SUSTAINABLE ENERGY AUTHORITY OF IRELAND

# ENERGY IN IRELAND

2023 Report

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

**Energy in Ireland**

# 2023 Report

# Energy in Ireland

## 2023 Report

December 2023

**ID:** EII-2023-1.3

**Sustainable Energy Authority of Ireland**
SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

SEAI is funded by the Government of Ireland through the Department of Communications, Climate Action and Environment.

## Acknowledgements

SEAI gratefully acknowledges the co-operation of all the organisations, agencies, energy suppliers and distributors that provide data and respond to its questionnaires throughout the year. This co-operation is especially appreciated in 2023, when many data providers have been asked to submit more data within shorter deadlines, as SEAI worked to collect energy details to inform Government policy and satisfy new emergency reporting brought about by the current energy crisis.

## Foreword

As COP28 unfolded in Dubai, reports from the *Global Carbon Project* emerged that the world is on track to have burned more coal, oil, and gas in 2023 than in 2022. Given poor global performance, other experts have estimated that we need to be net-zero globally by 2040 to stay below the target of 1.5 degrees of warming. This year's *Energy in Ireland* is our national 'report card' on how Ireland is contributing to many of the global challenges being discussed at COP28. Around 60% of Ireland's GHG emissions are energy-related, and many of the energy trends we see in 2022 and 2023 are sobering.

Despite the excellent progress made on renewable electricity, the momentum on home retrofits, and the uptake of electric vehicles, Ireland remains highly dependent on imported fossil fuels to satisfy our energy needs. Currently over 81% of our energy is imported, and most of that is fossil fuel. Our investments in energy efficiency and our development of indigenous renewable energy sources are slowly starting to break those dependencies. But the pace of that change is currently too slow to achieve our national and EU obligations, both in the near and longer term. We are not yet acting in line with what climate science tells us – that we are living through a climate emergency.

Encouragingly, 2022 had the lowest energy-related emissions of any year in the last quarter century, except at the peak of COVID impacts in 2020. Energy-related emissions were down 1.7% on the previous year, largely due to reduced energy demand in the residential sector from a combination of weather effects, a post-COVID trend of returning-to-office, and high energy prices leading to behavioural change. But while 2022 and 2023 showed record levels of biofuel blending into our petrol and diesel, energy demand and related emissions from transport continued to rise, as travel patterns rebound to pre-COVID levels. Similarly, while the roll-out of electric heat pumps means that we have never seen more renewable energy used in Irish homes, we still have 94% of home heating coming from fossil fuels.

When taken together, SEAI's *Energy in Ireland* and *National Energy Projection* reports show that early corrective action is crucial. Unless GHG emissions are reduced sharply between now and the end of 2025, it is highly unlikely that Ireland will remain within its carbon budgets out to 2030. In the context of EU and national climate and energy obligations, we need immediate and significant scaling of activity now, if we are to avoid significant compliance costs later. The *Department of Public Expenditure, NDP Delivery and Reform* recently estimated that the cost of this compliance could run to between €3 billion and €8 billion – money that would be much better invested early-on to drive sustainable energy action in Ireland.

The International Energy Agency recently called for a doubling of energy efficiency and a tripling of renewables deployment globally, to give us a chance of living within the 1.5 degrees Paris target agreed in 2015. But in the context of reports from COP28 it is unclear who will lead on that necessary ambition globally. In Ireland, that climate leadership will involve significantly increased Government spending commitments; the delivery of deeper and more binding policy packages; increased regulation of fossil fuels; more effective use of financial incentives and disincentives; a supportive tax system; increased private finance; more citizen and community action; and broader societal engagement.

Ireland has some of Europe's strongest targets. Satisfying these obligations will require an unprecedented rate of decarbonisation in our energy system, and there are few international examples that we can look towards to suggest next moves. We need to imagine a future based not on our past experience, but on the possibility of our future – a future of clean, cheap, and secure energy for the next generations. A future where our dependence on imported fossil fuels is replaced with local renewables, and where we use energy wisely. A future where we support each other, especially those least able to afford the sustainable energy transition, whether at home or globally.

Please contact SEAI if you would like to play your part in that future.

**William Walsh, CEO**

## 2022 and 2023 Highlights

### From 2022

- Ireland imported 81.6% of its total primary energy requirement.
- 85.8% of Ireland's primary energy requirement came from fossil fuel.
- Ireland's total energy demand was 4.7% higher than in 2021.
- Energy-related emissions were 1.7% lower.
- 2022 had the lowest energy-related emissions of any year in the last quarter century, except 2020 with its particularly strong COVID-impacts.
- Energy-related emissions were down from heat (-1.0 $MtCO_2$) and electricity generation (-0.2 $MtCO_2$), but up from transport (+0.7 $MtCO_2$).
- 35.6% of energy-related emissions came from heat, 34.3% came from transport, and 30.1% came from electricity generation.
- Energy demand for transport was 19.9% higher than in 2021, as travel patterns continued to rebound to pre-COVID levels.
- Total transport energy demand has rebounded to 95% of pre-COVID 2019-levels.
- 93.9% of road transport energy demand came from fossil fuels.
- Demand for electricity was 2.5% higher than in 2021, consistent with the annual growth of recent years.
- The carbon intensity of Ireland's electricity was 332 $gCO_2$/kWh.
- 49.2% of the electricity indigenously generated in Ireland came from gas.
- 38.9% of electricity generated in Ireland came from renewables.
- Practically all new electricity demand in the last decade has come from the *commercial services* sector.
- Electricity demand in the *commercial services* sector has increased by 61.5% since 2012, while the electricity demand in all other sectors has increased by just 8.0%.
- Electricity demand in the *information & communication* sub-sector has increased by 562% since 2012.
- In 2022, 82% of all *information & communication* electricity demand came from data centres.
- Total heat demand was 7.3% lower than in 2021, but that reduction was not evenly distributed across all sectors of the economy.
- Heat demand in the residential sector was 13.8% lower than in 2022, driven by a combination of weather effects, return-to-office trend, and demand reductions due to high energy prices.

### From 2023

Using early provisional data from January to September 2023, SEAI can make best estimate extrapolations for energy demand and emissions to the end of 2023. These best estimates are leading indicators for 2023 and are not definitive results:

- Diesel demand may be 1.3% higher than in 2022 and reach 98.3% of the pre-COVID demand observed in 2019.
- Petrol demand may be 7.4% higher than in 2022 and reach 96.5% of the pre-COVID demand observed in 2019.
- Transport emissions may be 11.8 $MtCO_2e$, up slightly on 2022 emissions.
- In the first 9 months of 2023, Ireland imported 9.1% of its electricity supply, up from 1.1% in 2022.
- The increased use of imported electricity has significantly reduced Ireland's electricity emissions.
- Electricity emissions may be 7.3 $MtCO_2e$, down significantly on 2022 emissions.
- The carbon intensity of electricity may be 259 $gCO_2$/kWh, down significantly on the 2022 value.
- Electricity generation from utility-scale 'solar farms' may be 0.4 TWh, approximately twice that of rooftop solar.

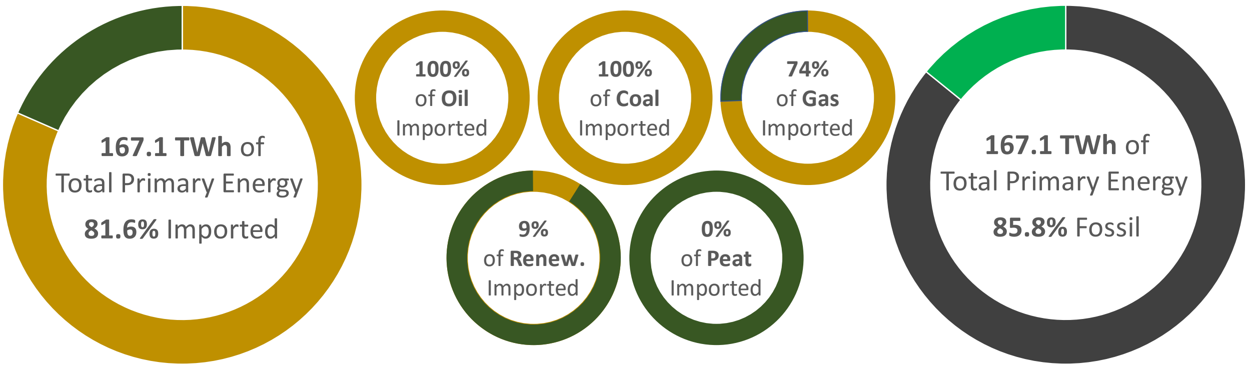
## Contents

# 1 Energy review of 2022 and 2023

## 1.1 Overall trends in energy and related emissions

In 2022, Ireland imported 81.6% of its total primary energy requirement. For comparison, the average energy import dependency of all EU member states was 57.5% in 2020. Ireland has a high energy import dependency because it imported all its coal and oil products, and 74.0% of its natural gas supplies. However, Ireland's import dependency on renewable energy is low. Ireland imported just 8.8% of its renewable energy in 2022, most of which was biodiesel.

**Figure 1.1: Ireland's 2022 energy import dependency and fossil fuel dependency**

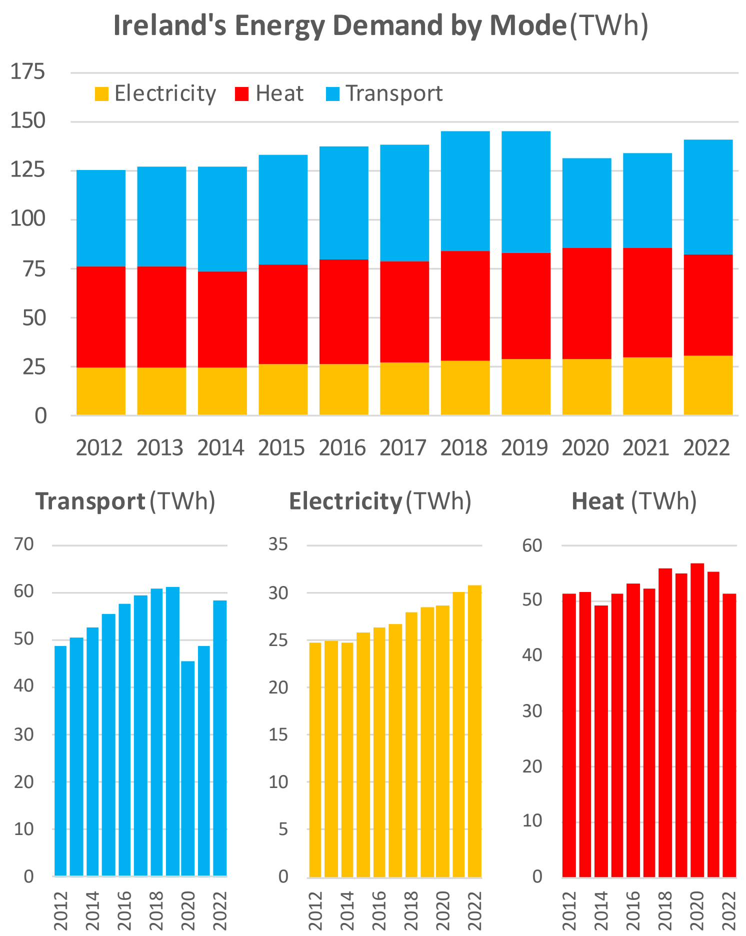



Ireland also has a high fossil fuel dependency, with 85.8% of primary energy coming from oil, natural gas, coal, and peat in 2022. 13.0% of Ireland's primary energy requirement in 2022 came from renewables. The remaining 1.2% of primary energy came from the use of non-renewable wastes and imported electricity across international interconnectors. Ireland's total energy demand in 2022 was 4.7% higher than in 2021. To help explain this overall increase, it is useful to break energy demand into the three energy 'modes' of *transport, electricity,* and *heat.*

Energy demand for *transport* in 2022 was 19.9% higher than in 2021, as travel patterns continued to rebound to pre-COVID levels. Energy demand for international and domestic flights in 2022 was 128% higher than in 2021, and this was a significant contributor to the overall increase in transport energy demand. Total transport energy demand in 2022 rebounded to 95% of pre-COVID 2019-levels. As detailed below in Section 1.2, best estimates from SEAI, based on provisional monthly data from January to September 2023, indicate a further continuation of transport rebound during 2023, which will act to increase transport emissions in 2023.
Demand for *electricity* in 2022 was 2.5% higher than in 2021, which is broadly consistent with the annual growth of recent years. As detailed in section 1.3, most of the increased electricity demand over the last decade has come from the *commercial services* sector of the economy, and specifically the *information & communication* sub-sector of the economy. Data centres are currently the dominant driver of increased electricity demand in Ireland.

Energy demand for *heating* in 2022 was 7.3% lower than in 2021. Heat demand includes not only the heating of our homes, offices, businesses, and schools but also industrial manufacturing processes and commercial service activities. Most of the overall heat demand reduction in 2022 was due to reduced heat demand in the residential sector. As detailed in section 1.4, residential heat demand accounts for just under half of all heat demand in Ireland, and the reduction observed in 2022 was due to a combination of weather effects, *i.e.,* relatively mild weather in the winter months of 2022, 'return to office' behaviours, and reduced demand for heating due to high energy prices.

**Figure 1.2: Total energy demand broken into the three modes of transport, electricity, and heat**



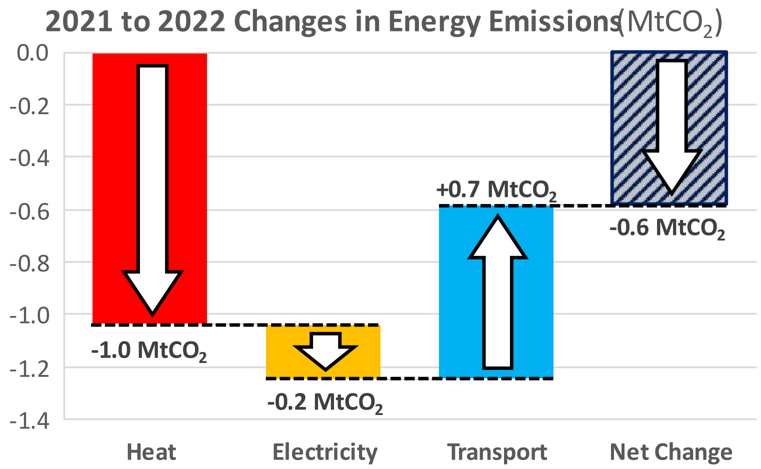

Despite total energy demand in 2022 being 4.7% higher than in 2021, energy-related emissions were 1.7% lower. This overall reduction in energy-related emissions is again best understood by looking separately at the emissions changes in the heat, electricity, and transport modes, and then summing those three changes together.

Emissions from heat in 2022 were 1.0 Mt$CO_2$ lower than in 2021, due to the reduced demand for heat across the economy. The reduction in heat emissions is particularly prominent because a substantial fraction of that demand reduction came from the residential sector, which uses particularly carbon intensive blend of fuels (*i.e.,* coal, peat, and oil) for heating.

Despite the quantity of electricity generated in Ireland increasing in 2022, the emissions from that generation were 0.2 Mt$CO_2$ lower in 2022 than in 2021. This is welcome, but context is important. In 2021, outages and maintenance work on gas-fired electricity generators forced the use of more carbon intensive coal and oil generation to satisfy Ireland's electricity demand in that year. As a result, electricity emissions in 2021 were temporarily inflated over previous years, and the 0.2 Mt$CO_2$ reduction recorded in 2022 is best viewed as a *'return to norm'* effect, rather than an improvement from more renewable generation.

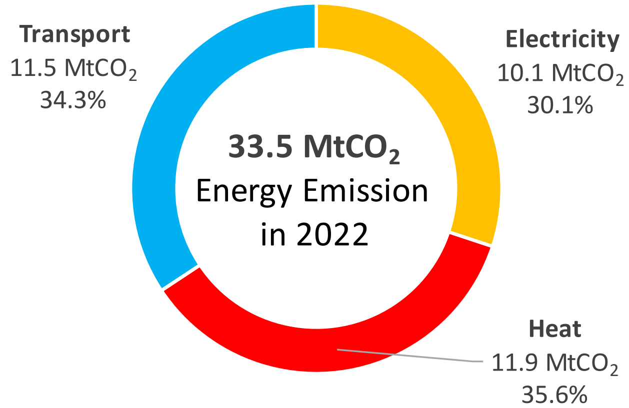
Emissions from transport were 0.7 Mt$CO_2$ higher in 2022 than in 2021, as travel patterns continued to rebound to pre-COVID levels. This increase in transport emissions is lower than what the previously mentioned 19.9% increase in transport energy demand might suggest. This occurs because the emissions associated with *international* transport (*i.e.,* international aviation and maritime navigation) are accounted for separately, outside the *national* accounts of Ireland's greenhouse gas inventory from the EPA, and our carbon budgets. The emissions from international flights (which increased by 128% in 2022) do not count towards national transport emissions[1]. Summing together the reduced emissions from heat and electricity with the increased emission from transport gives a net reduction in energy-related emissions of 0.6Mt$CO_2$ compared to 2021.

**Figure 1.3: Changes in energy emission from 2021 to 2022 in the three modes of transport, electricity, and heat**




In 2022, heat accounted for 35.6% of energy-related emissions, transport for 34.3% of energy-related emissions, and electricity for 30.1% of energy-related emissions. Overall, energy-related emissions accounted for about 56% of Ireland's total greenhouse gas emissions in 2022, with agriculture making up the majority share of the total.

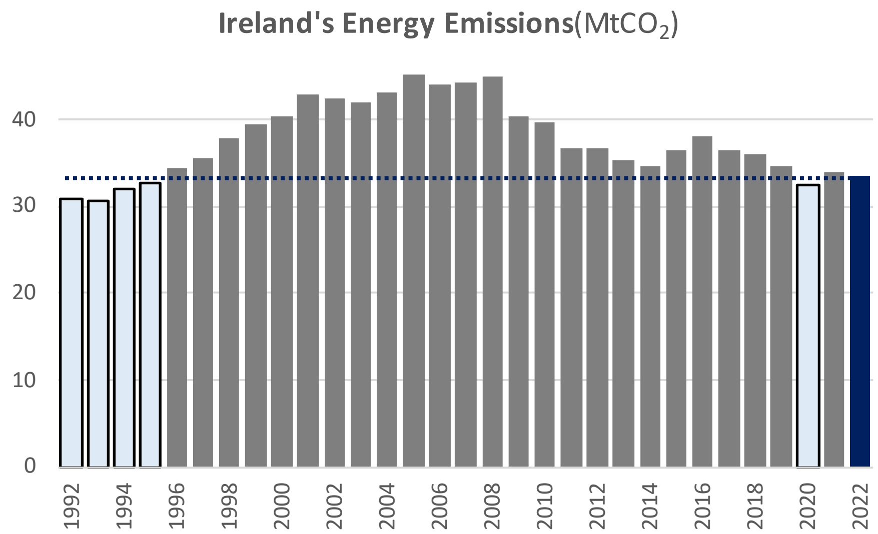
**Figure 1.4: 2022 emissions broken into the three modes of transport, electricity, and heat**




2022 had the lowest energy-related emissions of any year in the last quarter century, except 2020 with its particularly strong COVID-impacts. Energy emissions in 2022 were 7.2% lower than 2018-levels, which is an important comparator, because it is the baseline year for the setting of Ireland's carbon budgets, and their sectoral emission ceilings. However, despite electricity, transport, and heat emissions in 2022 all being lower than in 2018, the pace of reduction in energy-related emissions is not currently sufficient to our meet national climate obligations.

[1] In accordance with guidance from United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC).

**Figure 1.5: Long-term trends in Ireland’s energy emissions**




As detailed in SEAI’s 2023 *National Energy Projections*[2] report, even with a full delivery of the policies and measures identified in the Government’s 2023 Climate Action Plan (CAP-23), the energy sector will likely still be off-track to keep within its share of Ireland’s legally binding carbon budgets. In projections modelling the anticipated impact of *existing* policies and measures (*i.e.,* the *With Existing Measures* or WEM scenario) it is estimated that energy-related GHG emissions could exceed their 2021-2025 carbon budget by 11%, or 17.2 $MtCO_2e$. This overshoot would mean that 16% of the 2026-2030 carbon budget is already ‘consumed’ before its 5-year period begins. In the WEM scenario, the 2026-2030 carbon budget allocation for energy-related emissions is fully consumed sometime in 2028, and exceeded by 24%, or 63.7 $MtCO_2e$, by 2030.

Projections anticipating the impact of *additional* policies and measures from CAP-23 (*i.e.,* the *With Additional Measures* or WAM scenario) indicate that energy-related GHG emissions could exceed their 2021-2025 carbon budget by 8%, or 12.8 $MtCO_2e$. This overshoot would mean that 12% of the 2026-2030 carbon budget is consumed before its 5-year period begins. In the WAM scenario, the 2026-2030 carbon budget allocation for energy-related emissions could be exceeded by 14%, or 37.6 $MtCO_2e$, by 2030. If the WEM (or WAM trajectory) is followed until 2025, then energy-related greenhouse gas emissions would need to fall by 71% (or 66%) by 2030 to keep within the 2026-2030 carbon budget. This would require an average annual emission reduction during the 2026-2030 carbon budget of 19.7% per annum in the WEM scenario, and 16.5% in the WAM scenario.

SEAI’s 2023 *National Energy Projections* report highlights that early corrective action is crucial. The earlier that annual emissions can be reduced, the greater the impact on the *cumulative* emissions that are accounted in the carbon budgets. Unless greenhouse gas emissions are reduced sharply between now and the end of 2025, it is highly unlikely that Ireland will remain within its carbon budgets out to 2030.

---

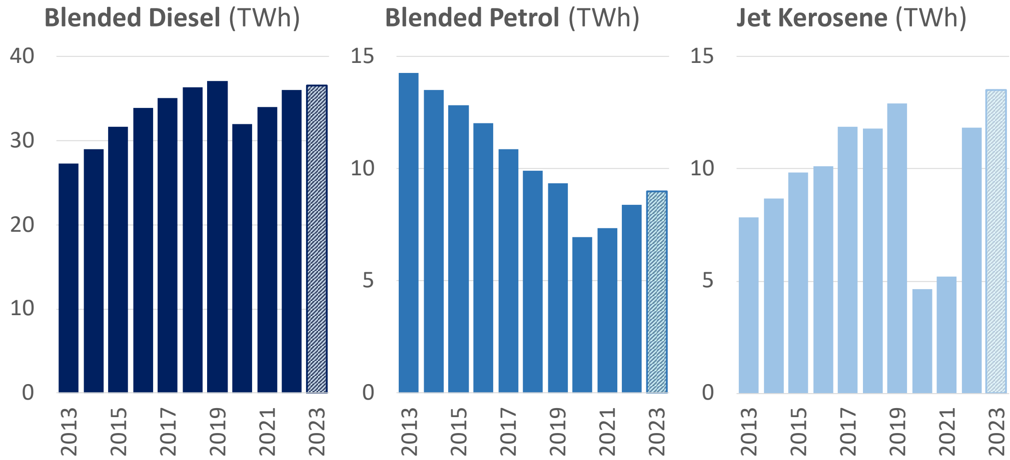
[2] https://www.seai.ie/publications/National-Energy-Projections-2023.pdf

## 1.2 Trends in transport energy demand and related emissions

Energy demand for transport in 2022 was 19.9% higher than in 2021, as travel patterns continued to rebound to pre-COVID levels. Demand for the diesel and petrol used in road transport in 2022 was 6.1% and 13.9% higher than in 2021, respectively. Demand for jet kerosene in 2022 was 128% higher than in 2021.

Using early provisional data from January to September 2023, SEAI can make best estimate extrapolations for transport energy demand to the end of 2023. These best estimates indicate a continuing rebound of transport energy demand into 2023. These estimates indicate that diesel demand in 2023 may be 1.3% higher than in 2022 and reach 98.3% of the pre-COVID demand observed in 2019. The same estimates show that petrol demand in 2023 may be 7.4% higher than in 2022 and reach 96.5% of the pre-COVID demand observed in 2019. If the best estimate for 2023 jet kerosene demand proves accurate, then 2023 demand will be higher than pre-COVID 2019-levels.

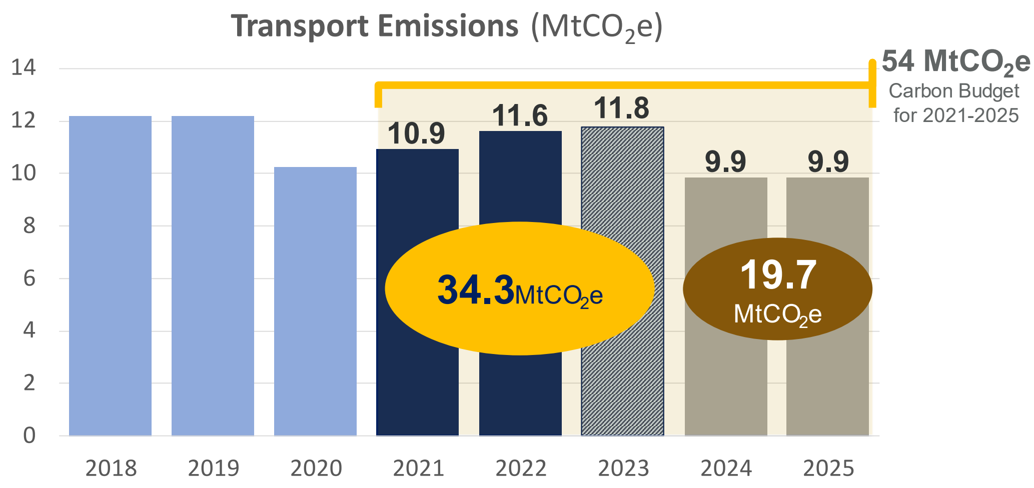
**Figure 1.6: Energy demand for blended diesel, blended petrol, and jet kerosene**




Using January to September 2023 extrapolations for road transport, rail transport, and national aviation and navigation, SEAI estimates transport emissions of 11.8 $MtCO_2e$ in 2023. Adding this best estimate for 2023 to the definitive 2021 and 2022 transport emissions reported by the EPA gives a 3-year 2021-2023 total of 34.3 $MtCO_2e$. The 5-year 2021-2025 sectoral emission ceiling for transport is 54 $MtCO_2e$. This means that just 19.7 $MtCO_2e$ of budgeted transport emissions will remain for the last 2-years of the 2021-2025 carbon budget. To remain within its sectoral emission ceiling, transport emissions would therefore need to remain below an average of 9.9 $MtCO_2e$ in both 2024 and 2025. For context, during the height of COVID-impacts to travel in 2020, annual transport emissions only dropped to 10.3 $MtCO_2e$.

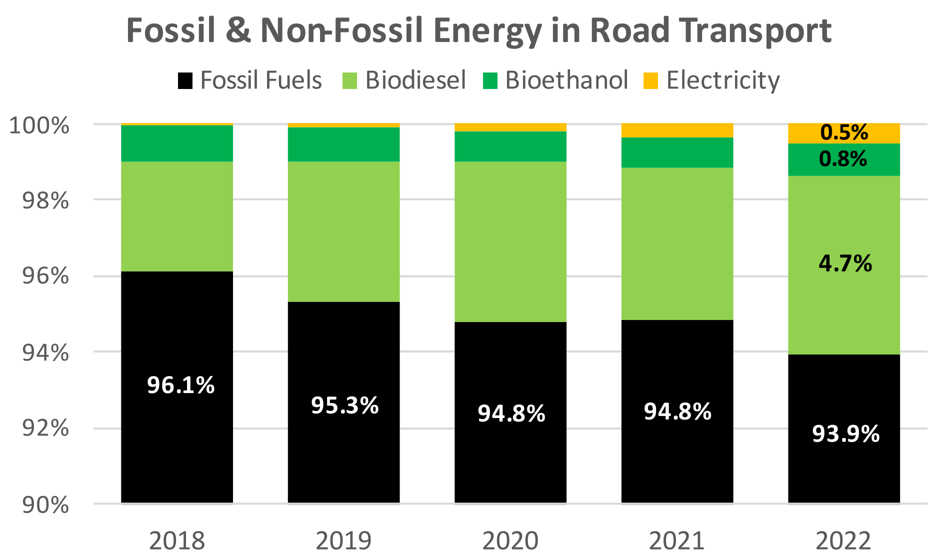
As reported in SEAI's 2023 *National Energy Projections* report, in both the WEM and WAM scenarios, the transport sector is anticipated to exceed its sectoral emission ceiling in both the 2021-2025 and 2026-2030 carbon budgets. The projected exceedance in the 2021-2025 carbon budget means that between 2% (WAM) and 9% (WEM) of the 2026-2030 carbon budget will be consumed before its period begins. Without deeper emissions cuts than currently anticipated, SEAI projections indicate a possible exceedance of 22.3 $MtCO_2e$ (24%) by the end of the 2026-2030 carbon budget in the WEM scenario, and an exceedance of 6.2 $MtCO_2e$ (7%) in the WAM scenario.

**Figure 1.7: Transport emissions in the 2021-2025 carbon budget**




Ireland's transport energy demand remains highly fossil dependent. In 2022, 93.9% of road transport energy demand came from fossil fuels, with 68.6% coming from fossil-diesel and 25.4% coming from fossil-petrol. Road transport covers the energy demand of private cars, road freight, light goods vehicles, buses, taxis, etc., and accounts for 96% of transport emissions for the carbon budget. The remaining 6.1% of non-fossil energy in road transport comes mainly from the biofuels blended into the diesel and petrol fuels available from garage forecourts across the country. 4.7% of road transport energy in 2022 came from the biodiesel blended into our diesel, and 0.8% came from the bioethanol blended into our petrol. Electricity accounted for just 0.5% of road transport energy in 2022.

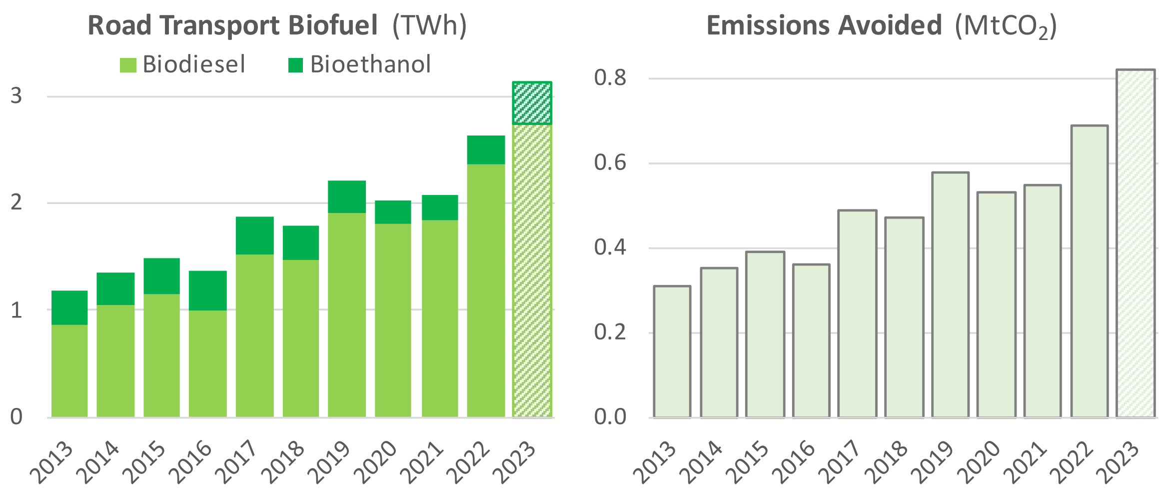
**Figure 1.8: Fossil and non-fossil energy in road transport**




The quantity of biofuel blended into diesel and petrol has increased over the last decade. This trend was further boosted in 2023, when the Irish Government announced the roll-out of E10 blended petrol in Ireland, in line with CAP-23 actions. Moving blended petrol to E10 acts to double the allowable bioethanol content from 5% to 10% (by volume). The more bioethanol blended into petrol, the less the emissions arise from using that petrol. CAP-23 also calls for roll-out of B12 blended diesel for 2025 and B20 blended diesel for 2030, increasing the biofuel blended into diesel to 12% and 20% (by volume), respectively.

Biofuel use in transport in 2022 was 26.2% higher than in 2021. Using early provisional data from January to September 2023, SEAI estimates that biofuel demand to the end of 2023 will be 18.8% higher than 2022. The increased use of biofuels helps avoid transport emissions by partially displacing fossil fuel demand. SEAI's best estimate is that the use of biofuel will help avoid 0.8 $MtCO_2$ of transport emissions in 2023 and has helped avoid 5.2 $MtCO_2$ of transport emissions over the last decade. For context, the estimate of 0.8 $MtCO_2$ of emissions avoided through biofuel use in 2023 is equivalent to taking off the road approximately 290,000 fully petrol or diesel fuelled private cars.

**Figure 1.9: Biofuels in road transport and the emissions they help avoid**

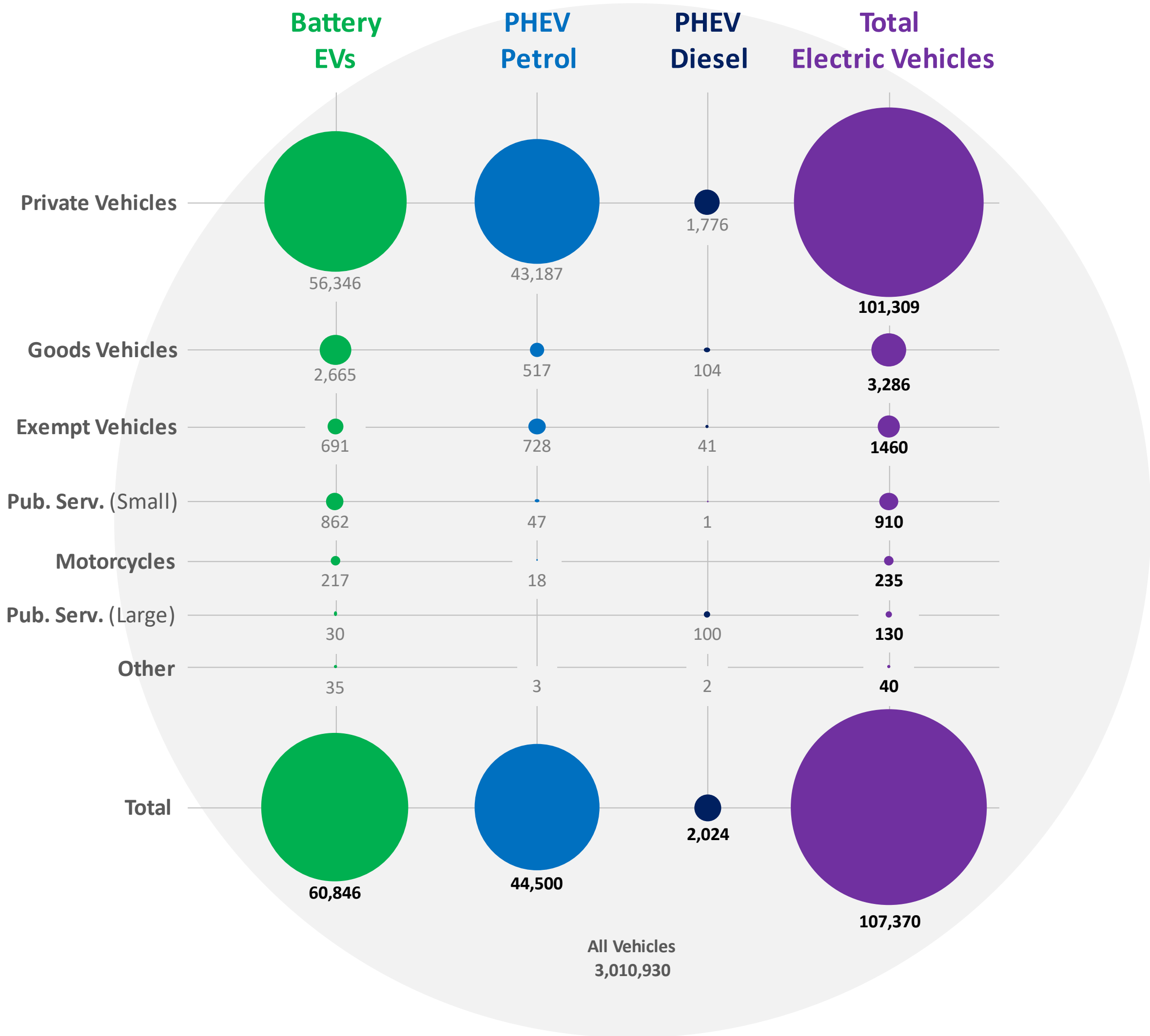



Electric vehicles (EVs) help reduce transport emissions because they are less fossil fuel dependent than conventional internal combustion engine (ICE) vehicles. On October 31st 2023, there were 107,370 EVs under taxation on Ireland's roads. On the same date, there were 3,010,930 vehicles in total, meaning that 3.6% (or 1-in-28) of Irish vehicles are EVs.

56.7% of Ireland's EVs are Battery-EVs (BEVs) that are entirely powered by plugging into an electrical source. BEVs offer the lowest emissions of all electric vehicles. The remaining 43.3% of EVs are Plug-In Hybrid EVs (PHEVs) that can be powered by plugging into an electrical source or through the combustion of petrol or diesel. If used optimally, *i.e.,* mainly using their battery power, then emissions from PHEVs are intermediate between BEVs and conventional ICE vehicles. 41.4% of EVs are Petrol-PHEVs and 1.9% of EVs are Diesel-PHEVs. Petrol and diesel 'hybrid' vehicles that cannot be externally electrically charged (and are therefore solely dependent on the combustion of petrol or diesel for locomotive power) are generally not regarded as EVs, because every kilometre they travel is entirely fuelled by petrol or diesel combustion.

94.4% of all EVs are classified as 'private' vehicles. 3.1% of EVs are classified as 'goods' vehicles, 1.4% are 'exempt' vehicles, and 1.0% are public service vehicles (both small and large). Examples of 'exempt' vehicles include state-owned vehicles, local authority vehicles, *etc.* Examples of small public service vehicles include taxis and hackneys, while large public service vehicles include those capable of carrying more than eight passengers, *i.e.,* buses and coaches. Most goods, exempt, and public passenger vehicles spend considerably more time 'on the road' than private vehicles, so they have higher energy use per vehicle than private cars. So, while these classes of vehicles only account for 5.4% of EV *numbers*, they account for a substantially larger fraction of EV *mileage*, and therefore brought a proportionally higher emission savings, when they were transitioned to an EV.

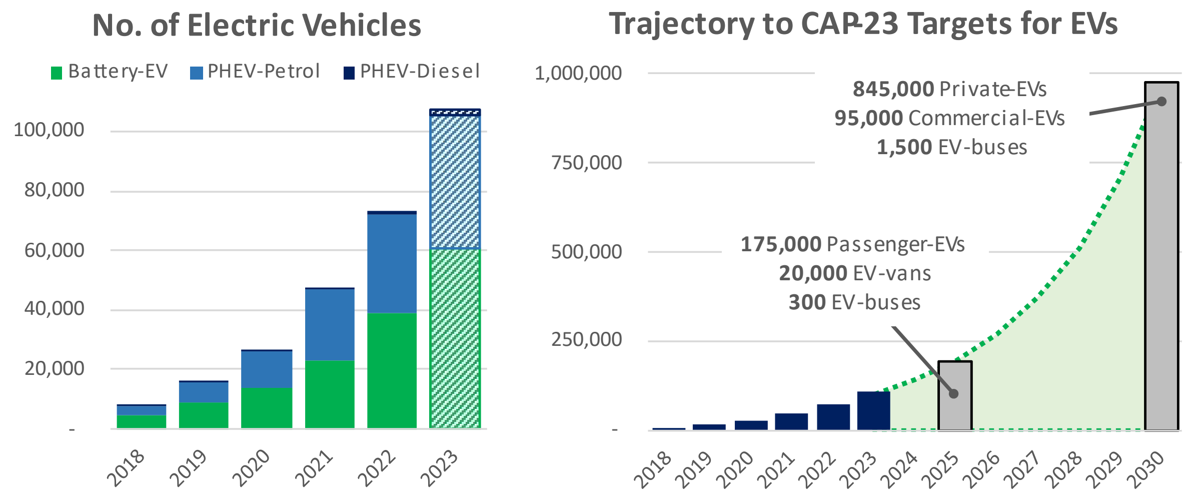
**Figure 1.10: Breakdown of EVs on Irish roads in October 2023**




On October 31st 2023, there were 33,798 more EVs under taxation on Ireland's roads than at the end of 2022. This corresponds to a 45.9% increase in the total number of EVs on Irish roads in 10 months. BEVs are the fastest growing type of EV. The number of BEVs on Irish roads increased by 54.9% between the end of 2022 and October 2023. These figures will increase further as November and December data is added to round-out the full 2023 calendar year.

Broadly speaking, the last 5 years have seen an exponential increase in the number of EVs on Irish roads, with approximately 50% more EVs being added each year. This exponential increase needs to continue if Ireland is to succeed against the ambitious EV targets set-out in CAP-23. These targets are 195,300 EVs by 2025 and 941,500 EVs by 2030. The 2030 targets correspond to a 30% EV-share of the total passenger car fleet, and a 30% zero-emission share of new heavy duty vehicle registrations.

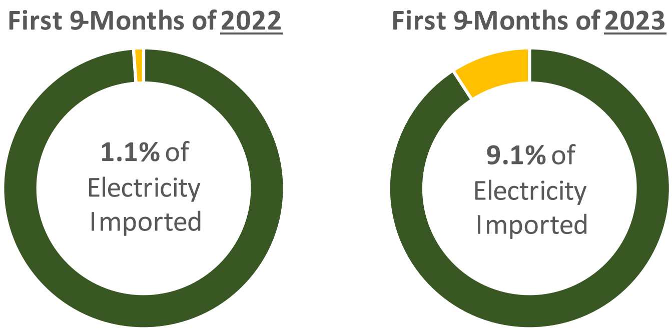
**Figure 1.11: Breakdown of EVs on Irish roads in October 2023**



## 1.3 Trends in electricity imports, generation, and demand

In the first 9 months of 2022, Ireland imported 1.2% of its electricity supply through interconnectors with mainland UK and Northern Ireland. One year later, in the first 9 months of 2023, Ireland had imported 9.1% of its electricity supply.

**Figure 1.12: Net import of electricity in the first 9 months of 2022 and 2023**




The integrated single electricity market (SEM) is the wholesale electricity market for Ireland and Northern Ireland. SEM allows electricity to be freely traded between market participants in either jurisdiction. The market is connected via two interconnectors to Great Britain (GB): the Moyle Interconnector between Northern Ireland and Scotland; and the East-West Interconnector between Ireland and Wales. For the purposes of Ireland's national energy statistics, physical flows of electrical power from Northern Ireland, or GB, to Ireland are considered imports (while flows in the opposite directions are considered exports). The GB electricity market is also connected to other European markets via interconnectors to France, Belgium, the Netherlands and Norway. Consequently, imports of electricity to Ireland are influenced by factors within SEM, the GB electricity market and the other European markets beyond, along with the physical limitations of interconnectors and other grid infrastructure.

The increase in net import of electricity across the interconnector between GB and Ireland began in March 2023 and coincided with several shifts in the GB electricity market: a steep drop in the UK carbon price with respect to that in the EU, an overall decrease in generation from fossil fuel in GB, and a significant increase in imports *to* GB via its other interconnectors (from France, Netherlands, Belgium and Norway). These and other market factors combined to increase imports of electricity through the interconnectors to Ireland from the UK (specifically GB), while reducing the quantity of electricity generated in Ireland.

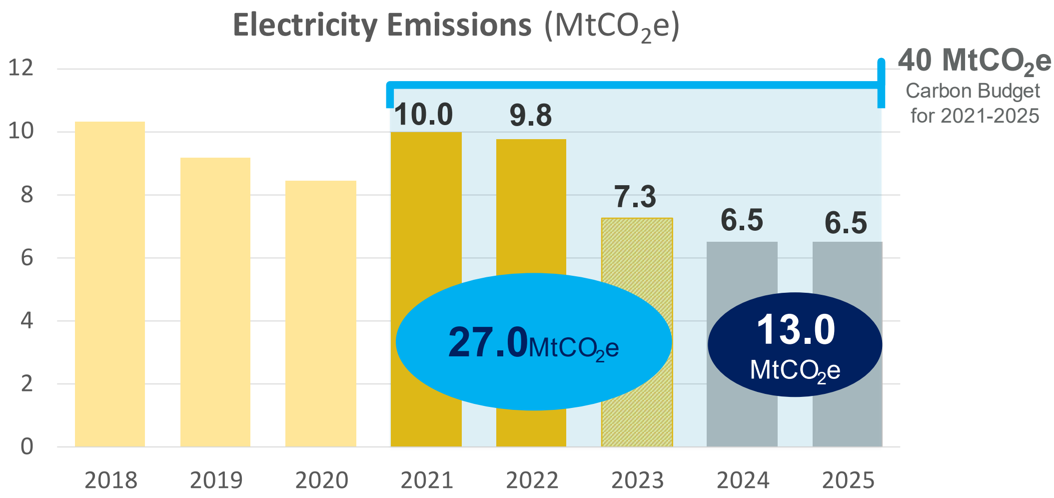
The overall effect of the increased use of imported electricity has acted to displace fossil-based generation in Ireland in 2023 and has significantly reduced Ireland's GHG emissions from electricity generation. In terms of the national carbon budgets, electricity imported into Ireland is 'emission free'. Any emissions are counted in the country that generates the electricity, not the country that imports and uses the electricity.

Using data from January to September 2023, SEAI estimates electricity emissions of 7.3 $MtCO_2e$ in 2023. Adding this best estimate for 2023 to the definitive 2021 and 2022 electricity emissions reported by the EPA gives a 3-year 2021-2023 total of 27.0 $MtCO_2e$. The 5-year 2021-2025 sectoral emission ceiling for electricity is 40 $MtCO_2e$. This means that just 13.0 $MtCO_2e$ of budgeted electricity emissions will remain for the last 2 years of the 2021-2025 carbon budget. To remain within its sectoral emission ceiling, electricity emissions would therefore need to remain below an average of 6.5 $MtCO_2e$ in both 2024 and 2025.

As reported in SEAI's 2023 *National Energy Projections* report, for both the WEM and WAM scenarios, the electricity sector is anticipated to exceed its sectoral emissions ceilings for both the 2021-2025 and 2026-2030 carbon budgets. The projected exceedance in the 2021-2025 carbon budget means that between 28% (WAM) and 37% (WEM) of the 2026-2030 carbon budget will be consumed before its period begins. Without deeper emissions cuts than those anticipated in the projections, the projections suggest a total exceedance of 20.1 $MtCO_2e$ (33%) in the

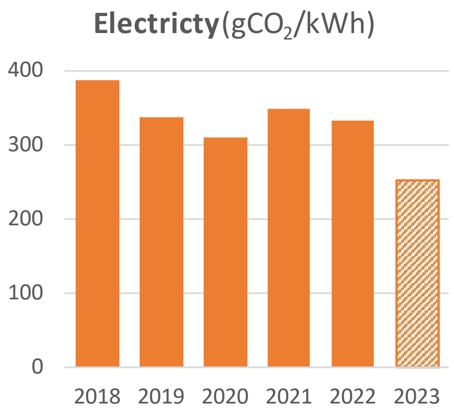
WEM scenario by the end of the 2026-2030 carbon budget, and an exceedance of 13.8 $MtCO_2e$ (23%) in the WAM scenario.

**Figure 1.13: Electricity emissions in the 2021-2025 carbon budget**




The import-led reduction in electricity emissions in 2023 acts to lower the carbon intensity of Ireland's electricity, *i.e.,* how many grams of carbon are emitted for every unit of electricity used. The carbon intensity of electricity is an important metric because it is used to calculate the emissions associated with EVs and heat pumps. It is also used to estimate emission savings on moving from fossil-fuel boilers to heat pumps, which is an important consideration for buildings aiming to decarbonise under CAP-23 actions.

**Figure 1.14: Carbon intensity of electricity**



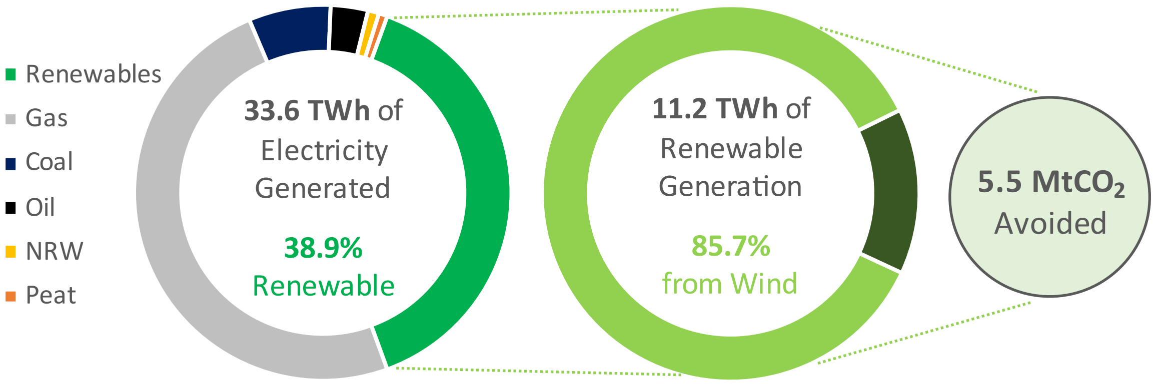

In 2022, the carbon intensity of Ireland's electricity was 332 $gCO_2/kWh$. Using January to September 2023 data, SEAI's current best estimate of the carbon intensity of electricity in 2023 is 259 $gCO_2/kWh$. If this best estimate proves accurate, then it will be the lowest carbon intensity value ever reached in Ireland.

It is important to acknowledge that the reduction in electricity emissions and carbon intensity of electricity have come about predominately through an increase in imported electricity – with increases in wind and solar generation also contributing – and the resultant decrease in fossil-fuel generation in Ireland. Flows across international interconnectors occur due to differences in marginal prices between jurisdictions. These price differences arise due to fuel mix differences (e.g., different levels of renewables in different countries), fuel and carbon price differences, and the level of interconnection between jurisdictions (e.g., new interconnection between two jurisdictions can have knock-on impacts for interconnector flows elsewhere). The market factors influencing the imports of electricity to Ireland could change as markets rebalance, or as new EU legislation is introduced (e.g., the CBAM Regulation).

In 2022, 49.2% of the electricity generated indigenously in Ireland came from gas, with renewables accounting for a further 38.9%. Coal (7.0%), oil (3.2%), non-renewable wastes (NRW) (0.9%), and peat (0.7%) accounted for the remainder of electricity generation in Ireland. 85.7% of renewable generation came from wind in 2022, with hydro (5.4%), biomass (3.9%), and renewable waste (2.7%) as the next three largest renewable sources. Solar generation accounted for 1.1% of renewable electricity in 2022.

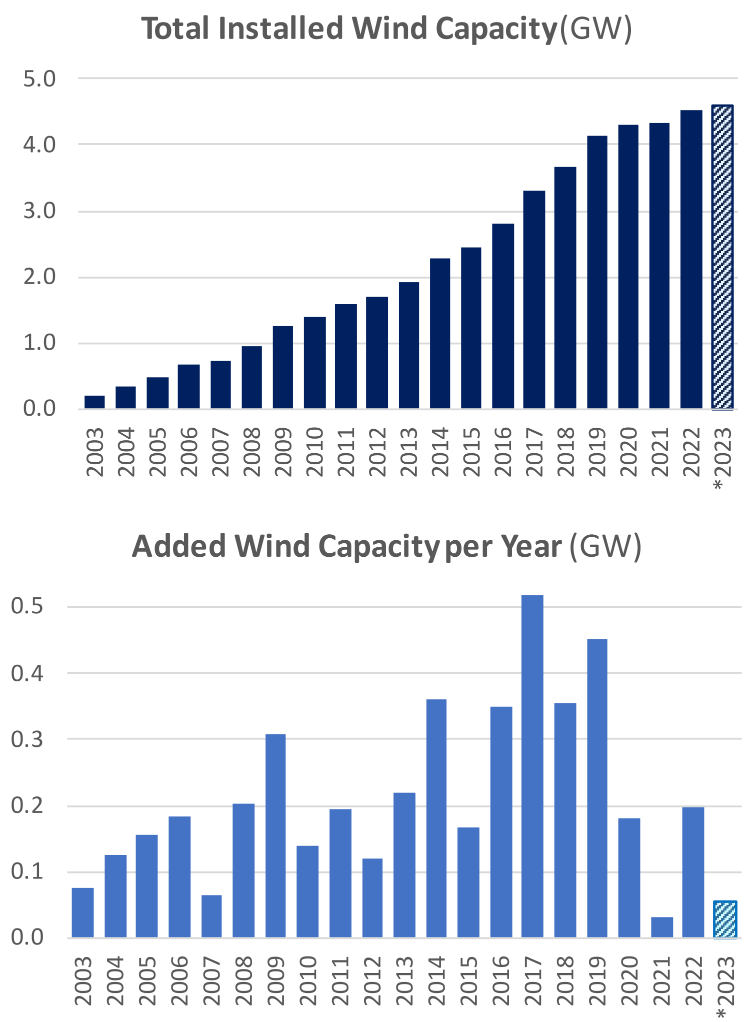
Renewable electricity is by far the largest vector of renewable energy into our homes, offices, and businesses. Renewable electricity accounted for 62.8% of all renewable energy demand in Ireland in 2022. The use of renewable electricity helped avoid 5.5 $MtCO_2$ of emissions in 2022.

**Figure 1.15: Breakdown of electricity generated in 2022**




Ireland's installed capacity for wind generation to the end of 2022 was 4.54 GW. SEAI's provisional estimate for installed wind capacity in 2023 is based on Eirgrid data to the end of August, and ESBN data to the end of September, and totals 4.59 GW.

**Figure 1.16: Total and added wind capacity**

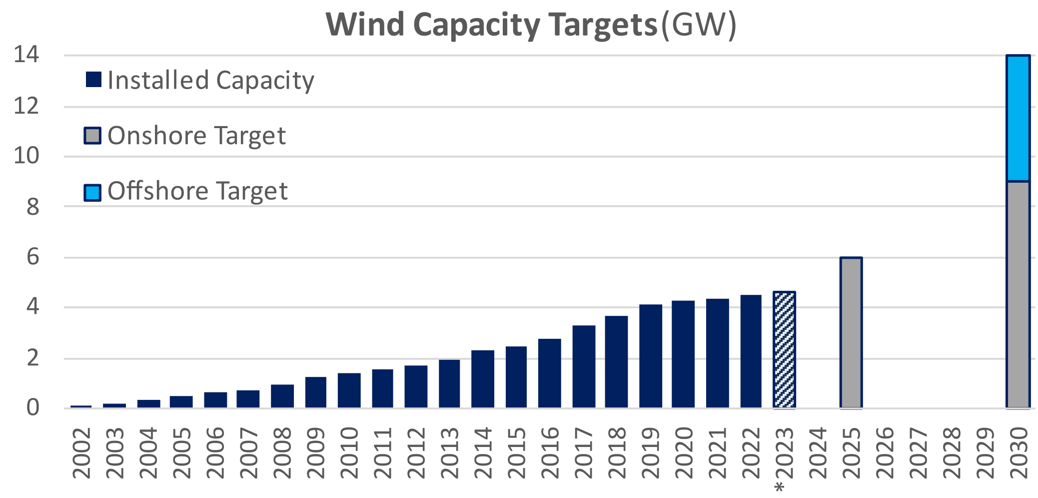


The pace of adding wind capacity has slowed in recent years from highs of 0.52 GW and 0.45 GW per year in 2017 and 2019, to a low of 0.03 GW per year in 2021. Based on available data from *Eirgrid* and *ESB-Networks*, Ireland has added 0.06 GW of wind capacity to date in 2023, but this number will likely increase once Q4 data is reported by *Eirgrid* and *ESB-Networks*. Historically, most capacity is added in the Q4 period of the year, after construction and commissioning during the summer and autumn months.

The reduced pace of added wind capacity in recent years has mainly been due to the profiling of renewable energy price support schemes. The latest wind farm projects supported under the *renewable energy feed-in tariff* (REFIT-2) scheme were scheduled for completion in 2019. Most of the 0.5 GW of wind energy projects awarded under the first *renewable electricity support scheme* (RESS) auctions are being constructed and will take time to be commissioned and connected. Under the terms and conditions of RESS-1, generators of commercial projects must ensure the projects achieve commercial operation by December 2023. RESS-2 has its 'longstop date' in December 2025, so a significant clustering of project completions at the end of 2023 and 2025 are likely.

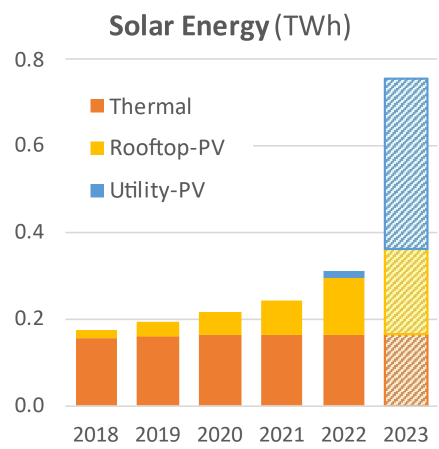
CAP-23 sets ambitious targets for installed onshore and offshore wind capacity. By 2025, Ireland has a target of 6 GW of installed onshore wind capacity, which is a 32.3% increase on the capacity installed by end 2022. By 2030, Ireland has a target of 9 GW of installed onshore wind capacity and at least 5 GW of installed offshore wind capacity. Achieving these targets will require almost doubling our onshore wind capacity, and tripling our total wind capacity, relative to 2022 levels. Accelerating planning decisions and appeals will be key to progressing against these targets at the necessary pace. The new *Maritime Area Regulatory Authority* (MARA) was established on July 17th 2023 and will contribute to delivering a more streamlined consenting system for the maritime area, to accelerate the delivery of offshore wind sites.

**Figure 1.17: Wind capacity targets under CAP-23**




Although still a relatively small contributor to Ireland's energy portfolio, the total amount of solar energy captured in 2022 was 28.4% higher than in 2021. In 2022, more heat energy was captured by solar-thermal panels than electricity generated by solar-photovoltaic (PV) panels. However, this changed significantly in 2023, with the grid-connection of several utility-scale PV sites, otherwise known as 'solar farms'.

**Figure 1.18: Solar Energy in Ireland**



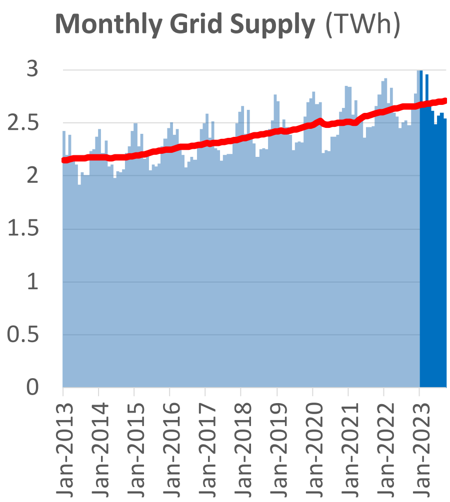

Using January to September 2023 data, SEAI's best estimate is that electricity generation from utility-scale PV sites will be 0.4 TWh in 2023. If this best estimate proves accurate, then solar farms will account for just over half of all solar energy captured in Ireland, they will deliver twice as much electricity as all rooftop-PV generation combined.

Based on data reported by *Eirgrid* and *ESB-Networks*, Ireland currently has 0.4 GW of utility-scale PV capacity in place, but this number will likely increase once Q4-2023 data is reported. The same data indicates that a further 157 solar farms are 'planned'. These would bring an additional 3.3 GW of contracted capacity if they progress to being 'installed'. CAP-23 calls for up to 5 GW of installed solar capacity by 2025, and 8 GW of capacity by 2030.

Electricity demand in Ireland continues to increase. Although it exhibits a strong seasonal variation, the long-term average annual increase in electricity supplied to the national grid, to satisfy our demand, has been relatively steady at 2.2% per annum. The compounding effect of this small annual increase means that Ireland's electricity demand in 2022 was 24% higher than a decade earlier in 2012.

A sectoral analysis of Ireland's electricity demand shows that practically all new electricity demand in the last decade has come from the *commercial services* sector of the economy. Electricity demand in the *commercial services* sector has increased by 61.5% since 2012, while the electricity demand in all other sectors (*i.e.*, the sum of demand from Ireland's *industry, residential, transport, public services,* and *agriculture & fisheries* sectors) has increased by just 8.0%.

**Figure 1.19: Electricity supplied to the national grid**




Further analysis shows that within the *commercial services* sector, practically all new electricity demand in the last decade has come from the *information & communication* sub-sector of the economy. Electricity demand in the *information & communication* sub-sector has increased by 562% since 2012. This rapid increase in *information & communication* electricity demand has mainly been driven by increased energy demands from data centres.

In 2022, 82% of all *information & communication* electricity demand came from data centres.

Given current trajectories, the electricity demand of the *information & communication* sub-sector will equal and then surpass electricity demand of the residential sector in 2023 or 2024. There is a clear need to balance the value of data centres to a modern digitised economy, with the challenges of accommodating their electricity demand from available sources of renewable generation.

**Figure 1.20: Electricity demand across all sectors, with detail on the *commercial service* sub-sector**

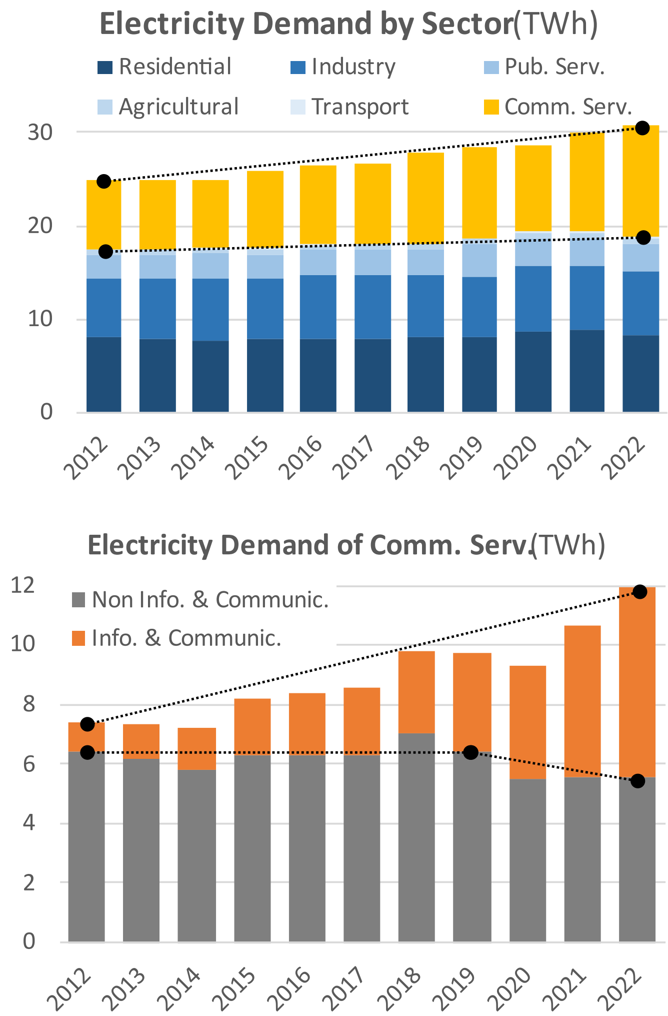
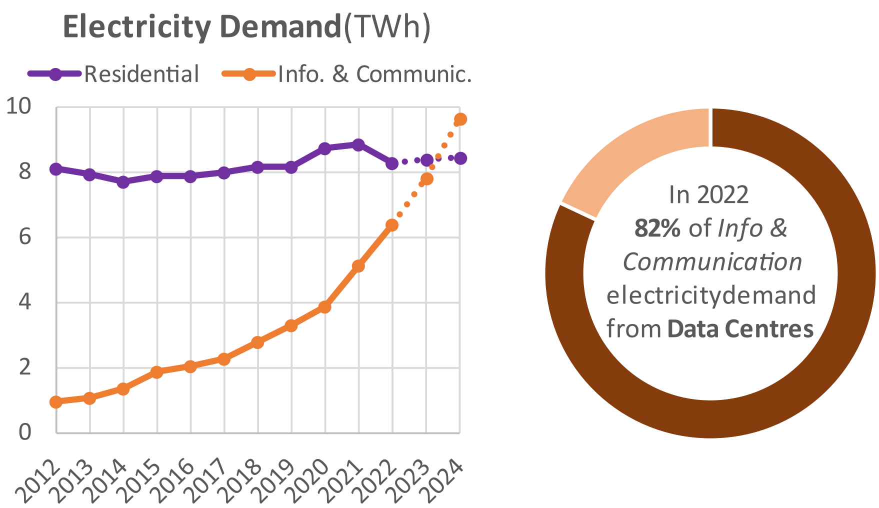


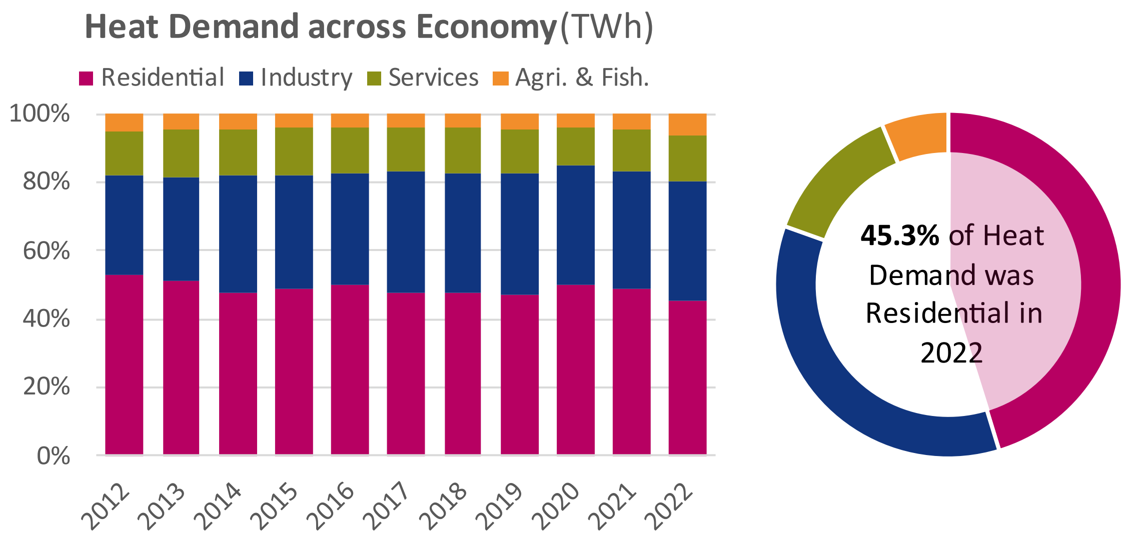

**Figure 1.21: Comparison of electricity demand from the *residential* sector and *information & communication* sub-sector**



## 1.4 Trends in heat demand

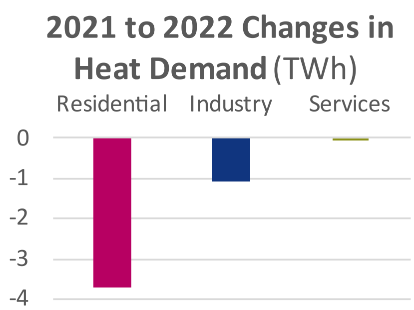
The non-electricity and non-transport energy that goes to the energy mode of 'heat' accounted for 36.5% of all energy in 2022. Heat demand includes, not only the heating of our homes, offices, businesses, and schools, but also industrial manufacturing processes and commercial service activities. Heat demand in the residential sector accounted for just under half (45.3%) of all heat demand in Ireland in 2022, followed by the industry sector, which accounted for 35.2% of heat demand.

**Figure 1.22: Heat demand across all sectors**




In 2022, Ireland's total heat demand was 7.3% lower than in 2021, but that reduction was not evenly distributed across all sectors of the economy. The heat demand reduction in the residential sector was significantly higher than all other sectors and dropped by 13.8%.

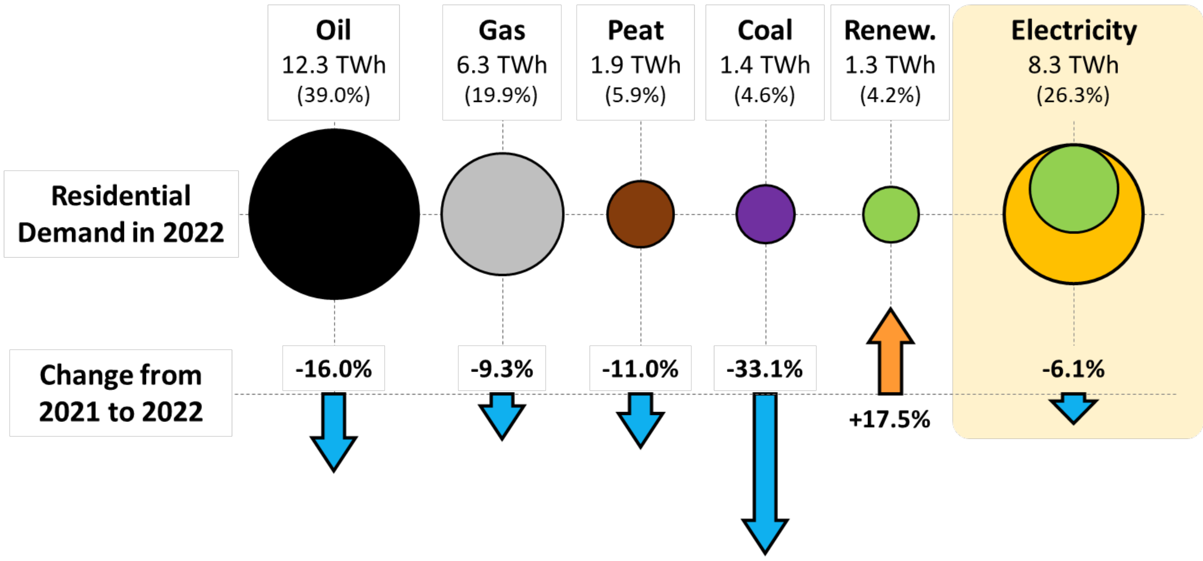
**Figure 1.23: 2022 Changes in heat demand**




Residential demand for oil, gas, peat, and coal were all significantly lower in 2022 than in 2021. Oil and gas demand, which combined, account for 58.9% of all residential heat, were down by 16.0% and 9.3%, respectively. Residential demand for electricity (which is counted in the 'electricity' mode rather than the 'heat' mode) was also down.

The only source of increased residential heat demand in 2022 came from the use of renewable energy, due to increased use of heat pumps to capture renewable ambient heat. Renewable heat in the residential sector was 17.5% higher in 2022 than in 2021.

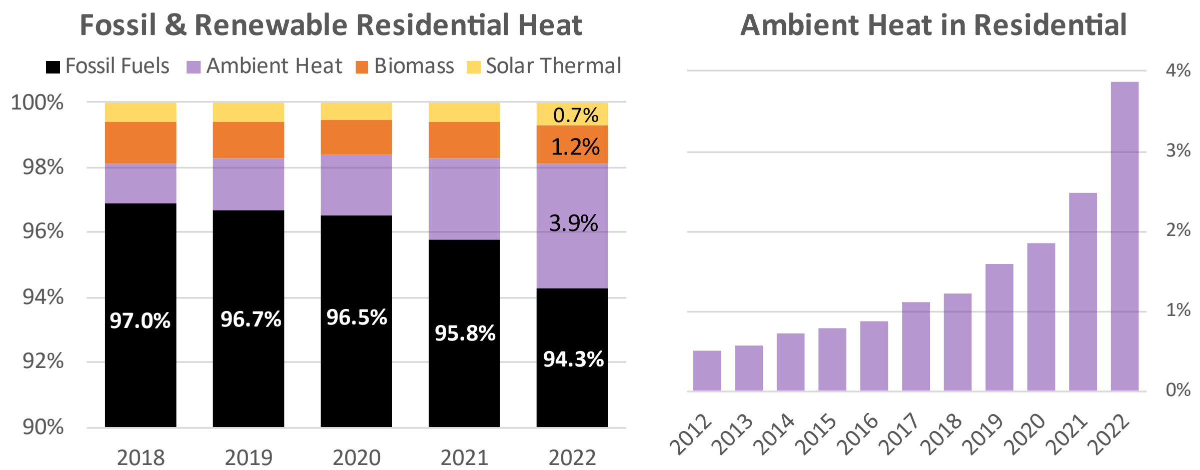
**Figure 1.24: 2022 Changes in residential heat demand**




Residential heat demand remains highly dependent on fossil fuels. In 2022, 94.3% of residential heat came from fossil fuels. Over the last 5 years, the combustion of biomass (*e.g.,* logs, wood-pellets, and wood-briquettes) and the use of solar thermal heating have held relatively constant at approximately 2% of residential heat demand. The largest source of renewable heat in the residential sector is now the ambient heat captured by heat pumps. In 2022, 3.9% of residential heat demand came from heat pumps, up from a value of 2.4% in 2021. This shows that heat pumps are actively displacing fossil fuels in Irish homes.

