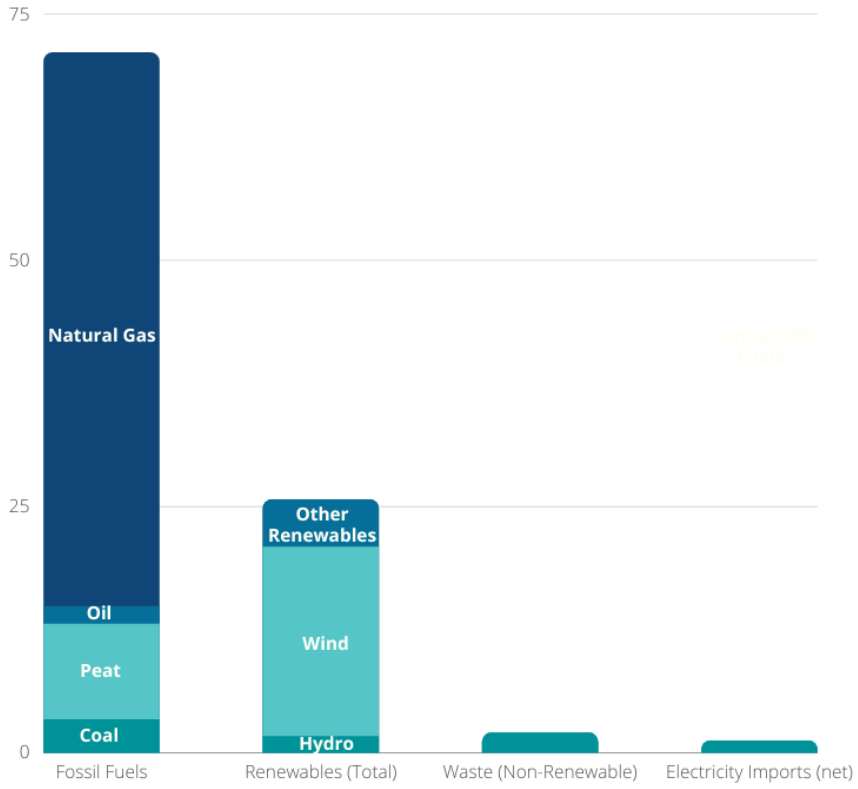


Figure 15 National Grid Fuel Breakdown

Natural gas dominates Ireland's electricity production at 56%, followed by wind energy at 19%. Renewables, including wind, contribute 26% to the grid's energy sources. However, inefficiencies in the grid result in a 46% energy loss before reaching consumers, leaving the grid with a 54% efficiency. Notably, the grid's carbon intensity has declined, dropping from 636 g CO_2/kWh in 2005 to 324 g CO_2/kWh in 2019.

7.3 The MapEIre Project

Starting in 2016, the Environmental Protection Agency (EPA), in collaboration with Aarhus University in Denmark, initiated the National Mapping of Greenhouse Gas (GHG) and non-GHG Emissions Sources project, known as MapEIre.[69] The primary objective of this project was to establish a spatial distribution for the national emissions inventory. Consequently, all emissions of greenhouse gases in the Irish emissions inventory were allocated across a square kilometre grid that encompasses the

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

entire Irish Exclusive Economic Zone. These emissions were categorised based on the type of gas and the subsectors corresponding to the Common Reporting Format (CRF) and the Nomenclature for Reporting from the United Nations Framework Convention on Climate Change (UNFCCC). This dataset also enables the calculation of emissions inventories for smaller geographic areas, such as Local Authority areas. It is worth noting that the methodology employed by the MapEIre project varied among different subsectors, and some subsectors may have undergone more robust mapping than others.

The MapEIre data accounts for Scope 1 emissions, meaning it includes only emissions generated in each area for that area but does not necessarily reflect where the outputs resulting in those emissions are consumed.

7.4 CSO - Small Area Population Statistics by the 2016 Census and the AgriMap by the Census of Agriculture

The Central Statistics Office (CSO) is Ireland's national statistical office, and its purpose is to impartially collect, analyse and make available statistics about Ireland's people, society, and economy.[70] Small Area Population Statistics (SAP) are 2016 Census statistics produced for a range of geographical levels from state to small areas. SAP data can be obtained either using an interactive map or by downloading tables and shapefiles.

The 2020 Census of Agriculture provides data on dimensions of holdings, livestock, and area farmed collected by the electoral divisions (another territorial subdivision of the national territory of Ireland).

The main data retrieved from the 2016 Census regarded the number of households in DZ (Theme 1), the type of fuel used for heating by number of households (Theme 6) and the number of livestock registered in the DZ to inform the calculation of emissions for the agricultural sector (Census of Agriculture). This data was used as supplementary information for data provided in the EMPs for the Residential sector and to inform calculations made using MapEIre data in the Agriculture sector.

7.5 Sectoral Emissions Calculations

Two energy master plans (EMPs) were provided by LAs for the formulation of this report: two comprehensive plans, a combined one for Arainn and Inis Meáin, and an additional plan for Inis Oírr.[71] Emissions figures in the Residential, Transportation, and Commercial and Industry sectors calculated using data collected during the one-year period from the start of May 2017 through the end of April 2018 were summed to find combined baseline figures for the three islands. The data for Ariann and Inis Meáin came from Table 3-2 in the two-island EMP. The data for Inis Oírr was found in Figure 10 of the Inis Oírr EMP. As more data becomes available and fewer assumptions are used, updated calculations for all sectors will improve the accuracy of this assessment.