CAP-23 calls for 170,000 heat pumps in new dwellings, and 45,000 heat pumps in existing dwellings by 2025. And 280,000 heat pumps in new dwellings, and 400,000 heat pumps in existing dwellings by 2030.

**Figure 1.25: Fossil and renewable residential heat demand**

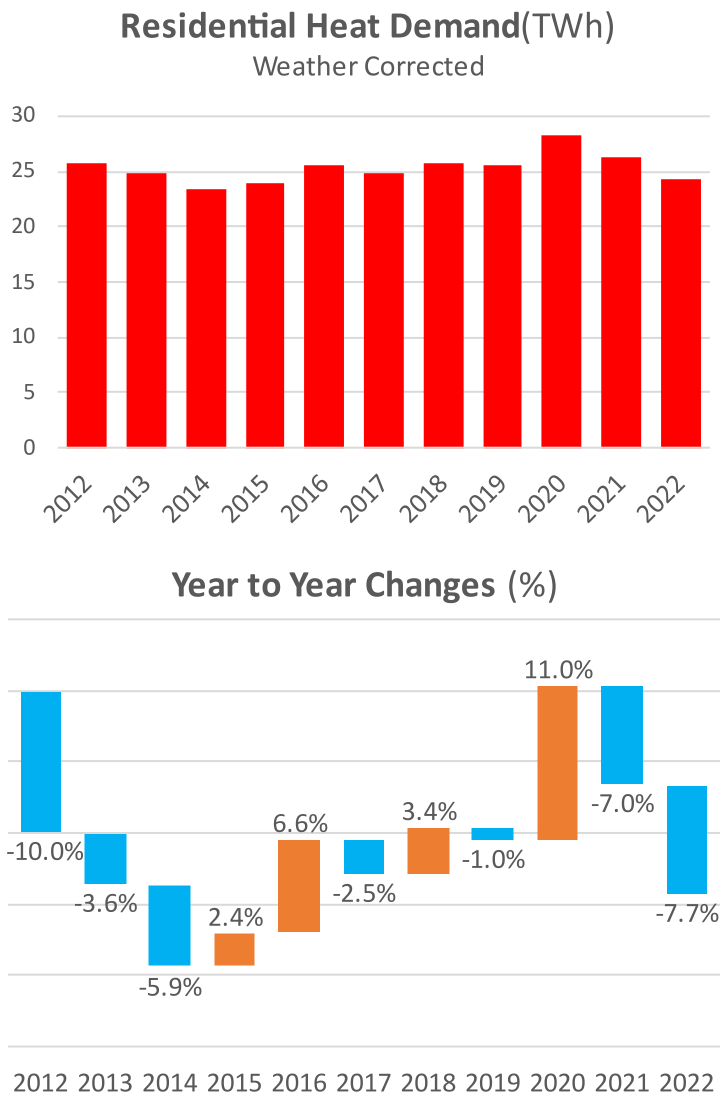



Residential heat demand is strongly weather dependent. Homes use more energy for heating in years that have particularly cold winters, and less in years with mild winters. Using heating degree day (HDD) data from *Met Éireann*, SEAI makes a weather correction to residential heat demand, to make it easier to identify non-weather-related energy trends.

The weather corrected data shows that approximately half of the drop in residential heat demand in 2022 was likely due to weather effects – the uncorrected data shows a drop of 13.8% in residential heat demand, while the corrected data shows a drop of just 7.7%.

The weather corrected data shows a 11.0% increase in residential heat demand in 2020, likely due to COVID impacts shifting work and study from offices and schools to homes. The annual drops of 7.0% and 7.7% in the weather corrected residential heat demand of 2021 and 2022 may be substantially driven by 'return to office' and 'return to school' effects. This suggestion is supported by the evidence of a corresponding increase in energy demand for private vehicles observed in 2021 and 2022.

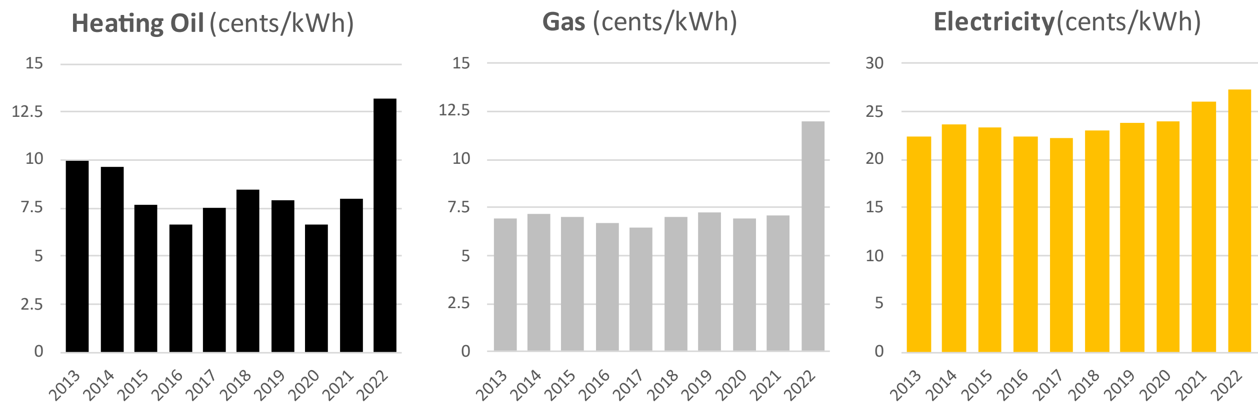
**Figure 1.26: Weather corrected residential heat demand, and year to year changes**




Another likely contributor to reduced residential heat demand in 2022 was the cost of energy. 2022 saw significant increases to the costs of all energy products commonly used in Irish homes. The average unit costs of heating oil and gas in 2022 were 66% and 69% higher than in 2021, respectively. The average unit cost of electricity also increased, but as shown by recent SEAI price analysis[3,4], the effect of the series of €200 account credits applied to household electricity bills in 2022 and 2023 had a significant stabilising effect.

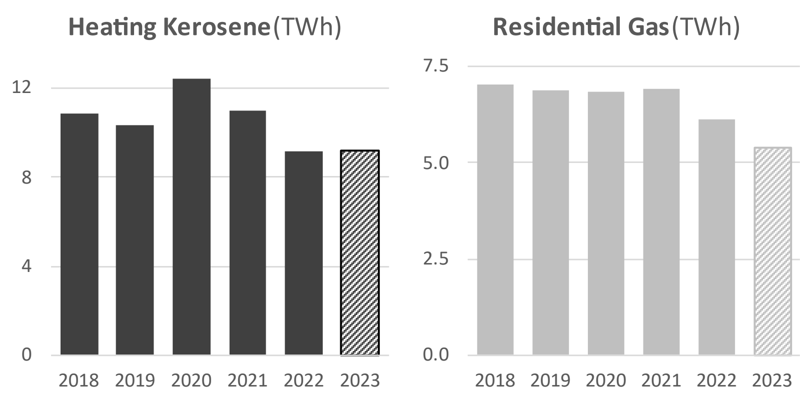
[3] https://www.seai.ie/blog/stat-chat-credit-due/
[4] https://www.seai.ie/publications/Electricity-Gas-Prices-2023-H1.pdf

**Figure 1.27: Average annual energy prices to households**




While the increased cost of energy to homes undoubtedly contributed to the reduced residential heat demand in 2022, it is unclear precisely what fraction of that 7.7% heat demand reduction was due to price effects. Comparable reductions in residential heat demand sector were observed in both 2021 and 2022, before and after the significant energy price increases could have influenced behaviour. The residential heat demand reduction in 2022 was therefore likely due to a combination of price effects, post COVID behaviour rebounds, as well as improvements from home energy upgrades, and the impact of behavioural changes in homes, which may have been promoted by Government campaigns such as, *'Reduce your Use'*.

**Figure 1.28: Residential Heating Kerosene and Gas demand**




Making provisional estimates of residential heat demand in 2023 is challenging, because high quality monthly data on coal, peat, and biomass demand are not available. However, reliable monthly data does exist for both residential gas demand and kerosene heating oil. Approximately 95% of kerosene heating oil goes to the residential sector, making it an excellent proxy for oil-based home heating. Using data from January to September 2023, SEAI's best estimate indicates that residential heating oil demand in 2023 will remain close to 2022 levels, and that residential gas demand in 2023 will be 12% lower than in 2022.

If these 2023 estimates prove accurate, and if they are more broadly representative of all energy products used in Irish homes (*i.e.,* peat and coal), then residential heat demand in 2023 will be somewhat lower than in 2022, but the reduction will not be as large as that observed in 2022. Any reduction in residential heat demand from fossil fuels in 2023 will act to reduce the residential emissions of the 'built environment' tracked in the 2021-2025 carbon budget.

As reported in SEAI's 2023 *National Energy Projections* report, for both the WEM and WAM scenarios, the residential sector is anticipated to exceed its sectoral emissions ceilings for both the 2021-2025 and 2026-2030 carbon budgets. The projected exceedance in the 2021-2025 carbon budget is 0.7 $MtCO_2e$ in the WEM scenario and 0.8 $MtCO_2e$ in the WAM scenario. Without deeper emissions cuts than those anticipated in these latest projections, these projections suggest a total exceedance of 2.2 $MtCO_2e$ in the WEM scenario by the end of the 2026-2030 carbon budget, and an exceedance of 0.6 $MtCO_2e$ in the WAM scenario.

# 2 Overview of energy data

## 2.1 The National Energy Balance

Following the formal establishment of the Energy Policy Statistical Support Unit (now called Energy Statistics Team, SEAI) in 2002, the Department of Communications, Marine and Natural Resources transferred the responsibility for the collection of data, to meet Ireland's reporting obligations in relation to energy statistics, to the new unit.

The information in this report is largely based on Ireland's 2022 National Energy Balance and the preceding annual energy balances back to 1990. These energy balances quantify the flow and transformation of energy sources from primary supply to final consumption, and profile that consumption across different sectors of the economy.

A simplified schematic for the energy balance flow is illustrated in Figure 2.1. National energy balances are the definitive sources for constructing other normalised national energy indicators, such as energy intensity, energy efficiency, and energy-related greenhouse gas emissions. A Sankey diagram showing the flow of energy in Ireland 2022 is provided in Figure 2.2.

**Figure 2.1: Main energy flows in Ireland**

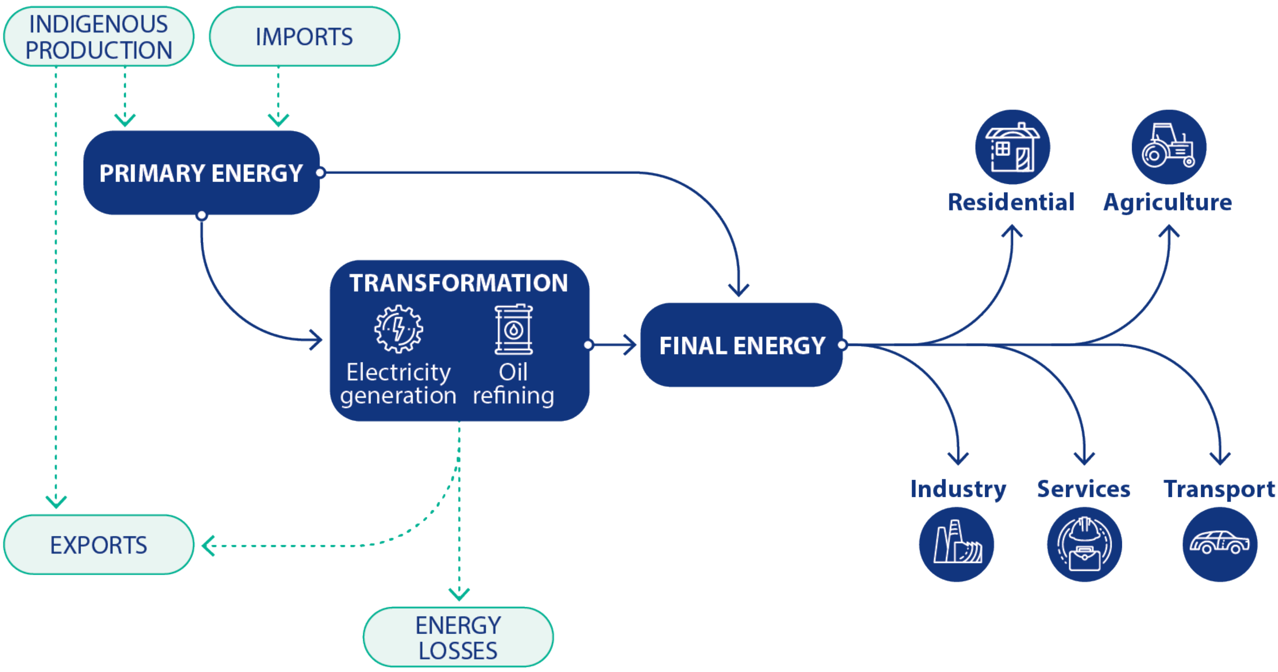
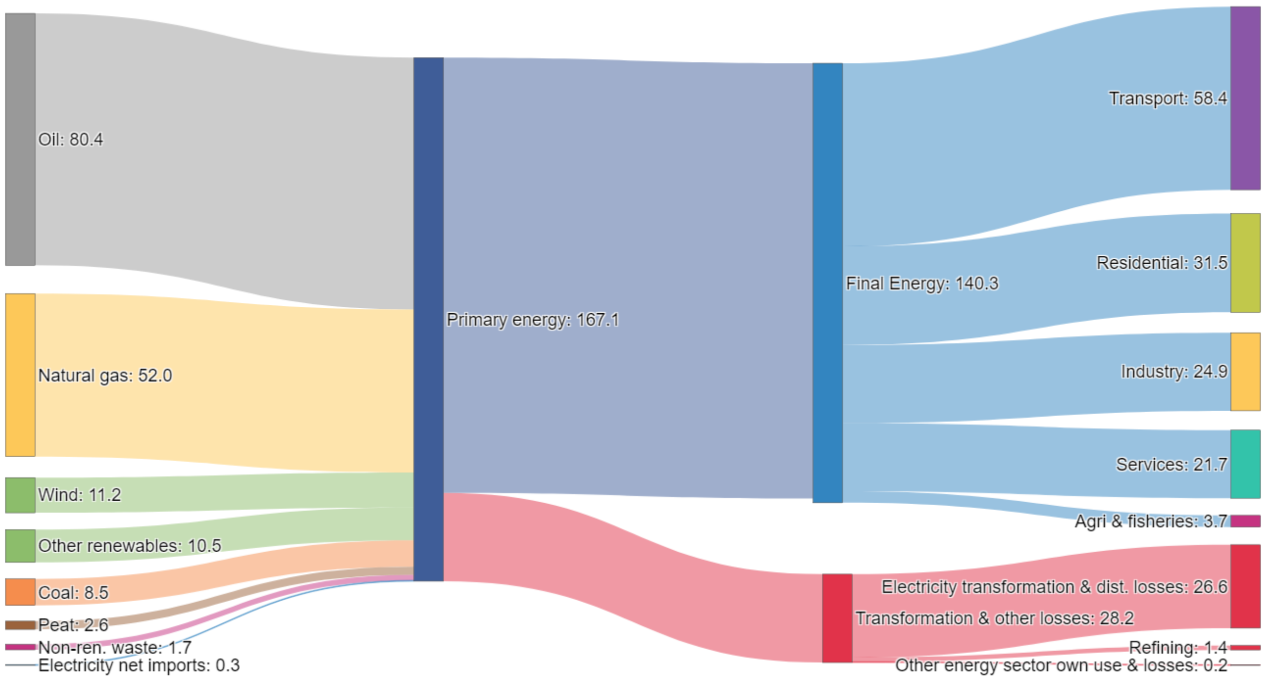


**Figure 2.2: Energy Flow in Ireland in 2022 (TWh)**




The energy balance is organised into three main parts, which are discussed in the following subsections:

- Primary energy – section 3
- Energy transformation – section 4
- Final energy consumption by sector– section 5

SEAI constructs the expanded energy balance for each fuel or energy product, such as gasoline, lignite, biomass and electricity. There are currently 34 fuels listed in the expanded balance. The number of fuels and energy products included in the balance has increased over the years as Ireland's energy mix has diversified. For analysis and presentation purposes, fuels can be combined into seven aggregated fuel or energy types:

- Coal
- Peat
- Oil
- Natural gas
- Renewables
- Non-renewable waste
- Electricity

In general, the data in this report is presented for aggregated energy types. Short versions of the energy balance in units of terawatt-hours (TWh), terajoules (TJ) and kilotonnes of oil equivalent (ktoe) are presented in Table 2.1, Table 2.2 and Table 2.3, respectively. A more detailed, expanded balance showing sub-fuel type data is available on the SEAI website at https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance/.

The data in the national energy balances are informed by survey responses received from approximately 300 organisations, including energy producers, import/export companies and energy supply companies. Besides populating the energy balance, SEAI uses these surveys to fulfil Ireland's energy statistics reporting obligations to Eurostat (EU Energy Statistics Regulation (EC 1099/2008)) and the International Energy Agency (IEA).

To ensure that the best possible information is always available to Government and other users, SEAI employs a policy of continuous improvement regarding historic energy balances, updating these with data revisions and new methodologies as they become available. An overview of the revisions and amendments to energy statistics made during 2023 is provided in Appendix 8.

## Table 2.1: Short energy balance 2022 (TWh)

| Terawatt hours (TWh) | Coal | Peat | Oil | Natural Gas | Renewables | Non-Renew. Waste | Electricity | Total |
|---|---|---|---|---|---|---|---|---|
| Indigenous Production | - | 1.485 | - | 13.545 | 19.912 | 1.726 | - | 36.668 |
| Imports | 11.126 | - | 103.323 | 38.455 | 2.076 | - | 1.582 | 156.561 |
| Exports | 0.440 | 0.015 | 18.334 | - | 0.170 | - | 1.330 | 20.288 |
| Mar. Bunkers | - | - | 1.526 | - | - | - | - | 1.526 |
| Stock Change | -2.232 | 1.124 | -0.415 | - | -0.149 | - | - | -1.673 |
| **Primary Energy Supply (incl. non-energy)** | **8.454** | **2.595** | **83.048** | **52.000** | **21.669** | **1.726** | **0.252** | **169.742** |
| **Primary Energy Requirement (excl. non-energy)** | **8.454** | **2.595** | **80.387** | **52.000** | **21.669** | **1.726** | **0.252** | **167.081** |
| **Transformation Input** | **6.561** | **1.024** | **39.078** | **30.368** | **2.823** | **1.047** | **0.487** | **81.389** |
| Public Thermal Power Plants | 6.561 | 0.582 | 2.964 | 27.339 | 2.641 | 1.047 | - | 41.134 |
| Combined Heat and Power Plants | - | 0.047 | 0.007 | 2.830 | 0.182 | - | - | 3.065 |
| Pumped Storage Consumption | - | - | - | - | - | - | 0.403 | 0.403 |
| Briquetting Plants | - | 0.395 | - | - | - | - | - | 0.395 |
| Oil Refineries & other energy sector | - | - | 36.107 | 0.200 | - | - | 0.084 | 36.391 |
| **Transformation Output** | **-** | **0.376** | **36.737** | **-** | **-** | **-** | **21.800** | **58.912** |
| Public Thermal Power Plants | - | - | - | - | - | - | 19.482 | 19.482 |
| Combined Heat and Power Plants | - | - | - | - | - | - | 2.070 | 2.070 |
| Pumped Storage Generation | - | - | - | - | - | - | 0.247 | 0.247 |
| Briquetting Plants | - | 0.376 | - | - | - | - | - | 0.376 |
| Oil Refineries | - | - | 36.737 | - | - | - | - | 36.737 |
| **Exchanges and transfers** | **0.266** | **-** | **-0.571** | **0.041** | **-12.101** | **-** | **12.060** | **-0.305** |
| Electricity | - | - | - | - | -12.060 | - | 12.060 | - |
| Heat | - | - | - | - | - | - | - | - |
| Other | 0.266 | - | -0.571 | 0.041 | -0.041 | - | - | -0.305 |
| **Own Use and Distribution Losses** | **-** | **0.106** | **1.378** | **0.629** | **-** | **-** | **3.284** | **5.397** |
| **Available Final Energy Consumption** | **2.158** | **1.841** | **78.757** | **21.043** | **6.745** | **0.679** | **30.341** | **141.564** |
| **Non-Energy Consumption** | **-** | **-** | **2.661** | **-** | **-** | **-** | **-** | **2.661** |
| Final Non-Energy Consumption | - | - | 2.661 | - | - | - | - | 2.661 |
| **Total Final Energy Consumption** | **2.270** | **1.867** | **76.944** | **21.030** | **6.696** | **0.679** | **30.772** | **140.259** |
| **Industry** | **0.824** | **-** | **3.784** | **10.582** | **2.170** | **0.679** | **6.859** | **24.898** |
| Non-Energy Mining | - | - | 0.134 | - | - | - | 0.275 | 0.409 |
| Food, Beverages and Tobacco | - | - | 0.819 | 3.524 | 0.082 | - | 1.202 | 5.625 |
| Textiles and Textile Products | - | - | 0.070 | 0.017 | - | - | 0.043 | 0.129 |
| Wood and Wood Products | - | - | 0.028 | 0.062 | 1.442 | - | 0.333 | 1.865 |
| Pulp, Paper, Publishing and Printing | - | - | 0.011 | 0.078 | - | - | 0.090 | 0.180 |
| Chemicals and Man-Made Fibres | - | - | 0.089 | 1.469 | - | - | 0.994 | 2.551 |
| Rubber and Plastic Products | - | - | 0.035 | 0.077 | - | - | 0.249 | 0.360 |
| Other Non-Metallic Mineral Products | 0.824 | - | 1.785 | 0.273 | 0.647 | 0.679 | 0.779 | 4.987 |
| Basic Metals and Fabricated Metal Products | - | - | 0.060 | 4.197 | - | - | 0.708 | 4.966 |
| Machinery and Equipment n.e.c | - | - | 0.033 | 0.148 | - | - | 0.202 | 0.383 |
| Electrical and Optical Equipment | - | - | 0.036 | 0.210 | - | - | 1.221 | 1.466 |
| Transport Equipment Manufacture | - | - | 0.015 | 0.013 | - | - | 0.030 | 0.059 |
| Other Manufacturing | - | - | 0.144 | 0.471 | - | - | 0.617 | 1.232 |
| Construction | - | - | 0.525 | 0.043 | - | - | 0.118 | 0.687 |
| **Transport** | **-** | **-** | **55.433** | **0.193** | **2.602** | **-** | **0.208** | **58.435** |
| Road Freight | - | - | 8.640 | 0.008 | 0.595 | - | - | 9.242 |
| Light Goods Vehicle | - | - | 3.323 | - | 0.229 | - | - | 3.552 |
| Road Private Car | - | - | 21.900 | - | 1.255 | - | 0.159 | 23.314 |
| Public Passenger Services | - | - | 1.193 | - | 0.081 | - | - | 1.274 |
| Rail | - | - | 0.446 | - | - | - | 0.049 | 0.495 |
| Domestic Aviation | - | - | 0.158 | - | - | - | - | 0.158 |
| International Aviation | - | - | 11.685 | - | - | - | - | 11.685 |
| Fuel Tourism | - | - | 2.114 | - | 0.142 | - | - | 2.257 |
| Navigation | - | - | 1.147 | - | - | - | - | 1.147 |
| Unspecified | - | - | 4.826 | 0.185 | 0.300 | - | - | 5.311 |
| **Residential** | **1.444** | **1.867** | **12.289** | **6.278** | **1.331** | **-** | **8.290** | **31.498** |
| **Commercial/Public Services** | **0.002** | **-** | **2.239** | **3.978** | **0.593** | **-** | **14.894** | **21.705** |
| Commercial Services | 0.002 | - | 1.051 | 2.258 | 0.402 | - | 11.922 | 15.635 |
| Public Services | - | - | 1.188 | 1.720 | 0.191 | - | 2.972 | 6.071 |
| **Agricultural** | **-** | **-** | **2.998** | **-** | **-** | **-** | **0.522** | **3.521** |
| **Fisheries** | **-** | **-** | **0.201** | **-** | **-** | **-** | **-** | **0.201** |
| Statistical Difference | -0.111 | -0.027 | -0.848 | 0.013 | 0.049 | - | -0.432 | -1.356 |

## Table 2.2: Short energy balance 2022 (TJ)

| Terajoules hours (TJ) | Coal | Peat | Oil | Natural Gas | Renewables | Non-Renew. Waste | Electricity | Total |
|---|---|---|---|---|---|---|---|---|
| Indigenous Production | - | 5,347 | - | 48,763 | 71,684 | 6,212 | - | 132,006 |
| Imports | 40,053 | - | 371,962 | 138,436 | 7,473 | - | 5,695 | 563,619 |
| Exports | 1,583 | 53 | 66,002 | - | 611 | - | 4,788 | 73,038 |
| Mar. Bunkers | - | - | 5,492 | - | - | - | - | 5,492 |
| Stock Change | -8,036 | 4,047 | -1,495 | - | -538 | - | - | -6,022 |
| **Primary Energy Supply (incl. non-energy)** | **30,433** | **9,340** | **298,973** | **187,199** | **78,008** | **6,212** | **907** | **611,073** |
| **Primary Energy Requirement (excl. non-energy)** | **30,433** | **9,340** | **289,393** | **187,199** | **78,008** | **6,212** | **907** | **601,493** |
| **Transformation Input** | **23,620** | **3,685** | **140,682** | **109,326** | **10,163** | **3,768** | **1,754** | **292,999** |
| Public Thermal Power Plants | 23,620 | 2,094 | 10,671 | 98,421 | 9,507 | 3,768 | - | 148,082 |
| Combined Heat and Power Plants | - | 167 | 25 | 10,186 | 656 | - | - | 11,034 |
| Pumped Storage Consumption | - | - | - | - | - | - | 1,451 | 1,451 |
| Briquetting Plants | - | 1,424 | - | - | - | - | - | 1,424 |
| Oil Refineries & other energy sector | - | - | 129,986 | 718 | - | - | 303 | 131,008 |
| **Transformation Output** | **-** | **1,352** | **132,253** | **-** | **-** | **-** | **78,478** | **212,083** |
| Public Thermal Power Plants | - | - | - | - | - | - | 70,137 | 70,137 |
| Combined Heat and Power Plants | - | - | - | - | - | - | 7,452 | 7,452 |
| Pumped Storage Generation | - | - | - | - | - | - | 889 | 889 |
| Briquetting Plants | - | 1,352 | - | - | - | - | - | 1,352 |
| Oil Refineries | - | - | 132,253 | - | - | - | - | 132,253 |
| **Exchanges and transfers** | **957** | **-** | **-2,055** | **147** | **-43,563** | **-** | **43,416** | **-1,098** |
| Electricity | - | - | - | - | -43,416 | - | 43,416 | - |
| Heat | - | - | - | - | - | - | - | - |
| Other | 957 | - | -2,055 | 147 | -147 | - | - | -1,098 |
| **Own Use and Distribution Losses** | **-** | **381** | **4,962** | **2,264** | **-** | **-** | **11,822** | **19,428** |
| **Available Final Energy Consumption** | **7,770** | **6,627** | **283,527** | **75,756** | **24,282** | **2,444** | **109,226** | **509,631** |
| **Non-Energy Consumption** | **-** | **-** | **9,580** | **-** | **-** | **-** | **-** | **9,580** |
| Final Non-Energy Consumption | - | - | 9,580 | - | - | - | - | 9,580 |
| **Total Final Energy Consumption** | **8,170** | **6,723** | **277,000** | **75,709** | **24,105** | **2,444** | **110,781** | **504,932** |
| **Industry** | **2,965** | **-** | **13,622** | **38,095** | **7,813** | **2,444** | **24,692** | **89,632** |
| Non-Energy Mining | - | - | 483 | - | - | - | 988 | 1,471 |
| Food, Beverages and Tobacco | - | - | 2,947 | 12,686 | 293 | - | 4,326 | 20,252 |
| Textiles and Textile Products | - | - | 250 | 60 | - | - | 154 | 464 |
| Wood and Wood Products | - | - | 102 | 222 | 5,190 | - | 1,198 | 6,712 |
| Pulp, Paper, Publishing and Printing | - | - | 41 | 283 | - | - | 323 | 647 |
| Chemicals and Man-Made Fibres | - | - | 319 | 5,289 | - | - | 3,577 | 9,185 |
| Rubber and Plastic Products | - | - | 125 | 277 | - | - | 895 | 1,297 |
| Other Non-Metallic Mineral Products | 2,965 | - | 6,427 | 982 | 2,330 | 2,444 | 2,804 | 17,952 |
| Basic Metals and Fabricated Metal Products | - | - | 217 | 15,109 | - | - | 2,550 | 17,876 |
| Machinery and Equipment n.e.c | - | - | 120 | 532 | - | - | 726 | 1,378 |
| Electrical and Optical Equipment | - | - | 128 | 756 | - | - | 4,394 | 5,278 |
| Transport Equipment Manufacture | - | - | 54 | 48 | - | - | 109 | 211 |
| Other Manufacturing | - | - | 519 | 1,696 | - | - | 2,221 | 4,436 |
| Construction | - | - | 1,891 | 155 | - | - | 426 | 2,473 |
| **Transport** | **-** | **-** | **199,559** | **694** | **9,368** | **-** | **747** | **210,368** |
| Road Freight | - | - | 31,104 | 27 | 2,141 | - | - | 33,272 |
| Light Goods Vehicle | - | - | 11,963 | - | 823 | - | - | 12,787 |
| Road Private Car | - | - | 78,842 | - | 4,518 | - | 571 | 83,931 |
| Public Passenger Services | - | - | 4,294 | - | 293 | - | - | 4,588 |
| Rail | - | - | 1,606 | - | - | - | 176 | 1,781 |
| Domestic Aviation | - | - | 570 | - | - | - | - | 570 |
| International Aviation | - | - | 42,067 | - | - | - | - | 42,067 |
| Fuel Tourism | - | - | 7,612 | - | 513 | - | - | 8,125 |
| Navigation | - | - | 4,128 | - | - | - | - | 4,128 |
| Unspecified | - | - | 17,372 | 667 | 1,079 | - | - | 19,118 |
| **Residential** | **5,197** | **6,723** | **44,241** | **22,600** | **4,790** | **-** | **29,844** | **113,394** |
| **Commercial/Public Services** | **8** | **-** | **8,060** | **14,320** | **2,134** | **-** | **53,618** | **78,139** |
| Commercial Services | 8 | - | 3,784 | 8,128 | 1,446 | - | 42,920 | 56,286 |
| Public Services | - | - | 4,276 | 6,192 | 688 | - | 10,698 | 21,854 |
| **Agricultural** | **-** | **-** | **10,795** | **-** | **-** | **-** | **1,880** | **12,674** |
| **Fisheries** | **-** | **-** | **724** | **-** | **-** | **-** | **-** | **724** |
| Statistical Difference | -401 | -96 | -3,053 | 47 | 177 | - | -1,555 | -4,881 |

## Table 2.3: Short energy balance 2022 (ktoe)

| kilotonnes of oil equivalent (ktoe) | Coal | Peat | Oil | Natural Gas | Renewables | Non-Renew. Waste | Electricity | Total |
|---|---|---|---|---|---|---|---|---|
| Indigenous Production | - | 128 | - | 1,165 | 1,712 | 148 | - | 3,153 |
| Imports | 957 | - | 8,884 | 3,306 | 178 | - | 136 | 13,462 |
| Exports | 38 | 1 | 1,576 | - | 15 | - | 114 | 1,744 |
| Mar. Bunkers | - | - | 131 | - | - | - | - | 131 |
| Stock Change | -192 | 97 | -36 | - | -13 | - | - | -144 |
| **Primary Energy Supply (incl. non-energy)** | **727** | **223** | **7,141** | **4,471** | **1,863** | **148** | **22** | **14,595** |
| **Primary Energy Requirement (excl. non-energy)** | **727** | **223** | **6,912** | **4,471** | **1,863** | **148** | **22** | **14,366** |
| **Transformation Input** | **564** | **88** | **3,360** | **2,611** | **243** | **90** | **42** | **6,998** |
| Public Thermal Power Plants | 564 | 50 | 255 | 2,351 | 227 | 90 | - | 3,537 |
| Combined Heat and Power Plants | - | 4 | 1 | 243 | 16 | - | - | 264 |
| Pumped Storage Consumption | - | - | - | - | - | - | 35 | 35 |
| Briquetting Plants | - | 34 | - | - | - | - | - | 34 |
| Oil Refineries & other energy sector | - | - | 3,105 | 17 | - | - | 7 | 3,129 |
| **Transformation Output** | **-** | **32** | **3,159** | **-** | **-** | **-** | **1,874** | **5,066** |
| Public Thermal Power Plants | - | - | - | - | - | - | 1,675 | 1,675 |
| Combined Heat and Power Plants | - | - | - | - | - | - | 178 | 178 |
| Pumped Storage Generation | - | - | - | - | - | - | 21 | 21 |
| Briquetting Plants | - | 32 | - | - | - | - | - | 32 |
| Oil Refineries | - | - | 3,159 | - | - | - | - | 3,159 |
| **Exchanges and transfers** | **23** | **-** | **-49** | **4** | **-1,040** | **-** | **1,037** | **-26** |
| Electricity | - | - | - | - | -1,037 | - | 1,037 | - |
| Heat | - | - | - | - | - | - | - | - |
| Other | 23 | - | -49 | 4 | -4 | - | - | -26 |
| **Own Use and Distribution Losses** | **-** | **9** | **119** | **54** | **-** | **-** | **282** | **464** |
| **Available Final Energy Consumption** | **186** | **158** | **6,772** | **1,809** | **580** | **58** | **2,609** | **12,172** |
| **Non-Energy Consumption** | **-** | **-** | **229** | **-** | **-** | **-** | **-** | **229** |
| Final Non-Energy Consumption | - | - | 229 | - | - | - | - | 229 |
| **Total Final Energy Consumption** | **195** | **161** | **6,616** | **1,808** | **576** | **58** | **2,646** | **12,060** |
| **Industry** | **71** | **-** | **325** | **910** | **187** | **58** | **590** | **2,141** |
| Non-Energy Mining | - | - | 12 | - | - | - | 24 | 35 |
| Food, Beverages and Tobacco | - | - | 70 | 303 | 7 | - | 103 | 484 |
| Textiles and Textile Products | - | - | 6 | 1 | - | - | 4 | 11 |
| Wood and Wood Products | - | - | 2 | 5 | 124 | - | 29 | 160 |
| Pulp, Paper, Publishing and Printing | - | - | 1 | 7 | - | - | 8 | 15 |
| Chemicals and Man-Made Fibres | - | - | 8 | 126 | - | - | 85 | 219 |
| Rubber and Plastic Products | - | - | 3 | 7 | - | - | 21 | 31 |
| Other Non-Metallic Mineral Products | 71 | - | 153 | 23 | 56 | 58 | 67 | 429 |
| Basic Metals and Fabricated Metal Products | - | - | 5 | 361 | - | - | 61 | 427 |
| Machinery and Equipment n.e.c | - | - | 3 | 13 | - | - | 17 | 33 |
| Electrical and Optical Equipment | - | - | 3 | 18 | - | - | 105 | 126 |
| Transport Equipment Manufacture | - | - | 1 | 1 | - | - | 3 | 5 |
| Other Manufacturing | - | - | 12 | 41 | - | - | 53 | 106 |
| Construction | - | - | 45 | 4 | - | - | 10 | 59 |
| **Transport** | **-** | **-** | **4,766** | **17** | **224** | **-** | **18** | **5,025** |
| Road Freight | - | - | 743 | 1 | 51 | - | - | 795 |
| Light Goods Vehicle | - | - | 286 | - | 20 | - | - | 305 |
| Road Private Car | - | - | 1,883 | - | 108 | - | 14 | 2,005 |
| Public Passenger Services | - | - | 103 | - | 7 | - | - | 110 |
| Rail | - | - | 38 | - | - | - | 4 | 43 |
| Domestic Aviation | - | - | 14 | - | - | - | - | 14 |
| International Aviation | - | - | 1,005 | - | - | - | - | 1,005 |
| Fuel Tourism | - | - | 182 | - | 12 | - | - | 194 |
| Navigation | - | - | 99 | - | - | - | - | 99 |
| Unspecified | - | - | 415 | 16 | 26 | - | - | 457 |
| **Residential** | **124** | **161** | **1,057** | **540** | **114** | **-** | **713** | **2,708** |
| **Commercial/Public Services** | **0** | **-** | **192** | **342** | **51** | **-** | **1,281** | **1,866** |
| Commercial Services | 0 | - | 90 | 194 | 35 | - | 1,025 | 1,344 |
| Public Services | - | - | 102 | 148 | 16 | - | 256 | 522 |
| **Agricultural** | **-** | **-** | **258** | **-** | **-** | **-** | **45** | **303** |
| **Fisheries** | **-** | **-** | **17** | **-** | **-** | **-** | **-** | **17** |
| Statistical Difference | -10 | -2 | -73 | 1 | 4 | - | -37 | -117 |

## 2.2 Additional data

To help policymakers, analysts, researchers, and the public better understand Ireland's energy data, SEAI is expanding its use of data visualisations and interactive dashboards. This work started with introducing an energy data portal in 2019, linked to the national energy balances, and in 2023 expanded to include new interactive graphics and dashboards that allow users to explore monthly updates on energy delivery; quarterly updates on energy and fuel costs; and geographical analysis, comparing Ireland to other EU countries, and zooming down to the local authority level within Ireland. Please visit SEAI's website at https://www.seai.ie/data-and-insights/ to access the data.

SEAI currently publishes the energy balance for each year from 1990 to 2022. However, for the purposes of lending clarity to the data of most interest, the charts in this report generally only show data from 2002 onwards, while the tables show comparisons back to 2012. A spreadsheet containing complete timeseries from 1990 to 2022 for almost all graphs and charts in this report will be made available on the SEAI website shortly after publication. Please visit https://www.seai.ie/data-and-insights/seai-statistics/key-publications/energy-in-ireland/ to download a copy.

Feedback and comments on this report are welcome. Contact details are available on the back cover of this report.

# 3 Primary energy

Primary energy is the total amount of energy that is required to satisfy the down-stream final energy use of end-users. It describes the initial energy sources that are transformed, transmitted, and distributed, before that energy is made available to end-users for final consumption. Primary energy therefore describes the energy inputs of processes like electricity generation and crude oil refining, rather than the consumption of that electricity or refined oil products.

The primary energy supply depends on the final energy use, as well as the efficiencies of the various transformation processes needed to ensure that end-users receive final energy in the form that is needed. Just like final energy use, primary energy supply can be usefully analysed by fuel, sector and mode.

## 3.1 Primary energy production

Primary energy production refers to the production of energy products from natural sources within Ireland's national boundaries. Examples of production include extraction of peat, crude oil or natural gas from natural deposits; recovery of waste for energy purposes; electricity generation by wind, solar or hydro; thermal energy collection by solar thermal systems; and production of biomass or biogas.

Figure 3.1 shows the latest split of Ireland's indigenous primary energy production by fuel type. Figure 3.2 shows Ireland's annual primary energy production by fuel type and the ratio of primary energy production to supply.

**Figure 3.1: Share of indigenous primary energy production by energy type**

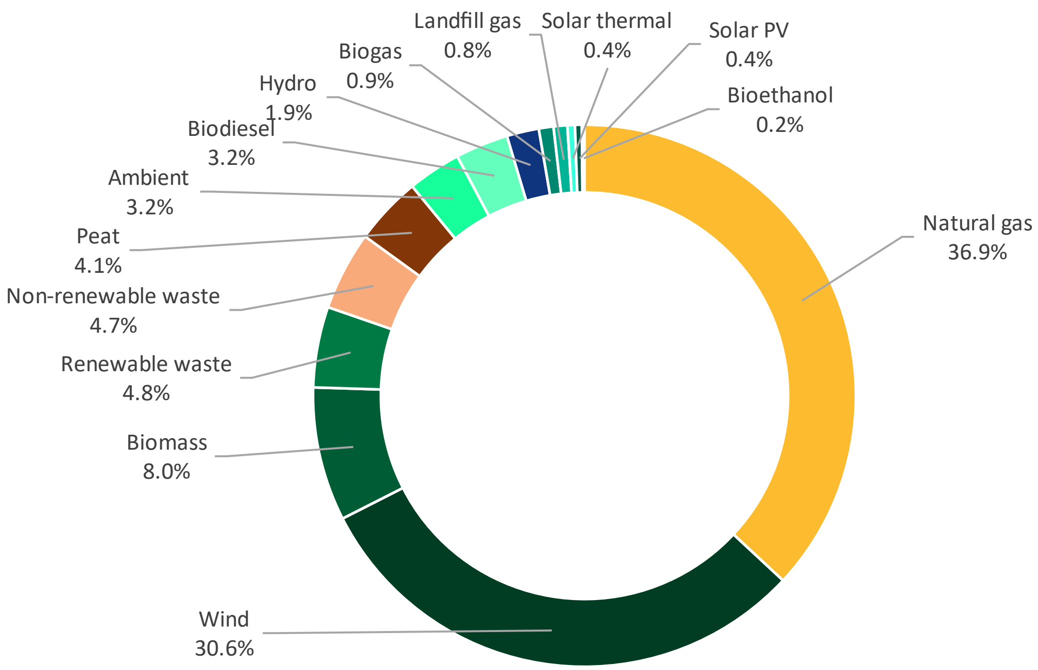


**Figure 3.2: Indigenous primary energy production by energy type with production / supply ratio**

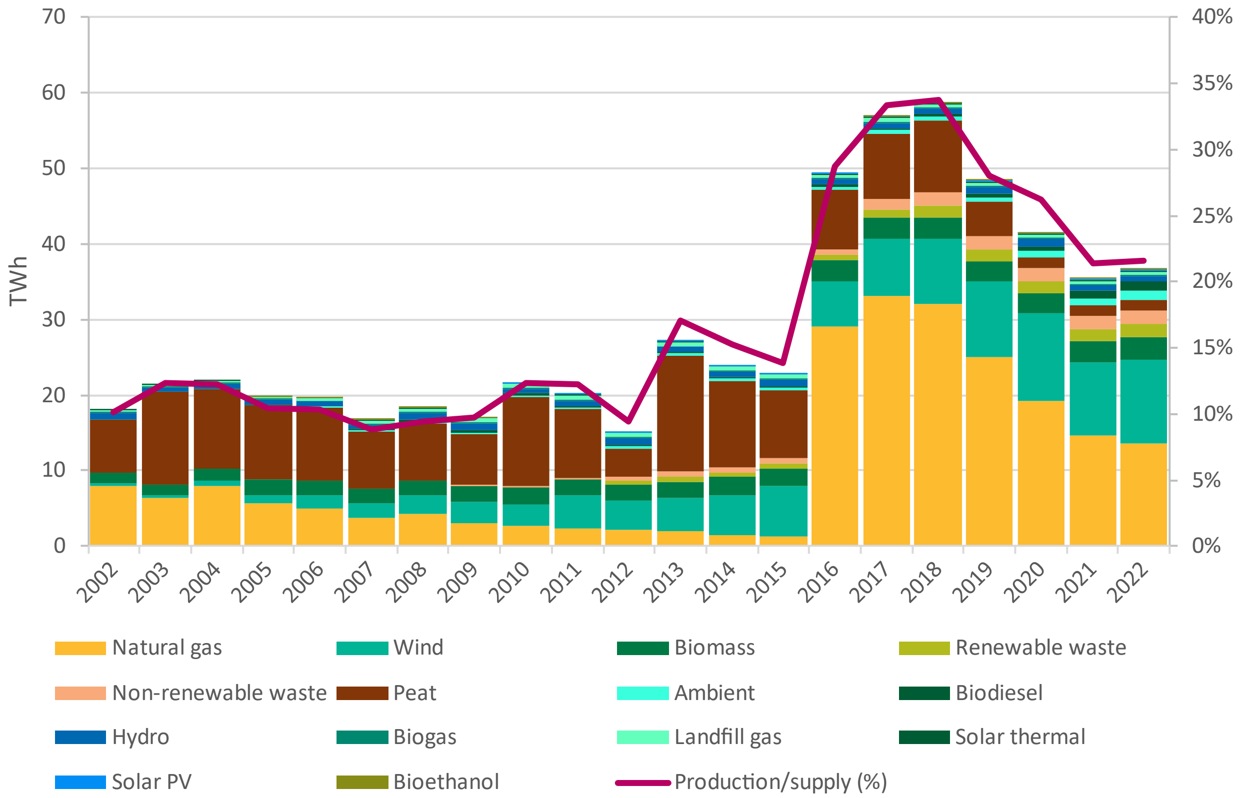


**Table 3.1: Indigenous primary energy production by energy type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Natural gas | 13.55 | 14.63 | 32.00 | 2.10 | 36.9% | 41.3% | 54.5% | 14.0% | -7.4% | -57.7% | +544% |
| Wind | 11.21 | 9.78 | 8.64 | 4.01 | 30.6% | 27.6% | 14.7% | 26.7% | +14.6% | +29.7% | +190% |
| Biomass | 2.92 | 2.70 | 2.89 | 2.07 | 8.0% | 7.6% | 4.9% | 13.8% | +8.3% | +1.0% | +41.3% |
| Renewable waste | 1.76 | 1.67 | 1.63 | 0.52 | 4.8% | 4.7% | 2.8% | 3.4% | +5.5% | +8.3% | +242% |
| Non-renewable waste | 1.73 | 1.66 | 1.69 | 0.53 | 4.7% | 4.7% | 2.9% | 3.5% | +3.8% | +2.0% | +225% |
| Peat | 1.49 | 1.49 | 9.49 | 3.73 | 4.1% | 4.2% | 16.2% | 24.8% | 0% | -84.3% | -60.2% |
| Ambient | 1.17 | 0.92 | 0.51 | 0.22 | 3.2% | 2.6% | 0.9% | 1.5% | +26.8% | +128% | +435% |
| Biodiesel | 1.16 | 0.90 | 0.36 | 0.28 | 3.2% | 2.5% | 0.6% | 1.9% | +28.3% | +220% | +306% |
| Hydro | 0.70 | 0.75 | 0.69 | 0.80 | 1.9% | 2.1% | 1.2% | 5.3% | -6.4% | +1.0% | -12.6% |
| Biogas | 0.32 | 0.26 | 0.20 | 0.15 | 0.9% | 0.7% | 0.3% | 1.0% | +21.4% | +63.8% | +113% |
| Landfill gas | 0.30 | 0.34 | 0.39 | 0.50 | 0.8% | 1.0% | 0.7% | 3.3% | -12.3% | -23.1% | -40.0% |
| Solar thermal | 0.16 | 0.16 | 0.16 | 0.11 | 0.4% | 0.5% | 0.3% | 0.7% | +0.3% | +3.8% | +50.0% |
| Solar PV | 0.15 | 0.08 | 0.02 | 0.00 | 0.4% | 0.2% | 0.0% | 0.0% | +85.8% | +714% | - |
| Bioethanol | 0.06 | 0.04 | 0.03 | 0.00 | 0.2% | 0.1% | 0.1% | 0.0% | +54.3% | +84.0% | - |
| **Total production** | **36.67** | **35.39** | **58.71** | **15.03** | **100%** | **100%** | **100%** | **100%** | **+3.6%** | **-37.5%** | **+144%** |

## 3.2 Primary energy imports and exports

Figure 3.3 shows Ireland's net energy imports by fuel type, along with the ratio of net imports to primary energy supply. Import dependency and energy security is discussed further in section 3.4.

**Figure 3.3: Imports (positive) and exports (negative) by energy type with total net imports**

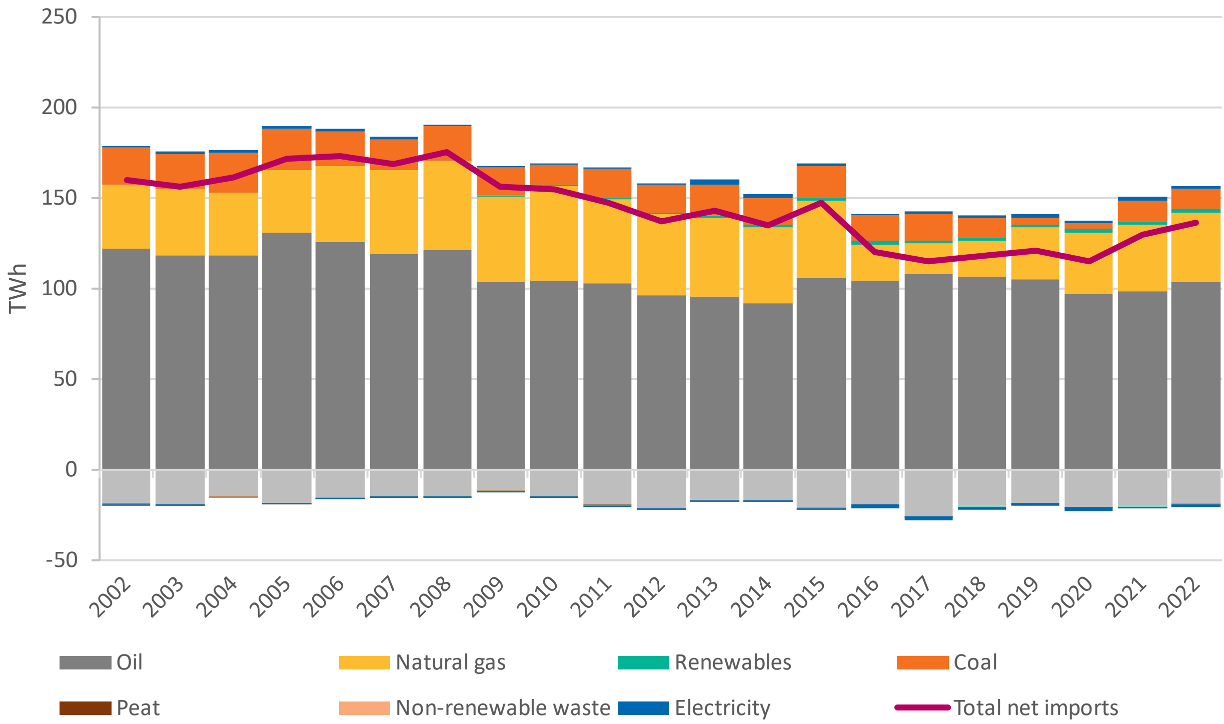



**Table 3.2: Imports by energy type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 103.32 | 98.74 | 106.28 | 96.13 | 66.0% | 65.4% | 75.8% | 60.8% | +4.6% | -2.8% | +7.5% |
| Natural gas | 38.45 | 36.35 | 20.10 | 44.73 | 24.6% | 24.1% | 14.3% | 28.3% | +5.8% | +91.3 | -14.0% |
| Renewables | 2.08 | 1.73 | 1.77 | 0.93 | 1.3% | 1.1% | 1.3% | 0.6% | +20.0% | +17.5% | +124.2% |
| Coal | 11.13 | 11.68 | 10.51 | 15.57 | 7.1% | 7.7% | 7.5% | 9.8% | -4.8% | +5.9% | -28.6% |
| Peat | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| Non-renewable waste | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| Electricity | 1.58 | 2.45 | 1.62 | 0.78 | 1.0% | 1.6% | 1.2% | 0.5% | -35.5% | -2.5% | +101.8% |
| **Total imports** | **156.56** | **150.96** | **140.28** | **158.15** | **100%** | **100%** | **100%** | **100%** | **+3.7%** | **+11.6%** | **-1.0%** |

**Table 3.3: Exports by energy type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 18.33 | 19.97 | 19.97 | 20.82 | 90.4% | 93.0% | 90.8% | 97.3% | -8.2% | -8.2% | -12.0% |
| Natural gas | 0 | 0 | 0 | 0 | 0.0% | 0.0% | 0.0% | 0.0% | - | - | - |
| Renewables | 0.17 | 0.20 | 0.11 | 0.00 | 0.8% | 0.9% | 0.5% | 0.0% | -16.7% | +54.5% | - |
| Coal | 0.44 | 0.41 | 0.18 | 0.11 | 2.2% | 1.9% | 0.8% | 0.5% | +7.2% | +149.0% | +306.1% |
| Peat | 0.01 | 0.03 | 0.08 | 0.10 | 0.1% | 0.1% | 0.4% | 0.5% | -51.0% | -81.9% | -85.6% |
| Non-renewable waste | 0 | 0 | 0 | 0 | 0.0% | 0.0% | 0.0% | 0.0% | - | - | - |
| Electricity | 1.33 | 0.86 | 1.65 | 0.37 | 6.6% | 4.0% | 7.5% | 1.7% | +54.1% | -19.4% | +259.3% |
| **Total exports** | **20.29** | **21.48** | **21.99** | **21.40** | **100%** | **100%** | **100%** | **100%** | **-5.5%** | **-7.7%** | **-5.2%** |

**Table 3.4: Net imports by energy type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 84.99 | 78.77 | 86.31 | 75.31 | 62.4% | 60.8% | 73.0% | 55.1% | +7.9% | -1.5% | +12.9% |
| Natural gas | 38.45 | 36.35 | 20.10 | 44.73 | 28.2% | 28.1% | 17.0% | 32.7% | +5.8% | +91.3% | -14.0% |
| Renewables | 1.91 | 1.53 | 1.66 | 0.93 | 1.4% | 1.2% | 1.4% | 0.7% | +24.8% | +15.0% | +105.9% |
| Coal | 10.69 | 11.27 | 10.33 | 15.47 | 7.8% | 8.7% | 8.7% | 11.3% | -5.2% | +3.4% | -30.9% |
| Peat | -0.01 | -0.03 | -0.08 | -0.10 | -0.0% | -0.0% | -0.1% | -0.1% | -51.0% | -81.9% | -85.6% |
| Non-renewable waste | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| Electricity | 0.25 | 1.59 | -0.03 | 0.41 | 0.2% | 1.2% | -0.0% | 0.3% | -84.1% | -1,008.4% | -39.1% |
| **Total net imports** | **136.27** | **129.48** | **118.29** | **136.75** | **100%** | **100%** | **100%** | **100%** | **+5.2%** | **+15.2%** | **-0.3%** |

## 3.3 Primary energy supply and requirement

SEAI uses the following standard definition of primary energy supply for each fuel and energy type in the energy balance:

*Primary energy supply = indigenous production + imports – exports – int. marine bunkers + stock change*

Section 3.1 discusses production. Imports and exports refer to the quantities of each energy product that enters and exits Ireland. International marine bunkers refer to the fuel delivered at Ireland's ports to vessels that are engaged in international navigation; currently only fuel oil and gas oil are used for this purpose. Stock change is the change between opening and closing stock levels for a fuel held in Ireland during the year. A positive stock change indicates the net effect of the stock of a product being drawn down to enter the primary energy supply. A negative value indicates that the stock of the product has increased during the year. Stocks do not include reserves of fuels or products that are not yet extracted from natural deposits.

Another key measure of primary energy is primary energy requirement, defined as primary energy supply less non-energy use of the fuel or energy type:

*Primary energy requirement = primary energy supply – non-energy use*

For most fuel types included in the energy balance, there are no significant non-energy uses, and their primary energy supply and requirement are equal. In Ireland, the exceptions to this are bitumen, lubricating oil and white spirits, and oil products not used for energy purposes. Renewables used for materials, such as wood for construction or peat for gardening are not tracked in the energy balance.

Figure 3.4 displays the split of fuels in Ireland's primary energy requirement for 2022.

**Figure 3.4: Share of primary energy requirement by energy type**

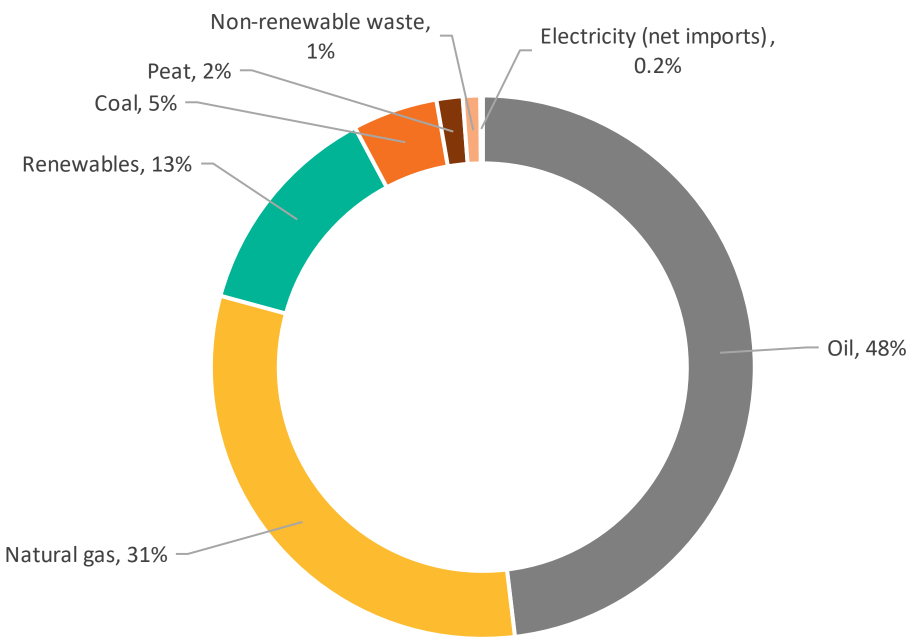



Figure 3.5 shows the trend in annual total primary energy requirement by energy type. Table 3.5 provides a detailed summary of the quantities and share of each energy type in Ireland's total primary energy requirement in comparison to previous years.

Total primary energy requirement peaked in 2008 before the economic downturn and reached a low in 2014 before growing to a relatively stable level from 2016 to 2019. A significant contraction to TPER occurred in 2020 due to the impacts of the COVID-19 pandemic; this contraction was mostly confined to oil products, caused by a downturn in transport demand.

In absolute terms, Ireland's current total primary energy requirement is comparable to that from 20 and 10 years ago, despite intervening periods of significant growth and decline. Nevertheless, the mix of fuels and energy types in primary energy has evolved significantly during this time. The broad trend has been the growth of renewables and natural gas displacing oil, coal and peat. Despite the meaningful development of renewables, fossil fuels still dominate Ireland's primary energy supply.

**Figure 3.5: Annual primary energy requirement by energy type[5]**

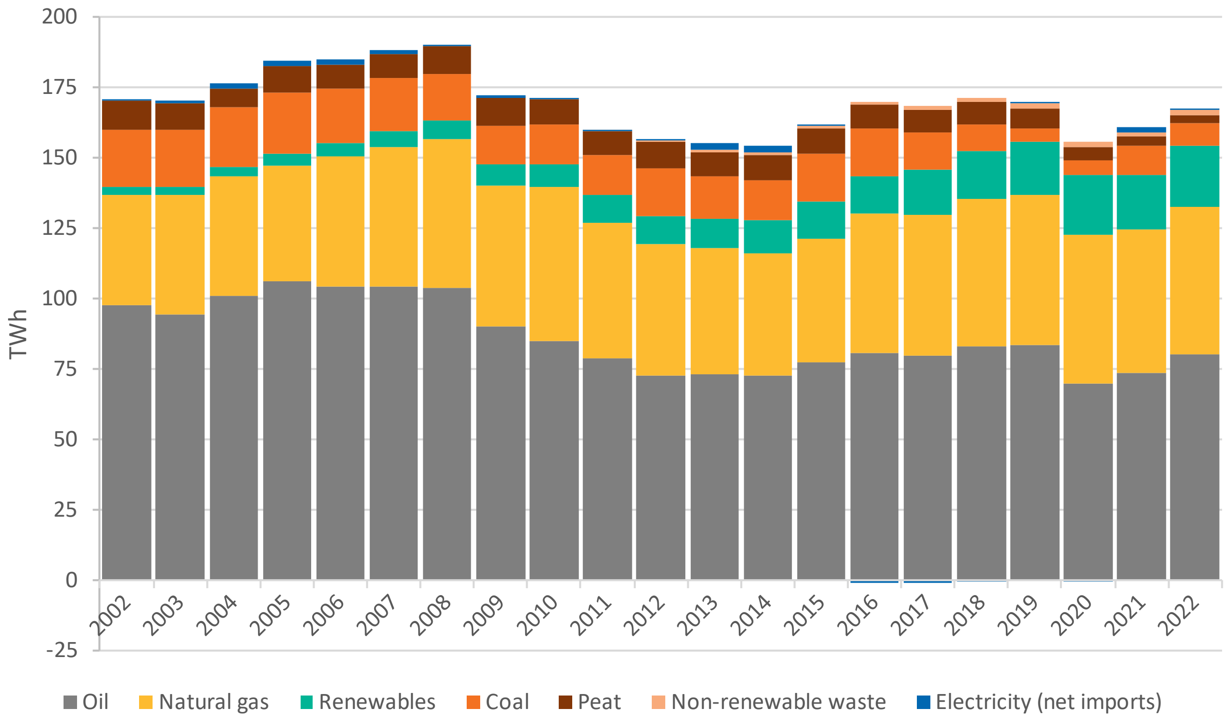



**Table 3.5: Primary energy requirement by fuel type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 80.39 | 73.67 | 83.21 | 72.49 | 48.1% | 45.8% | 48.6% | 46.3% | +9.1% | -3.4% | +10.9% |
| Gas | 52.00 | 50.98 | 52.11 | 47.00 | 31.1% | 31.7% | 30.4% | 30.0% | +2.0% | -0.2% | +10.6% |
| Renewables | 21.67 | 19.17 | 17.23 | 9.56 | 13.0% | 11.9% | 10.1% | 6.1% | +13.0% | +25.7% | +127% |
| Coal | 8.45 | 10.59 | 9.15 | 17.27 | 5.1% | 6.6% | 5.3% | 11.0% | -20.2% | -7.6% | -51.1% |
| Peat | 2.59 | 3.08 | 7.98 | 9.19 | 1.6% | 1.9% | 4.7% | 5.9% | -15.8% | -67.5% | -71.8% |
| NRW | 1.73 | 1.66 | 1.69 | 0.53 | 1.0% | 1.0% | 1.0% | 0.3% | +3.8% | +2.0% | +225% |
| Electricity (net imports) | 0.25 | 1.59 | -0.03 | 0.41 | 0.2% | 1.0% | -0.0% | 0.3% | -84.1% | -1,008% | -39.1% |
| **Total** | **167.08** | **160.74** | **171.34** | **156.46** | **100%** | **100%** | **100%** | **100%** | **+3.9%** | **-2.5%** | **+6.8%** |

## 3.4 Energy security and import dependency

Energy security, in its simplest terms, means having uninterrupted access to reliable, affordable supplies of energy. Secure supplies of energy are essential for our economy and for maintaining safe and comfortable living conditions.

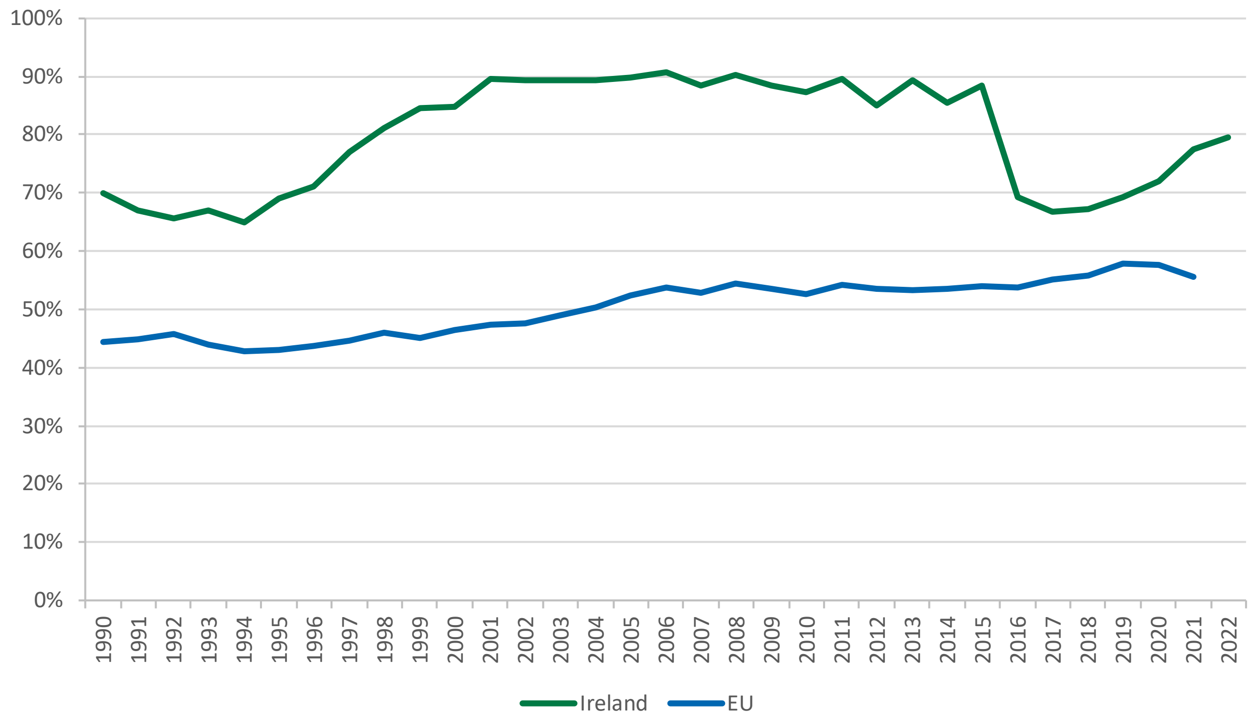
Energy import dependency is one of the simplest and most widely used indicators of a country's energy security, with indigenous energy sources generally considered to be more secure than imported energy. While the overall import dependency figure provides a useful context, a deeper understanding of energy security requires more detailed information on individual energy sources. This includes the countries from where each fuel is sourced, global market conditions, transportation and other infrastructure requirements. It also requires analysis of the

[5] 'Wastes (non-renewable)' in the graph represents energy from non-renewable wastes.

current trends in energy use, and of the significant changes that will occur in energy use - both nationally and globally over the coming years. Energy security is considered in more detail in a separate SEAI publication.

Figure 3.6 illustrates the trend in import dependency since 1990, comparing it with that for the EU as a whole, and shows the dramatic change in Ireland's import dependency in 2016 resulting from the start of natural gas production from the Corrib gas field. Indigenous production accounted for 32% of Ireland's energy requirements in 1990. From the mid-1990s, import dependency grew significantly due to the increase in energy use, together with the decline in indigenous natural gas production at Kinsale since 1995, and decreasing peat production. Ireland's overall import dependency reached 91% in 2006. In 2016, import dependency fell sharply following the opening of the Corrib gas field, but has been increasing again since, as the Corrib field production capacity declines.

**Figure 3.6: Import dependency of Ireland and the EU**




*Source: SEAI and Eurostat*

This trend reflects the fact that Ireland is not endowed with significant indigenous fossil fuel resources and has only in recent years begun to harness significant quantities of renewable resources and natural gas from the Corrib gas field.

# 4 Energy transformation

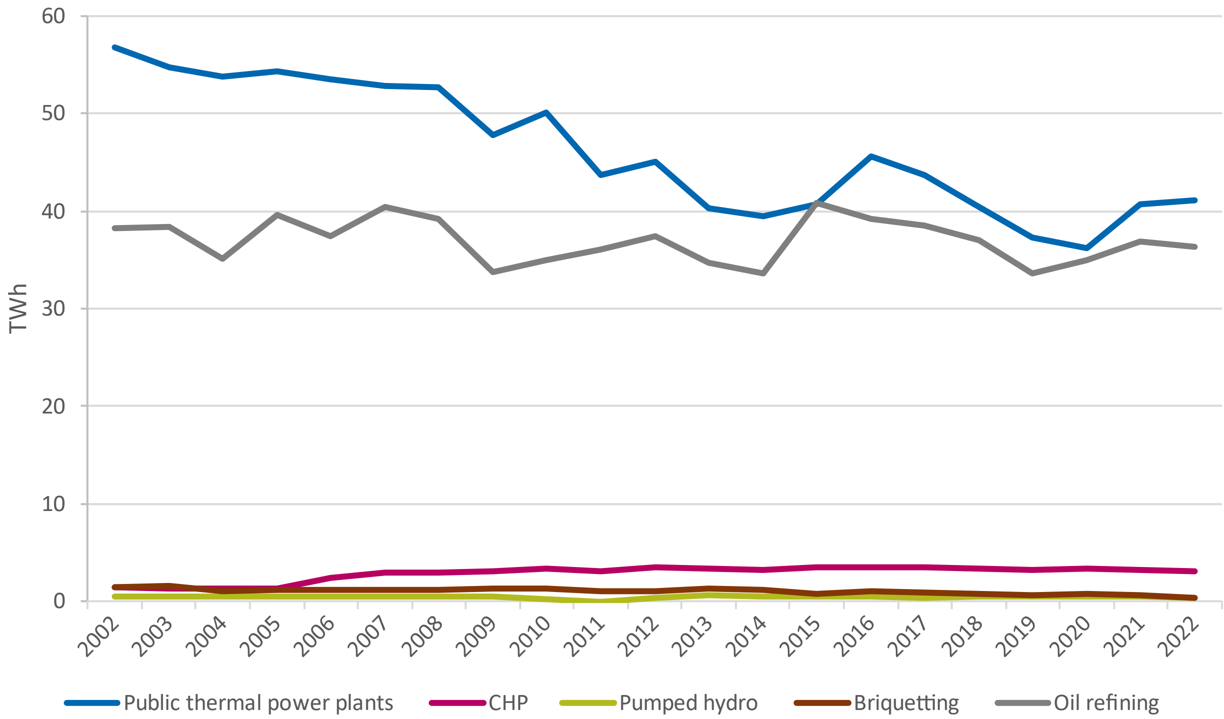
Energy transformation involves converting one fuel type or energy source into another, such as transforming crude oil into petrol and diesel in an oil refinery, or converting coal and gas into electricity in a thermal generation plant. Approximately half of all primary energy undergoes a transformation, of one kind or another, before it reaches an end user for final consumption.

Primary energy supply includes all inputs and losses in energy transformation processes, while final energy use only includes the outputs from those transformation processes. Transformation outputs are less than the primary supply inputs due to the energy required to make the transformations, and losses from those processes.

## 4.1 Overview of transformation

As shown in Figure 4.1, the two most significant energy transformation processes in Ireland are electricity generation and oil refining. Oil refining has had a relatively constant, long-term average input of approximately 37 TWh per annum, while the transformation input of public thermal power plants for electricity generation has been trending downward over the long term as coal, oil and peat fired power are replaced by gas and renewables.

**Figure 4.1: Primary energy inputs to transformation processes**[6]



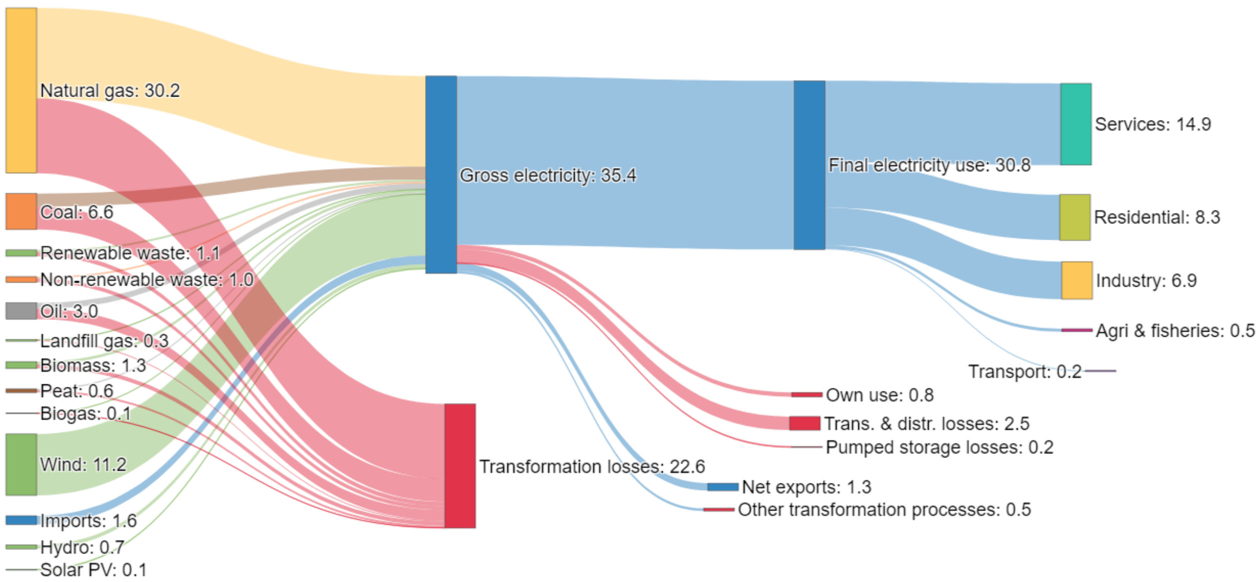

## 4.2 Electricity generation

Modern economies and societies depend on reliable and secure supplies of electricity. Total energy inputs to electricity generation account for approximately one-third of Ireland's total primary energy supply. The Sankey diagram in Figure 4.2 shows the flow of energy from the inputs to electricity generation through to the final electricity used by the different sectors. As the diagram shows, a significant portion of the energy used to generate

[6] In this graph, non-combustible renewables such as hydro, wind and solar are not included under electricity, as they do not involve a statistical energy transformation. However, these non-combustible sources of renewable electricity generation are presented in the following sub-sections in section 4.

electricity is lost before the electricity reaches the end user, through a combination of transformation losses, own use of electricity by power plants, pumped hydro storage losses, and transmission and distribution losses.