7.5.1 Agriculture

Emissions from the Agriculture sector were calculated using the MapEIre data set. The AgriLivestock and AgriOther data sets were filtered to include only data from the decarbonisation zone (DZ). This

[70] https://www.cso.ie/en/aboutus/whoweare/

[71] The Energy Master Plan for Arainn and Inis Meáin can be found here, https://www.aranislandsenergycoop.ie/wp-content/uploads/2021/06/Energy-Masterplan.pdf, and the Energy Master Plan for Inis Oírr was provided by Local Authorities.

data set included the number of particles of CH_4, CO_2, N_2O, NH_3, and NO_x gases in the DZ. All gases were converted into CO_2 equivalents so that they could be summed to be one representative figure.

The livestock emissions data found through the top-down approach using MapEIre was further informed with a bottom-up approach using 2020 data from the Central Statistics Office (CSO).[72] The total number of units of cattle and sheep were taken and converted to CH_4 and then CO_2 to be comparable with emissions from other sectors. The number that resulted from the bottom-up calculations was 9% higher than the calculated value from the top-down method. In the final calculation, the number from the bottom-up approach was summed with the data from other agricultural emissions from the top-down approach as there was no bottom-up approach available.

7.5.2 Land Use, Land Use Change, and Forestry

Emissions from the Land Use, Land Use Change, and Forestry (LULUCF) sector were calculated in two ways. First, the LULUCF MapEIre Geospatial dataset was snapped to the Aran Islands Decarbonisation Zone and emissions were calculated. This data provided a high-level look at LULUCF emissions.

The second calculation was made using land cover data from the National Land Cover Map because of its high resolution compared to other national mapping efforts. The area of each category of land cover (Forest, Grassland, Artificial Surface, and Heath and Bracken) was calculated using an emissions factor derived from Ireland's National Inventory Report.[73] The factors for Forest, Grassland, and Artificial Surfaces were derived by dividing the total emissions by sector by the land area of each sector, resulting in an emissions factor per hectare. The sector of Heath and Bracken was not measured in the National Inventory, so the emissions factor used for this sector was taken as the average between Grassland and Forest.

7.5.3 Waste

Waste sector emissions were calculated in three steps to account for emissions from solid waste processed on and off the islands, as well as wastewater emissions. Waste processed within the DZ was accounted for using the MapEIre data set. One recycling centre exists on the islands and an assumption was made that the MapEIre Waste data accounts for emissions from this centre. The DZ was layered with the Waste data set and the results were exported and analysed. The emissions from methane and nitrous oxide were converted to their carbon dioxide equivalents and summed with the carbon dioxide emissions for the total emissions. Additional data on the types of waste processed on the islands was provided by the Local Authorities and is available in the waste supplementary information section.

Wastewater emissions were calculated using a top-down approach based on county-level MapEIre data as more localised data was not available. An assumption was made that the wastewater and resulting emissions produced within the Aran Islands DZ could be calculated as a proportion of the total wastewater emissions produced by County Galway. The wastewater calculations make with MapEIre data from the County Galway BEI were used proportionally for this BEI.

Emissions for waste processed off-island were calculated using an emissions factor derived from national waste emissions data.[74] Waste is shipped to a Waste to Energy plant, so the actual waste emissions are likely lower than this number.

[72] https://visual.cso.ie/?body=entity/ima/coa&boundary=C03904V04656&guid=2AE19629236913A3E055000000000001

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

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

7.5.4 Fluorinated Gases

The F-gas inventory was completed using data from the MapEIre project, specifically datasets concerning agriculture, transportation, and industry. Four F-gases were measured: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6). MapEIre data for fluorinated gases are provided in $ktCO_2e$, so no conversion factors were needed. This inventory is not included in the general inventory as it is a small portion of industrial emissions and relies heavily on assumptions.

7.5.5 Local Authority Emissions

The Local Authority is required to report its own emissions to the SEAI's Monitoring and Reporting system annually. These emissions do not necessitate additional calculations for the total BEI report but as context to support the Local Authority when considering steps towards mitigation of emissions. The data included in this inventory is also incorporated in the other sectors of the report. The heating and electricity data were provided in the Energy Master Plans. Lighting data was provided by the Local Authority and converted from kWh to CO_2 equivalents using a conversion factor from the SEAI based on the 2022 consumption of the Irish grid.[75]

7.5.6 Data Usage Summary

The following tables summarise the data sets used in each sector calculation as well as the supporting information for each sector.

Primary Calculation

Sector	Data Source
Residential	Energy Master Plans
Transport	Energy Master Plans
Commercial and Industry	Energy Master Plans
Agriculture	MapEIre (Agri_Other, Goats), Agricultural Census Data
LULUCF	National Land Cover Map, National Baseline Emissions Inventory
Waste	Mass of Wastes from Local Authority, MapEIre (Waste, Wastewater county level), National Waste Emissions
F-Gases	MapEIre Industry
Local Authorities	Energy Master Plans, Public Lighting from Local Authority

Supporting Information

Sector	Data Source
Residential	CSO Small Area Data, BER Map, Social Housing from Local Authority
Transport	CSO Small Area Data, Energy Master Plans
Commercial and Industry	BER Map, Monitoring and Reporting Data
Agriculture	Agricultural Census Data
LULUCF	National Land Cover Map
Waste	Energy Master Plans, Input from Local Authority

Table 11 Data Sources used in BEI by Sector

[75] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/

BASELINE EMISSIONS INVENTORY

ARAN ISLANDS DECARBONISATION ZONE

BABLE

BABLE
INNOVATION WITH AND FOR CITIES
SEYFFERSTRASSE 34, 70197
STUTTGART - GERMANY
info@bable-smartcities.eu
www.bable-smartcities.eu