**Figure 4.2: Flow of energy in electricity generation and consumption (TWh)**



### 4.2.1 Primary energy input to electricity generation

Figure 4.3 shows the trends in primary energy supply to electricity generation broken out by energy type.

Note that non-combustible renewable sources accounted for a higher share of generated electricity than of primary energy input to electricity generation. This is because the thermal generation of electricity from natural gas and coal has significant energy losses (see Figure 4.2), while electricity generation from non-combustible renewable sources (wind, hydro and solar) is considered to be 100% efficient as this is the point at which the measurable energy enters the system.

Table 4.1 shows the energy input to electricity generation by energy type with comparison to previous years.

**Figure 4.3: Energy input to electricity generation by energy type**

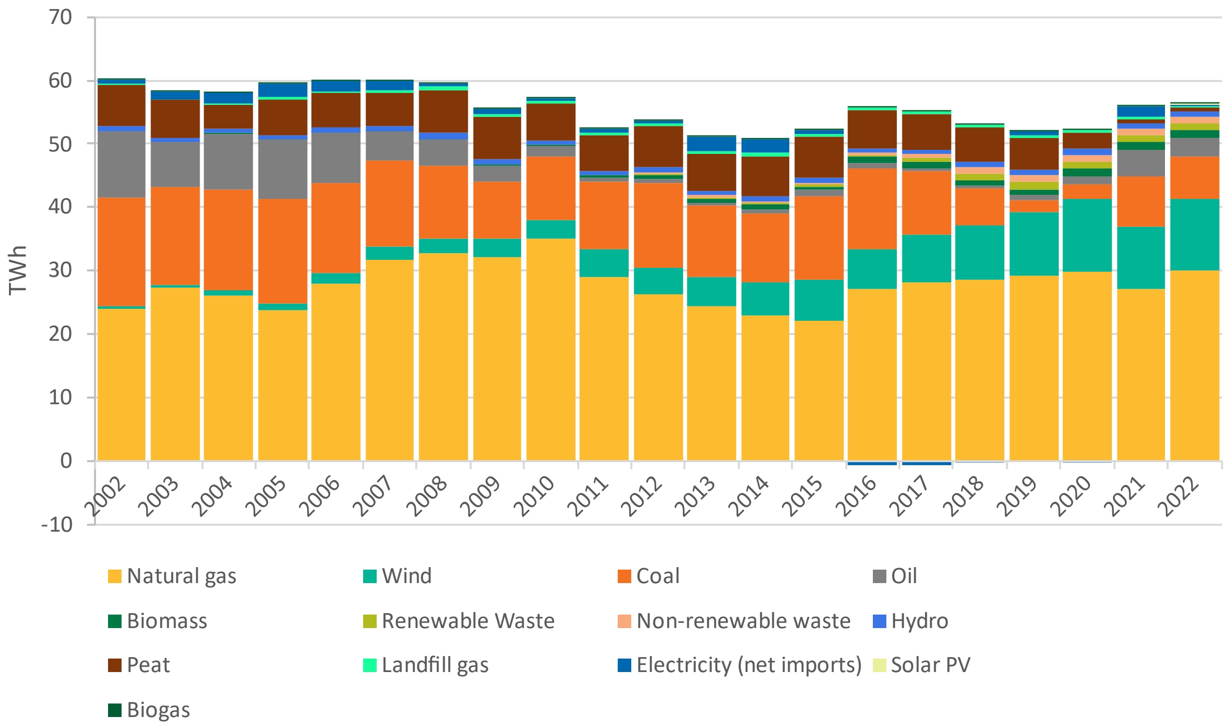


**Table 4.1: Energy input to electricity generation by energy type with comparison to previous years**

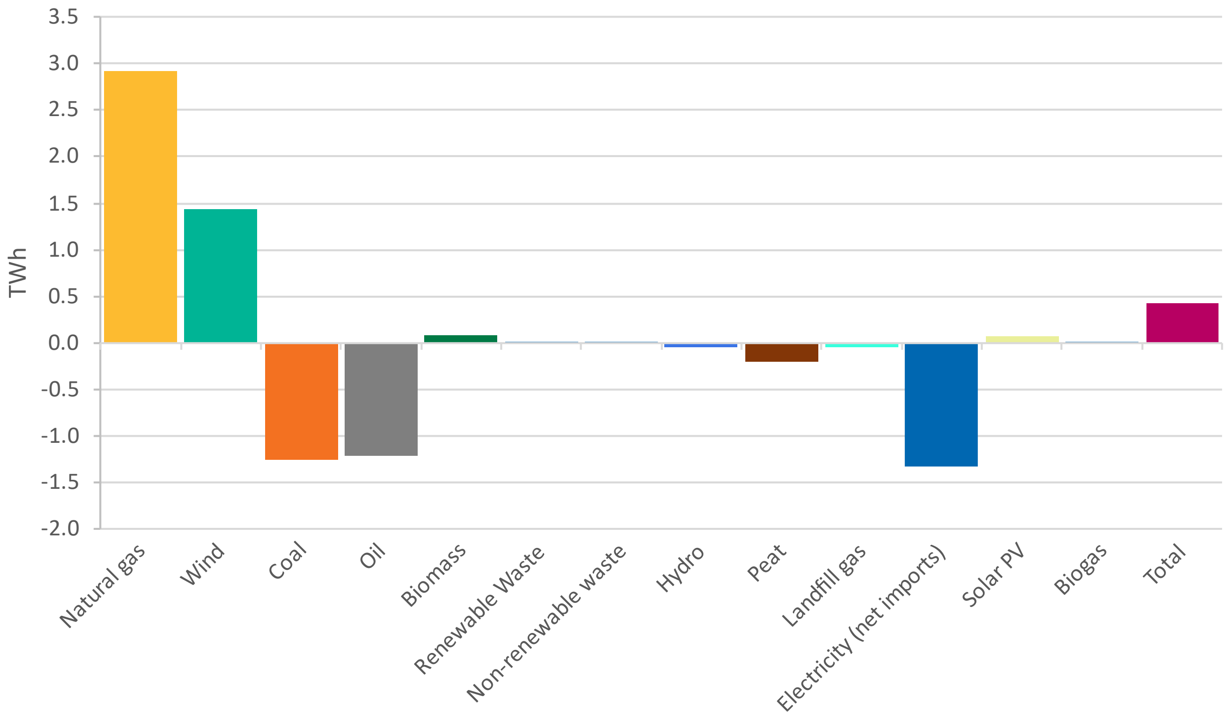
| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Natural gas | 30.17 | 27.24 | 28.62 | 26.40 | 53.4% | 48.6% | 53.9% | 49.1% | +10.7% | +5.4% | +14.3% |
| Wind | 11.21 | 9.78 | 8.64 | 4.01 | 19.8% | 17.4% | 16.3% | 7.5% | +14.6% | +29.7% | +179% |
| Coal | 6.56 | 7.82 | 5.69 | 13.49 | 11.6% | 14.0% | 10.7% | 25.1% | -16.1% | +15.3% | -51.4% |
| Oil | 2.97 | 4.19 | 0.40 | 0.65 | 5.3% | 7.5% | 0.8% | 1.2% | -29.0% | +636% | +357% |
| Biomass | 1.26 | 1.18 | 0.88 | 0.47 | 2.2% | 2.1% | 1.7% | 0.9% | +7.0% | +42.8% | +168% |
| Renewable Waste | 1.14 | 1.13 | 1.15 | 0.29 | 2.0% | 2.0% | 2.2% | 0.5% | +0.7% | -1.5% | +297% |
| Non-renewable waste | 1.05 | 1.04 | 1.06 | 0.21 | 1.9% | 1.8% | 2.0% | 0.4% | +1.1% | -0.8% | +390% |
| Hydro | 0.70 | 0.75 | 0.69 | 0.80 | 1.2% | 1.3% | 1.3% | 1.5% | -6.4% | +1.0% | -12.6% |
| Peat | 0.63 | 0.83 | 5.50 | 6.48 | 1.1% | 1.5% | 10.4% | 12.1% | -24.4% | -88.6% | -90.3% |
| Landfill gas | 0.30 | 0.34 | 0.39 | 0.50 | 0.5% | 0.6% | 0.7% | 0.9% | -12.3% | -23.1% | -40.0% |
| Electricity (net imports) | 0.25 | 1.59 | -0.03 | 0.41 | 0.4% | 2.8% | -0.1% | 0.8% | -84.1% | -1,008% | -39.1% |
| Solar PV | 0.15 | 0.08 | 0.02 | 0.00 | 0.3% | 0.1% | 0.0% | 0.0% | +85.8% | +714% | - |
| Biogas | 0.12 | 0.11 | 0.08 | 0.05 | 0.2% | 0.2% | 0.2% | 0.1% | +7.6% | +50.5% | +155.3% |
| **Total** | **56.51** | **56.08** | **53.10** | **53.77** | **100%** | **100%** | **100%** | **100%** | **+0.8%** | **+6.4%** | **+5.1%** |

**Table 4.2: Energy input to electricity generation by renewable sources, non-renewable sources**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Renewable | 14.88 | 13.38 | 11.86 | 6.12 | 26.2% | 23.2% | 22.4% | 11.3% | +11.3% | +25.4% | +143.2% |
| Non-renewable | 41.63 | 42.71 | 41.24 | 47.65 | 73.3% | 74.1% | 77.7% | 87.9% | -2.5% | +0.9% | -12.6% |
| Electricity (net imports) | 0.25 | 1.59 | -0.03 | 0.41 | 0.4% | 2.8% | -0.1% | 0.8% | -84.1% | -1,008% | -39.1% |
| **Total** | **56.76** | **57.67** | **53.07** | **54.18** | **100%** | **100%** | **100%** | **100%** | **-1.6%** | **+7.0%** | **+4.8%** |

Table 4.1 provides a detailed summary of the quantities, shares and trends of fuel types and energy sources that go into electricity generation. Figure 4.4 shows the changes in primary supply for electricity generation in the last year, by fuel type and energy source.

**Figure 4.4: Change in input energy type to electricity generation in 2022 compared with 2021**




## 4.2.2 Electricity generated and net imports

Figure 4.5 and Table 4.3 detail the generated electricity available for final consumption by end users, broken down by fuel type and energy source.

**Figure 4.5: Electricity generated by source energy type with net imports**

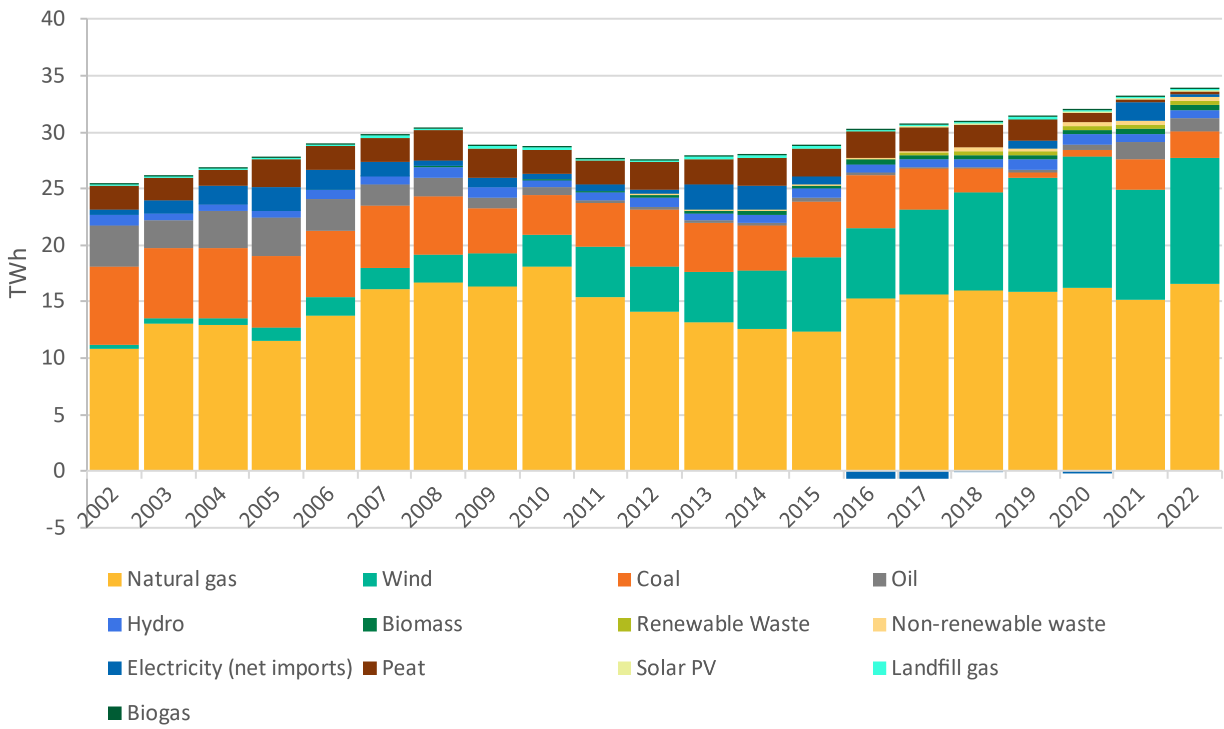


**Table 4.3: Electricity generated by input energy type with comparison to previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Natural gas | 16.53 | 15.16 | 16.02 | 14.14 | 48.8% | 45.7% | 51.9% | 51.3% | +9.1% | +3.2% | +16.9% |
| Wind | 11.21 | 9.78 | 8.64 | 4.01 | 33.1% | 29.5% | 28.0% | 14.6% | +14.6% | +29.7% | +179% |
| Coal | 2.37 | 2.72 | 2.15 | 5.03 | 7.0% | 8.2% | 7.0% | 18.2% | -12.9% | +10.0% | -52.9% |
| Oil | 1.08 | 1.45 | 0.14 | 0.24 | 3.2% | 4.4% | 0.5% | 0.9% | -26.0% | +672% | +356% |
| Hydro | 0.70 | 0.75 | 0.69 | 0.80 | 2.1% | 2.3% | 2.2% | 2.9% | -6.4% | +1.0% | -12.6% |
| Biomass | 0.51 | 0.47 | 0.33 | 0.18 | 1.5% | 1.4% | 1.1% | 0.6% | +7.9% | +52.0% | +184% |
| Renewable Waste | 0.35 | 0.35 | 0.33 | 0.07 | 1.0% | 1.1% | 1.1% | 0.2% | -1.3% | +5.0% | +420% |
| Non-renewable waste | 0.32 | 0.32 | 0.30 | 0.05 | 0.9% | 1.0% | 1.0% | 0.2% | -0.9% | +5.8% | +542% |
| Electricity (net imports) | 0.25 | 1.59 | -0.03 | 0.41 | 0.7% | 4.8% | -0.1% | 1.5% | -84.1% | -1,008% | -39.1% |
| Peat | 0.25 | 0.32 | 2.09 | 2.44 | 0.7% | 1.0% | 6.8% | 8.8% | -23.9% | -88.2% | -89.9% |
| Solar PV | 0.15 | 0.08 | 0.02 | 0.00 | 0.4% | 0.2% | 0.1% | 0.0% | +85.8% | +714% | - |
| Landfill gas | 0.10 | 0.12 | 0.14 | 0.17 | 0.3% | 0.4% | 0.5% | 0.6% | -15.4% | -27.8% | -41.8% |
| Biogas | 0.06 | 0.05 | 0.04 | 0.02 | 0.2% | 0.2% | 0.1% | 0.1% | +7.9% | +29.7% | +138% |
| **Total** | **33.87** | **33.17** | **30.88** | **27.56** | **100%** | **100%** | **100%** | **100%** | **+2.1%** | **+9.7%** | **+22.9%** |

A comparison of Figure 4.3 and Figure 4.5 is equivalent to a comparison of the primary energy supply for electricity and final energy use of electricity. The difference in scale between the two figures (40 TWh *vs*. 70 TWh) reflects the generation losses. The relative increase in share from renewable sources in Figure 4.5 (*vs*. Figure 4.3) is due to wind, hydro and solar generation being taken as 100% efficient.

Figure 4.6 shows the changes in electricity generation by source in 2022 compared to 2021

**Figure 4.6: Change in electricity generation by source in 2022 compared with 2021**

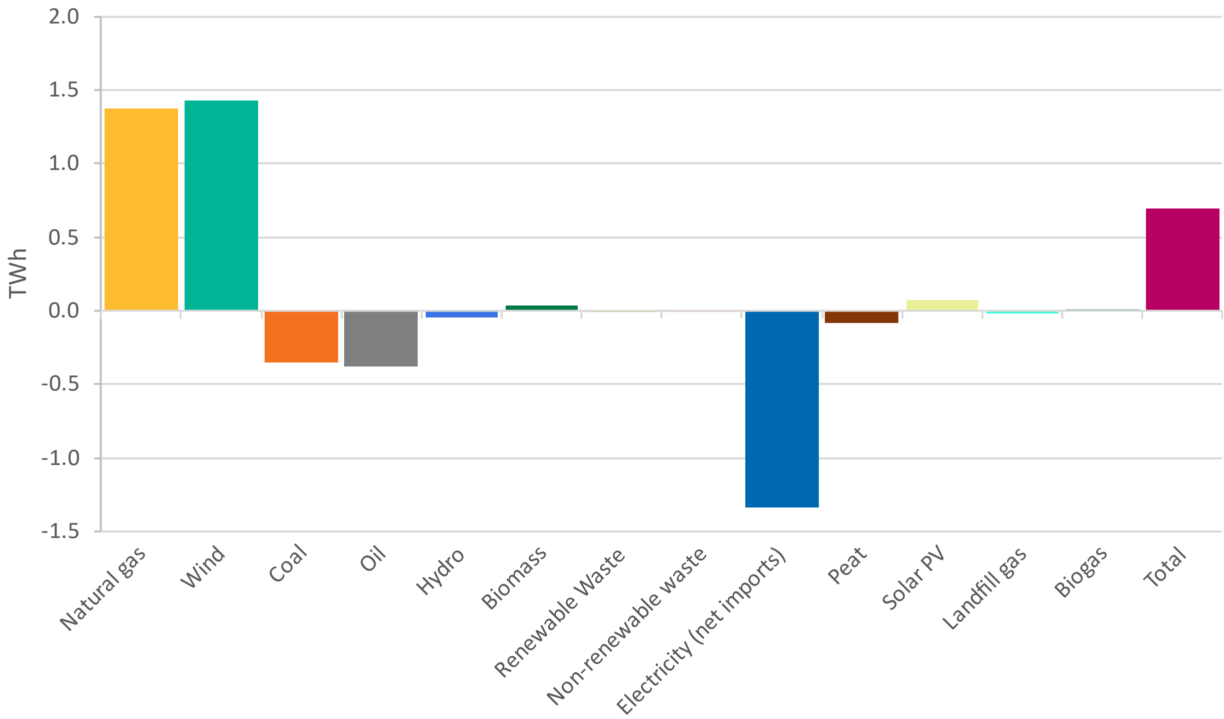
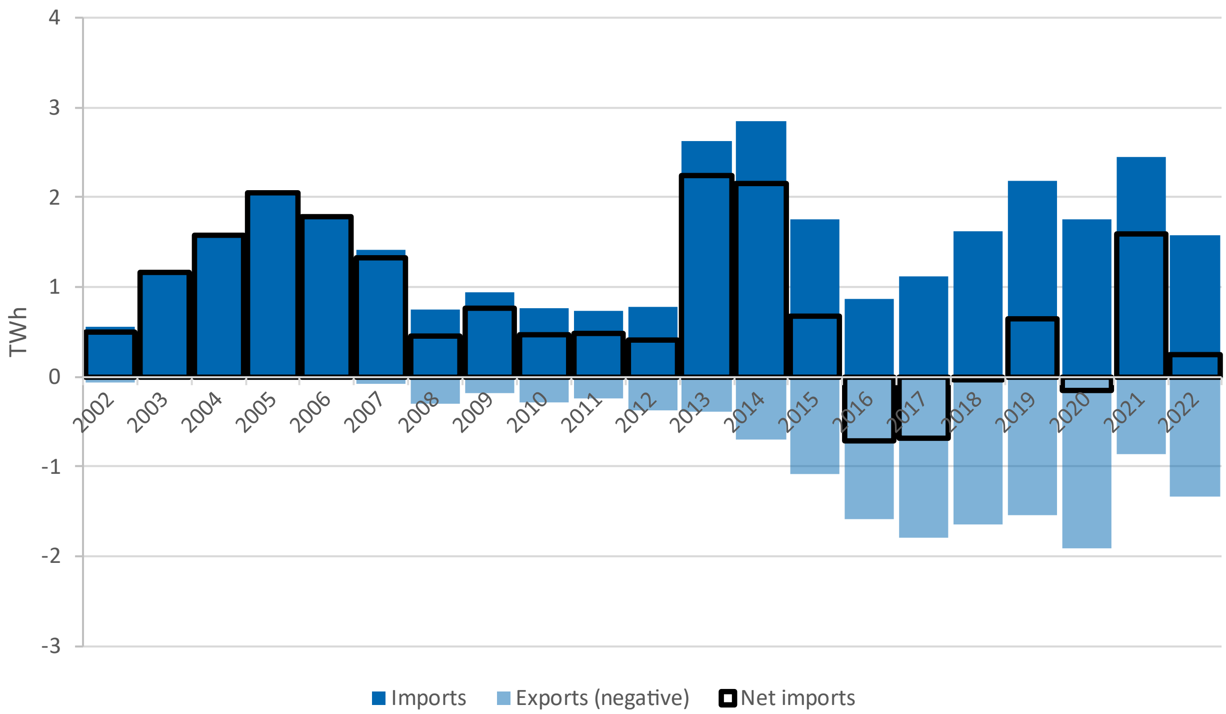



Figure 4.7 shows the annual imports, exports and net exports of electricity from 2002 to 2022.

**Figure 4.7: Electricity imports, exports and net imports**



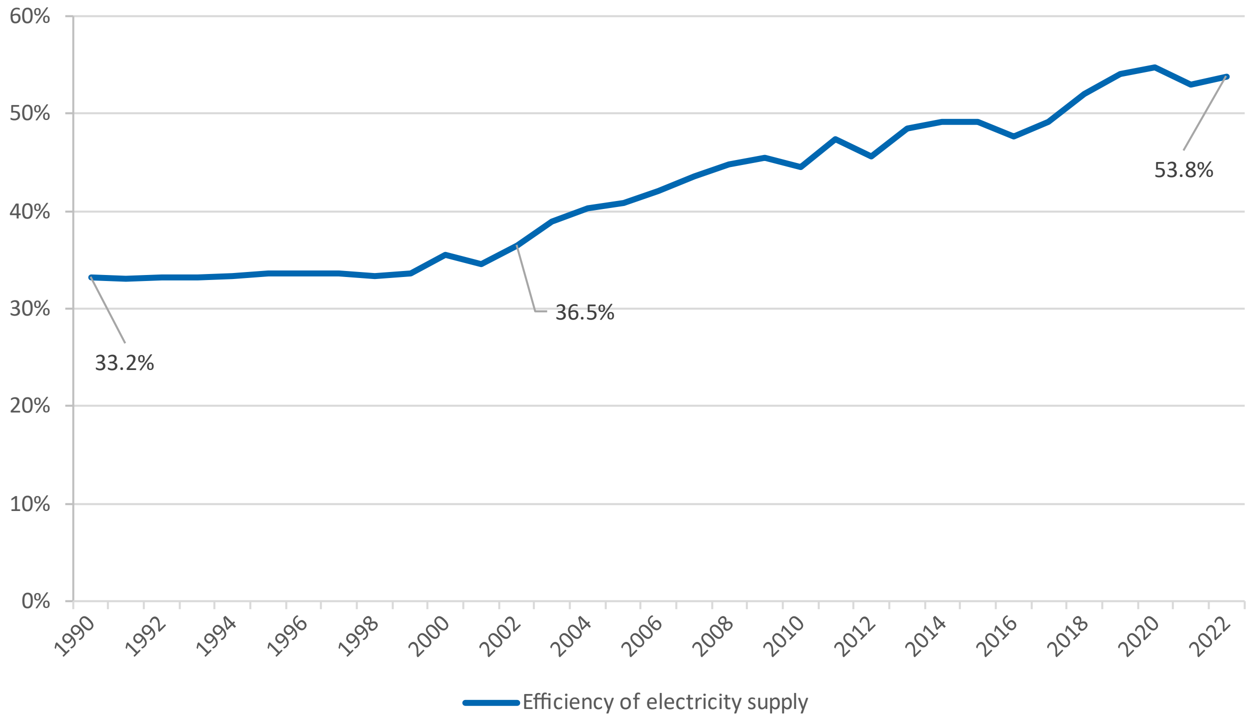
### 4.2.3 Efficiency of electricity supply

Figure 4.8 shows trends in the efficiency of Ireland's electricity supply. Efficiency of electricity supply is defined as the ratio of final energy use of electricity and the primary energy supply for the generation of that electricity.[7]

The overall efficiency is determined by the weighted average of electricity generation from non-combustible renewable sources, such as wind, hydro and solar (taken to be 100% efficient), and electricity from combustible sources, such as gas, coal and biomass (which have transformation losses). The efficiency of electricity supply efficiency therefore increases as the share of non-combustible renewable sources, and as more efficient fuels and technologies are employed in thermal generation plants.

The efficiency of Ireland's electricity supply has generally improved over the last two decades, due to introducing higher efficiency natural gas plants, the closure of or reduction in utilisation of older oil-, coal-, and peat-fired stations, as well as increased direct generation from renewable sources.

**Figure 4.8: Efficiency of electricity supply**




### 4.2.4 Combined heat and power generation

Combined heat and power (CHP) is the simultaneous generation of usable heat and electricity in a single process. In conventional electricity generation, much of the input energy is lost as waste heat. The efficiency of a CHP plant can be 20-25% higher than the combined efficiency of heat-only boilers and conventional power stations. Also, if embedded in the network close to the point of electrical consumption, CHP can avoid some of the transmission losses incurred by centralised generation. In the right circumstances, despite higher capital outlay, CHP can be an economical means of improving the efficiency of energy use and reducing emissions. Table 4.4 contains the number of CHP units and installed electrical capacity (MWe), broken down by fuel for 2022 and 2021.

---

[7] Electricity supply efficiency calculations include energy consumed by electricity generating plants themselves, as well as transmission and distribution losses. Electricity generation efficiency ignores these losses, hence generation efficiency is higher than supply efficiency.

**Table 4.4: Number of operational CHP units and installed capacity by fuel, 2022 and 2021**

| | 2022 | | 2021 | |
|---|---|---|---|---|
| | No. of Units | Installed Capacity (MWe) | No. of Units | Installed Capacity (MWe) |
| Natural Gas | 275 | 305.5 | 277 | 303.7 |
| Solid Fuels | 1 | 2.6 | 1 | 2.6 |
| Biomass | 3 | 6.6 | 3 | 6.6 |
| Oil Fuels | 21 | 1.1 | 20 | 1.1 |
| Biogas | 18 | 11.9 | 18 | 11.9 |
| **Total** | **318** | **327.7** | **319** | **325.8** |

Figure 4.9 illustrates the contribution from CHP to Ireland's energy requirements in the period 2000 to 2022. The step-change increase observed in 2006 is due to the Aughinish Alumina CHP plant coming online.

**Figure 4.9: CHP fuel input and thermal/electricity output**

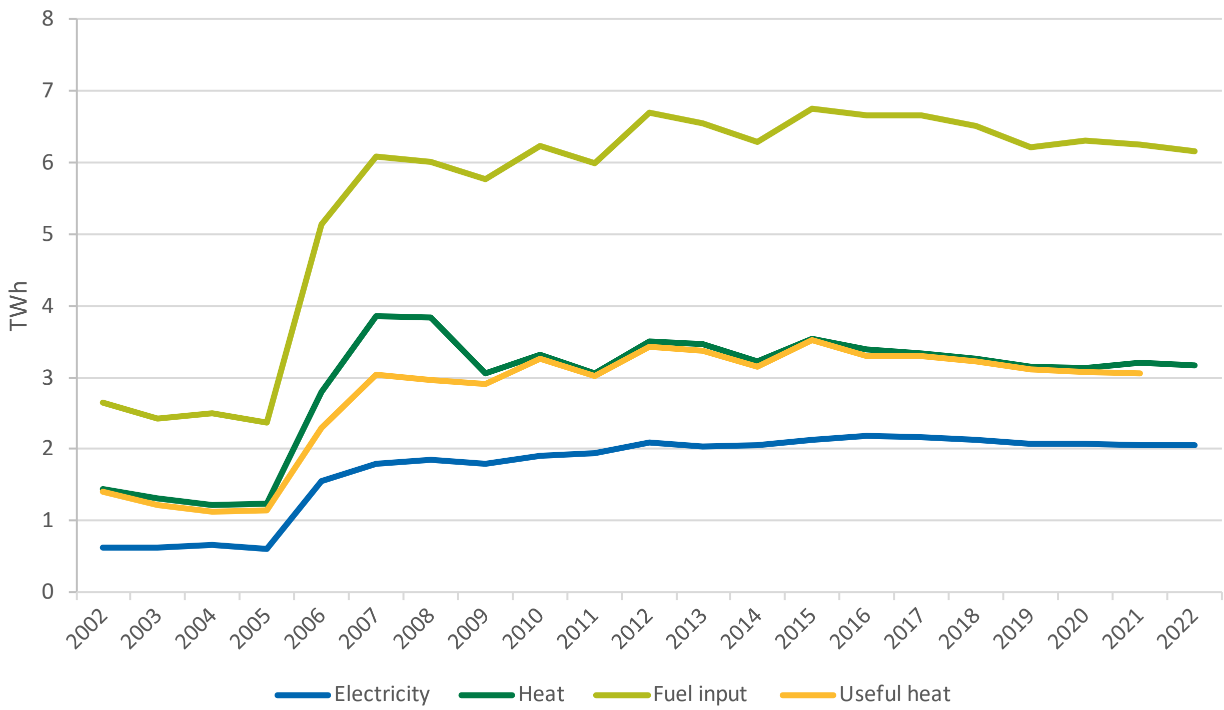


Figure 4.10 focuses on CHP generated electricity in Ireland as a proportion of gross electricity consumption (that is electricity generation plus net imports) in the period 2001 to 2022. Table 4.5 provides data on the number of CHP units that exported electricity to the grid in the last two years and the total quantity of electricity exported.

**Figure 4.10: CHP electricity as percentage of total electricity generation**

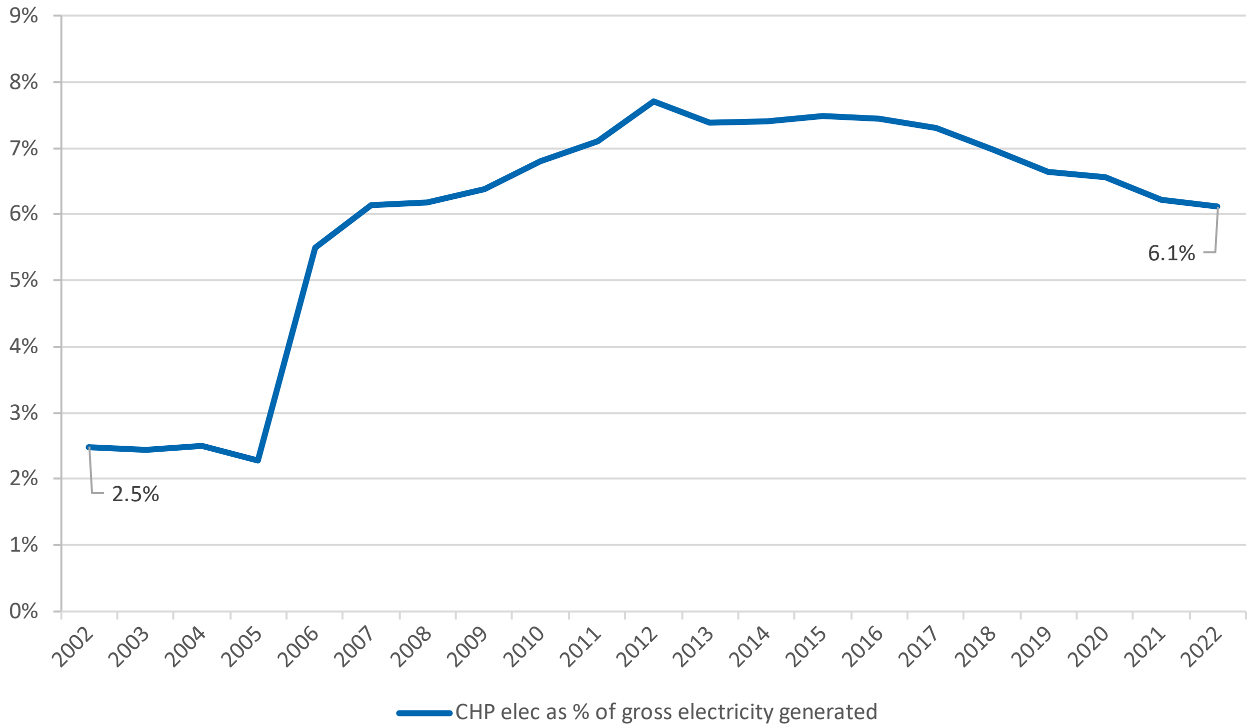



**Table 4.5: Electricity exported to the grid from CHP**

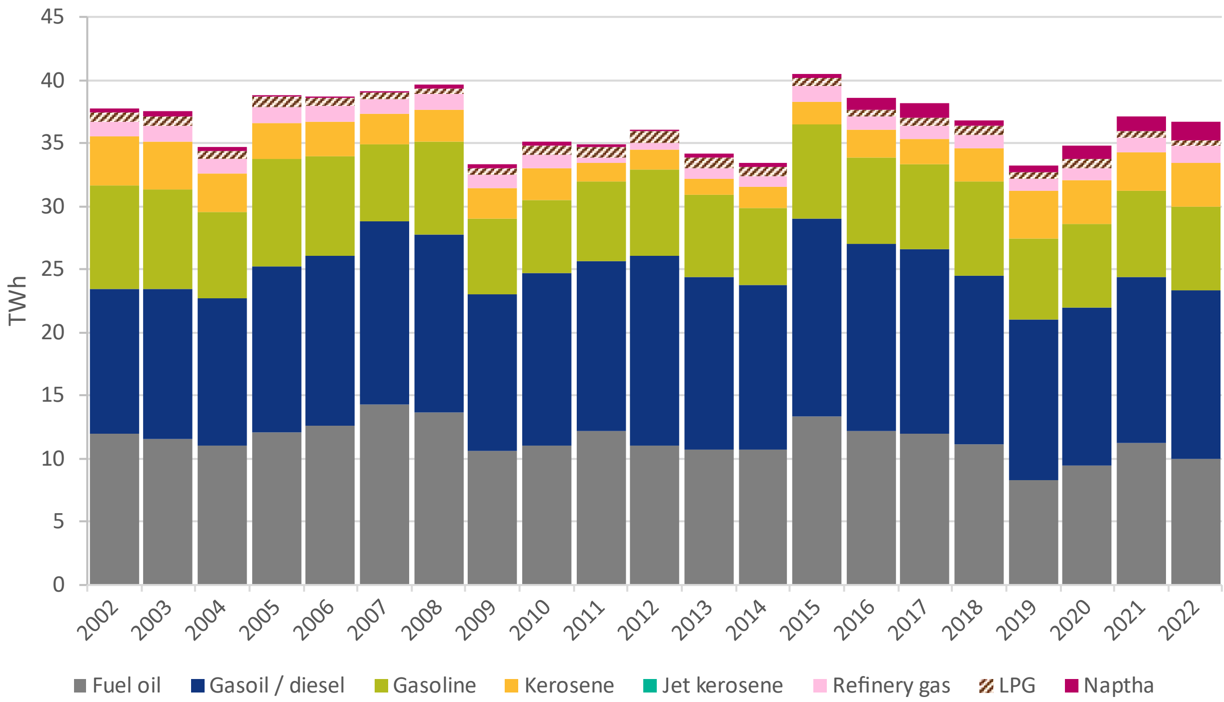
| | 2022 | 2021 |
|---|---|---|
| No. of CHP units exporting to grid | 15 | 15 |
| Electricity exported to grid (GWh) | 1,309 | 1,317 |

## 4.3 Oil refining

Ireland has one oil refinery at Whitegate in Cork, that is currently operated by Irving Oil. Whereas electricity generation has a variety of fuel inputs and just one output (electricity), oil refining has one major fuel input (crude oil), but multiple fuel outputs (petrol, diesel and kerosene, *etc*.). Figure 4.11 shows the outputs from oil refining, primarily being fuel oil, diesel (gas oil) and petrol (gasoline).

Due to the highly international nature of the oil market, refinery outputs are not heavily influenced by local demand in the Irish market, but on the configuration and capabilities of the refinery. A significant portion of the refinery's output is exported directly, while the majority of oil products used for final energy in Ireland are imported as finished products. Nonetheless, the refinery is an important piece of infrastructure regarding energy security.

**Figure 4.11: Outputs from oil refining**




## 4.4 Other transformation processes

Several other energy transformation processes operate in the Irish energy sector, though all are very small compared to electricity generation, CHP and oil refining.

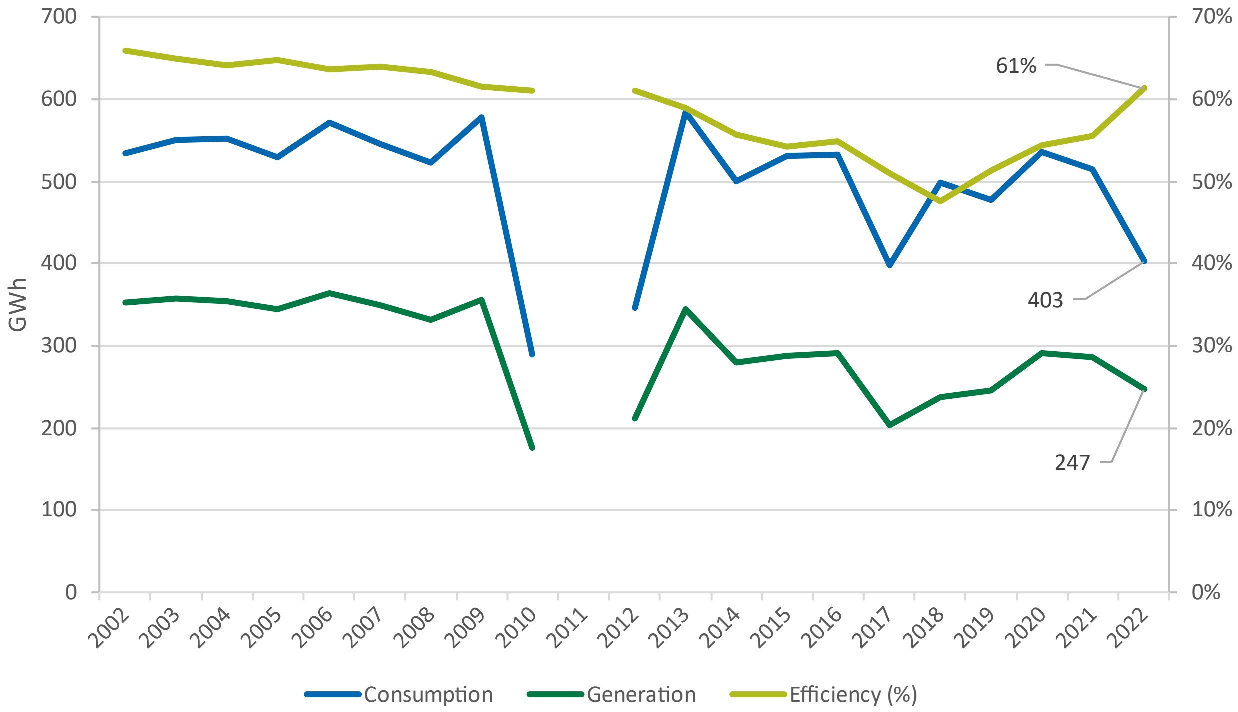
### 4.4.1 Pumped hydroelectric storage

Pumped hydroelectricity storage is the process of using electricity to pump water to an uphill reservoir, and later releasing the water from the reservoir through a turbine to generate electricity. A pumped storage facility acts like a battery to store relatively large amounts of electricity. There is one pumped hydroelectric station in Ireland at Turlough Hill in Wicklow, with a total capacity of 292 MW. It can operate for roughly 6 hours at maximum generating capacity.

The electricity generated from pumped hydro storage is not considered hydroelectricity for statistical purposes and is not counted as renewable energy. Pumped storage facilities act to store electricity previously generated by other sources. Although it is not a renewable source, pumped hydro storage is useful for integrating and smoothing variable non-synchronous renewable electricity sources, such as wind, onto the electricity system.

Figure 4.12 shows the annual consumption and generation of electricity, along with associated overall efficiency, at Turlough Hill. The facility underwent significant overhaul work from 2010 to 2012, producing no electricity in 2011.

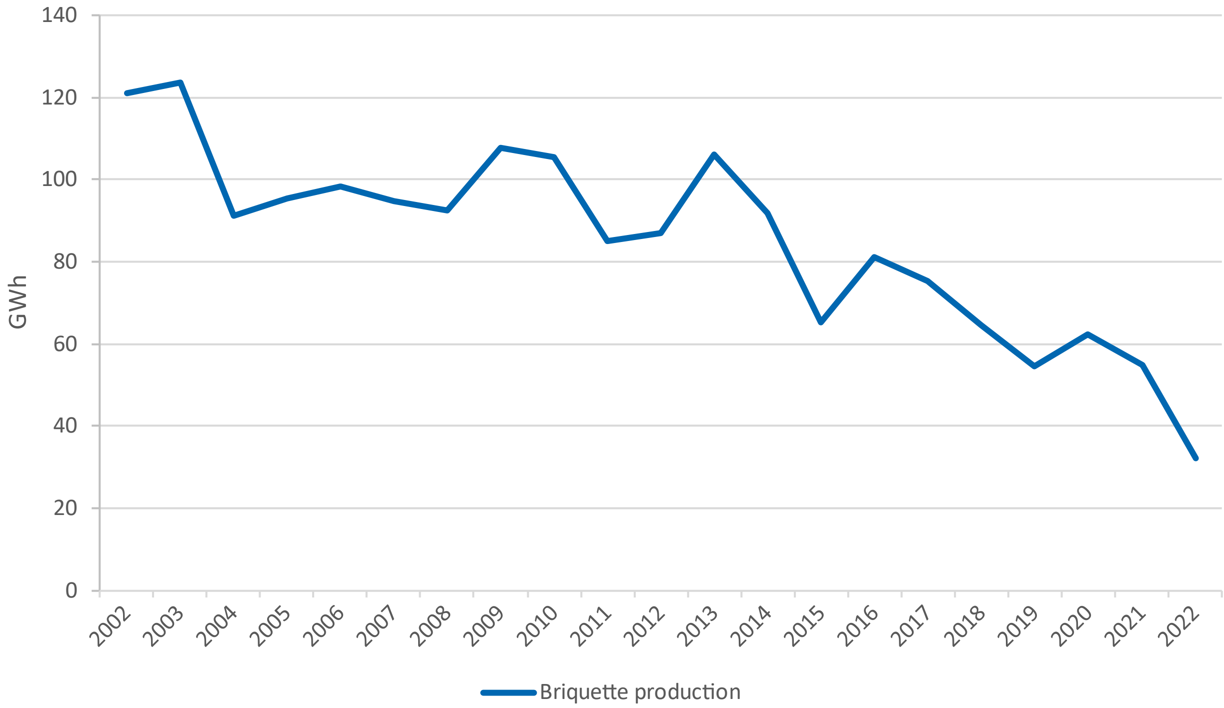
**Figure 4.12: Pumped hydroelectric storage (Turlough Hill)**



### 4.4.2 Peat briquetting

Peat briquetting converts milled peat into briquettes for residential use. Peat briquette production has been reducing since the early 1990s, as shown in Figure 4.13. Production of peat briquettes in Ireland ended in 2023 with the closure of Bord na Móna's Derrinlough facility in Co Offaly.

**Figure 4.13: Annual production of peat briquettes**



# 5 Final energy

The term final energy describes the energy that is directly consumed by an end-user. It covers energy delivered for manufacturing, transport of goods and people, and the day-to-day energy requirements of living, such as heating and cooking. SEAI analyses final energy consumption by fuel and by sector.

Final energy use excludes energy lost in the transformation or transmission of primary energy supply, because this energy is not available to the end user. Multiple primary energy sources may be aggregated and transformed into a single final energy type for an end user. For example, when an end user consumes electricity (as final energy), that electricity originated from a blend of wind, natural gas, *etc*., (that is, primary energy sources). Similarly, final energy use covers the energy in petrol and diesel consumed by end users, but not the energy that was needed to convert crude oil into that petrol and diesel in a refinery.

Final energy use is important, because individuals and businesses have direct control over how they decide to consume it – petrol *vs*. diesel *vs*. electric vehicles for surface transport, gas *vs*. oil *vs*. heat-pumps for heating, *etc*.

## 5.1 Final energy consumption by energy type

In evaluating final energy use or consumption in Ireland, SEAI collects data on each fuel, or energy type, from various sources:

- Aggregated electricity consumption data collected by the meter registration system operator (MRSO, a function within ESB Networks).
- Aggregated gas consumption data collected by Gas Networks Ireland (GNI).
- Oil supply data reported to the DECC for the payment of the National Oil Reserves Agency (NORA) levy.
- Biofuel data collected by NORA for the Renewable Transport Fuel Obligation (RTFO).
- Fuel consumption data reported by permit holders to the EPA under EU Emissions Trading System (ETS).
- Aggregated carbon tax receipts published by the Central Statistics Office (CSO).
- SEAI surveys of solid fuel suppliers.
- SEAI surveys of biomass/wood suppliers.
- Other data requests made by SEAI.
- SEAI data on the number and size of heat pumps and solar thermal collectors in dwellings.

Figure 5.1 shows the current percentage breakdown of Ireland's final energy use by energy type. Oil products account for more than half of Ireland's final energy use, followed by electricity, gas, renewables, coal and peat, in that order. Ireland is almost completely dependent on oil for the servicing of its transport sector, and that sector is Ireland's largest end use of energy. Electricity from renewable sources (*e.g.* wind, solar, renewable waste) is included in the 'electricity' energy type for final energy use, not 'renewables'. The 'renewables' energy type in final energy comprises the combustion of biomass and biogas for heat, the combustion of biofuels in transport, solar thermal and ambient heat (*via* heat pumps). Similarly, consumption of oil, gas, coal and peat reported here is the direct consumption of these fuels and excludes fuels consumed for generation of electricity, non-energy use, and those converted into other fuels as discussed in section 4.

**Figure 5.1: Share of final energy consumption by energy type**

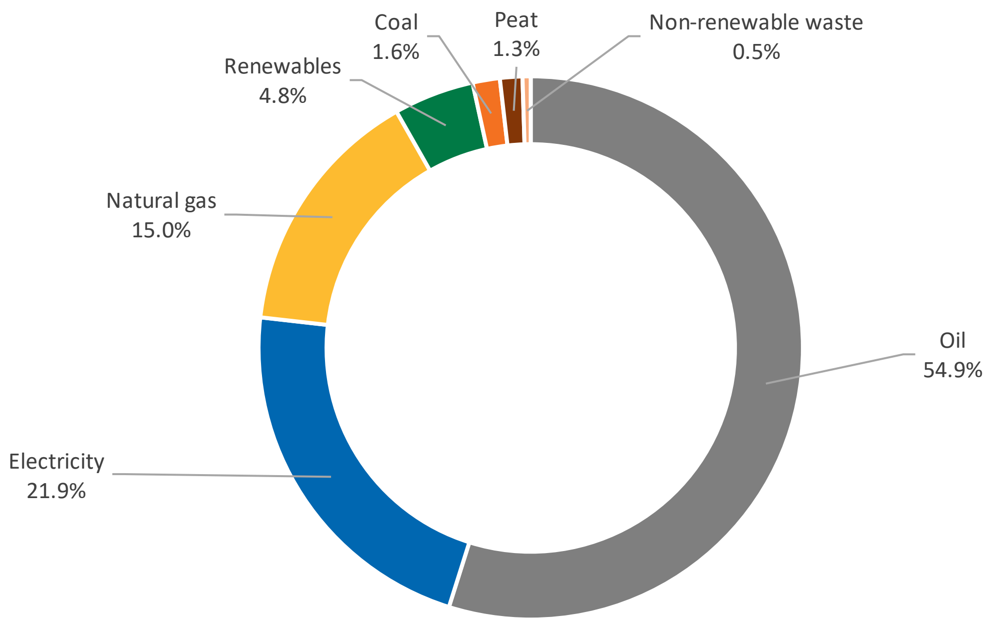



Figure 5.2 shows the annual trends in final energy use by energy type for the most recent 21-year period. Table 5.1 provides numerical details on the absolute values, relative shares, and percentage changes in the final energy use by energy type shown in Figure 5.2. Although Ireland remains heavily reliant on oil, its consumption has decreased, in absolute and percentage terms, over the period presented. Decreases were precipitated by two events: the economic downturn from 2008 to 2012 and the COVID-19 impact in 2020 and 2021. Outside of these events, oil consumption has increased each year. Other general trends over the period shown have been decreases in the consumption of coal and peat, and increases in the consumption of gas, electricity and renewables.

**Figure 5.2: Total final consumption by energy type**

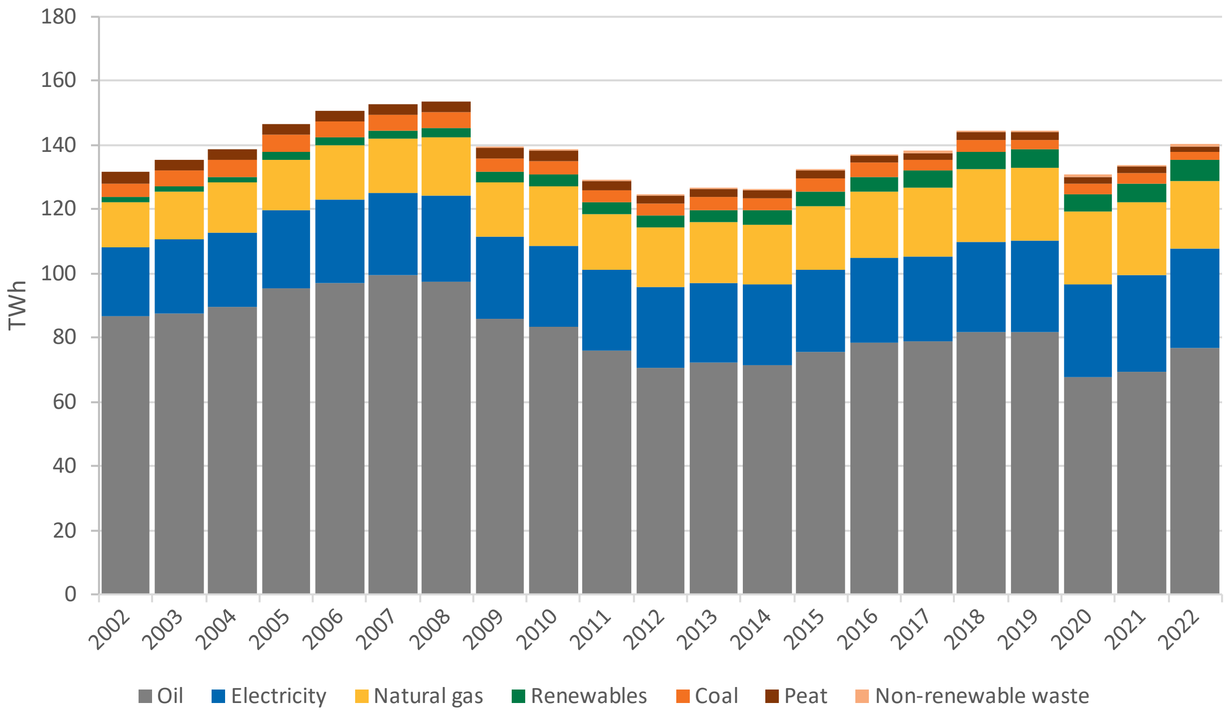



**Table 5.1: Final energy by fuel compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 76.94 | 69.50 | 81.93 | 70.80 | 54.9% | 51.9% | 56.6% | 56.7% | +10.7% | -6.1% | +8.7% |
| Electricity | 30.77 | 30.02 | 27.89 | 24.83 | 21.9% | 22.4% | 19.3% | 19.9% | +2.5% | +10.4% | +23.9% |
| Natural gas | 21.03 | 22.69 | 22.81 | 18.89 | 15.0% | 16.9% | 15.8% | 15.1% | -7.3% | -7.8% | +11.3% |
| Renewables | 6.70 | 5.77 | 5.34 | 3.47 | 4.8% | 4.3% | 3.7% | 2.8% | +16.0% | +25.5% | +92.8% |
| Coal | 2.27 | 3.20 | 3.75 | 3.94 | 1.6% | 2.4% | 2.6% | 3.2% | -29.1% | -39.5% | -42.4% |
| Peat | 1.87 | 2.10 | 2.30 | 2.50 | 1.3% | 1.6% | 1.6% | 2.0% | -11.0% | -18.6% | -25.4% |
| Non-renewable waste | 0.68 | 0.63 | 0.64 | 0.32 | 0.5% | 0.5% | 0.4% | 0.3% | +8.3% | +6.7% | +113% |
| **Total** | **140.26** | **133.91** | **144.65** | **124.76** | **100%** | **100%** | **100%** | **100%** | **+4.7%** | **-3.0%** | **+12.4%** |

## 5.2 Final energy consumption by sector

In calculating the final energy use by sector, SEAI uses the data on final energy use of each fuel type as described in section 5.1 and apportions it to each sector using data from, among other things:

- CSO's most recent annual Business Energy Use Survey.
- SEAI solid fuel and biomass/wood supplier surveys indicating sales to industry, commercial and residential sectors.
- Aggregated metered electricity consumption in each sector.
- Aggregated metered gas consumption in each sector.
- SEAI's Public Sector Monitoring and Reporting Programme.

Figure 5.3 shows the share of each sector in final energy consumption. The transport sector consumes more than 40% of total final energy, more than the next two sectors (residential and industry) combined. The services sector contains both commercial and public services, a further breakdown is given in section 5.2.4.

**Figure 5.3: Share of final energy consumption by sector**

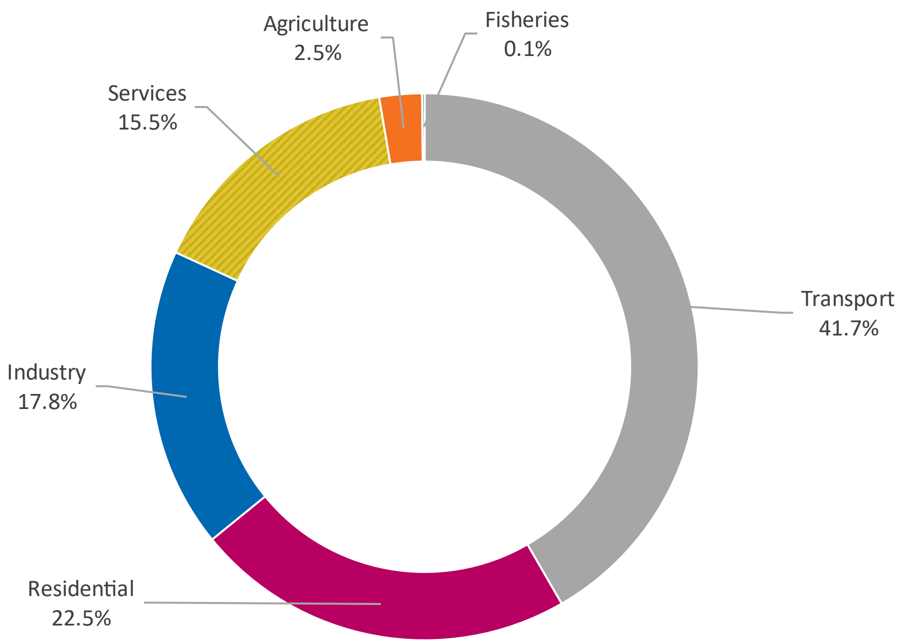



Figure 5.4 shows the annual final energy demand broken out by sector. The broad reduction in final energy use across all sectors from 2008 to 2012 is attributed to the international economic downturn, with the industry, transport and services sectors returning to growth after 2012, and growth in the residential sector delayed until 2014.

The reduction in 2020 final energy use was mostly due to the COVID-19 restrictions and was almost entirely limited to the transport sector. Prior to 2020, final energy demand for transport had risen every year since 2012 as activity growth outstripped efficiency improvements. Transport remains the sector with greatest final energy use, followed in order by the residential sector, industry and services.

**Figure 5.4: Annual final energy consumption by sector**

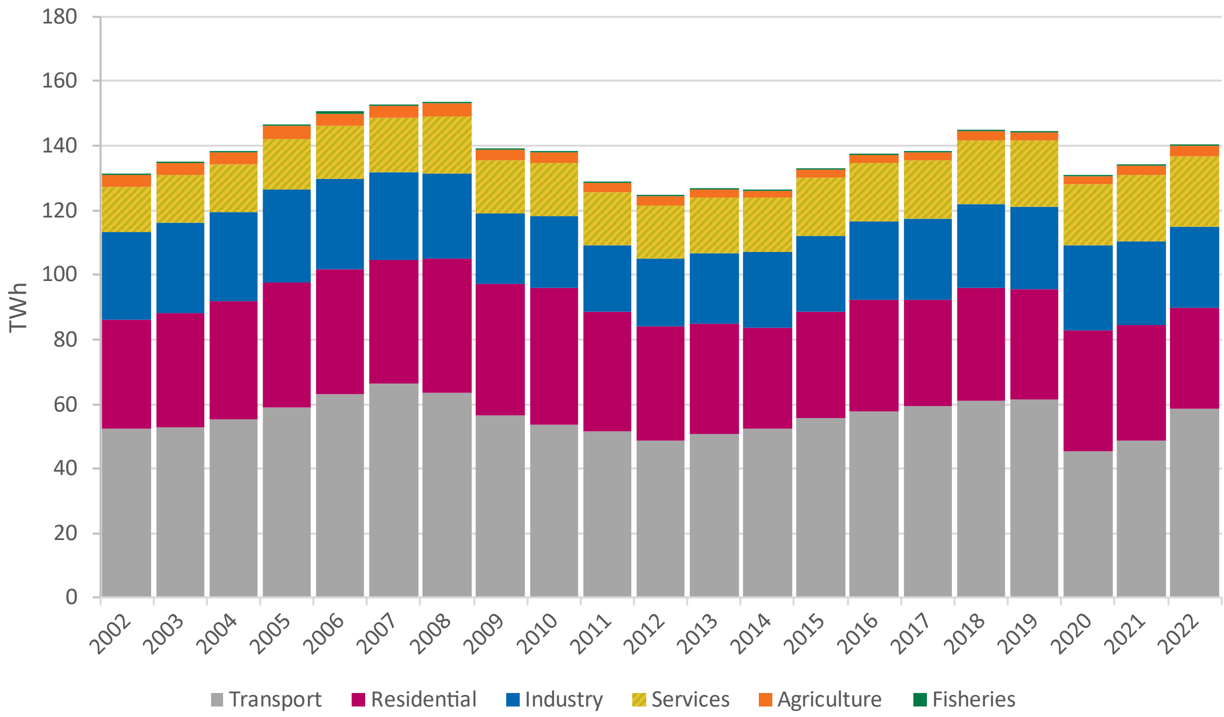



Table 5.2 provides absolute values, relative shares, and percentage changes in the final energy use by sector.

**Table 5.2: Final energy by sector compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Transport | 58.44 | 48.72 | 60.86 | 48.57 | 41.7% | 36.4% | 42.1% | 38.9% | +20.0% | -4.0% | +20.3% |
| Residential | 31.50 | 35.76 | 35.03 | 35.35 | 22.5% | 26.7% | 24.2% | 28.3% | -11.9% | -10.1% | -10.9% |
| Industry | 24.90 | 25.98 | 26.04 | 20.99 | 17.8% | 19.4% | 18.0% | 16.8% | -4.2% | -4.4% | +18.6% |
| Services | 21.71 | 20.51 | 19.80 | 16.67 | 15.5% | 15.3% | 13.7% | 13.4% | +5.8% | +9.6% | +30.2% |
| Agriculture | 3.52 | 2.71 | 2.60 | 2.91 | 2.5% | 2.0% | 1.8% | 2.3% | +29.8% | +35.5% | +20.8% |
| Fisheries | 0.20 | 0.22 | 0.32 | 0.26 | 0.1% | 0.2% | 0.2% | 0.2% | -7.9% | -36.6% | -23.3% |
| **Total** | **140.26** | **133.91** | **144.65** | **124.76** | **100%** | **100%** | **100%** | **100%** | **+4.7%** | **-3.0%** | **+12.4%** |

### 5.2.1 Final energy consumption in industry

In determining the sectoral breakdown of energy consumption, SEAI uses a blend of data sources, including the BEUS from the CSO. In June 2023, the CSO published the latest version of the BEUS, which is based on energy use in 2021. SEAI uses this most recent BEUS release in estimating the breakdown of 2022 energy consumption across the industry sector.

Figure 5.5 shows the current share of each energy type in the final energy consumed in industry. Natural gas forms the largest share, at more than 40%, followed by electricity and oil. Renewables accounts for around 9%.

**Figure 5.5: Shares of energy types in industry final energy**

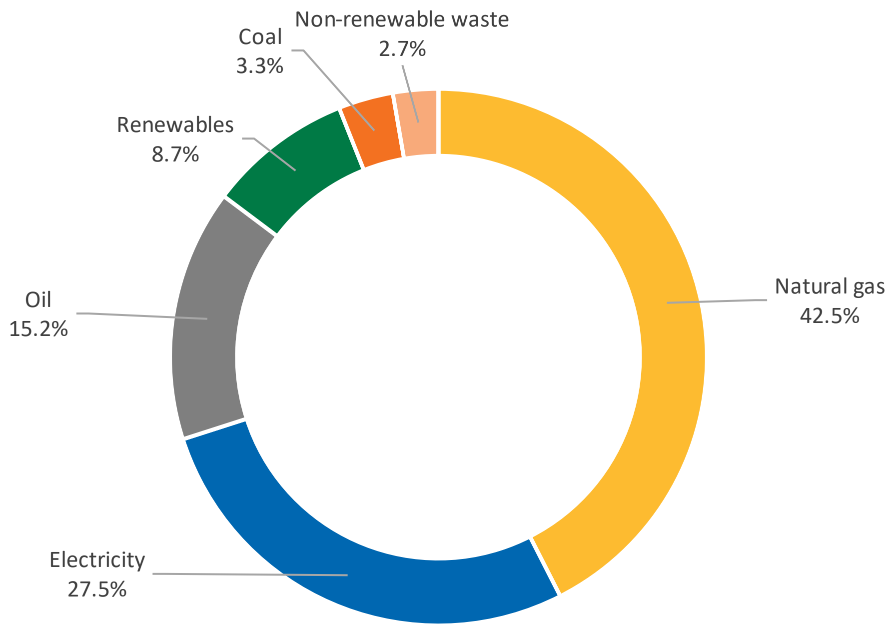



Figure 5.5 shows that natural gas, wastes and renewables have all increased their shares of industrial energy use over the period, while the shares of oil and coal have decreased. The share of electricity has declined slightly faster than overall energy consumption within the industry sector. The increase evident in renewables, is mainly due to the use of biomass in the wood-processing industry, and the use of the renewable portion of wastes in cement manufacturing.

There was also significant fuel switching from coal and oil to natural gas during this period. Because gas is less carbon intensive than oil or coal, this fuel switching, along with increased use of renewable energy, has resulted in lower average emissions per unit of energy used in industry during this period.

**Figure 5.6: Final energy in industry by energy type**

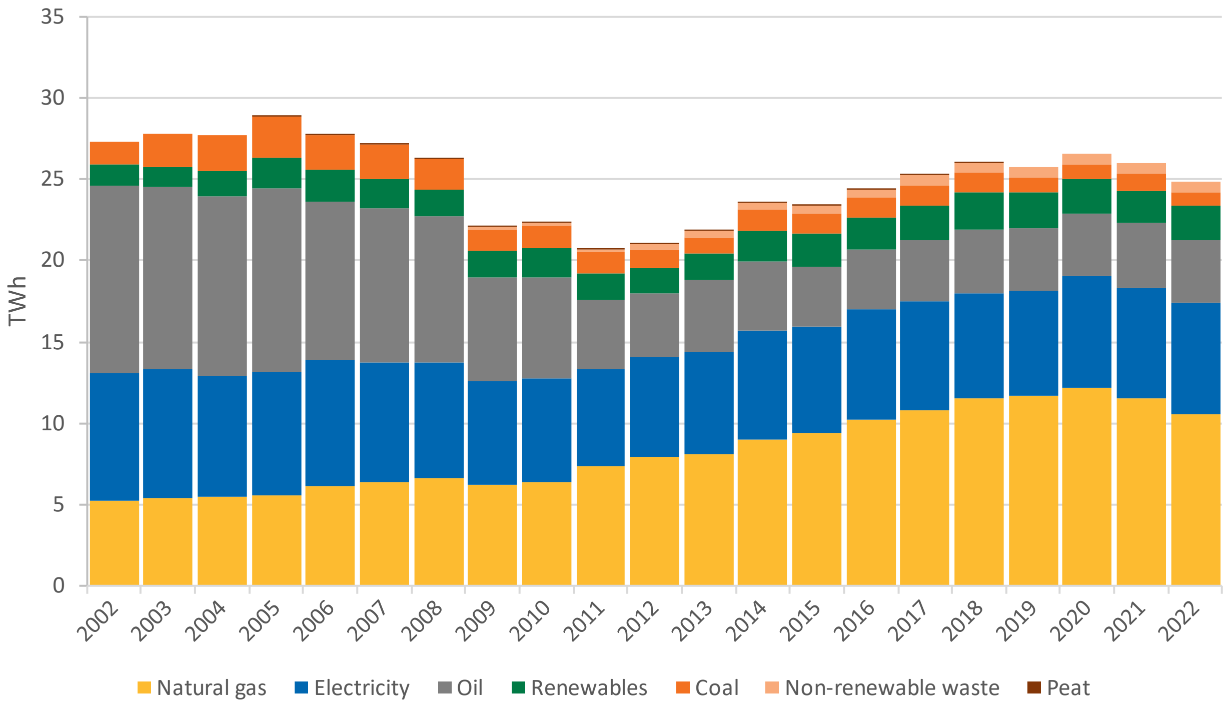



Table 5.3 shows the growth rates, quantities and relative shares of energy used in industry by fuel.

**Table 5.3: Growth rates, quantities and shares of final energy in industry by energy type**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Natural gas | 10.58 | 11.49 | 11.53 | 7.91 | 42.5% | 44.2% | 44.3% | 37.7% | -7.9% | -8.2% | +33.7% |
| Electricity | 6.86 | 6.85 | 6.48 | 6.14 | 27.5% | 26.4% | 24.9% | 29.2% | +0.1% | +5.8% | +11.7% |
| Oil | 3.78 | 3.95 | 3.91 | 3.91 | 15.2% | 15.2% | 15.0% | 18.6% | -4.1% | -3.2% | -3.3% |
| Renewables | 2.17 | 2.02 | 2.25 | 1.57 | 8.7% | 7.8% | 8.6% | 7.5% | +7.4% | -3.6% | +38.2% |
| Coal | 0.82 | 1.04 | 1.23 | 1.13 | 3.3% | 4.0% | 4.7% | 5.4% | -20.8% | -32.8% | -27.0% |
| Non-renewable waste | 0.68 | 0.63 | 0.64 | 0.32 | 2.7% | 2.4% | 2.4% | 1.5% | +8.3% | +6.7% | +113% |
| Peat | 0 | 0 | 0.01 | 0.01 | 0% | 0% | 0.0% | 0.0% | | -100.0% | -100.0% |
| **Total** | **24.90** | **25.98** | **26.04** | **20.99** | **100%** | **100%** | **100%** | **100%** | **-4.2%** | **-4.4%** | **+18.6%** |

## 5.2.2 Final energy consumption in transport

Fuel consumption in transport is often closely aligned to the mode of transport used: jet kerosene is used for air transport; fuel oil for shipping; petrol and liquefied petroleum gas (LPG) are almost exclusively used for road transport; and diesel is used for road transport, domestic water navigation, and rail. Figure 5.7 shows the share of each energy type in transport energy consumption. Figure 5.7 shows the share of energy types in transport in 2022.

Figure 5.8 and Table 5.4 show the trends in transport's final energy use, split by energy type between 2002 and 2022. Blended fuels (fossil fuels and biofuels) are reported separately as their renewable and non-renewable constituent components, despite being consumed as blended products.

The most important point to note is that transport remains almost completely dependent on fossil fuels, particularly oil products. This lack of fuel diversity is unique amongst the energy using sectors. Renewables made up a very small share of transport energy use in 2022. Electricity also remains a small share of transport energy use, which is split between electric rail (Dublin Area Rapid Transit (DART) and Luas) and electric vehicles (mostly private cars). This has meant that there has been very little decarbonisation of the transport fuel mix to date, with transport $CO_2$ emissions remaining tightly coupled to energy use.

There was a clear shift from petrol to diesel over the time period, due to the switch to diesel private cars accelerated by the changes to the private car tax system from 2008 onwards.

**Figure 5.7: Shares of energy types in transport final energy**

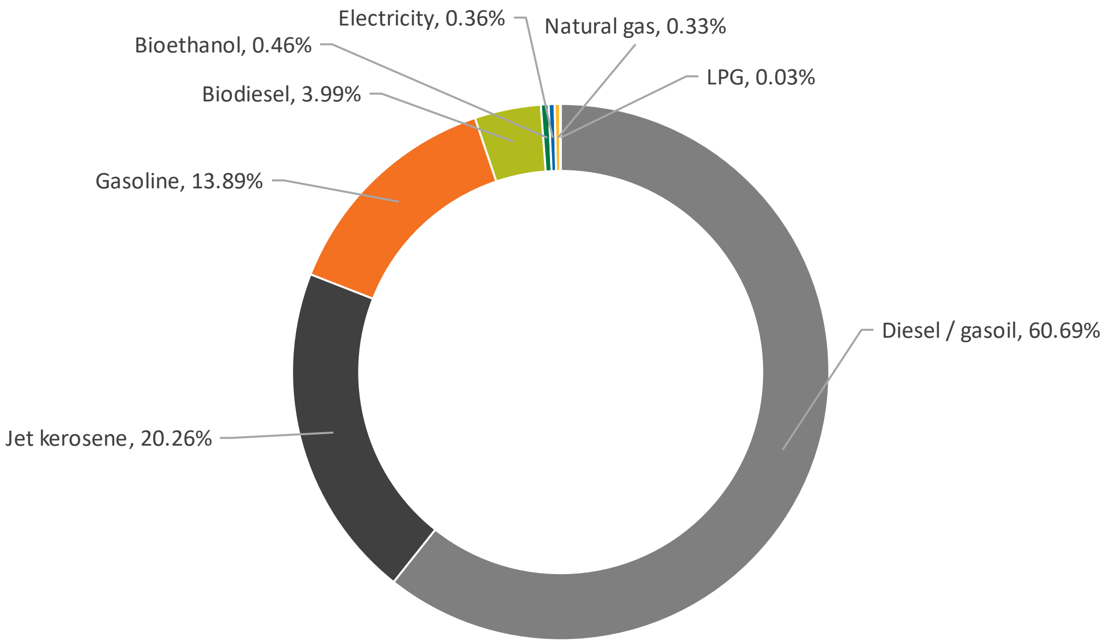


**Figure 5.8: Final energy in transport sector by energy type**

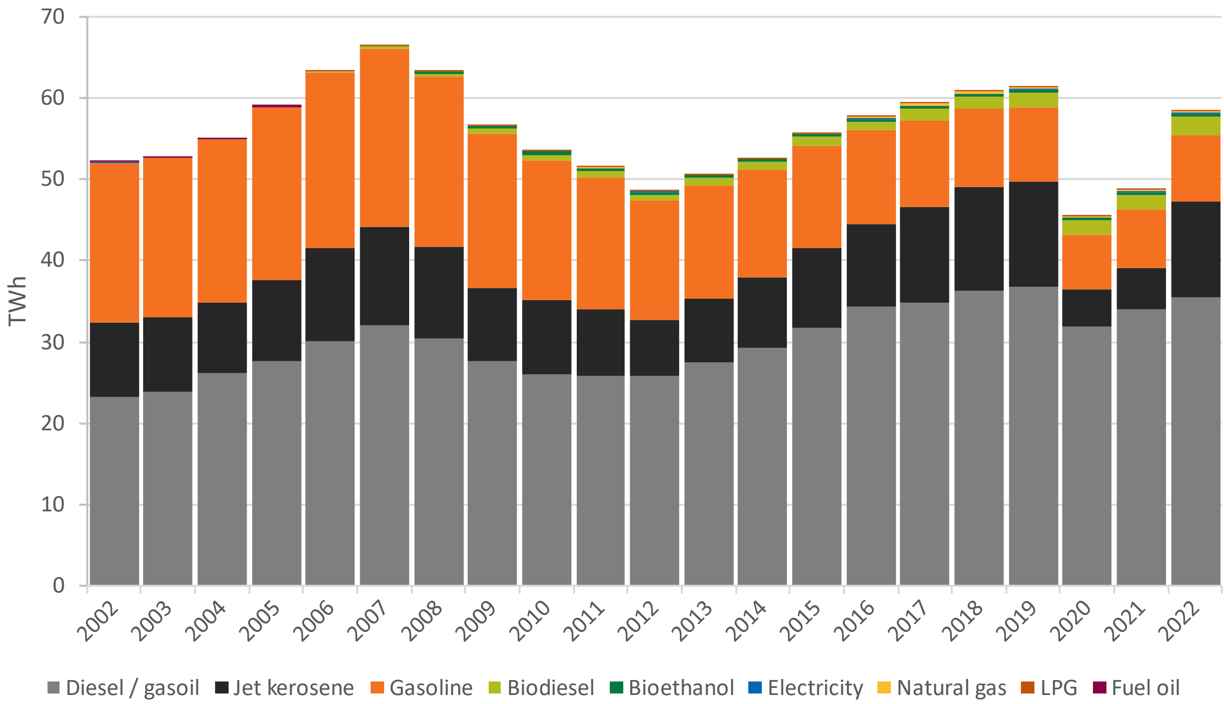



**Table 5.4: Growth rates, quantities and shares of energy types in transport sector**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Diesel / gas oil | 35.46 | 33.98 | 36.31 | 25.87 | 60.7% | 69.7% | 59.7% | 53.3% | +4.4% | -2.3% | +37.1% |
| Jet kerosene | 11.84 | 5.18 | 12.83 | 6.81 | 20.3% | 10.6% | 21.1% | 14.0% | +128.3% | -7.7% | +73.8% |
| Gasoline | 8.12 | 7.13 | 9.59 | 14.80 | 13.9% | 14.6% | 15.8% | 30.5% | +13.9% | -15.3% | -45.2% |
| Biodiesel | 2.33 | 1.84 | 1.48 | 0.65 | 4.0% | 3.8% | 2.4% | 1.3% | +26.9% | +57.9% | +256.2% |
| Bioethanol | 0.27 | 0.24 | 0.32 | 0.33 | 0.5% | 0.5% | 0.5% | 0.7% | +14.6% | -14.6% | -18.6% |
| Electricity | 0.21 | 0.15 | 0.07 | 0.05 | 0.4% | 0.3% | 0.1% | 0.1% | +39.3% | +214.8% | +356.2% |
| Natural gas | 0.19 | 0.19 | 0.26 | 0.05 | 0.3% | 0.4% | 0.4% | 0.1% | -0.6% | -26.5% | +300.7% |
| LPG | 0.02 | 0.01 | 0.02 | 0.01 | 0.0% | 0.0% | 0.0% | 0.0% | +39.2% | -12.4% | +62.2% |
| Fuel oil | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **58.44** | **48.72** | **60.86** | **48.57** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+20.0%** | **-4.0%** | **+20.3%** |

Figure 5.9 shows the current share of each sub-sector in transport by final energy.

**Figure 5.9: Shares of sub-sectors in transport final energy**

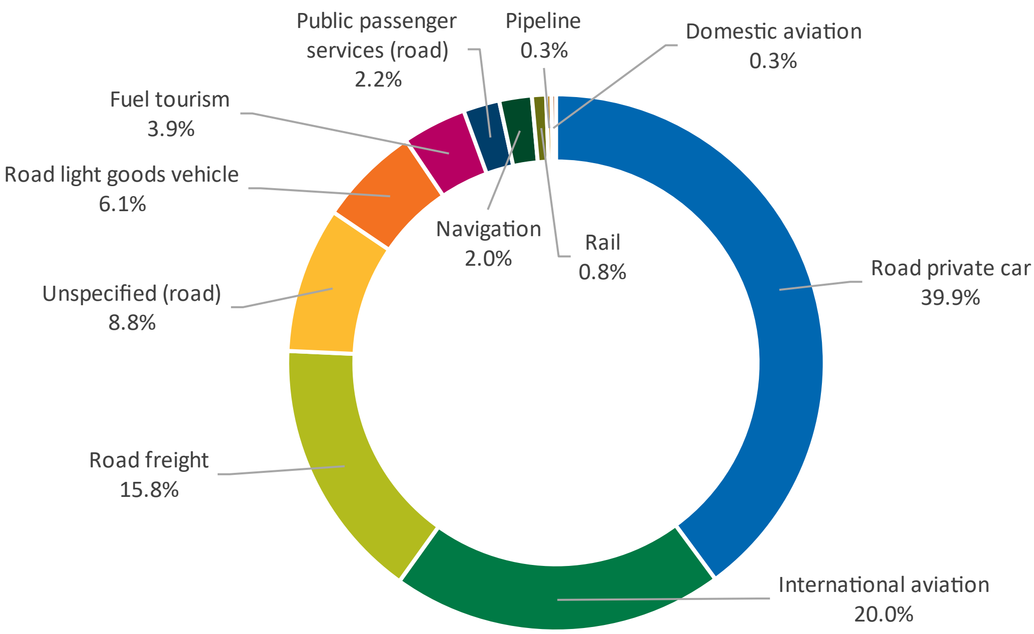



Figure 5.10 shows the trend for energy use of transport by sub-sector over the period. Transport has been the sector most responsive to changes in economic growth. Transport energy use and $CO_2$ emissions peaked in 2007, before falling sharply during the recession. It returned to growth in 2013, but by 2021, total transport energy use was still below the 2007 peak. The energy use of light goods vehicles (LGV) is estimated from 2008 onwards. Prior to 2008, the energy use of this sub-sector was included in the 'unspecified' category.

Private car energy use clearly dominates and accounted for nearly 40% of transport energy use in 2022. Private car energy use declined briefly during the recession in 2009 and 2010 but returned to growth in 2011. It peaked in 2015 and remained relatively flat until 2019, before the sharp drop in 2020.

Aviation energy use is notable in that it usually makes up a large share of transport energy use in Ireland, particularly since 2000, but can be severely affected by external factors, such as recessions or the COVID-19 pandemic. International aviation energy consumption fell by 44% between 2007 and 2012 during the recession. It returned to strong growth after 2012, reaching an all-time-high in 2019, 6.8% above the previous 2007 peak, before the dramatic fall in 2020. In 2022, consumption in international aviation had returned to around the same level as 2017.

Heavy goods vehicles (HGV) energy use also saw a large reduction during the recession, falling by 49% between 2007 and 2013. It has increased since, but remains below the 2007 peak. These changes are due to changes in the amount of goods transported, as discussed further in section 10.3.4.

**Figure 5.10: Transport final energy by sub-sector**

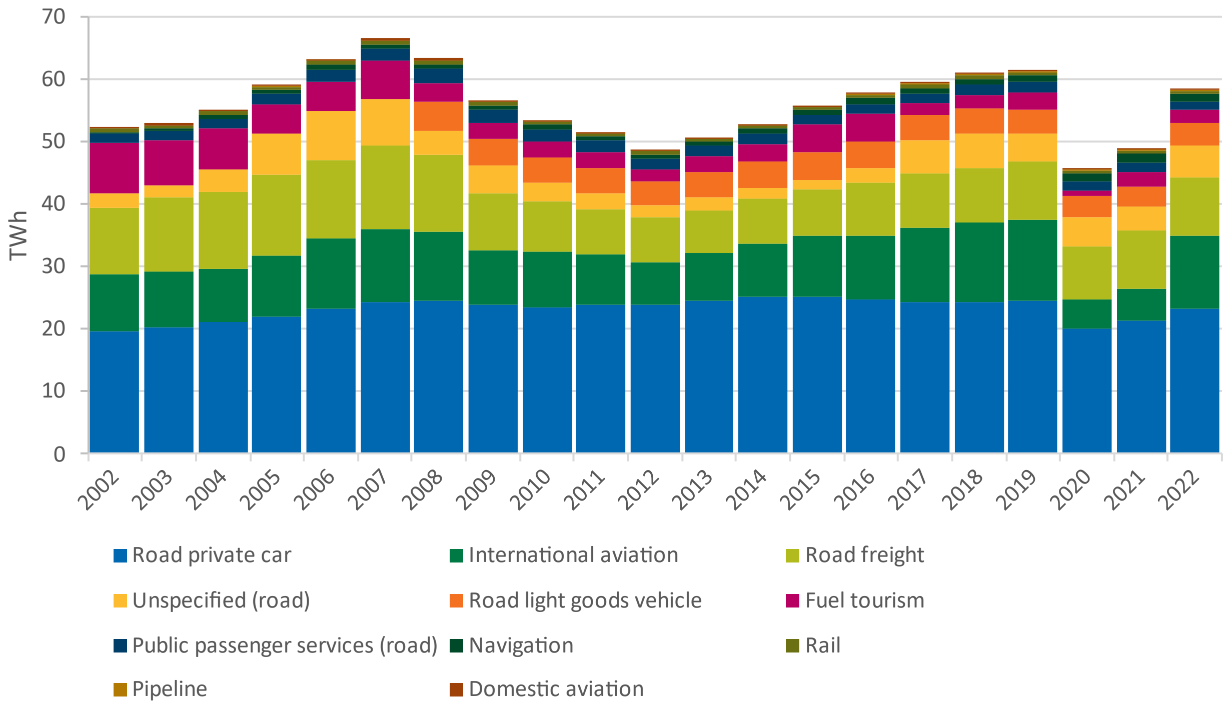


**Table 5.5: Growth rates, quantities and shares of transport final energy by sub-sector**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Road private car | 23.31 | 21.40 | 24.36 | 23.90 | 39.9% | 43.9% | 40.0% | 49.2% | +8.9% | -4.3% | -2.4% |
| International aviation | 11.69 | 5.12 | 12.77 | 6.76 | 20.0% | 10.5% | 21.0% | 13.9% | +128% | -8.5% | +72.8% |
| Road freight | 9.24 | 9.25 | 8.53 | 7.32 | 15.8% | 19.0% | 14.0% | 15.1% | -0.1% | +8.3% | +26.3% |
| Unspecified (road) | 5.13 | 3.85 | 5.70 | 1.79 | 8.8% | 7.9% | 9.4% | 3.7% | +33.2% | -10.1% | +187% |
| Road light goods vehicle | 3.55 | 3.20 | 3.97 | 3.82 | 6.1% | 6.6% | 6.5% | 7.9% | +11.1% | -10.5% | -7.0% |
| Fuel tourism | 2.26 | 2.41 | 2.14 | 1.97 | 3.9% | 4.9% | 3.5% | 4.1% | -6.4% | +5.4% | +14.5% |
| Public passenger services (road) | 1.27 | 1.43 | 1.60 | 1.73 | 2.2% | 2.9% | 2.6% | 3.6% | -10.8% | -20.3% | -26.4% |
| Navigation | 1.15 | 1.36 | 0.98 | 0.69 | 2.0% | 2.8% | 1.6% | 1.4% | -15.6% | +17.5% | +66.5% |
| Rail | 0.49 | 0.45 | 0.49 | 0.49 | 0.8% | 0.9% | 0.8% | 1.0% | +10.4% | +0.5% | +0.5% |
| Pipeline | 0.19 | 0.18 | 0.26 | 0.05 | 0.3% | 0.4% | 0.4% | 0.1% | +5.2% | -29.3% | +285% |
| Domestic aviation | 0.16 | 0.08 | 0.06 | 0.06 | 0.3% | 0.2% | 0.1% | 0.1% | +111% | +145% | +173% |
| **Total** | **58.44** | **48.72** | **60.86** | **48.57** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+20.0%** | **-4.0%** | **+20.3%** |

### 5.2.3 Final energy consumption in residential

Figure 5.12 shows the mix of energy types consumed in the residential sector between 2005 and 2022. The shares of each were relatively stable, with a gradual increase in the share of electricity, gas, and of renewables, and a continuing, though gradual, decline in coal, peat and oil use.

Oil remains the dominant fuel in the residential sector. Electricity was the second largest source of energy in the sector in 2022, with natural gas having the third largest share. Use of renewables for final energy directly in households has grown each year since 2016. *Table* 5.6 shows the growth rates, quantities and shares.

It is notable that electricity consumption over the period was at its highest in 2022.

**Figure 5.11: Shares of energy types in residential final energy**

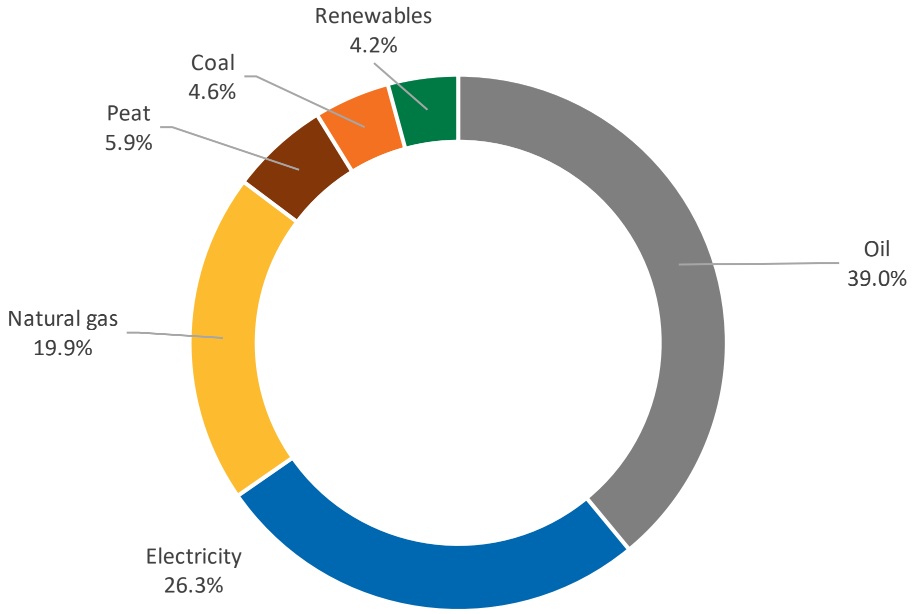



**Figure 5.12: Final energy in residential by energy type**

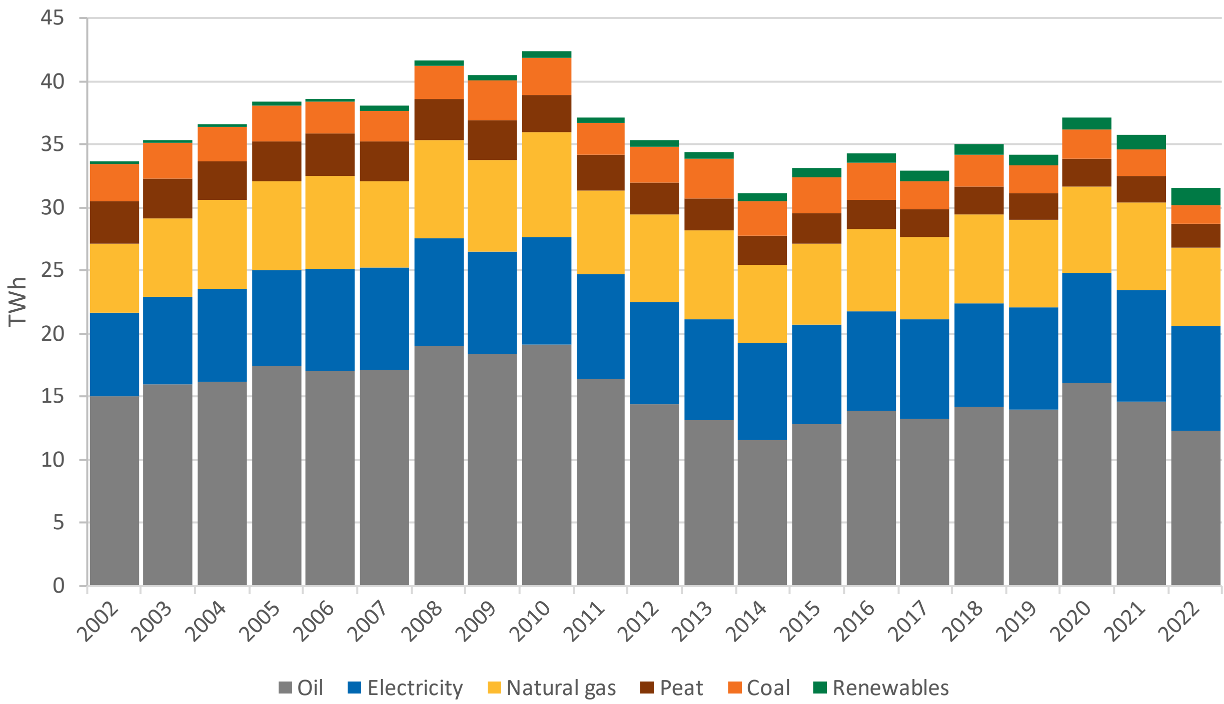


**Table 5.6: Growth rates, quantities and shares of final energy in residential**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 12.29 | 14.63 | 14.19 | 14.38 | 39.0% | 40.9% | 40.5% | 40.7% | -16.0% | -13.4% | -14.5% |
| Electricity | 8.29 | 8.83 | 8.18 | 8.12 | 26.3% | 24.7% | 23.3% | 23.0% | -6.1% | +1.4% | +2.1% |
| Natural gas | 6.28 | 6.92 | 7.03 | 6.98 | 19.9% | 19.3% | 20.1% | 19.8% | -9.3% | -10.6% | -10.1% |
| Peat | 1.87 | 2.10 | 2.29 | 2.50 | 5.9% | 5.9% | 6.5% | 7.1% | -11.0% | -18.3% | -25.2% |
| Coal | 1.44 | 2.16 | 2.52 | 2.80 | 4.6% | 6.0% | 7.2% | 7.9% | -33.1% | -42.7% | -48.5% |
| Renewables | 1.33 | 1.13 | 0.83 | 0.57 | 4.2% | 3.2% | 2.4% | 1.6% | +17.5% | +60.0% | +135% |
| **Total** | **31.50** | **35.76** | **35.03** | **35.35** | **100%** | **100%** | **100%** | **100%** | **-11.9%** | **-10.1%** | **-10.9%** |

### 5.2.4 Final energy consumption in services

In determining the sectoral breakdown of commercial and public service energy use, SEAI uses a blend of data sources, including the BEUS from the CSO. In June 2023, the CSO published the latest version of the BEUS, which is based on energy use in 2021. SEAI uses this most recent BEUS release in estimating the 2022 energy consumption across the commercial and public service sectors.

**Figure 5.13: Shares of energy types in commercial and public services final energy**

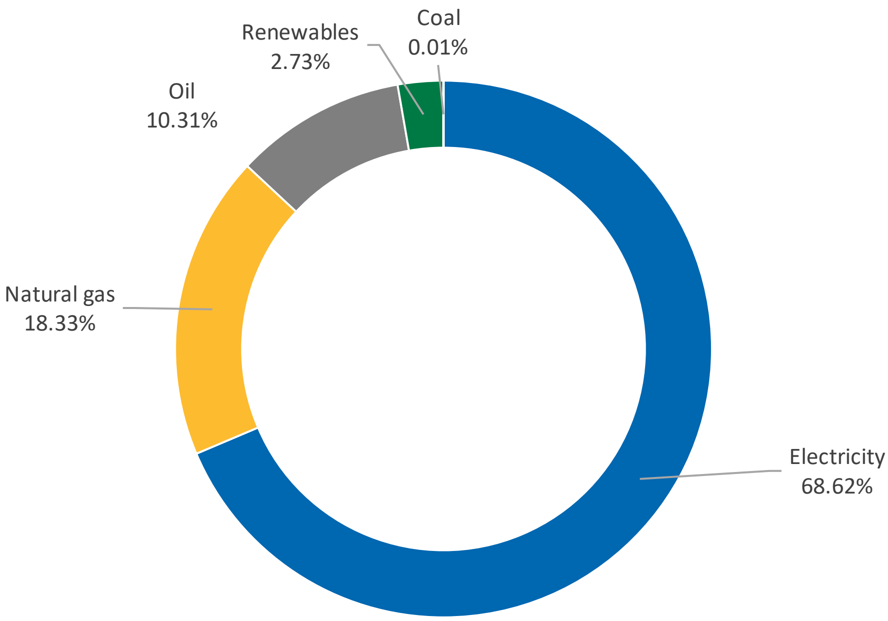



**Figure 5.14: Final energy in commercial and public services by energy type**

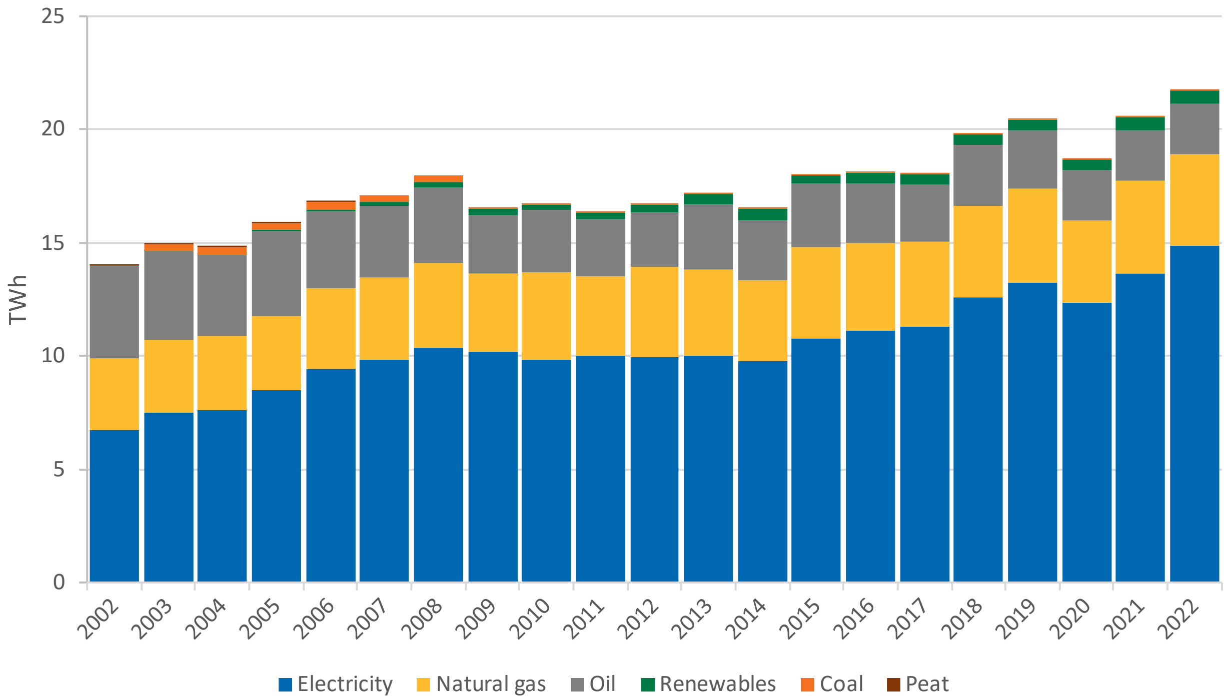



Figure 5.14 shows the changes in the fuel mix in the services sector over the period. The range of fuels used in this sector is small – essentially oil, gas and electricity. Oil and gas are used predominantly for space heating, but also for

water heating, cooking and, in some sub-sectors, laundry. Electricity is used in buildings for heating, air conditioning, water heating, lighting, lifts and escalators, automatic doors, and ICT. Electricity in services is also used for public lighting, off-road electric vehicles, and water and sanitation services.

Electricity use in services is driven by the changing structure of this sector and the general increase in use of ICT, electric heating and air conditioning. Data centres are also included under commercial services.

Small quantities were consumed in services until 2006; however, consumption of peat is no longer recorded as statistically significant. Similarly, the consumption of coal in the sector is now very low, at approximately 2 GWh per annum.

Growth rates, quantities and shares are shown in Table 5.7.

**Table 5.7: Growth rates, quantities and shares of final energy in the commercial and public services**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity | 14.89 | 13.64 | 12.60 | 9.97 | 68.6% | 66.5% | 63.7% | 59.8% | +9.2% | +18.2% | +49.4% |
| Natural gas | 3.98 | 4.08 | 4.00 | 3.95 | 18.3% | 19.9% | 20.2% | 23.7% | -2.5% | -0.6% | +0.8% |
| Oil | 2.24 | 2.25 | 2.73 | 2.40 | 10.3% | 11.0% | 13.8% | 14.4% | -0.4% | -18.0% | -6.7% |
| Renewables | 0.59 | 0.54 | 0.46 | 0.35 | 2.7% | 2.7% | 2.3% | 2.1% | +8.9% | +29.2% | +69.7% |
| Coal | 0.002 | 0.002 | 0.007 | 0.007 | 0.0% | 0.0% | 0.0% | 0.0% | 0% | -65.0% | -68.6% |
| Peat | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **21.71** | **20.51** | **19.80** | **16.67** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+5.8%** | **+9.6%** | **+30.2%** |

Figure 5.15 shows the current share of energy types in commercial services alone, while Figure 5.16 shows the timeseries of the annual final energy consumption in commercial services.

Figure 5.17 shows the current share of energy types in public services alone and Figure 5.18 shows the corresponding timeseries of annual final energy consumption in public services.

**Figure 5.15: Shares of sub-sectors in commercial final energy**

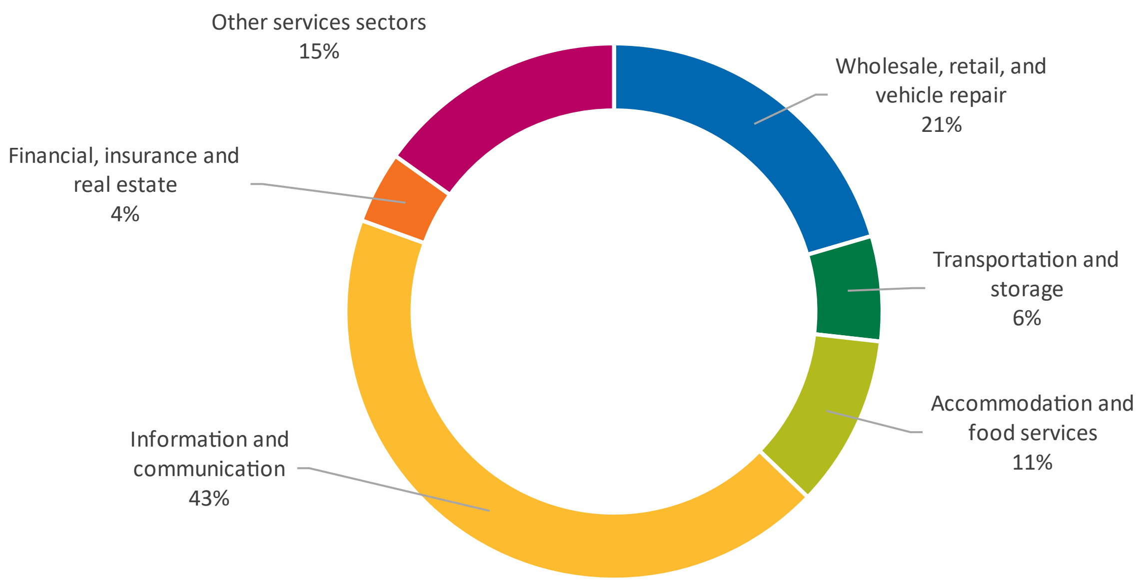


**Figure 5.16: Final energy in commercial services by sub-sector (breakdown not available prior to 2009)**

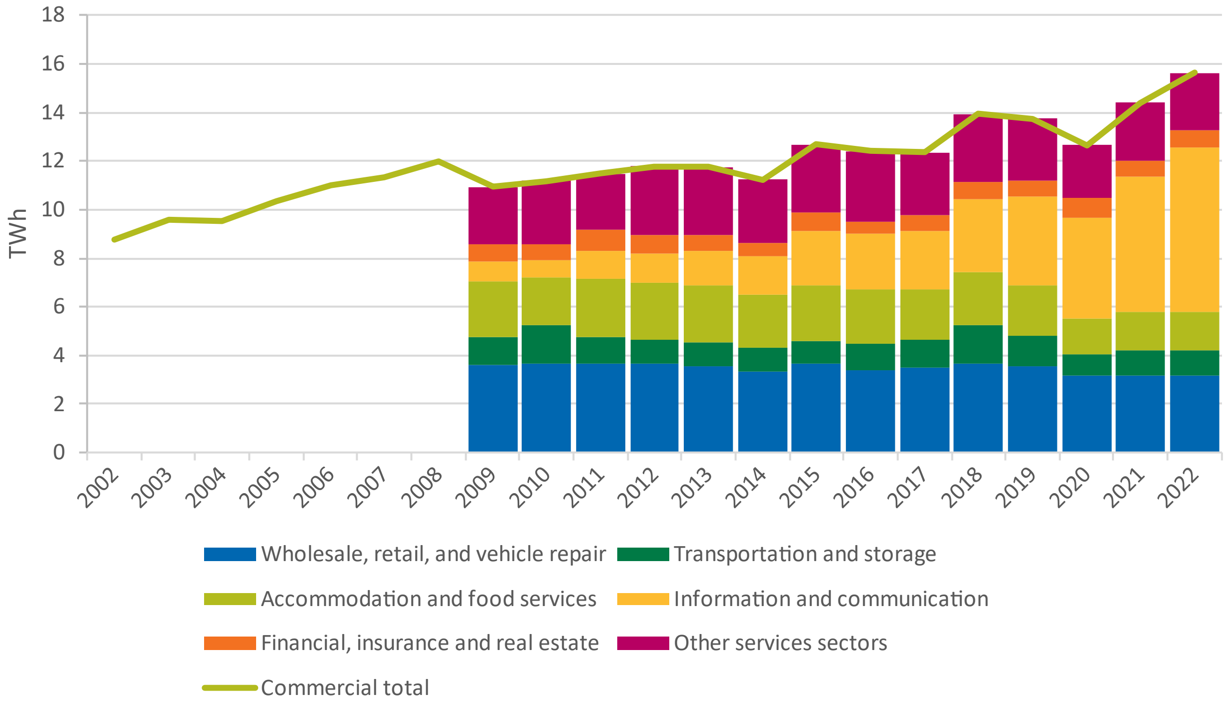



**Figure 5.17: Shares of sub-sectors in public services final energy**

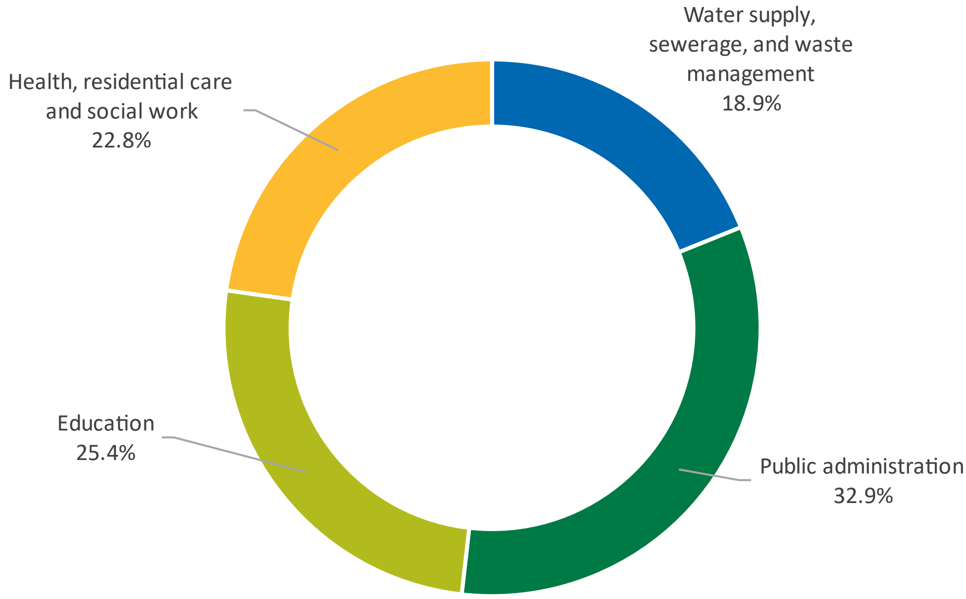
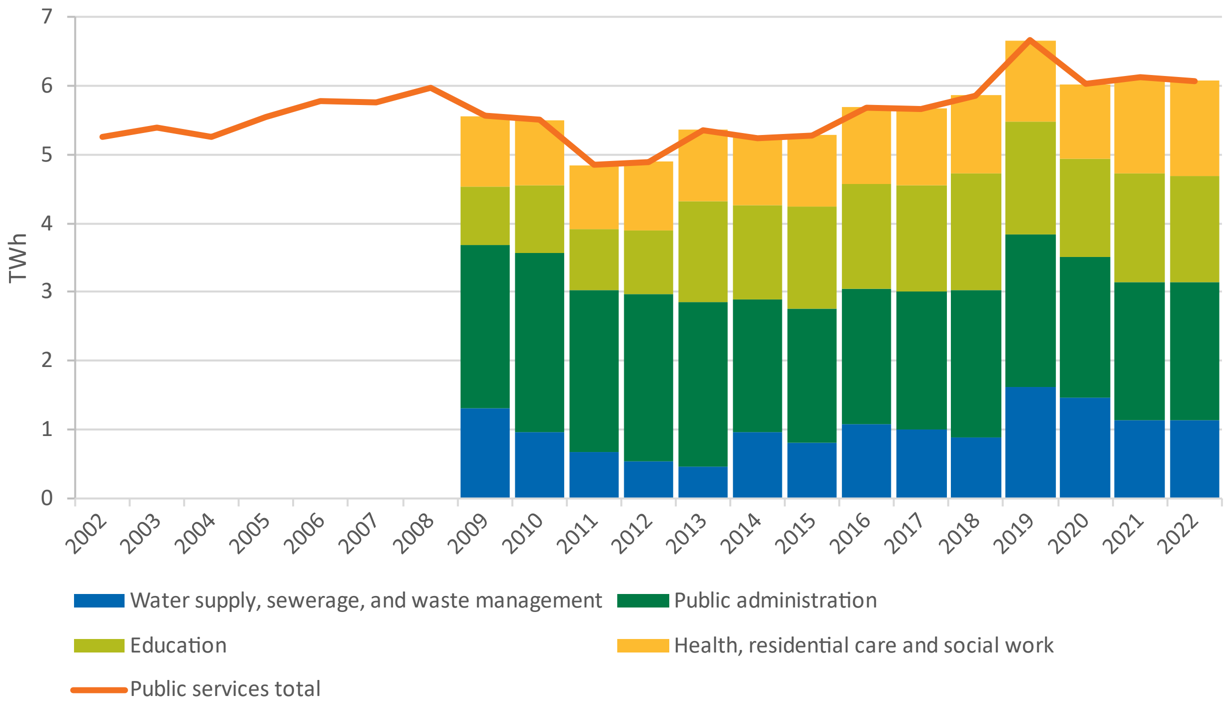


**Figure 5.18: Final energy in public services by sub-sector (breakdown not available prior to 2009)**



# 6 Energy modes

It is useful to split energy supply or use into the three modes of electricity, transport and heat. These represent distinct energy services and markets, and also map onto national and European renewable energy targets. To avoid double counting across modes, any heat and transport energy provided by electricity (for example electric heaters and electric vehicles (EVs)) is counted in the electricity mode only, not the heat or transport modes. This ensures that summing across the three modes gives a consistent total energy use.

## 6.1 Final energy consumption by mode

Figure 6.1 shows the current split in final energy use between electricity, transport and heat. Figure 6.2 shows the historical trend of the three modes in terms of final energy use. Table 6.1 shows the quantities and shares of final energy use in each mode and changes relative to previous years.

The transport and heat modes historically account for approximately 40% of final energy use each, with the electricity mode accounting for the remaining 20%. However, electricity consumption has increased steadily over this period at a faster rate than total energy consumption. The heat mode tends to show the greatest year-to-year fluctuations, due to its sensitivity to weather effects. Section 9.2 provides more detail on weather effects on heating energy. Final energy use in transport decreased during the 2008-2012 recession, and again during the COVID-19 restrictions in 2020 and early 2021. Outside of these events, final energy use in the transport mode has increased each year.

**Figure 6.1: Current split of final energy by mode of application**

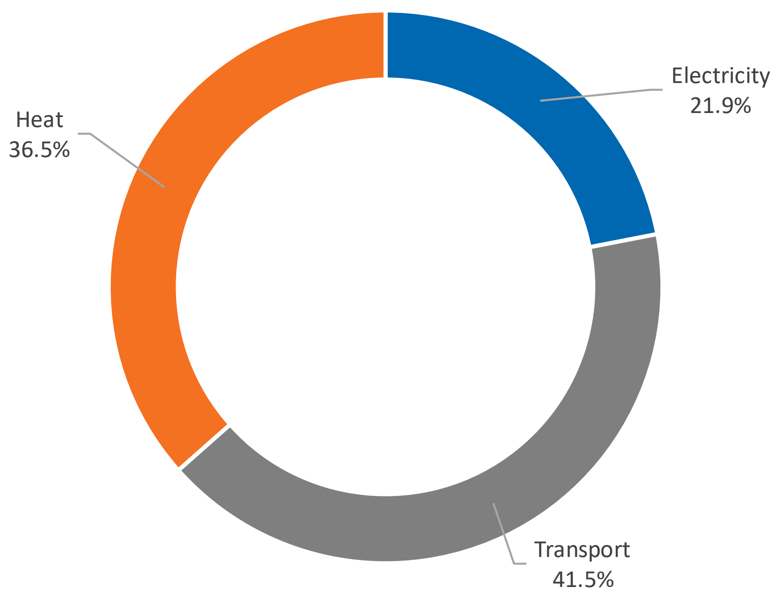


**Figure 6.2: Final energy in electricity, transport and heat modes**

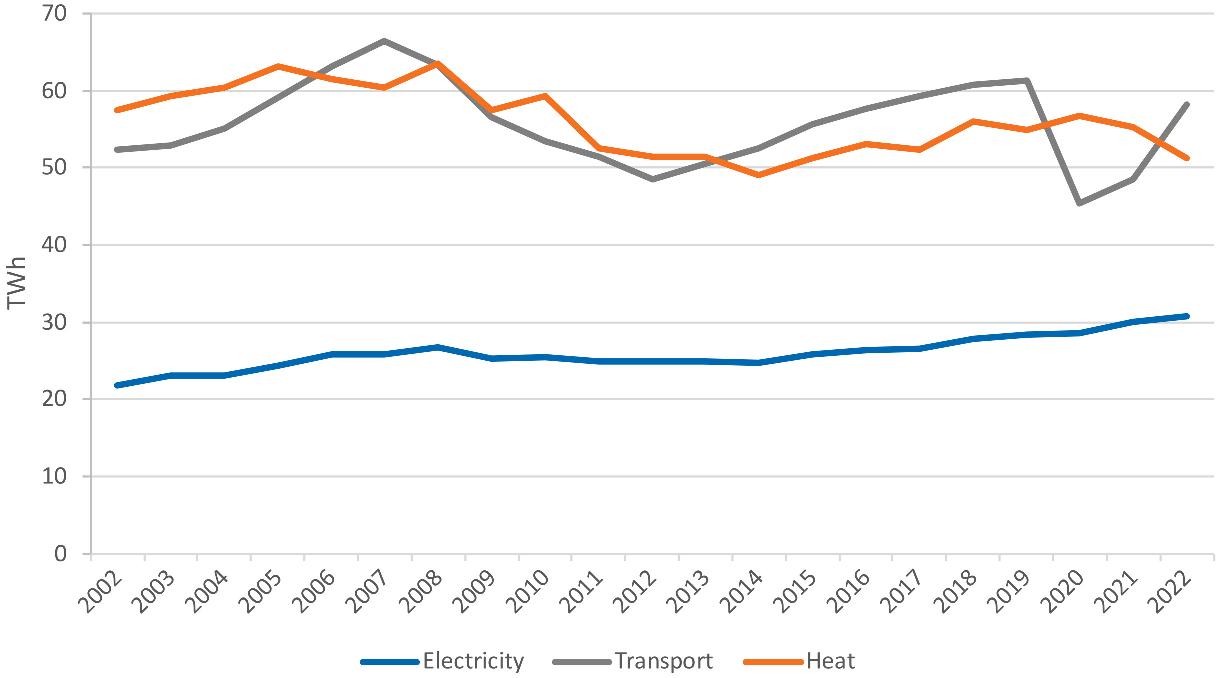



**Table 6.1: Final energy in electricity, transport and heat compared with previous years**

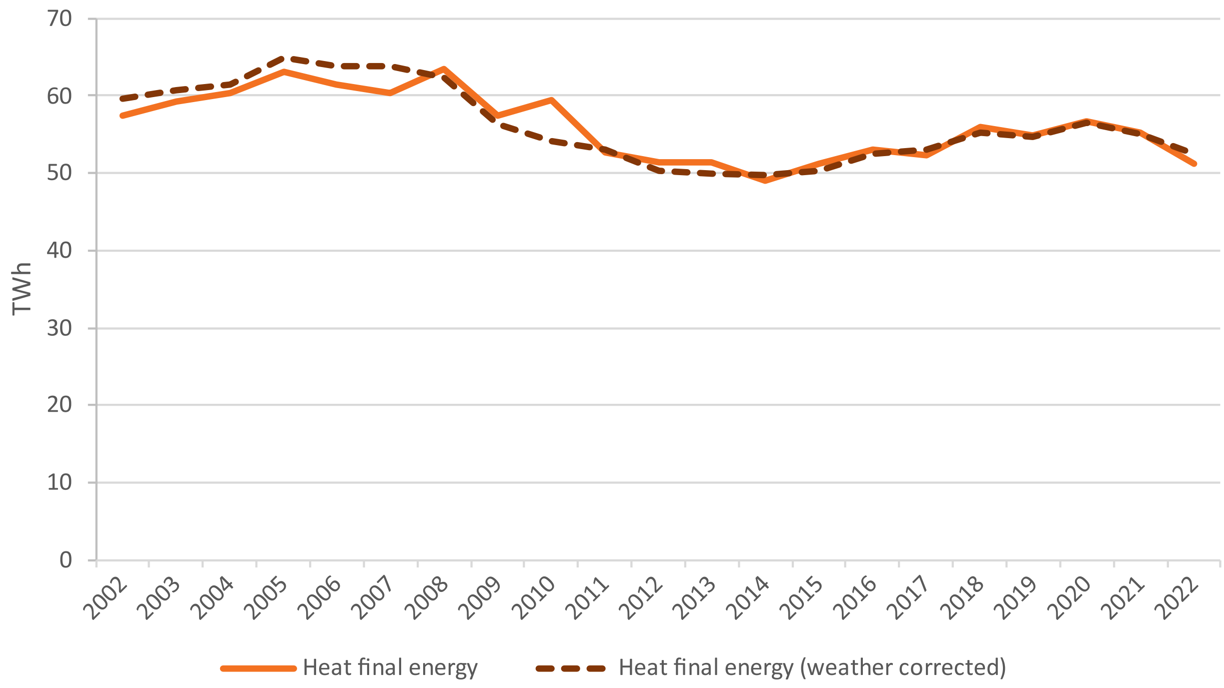
| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity | 30.77 | 30.02 | 27.89 | 24.83 | 21.9% | 22.4% | 19.3% | 19.9% | +2.5% | +10.4% | +23.9% |
| Transport | 58.23 | 48.57 | 60.80 | 48.53 | 41.5% | 36.3% | 42.0% | 38.9% | +19.9% | -4.2% | +20.0% |
| Heat | 51.26 | 55.31 | 55.97 | 51.40 | 36.5% | 41.3% | 38.7% | 41.2% | -7.3% | -8.4% | -0.3% |
| **Total** | **140.26** | **133.91** | **144.65** | **124.76** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+4.7%** | **-3.0%** | **+12.4%** |

## 6.2 Heat mode

Figure 6.3 shows the historical final energy use in the heat mode with and without a weather correction. SEAI uses the concept of degree days for weather normalisation across warmer and colder years, which is the established standard recommended by Eurostat. Further details are provided in section 9.2.

Weather-corrected heat demand reached a broad minimum in the period of 2012 to 2015 (averaging 49.5 TWh), likely due to a combination of impacts from the economic recession, a period of record high oil prices, and efficiency improvements in the heating and insulation of buildings. Since 2015, reduced international oil prices coupled with the recovery of the Irish economy have acted to increase heat demand.

**Figure 6.3: Final energy use for heat, actual and weather corrected**




### 6.2.1 Final energy in heat mode by sector

As shown in Figure 6.4 and detailed in Table 6.2, the residential sector is the largest end user of final energy in the heat mode, followed by industry, services, and agricultural and fisheries sectors.

Household demand for heat is strongly affected by weather, as evidenced by the historic peak in 2008, a year that had periods of extremely cold weather.

**Figure 6.4: Final energy in heat mode by sector**

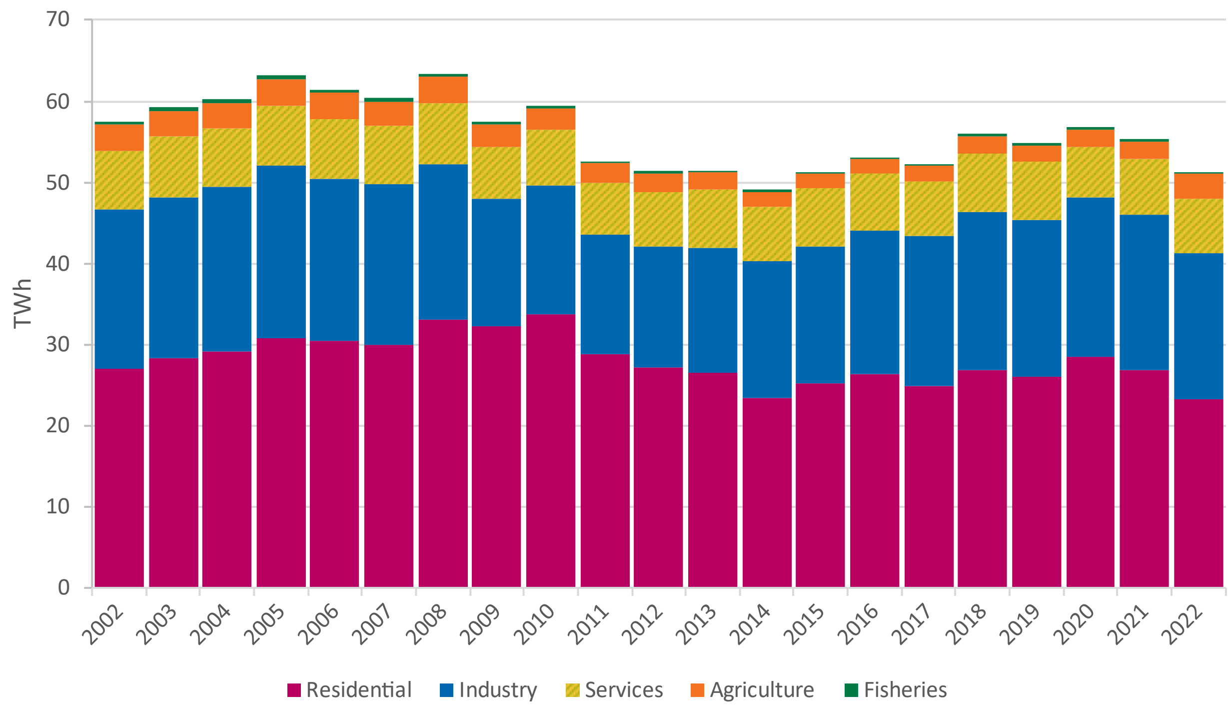


**Table 6.2: Final energy in heat mode by sector compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Residential | 23.21 | 26.94 | 26.85 | 27.23 | 45.3% | 48.7% | 48.0% | 53.0% | -13.8% | -13.6% | -14.8% |
| Industry | 18.04 | 19.13 | 19.56 | 14.85 | 35.2% | 34.6% | 34.9% | 28.9% | -5.7% | -7.8% | +21.5% |
| Services | 6.81 | 6.87 | 7.19 | 6.70 | 13.3% | 12.4% | 12.9% | 13.0% | -0.9% | -5.3% | +1.6% |
| Agriculture | 3.00 | 2.16 | 2.04 | 2.36 | 5.8% | 3.9% | 3.6% | 4.6% | +39.0% | +46.9% | +27.3% |
| Fisheries | 0.20 | 0.22 | 0.32 | 0.26 | 0.4% | 0.4% | 0.6% | 0.5% | -7.9% | -36.6% | -23.3% |
| **Total** | **51.26** | **55.31** | **55.97** | **51.40** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-7.3%** | **-8.4%** | **-0.3%** |

### 6.2.2 Final energy in heat mode by fuel and source

Figure 6.5 and Table 6.3 detail the fuels and energy sources in the final energy heat mode. Oil remains the largest fuel type for the delivery of heat, followed closely by natural gas. The last two decades have seen Ireland shift from an oil dominance in the heat mode to near parity between oil and gas for heat supply. This was driven by Ireland's expanding gas network and an industrial transition from oil to gas. Since 2015, both oil and natural gas have been approximately equal sources of final energy for the heat mode, with oil always slightly leading.

Coal and peat combined make up just less than 10% of Ireland's final energy demand in the heat mode. These are followed by renewables and non-renewable waste.

**Figure 6.5: Final consumption of heat by fuel**

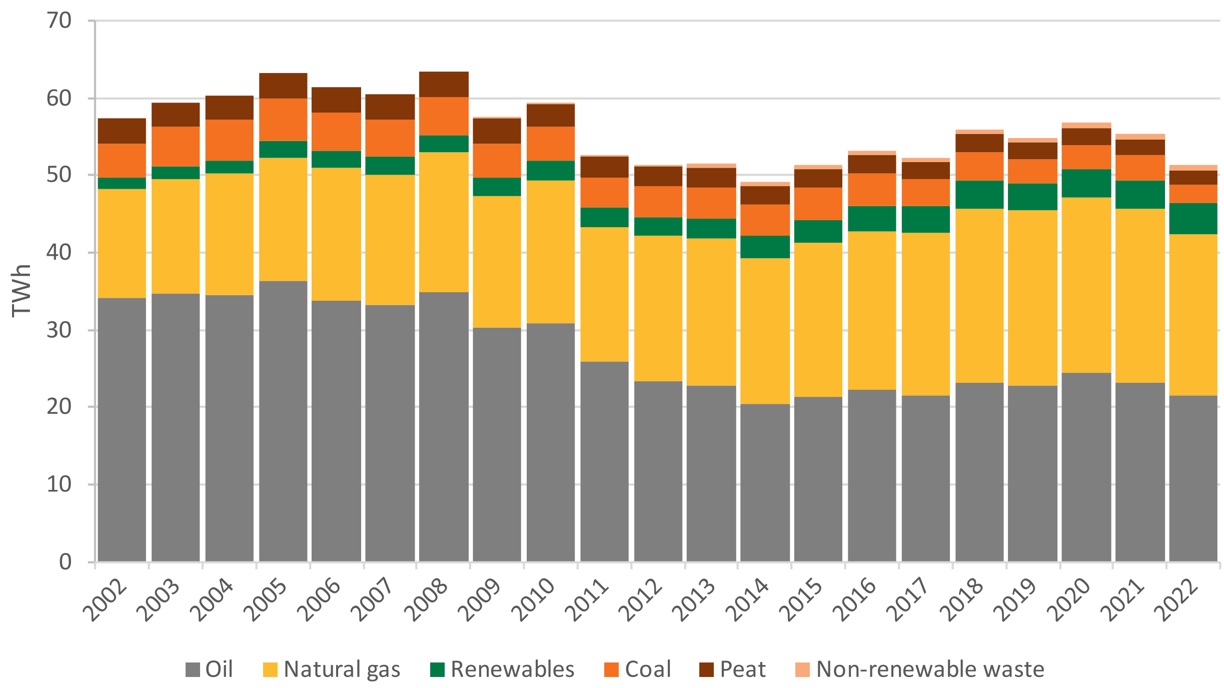


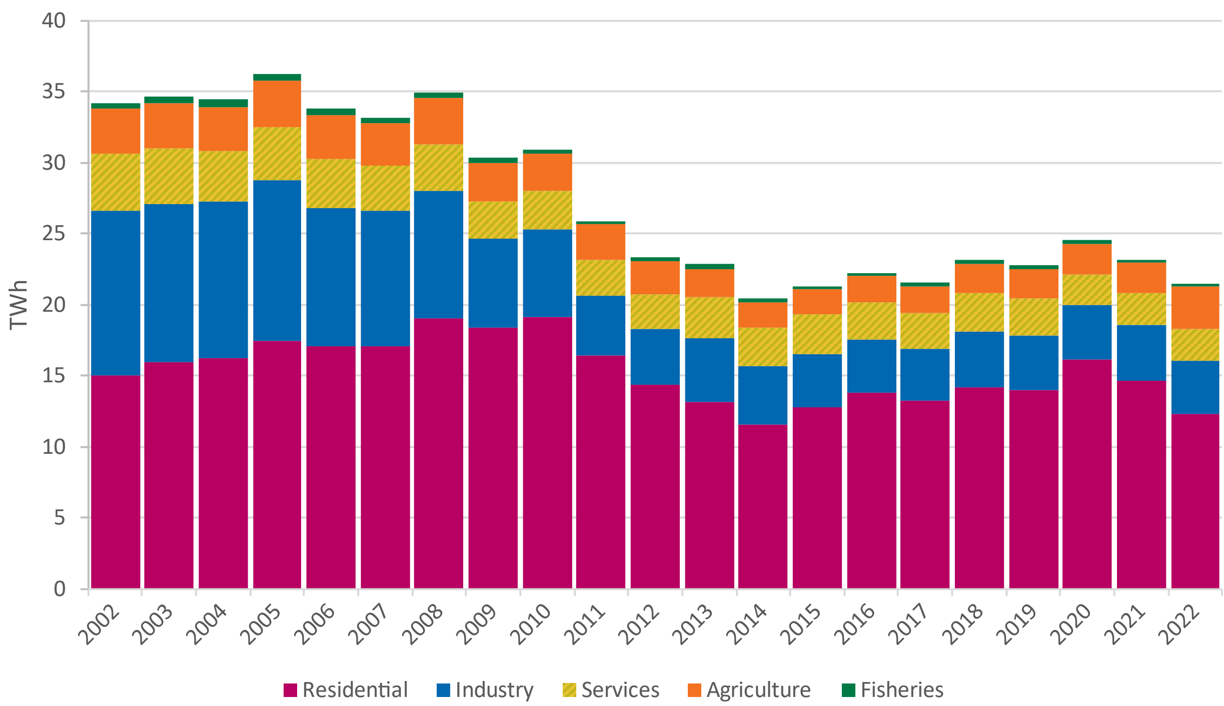
**Table 6.3: Final energy in heat by energy type compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 21.51 | 23.20 | 23.19 | 23.31 | 42.0% | 41.9% | 41.4% | 45.4% | -7.3% | -7.2% | -7.7% |
| Natural gas | 20.84 | 22.49 | 22.55 | 18.84 | 40.7% | 40.7% | 40.3% | 36.7% | -7.4% | -7.6% | +10.6% |
| Renewables | 4.09 | 3.70 | 3.54 | 2.49 | 8.0% | 6.7% | 6.3% | 4.8% | +10.7% | +15.6% | +64.7% |
| Coal | 2.27 | 3.20 | 3.75 | 3.94 | 4.4% | 5.8% | 6.7% | 7.7% | -29.1% | -39.5% | -42.4% |
| Peat | 1.87 | 2.10 | 2.30 | 2.50 | 3.6% | 3.8% | 4.1% | 4.9% | -11.0% | -18.6% | -25.4% |
| Non-renewable waste | 0.68 | 0.63 | 0.64 | 0.32 | 1.3% | 1.1% | 1.1% | 0.6% | +8.3% | +6.7% | +113% |
| **Total** | **51.26** | **55.31** | **55.97** | **51.40** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-7.3%** | **-8.4%** | **-0.3%** |

Figure 6.6 profiles oil use for final energy in the heat mode broken down by sector. The largest and most consistent reduction in oil use for heat has come from the industry sector, with the service sector also seeing smaller reductions. Oil consumption in residential fell in 2021 and again in 2022, primarily due to the end of COVID restrictions, milder weather and higher prices.

Oil consumption for heat in the residential sector fell by 40% from 2010 to 2014, during a period of record high oil prices, before trending upwards in the second half of the decade.

**Figure 6.6: Final consumption of oil for heat by sector**




## 6.3 Transport mode

### 6.3.1 Final energy in transport mode by sub-sector

Figure 6.7 and Table 6.4 show the trends and details of final energy use in the transport mode by sub-sector.

Private car energy use remains the transport sub-sector with the greatest energy use. Energy use in private cars had been relatively constant for a decade at an average of 24 TWh, but this changed in 2020, when energy use for private cars dropped by 21%. This reduction was mostly due to the impact of public health measures on limiting travel during the pandemic and resulted in the lowest energy use in private cars for almost 20 years.

From 2013 to 2019, the second largest transport sub-sector was aviation, reaching a historic peak in 2019, just prior to the COVID-19 pandemic. Final energy use in the aviation sub-sector fell by 64.1% in 2020, taking it below the HGV sub-sector demand for the first time since 2012.

The unspecified quantity in Figure 6.7 and Table 6.4 relates to measured consumption of transport fuels that cannot be definitively attributed to one of the road transport sub-sectors, and is composed entirely of petrol, road diesel and respective blended biofuels.

**Figure 6.7: Final energy in transport mode by sub-sector**

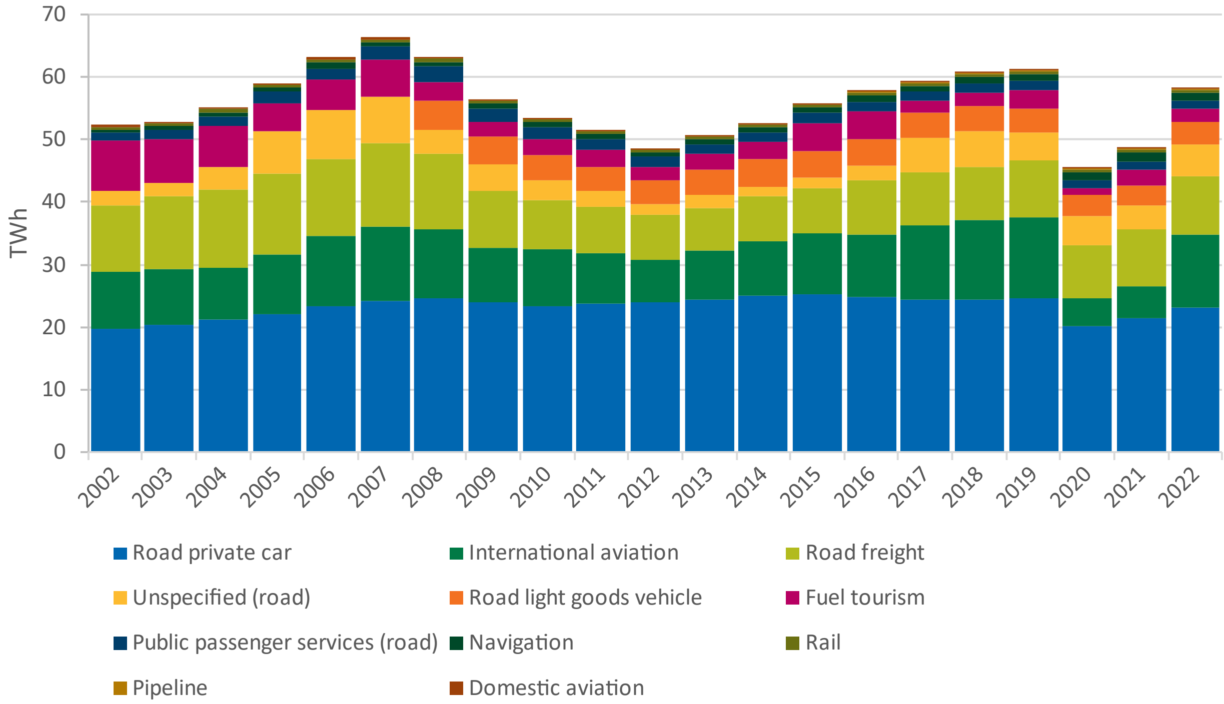


**Table 6.4: Final energy in transport by sub-sector compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Road private car | 23.16 | 21.30 | 24.34 | 23.89 | 39.8% | 43.9% | 40.0% | 49.2% | +8.7% | -4.9% | -3.1% |
| International aviation | 11.69 | 5.12 | 12.77 | 6.76 | 20.1% | 10.5% | 21.0% | 13.9% | +128.3% | -8.5% | +72.8% |
| Road freight | 9.24 | 9.25 | 8.53 | 7.32 | 15.9% | 19.1% | 14.0% | 15.1% | -0.1% | +8.3% | +26.3% |
| Unspecified (road) | 5.13 | 3.85 | 5.70 | 1.79 | 8.8% | 7.9% | 9.4% | 3.7% | +33.2% | -10.1% | +186.9% |
| Road light goods vehicle | 3.55 | 3.20 | 3.97 | 3.82 | 6.1% | 6.6% | 6.5% | 7.9% | +11.1% | -10.5% | -7.0% |
| Fuel tourism | 2.26 | 2.41 | 2.14 | 1.97 | 3.9% | 5.0% | 3.5% | 4.1% | -6.4% | +5.4% | +14.5% |
| Public passenger services (road) | 1.27 | 1.43 | 1.60 | 1.73 | 2.2% | 2.9% | 2.6% | 3.6% | -10.8% | -20.3% | -26.4% |
| Navigation | 1.15 | 1.36 | 0.98 | 0.69 | 2.0% | 2.8% | 1.6% | 1.4% | -15.6% | +17.5% | +66.5% |
| Rail | 0.45 | 0.40 | 0.44 | 0.45 | 0.8% | 0.8% | 0.7% | 0.9% | +11.8% | +0.8% | -0.3% |
| Pipeline | 0.19 | 0.18 | 0.26 | 0.05 | 0.3% | 0.4% | 0.4% | 0.1% | +5.2% | -29.3% | +285.0% |
| Domestic aviation | 0.16 | 0.08 | 0.06 | 0.06 | 0.3% | 0.2% | 0.1% | 0.1% | +110.9% | +145.4% | +173.3% |
| **Total** | **58.23** | **48.57** | **60.80** | **48.53** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+19.9%** | **-4.2%** | **+20.0%** |

### 6.3.2 Final energy use in transport mode by energy type

Figure 6.8 and Table 6.5 show the final energy use in the transport mode by fuel type. To avoid double counting across the transport and electricity modes, energy provided by electricity (*e.g.* EVs) are counted in the electricity mode only, and so are excluded from this transport analysis.

In 2020, every single fuel type in the transport mode saw a reduction against its 2019 values, with an overall reduction in final energy use of 26% in transport. Diesel remained by the largest fuel type with a share of 70%, followed by petrol (15%) and jet kerosene (10%). Most of the reduction in transport fuel use in 2020 was in diesel and jet kerosene, which fell by 13.6% and 64.3% respectively. All fuels remained below pre-pandemic levels in 2021 and 2022 (with the exception of biodiesel).

One significant long-term trend is the year-on-year reduction in petrol use since 2007, which continued into the COVID-impacted years (2020 and 2021). This was mostly driven by a sustained switch from petrol to diesel vehicles.

Liquid biofuels accounted for 4.5% of final energy in the transport mode in 2022.

**Figure 6.8: Final energy in transport mode by fuel**

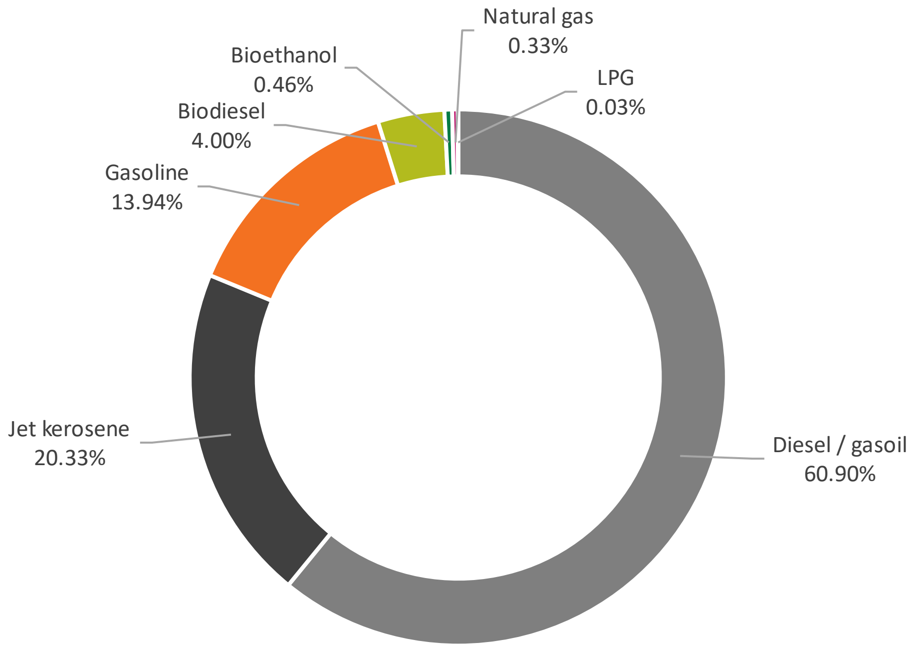



**Table 6.5: Final energy in transport by fuel compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Diesel / gas oil | 35.46 | 33.98 | 36.31 | 25.87 | 60.9% | 70.0% | 59.7% | 53.3% | +4.4% | -2.3% | +37.1% |
| Jet kerosene | 11.84 | 5.18 | 12.83 | 6.81 | 20.3% | 10.7% | 21.1% | 14.0% | +128% | -7.7% | +73.8% |
| Gasoline | 8.12 | 7.13 | 9.59 | 14.80 | 13.9% | 14.7% | 15.8% | 30.5% | +13.9% | -15.3% | -45.2% |
| Biodiesel | 2.33 | 1.84 | 1.48 | 0.65 | 4.0% | 3.8% | 2.4% | 1.3% | +26.9% | +57.9% | +256% |
| Bioethanol | 0.27 | 0.24 | 0.32 | 0.33 | 0.5% | 0.5% | 0.5% | 0.7% | +14.6% | -14.6% | -18.6% |
| Natural gas | 0.19 | 0.19 | 0.26 | 0.05 | 0.3% | 0.4% | 0.4% | 0.1% | -0.6% | -26.5% | +301% |
| LPG | 0.02 | 0.01 | 0.02 | 0.01 | 0.0% | 0.0% | 0.0% | 0.0% | +39.2% | -12.4% | +62.2% |
| Fuel oil | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **58.23** | **48.57** | **60.80** | **48.53** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+19.9%** | **-4.2%** | **+20.0%** |

## 6.4 Electricity mode

### 6.4.1 Final energy use in electricity mode by sector

Figure 6.9 shows the trends and breakdown of final energy consumption in the electricity mode across the main sectors. 2022 was a record high for final energy demand for electricity. In order of largest to smallest, the sectoral consumers are services, residential, industry, agriculture and fisheries, and transport (barely visible in Figure 6.9).

**Figure 6.9: Final consumption of electricity by sector**

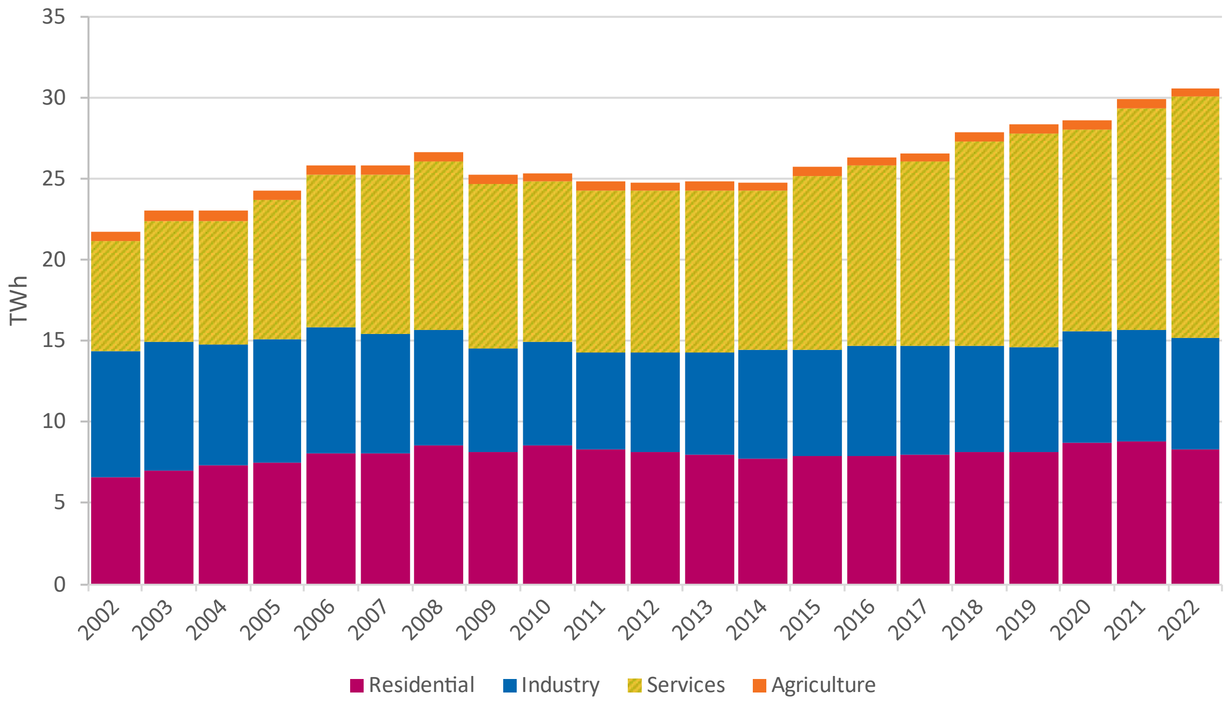



Table 6.6 details the quantities, shares and trends in final energy use of the electricity mode. Overall, the last 10 years have seen a significant increase in demand in services, a modest increase in residential and industry, and a small increase in agriculture and fisheries. The percentage growth in using electricity in transport over the last 10- and 20-year period is significant, but the absolute quantity of electricity used in transport is remains small. Electricity use in transport includes the DART rail system, the Luas light rail system and EVs on the road.

**Table 6.6: Final consumption of electricity by sector compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Services | 14.89 | 13.64 | 12.60 | 9.97 | 48.4% | 45.4% | 45.2% | 40.1% | +9.2% | +18.2% | +49.4% |
| Residential | 8.29 | 8.83 | 8.18 | 8.12 | 26.9% | 29.4% | 29.3% | 32.7% | -6.1% | +1.4% | +2.1% |
| Industry | 6.86 | 6.85 | 6.48 | 6.14 | 22.3% | 22.8% | 23.2% | 24.7% | +0.1% | +5.8% | +11.7% |
| Agriculture | 0.52 | 0.55 | 0.56 | 0.56 | 1.7% | 1.8% | 2.0% | 2.2% | -5.8% | -6.4% | -6.4% |
| Transport | 0.21 | 0.15 | 0.07 | 0.05 | 0.7% | 0.5% | 0.2% | 0.2% | +39.3% | +214.8% | +356.2% |
| Fisheries | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **30.77** | **30.02** | **27.89** | **24.83** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+2.5%** | **+10.4%** | **+23.9%** |

## 6.5 Primary energy requirement by mode

Figure 6.10 shows the primary energy supply through the lens of the electricity, transport and heat modes. To avoid double counting, heat and transport energy provided by electricity is counted in the electricity mode only.

Figure 6.11 shows the historical trend in primary energy by mode. All three modes have a broadly similar share in primary energy. This differs from the mode split of final energy use (see section 6.1) where the electricity mode is approximately half that of heat and transport. This is because a significant amount of energy is lost in the thermal generation of electricity, and never reaches end users for final consumption. Therefore, the primary supply electricity mode is always substantially higher than the final use electricity mode. For more information on electricity generation inputs, outputs and efficiency, see section 4.2.

All three of the modes decreased during the economic downturn from 2008 to 2012. Transport grew to become the largest of the three modes from 2014 to 2019, before shrinking to become the smallest in 2020 due to the impact of the COVD-19 travel restrictions.

**Figure 6.10: Current split of primary energy by mode of application**

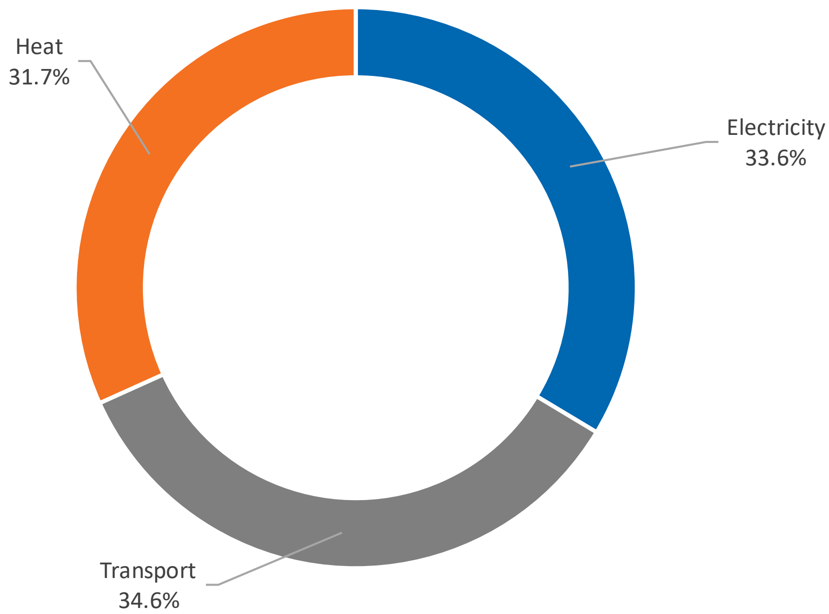
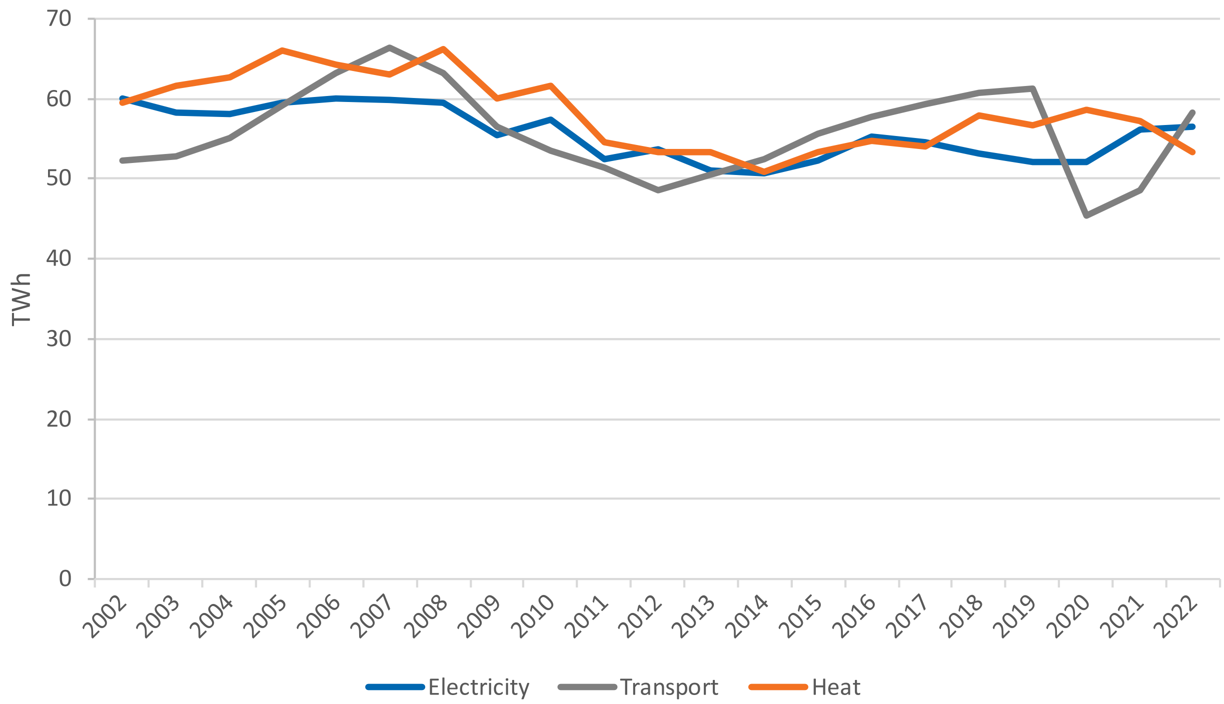


**Figure 6.11: Primary energy by mode of application**

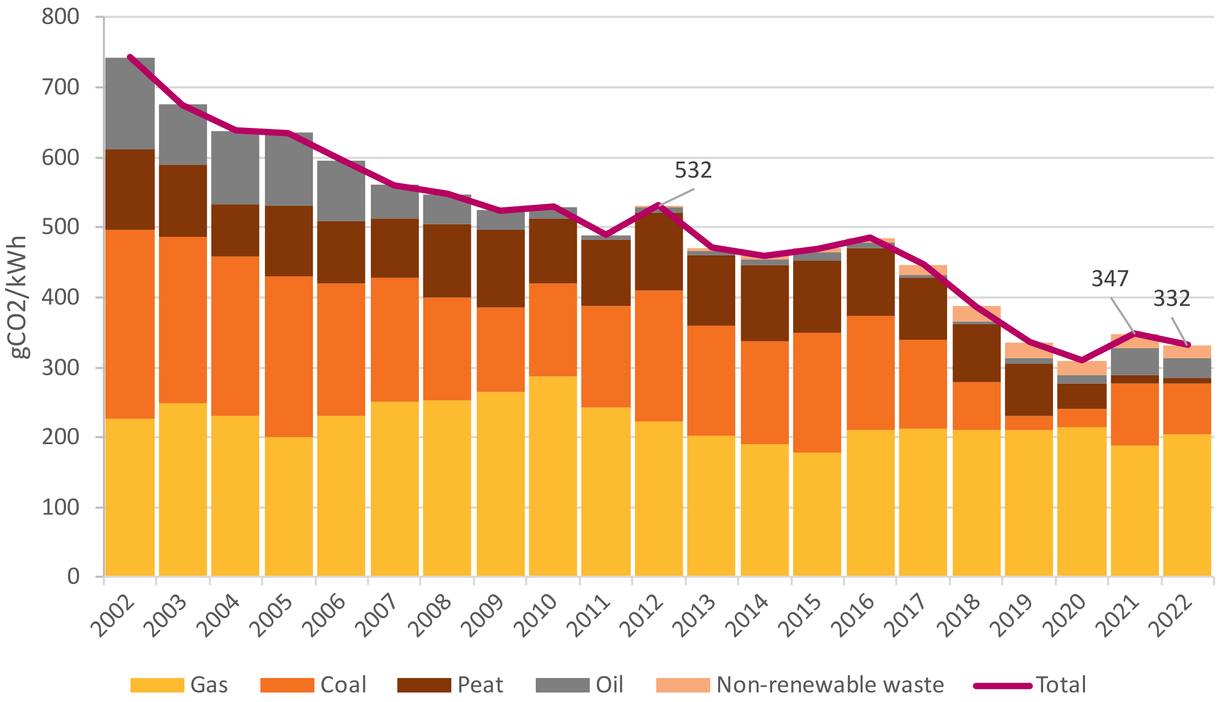


# 7 Energy-related $CO_2$ emissions

## 7.1 Carbon intensity of electricity supply

Figure 7.1 shows the $CO_2$ emission intensity of Ireland's electricity supply, which is measured in $gCO_2$/kWh. The stacked bars show the share of $CO_2$ emissions by fuel for each kWh of electricity supplied in Ireland. It is important to note that the stacked bars in the graph represent the contributions of different fuels to the overall $CO_2$ intensity of Ireland's electricity supply, not the $CO_2$ intensity of the individual fuels themselves.

**Figure 7.1: $CO_2$ emissions per kWh of electricity supplied, with contribution by fuel**




The $CO_2$ intensity of electricity generation fell to a historic low in 2020, before increasing slightly in 2021 due to an increase in emissions from coal and, to a lesser extent, oil. The $CO_2$ intensity fell again in 2022, due to a decrease the share of oil and coal in the generation mix. The dramatic overall improvements in annual $CO_2$ emission intensity, as seen in Figure 7.1, are due to reductions in using coal for electricity generation, and increased generation from zero-carbon renewable sources.

Over the longer term, there has been a shift away from coal and oil, two of the fuels with the highest $CO_2$ intensity. These fuels have been replaced by a combination of high efficiency gas combined cycle gas turbine (CCGT) generation and zero-carbon renewables. Imported electricity is also considered as zero carbon from Ireland's perspective, as emissions are counted in the jurisdiction in which they are emitted.

## 7.2 Energy-related $CO_2$ emissions by sector

Figure 7.2, Figure 7.3 and Table 7.1 show the most recent and historical energy-related $CO_2$ emissions split by sector. In this case, the emissions from electricity generation are shown separately from the emissions from direct fossil fuel use in the end-use sectors. This aligns more closely with the breakdown used by the EPA and internationally for reporting greenhouse gas emissions.

International aviation is also shown separately. It is included in the National Energy Balance (in line with international practice) and so is included in the figures for transport energy use in this report. However, it is not included in the National Greenhouse Gas Inventory (in line with international practice) and is also not included in Ireland's national greenhouse gas emissions reduction targets for 2030 and 2050.

Excluding international aviation, energy-related $CO_2$ emissions reached a recent low point in 2020 before increasing slightly in 2021 and decreasing again in 2022. Transport (excluding international aviation) provides the largest share of energy-related $CO_2$ emissions, followed by electricity generation, the residential sector, industry, services, international aviation, agriculture and fisheries, and other, in that order.

**Figure 7.2: Current sectoral shares of energy-related $CO_2$**

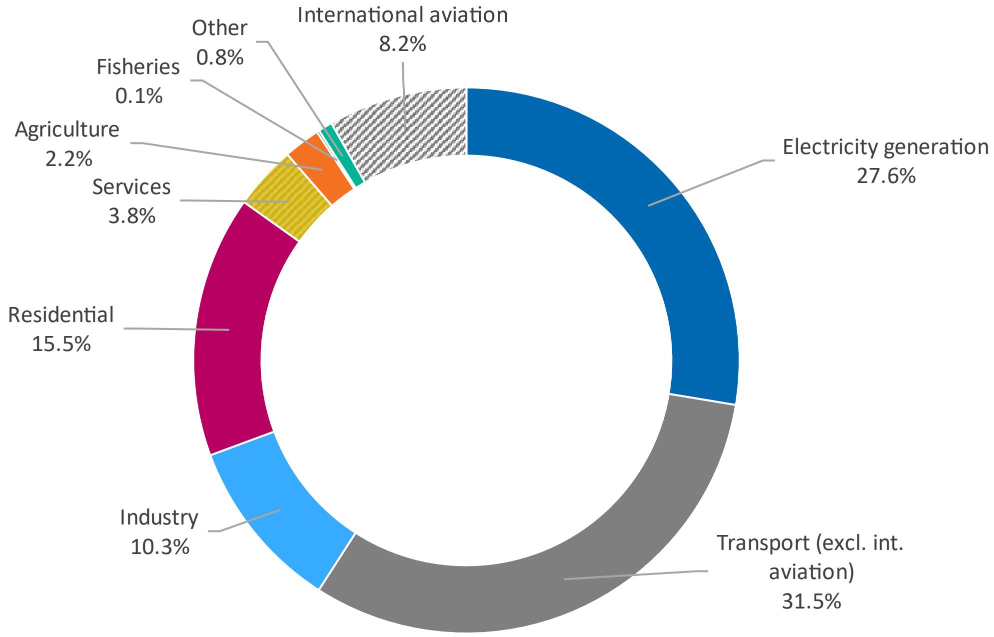
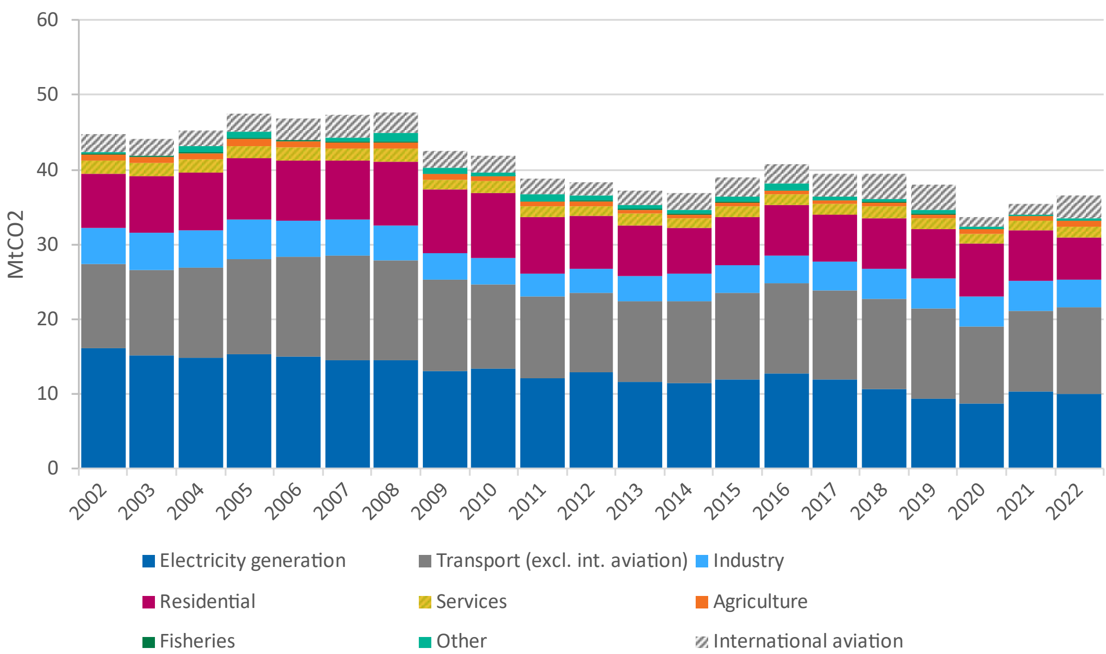



**Figure 7.3: Energy-related annual $CO_2$ emissions by sector[8]**




[8] Emissions for agriculture, as with all sectors, shown in the chart and tables are for energy-related emissions only.

**Table 7.1: Energy-related $CO_2$ by sector with comparison to previous years**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity generation | 10.07 | 10.27 | 10.64 | 12.93 | 27.6% | 29.1% | 27.0% | 33.7% | -2.0% | -5.3% | -22.1% |
| Transport (excl. int. aviation) | 11.48 | 10.82 | 12.07 | 10.58 | 31.5% | 30.6% | 30.6% | 27.6% | +6.1% | -4.8% | +8.6% |
| Industry | 3.74 | 4.02 | 4.06 | 3.17 | 10.3% | 11.4% | 10.3% | 8.3% | -6.9% | -7.9% | +18.0% |
| Residential | 5.65 | 6.71 | 6.79 | 7.05 | 15.5% | 19.0% | 17.2% | 18.4% | -15.7% | -16.7% | -19.8% |
| Services | 1.37 | 1.39 | 1.49 | 1.41 | 3.8% | 3.9% | 3.8% | 3.7% | -1.4% | -8.0% | -2.7% |
| Agriculture | 0.79 | 0.57 | 0.54 | 0.62 | 2.2% | 1.6% | 1.4% | 1.6% | +39.0% | +46.9% | +27.3% |
| Fisheries | 0.05 | 0.06 | 0.08 | 0.07 | 0.1% | 0.2% | 0.2% | 0.2% | -7.9% | -36.6% | -23.3% |
| Other | 0.30 | 0.21 | 0.42 | 0.79 | 0.8% | 0.6% | 1.1% | 2.1% | +45.5% | -27.3% | -61.4% |
| **Total (excl. int. aviation)** | **33.47** | **34.05** | **36.09** | **36.62** | **91.8%** | **96.3%** | **91.7%** | **95.5%** | **-1.7%** | **-7.2%** | **-8.6%** |
| International aviation | 3.00 | 1.32 | 3.28 | 1.74 | 8.2% | 3.7% | 8.3% | 4.5% | +128% | -8.5% | +72.8% |
| **Total (incl. int. aviation)** | **36.48** | **35.37** | **39.37** | **38.36** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+3.1%** | **-7.4%** | **-4.9%** |

### 7.2.1 Industry emissions

Approximately 60% of greenhouse gas emissions from industry are energy related. In order to determine industry's total energy-related $CO_2$ emissions, it is necessary to include estimations of upstream emissions for the electricity consumed by industry. Figure 7.4 shows the primary energy-related $CO_2$ emissions from industry, detailing the on-site $CO_2$ emissions associated with direct fuel use and the upstream emissions associated with electricity consumption.

**Figure 7.4: Industry energy-related $CO_2$ emissions by fuel**

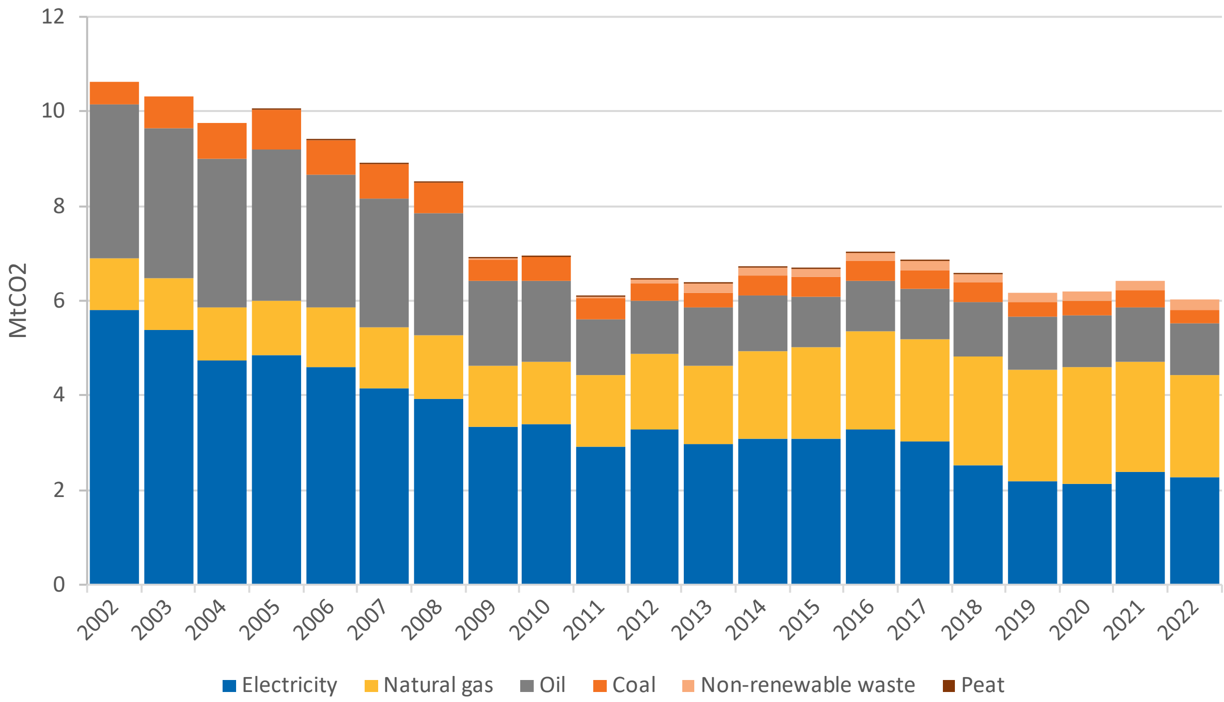



Table 7.2 shows the growth rates, quantities and relative shares of energy-related $CO_2$ emissions in industry.

**Table 7.2: Growth rates, quantities and shares of energy-related $CO_2$ emissions in industry**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity | 2.277 | 2.382 | 2.511 | 3.264 | 37.8% | 37.2% | 38.2% | 50.7% | -4.4% | -9.3% | -30.3% |
| Natural gas | 2.158 | 2.332 | 2.315 | 1.620 | 35.8% | 36.4% | 35.2% | 25.2% | -7.4% | -6.8% | +33.2% |
| Oil | 1.088 | 1.141 | 1.135 | 1.105 | 18.1% | 17.8% | 17.3% | 17.2% | -4.7% | -4.2% | -1.6% |
| Coal | 0.281 | 0.354 | 0.418 | 0.384 | 4.7% | 5.5% | 6.4% | 6.0% | -20.7% | -32.8% | -27.0% |
| Non-renewable waste | 0.218 | 0.196 | 0.193 | 0.061 | 3.6% | 3.1% | 2.9% | 0.9% | +10.8% | +12.8% | +255.8% |
| Peat | 0.0 | 0.0 | 0.004 | 0.004 | 0% | 0% | 0.1% | 0.1% | - | -100.0% | -100.0% |
| **Total** | **6.021** | **6.405** | **6.575** | **6.438** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-6.0%** | **-8.4%** | **-6.5%** |

### 7.2.2 Transport emissions

Figure 7.5 and Table 7.3 show the annual $CO_2$ emissions from transport with a breakdown by fuel type, while Table 7.4 provides a breakdown by sub-sector.

**Figure 7.5: Transport energy-related emissions by energy type (including international aviation)**

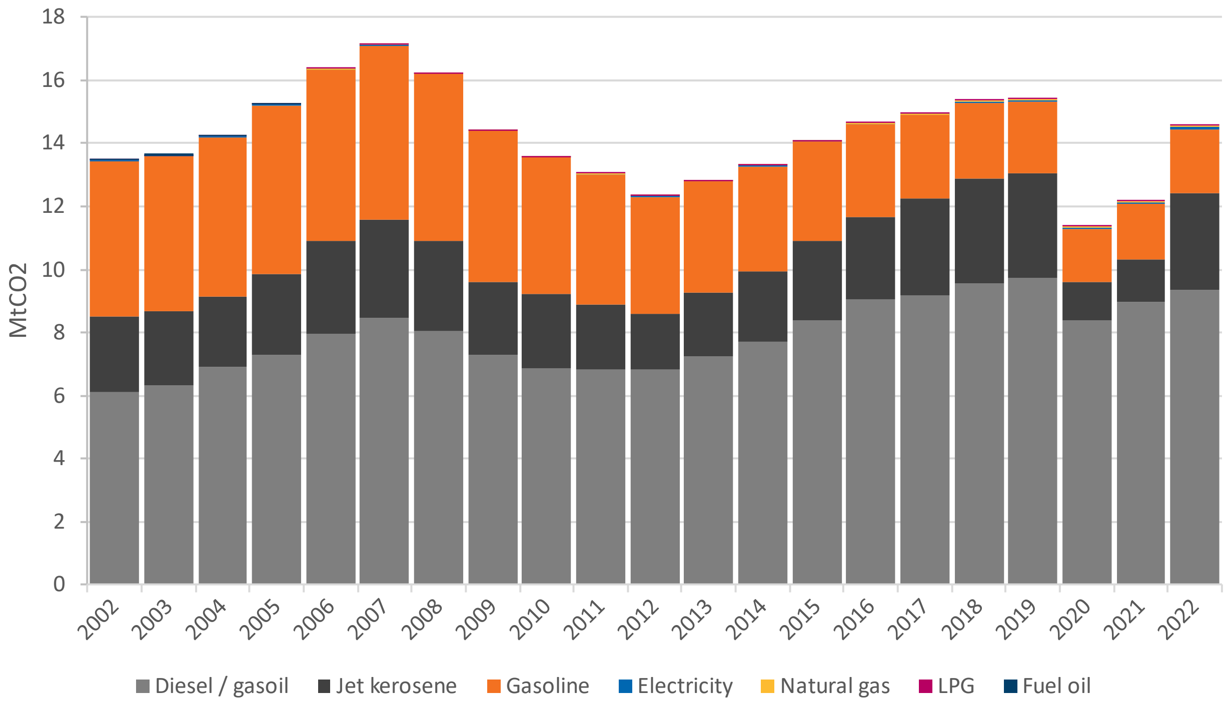



**Table 7.3: Growth rates, quantities and shares of energy-related $CO_2$ emissions in transport**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Diesel / gas oil | 9.357 | 8.965 | 9.580 | 6.826 | 64.3% | 73.6% | 62.3% | 55.3% | +4.4% | -2.3% | +37.1% |
| Jet kerosene | 3.042 | 1.332 | 3.296 | 1.751 | 20.9% | 10.9% | 21.4% | 14.2% | +128% | -7.7% | +73.8% |
| Gasoline | 2.044 | 1.795 | 2.414 | 3.727 | 14.0% | 14.7% | 15.7% | 30.2% | +13.9% | -15.3% | -45.2% |
| Electricity | 0.069 | 0.052 | 0.026 | 0.024 | 0.5% | 0.4% | 0.2% | 0.2% | +33.1% | +170% | +185% |
| Natural gas | 0.039 | 0.039 | 0.053 | 0.010 | 0.3% | 0.3% | 0.3% | 0.1% | -0.1% | -25.4% | +299% |
| LPG | 0.004 | 0.003 | 0.005 | 0.003 | 0.0% | 0.0% | 0.0% | 0.0% | +39.2% | -12.4% | +62.2% |
| Fuel oil | 0.0 | 0.0 | 0.0 | 0.0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **14.556** | **12.186** | **15.374** | **12.341** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+19.4%** | **-5.3%** | **+17.9%** |

**Table 7.4: Growth rates, quantities and shares of transport $CO_2$ emissions by sub-sector**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Road private car | 5.746 | 5.316 | 6.089 | 5.998 | 39.5% | 43.6% | 39.6% | 48.6% | +8.1% | -5.6% | -4.2% |
| Road freight | 2.281 | 2.309 | 2.160 | 1.882 | 15.7% | 18.9% | 14.1% | 15.2% | -1.2% | +5.6% | +21.2% |
| Unspecified (road) | 1.262 | 0.954 | 1.429 | 0.446 | 8.7% | 7.8% | 9.3% | 3.6% | +32.3% | -11.7% | +183% |
| Road light goods vehicle | 0.877 | 0.798 | 1.005 | 0.982 | 6.0% | 6.5% | 6.5% | 8.0% | +9.9% | -12.7% | -10.7% |
| Fuel tourism | 0.557 | 0.602 | 0.542 | 0.506 | 3.8% | 4.9% | 3.5% | 4.1% | -7.5% | +2.7% | +10.1% |
| Public passenger services (road) | 0.315 | 0.356 | 0.404 | 0.442 | 2.2% | 2.9% | 2.6% | 3.6% | -11.7% | -22.1% | -28.8% |
| Navigation | 0.303 | 0.359 | 0.258 | 0.182 | 2.1% | 2.9% | 1.7% | 1.5% | -15.6% | +17.5% | +66.5% |
| Rail | 0.149 | 0.137 | 0.149 | 0.147 | 1.0% | 1.1% | 1.0% | 1.2% | +8.9% | +0.1% | +1.4% |
| Pipeline | 0.037 | 0.035 | 0.052 | 0.010 | 0.3% | 0.3% | 0.3% | 0.1% | +5.2% | -29.3% | +285% |
| Domestic aviation | 0.041 | 0.019 | 0.017 | 0.015 | 0.3% | 0.2% | 0.1% | 0.1% | +111% | +146% | +174% |
| **Total (ex. int. aviation)** | **11.553** | **10.871** | **12.092** | **10.603** | **79.4%** | **89.2%** | **78.7%** | **85.9%** | **+6.3%** | **-4.5%** | **+9.0%** |
| International aviation | 3.003 | 1.315 | 3.282 | 1.738 | 20.6% | 10.8% | 21.3% | 14.1% | +128% | -8.5% | +72.8% |
| **Total (incl. int. aviation)** | **14.556** | **12.186** | **15.374** | **12.341** | **100%** | **100%** | **100%** | **100%** | **+19.4%** | **-5.3%** | **+17.9%** |

### 7.2.3 Residential emissions

Figure 7.6 shows energy-related $CO_2$ emissions from the residential sector, including upstream electricity emissions. There was a reduction in energy-related $CO_2$ emissions between 2010 and 2014, but a return to growth in 2015, 2016, 2018 and again in 2020. Emissions reduced again in 2022, reflecting the decrease in consumption in the sector due to milder weather and high energy prices.

**Figure 7.6: Residential energy-related $CO_2$ by fuel**

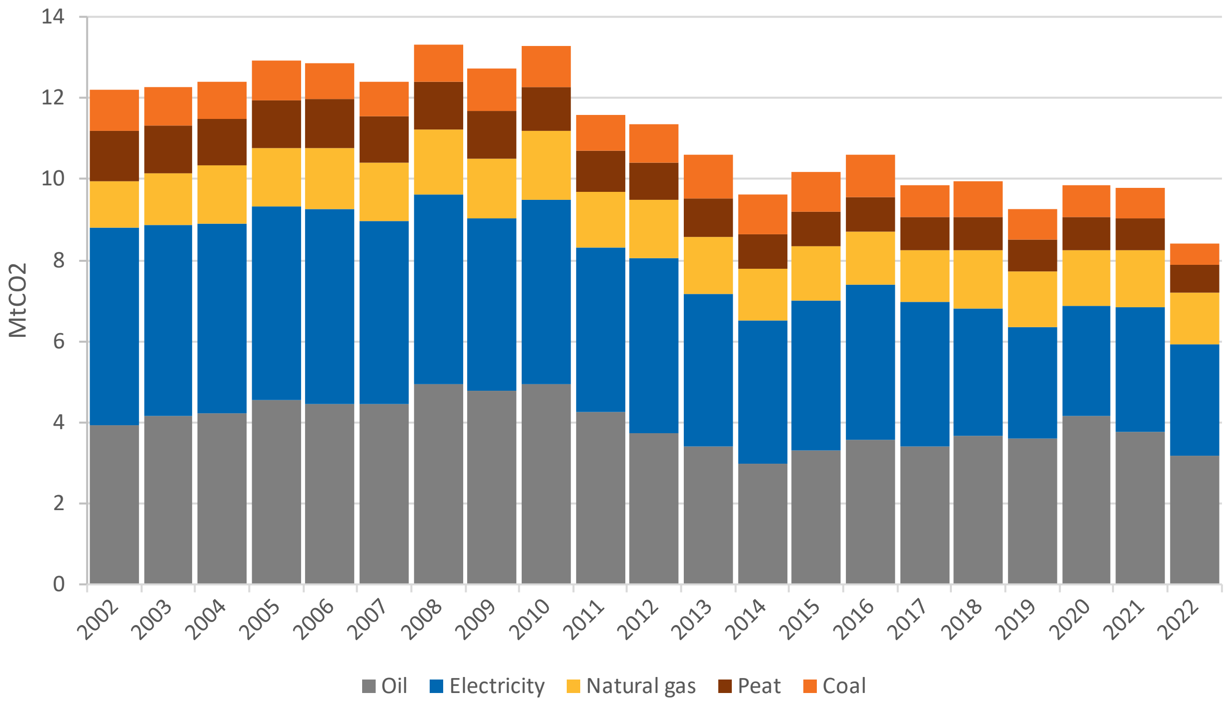



**Table 7.5: Growth rates, quantities and shares of energy-related $CO_2$ emissions in the residential sector**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Oil | 3.171 | 3.775 | 3.658 | 3.733 | 37.7% | 38.6% | 36.8% | 32.8% | -16.0% | -13.3% | -15.0% |
| Electricity | 2.752 | 3.068 | 3.166 | 4.319 | 32.7% | 31.4% | 31.8% | 38.0% | -10.3% | -13.1% | -36.3% |
| Natural gas | 1.280 | 1.404 | 1.411 | 1.430 | 15.2% | 14.4% | 14.2% | 12.6% | -8.8% | -9.3% | -10.4% |
| Peat | 0.692 | 0.774 | 0.841 | 0.915 | 8.2% | 7.9% | 8.5% | 8.1% | -10.6% | -17.7% | -24.4% |
| Coal | 0.508 | 0.753 | 0.876 | 0.968 | 6.0% | 7.7% | 8.8% | 8.5% | -32.6% | -42.0% | -47.6% |
| **Total** | **8.403** | **9.773** | **9.952** | **11.365** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-14.0%** | **-15.6%** | **-26.1%** |

### 7.2.4 Commercial and public services emissions

Figure 63 shows the primary energy-related $CO_2$ emissions of the services sector, distinguishing between the on-site $CO_2$ emissions associated with direct fuel use and the upstream emissions associated with electricity consumption.

**Figure 7.7: Commercial and public services sector $CO_2$ emissions by energy type**

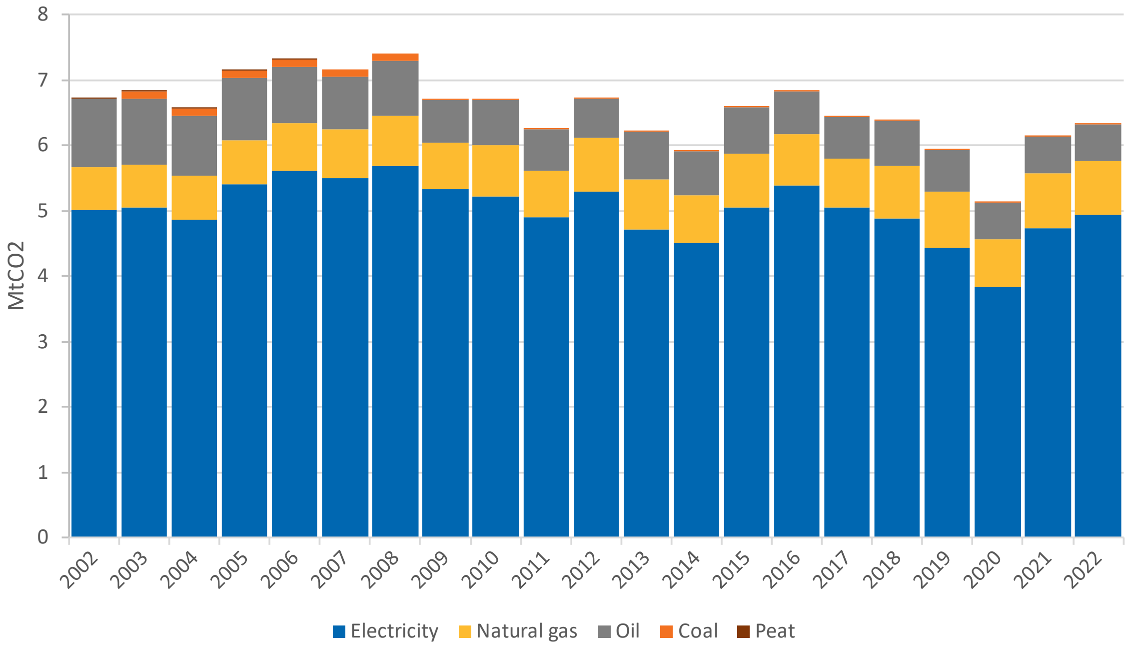


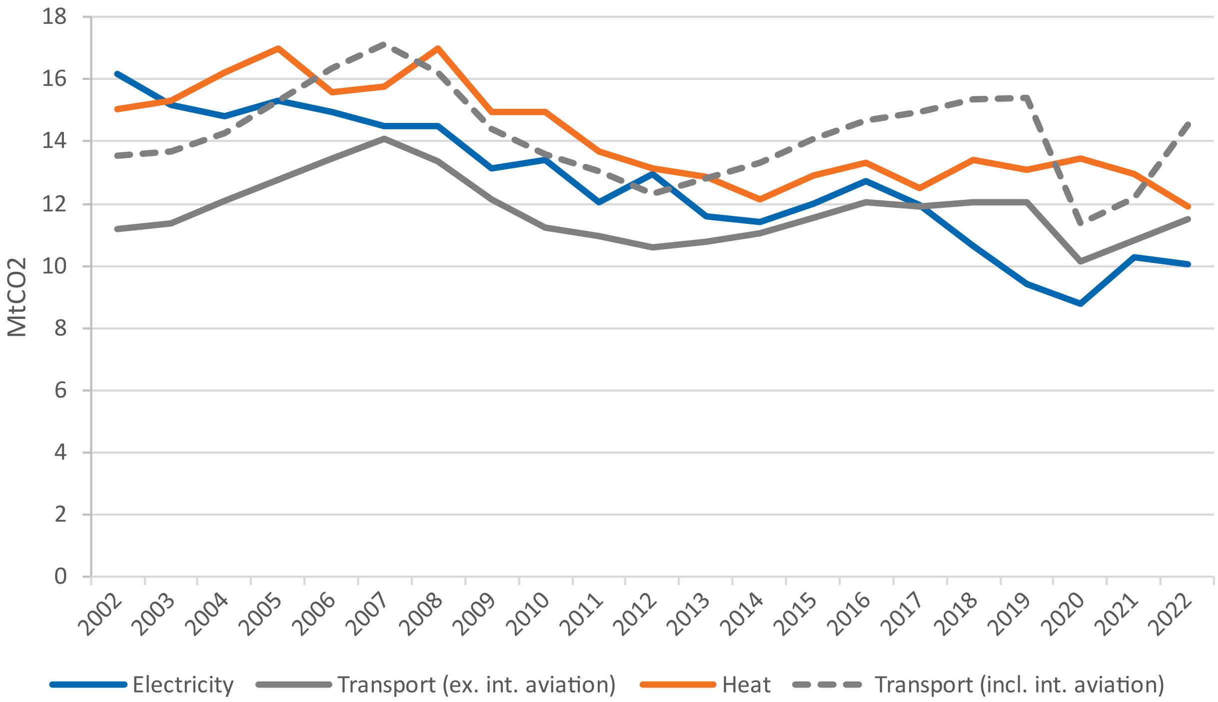

**Table 7.6: Growth rates, quantities and shares of $CO_2$ emissions in commercial and public services**

| | Quantity ($MtCO_2$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity | 4.944 | 4.739 | 4.881 | 5.301 | 78.2% | 77.3% | 76.6% | 79.0% | +4.3% | +1.3% | -6.7% |
| Natural gas | 0.811 | 0.828 | 0.804 | 0.808 | 12.8% | 13.5% | 12.6% | 12.0% | -2.0% | +1.0% | +0.4% |
| Oil | 0.562 | 0.565 | 0.688 | 0.602 | 8.9% | 9.2% | 10.8% | 9.0% | -0.5% | -18.4% | -6.7% |
| Coal | 0.001 | 0.001 | 0.002 | 0.002 | 0.0% | 0.0% | 0.0% | 0.0% | 0% | -65.0% | -68.6% |
| Peat | 0.0 | 0.0 | 0.0 | 0.0 | 0% | 0% | 0% | 0% | - | - | - |
| Non-renewable waste | 0.0 | 0.0 | 0.0 | 0.0 | 0% | 0% | 0% | 0% | - | - | - |
| **Total** | **6.318** | **6.133** | **6.375** | **6.714** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+3.0%** | **-0.9%** | **-5.9%** |

## 7.3 Energy-related $CO_2$ emissions by mode

Figure 7.8 shows energy-related $CO_2$ emissions, but divided into the three modes of electricity, transport and heat. This aggregates the direct energy-related emissions from industry, residential, commercial services, public services, and agriculture and fisheries shown in Figure 7.2, Figure 7.3 and Table 7.1 together as heat. The emissions for transport, including and excluding international aviation, are shown for reference.

**Figure 7.8: Energy-related $CO_2$ emissions by electricity, transport and heat**




Energy-related $CO_2$ emissions in all three modes declined after 2007 during the recession, but transport returned to growth after 2012 with heat and electricity returning to growth after 2014.

From 2016, there was a dramatic reduction in $CO_2$ emissions from electricity generation, due to the reduction in coal and peat (the most carbon-intensive fossil fuels) and an increase in electricity from renewable, zero-carbon sources.

$CO_2$ emissions from electricity generation reached a minimum in 2020, before increasing again in 2021. Between 2016 and 2019, the success seen in decarbonising electricity generation was not repeated in either heat or transport (excluding international aviation), where emissions remained flat.

In 2020, there was a dramatic reduction in $CO_2$ emissions from transport due to travel restrictions imposed during the COVID-19 pandemic, with emissions from international aviation alone dropping 64.3%. Emissions from transport subsequently increased in 2021, almost returning to pre-pandemic levels in 2022. In contrast, $CO_2$ emissions from heat increased slightly during 2020, due in part to more time spent at home during COVID-19 restrictions, before decreasing again in 2021 and 2022, due the end of restrictions, milder weather and high fuel prices.

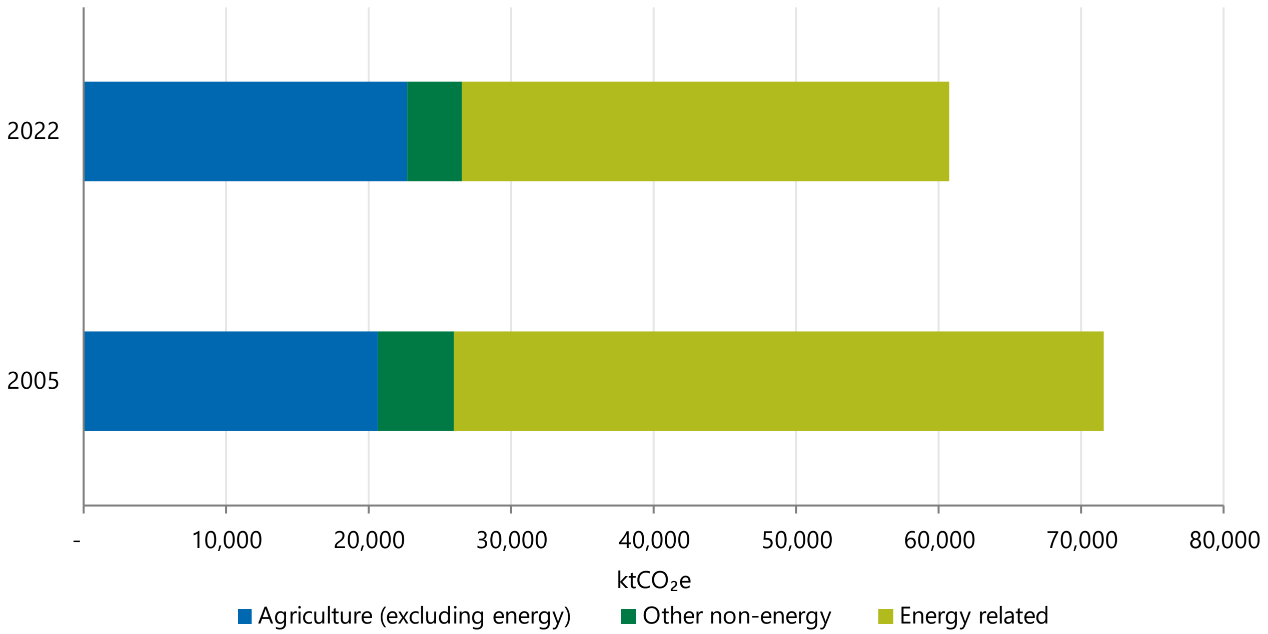
# 8 Energy targets and policy

This section examines areas that are a focus of national and international energy policy, including Ireland's progress towards its EU targets for renewable energy and greenhouse gas emissions, and also the issues of energy security and cost competitiveness.

## 8.1 Greenhouse gas emissions

Figure 8.1 shows greenhouse gas emissions by source for 2005 and provisional figures for 2022 (excluding land use and land use change), as reported by the EPA. The share of greenhouse gas emissions from energy use has fallen in both percentage and absolute quantity since 2005. Ireland has a comparably large share of greenhouse gas emissions from agriculture when compared to the EU average. For the EU as a whole in 2019, 12% of greenhouse gas emissions were from agriculture, compared to 34% in Ireland. Almost all (98%) of the energy-related greenhouse gas emissions are from $CO_2$, with the rest from other by-products of combustion such as nitrous oxide ($N_2O$) emissions.

**Figure 8.1: Total greenhouse gas emissions by source (excluding international aviation)**




*Source: data from EPA*

### 8.1.1 Greenhouse gas emissions reductions targets

The EU 2030 climate and energy framework sets a target for the EU as a whole to achieve a 55% greenhouse gas emissions reduction by 2030 compared to 1990. The greenhouse gas emissions reductions targets are split across two categories. The first category covers large-scale carbon emitters, typically large industrial sites or electricity generation stations, but also including some bodies in the services sector and international aviation. These bodies are dealt with at EU level under the EU ETS. The second category covers all greenhouse gas emissions not covered by the ETS, known as the non-ETS sector. Achieving greenhouse gas emissions reductions in the non-ETS sector is the responsibility of national governments. The EU Effort Sharing Regulation[9] and implementing decision[10] set

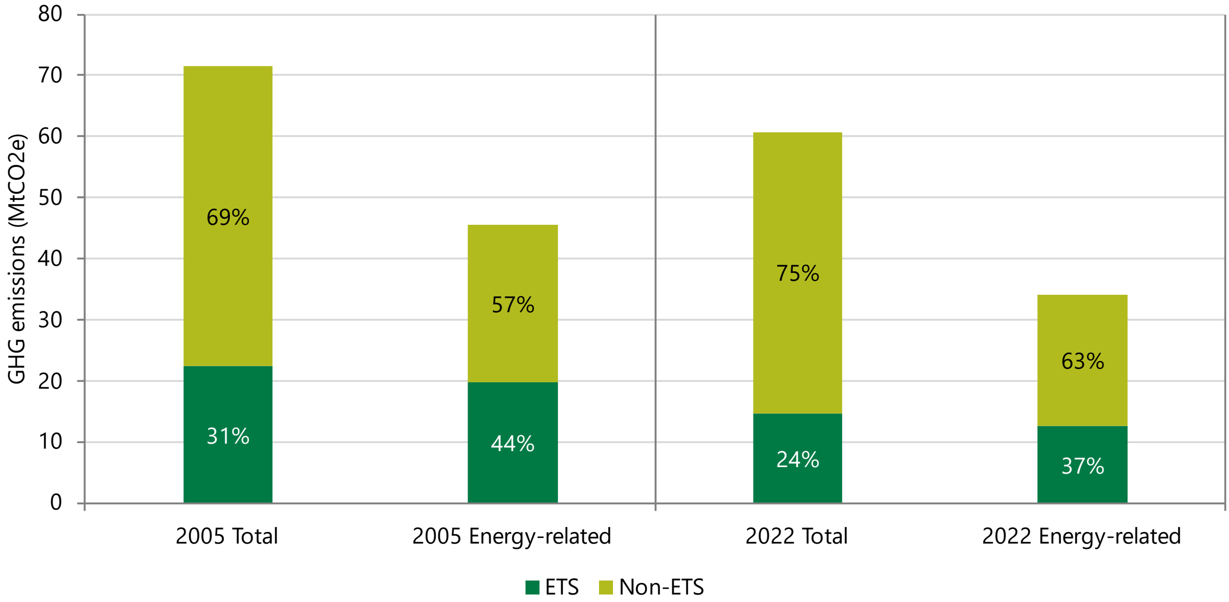
[9] Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement. Available from: https://eur-lex.europa.eu/eli/reg/2018/842.

[10] Commission Implementing Decision (EU) 2020/2126 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council. Available from: https://eur-lex.europa.eu/eli/dec_impl/2020/2126/oj

national annual emission allocations relative to the baseline year 2005, from a 9% reduction in 2021 to a 30% reduction in 2030.

Figure 8.2 compares Ireland's total and energy emissions, split between ETS and non-ETS sectors, for the baseline year (2005) and 2022.

**Figure 8.2: Energy-related and total GHG emissions in the ETS and non-ETS sectors for 2005 and 2022**

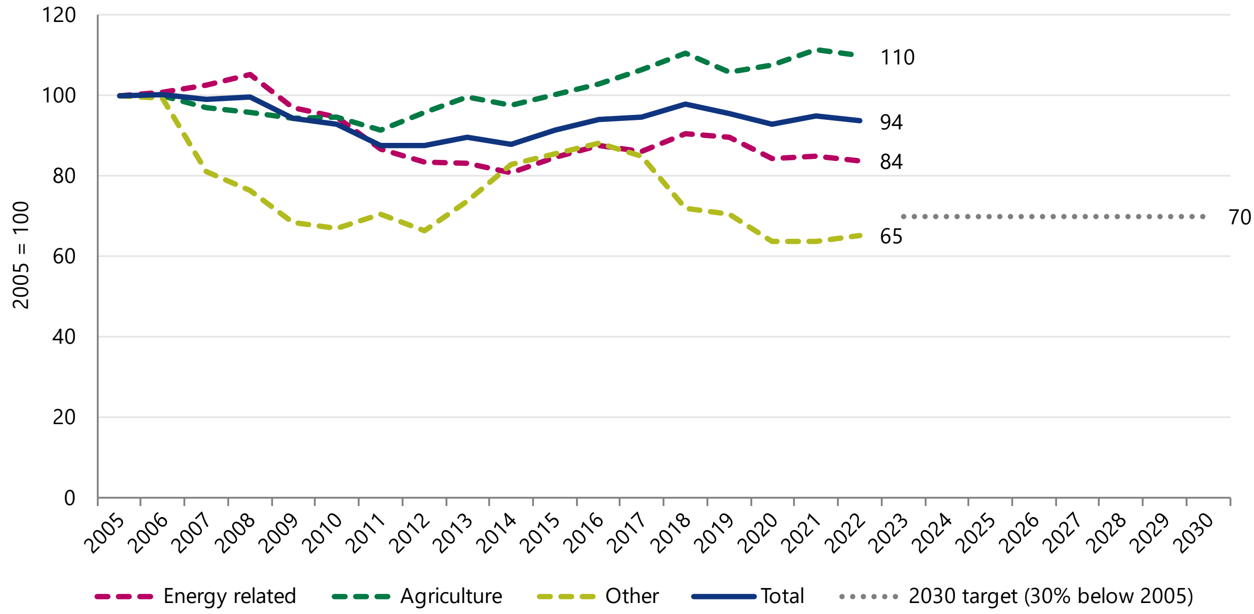



*Source: EPA and SEAI*

The non-ETS sector includes most greenhouse gas emissions in the residential, transport and services sectors. It also includes most non-energy-related emissions, notably from agriculture.

Figure 8.3 shows the trend in non-ETS emissions relative to 2005 for all non-ETS emissions, and also separately for energy related non-ETS emissions and agriculture non-ETS emissions. The data are from the EPA and are provisional for 2022.

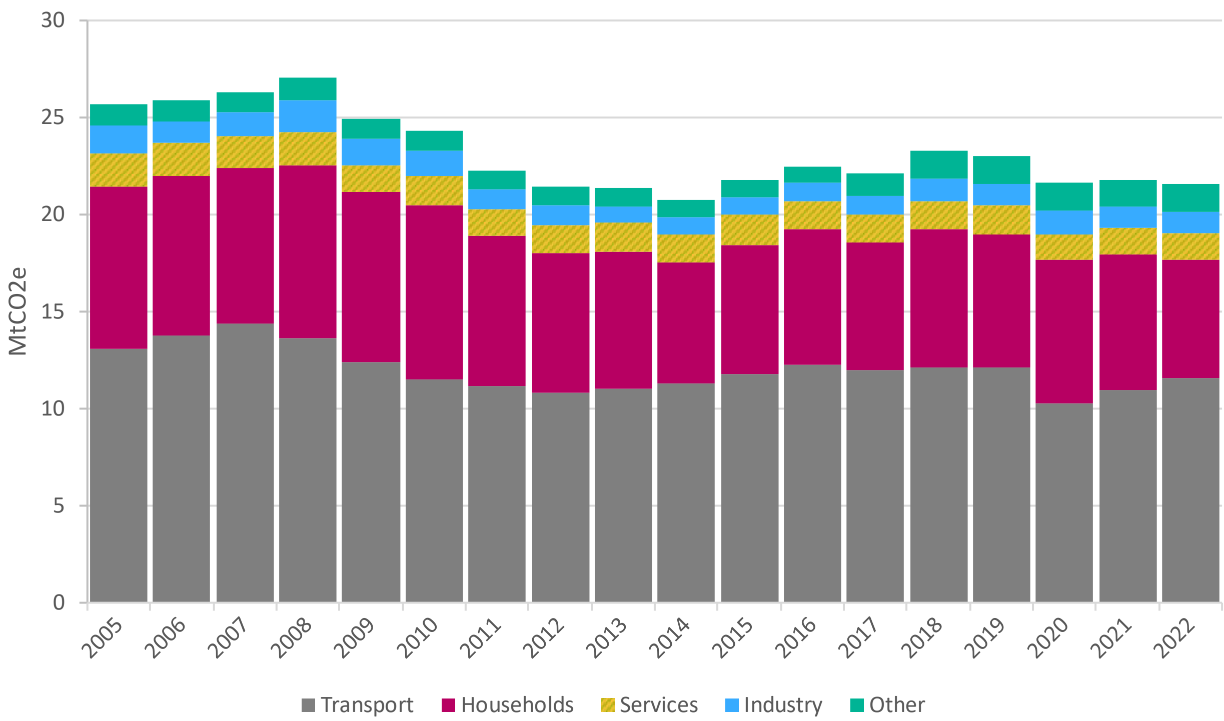
**Figure 8.3: Index of non-ETS greenhouse gas emissions relative to 2005**




*Source: data from EPA*

Figure 8.4 shows the trend in non-ETS energy-related greenhouse gas emissions split by sector.[11] Transport and households typically account for about 80% of energy-related non-ETS emissions.

**Figure 8.4: Energy-related non-ETS greenhouse gas emissions**

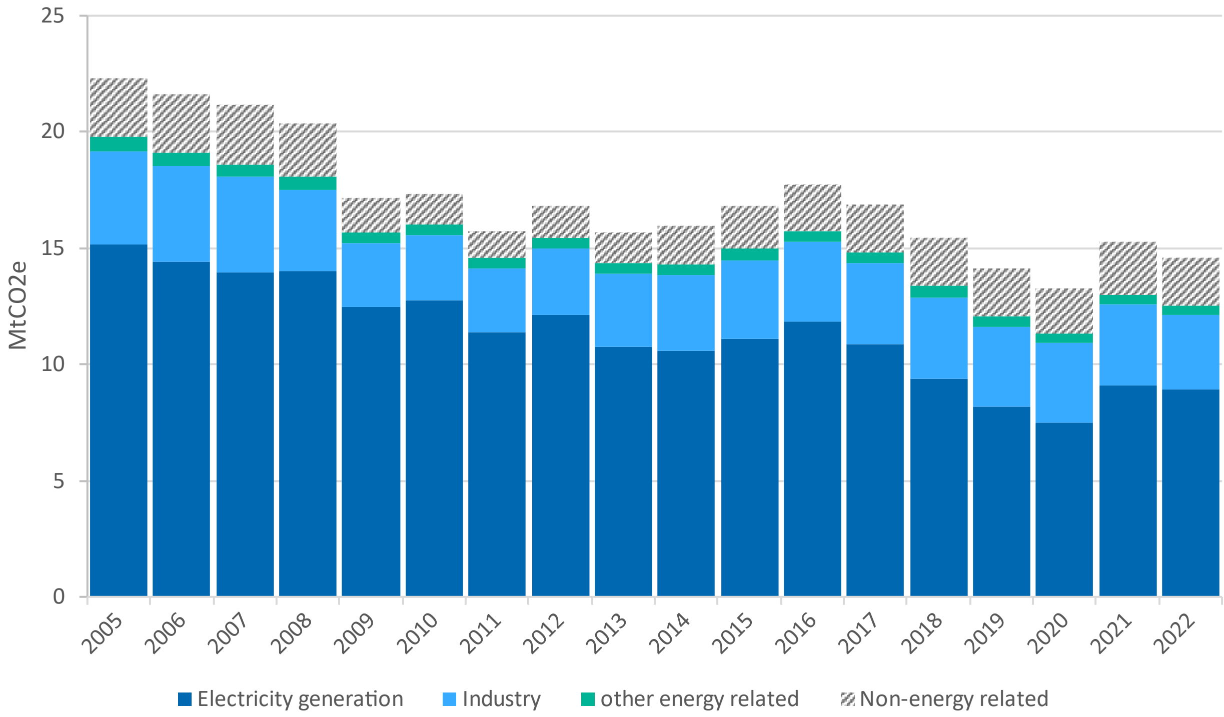



[11] This excludes emissions associated with electricity use by these sectors – emissions from electricity generation are included in the EU ETS. It also excludes international aviation and the activity of organisation in the industry and services sectors that are within the ETS.

*Source: data from EPA*

Figure 8.5 shows the trend in emissions from fossil fuel combustion from those installations included in the EU ETS in Ireland after 2005. Most of the ETS emissions in Ireland are from electricity generation, and this is also where most of the reduction in greenhouse gas emissions has occurred.

**Figure 8.5: EU ETS greenhouse gas emissions in Ireland (excluding international aviation)**




*Source: data from EPA*

**Table 8.1: Energy-related GHG emissions, ETS and non-ETS, compared with previous years**

| | Quantity ($MtCO_2e$) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Energy-related ETS | 12.61 | 13.08 | 13.44 | 15.46 | 20.8% | 21.1% | 21.1% | 25.8% | -3.6% | -6.1% | -18.4% |
| Non-energy related ETS | 2.07 | 2.26 | 2.09 | 1.39 | 3.4% | 3.6% | 3.3% | 2.3% | -8.4% | -1.2% | +48.6% |
| **Total ETS** | **14.68** | **15.34** | **15.54** | **16.85** | **24.2%** | **24.8%** | **24.4%** | **28.1%** | **-4.3%** | **-5.5%** | **-12.9%** |
| Energy-related non-ETS | 21.57 | 21.82 | 23.31 | 21.47 | 35.5% | 35.2% | 36.6% | 35.8% | -1.2% | -7.5% | +0.5% |
| Non-energy related non-ETS | 24.51 | 24.80 | 24.82 | 21.64 | 40.3% | 40.0% | 39.0% | 36.1% | -1.1% | -1.2% | +13.3% |
| **Total non-ETS** | **46.08** | **46.62** | **48.13** | **43.11** | **75.8%** | **75.2%** | **75.6%** | **71.9%** | **-1.2%** | **-4.3%** | **+6.9%** |
| **Total** | **60.76** | **61.95** | **63.67** | **59.96** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-1.9%** | **-4.6%** | **+1.3%** |

ETS is a 'cap and trade' system where an EU-wide limit or cap is set for participating installations. The cap is reduced over time so that total emissions fall. Within that limit, 'allowances' for emissions are auctioned or allocated for free (outside the power generation sector and depending on the nature of the installation). Individual operators must report the greenhouse gas emissions from their installations each year and surrender sufficient allowances to cover their emissions. If an operator exceeds its available allowances, it must purchase more. If an operator has reduced its emissions, it can sell its leftover allowances. The system is designed to bring about reductions in emissions at the lowest possible overall cost. The EPA is responsible for implementing the EU ETS in Ireland and administering the accounts on Ireland's domain in the Union Registry.

### 8.1.2 Carbon budgets and sectoral emission ceilings

The carbon budget represents the total amount of emissions, measured in tonnes of $CO_2$ equivalent ($CO_2e$), that Ireland may emit in different periods. The Climate Action and Low Carbon Development Act commits Ireland to a legally binding target of a 51% reduction in emissions by 2030, compared to 2018 levels. The carbon budget programme comprises three successive five-year carbon budgets, also legally binding:

- **295 $MtCO_2e$** between 2021-2025
- **200 $MtCO_2e$** between 2026-2030
- **151 $MtCO_2e$** between 2031-2035

In total, these budgets commit us to an average overall reduction in emissions of -4.8% per annum from 2021 to 2025, and -8.3% per annum from 2026 to 2030. Sectoral ceilings published in July 2022 set out the maximum amount of greenhouse gas emissions that are permitted in different sectors of the economy during a carbon budget period. Combined, the carbon budgets and sectoral ceilings tell us when and where we need to make the emission reductions to remain on track for our 2030 target.

In 2022, Ireland's energy-related emissions, excluding international aviation (34.2 $MtCO_2e$), accounted for 56.3% of Ireland's total greenhouse gas (GHG) emissions (60.8 $MtCO_2e$). This means SEAI's National Energy Balance is a critical input into the Environmental Protection Agency's (EPA) GHG inventory calculation for the formal calculation of emission results. Practically 100% of emissions from the electricity, transport, residential (buildings) and commercial (buildings) sectors are energy related; however, 65% of emissions from the industry sector and only about 3% of emissions from the agriculture sector are energy related. Most agriculture emissions are methane from livestock, and nitrous oxide from fertiliser and manure management.

Figure 8.6 summarises the sectoral ceilings within the first two carbon budgets, spanning 2021–2025 and 2026–2030. The five-year total $CO_2$e emissions permitted by the different sectors in each budget period (squares), and the annual 'indicative emissions' of each sector in the last year of a carbon budget (circles). The 'indicative emission' value for a sector is a guide to the maximum annual emissions expected from that sector at the end of the budget period, but it is not a binding target. For example, the transport sector is permitted to emit a total of 54 $MtCO_2$e in the five-year period between 2021 to 2025, with an indicative annual emission of 10 $MtCO_2$e in the 2025 calendar year.

**Figure 8.6: Sectoral ceilings first two carbon budgets, spanning 2021–2025 and 2026–2030**

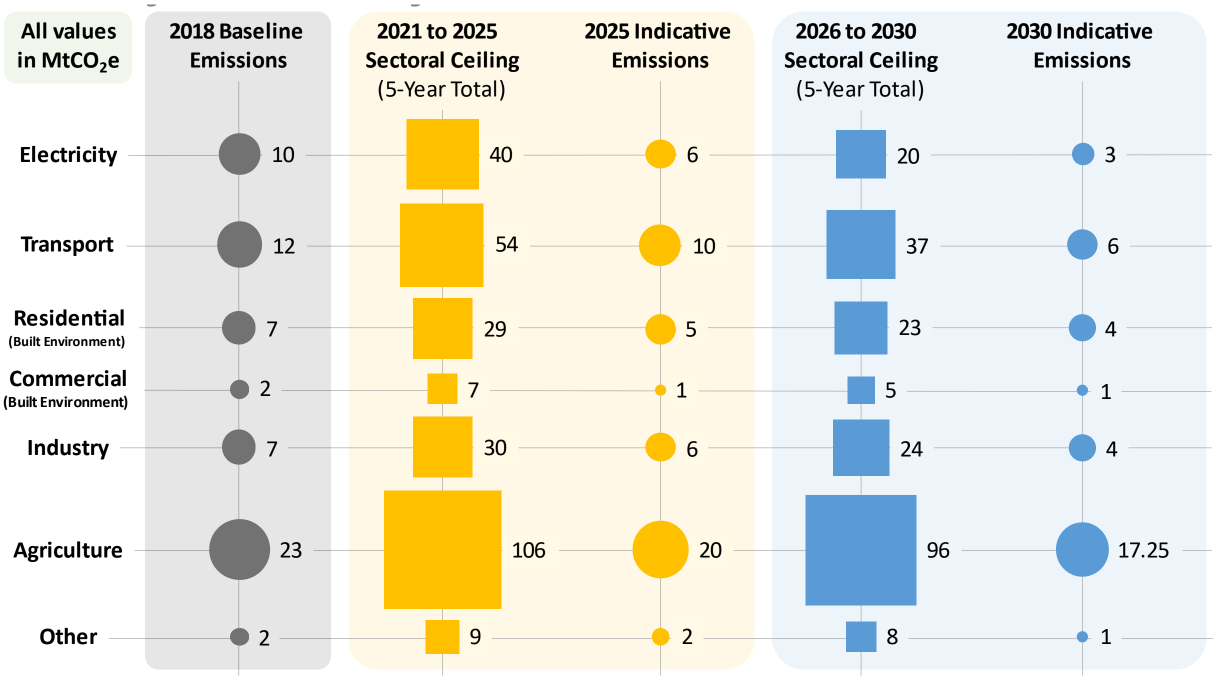
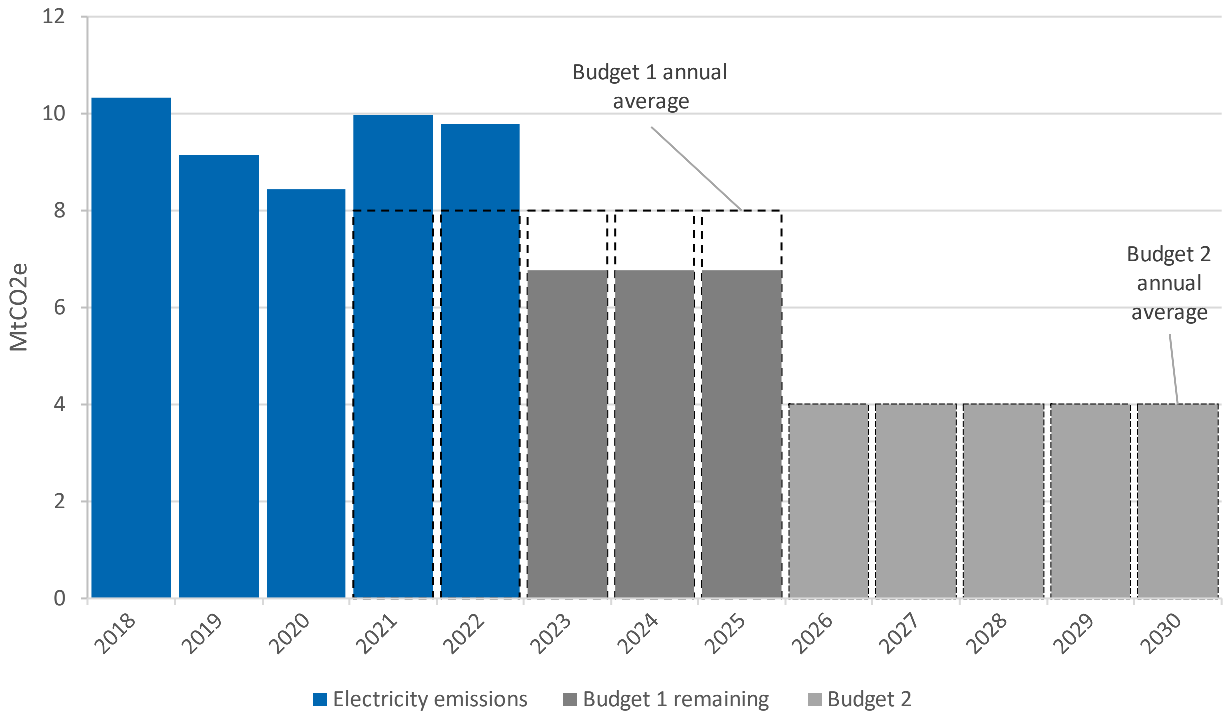



Figure 8.7 shows the emissions to the end of 2022 under the *electricity* sectoral emission ceiling, along with remaining budget for the 2021-2025 and 2026-2030 periods. The remaining budget amounts are represented as annual averages. The solid blue bars for 2021 and 2022 relate to GHG emissions emitted from the electricity sector. It is worth noting that the remaining budget values (grey bars) are not targets. They convey only the average annual emissions compatible with satisfying the sectoral emission ceiling. The policies and strategies for reducing emissions in different sectors may be back-loaded to the end of the carbon budgets.

The 2021-2025 ceiling for emissions from the electricity sector is 40 $MtCO_2$e in total, or 8 $MtCO_2$e as an annual average (denoted by the dotted bars). Over the first two years of the budget period, the total sectoral emissions were 19.74 $MtCO_2$e, meaning that remaining budget is 20.26 $MtCO_2$e for 2023-2025, or 6.75 $MtCO_2$e as an annual average (denoted by the dark grey bars).

**Figure 8.7: Carbon budget sectoral emissions for electricity ($MtCO_2e$)**

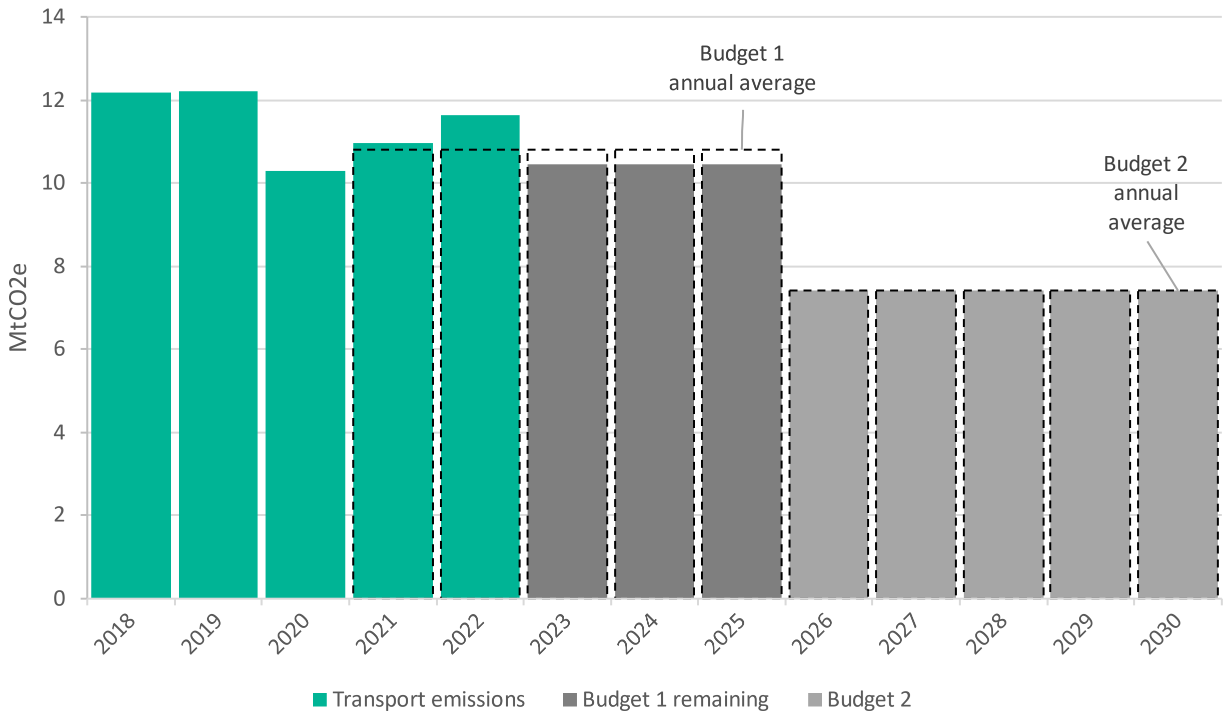



*Source: emission data from EPA's GHG Provisional Emissions 1990-2022*

Figure 8.8 shows the emissions to the end of 2022 under the *transport* sectoral emission ceiling, along with remaining budget for the 2021-2025 and 2026-2030 periods. The remaining budget amounts are represented as annual averages. The solid green bars for 2021 and 2022 relate to GHG emissions emitted from the transport sector. It is worth noting that the remaining budget values (grey bars) are not targets. They convey only the average annual emissions compatible with satisfying the sectoral emission ceiling. The policies and strategies for reducing emissions in different sectors may be back-loaded to the end of the carbon budgets.

The 2021-2025 ceiling for emissions from the transport sector is 54 $MtCO_2e$ in total, or 10.8 $MtCO_2e$ as an annual average (denoted by the dotted bars). Over the first two years of the budget period, the total sectoral emissions were 22.61 $MtCO_2e$, meaning that remaining budget is 31.39 $MtCO_2e$ for 2023-2025, or 10.46 $MtCO_2e$ as an annual average (denoted by the dark grey bars).

**Figure 8.8: Sectoral emissions for transport ($MtCO_2e$)**




*Source: emission data from EPA's GHG Provisional Emissions 1990-2022*

## 8.2 Renewable energy targets

### 8.2.1 Renewable Energy Directive and targets

The first Renewable Energy Directive (RED)[12] was the most important legislation influencing the growth of renewable energy in the EU and Ireland for the decade ending in 2020. From 2021, RED was replaced by the second (or recast) Renewable Energy Directive (REDII),[13] which continues to promote the growth of renewable energy out to 2030. RED set out two mandatory targets for renewable energy in Ireland to be met by 2020, while REDII sets new targets and criteria to be met by Ireland in 2030 and the interim. Under the European Green Deal and REPowerEU plan, a significant revision[14] to REDII was finalised during 2023 and entered into force on 20 November 2023 (referred to as REDIII). REDIII sets more ambitious targets for 2030 and requires Member States to take additional measures to promote the use of renewable energy.

The first target relates to overall renewable energy share (RES) and is commonly referred to as the overall RES target. For Ireland, the overall RES target was for at least 16% of gross final energy consumption (GFC)[15] to come from renewable sources in 2020. Ireland's actual overall RES in 2020 was 13.5%, meaning that Ireland was obligated to acquire statistical transfers of 3.3 TWh of renewable energy from other Member States to compensate for this shortfall.

---

[12] Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Available from: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0028

[13] Directive (EU) 2018/2001 on the promotion of the use of energy from renewable resources (recast). Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L2001

[14] Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023L2413

[15] Total primary energy requirement is a measure of all energy inputs, including energy that is lost during transformation before it is used by the final customer. Total final consumption (TFC) is a measure of the energy used by final customers only, that is excluding the losses from transformation. Gross final consumption of energy is an alternative to TFC and is the denominator used by the EU to track progress towards the targets in the RED.

REDII introduced a binding EU-wide target for overall RES of 32% in 2030 and requires Member States to set their national contributions to the EU-wide target. As per the National Energy and Climate Plant (NECP) 2021-2030,[16] Ireland's overall RES target is 34.1% in 2030.

REDIII increased the binding EU-wide target for overall RES to at least 42.5%. Ireland will set its national contributions to this target in its revised NECP.

The second mandatory target set by the RED related to the renewable energy share in transport sector.[17] This is commonly referred to as the RES-T target. The 2020 RES-T target was for at least 10% of energy consumed in road and rail transport to come from renewable sources. The actual RES-T achieved in 2020 was 10.2%, meaning that Ireland did meet this target. REDII sets a new RES-T target of 14% by 2030.

RED III has increased the 2030 RES-T target to 29%, on an energy basis, or a target to reduce the greenhouse gas intensity of energy in transport by 14.5%. RED III also slightly changes the scope of the RES-T to include additional forms of transport.

Besides these EU mandatory targets, Ireland had two further national renewable energy targets for 2020. These were for the electricity and heat sectors and were designed to help Ireland meet the overall RES target.

The renewable electricity target is commonly referred to as the RES-E target. The RES-E target was for 40% of gross electricity consumption to come from renewable sources in 2020 The actual RES-E achieved in 2020 was 39.1%, falling just short of the national target. Nevertheless, the development of renewable electricity was a major success in Ireland since 2005. Ireland's NECP 2021-2030 includes a planned RES-E of 70% in 2030, which will ensure that renewable electricity continues to form the backbone of our renewable energy use for the coming decade and beyond. Ireland's Climate Action Plan 2023 (CAP 23) includes a target to increase the share of electricity generated from renewable sources up to 80% in 2030.[18]

The renewable heat target is commonly referred to as the RES-H target. For 2020, the RES-H target was for 12% of energy used for heating and cooling to come from renewable sources. The actual RES-H achieved in 2020 was 6.3%, falling well short of the national target. The lack of progress in RES-H was the main reason for failing to meet the overall RES target in 2020. The NECP 2021 shows a planned RES-H of 24% in 2030. Although REDII does not specify a target for RES-H, the directive requires Ireland to "endeavour to increase" the RES-H by an indicative 1.1 percentage points as an annual average calculated for the periods 2021–2025 and 2026–2030.

### 8.2.2 Biomass sustainability

Besides specifying new EU and national renewable energy targets, REDII also introduced new sustainability and verification criteria for biomass fuels (solid and gaseous) from the beginning of 2021. Introducing these criteria led to circumstances where a portion of the biomass fuel consumed in Ireland in 2021 and 2022 could not be counted in the national renewable shares, specifically the overall RES, RES-E and RES-H.

From the beginning of 2021, biomass fuel consumed in installations, above certain sizes, must fulfil various sustainability[19] and greenhouse gas saving criteria to be counted towards national renewable energy targets, or be eligible for financial supports. In addition, the biomass fuel must be subject to a verification procedure requiring economic operators to demonstrate that the sustainability and greenhouse gas saving criteria, as laid out in the directive, have been fulfilled. Verification must require economic operators to, among other things, maintain sustainability records of all consignments of biomass, applying a mass balance, and arrange for independent auditing of all information submitted to the competent authority.

[16] Ireland's National Energy and Climate Plan 2021-2030. Available from: https://www.gov.ie/en/publication/0015c-irelands-national-energy-climate-plan-2021-2030/?adlt=strict
[17] In the context of RED and REDII, consumption in the transport sector relates only to energy in road and rail; however, renewable energy consumed in aviation and marine can contribute towards the RES-T.
[18] Climate Action Plan 2023. Available from: https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/
[19] 'Sustainability', in the context of biomass under REDII, relates to: soil monitoring and management; protection of land with high biodiversity; protection of land with high carbon stock; protection of peatland; sustainable forest production; and land-use, land-use change and forestry (LULUCF).

Legislation[20] was introduced in July 2022 to transpose the biomass sustainability and verification requirements of REDII into Irish law. While a system of verification commenced in 2023 for operators of biomass installations under support schemes, no verification system was in place during 2021 or 2022. Consequently, any biomass consumed during 2021 or 2022 that was required to meet the sustainability criteria and undergo verification could not be included in the overall RES, RES-E and RES-H. In total, this amounted to approximately 8% of Ireland's 2021 and 2022 renewable final energy that could not be counted towards the RES.

Only biomass fuel consumed in an installation with a rated thermal output above one of the following thresholds is required to meet the sustainability criteria:

- Equal to or exceeding 20 MW for solid biomass fuels; or
- Equal to or exceeding 2 MW for gaseous biomass fuels.

Biomass fuels consumed in smaller installations are not required to meet the sustainability and verification criteria to be counted towards the renewable energy targets. Biomass, such as wood, consumed in the residential sector and in many smaller commercial/industrial boilers can be included the RES.

Where biomass fuel cannot be included in the RES calculations, due to the absence of verification, it still contributed to decarbonisation by displacing fossil fuel and reducing greenhouse gas emissions under EU ETS and Ireland's national emissions allocations.

### 8.2.3 Overall renewable energy share

Table 8.2 shows the RES for the individual modes, and overall, for 2022. It also shows the progress at a selection of previous years for reference.

**Table 8.2: Ireland's progress towards overall renewable energy share (RES) targets**

| | 2020 | 2021 | 2022 | 2030 Target |
|---|---|---|---|---|
| RES-E | 39.0% | 36.4% | 36.8% | 80%[21] |
| RES-T | 10.1% | 4.4% | 5.5% | 14% (RED II) / 29% (RED III) |
| RES-H | 6.3% | 4.9% | 6.3% | 24%[22] |
| **Overall RES** | **13.5%** | **12.5%** | **13.1%** | **34.1%** |

Figure 8.9 shows the current split of renewable energy between the three modes. Figure 8.10 shows the contribution of renewable electricity, heat and transport to the overall RES target. Renewable electricity makes the largest contribution to the overall RES and has been responsible for most of the overall growth in renewable energy since 2005. The figure includes the share of heat and electricity generated by biomass fuels that required verification of sustainability under REDII and, consequently, could not be included in Ireland's 2022 RES (see section 8.2.2 for further details).

[20] SI No. 350 of 2022 European Union (Renewable Energy) Regulations (2) 2022. Available from: https://www.irishstatutebook.ie/eli/2022/si/350/

[21] As stated in the Climate Action Plant 2023

[22] This is the planned RES-H set out in Ireland's National Energy and Climate Plan (NECP) 2021-2030.

**Figure 8.9: Current share of renewable energy by mode**

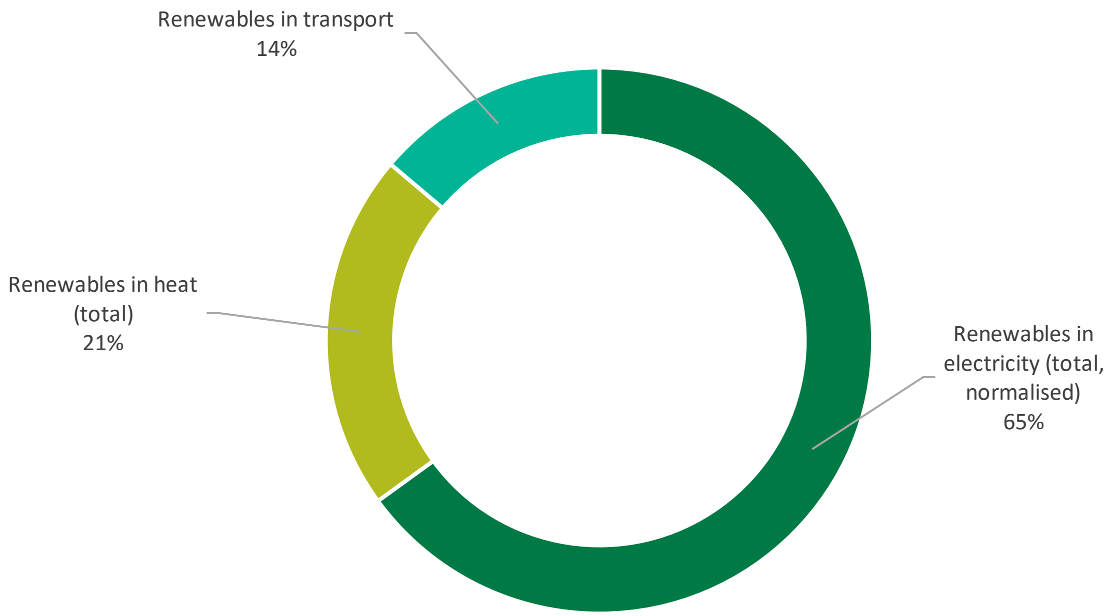



**Figure 8.10: Renewable energy share (overall RES) with contribution by mode**

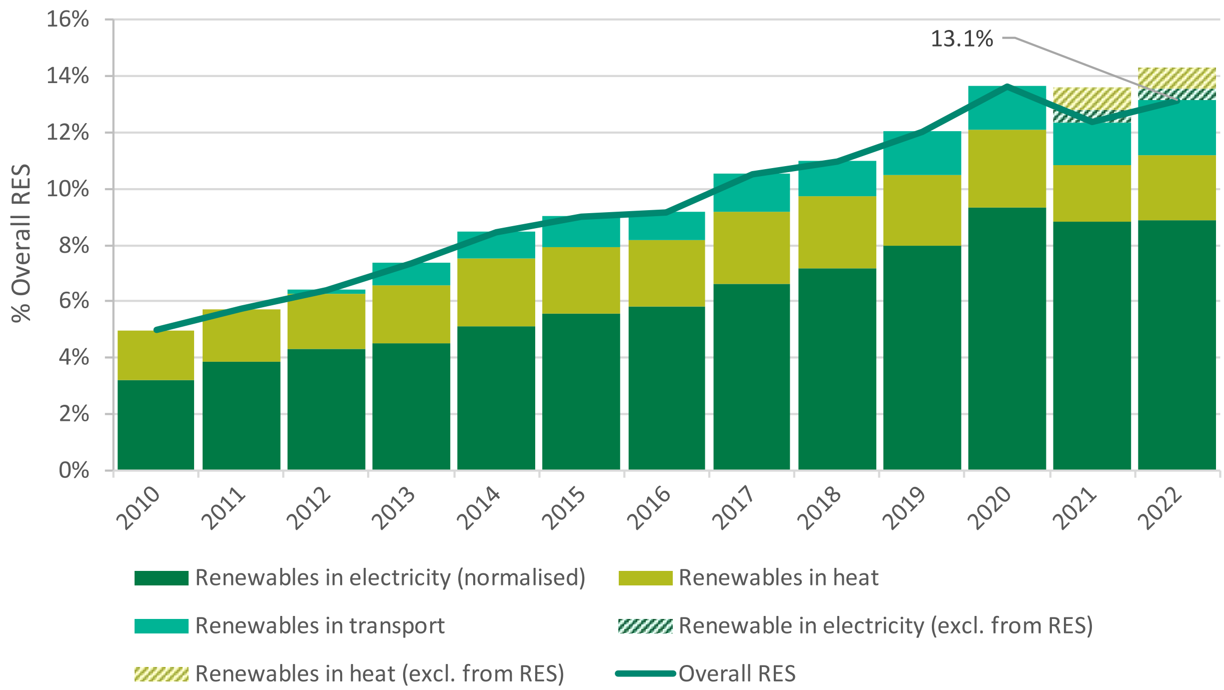



Figure 8.11 shows the overall RES from 2010 to 2022 along with Ireland's current 2030 target of 34.1%. The figure also includes the projected trajectory set out in Ireland's NECP, the indicative trajectory as per EU legislation[23].

[23] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action. Available from: http://data.europa.eu/eli/reg/2018/1999/oj

In November 2023, RED III amended the EU-wide overall 2030 RES target from 32% to at least 42.5%. It is likely that Ireland's 2030 RES target will increase accordingly.

**Figure 8.11: Renewable energy share (overall RES) and trajectories to 2030 targets**

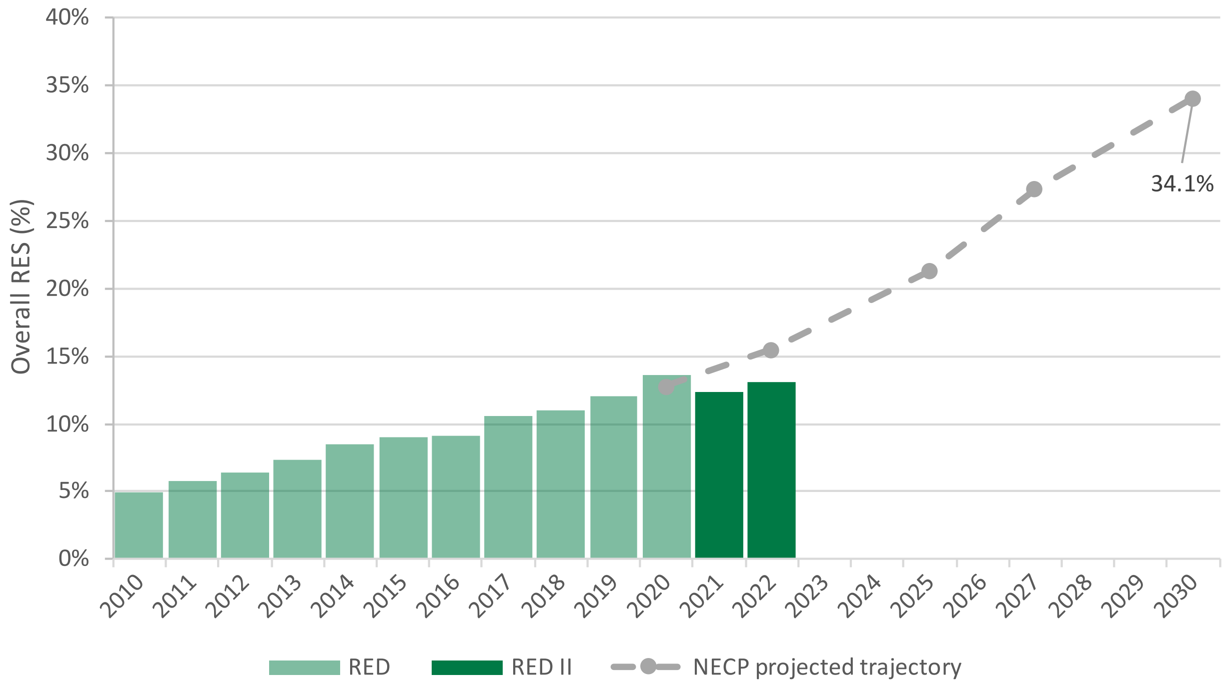



Figure 8.12 illustrates the total GFC in each mode according to the RED II calculation, and the portion of each mode that comes from renewable sources. This gives important context to the separate heat, transport and electricity targets. Although electricity has the highest share of renewable energy, it is the smallest of the modes in terms of GFC. The heat mode makes up the largest share of GFC, follow by transport, which has the smallest renewable share.

**Figure 8.12: Renewable and fossil gross final energy consumption by mode**

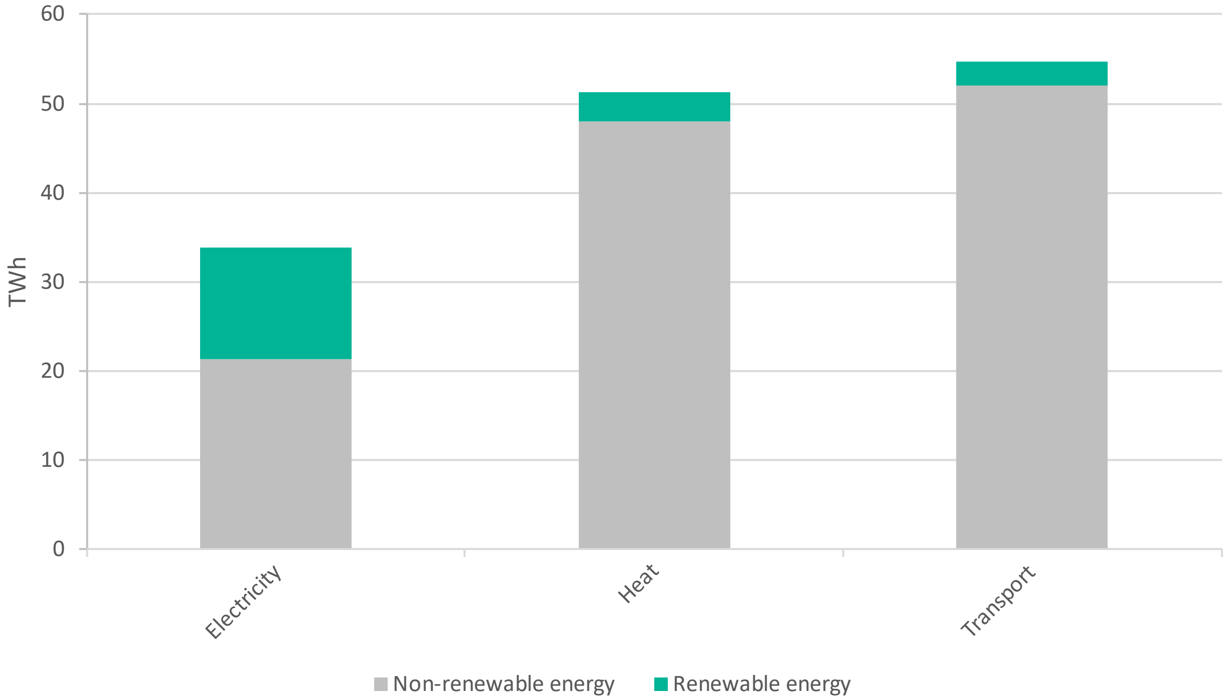



Figure 8.13 and Table 8.3 show the share and quantity of renewable energy used each year, split by source. Most of the growth in renewable energy has come from wind. Wind provides more than half of all renewable energy. Solid biomass and bioliquids were the next largest sources of growth. Bioenergy, including solid biomass, renewable wastes, landfill gas, biogas and bioliquids, collectively accounted for approximately one-third of Ireland's renewable energy.

Figure 8.13 also shows the share of biomass and biogas that was that was excluded from the 2021 and 2022 RES figures as verification of sustainability was outstanding, see section 8.2.2 for further details. In 2022 this amounted to 1,446 GWh of the final energy from biomass & renewable waste and 184 GWh of the final energy of biogas & landfill gas as shown in Table 8.3.

**Figure 8.13: Renewable energy share of gross final consumption by source**

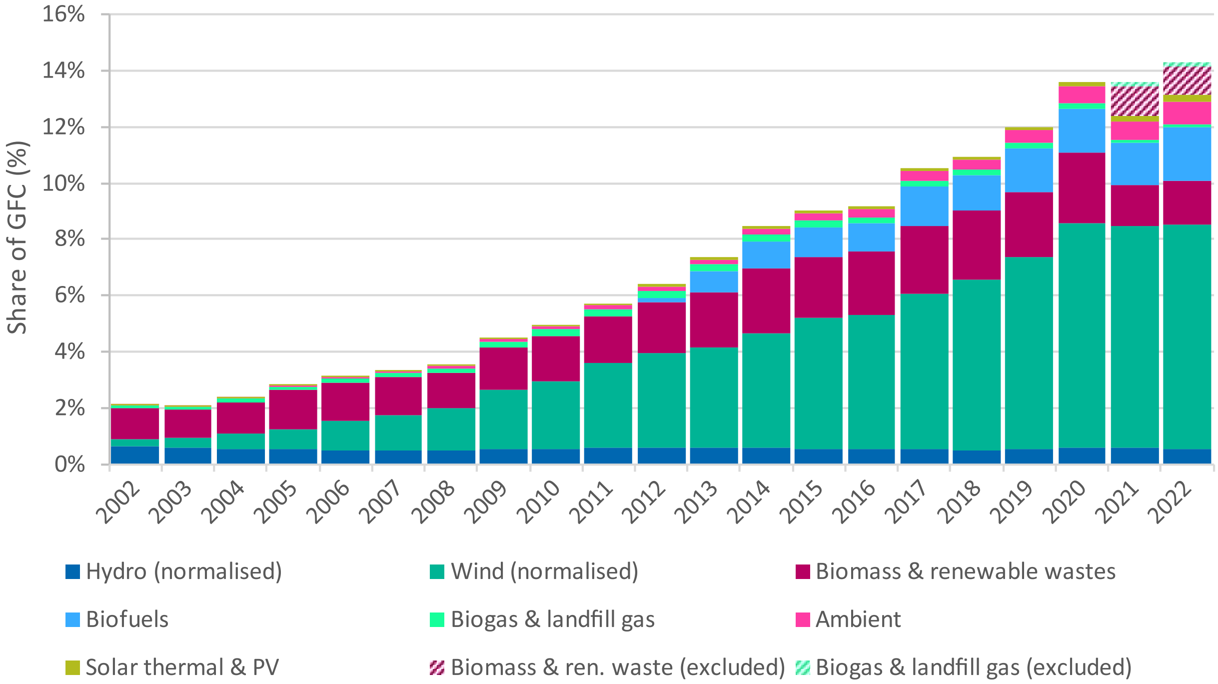


**Table 8.3: Renewable energy contribution to gross final consumption by source**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Hydro (normalised) | 0.76 | 0.76 | 0.72 | 0.76 | 3.8% | 4.1% | 4.6% | 9.3% | +0.2% | +5.5% | +0.6% |
| Wind (normalised) | 11.15 | 10.79 | 8.69 | 4.26 | 55.8% | 58.1% | 55.4% | 52.3% | +3.3% | +28.3% | +161.5% |
| Biomass & renewable wastes | 2.16 | 1.98 | 3.48 | 2.30 | 10.8% | 10.6% | 22.2% | 28.3% | +9.1% | -38.1% | -6.4% |
| Liquid biofuels | 2.68 | 2.11 | 1.80 | 0.19 | 13.4% | 11.4% | 11.5% | 2.4% | +27.1% | +48.7% | +1,285.8% |
| Biogas & landfill gas | 0.13 | 0.09 | 0.30 | 0.30 | 0.7% | 0.5% | 1.9% | 3.7% | +51.0% | -56.0% | -56.2% |
| Ambient | 1.17 | 0.92 | 0.51 | 0.22 | 5.8% | 5.0% | 3.3% | 2.7% | +26.8% | +127.9% | +434.9% |
| Solar thermal & PV | 0.31 | 0.24 | 0.18 | 0.11 | 1.6% | 1.3% | 1.1% | 1.3% | +28.4% | +77.4% | +184.4% |
| **Total included in RES** | **18.36** | **16.89** | **15.69** | **8.15** | **91.8%** | **91.0%** | **100.0%** | **100.0%** | **+8.7%** | **+17.0%** | **+125.4%** |
| Biomass & ren. waste (excluded) | 1.45 | 1.44 | 0 | 0 | 7.2% | 7.8% | 0% | 0% | +0.3% | - | - |
| Biogas & landfill gas (excluded) | 0.18 | 0.23 | 0 | 0 | 0.9% | 1.2% | 0% | 0% | -20.1% | - | - |
| **Total renewable energy in GFC** | **19.99** | **18.56** | **15.69** | **8.15** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+7.7%** | **+27.4%** | **+145.4%** |

### 8.2.4 Transport energy from renewable sources (RES-T)

REDI established a mandatory minimum target for the share of renewable energy sources in transport (RES-T) by 2020: 10% of all petrol, diesel, biofuels and electricity consumed in road and rail transport. Ireland exceeded this target reaching 10.2% RES-T in 2020. REDII requires Ireland, along with all Member States, to set an obligation on fuel suppliers to ensure that the share of renewable energy within the final consumption of energy in transport is at least 14% by 2030.

It should be noted that renewable energy consumed in any mode of transport contributes towards the RES-T, but that only energy consumed in *road & rail* is counted in the denominator:

$$\text{RES\_T} = \frac{\text{Final consumption of renewable energy in all transport}}{\text{Final consumption of energy in road \& rail}}$$

The only fossil fuels counted in the denominator are petrol, diesel and natural gas; the relatively small quantity of fossil LPG consumed in road transport is not included in RES-T denominator, but is included in the overall RES.

REDII, as with REDI before it, specifies several weightings or multipliers that are applied to certain fuels or energy for the calculation of RES-T. These weightings help to incentivise the use of advanced biofuels and biofuels from wastes over crop-based fuels, generally promoting those with lower life-cycle greenhouse gas intensities. Table 8.4 sets out the current multipliers under REDII and how they have changed from those used for REDI. More than 85% of the biofuel used in Ireland is produced from feedstocks listed in Annex IX of REDII, including used cooking oil (UCO) and tallow (category 1 & 2), and consequently count twice towards the RES-T target.

These multipliers do not apply to the overall RES. Prior to the transition to REDII, there was a significant difference between the RES-T value and the share of renewable energy in transport, as a component of the overall RES.

**Table 8.4: Change in multipliers used in the calculation of RES-T**

| | REDI | REDII |
|---|---|---|
| Biofuels from Annex IX feedstocks | 2× (numerator only) | 2× (numerator & denominator) |
| Renewable electricity in road | 5× (numerator only) | 4 × (numerator & denominator) |
| Renewable electricity in rail | 2.5 × (numerator & denominator) | 1.5 × (numerator & denominator) |
| Aviation & maritime fuels (excl. fuels from food & feed crops) | - | 1.2 × (numerator) |

In addition to the change in multipliers used in the RES-T calculation, REDII also includes three limits on biomass fuels produced from certain feedstocks, see Table 8.5. These limits are defined as percentages of energy consumed in transport. Although two of these limits can technically apply to bioliquids or biomass fuels consumed outside of the transport sector, they are currently only relevant to fuels used in the transport sector.

The first limit relates to the share of used cooking oil (UCO) and animal fat (tallow) category 1 & 2 and is the most consequential change to the calculation of Ireland's RES-T arising from the transition to REDII. UCO and tallow (cat. 1 & 2) accounted for 4.6% of final energy consumption in transport in 2022; under REDII, this biofuel is limited to 1.7% of transport energy for the purposes of RES-T. In 2022, approximately half of the biofuel consumed in Ireland (before application of multipliers) cannot be counted towards RES-T due to this limit.

The second limit relates to fuels produced from food and feed crops (*e.g.* bioethanol from maize, biodiesel from sunflower). Biofuels from food and feed crops only constituted 0.1% of final consumption of energy in transport in 2022, well below the limit of 2%.

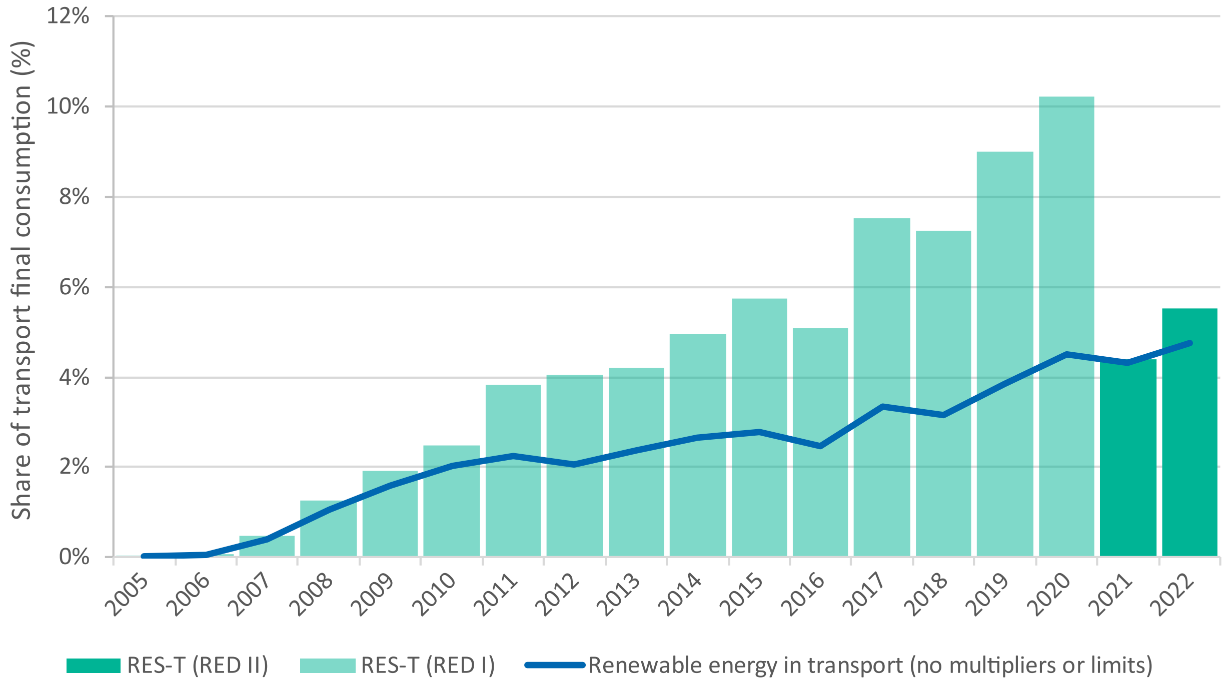
The third limit applies to biofuels (as well as to bioliquids and biomass fuels) produced from crops with a 'high indirect land-use change risk' (high ILUC risk), specifically fuels produced from palm oil. The limit is based on the share of high ILUC risk biofuels in Ireland in 2019, *i.e.* 0.028%. The share in 2022 was 0.025%, *i.e.* below the limit.

**Table 8.5: Limits on biofuels from certain feedstocks**

| Feedstocks | Fuel type | Scope | Limit | 2022 share |
|---|---|---|---|---|
| Used cooking oil (UCO) and animal fat (tallow cat. 1 & 2) | • Biofuels<br>• Biogas | RES-T only | 1.7% of transport energy | **4.6%** |
| Food and feed crops | • Biofuels<br>• Bioliquids<br>• Biomass fuels in transport | Overall RES & RES-T | 2% of transport energy | 0.1% |
| High ILUC-risk food & feed crops | • Biofuels<br>• Bioliquids<br>• Biomass fuels | Overall RES & RES-T | 0.028% of transport energy | 0.025% |

Figure 8.14 shows the annual RES-T from 2005 to present and the share of renewable energy in transport, as it contributes to the overall RES. The RES-T decreased from 10.2% in 2020 to 4.4% in 2021 – 5.6 percentage points of the decrease is due to the change in calculation methodology between REDI and REDII. The RES-T increased to 5.5% in 2022. The share of renewable energy in transport, without multipliers or limits, increased from 4.3% in 2021 to 4.8% in 2022.

**Figure 8.14: Renewable energy share of gross final consumption in transport**




In 2010, a Biofuel Obligation Scheme[24] (now called the Renewable Transport Fuel Obligation or RTFO) was established which required fuel suppliers to include, on average, 4% biofuel by volume (equivalent to approximately 3% in energy terms) in their annual sales. The Biofuel Obligation Scheme is a certificate-based scheme that granted one certificate for each litre of biofuel placed on the market in Ireland; two certificates were granted to biofuel that was produced from wastes and residues. The scheme now operates on an energy basis instead of volume. Oil companies are required to apply to NORA for certificates and to demonstrate that the quantities of biofuel for which they are claiming certificates are accurate. Since the Sustainability Regulations (SI 33 of 2012) were introduced, companies are also required to demonstrate that the biofuel being placed on the market is sustainable, fulfilling the requirements of the RED. Biofuel that is not deemed to be sustainable will not be awarded certificates and cannot be counted towards the biofuel obligation. The obligation was subsequently increased, on a volume basis, to:

- 6% in 2013;
- 8% in 2017;
- 10% in 2019;
- 11% in 2020; and
- 13% in 2022.

In January 2023, the scheme changed from a volume basis to an energy basis one and increased to 16.985% (by energy).

[24] See National Oil Reserves Agency's (NORA) website for more details: https://www.nora.ie/

Figure 8.15 and Table 8.6 show the renewable energy used in transport in absolute terms, without multipliers or limits applied. Biofuels provide almost all of the renewable energy in transport, 96.6% in 2022, with renewable electricity providing 3.4% and biomethane (also referred to as bio compressed natural gas) contributing 0.4%. While renewable electricity in private cars still constitutes a small share of the total, it has seen significant percentage growth in the last 5 years. A small quantity, 9 GWh, of bio jet kerosene (aviation biofuel) was used in Ireland for the first time in 2022.

**Figure 8.15: Renewable energy in transport by source (without multipliers)**

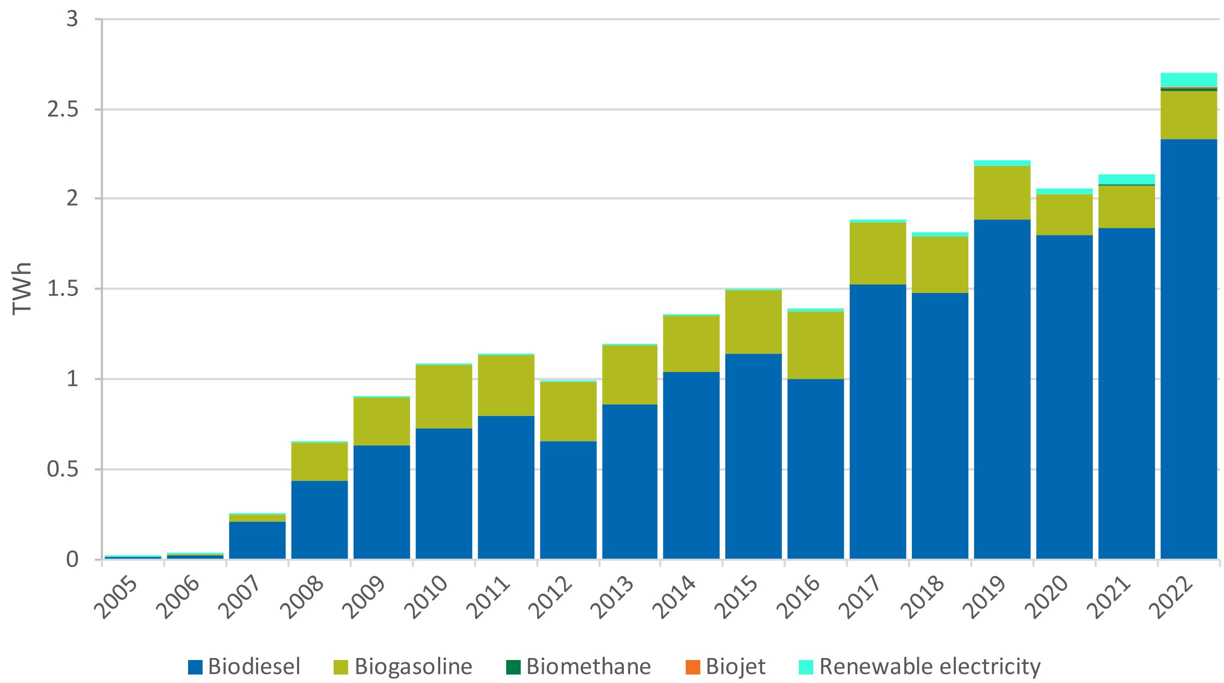



**Table 8.6: Renewable energy for transport by source (without multipliers)**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Biodiesel | 2.331 | 1.838 | 1.477 | 0.654 | 86.2% | 86.2% | 81.5% | 65.8% | +26.9% | +57.9% | +256.2% |
| Biogasoline | 0.271 | 0.236 | 0.317 | 0.333 | 10.0% | 11.1% | 17.5% | 33.4% | +14.6% | -14.6% | -18.6% |
| Renewable electricity | 0.081 | 0.054 | 0.018 | 0.007 | 3.0% | 2.5% | 1.0% | 0.7% | +49.0% | +353.3% | +1,035% |
| Biojet | 0.009 | 0.0 | 0.0 | 0.0 | 0.3% | 0% | 0% | 0% | - | - | - |
| Biomethane | 0.011 | 0.005 | 0.0 | 0.0 | 0.4% | 0.2% | 0% | 0% | +141.7% | - | - |
| **Total** | **2.703** | **2.133** | **1.812** | **0.994** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+26.7%** | **+49.2%** | **+171.9%** |

### 8.2.5 Electricity from renewable energy sources (RES-E)

Ireland has no mandatory national target for RES-E for 2030, nor was there one for 2020, but RES-E forms the backbone of Ireland's strategy to achieve the overall renewable energy target for 2030. Ireland's National Energy and Climate Plant (NECP 2021-2030) includes a planned RES-E of 70% in 2030, while Ireland's Climate Action Plan 2023 (CAP 23) includes a target to increase the share of electricity generated from renewable sources up to 80% by 2030.

The Government set an ambitious national target for RES-E of 40% for 2020. Ireland fell just short of this target, achieving 39.1% RES-E in 2020, but despite this, electricity generation has been the most successful of the three modes for the development of energy from renewable sources. Renewable energy (when aggregated) is now the second largest source of electricity after natural gas.

The share of electricity from renewable energy increased fivefold between 2005 and 2020 and there was a sevenfold increase in the annual quantity of renewable electricity generated.

Figure 8.16 and Table 8.7 show renewable energy share in electricity (RES-E) by source. RES-E decreased from 39.1% in 2020 to 36.4% in 2021 and, in 2022, increased by 0.4 percentage points to reach 36.8%.

In 2022, 627 GWh of the electricity that was generated from biomass fuels (*i.e.* biomass, landfill gas and biogas) could not be counted towards the RES-E and overall RES, as it was not verified as sustainable under RED II, see section 8.2.2 for further details.

**Figure 8.16: Share of gross final consumption of electricity from renewable sources (RES-E)**

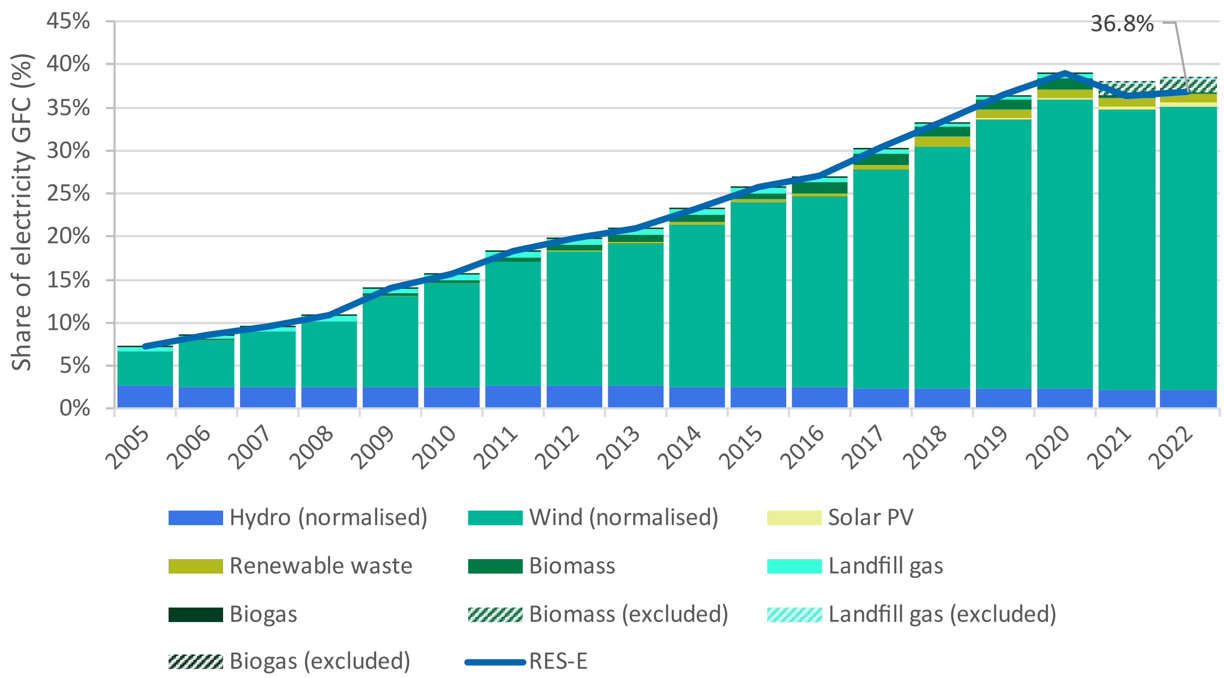


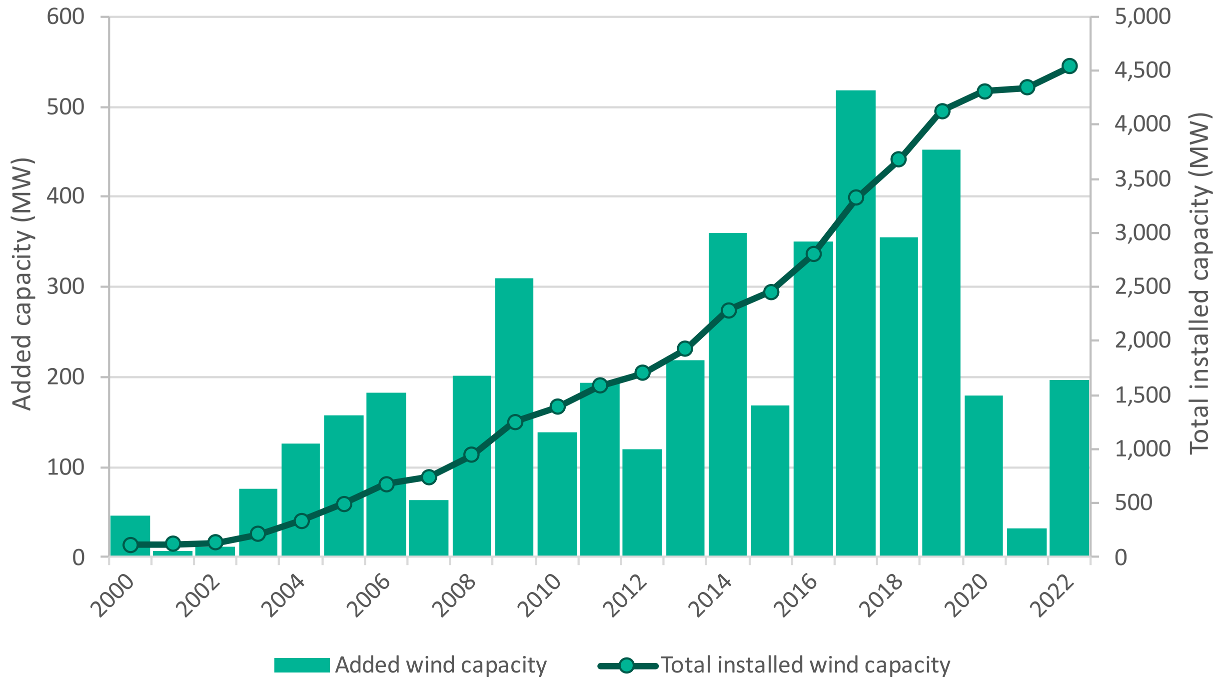
**Table 8.7: Electricity generated from renewable sources by energy type**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Hydro (normalised) | 0.76 | 0.76 | 0.72 | 0.76 | 5.8% | 6.0% | 7.0% | 13.9% | +0.2% | +5.5% | +0.6% |
| Wind (normalised) | 11.15 | 10.79 | 8.69 | 4.26 | 85.3% | 85.5% | 84.5% | 78.0% | +3.3% | +28.3% | +161.5% |
| Solar PV | 0.15 | 0.08 | 0.02 | 0.00 | 1.1% | 0.6% | 0.2% | 0.0% | +85.8% | +713.6% | +22,863% |
| Renewable waste | 0.35 | 0.35 | 0.33 | 0.07 | 2.7% | 2.8% | 3.2% | 1.2% | -1.3% | +5.0% | +420.0% |
| Biomass | 0.02 | 0.02 | 0.33 | 0.18 | 0.2% | 0.2% | 3.2% | 3.3% | +2.4% | -93.5% | -87.9% |
| Landfill gas | 0.01 | 0.03 | 0.14 | 0.17 | 0.0% | 0.3% | 1.4% | 3.2% | -82.1% | -95.7% | -96.5% |
| Biogas | 0.01 | 0.02 | 0.04 | 0.02 | 0.1% | 0.2% | 0.4% | 0.4% | -42.4% | -73.0% | -50.5% |
| **Total included in RES-E** | **12.45** | **12.06** | **10.28** | **5.47** | 95.2% | 95.5% | 100.0% | 100.0% | +3.2% | +21.1% | +127.7% |
| Biomass (excluded) | 0.49 | 0.45 | 0 | 0 | 3.7% | 3.6% | 0% | 0% | +8.1% | - | - |
| Landfill gas (excluded) | 0.09 | 0.09 | 0 | 0 | 0.7% | 0.7% | 0% | 0% | +10.7% | - | - |
| Biogas (excluded) | 0.05 | 0.03 | 0 | 0 | 0.4% | 0.3% | 0% | 0% | +40.1% | - | - |
| **Total electricity from renewable sources** | **13.08** | **12.63** | **10.28** | **5.47** | **100%** | **100%** | **100%** | **100%** | **+3.5%** | **+27.2%** | **+139.2%** |

Figure 8.17 shows the annual growth in installed wind generation capacity and overall cumulative capacity since 2000[25]. 197 MW of wind capacity was added during 2022 and the total installed capacity at the end of the year was 4,536 MW. Note that these capacity figures include both transmission-connected and distribution-connected windfarms, along with a small number of autoproducers (sites that generate electricity for their own consumption).

[25] Data on connected wind generators from Eirgrid: https://www.eirgridgroup.com/how-the-grid-works/renewables/

**Figure 8.17: Installed wind generating capacity**




*Source: EirGrid and ESB Networks*

The output from wind and hydro generation is affected by the amount of the resource (wind and rainfall) in a particular year. It is also affected by the extent of outages of the plant for reasons such as faults, maintenance and curtailment. An indication of how these factors affect the output of wind and hydro can be obtained by examining the capacity factors for these generation types. The capacity factor is the ratio of average electricity produced to the theoretical maximum possible if the installed capacity was generating at a maximum for a full year.

The rates of capacity increase each year can have a significant impact on the capacity factor in periods of large annual capacity increases. If significant capacity is added late in the year, this artificially reduces the capacity factor for the year. To mitigate this, the wind capacity factors in Table 8.8 are calculated using the average of the installed capacity in any given year and the previous year.

**Table 8.8: Annual capacity factor for wind and hydro generation**

| Capacity factor | 2002 | 2012 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| Wind | 34.4% | 27.8% | 31.7% | 26.7% | 27.8% | 28.2% | 29.3% | 31.3% | 25.8% | 28.8% |
| Hydro | 43.4% | 38.7% | 38.9% | 32.8% | 33.3% | 33.4% | 42.7% | 44.9% | 36.1% | 33.8% |

*Source: EirGrid and SEAI*

### 8.2.6 Heat from renewable energy sources (RES-H)

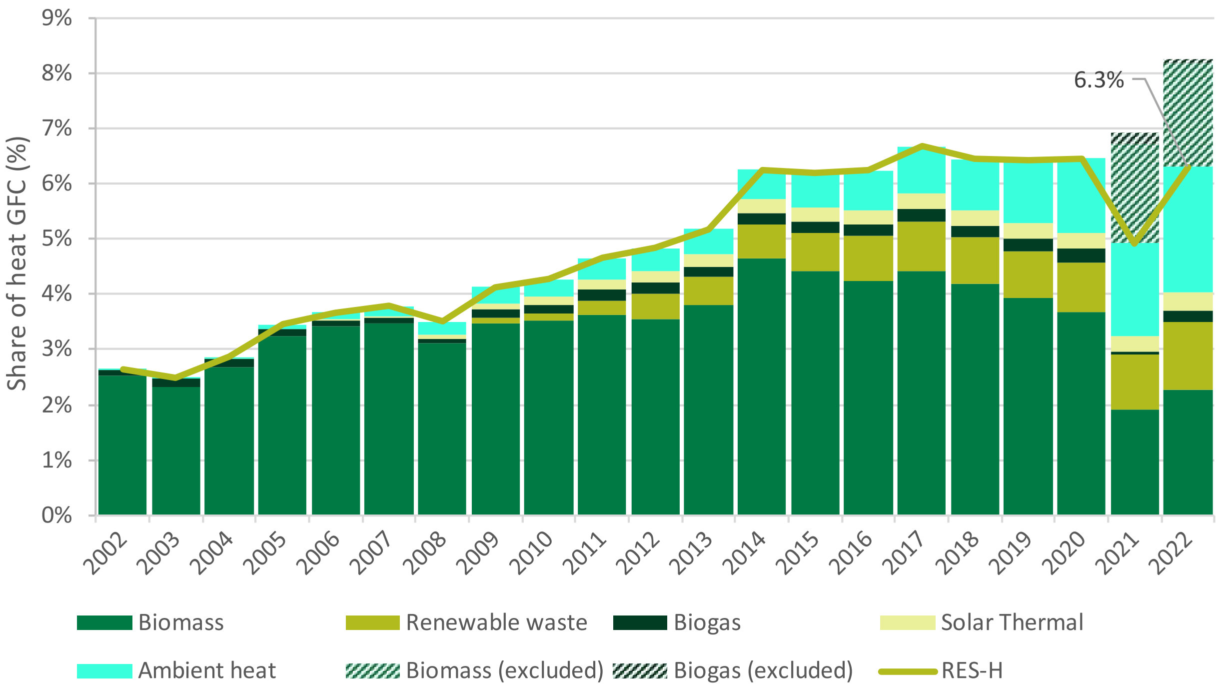
Although there is no mandatory target for RES-H set in REDII, Ireland's NECP 2021-2030 sets out a planned RES-T of 24% by 2020 to help deliver the overall mandatory target of 34.1% renewable energy. Under REDII, Ireland, along with all other Member States, must endeavour to increase the share of renewable energy in heating and cooling by an indicative 1.1 percentage points as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030. Under RED III, which entered into force in November 2023, Member States must increase the share of renewable energy in heating and cooling by at least 0.8 pp and 1.1 pp as annual averages for the periods 2021-2025 and 2026-2030, respectively.

Figure 8.18 shows the contribution from renewable energy to heat or thermal energy uses as a share of overall heat use. RES-H fell from 6.3% in 2020 to 4.9% in 2021; this decrease can be attributed to the transition from REDI to REDII and the introduction of new sustainability and verification criteria for biomass fuels. In 2022 the RES-H increased again to 6.3%.

In 2022, 1,003 GWh of the heat from biomass fuels (*i.e.* biomass and biogas) could not be counted towards the RES-H and overall RES, as it was not verified as sustainable under RED II, see section 8.2.2 for further details.

Between 2008 and 2014 there was a reduction in overall amount of energy used for heat, which contributed positively towards the RES-H target, as the share of renewable heat is measured against a smaller total. During this period the quantity of renewable heat energy increased by 38% but the share of renewable heat energy increased by 81%. This trend reversed after 2014, when the total energy used for heat began increasing again following the return to economic growth and a reduction in international oil prices. Between 2014 and 2020 the quantity of renewable heat increased by 16%, but so did the overall amount of energy used for heat, meaning that the share of renewable heat remained virtually unchanged.

**Figure 8.18: Renewable energy share in heat (RES-H)**




Renewable heat energy is dominated by the use of solid biomass and renewable wastes in industry. Utilisation of ambient energy (*via* ground-source and air-source heat pumps) has grown more than ten-fold between 2005 and 2020 and is now a significant source of renewable heat energy, accounting for approximately 28% of renewable heat energy in 2022. Table 8.9 shows the breakdown of renewable energy types used for heat.

Recent growth in renewable energy use for heat has been due to increased use of renewable wastes in industry and increased use of heat pumps delivering ambient energy in the residential and services sectors. The latter is mostly due to revisions to building regulations for new dwellings and the support of grant schemes.

**Table 8.9: Heat generated from renewable sources by energy type**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Biomass | 1.16 | 1.06 | 2.35 | 1.83 | 27.4% | 27.8% | 65.1% | 73.5% | +9.3% | -50.6% | -36.5% |
| Renewable waste | 0.63 | 0.54 | 0.47 | 0.23 | 14.8% | 14.2% | 13.1% | 9.2% | +15.6% | +32.5% | +172.9% |
| Biogas | 0.11 | 0.03 | 0.11 | 0.10 | 2.7% | 0.8% | 3.2% | 4.1% | +250.1% | -0.7% | +10.6% |
| Solar Thermal | 0.16 | 0.16 | 0.16 | 0.11 | 3.9% | 4.3% | 4.4% | 4.4% | +0.3% | +3.8% | +50.0% |
| Ambient heat | 1.17 | 0.92 | 0.51 | 0.22 | 27.6% | 24.1% | 14.2% | 8.8% | +26.8% | +127.9% | +434.9% |
| **Total included in RES-H** | **3.23** | **2.72** | **3.60** | **2.49** | **76.3%** | **71.1%** | **100.0%** | **100.0%** | **+18.8%** | **-10.3%** | **+30.0%** |
| Biomass (excluded) | 0.96 | 0.99 | 0 | 0 | 22.7% | 25.9% | 0% | 0% | -3.2% | - | - |
| Biogas (excluded) | 0.04 | 0.11 | 0 | 0 | 1.0% | 2.9% | 0% | 0% | -61.3% | - | - |
| **Total heat from renewable sources** | **4.23** | **3.82** | **3.60** | **2.49** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+10.7%** | **+17.5%** | **+70.3%** |

### 8.2.7 Avoided $CO_2$

Using renewable energy displaces the use of fossil fuels, thereby avoiding $CO_2$ emissions and reducing the amount of fossil fuels we need to import. We estimate the amount of $CO_2$ avoided and fossil fuel imports displaced using the primary energy equivalent approach. This estimates the quantity of fossil fuels that would have been required to replace renewable energy use. The estimates for electricity are based on the use of marginal generation fuel that would otherwise have been required to produce the electricity. We also include a factor to account for the effects of increased ramping and cycling of fossil fuel generators, based on previous detailed electricity dispatch modelling[26,27].

Figure 8.19 shows the trend in annual avoided $CO_2$ emissions from renewable energy from 2002 to present. The estimated amount of $CO_2$ avoided through the use of renewable energy was 6.75 $MtCO_2$ in , more than any previous year, with 4.48 $MtCO_2$ avoided by wind energy.

Decarbonising the electricity system, combined with increased electrification of heat and transport through the use of electric vehicles (EVs) and heat pumps is an important part of the strategy for decarbonising the energy system as a whole. The use of renewable electricity ensures that switching to EVs and heat pumps results in less $CO_2$ emissions than the fossil fuel alternative. Electrification of heat and transport reduces direct fossil fuel use in the non-ETS sector, thereby contributing to meeting the non-ETS greenhouse gas emissions reduction target[28], see section 8.1.

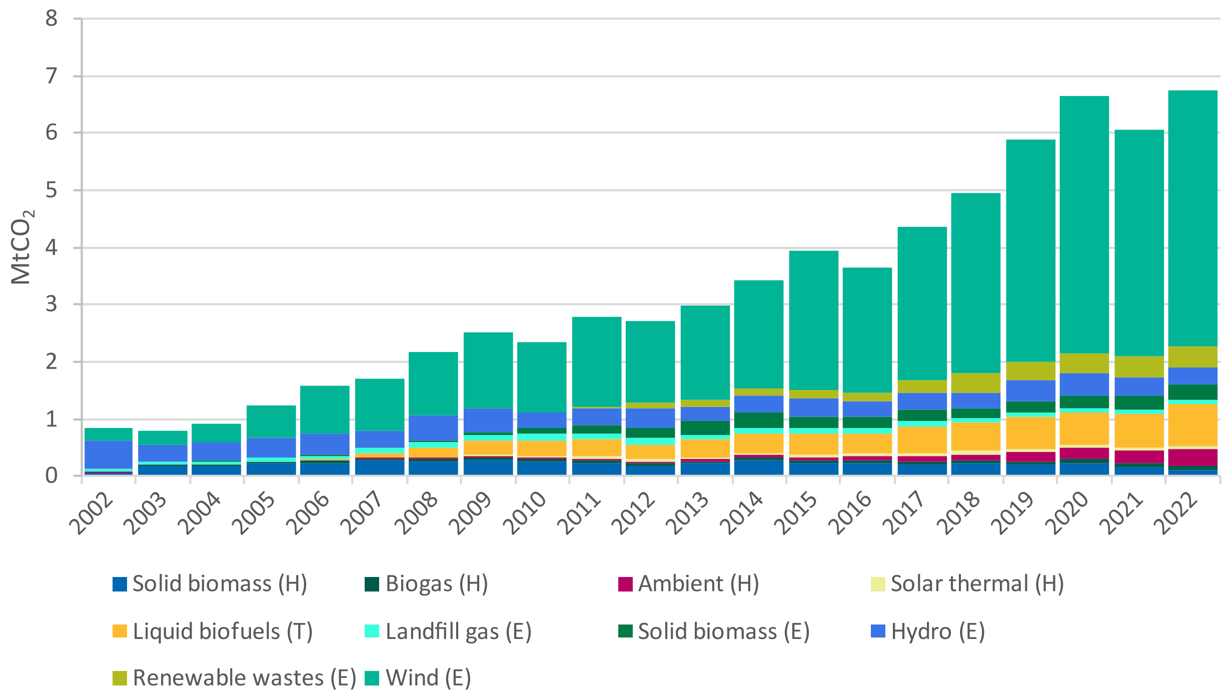
---

[26] See SEAI reports Quantifying Ireland's Fuel and CO2 Emissions Savings from Renewable Electricity in 2012 and Renewable Energy in Ireland 2012 for further details on the methodologies used to calculate the avoided emissions.

[27] Holttinen, Hannele, *et al.* (2014), *Estimating the reduction of generating system CO2 emissions resulting from significant wind energy penetration* 13h International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants. Berlin: Energynautics

[28] Electricity generation is covered by the EU emissions trading system (ETS), therefore $CO_2$ emissions savings achieved in electricity generation do not count directly towards Ireland's EU targets to reduce greenhouse gas emissions outside of the ETS (non-ETS)

**Figure 8.19: Avoided $CO_2$ from renewable energy**




## 8.3 Energy prices to industry

Energy use is an important part of economic activity and therefore the price paid for energy is a determining factor in the economy's competitiveness. Ireland has a high import dependence on oil and gas and is essentially a price-taker on these commodities. The EU has introduced competition into the electricity and gas markets through the liberalisation process to reduce energy costs to final consumers.

SEAI publishes biannual reports titled Electricity and Gas Prices in Ireland[29] based on data collected under EU legislation[30] on the transparency of gas and electricity prices. These reports focus specifically on gas and electricity prices using data published by Eurostat and are a useful reference on cost competitiveness and cover both business and households. SEAI are aiming to publish a more comprehensive report on energy prices in 2024.

This section focuses on business energy prices. It presents comparisons of the cost of energy in various forms in Ireland and compares prices in OECD Europe and the US. The source of the data presented here is the International Energy Agency's (IEA) Energy Prices and Taxes[31]. This data source was chosen because it is produced quarterly and contains data to the end of 2022. Prices shown are in US dollars and are in current (nominal) money. Relative price increases since 2015, however, are tabulated for EU countries and the US in index format in both nominal and real terms.

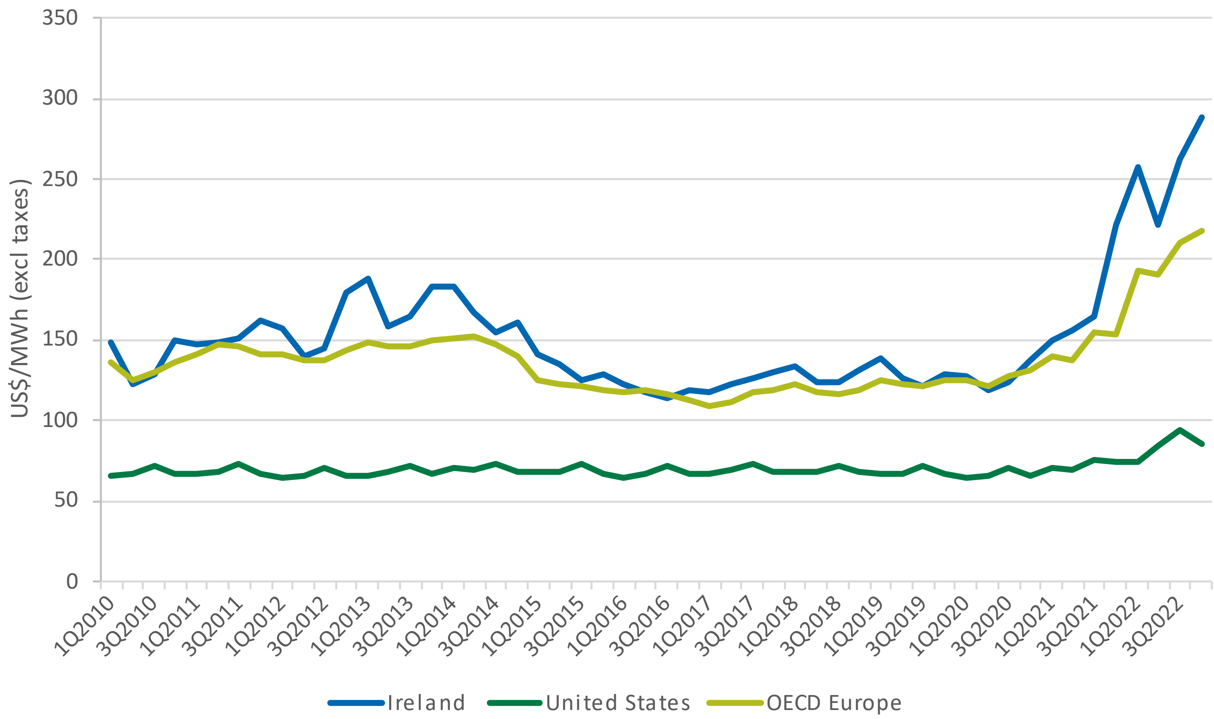
Nominal value refers to the current value expressed in money terms in a given year, whereas real value adjusts nominal value to remove the effects of price changes and inflation, to give the constant value over time indexed to a reference year.

Figure 8.20 shows that electricity prices to Irish industry have been increasing in recent years, with a steep increase from Q1 2021 and continuing into 2022. The fuel mix for electricity generation is one factor that has a key bearing on the variation in the price of electricity. Compared to the EU, Ireland has a high overall dependency for electricity generation on fossil fuels including gas generation.

---

[29] SEAI, *Electricity & Gas Prices* biannual reports. Available from: https://www.seai.ie/data-and-insights/seai-statistics/key-publications/
[30] Regulation (EU) 2016/1952 of the European Parliament and of the Council of 26 October 2016 on European statistics on natural gas and electricity prices. Available from: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32016R1952
[31] IEA, *OECD Energy Prices and Taxes Quarterly*. Available from: https://www.iea.org/data-and-statistics/data-sets

**Figure 8.20: Electricity prices to industry**




*Source: Energy Prices and Taxes ©OECD/IEA*

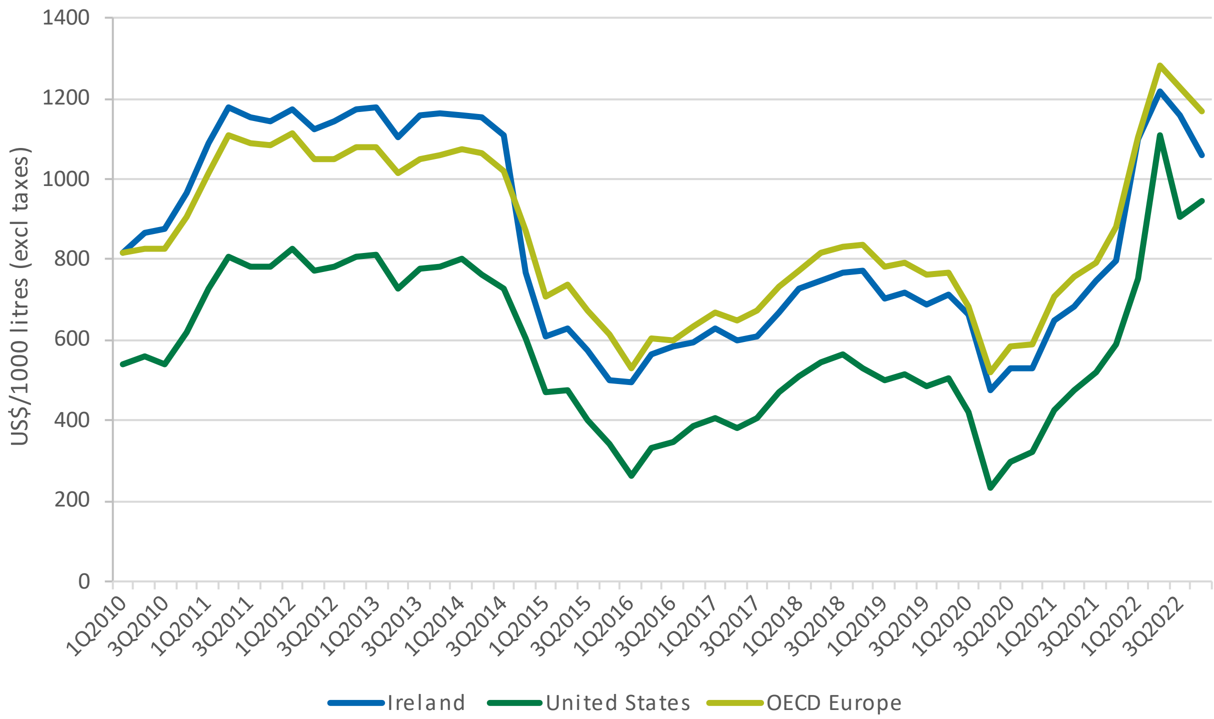
**Table 8.10: Electricity price to industry change since 2015**

| Index 2015 = 100 | OECD Europe | Austria | Belgium | Denmark | Finland | France | Germany | Greece | Ireland | Italy | Luxembourg | Netherlands | Portugal | Spain | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4th quarter 2022 (nominal) | 361 | 205 | 210 | 207 | 190 | 124 | 149 | 238 | 237 | 199 | 266 | 257 | 118 | 195 | 293 | 258 | 123 |
| 4th quarter 2022 (real) | 164 | 162 | 140 | 175 | 136 | 97 | 113 | 182 | 270 | 156 | 177 | 180 | 86 | 143 | 200 | 188 | 91 |

*Source: Energy Prices and Taxes ©OECD/IEA*

Table 8.11 shows that oil prices to industry in Ireland were 78% higher in real terms in Q4 2022 than in 2015. The average oil price in Europe and the US also increased. Crude oil prices averaged around $101/barrel in 2022, compared with $71/barrel on average in 2021.

**Figure 8.21: Oil prices to industry**




*Source: Energy Prices and Taxes ©OECD/IEA*

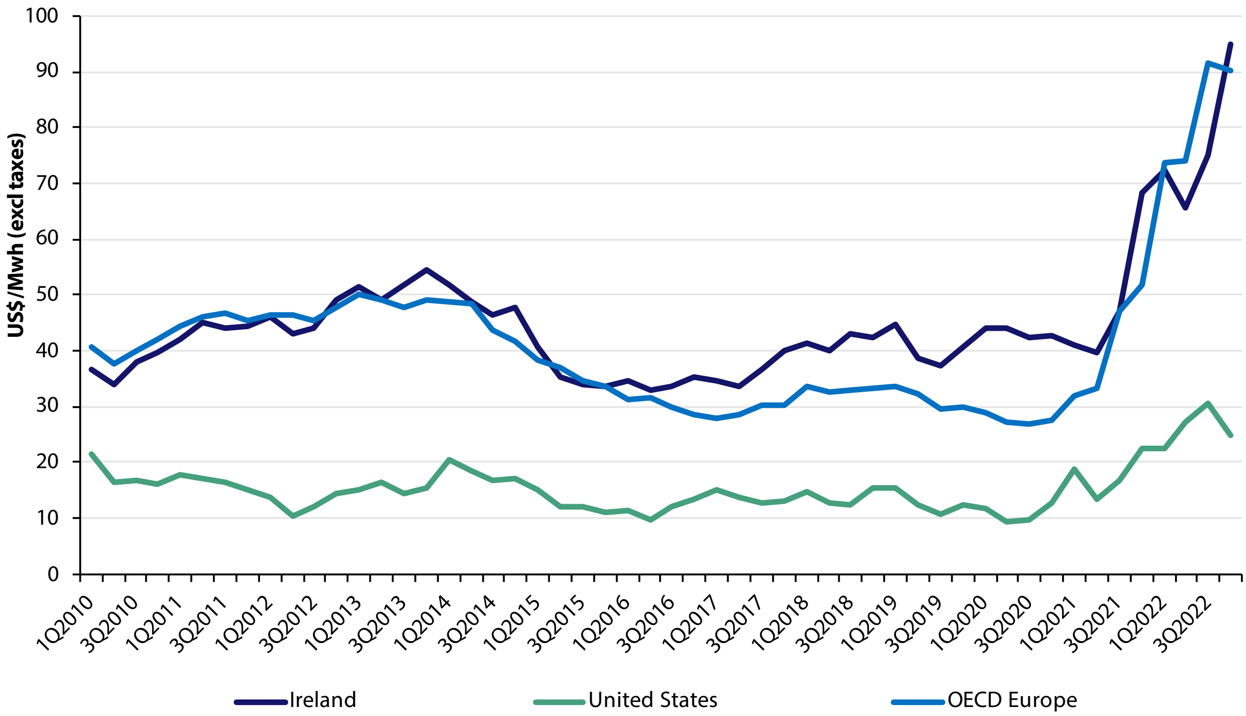
**Table 8.11: Oil prices to industry change since 2015**

| Index 2015 = 100 | OECD Europe | Austria | Belgium | Denmark | Finland | France | Germany | Greece | Ireland | Italy | Luxembourg | Netherlands | Portugal | Spain | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4th quarter 2022 (nominal) | 208 | 188 | 157 | 161 | 172 | 160 | 172 | 168 | 156 | 129 | 176 | 158 | 149 | 166 | 187 | 161 | 190 |
| 4th quarter 2022 (real) | 120 | 148 | 105 | 136 | 123 | 124 | 131 | 128 | 178 | 101 | 117 | 110 | 108 | 122 | 128 | 117 | 141 |

*Source: Energy Prices and Taxes ©OECD/IEA*

As Figure 8.22 shows, natural gas prices to Irish industry increased dramatically from the end of 2021, continuing growth well into 2022. In the fourth quarter of 2022, the price of gas to industry in Ireland was 229% above 2015 levels in real terms. Figure 8.22 also shows the gap between gas prices in Europe and the US.

### Figure 8.22: Natural gas prices to industry




*Source: Energy Prices and Taxes ©OECD/IEA*

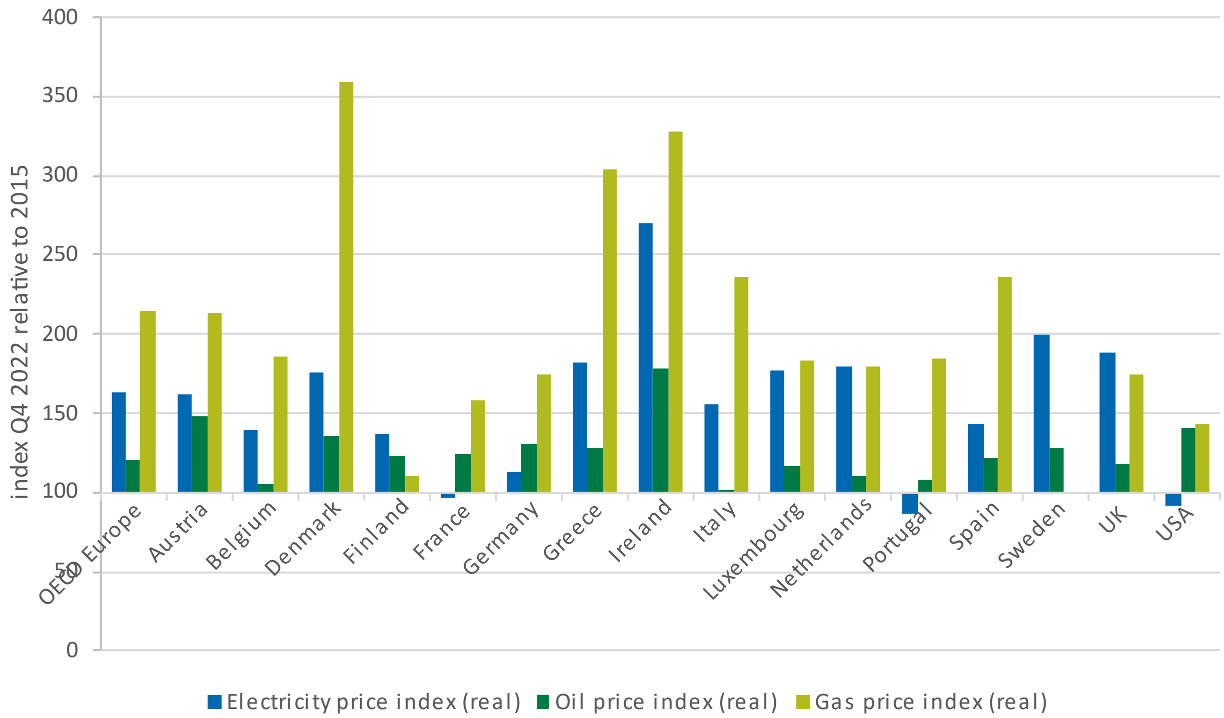
### Table 8.12: Natural gas prices to industry change since 2015

| Index 2015 = 100 | OECD Europe | Austria | Belgium | Denmark | Finland | France | Germany | Greece | Ireland | Italy | Luxembourg | Netherlands | Portugal | Spain | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4th quarter 2022 (nominal) | 472 | 271 | 278 | 425 | 155 | 203 | 228 | 399 | 287 | 302 | 275 | 258 | 253 | 322 | 0 | 240 | 193 |
| 4th quarter 2022 (real) | 214 | 213 | 186 | 359 | 111 | 158 | 174 | 304 | 329 | 236 | 183 | 180 | 184 | 236 | 0 | 175 | 143 |

*Source: Energy Prices and Taxes ©OECD/IEA*

Figure 8.23 summarises the data presented in Table 8.10, Table 8.11 and Table 8.12. The IEA publishes an overall energy price index (real) for industry, which shows that the overall energy price to Irish industry between 2015 and the fourth quarter of 2022 increased for all fuels.

**Figure 8.23: Real energy price changes to industry since 2015 (index)**




*Source: Energy Prices and Taxes ©OECD/IEA*

# 9 Drivers of energy demand

This section takes a high-level view of the trends in the economy, weather, energy use and energy-related $CO_2$ emissions since 2001.

## 9.1 Energy, economy and emissions

Energy supply responds to the level of demand for energy services (heating, transportation and electricity) and how end users want that energy demand satisfied. Energy service demand is driven primarily by economic activity and by the energy end-use technologies employed in undertaking such activity.

The relationship between economic activity and energy demand is less straightforward in Ireland than it is for most other countries. Gross Domestic Product (GDP) is the most widely accepted measure of economic activity internationally, but Ireland's GDP is strongly influenced by the revenue and profits reported by multinational companies. Some economic activity of these companies results in large amounts of value added (see Appendix 4), but with little energy consumption. This was illustrated clearly in 2015, when Irish GDP increased suddenly by +25% from 2014, due to the transfer of intellectual property from multinational companies. Care must be taken when comparing macro-economic indicators, such as energy per unit GDP, across countries.

The CSO has developed alternative indicators to GDP that more accurately reflect the level of economic activity in the domestic economy, and to remove the distorting effects of globalisation. Modified domestic demand[32] (MDD) was first published in the Quarterly National Accounts[33] results for Q1-2017 and excluded trade by aircraft leasing companies, exports and imports of R&D services, and exports and imports of R&D-related IP products. For comparison, Ireland's MDD grew by +5.3% from 2014 to 2015, *vs.* +25% for GDP.

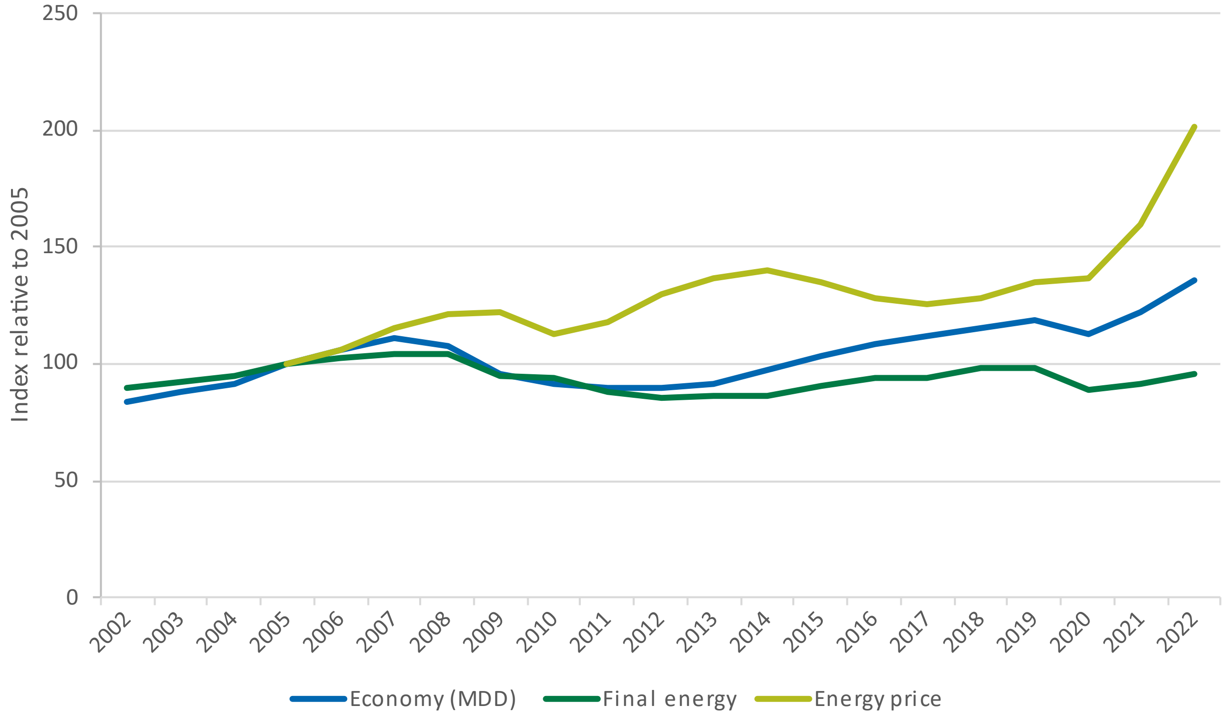
Figure 9.1 shows the historical trends for modified domestic demand, energy prices and final energy, each expressed as an index relative to 2005. This figure illustrates changes in economic growth and shows the effect of the economic downturn between 2008 and 2012 (and the subsequent return to growth after 2013).

Table 9.1 gives the growth rates for the economy (GDP and MDD), primary energy, final energy and energy-related $CO_2$ emissions for the period. Transport and industry have responded to economic activity, while energy use in the residential and services sectors is more driven by short-term annual variations in weather and energy prices.

---

[32] Previous editions of this report presented another economic indicator, modified gross national income (GNI*), as an alternative to GDP. For more information on the differences between GDP, GNI* and modified domestic demand refer to the CSO.
[33] CSO, *Quarterly National Accounts*. Available from: https://www.cso.ie/en/statistics/nationalaccounts/quarterlynationalaccounts/

**Figure 9.1: Index of modified domestic demand, final energy demand and energy price**




*Source: SEAI and CSO*

**Table 9.1: GDP, MDD, final energy, primary energy and energy-related $CO_2$ growth rates**

| | Quantity | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Economy (GDP) Million €2021 | 475,016 | 434,070 | 335,848 | 203,080 | +9.4% | +41.4% | +133.9% |
| Economy (MDD) Million €2021 | 229,866 | 206,386 | 194,852 | 151,925 | +11.4% | +18.0% | +51.3% |
| Final energy (TWh) | 140.26 | 133.91 | 144.65 | 124.76 | +4.7% | -3.0% | +12.4% |
| Primary energy (TWh) | 167.08 | 160.74 | 171.34 | 156.46 | +3.9% | -2.5% | +6.8% |
| Energy related $CO_2$ ($ktCO_2$) | 36,475 | 35,368 | 39,369 | 38,362 | +3.1% | -7.4% | -4.9% |

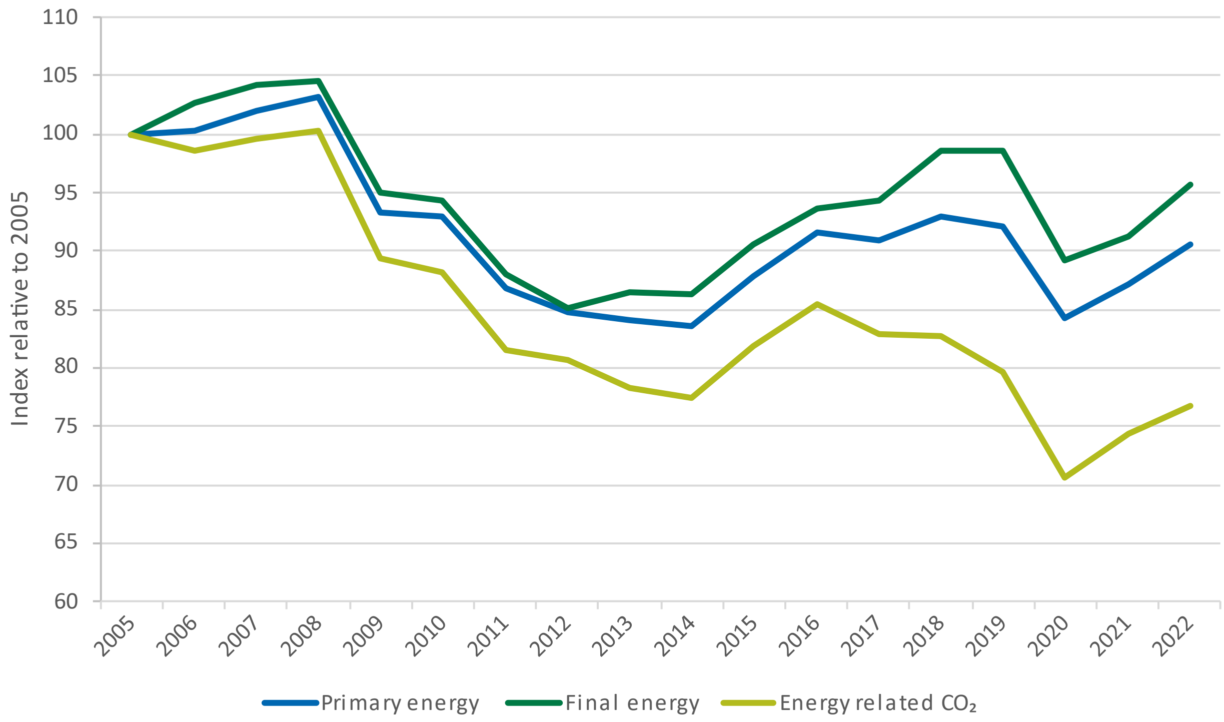
*Source: CSO and SEAI*

In 2020, final energy use, energy-related $CO_2$ emissions and MDD fell, due largely to the impact of COVID-19 on economic activity (while GDP increased by +5.9%). All indicators returned to growth in 2021 and continued into 2022.

Figure 9.2 shows the relationship between final energy demand, primary energy use and energy-related $CO_2$ emissions, expressed as an index relative to 2005. The difference between the trends in final energy use and primary energy supply arises from improvements in the efficiency of energy transformations, particularly electricity generation.

The overall efficiency of electricity generation has increased over the period. These improvements are driven by introducing higher efficiency CCGT gas generators, reductions in inefficient coal generation, and the increased supply of wind-generated electricity (considered 100% efficient).

**Figure 9.2: Index of final energy, primary energy and energy-related $CO_2$**




*Source: CSO and SEAI*

## 9.2 Energy and the weather

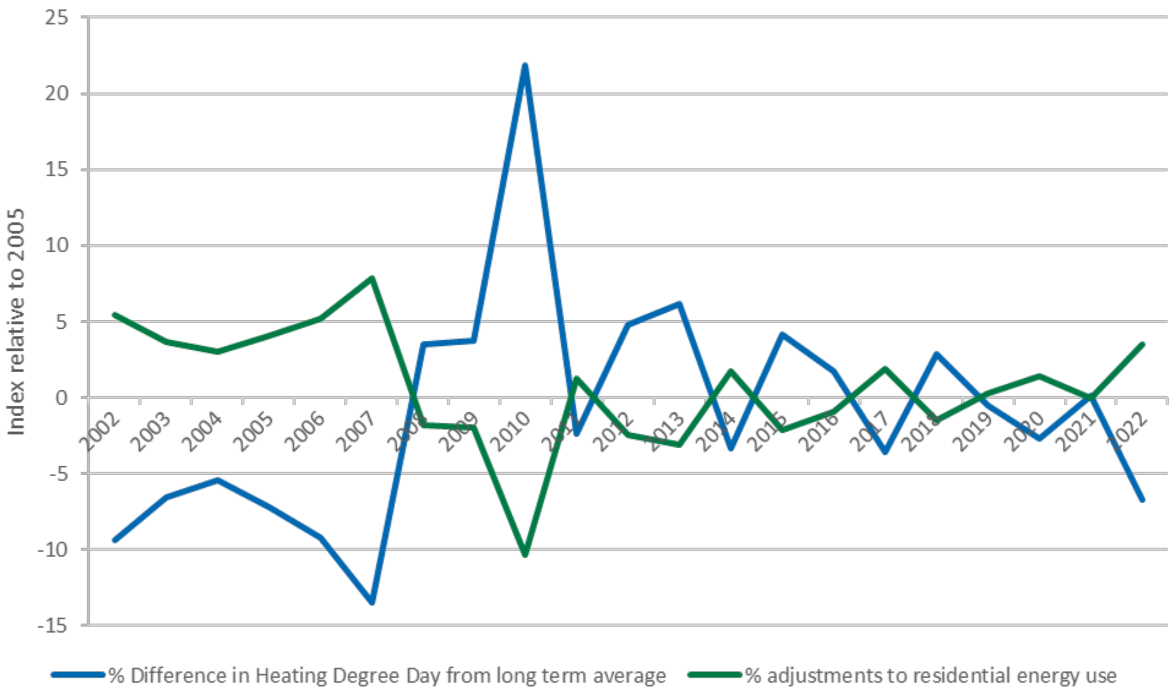
Weather variations from year to year can have a significant effect on the energy demand of a country, particularly on the portion of the energy demand associated with space heating. A method to measure the weather, or climatic variation, is the use of 'degree days'.

Degree days are the measure or index used to consider the severity of the weather when looking at energy use in terms of heating (or cooling) load on a building. A degree day is a measure of how cold (or warm) it is outside, relative to a day on which little or no heating (or cooling) would be required. Thus, it is a measure of the cumulative temperature deficit (or surplus) of the outdoor temperature, relative to a neutral target temperature (base temperature) at which no heating or cooling would be required. The larger the number of heating degree days, the colder the weather. For example, if the outdoor temperature for a particular day is 10 degrees lower, on average, than the base temperature (15.5 degrees), this would contribute 10 degree days to the annual or monthly total. The typical heating season in Ireland is October to May.

Met Éireann calculates degree day data for each of its synoptic weather stations. SEAI calculates a population weighted average of these data to arrive at a meaningful degree day average for Ireland that is related to the heating energy demand of the country.

Figure 9.3 shows the percentage deviation in the number of heating degree days from the long-term average between 2005 and 2022. Over that period, 2010 was the coldest year recorded and 2007 was the warmest. The portion of each fuel assumed to be used for heating is adjusted by multiplying it by the ratio of the long-term average number of degree days to the number of degree days in the given year. This adjustment yields a lower normalised energy consumption in cold years, and a higher normalised consumption in mild years. Typically, the weather adjustment is within ±6% of the actual energy consumption. The largest correction over the period was for 2010, an exceptionally cold year, where the weather-corrected energy consumption was 12% less than the actual energy consumption.

**Figure 9.3: Deviation from average heating degree days and resulting weather adjustment**




*Source: Met Éireann and SEAI*

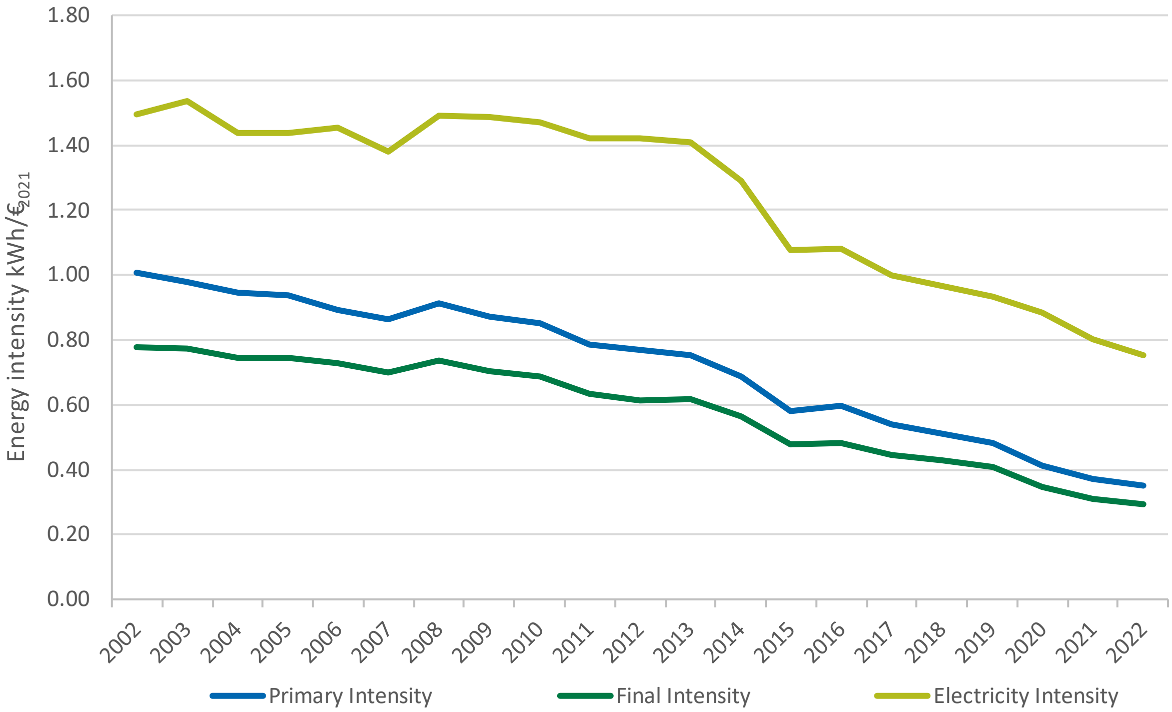
## 9.3 Economic energy intensities

Energy intensity is defined as the amount of energy required to produce a functional output. For the economy, the measure of output is generally taken to be the GDP. As mentioned in section 5.1, MDD is a more meaningful indicator of economic activity in Ireland, but GDP is still the standard international metric; therefore, here we present energy intensity in terms of GDP. We use GDP measured in constant prices to remove the influence of inflation.

Figure 9.4 shows the trend in both primary energy intensity (primary energy divided by GDP) and final energy intensity (final energy consumption divided by GDP) (at constant 2021 prices). The difference between these two trends reflects the amount of energy lost in the transformation of primary energy into final energy, mostly for electricity generation. The primary and final energy intensity of the economy has generally fallen since 2002, except in 2008 and 2016, which can be attributed to a combination of increased energy efficiency and increases in GDP.

The sharp fall in the energy intensity of the economy in 2015 of 16% must be understood in the context of the 25% increase in GDP, which resulted from transferring assets into Ireland and had little or no effect on energy consumption. This change should be viewed as an adjustment rather than a reduction in intensity. This is a good example of why energy intensity is not a good measure of energy efficiency progress, especially in Ireland.

**Figure 9.4: Primary, final and electricity intensities**




*Source: SEAI*

There are many factors that contribute to how trends in energy intensity of the economy evolve. These factors include technological efficiency and the fuel mix, particularly in relation to electricity generation; economies of scale in manufacturing; and, not least, the structure of the economy. The structure of the economy in Ireland has changed considerably over the past 20 to 30 years. It has shifted toward the high value-added sectors, such as pharmaceuticals, electronics and services. Relative to traditional 'heavier' industries, such as car manufacturing and steel production, these growing sectors are not highly energy intensive. Examples of changes to the structure of the industry sector include the cessation of steel production in 2001, of fertiliser production in late 2002, and of sugar production in 2007.

The energy intensity of the economy will continue to decrease if, as expected, the economy becomes increasingly dominated by high value added, low energy-consuming sectors. This results in a more productive economy from an energy perspective, but does not necessarily mean that the actual processes used are more energy efficient, or that less energy is being used overall in the economy.

# 10 Further sectoral analysis

This section explores in more detail the changes in energy use in each of the main sectors: industry, transport, residential and services.

## 10.1 Primary energy requirement by sector

Figure 10.1 shows how Ireland's primary energy supply ultimately services the energy needs of different sectors of the economy. Where primary energy is used directly by end users in a particular sector, then allocation is straightforward. An example is the use of natural gas in the residential sector. Where fuels undergo a transformation process before final use by an end-user, then the full primary energy required to satisfy that final use is allocated to the sector. For example, for the electricity used in the residential sector, the fuels used to generate that electricity (gas, wind, coal, peat and oil, *etc.*) are allocated to the residential sector.

**Figure 10.1: Total primary energy requirement by sector**

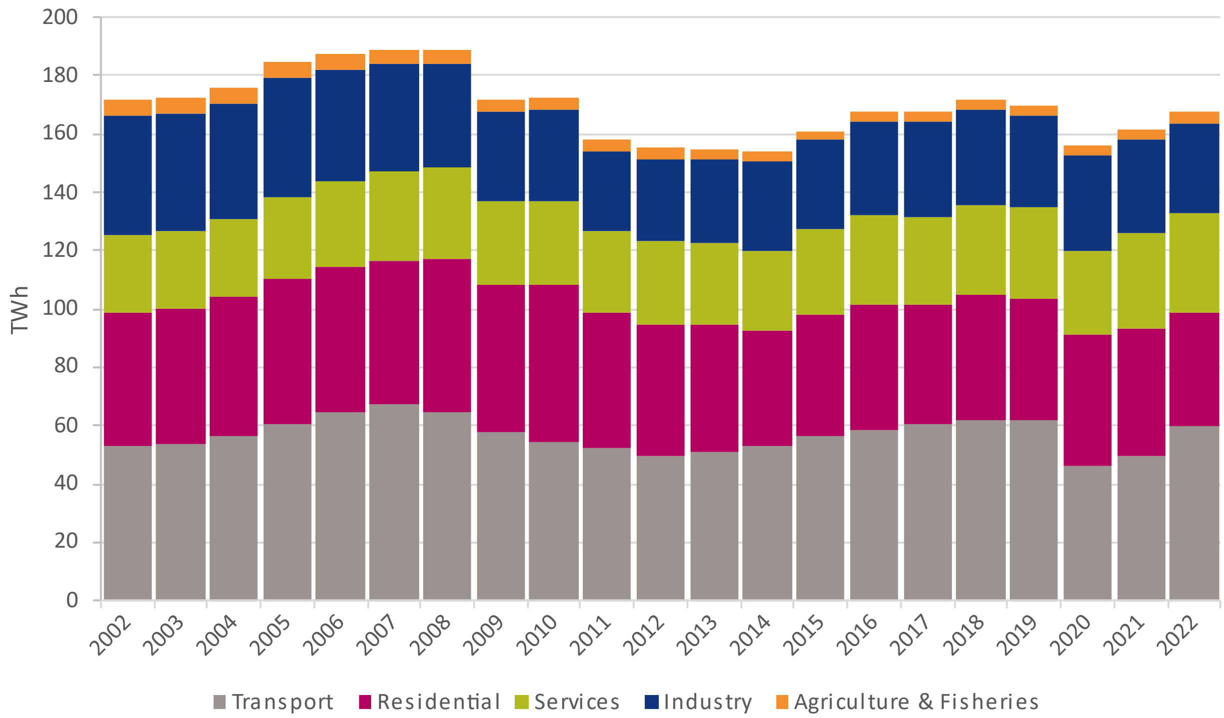



Table 10.1 details the quantities, shares and trends of primary energy supply across economic sectors. The total primary supply is split across the transport, residential, services, industry, and agriculture and fisheries sectors. Sectoral energy-related $CO_2$ emissions are presented in section 7.2.

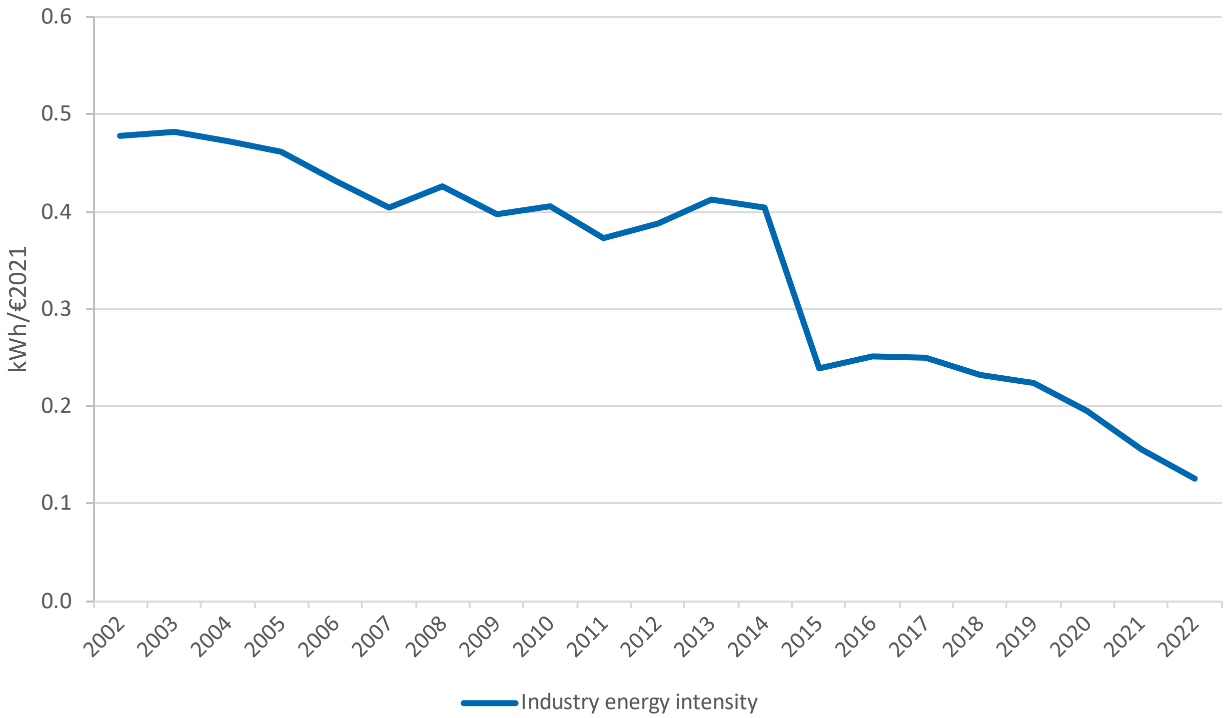
**Table 10.1: Primary energy by sector compared with previous years**

| | Quantity (TWh) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Transport | 59.61 | 49.63 | 61.75 | 49.28 | 34.7% | 30.1% | 35.3% | 30.9% | +20.1% | -3.5% | +21.0% |
| Residential | 38.80 | 43.84 | 42.82 | 45.32 | 22.6% | 26.6% | 24.5% | 28.4% | -11.5% | -9.4% | -14.4% |
| Services | 34.19 | 32.41 | 31.30 | 28.48 | 19.9% | 19.6% | 17.9% | 17.9% | +5.5% | +9.2% | +20.1% |
| Industry | 30.98 | 32.30 | 32.28 | 28.54 | 18.0% | 19.6% | 18.4% | 17.9% | -4.1% | -4.0% | +8.6% |
| Agriculture & Fisheries | 4.21 | 3.45 | 3.45 | 3.86 | 2.4% | 2.1% | 2.0% | 2.4% | +22.2% | +22.0% | +9.1% |
| **Total** | **167.79** | **161.63** | **171.60** | **155.48** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **+3.8%** | **-2.2%** | **+7.9%** |

## 10.2 Industry energy intensity

Industrial energy intensity is the amount of energy required to produce a unit of value added, measured in constant money values. Figure 10.2 shows the industrial energy intensity over the period expressed in kilograms of oil equivalent per euro of industrial value added at 2021 money value (kWh/€2021). Over the period, industrial energy consumption fell, while value added increased, resulting in a reduction in intensity.

**Figure 10.2: Industry energy intensity**




Value-added output from industry was 74% higher in 2015 compared with 2014. The large increase in gross value added in 2015 is explained by several one-off factors, such as transferring assets into Ireland, and what are known as reverse takeovers. This increase in gross value added incurred no additional energy consumption.

The step-change in industry energy intensity in 2015 illustrates the fact that energy intensity is not a good indicator of energy efficiency, as variations may result from many factors, such as structural changes, or changes to the fuel mix or activity.

## 10.3 Transport

### 10.3.1 Private car activity

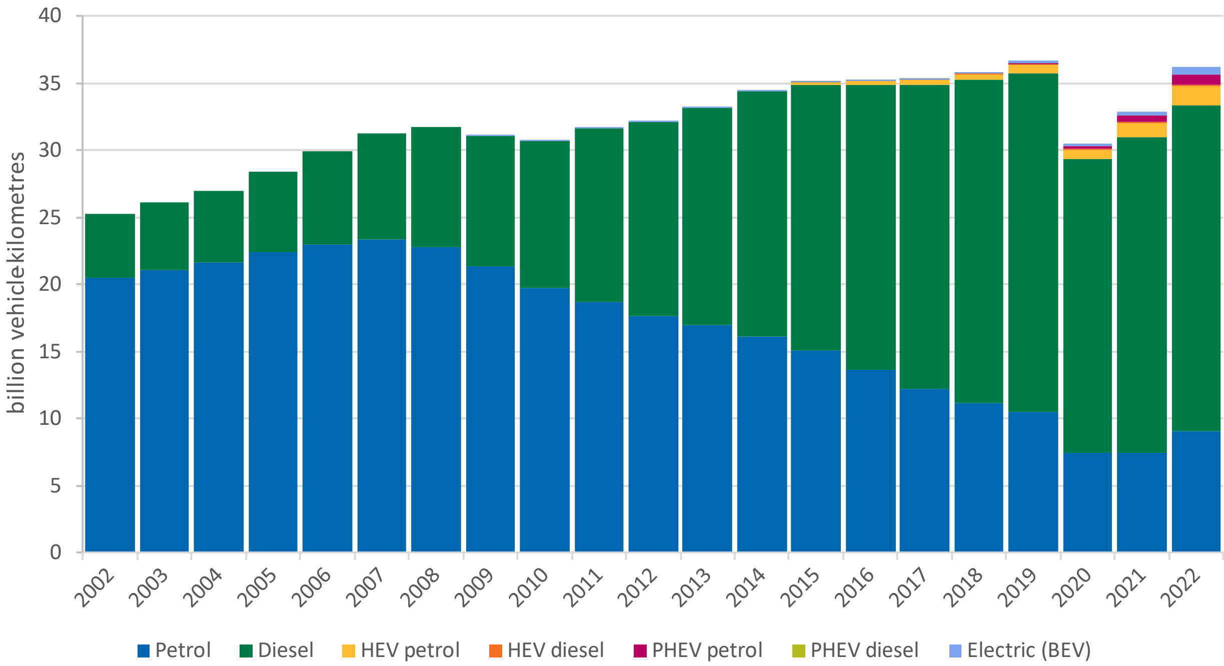
Figure 10.3 shows the total kilometres driven by private cars in Ireland each year. This is based on an analysis of NCT data for all years, except 2020 and 2021. The NCT methodology assumes that the kilometres driven between the last two dates in a car which has had an NCT are split evenly across that time periods, which can be 4, 2 or 1 years. In normal times, this is a reasonable assumption, but if there is a sudden change the activity pattern and the functioning of the NCT is disrupted, both of which occurred during COVID-19, then this method no longer gives good results. Therefore, we developed an alternative approach for 2020 and 2021. We estimated the reduction in activity of the average petrol car in these years from the observed drop in petrol use (most of which occurs in private cars). We then assumed that the average diesel car's activities were reduced by the same proportion as the average petrol car. In 2022, we returned to the NCT methodology for estimating the 2022 kilometres.

The total number of vehicle-kilometres travelled declined following the economic crash (during 2009 and 2010) but returned to growth soon after in 2011. Total vehicle-kilometres continued to grow until the dramatic fall in 2020 due to travel restrictions during COVID-19.

There was a clear shift from petrol to diesel cars in this period. This was already underway prior to the changes in motor taxation in 2008, but accelerated sharply after that.

Annual vehicle-kilometres for electric vehicles (EVs) have been estimated since 2009 and have grown every year since. Hybrid electric vehicles (HEV) and Plug-in hybrid electric vehicles (PHEV) have been estimated since 2015.

**Figure 10.3: Private car total annual vehicle-kilometres**




*Source: Based on NCT Data*

### 10.3.2 $CO_2$ intensity of new private cars

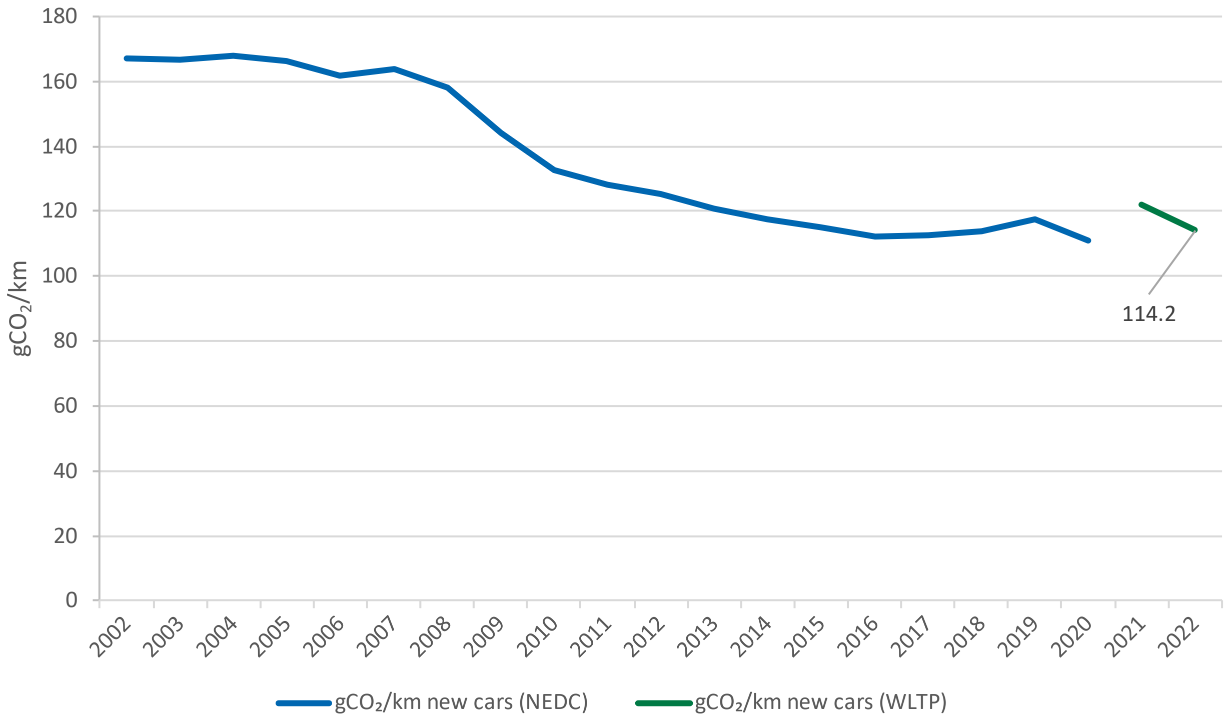
Figure 10.4 shows the change in the weighted average specific $CO_2$ emissions of new cars licensed for the first time (excluding battery EVs) over the period, according to standardised testing procedures. This does not include imported, second-hand cars.

Since 2008, the combined effect of the EU legislation obligating manufacturers to reduce average fleet emissions and the changes to the Irish taxation system for private cars has been to shift new car purchases from higher to lower $CO_2$ emissions bands, and to reduce the average specific $CO_2$ emissions of new cars.

The standardised testing procedures are known to underestimate the fuel use and $CO_2$ emissions of cars, compared to typical real-world driving conditions. The difference between the test emissions and the emissions produced in real-world driving conditions is referred to as the on-road factor, or the performance gap. Several reports by the International Council on Clean Transportation highlighted that the performance gap between test results and real-world driving increased dramatically after 2008, and that the real-world fuel consumption and carbon emissions of new vehicles are increasingly higher than the reported values under standardised testing procedures.

The data up to 2020 is based on the results of a standardised laboratory test procedure called the New European Driving Cycle (NEDC). From January 2021, a new test methodology called the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) came into force for all new cars to better reflect real-world driving profiles.

**Figure 10.4: Specific $CO_2$ emissions of new cars, excluding battery electric vehicles**

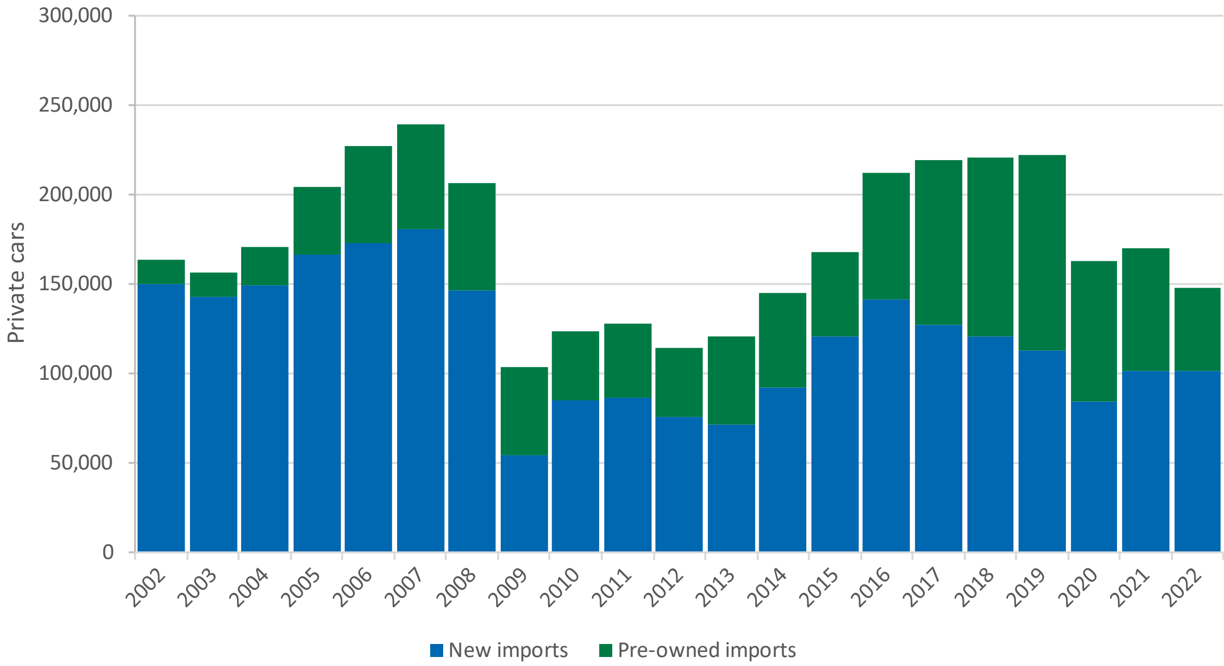



*Source: Dept. Transport, Vehicle Registration Unit data.*

### 10.3.3 Penetration of zero emissions vehicles

There are two sources of cars for the Irish market: brand new imports and pre-owned imports, shown in Figure 10.5. The importance of the pre-owned imports market varies over time, but in the lead up to the UK leaving the EU, its share had increased until 2019, and has fallen since then. This is important as the profile of pre-owned imports tends to differ to that of new car imports.

**Figure 10.5: Share of private cars licensed for the first time that are new or pre-owned imports**

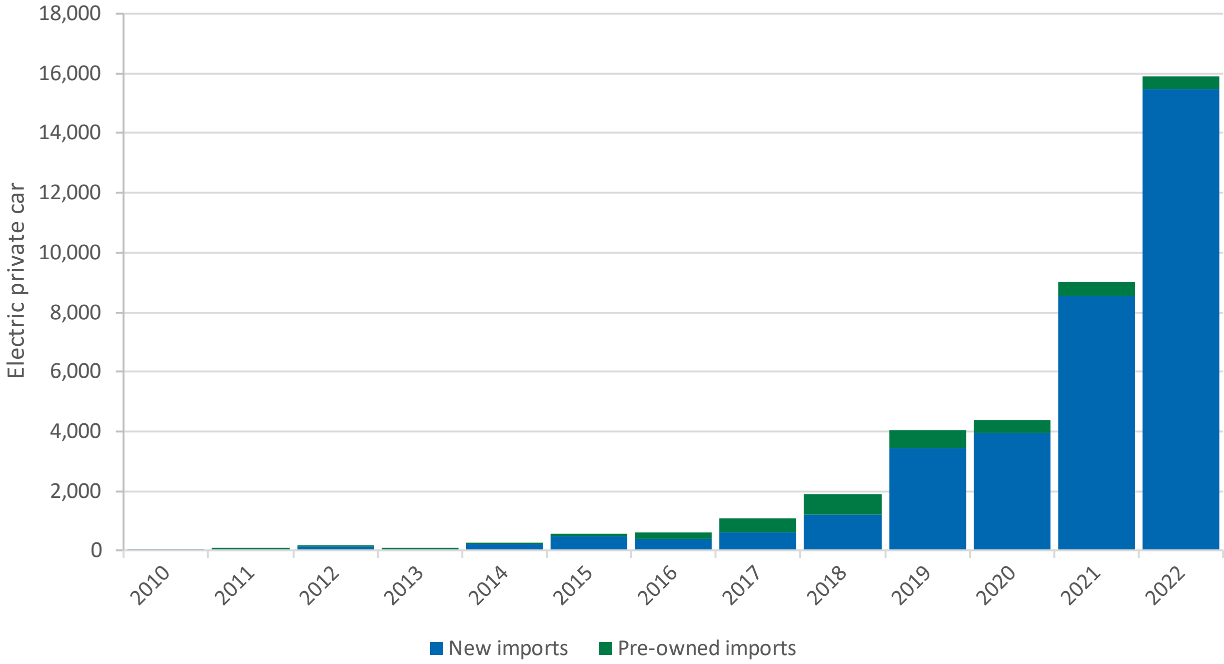



*Source: CSO and Dept. Transport, Vehicle Registration Unit*

Figure 10.6 and Table 10.2 show the share of private cars added to the Irish car stock each year that are EVs, split into new imports and pre-owned imports.

This is showing strong growth, but still from a low base. As 85% of all vehicles licensed for the first time in 2022 have an internal combustion engine, and given that the typical lifespan of a car is around 15 years, it will be well into the next decade before there is a significant phasing out of cars with internal combustion engines.

**Figure 10.6: Private cars licensed for the first time that are battery electric vehicles**




*Source: CSO and Dept. Transport, Vehicle Registration Unit.*

**Table 10.2: Share of electric private cars licensed for the first time**

| | Quantity (cars) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| New imports | 15,462 | 8,554 | 1,222 | 163 | 97.3% | 94.9% | 63.6% | 98.8% | +81% | +1,165% | +9,386% |
| Pre-owned imports | 435 | 455 | 700 | 2 | 2.7% | 5.1% | 36.4% | 1.2% | -4% | -38% | +21,650% |
| **Total electric cars licensed for the first time** | **15,897** | **9,009** | **1,922** | **165** | **100%** | **100%** | **100%** | **100%** | **+76%** | **+727%** | **+9,535%** |

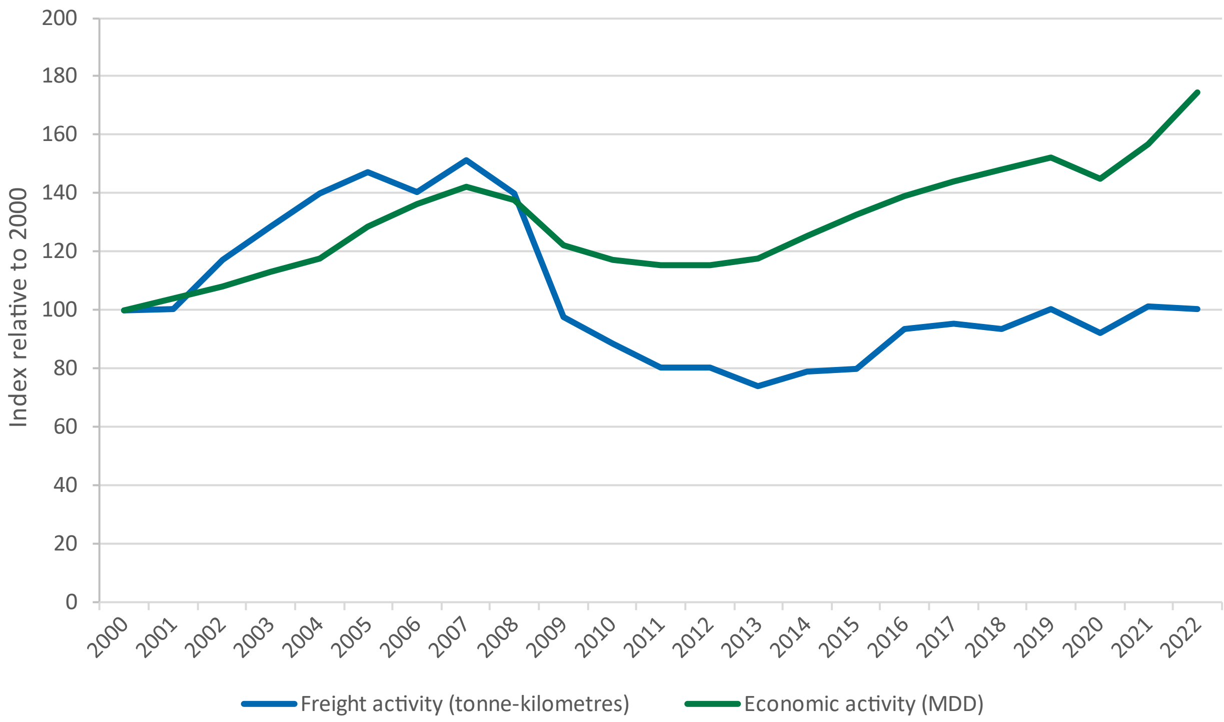
## 10.3.4 Heavy goods vehicle activity

The main metric used to measure activity in the road freight sector is tonne-kilometres. This is the total weight of material transported, multiplied by the distance over which it is transported. Figure 10.7 and Table 10.3 present data on road freight tonne-kilometres, along with data on economic growth, as measured by MDD. In Figure 10.7, the data are presented as an index with respect to 2000. The data are taken from the CSO's Road Freight Transport Survey,[34] which considers, for example, vehicles taxed as goods vehicles, those weighing over two tonnes unladen and those which are actually used as goods vehicles, rather than for service-type work. We estimate the energy use of HGVs based on the activity, as measured by tonne-kilometres, and the energy consumption per tonne-kilometre, based on the EU average.

[34] CSO, *Road Freight Transport Survey*. Available from: https://www.cso.ie/en/methods/transport/roadfreighttransportsurvey/

Although HGV activity was less affected by COVID-19 travel restrictions than private cars or aviation, the number of tonne-kilometres still fell in 2020. This was nearly twice the reduction seen in total economic activity, as measured by MDD. HGV activity returned to growth in 2021.

**Figure 10.7: Road freight activity**




*Source: CSO*

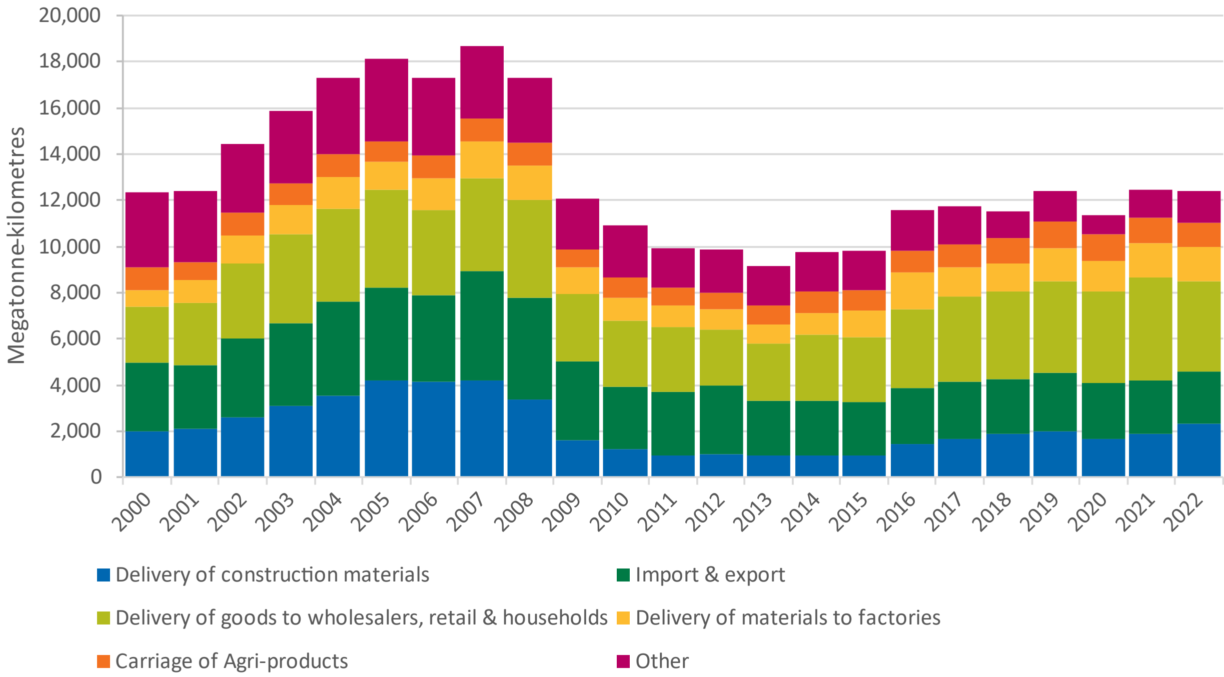
**Table 10.3: Road freight activity**

| | Quantity | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Mega tonne-kilometres | 12,384 | 12,485 | 11,537 | 9,895 | -0.8% | +8.2% | +26.2% |
| Modified domestic demand (billion € 2021) | 229,866 | 206,386 | 194,852 | 151,925 | +11.4% | +18.0% | +51.3% |

*Source: CSO*

The CSO also provides data on HGV activity, classed by main type of work done. Figure 10.8 shows the trends for tonne-kilometres in each category between 2000 and 2022.

**Figure 10.8: Road freight activity by main type of work done**




*Source: CSO*

Between 2007 and 2013, the category 'Delivery of construction materials' experienced both the largest absolute decrease and the largest percentage decrease (77%). It was responsible for the largest share of the total reduction in activity from 2007 to 2013, accounting for 34%. This corresponded to the collapse of activity in the construction sector during this period. The next biggest contributor to the fall of transport activity was 'Import and export'. Between 2007 and 2013 it reduced by 49% and accounted for 24% of the total reduction.

Despite the recovery of the economy between 2012 and 2019, the HGV activity in most categories did not recover to 2007 levels. By 2019, 'Delivery of construction materials' remained 52% below 2007 levels, 'Import and export' was 46% below and 'Other' was 58% below.

For 'Delivery of construction materials', this is to be expected, as despite the recovery in the economy, activity in both new house construction and motorway construction remained well below 2007 levels, and may never reach the exceptional output of those years again. For 'Import and export' and 'Other', it is not clear why these remained so far below 2007 levels, or if they are ever likely to reach those levels again.

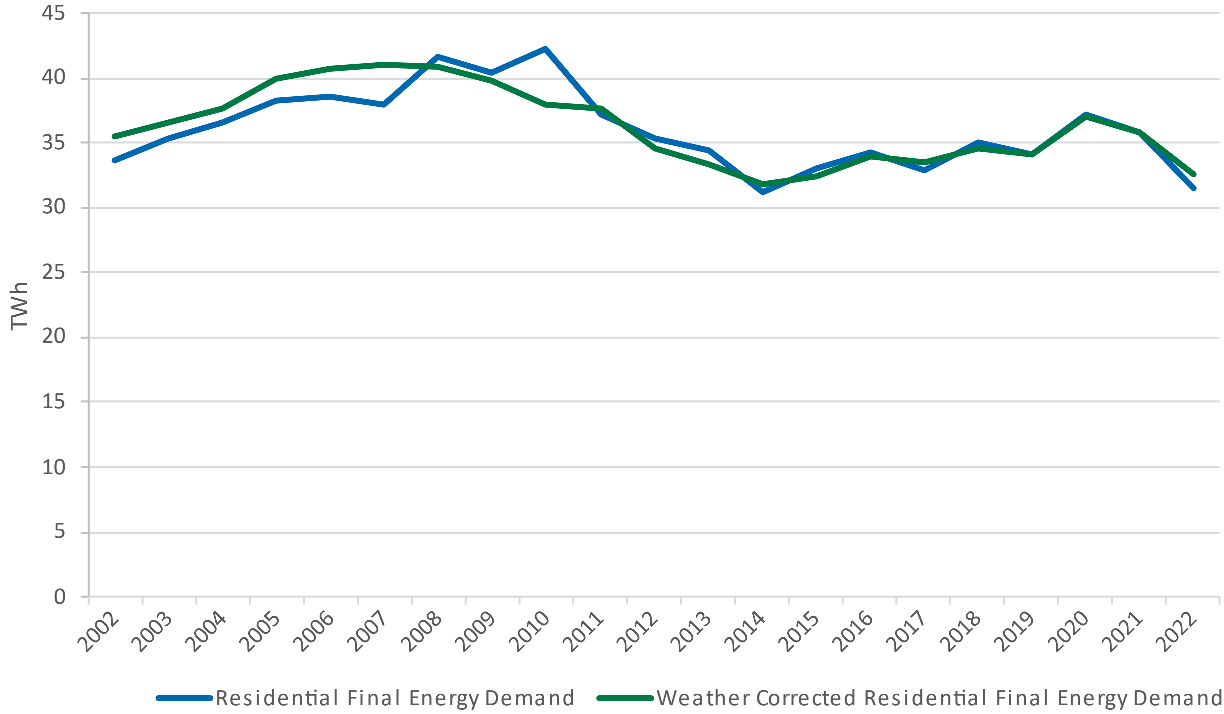
## 10.4 Residential

### 10.4.1 Weather correction

Figure 10.9 shows the trend for the residential sector's final energy consumption between 2002 and 2022, with and without weather correction. Weather correction yields a lower normalised energy consumption in cold years (*e.g.* 2010), and a higher normalised consumption in mild years (*e.g.* 2022).

Annual variations in weather affect the space heating requirements of occupied buildings. Weather correction involves adjusting the energy used for space heating by benchmarking the weather in a particular year with that of a long-term average, measured in terms of numbers of degree days.

**Figure 10.9: Residential final energy**

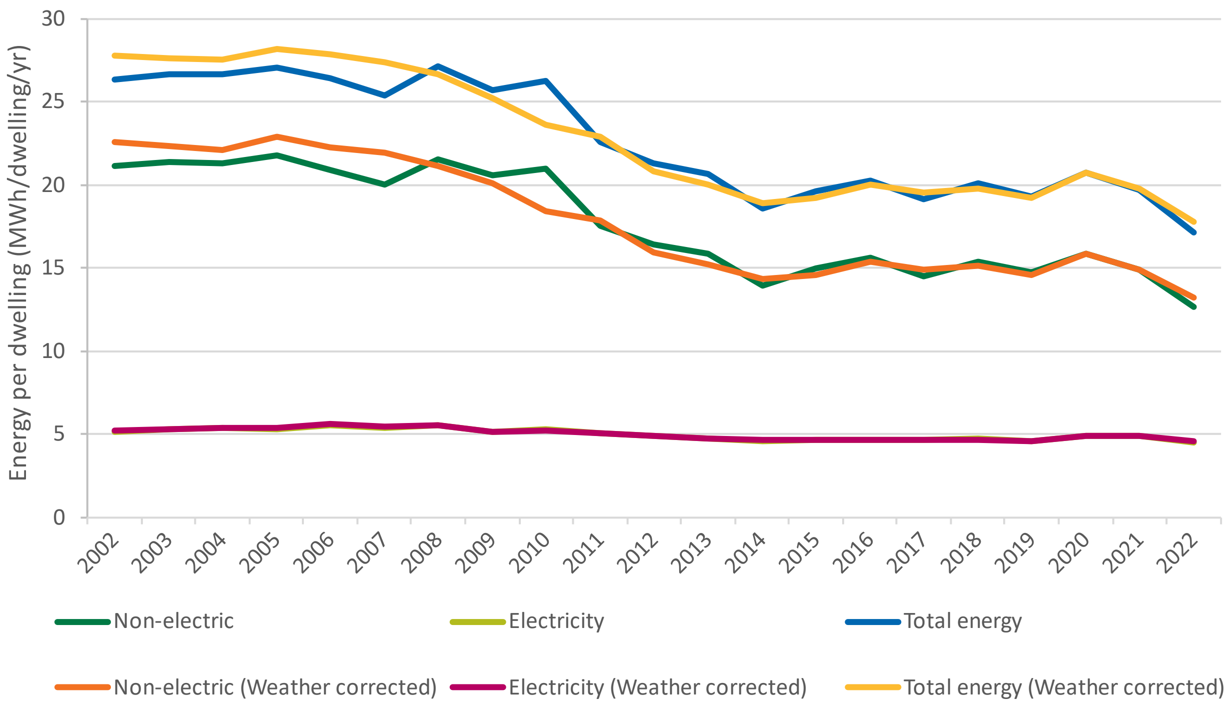



Source: Based on SEAI, CSO and Met Éireann data

## 10.4.2 Energy consumption per dwelling

Figure 10.10 shows the trend in final energy consumption per dwelling with and without weather correction.

**Figure 10.10: Energy per dwelling (permanently occupied)**



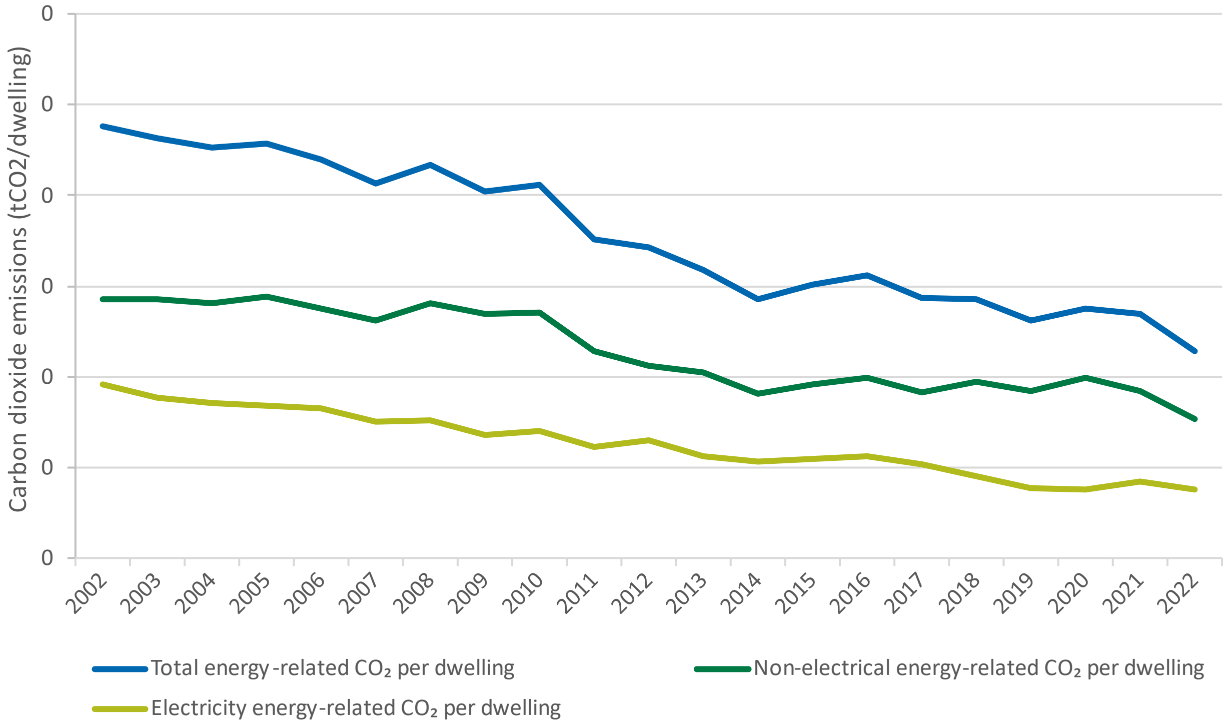

Source: Based on SEAI, CSO and Met Éireann data

**Table 10.4: Growth rates and quantities of energy consumption and $CO_2$ emissions per dwelling**

| | Quantity (MWh/dwelling) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Non-electric | 12.64 | 14.85 | 15.40 | 16.41 | 73.7% | 75.3% | 76.7% | 77.0% | -14.9% | -17.9% | -23.0% |
| Electricity | 4.51 | 4.87 | 4.69 | 4.90 | 26.3% | 24.7% | 23.3% | 23.0% | -7.3% | -3.7% | -7.8% |
| **Total energy** | **17.15** | **19.72** | **20.09** | **21.31** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-13.0%** | **-14.6%** | **-19.5%** |
| | **$tCO_2$ emissions/dwelling** | | | | **Share (%)** | | | | **Change to 2022 (%)** | | |
| | **2022** | **2021** | **2018** | **2012** | **2022** | **2021** | **2018** | **2012** | **2021** | **2018** | **2012** |
| Non-electrical energy-related $CO_2$ per dwelling | 3.08 | 3.70 | 3.89 | 4.25 | 67.3% | 68.6% | 68.2% | 62.0% | -16.8% | -20.9% | -27.6% |
| Electricity energy-related $CO_2$ per dwelling | 1.50 | 1.69 | 1.82 | 2.60 | 32.7% | 31.4% | 31.8% | 38.0% | -11.4% | -17.5% | -42.4% |
| **Total energy-related $CO_2$ per dwelling** | **4.57** | **5.39** | **5.71** | **6.85** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-15.1%** | **-19.8%** | **-33.2%** |

Source: Based on SEAI, CSO and Met Éireann data

**Figure 10.11: Unit energy-related $CO_2$ emissions per dwelling**



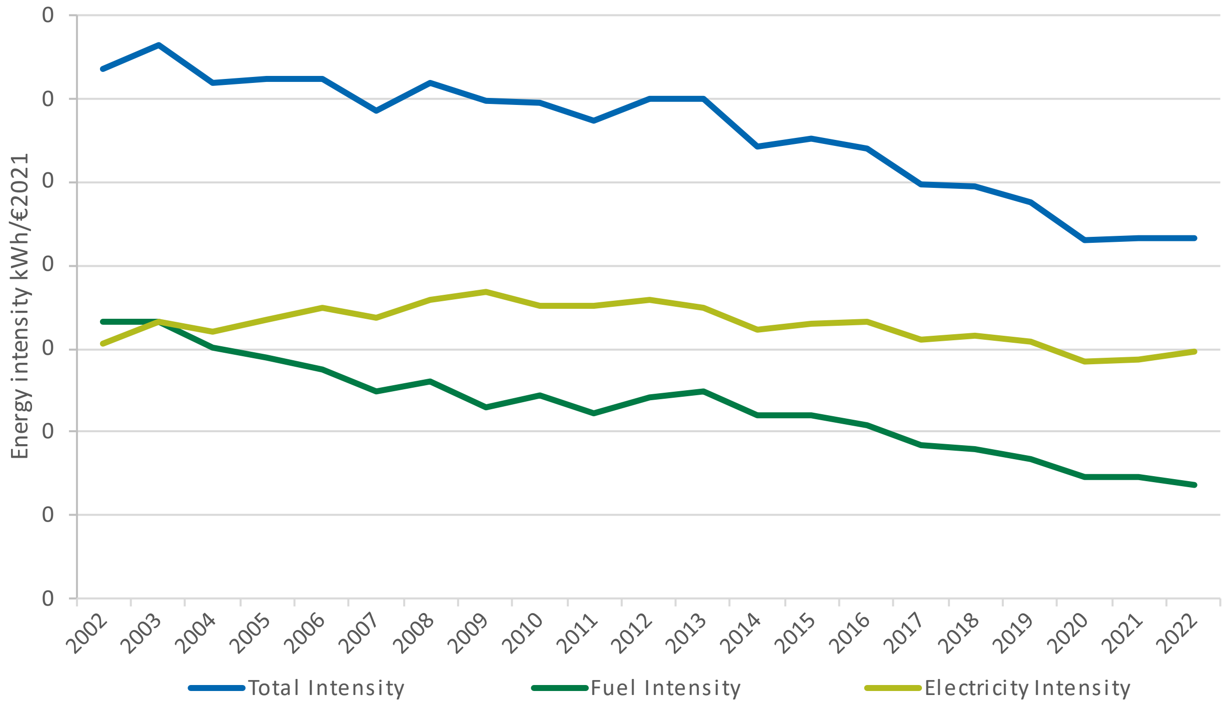

Source: Based on SEAI, CSO and Met Éireann data

## 10.5 Commercial and public services

### 10.5.1 Energy intensity of the commercial and public services sector

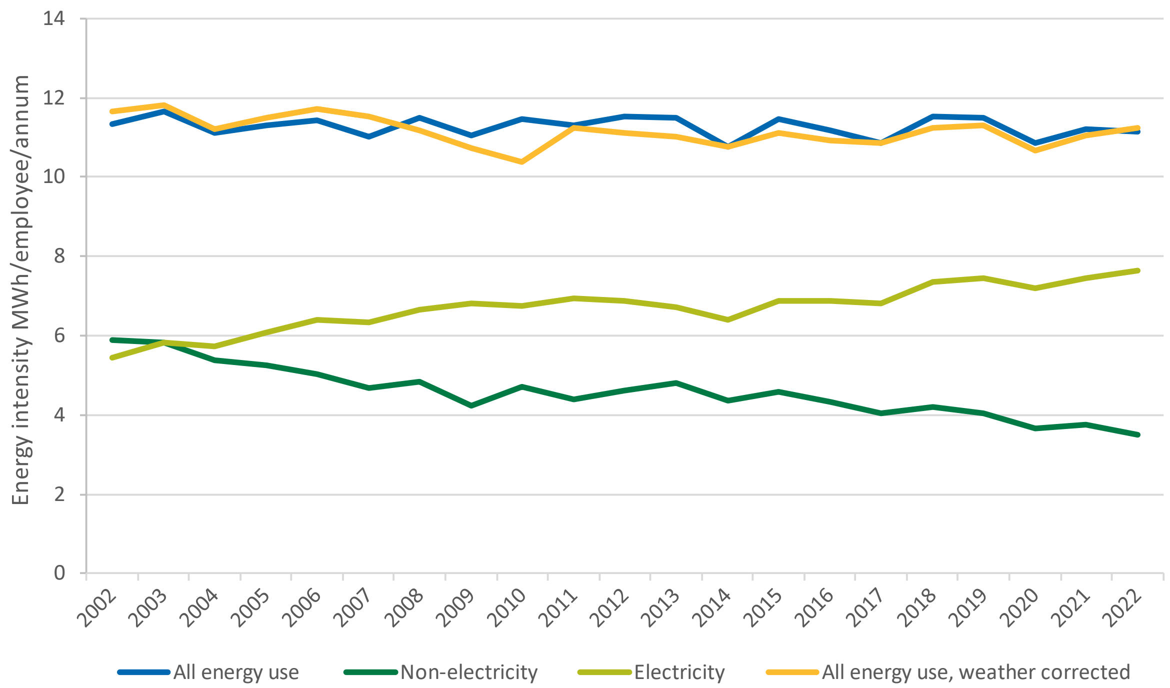
The energy intensity of the services sector is generally measured in relation to the value added generated by services activities. As shown in Figure 10.12, this intensity is flatter than that of industry.

**Figure 10.12: Energy intensity of the commercial and public services sector**




Two other indicators in this sector are energy use per unit of floor area and per employee. The consumption of oil and gas is mainly for space heating purposes and is likely to be more related to the floor area heated, rather than to the number of people occupying a building at a given time. Due to an absence of data on floor area in the services sector, it is not currently possible to calculate the consumption per unit of floor area.

**Figure 10.13: Energy per employee in the commercial and public services sector**



Electricity use per employee is used as an indicator of energy use in the services sector because, usually, there is a correlation between electricity use and the number of employees. Figure 10.13 shows electricity per employee has been increasing since 2017.

**Table 10.5: Growth rates and quantities of energy per employee in commercial and public services**

| | Quantity (MWh/employee) | | | | Share (%) | | | | Change to 2022 (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2018 | 2012 | 2022 | 2021 | 2018 | 2012 | 2021 | 2018 | 2012 |
| Electricity | 7.64 | 7.45 | 7.35 | 6.88 | 68.6% | 66.5% | 63.7% | 59.8% | +2.5% | +3.9% | +11.0% |
| Non-electricity | 3.49 | 3.76 | 4.19 | 4.63 | 31.4% | 33.5% | 36.3% | 40.2% | -7.0% | -16.7% | -24.5% |
| **Total** | **11.13** | **11.21** | **11.54** | **11.51** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **-0.7%** | **-3.6%** | **-3.3%** |

### 10.5.2 Public sector developments

The public sector comprises approximately 4,000 separate public bodies, about 3,650 of which are individual schools. The other 350 comprise, among other things, Government departments, non-commercial State bodies, State-owned companies and local authorities. Each 'public body' is a stand-alone organisation and can range in size from very small (for example, a small rural school or a five-person agency) to very large (for example, the Health Service Executive or An Garda Síochána). The vast majority of energy is consumed by the 100 largest organisations.

Public services energy consumption comprises two main classes of energy consumer:

- **Public sector buildings** (offices, hospitals, clinics, nursing homes, schools, prisons, barracks, Garda stations, *etc.*), which primarily consume electricity, natural gas and oil-based fuels in addition to smaller amounts of renewable and solid fuels.
- **Public sector utilities**, which primarily consume electricity, such as wastewater treatment plants, water treatment facilities, pumping stations and street lighting (~400,000 units).

In addition, the energy consumed by public bodies also includes some consumption counted in the transport sector in the National Energy Balance. For example, this includes public transport fleets (rail, bus, *etc.*), as well as other transport fleets operated by public bodies such as ambulances, local authority vehicles, Garda fleet, Defence Forces' vehicles, *etc.*

Under the Climate Action Plan, every public sector organisation must reduce energy-related emissions by 51% by 2030 and achieve a 50% improvement in energy efficiency in the public sector by 2030.

Since 1 January 2011, public sector bodies have been required to report to the Government annually on their energy use and the actions they have taken to reduce consumption. The reporting system includes a national public sector energy database, which includes all public sector electricity and natural gas meter numbers. Over time, the monitoring and reporting system will build a comprehensive bottom-up picture of energy consumption in the sector through the population of the national public sector energy database.

SEAI have published the Annual Report 2022 on Public Sector Energy Efficiency Performance.[35] It noted that 345 public sector bodies and 2,898 schools completed reports on energy and these represented 99% of total public sector energy consumption. The total energy consumption in 2021 of these bodies was 9,787 GWh (primary energy), which comprised 4,498 GWh of electricity, 3,245 GWh of thermal energy and 2,043 GWh of transport energy. This cost the State €728 million in 2021. The report also noted that the improvement in energy efficiency amounts to 31.5% on business as usual, equivalent to 4,353 GWh of avoided primary energy consumption, or €307

[35] https://www.seai.ie/publications/Public-Sector-Annual-Report-2022-English.pdf

million in cost savings for the sector. Non-electricity greenhouse gas emissions had decreased by 2.7% in 2021 since the baseline, while total emissions had decreased by 14.1%.

# 11 Provisional energy data from monthly surveys

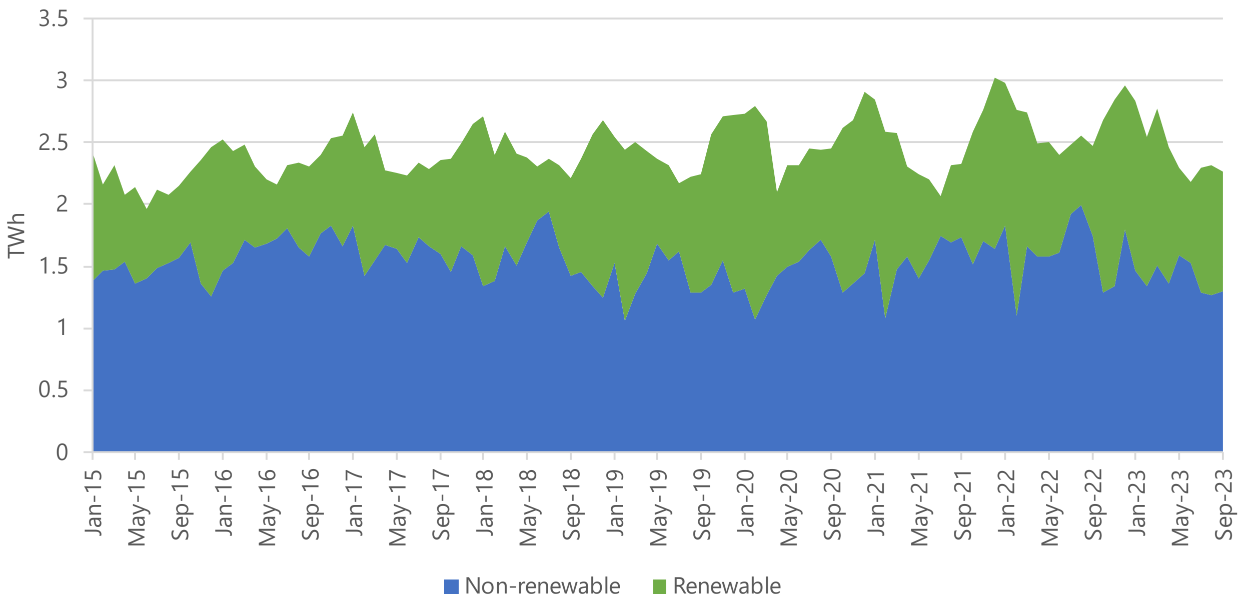
Besides its definitive annual reporting, SEAI collects and publishes provisional monthly energy data on electricity generation, gas supply and oil deliveries. The coverage of this monthly data is not as comprehensive as annual data. For example, the monthly electricity data only covers electricity exported to the grid from generator stations, and so does not include industry auto-producers or residential solar PV generation. Nor is it possible to carry out the same level of double checks and cross-agency reconciliation on monthly data as applied to definitive annual records. However, monthly data brings valuable timeliness to national energy reporting, and allows us to examine seasonal variations that are otherwise 'washed out' in annual totals. Simply put, both definitive annual reporting and provisional monthly reporting bring different advantages to energy reporting and are complementary, provided their differences are understood and acknowledged. In this section, we present provisional monthly data for electricity, gas and oil up to and including 2023, to examine medium-term trends and explore seasonal effects.

## 11.1 Monthly electricity data to 2023

### 11.1.1 Seasonality in monthly electricity generated

Figure 11.1 shows monthly electricity generation exported to the grid over the last several years, split by electricity generated from renewable sources and non-renewable sources. While the seasonality of both total electricity generation and electricity generation from renewable sources is somewhat apparent in this 'raw' monthly data, it can be made much clearer through cross-year averaging, as shown in subsequent figures.

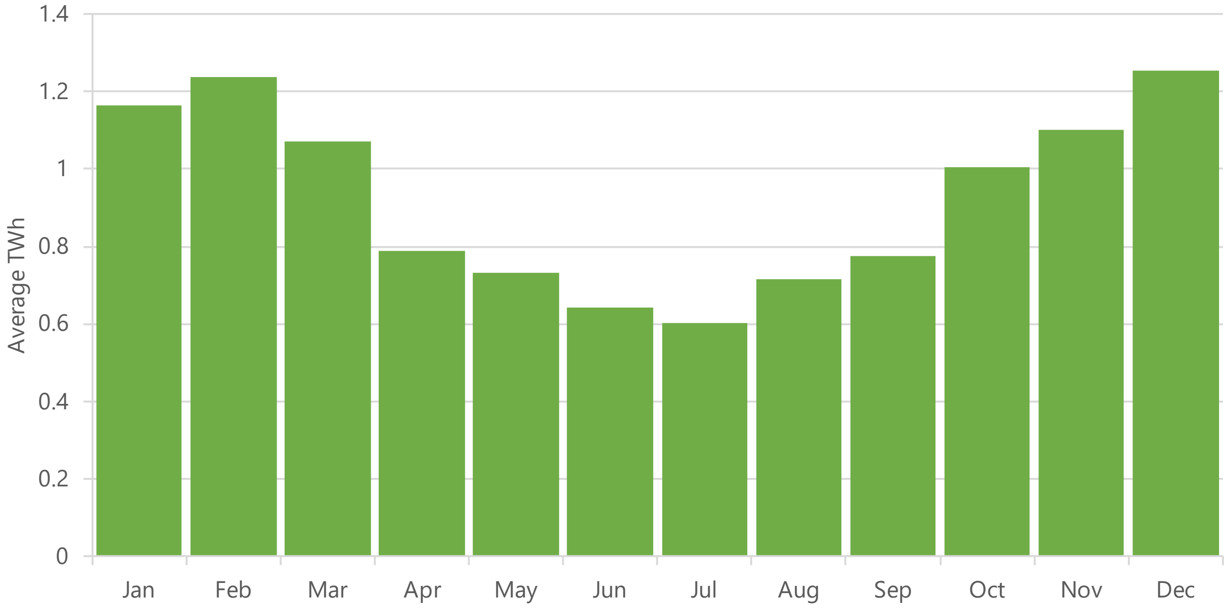
**Figure 11.1: Monthly electricity generation – January 2015 to September 2023**




*Source: data from EirGrid and SEAI*

Figure *11.2* shows the renewable electricity generation to the grid by calendar month, where each month's value is the average of that month's electricity generation over the previous 5-6 years. For example, the January value is the average of January 2015, January 2016, *etc.*, to January 2023. It shows a pronounced seasonal variation approximating a sine wave, oscillating around an average value of approximately 0.9 TWh. It has a maximum of approximately 1.2 TWh from December to February, and a minimum of approximately 0.7 TWh from June to August. The seasonal variation of renewable electricity generation is therefore approximately ±32% the annual average. This variation is largely driven by the strong seasonality of wind generation, which makes up a considerable fraction of our renewable electricity generation (see below for more details). Fortunately, the seasonality of our renewable electricity generation matches the seasonality of our demand – the wind generally blows hardest in the winter months, and this is when energy demand for light and heat is highest.

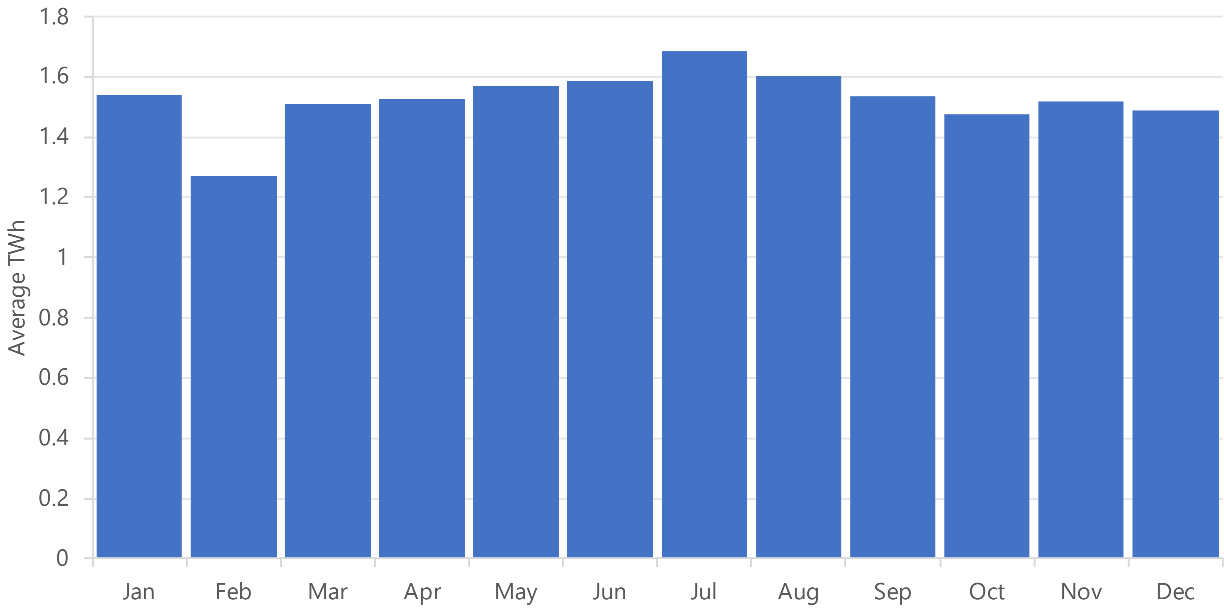
**Figure 11.2: Average renewable electricity generated – January 2015 to September 2023**




*Source: data from EirGrid and SEAI*

Figure 11.3 shows the non-renewable electricity generation to the grid by month, where each month's value is the average value of that month's electricity generation over the previous 8-9 years, as explained above. It is relatively flat at approximately 1.5 TWh per month, but shows higher non-renewable electricity generation in the summer months, and lower non-renewable electricity generation in the winter months. Non-renewable electricity generation is anti-correlated to renewable generation – when renewable generation is high, non-renewable electricity is low, and vice versa. This is most clearly illustrated by comparing the average values of February and July in Figure 11.2 and Figure 11.3, where the particularly high and low renewable generation values match particularly low and high renewable generation values.

**Figure 11.3: Average non-renewable electricity generated – January 2015 to September 2023**

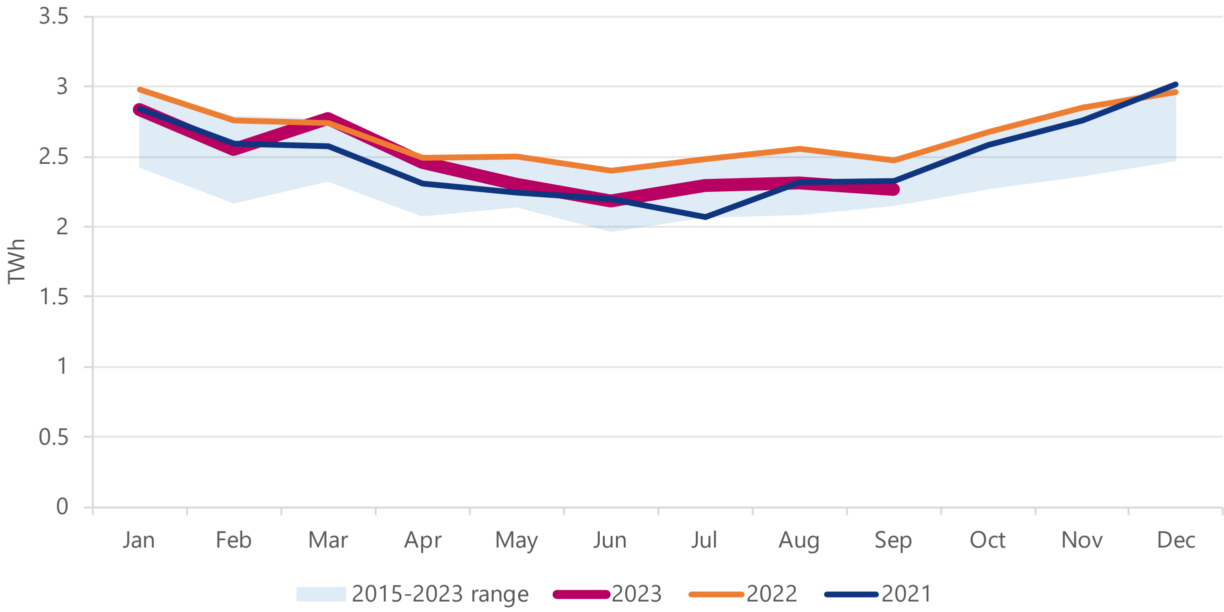



*Source: data from EirGrid and SEAI*

### 11.1.2 Monthly electricity generated in 2023

Figure 11.4 shows the total electricity generation to the grid by month in 2023, compared to the last 2 years, and the maximum-to-minimum envelope back to 2015. For almost every month in this year to date, the total monthly electricity generation in 2023 has been below the maximum level of the historic envelope. However, in March 2023, total monthly electricity generation defined the maximum level of the historic envelope for that month.

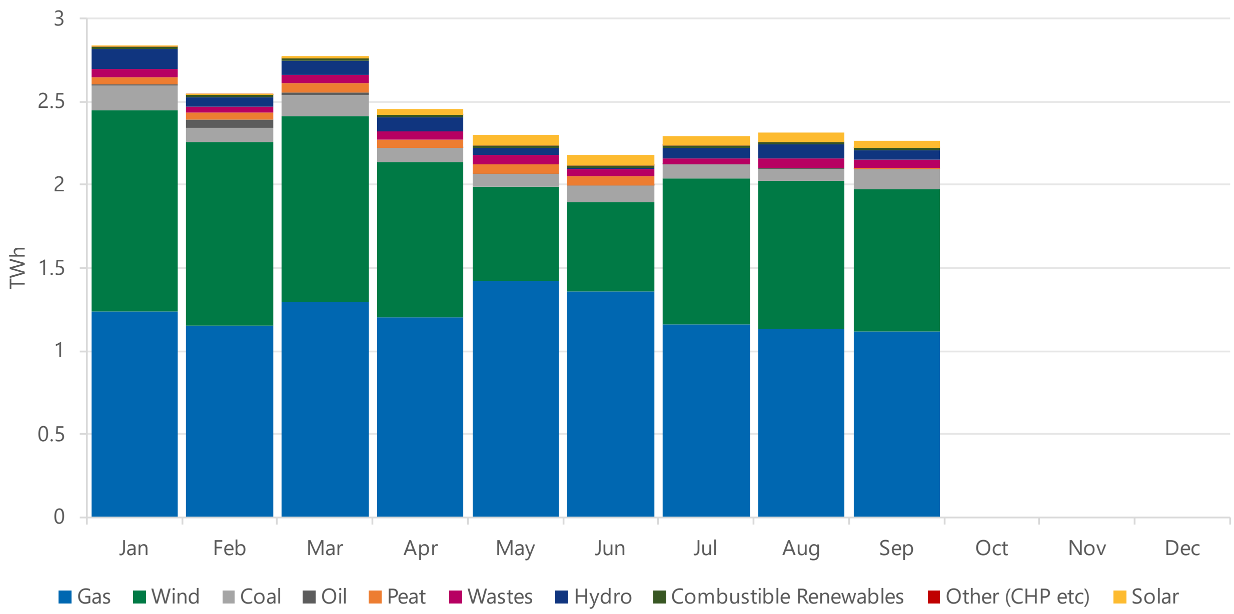
**Figure 11.4: Monthly electricity generated – 2023 to previous 2 years**




*Source: data from EirGrid and SEAI*

Figure 11.5 shows the monthly electricity generation to the grid to date in 2023, broken down by input fuel or energy type. Note that this figure shows the electricity generated due to each fuel/energy input, rather than the quantity of fuel/energy needed to generate that electricity. The seasonal variations in electricity generated from wind and gas are visible, with wind accounting for 43% of grid exported electricity in January 2023.

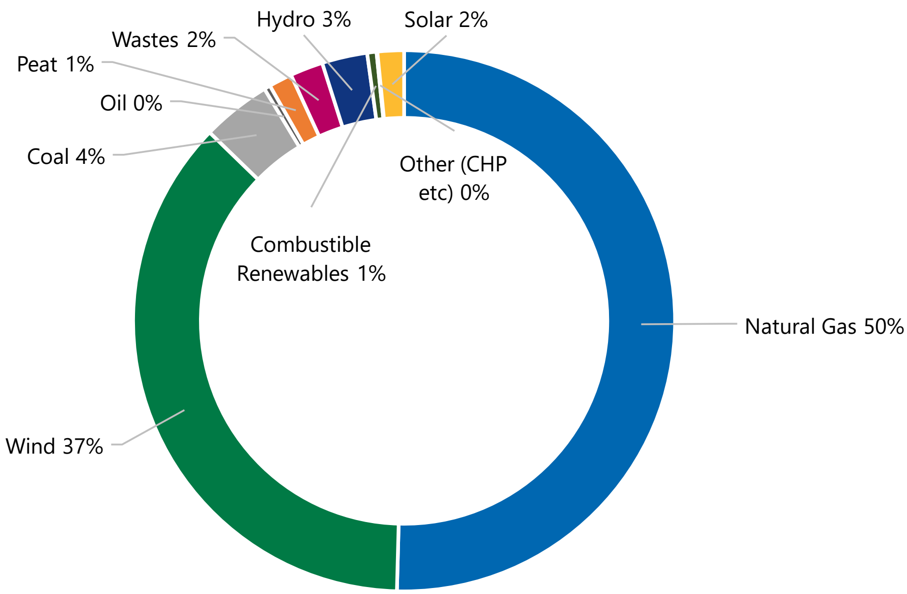
**Figure 11.5: Monthly electricity generation by source in 2023**




*Source: data from EirGrid and SEAI*

Figure 11.6 shows the breakdown of the generated electricity by input fuel or energy type, averaged over the last 12 calendar months, *e.g.* from September 2022 to September 2023. This 12-month approach is more appropriate than simply averaging over the year-to-date, because electricity generation from October to December has higher seasonal renewable contributions.

**Figure 11.6: Sources of electricity generation – 12-month rolling average to September 2023**

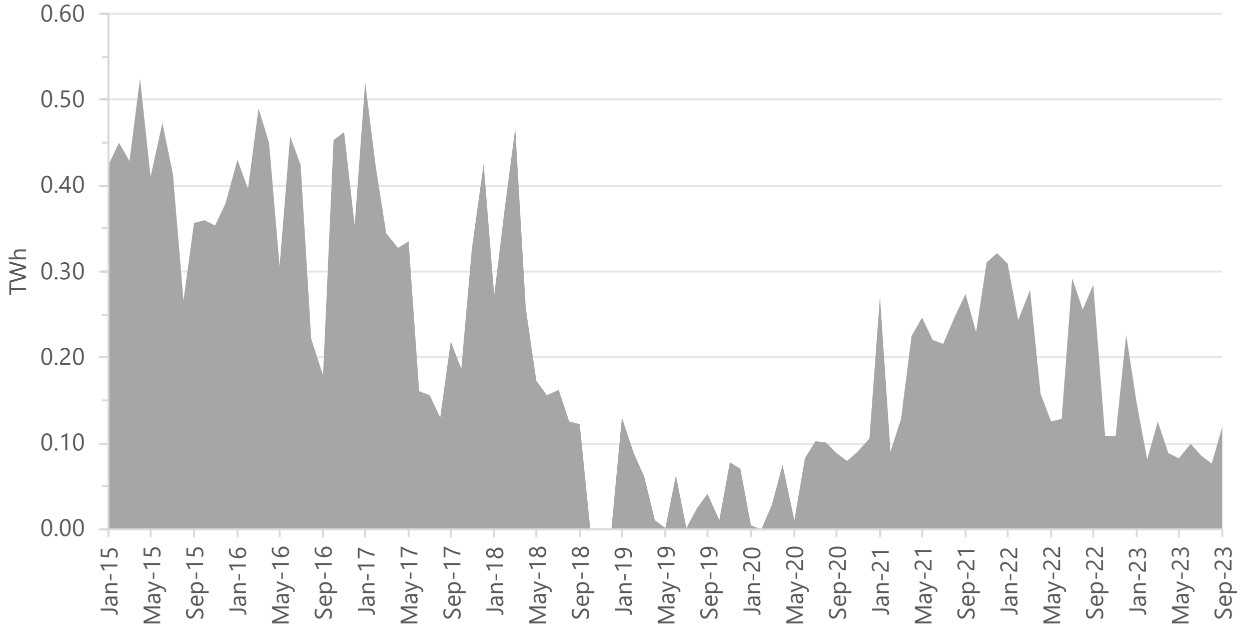



*Source: data from EirGrid and SEAI*

### 11.1.3 Spotlight on coal and oil in electricity generation

Figure 11.7 shows the monthly electricity generation arising from the combustion of coal. From late-2018 to mid-2020, coal was substantially removed from the fuel mix of grid electricity. It made a return in 2021-2022, but in 2023 to date, coal accounted for approximately 4% of monthly electricity generation.

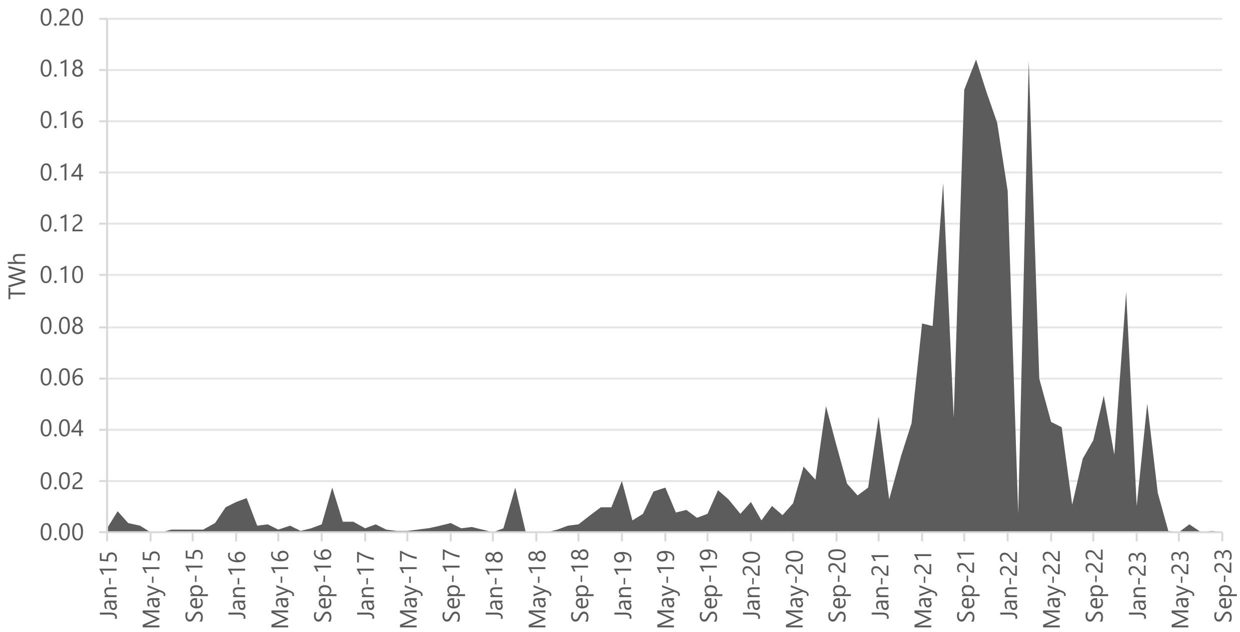
**Figure 11.7: Monthly electricity generated from coal**




*Source: data from EirGrid and SEAI*

Figure 11.8 shows the monthly electricity generation arising from the combustion of oil products. For the last decade, oil has generally been used as a secondary or priming fuel for electricity generation by other fuel types. However, from mid-2021, electricity generation from oil increased significantly, peaking at almost 0.2 TWh per month in September 2021. This increase in electricity generation from oil products appears to have been short-lived, with average monthly values in 2023 falling below 0.01 TWh.

**Figure 11.8: Monthly electricity generated from oil**



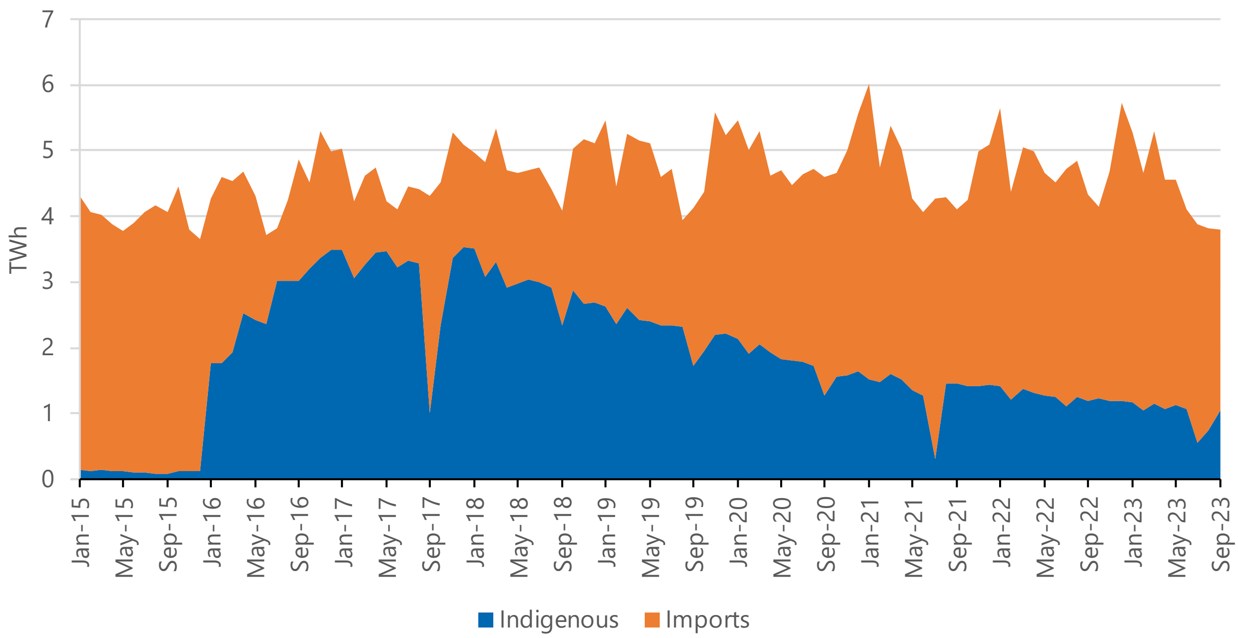
*Source: data from EirGrid and SEAI*

## 11.2 Gas

### 11.2.1 Seasonality in monthly gas supply

Figure 11.9 shows the monthly supply of grid gas over the last few years, split into imported gas and indigenous gas supply. The large step-change increase in indigenous production in January 2016 is due to the connection of the Corrib gas field to the national gas grid. Indigenous production peaked in 2017 and has slowly been decreasing since then, which is commensurate with the natural life cycle of a gas field. The sharp drops in indigenous production in September 2017, July 2021 and July-August 2023 correspond to periods of maintenance at the Corrib gas field or its connection to the grid. In these periods of low indigenous production, the gas interconnectors between Ireland and Scotland stepped-up delivery of imports to satisfy demand. The monthly supply of gas to the grid can be 'spikey' because a substantial fraction of total gas supply is used for electricity generation which backs intermittent wind generation. In periods of low wind, gas supply to gas-fired electricity plants needs to increase, and vice versa.

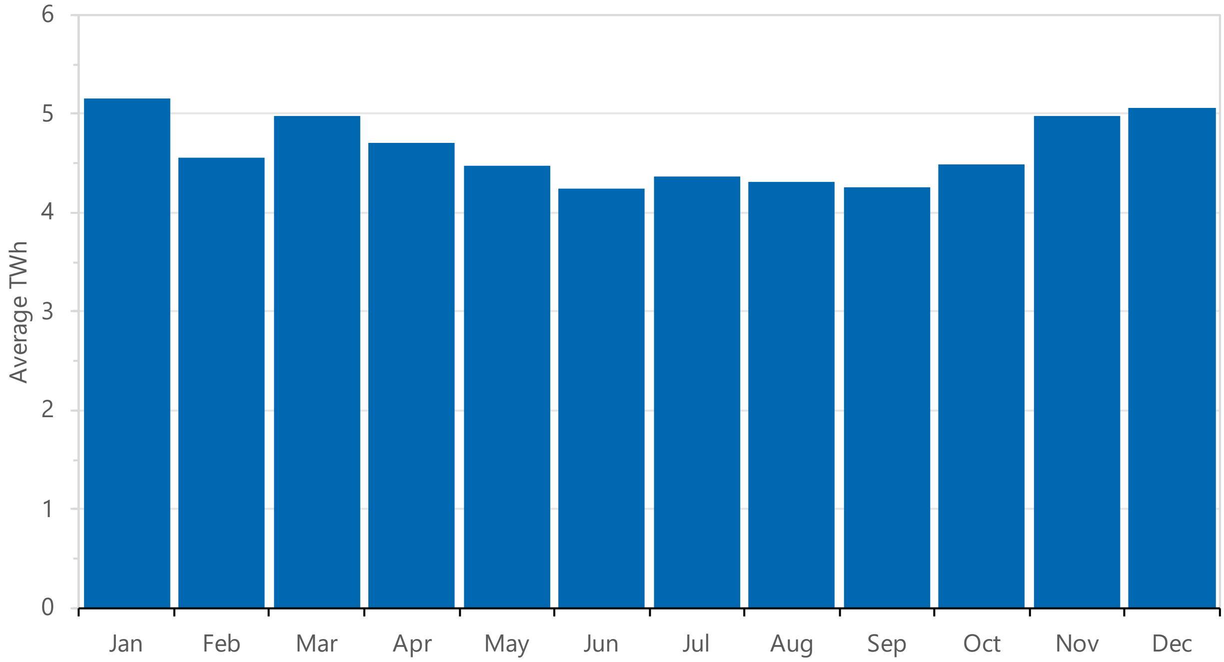
**Figure 11.9: Monthly gas supply trends**




*Source: data from GNI*

Figure 11.10 shows the total gas supply to the grid by month, where each month's value is the average value of that month's gas supply over the previous 8-9 years. For example, the January value is the average of total gas supply to the grid from January 2023, January 2022, January 2021, *etc.*, back to January 2015. While certain sectors have pronounced seasonal variations, particularly the residential sector's gas demand for space heating, the overall seasonal variation in total gas supply is relatively small. Market-shifts act to flatten the profile of monthly gas supply across the year. In winter months, gas supply to the residential sector is higher for heating, but gas supply to electricity generation is lower (because wind generation has a seasonal peak). Conversely, in summer months, gas supply to the residential sector is lower, but gas supply to electricity generation is higher (because wind generation has a seasonal low).

**Figure 11.10: Average monthly gas supply – 2015 to 2023**

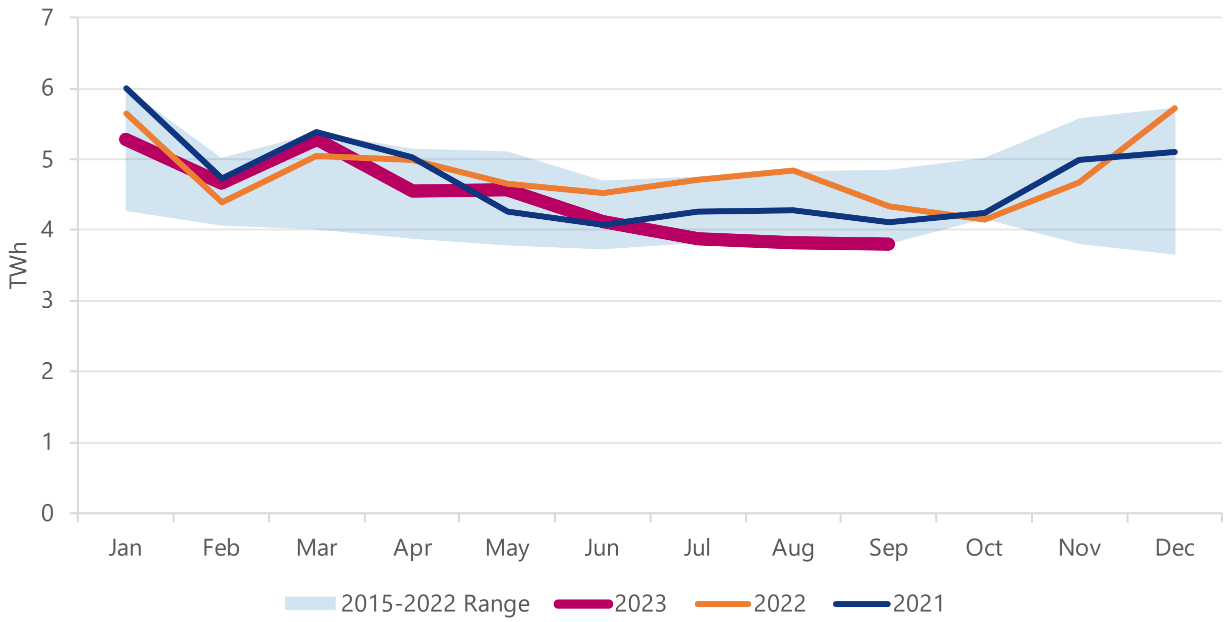



*Source: data from GNI*

### 11.2.2 Monthly gas supply in 2023

Figure 11.11 shows the overall monthly gas supply in 2023 compared to the previous two calendar years, and in the context of the maximum and minimum monthly supplies back to 2015. Overall gas supply in the first half of 2023 was typical, but fell below 2022 and 2021 levels in Q3 of the year. One factor behind this was the lower than typical use of natural gas for power generation; in Q3 2023, output from gas-fired generation was the lowest for that time of year since 2015.

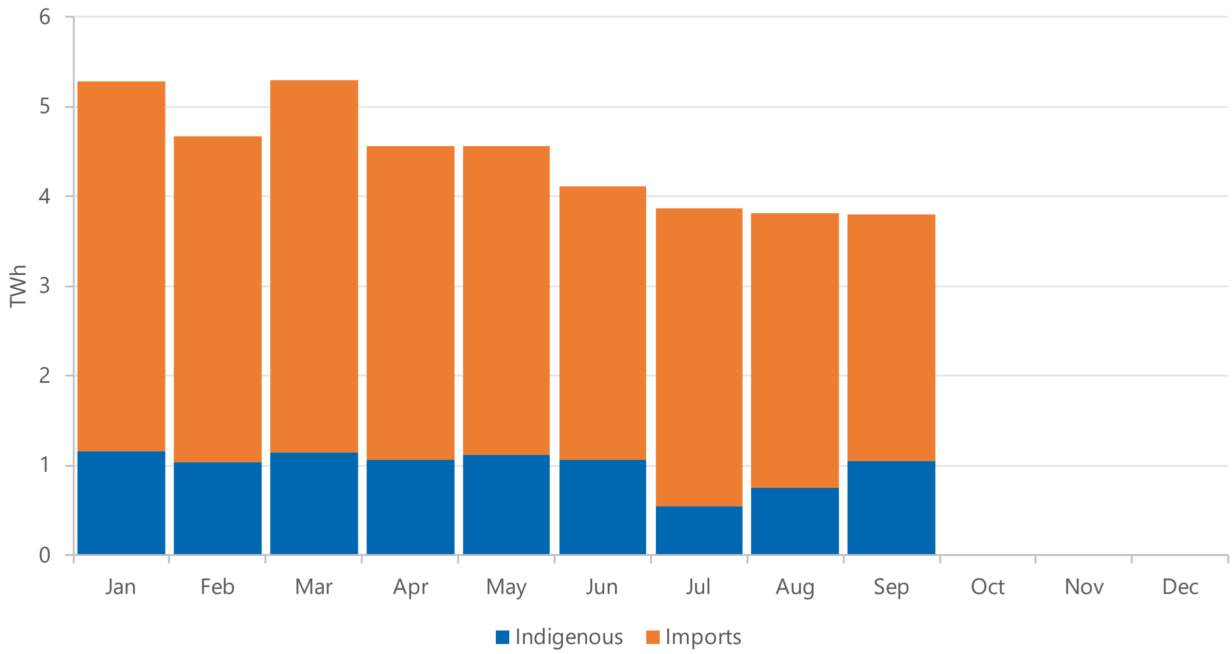
**Figure 11.11: Monthly gas supply – 2023 compared to previous 2 years**




*Source: data from GNI and SEAI*

As currently collected, the monthly gas supply data shown in Figure 11.12 is broken down only into indigenous gas and imported gas. In general, indigenous supply is relatively constant and demand supply of imported gas is adjusted to match demand patterns, especially those arising from gas-fired electricity generation plants stepping-up and -down to back renewable generation of electricity. The drop in indigenous production in July and August 2023 correspond to periods of maintenance at the gas terminal.

**Figure 11.12: 2023 monthly gas supply**

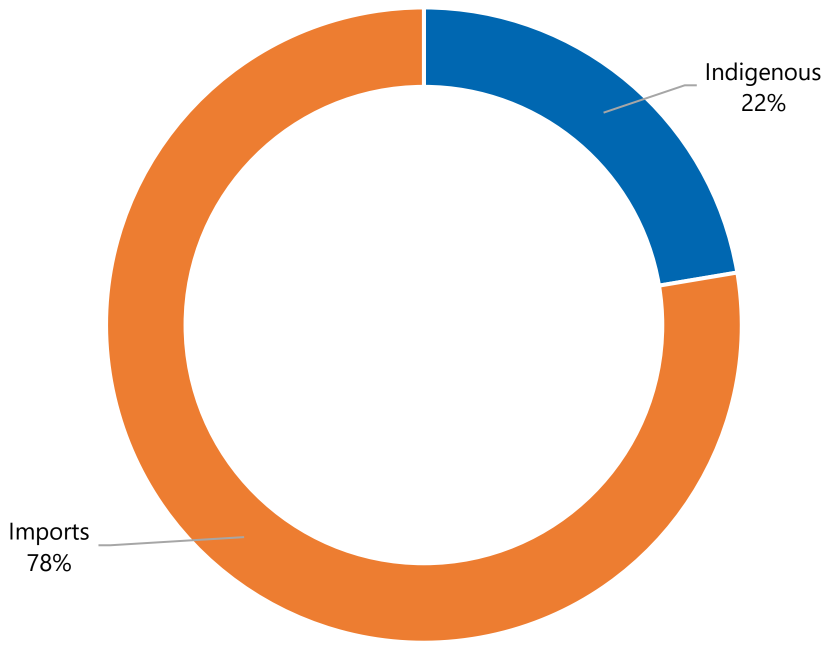



*Source: data from GNI*

Figure 11.13 shows the breakdown of monthly gas supply data in 2023 by indigenous gas and imported gas, averaged over the last 12 calendar months, *i.e.* from September 2022 to September 2023. This approach is more appropriate than simply averaging over the year-to-date to September 2023, because electricity generation from October to December has higher seasonal renewable contributions. In the last 12-months, the proportion of electricity generation to the grid was:

- Imported gas 22%
- Indigenous gas 78%

**Figure 11.13: Source of gas supply – 12-month rolling average to September 2023**




*Source: data from GNI*

## 11.3 Oil

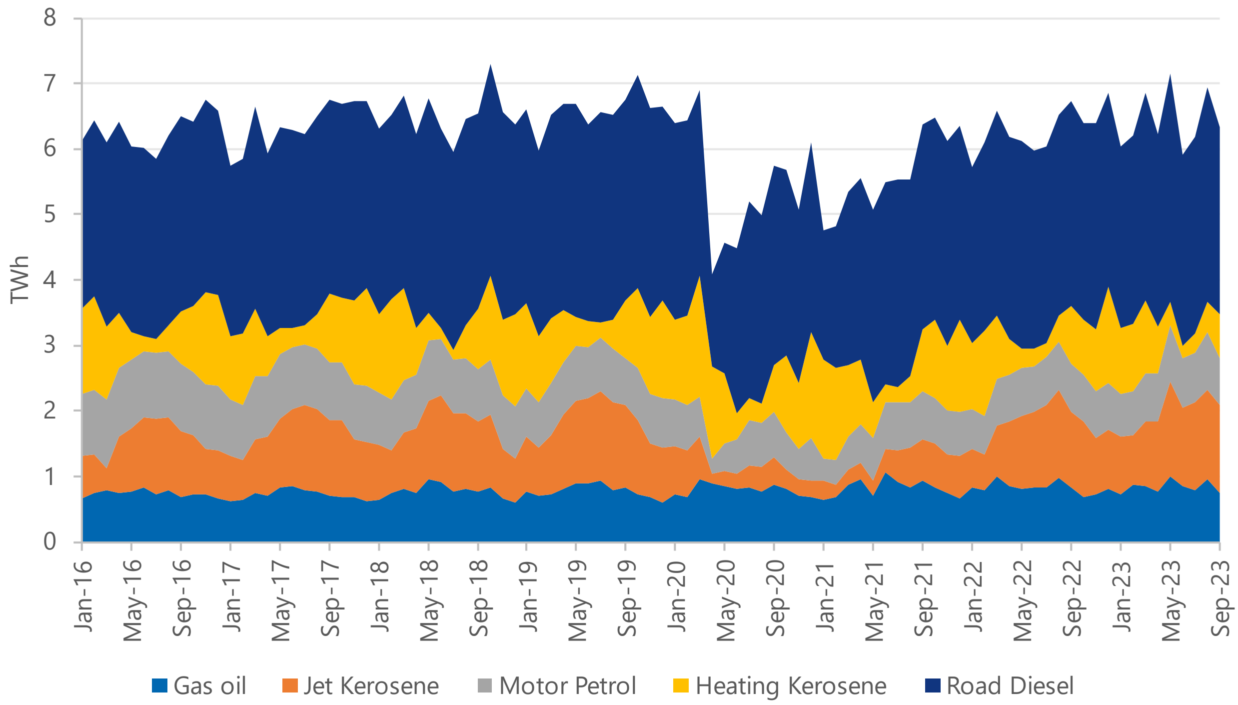
Monthly oil supply is captured in terms of gross inland deliveries (GIDs), or "The observed delivery of finished petroleum products from primary sources (*e.g.* refineries, blending plants *etc.*) to the inland market". GID is the quantity of oil-products flowing through the market from production to delivery, now ready sale or consumption:

> **Gross Inland Delivery** = Primary product receipts + Refinery gross output + Recycled products - Refinery fuel + Imports - Exports - International marine bunkers + Inter-product transfers - Products transferred - Stocks changes

### 11.3.1 Seasonality and COVID impacts in monthly oil deliveries

Figure 11.14 shows the sum of monthly oil deliveries from Road Diesel, Motor Petrol, Heating Kerosene, Jet Kerosene, and Gas oil from January 2016 to September 2023.

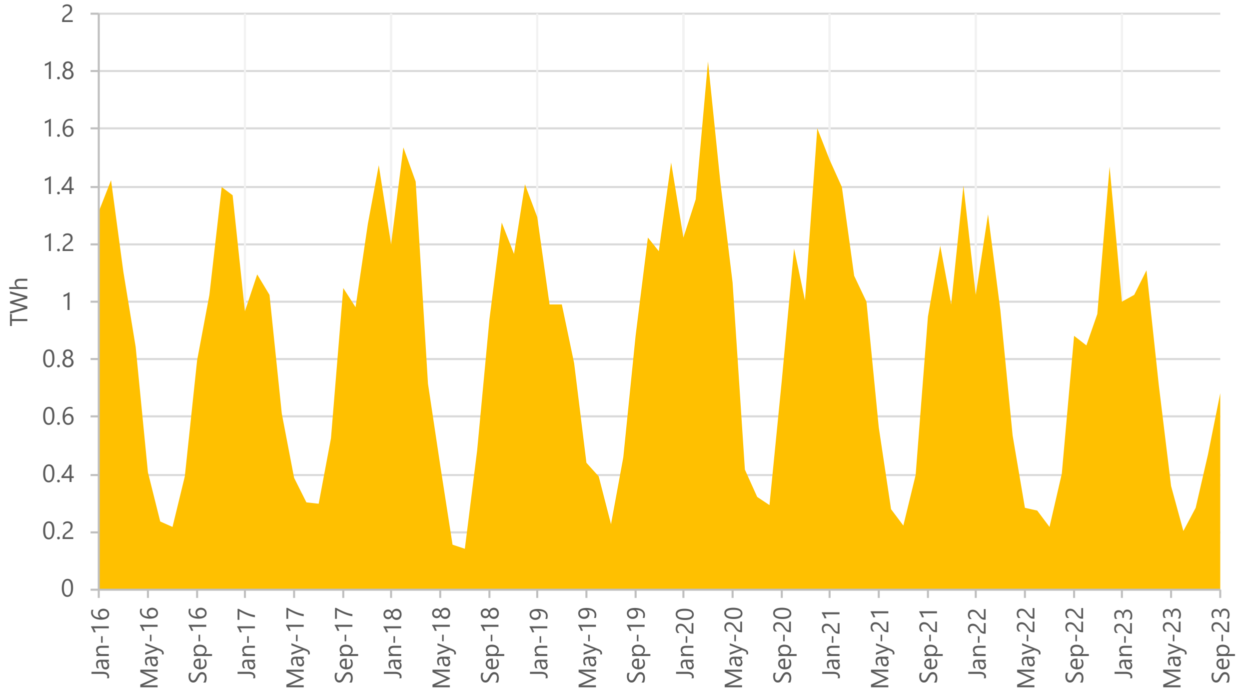
**Figure 11.14: Oil supply trends**




*Source: data from Dept. of Environment, Climate and Communications and SEAI*

Figure 11.15 to Figure 11.18 breakout the monthly delivery of different oil products to better show their seasonal variation, and any impacts from COVID. The monthly delivery of heating kerosene has a strong seasonal pattern with demand peaking in the height of winter and falling to about 20% of peak values in the summer months.

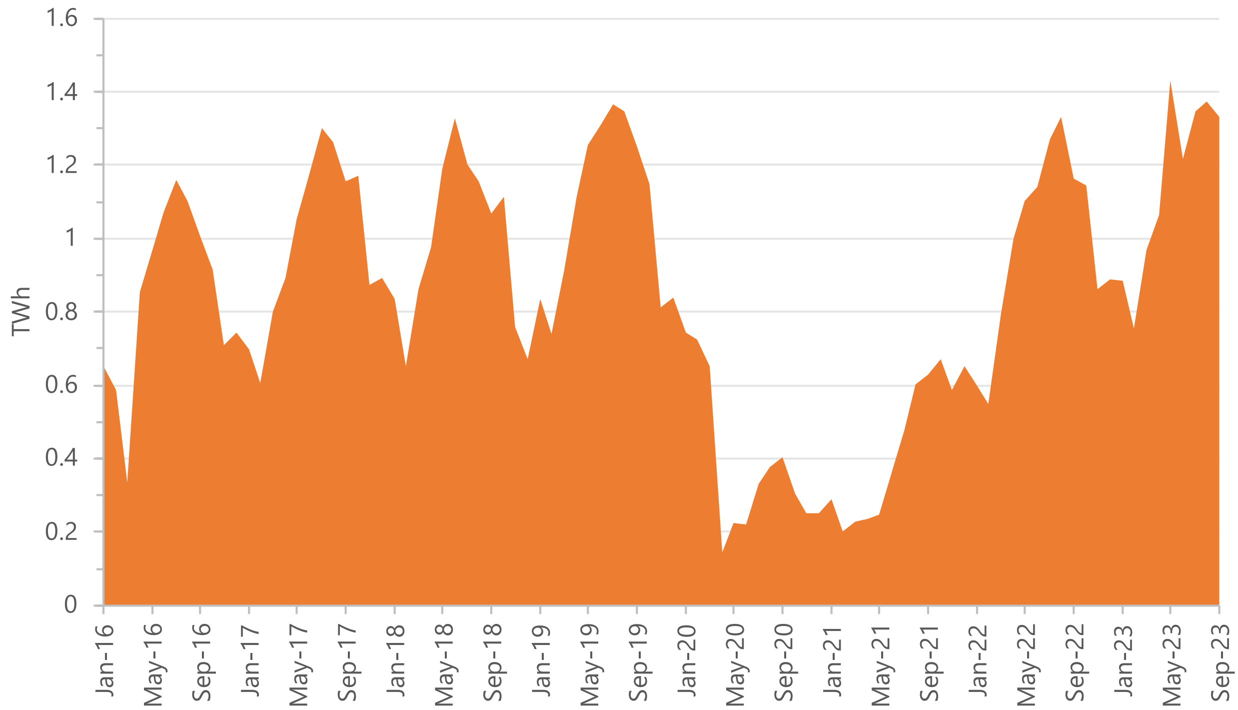
**Figure 11.15: Trend in heating kerosene**




*Source: data from Dept. of Environment, Climate and Communications and SEAI*

Deliveries of jet kerosene show peaks in summer months and in the Christmas / New Years period, due to the high volume of flights to and from Ireland for holidays and tourism. In April 2020, delivery of jet kerosene fell to just 10% of its peak value in 2019, as COVID travel restrictions were rolled out. When averaging jet kerosene deliveries for the first nine months of the 2023, jet kerosene deliveries had rebounded to 102% of 2019 values.

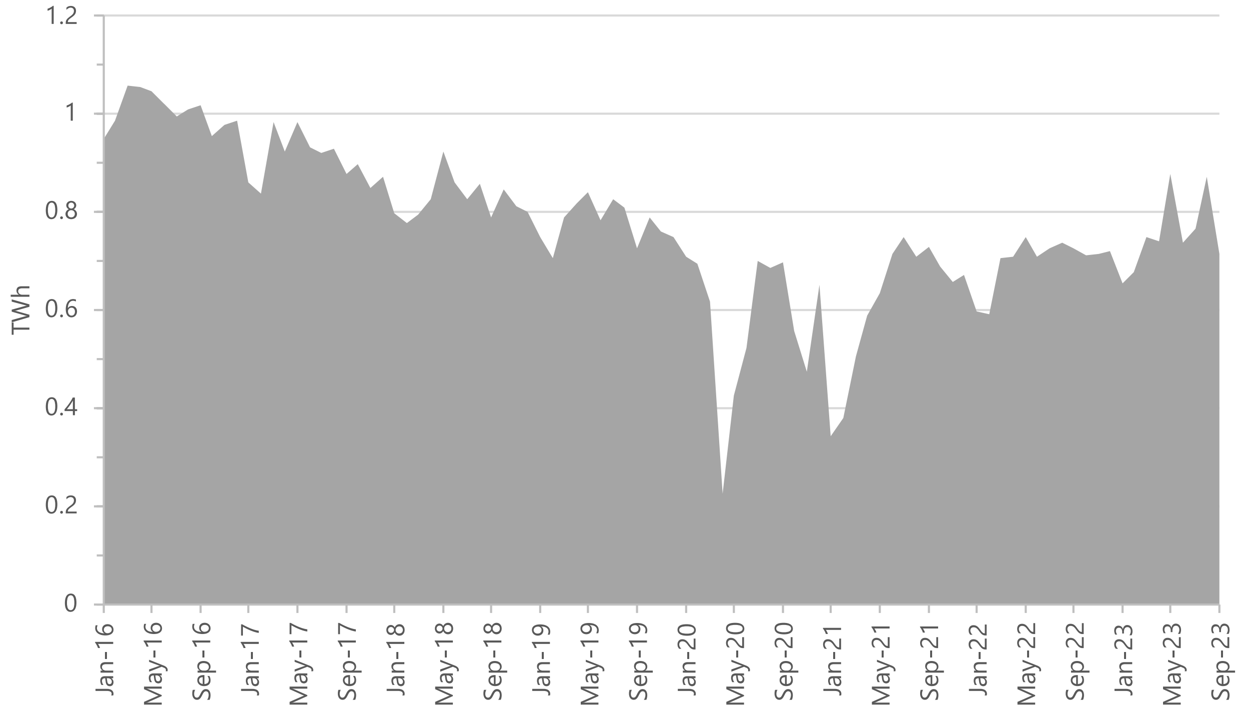
**Figure 11.16: Trend in jet kerosene**



*Source: data from Dept. of Environment, Climate and Communications and SEAI*

Monthly deliveries of motor petrol show a gradual but noticeable decline from January 2016 to January 2020, before being disrupted by COVID impacts. This led to significant dips in April 2020 and January 2021 following the announcement of national lockdown restrictions on 27 March and 31 December 2020, respectively. A smaller dip around and after Christmas 2021 was likely due to travel hesitancy after the COVID-Omicron surge. When averaging motor petrol deliveries for the first nine months of the 2023, motor petrol deliveries had rebounded to within 96% of 2019 values.

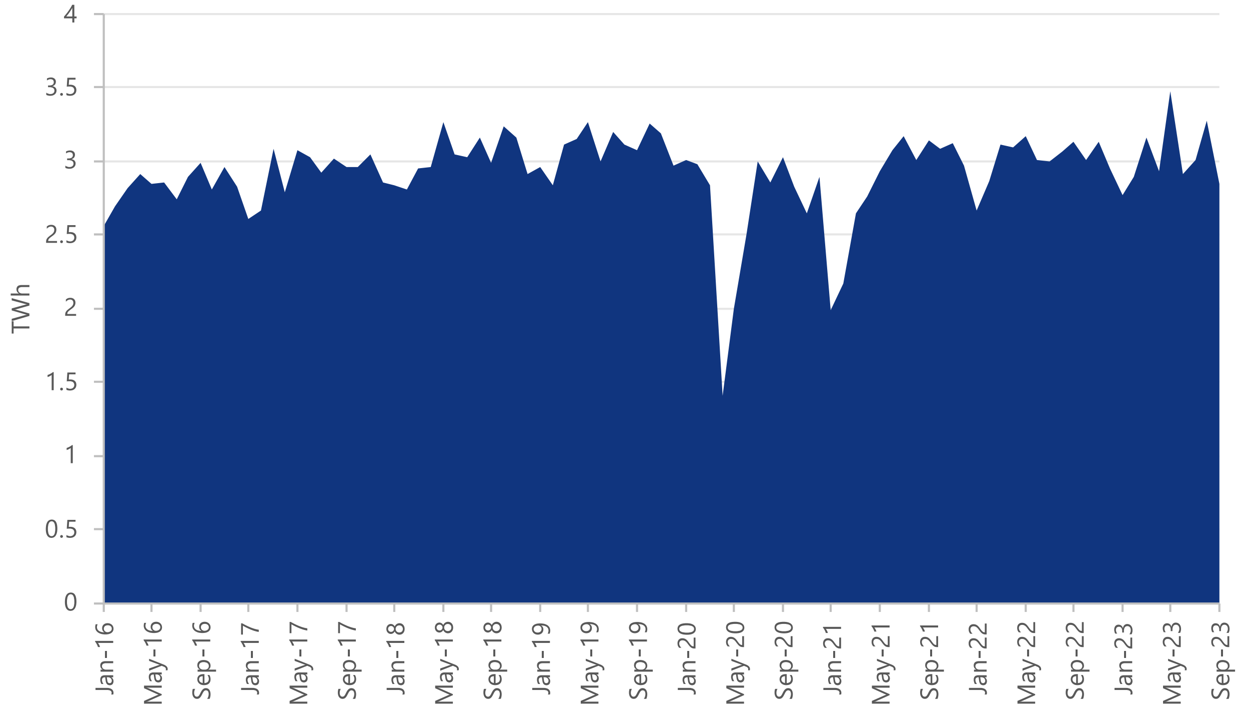
**Figure 11.17: Trend in motor petrol**




*Source: data from Dept. of Environment, Climate and Communications and SEAI*

Monthly deliveries of road diesel show the same sharp COVID features as motor petrol. However, in contrast to motor petrol, road diesel shows a gradual but noticeable increase from January 2016 to January 2020. When averaging road diesel deliveries for the first nine months of the year, road diesel deliveries had rebounded to within 98% of 2019 values.

**Figure 11.18: Trend in road diesel**

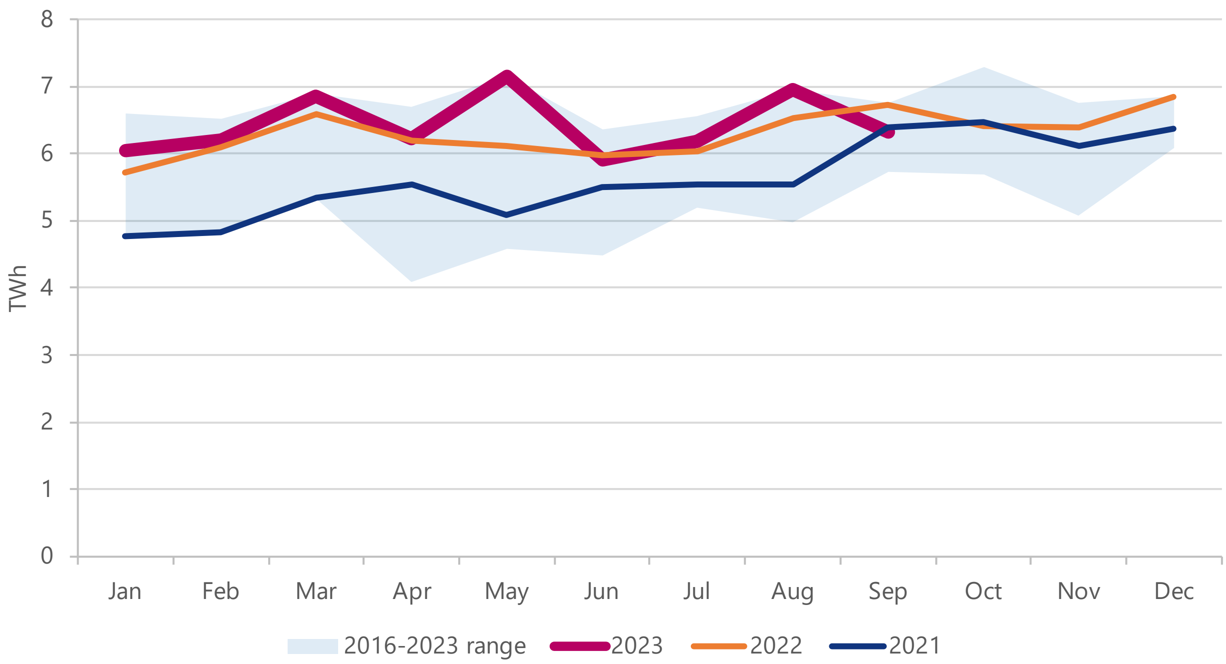



*Source: data from Dept. of Environment, Climate and Communications and SEAI*

### 11.3.2 Monthly oil supplies in 2023

Figure 11.19 shows 2023 total monthly oil supply compared to the previous two calendar years, and in the context of the maximum and minimum monthly supplies back to 2016. Most minimum values in this period were set during COVID impacts in 2020. Almost every month in the first nine months of 2023, with the exception of June and September, total oil deliveries were higher than in 2022.

**Figure 11.19: Monthly oil supply – 2023 compared to previous 2 years**



*Source: data from Dept. of Environment, Climate and Communications and SEAI*

Figure 11.20 shows the breakdown of monthly oil deliveries by type in 2023 to date. The seasonal variations in heating kerosene and jet kerosene are visible, and tend to compensate for each other in the total oil deliveries, *i.e.* deliveries of jet kerosene are highest in summer, when deliveries of heating kerosene are lowest.

**Figure 11.20: Monthly oil product supply – 2023 to date**

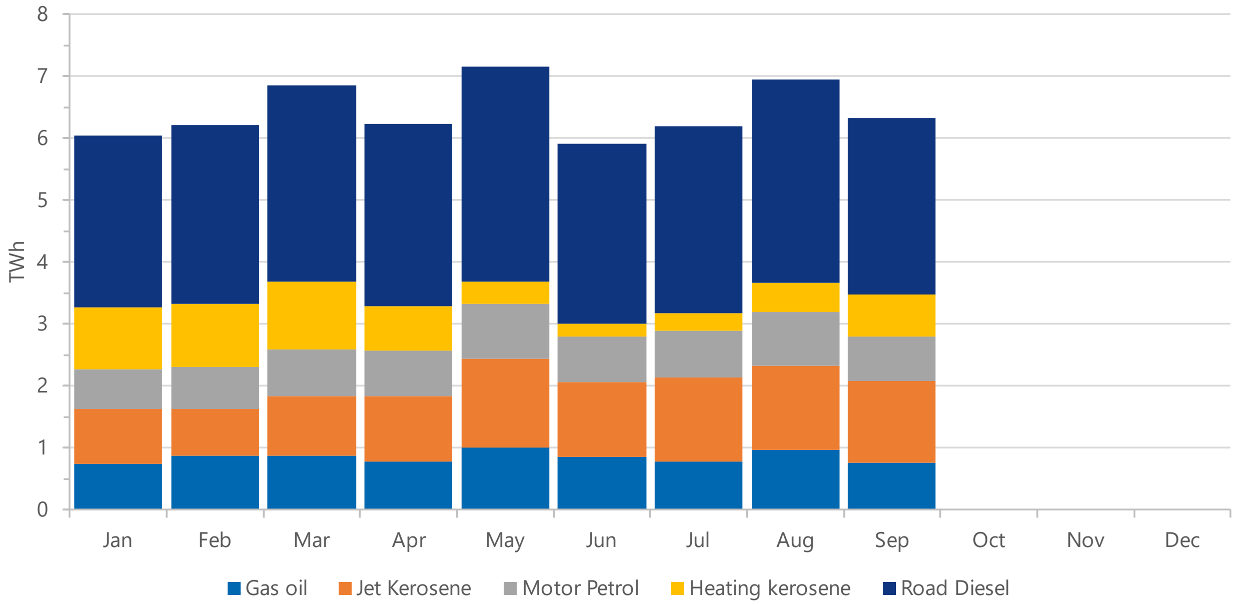
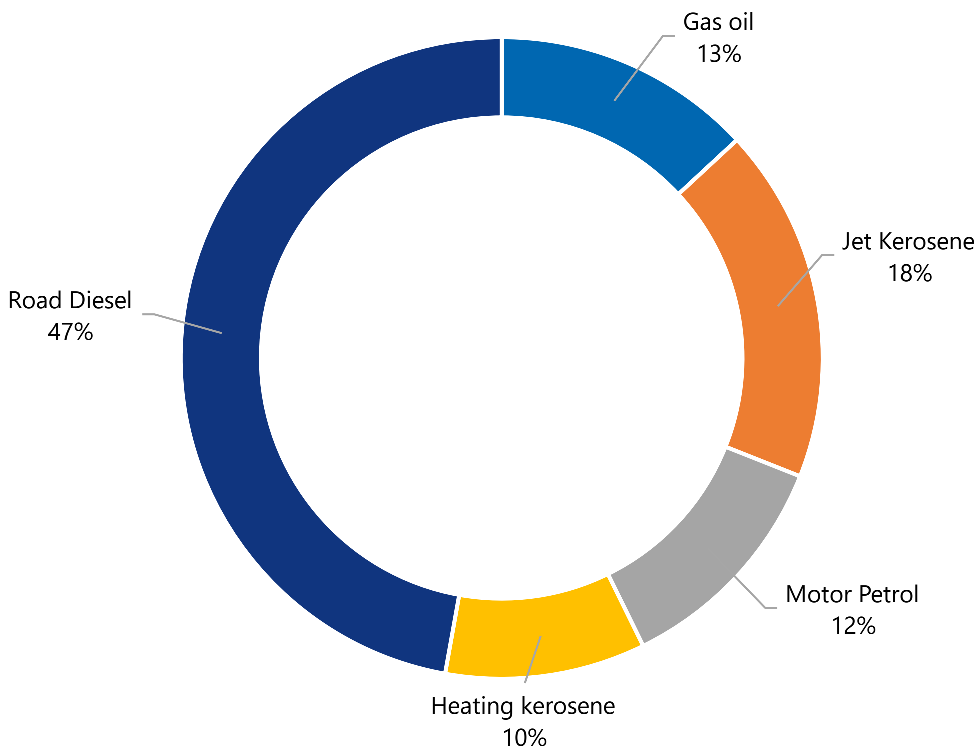



Figure 11.21 shows the percentage breakdown of average monthly oil deliveries by type to date in 2023:

- Road Diesel 47%
- Jet Kerosene 18%
- Gas oil 13%
- Motor Petrol 12%
- Heating Kerosene 10%

**Figure 11.21: Breakdown of oil product supply – 2023 to date**



## Appendix 1: List of figures

## Appendix 2: List of tables

## Appendix 3: Glossary of abbreviations

| Abbreviation | Explanation |
|---|---|
| BEUS | Business Energy Use Survey |
| CAP | Climate action plan |
| CCGT | Combined cycle gas turbine |
| CHP | Combined heat and power |
| $CO_2$ | Carbon dioxide |
| CSO | Central Statistics Office |
| DART | Dublin Area Rapid Transit |
| DECC | Department of the Environment, Climate and Communications |
| EPA | Environmental Protection Agency |
| ETS | EU Emission Trading Scheme |
| EV | Electric vehicle |
| GCV | Gross calorific value |
| GDP | Gross domestic product |
| GFC | Gross final consumption (of energy) |
| GHG | Greenhouse gas |
| GNI* | Modified gross national income |
| GNP | Gross national product |
| goe | Gramme of oil equivalent |
| GWh | Gigawatt hour |
| HGV | Heavy goods vehicle |
| ICT | Information and communications technology |
| IEA | International Energy Agency |
| IP | Intellectual property |
| IPCC | Intergovernmental Panel on Climate Change |
| ktoe | Kilotonne of oil equivalent |
| LNG | Liquefied natural gas |
| MDD | Modified domestic demand |
| NCT | National Car Testing service |
| NCV | Net calorific value |
| NECP | National Energy and Climate Plan |
| NEDC | New European Driving Cycle |
| NEEAP | National energy efficiency action plan |

| Abbreviation | Explanation |
|---|---|
| NORA | National Oil Reserves Agency |
| NREAP | National renewable energy action plan |
| OECD | Organization for Economic Co-operation and Development |
| PV | Photovoltaic |
| R&D | Research and development |
| RED | Renewable Energy Directive |
| REDI | First Renewable Energy Directive |
| REDII | Recast Renewable Energy Directive |
| RES | Renewable energy share |
| RES-E | Renewable energy share in electricity |
| RES-H | Renewable energy share in heat |
| RES-T | Renewable energy share in transport |
| SEAI | Sustainable Energy Authority of Ireland |
| TFC | Total final energy consumption |
| TJ | Terajoule |
| TPER | Total primary energy requirement |
| TWh | Terawatt hour |
| UCO | Used cooking oil |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VOC | Volatile organic compounds |
| WLTP | Worldwide Harmonised Light Vehicle Test |

## Appendix 4: Glossary of terms

**Biomass:** Directive (EU) 2018/2001 defines biomass as the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin.

**Carbon dioxide ($CO_2$):** A compound of carbon and oxygen formed when carbon is burned. Carbon dioxide is one of the main greenhouse gases. Units used in this report are t $CO_2$ – tonnes of $CO_2$, kt $CO_2$ – kilotonnes of $CO_2$ (103 tonnes) and Mt$CO_2$ – megatonnes of $CO_2$ (106 tonnes).

**Carbon intensity (g$CO_2$/kWh)**: This is the amount of $CO_2$ that will be released per kWh of energy of a given fuel. For most fossil fuels the value of this is almost constant, but in the case of electricity it will depend on the fuel mix used to generate the electricity and also on the efficiency of the technology employed.

**Combined heat and power (CHP) plants**: CHP refers to plants which are designed to produce both heat and electricity, for own use only or third-party owned and selling electricity and heat on site as well as exporting electricity to the grid.

**Energy intensity**: The amount of energy used per unit of activity. Examples of activity used in this report are gross domestic product (GDP), value added, number of households, employees, *etc.* Where possible, the monetary values used are in constant prices.

**Gross and net calorific value (GCV and NCV)**: The GCV gives the maximum theoretical heat release during combustion, including the heat of condensation of the water vapour produced during combustion. This water is produced by the combustion of the hydrogen in the fuel, or in some cases from the evaporation of water already present in the fuel. The NCV excludes this heat of condensation because it cannot be recovered in conventional boilers. For natural gas, the difference between GCV and NCV is about 10%, for oil it is approximately 5%.

**Gross domestic product (GDP)**: The GDP represents the total output of the economy over a period.

**Gross electrical consumption**: Gross electricity production is measured at the terminals of all alternator sets in a station; it therefore includes the energy taken by station auxiliaries and losses in transformers that are considered integral parts of the station. The difference between gross and net production is the amount of own use of electricity in the generation plants.

**Gross final consumption (GFC)**: Directive 2008/28/EC defines gross final consumption of energy as the energy commodities delivered for energy purposes to industry, transport, households, services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production, and including losses of electricity and heat in distribution.

**Gross inland energy consumption**: Sometimes abbreviated as gross inland consumption, is the total energy demand of a country or region. It represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration.

**Heating degree days**: 'Degree days' is the measure or index used to take account of the severity of the weather when looking at energy use in terms of heating (or cooling) 'load' on a building. A degree day is an expression of how cold (or warm) it is outside, relative to a day on which little or no heating (or cooling) would be required. It is thus a measure of the cumulative temperature deficit (or surplus) of the outdoor temperature relative to a neutral target temperature (base temperature) at which no heating or cooling would be required.

**Modified gross national income (GNI*)**: Modified gross national income (or GNI*) was introduced by the CSO in 2017 to assess the level of activity in the Irish economy excluding the effects of globalisation that disproportionately affect the Irish economic results. GNI* is defined as GNI less the effects of the profits of re-domiciled companies and the depreciation of intellectual property products and aircraft leasing companies.

**Nominal and real values**: Nominal value refers to the current value expressed in money terms in a given year, whereas real value adjusts nominal value to remove effects of price changes and inflation to give the constant value over time indexed to a reference year.

**Total final consumption (TFC)**: This is the energy used by the final consuming sectors of industry, transport, residential, services, agriculture and fisheries. It excludes the energy sector: electricity generation, oil refining, *etc.*

**Total primary energy requirement (TPER)**: This is the total requirement for all uses of energy, including energy used to transform one energy form to another (such as burning fossil fuel to generate electricity) and energy used by the final consumer.

**Value added**: Value added is an economic measure of output. The value added of industry, for instance, is the additional value created by the production process through the application of labour and capital. It is defined as the value of industry's output of goods and services less the value of the intermediate consumptions of goods (raw materials, fuel, *etc.*) and services.

**Wastes (non-renewable)**: The non-renewable portion of wastes used as an energy source.

**Weather correction**: Annual variations in weather affect the space heating requirements of occupied buildings. Weather correction involves adjusting the energy used for space heating by benchmarking the climate in a particular year with that of a long-term average measured in terms of number of degree days.

# Appendix 5: Energy units and conversion factors

## Energy conversion factors

| To: / From: | toe (Multiply by) | MWh | GJ |
|---|---|---|---|
| toe | 1 | 11.63 | 41.868 |
| MWh | 0.08598 | 1 | 3.6 |
| GJ | 0.02388 | 0.2778 | 1 |

## Energy units

**Joule (J):** Joule is the international (SI) unit of energy.

**Kilowatt hour (kWh):** The conventional unit of energy that electricity is measured by and charged for commercially.

**Tonne of oil equivalent (toe):** This is a conventional standardised unit of energy. One tonne of oil equivalent is defined as having a net calorific value (NCV) of 41.868 GJ. A related unit is the kilogram of oil equivalent (kgoe), where 1 kgoe = $10^{-3}$ toe.

## Decimal prefixes

| | | | |
|---|---|---|---|
| deca (da) | $10^{1}$ | deci (d) | $10^{-1}$ |
| hecto (h) | $10^{2}$ | centi (c) | $10^{-2}$ |
| kilo (k) | $10^{3}$ | milli (m) | $10^{-3}$ |
| mega (M) | $10^{6}$ | micro (μ) | $10^{-6}$ |
| giga (G) | $10^{9}$ | nano (n) | $10^{-9}$ |
| tera (T) | $10^{12}$ | pico (p) | $10^{-12}$ |
| peta (P) | $10^{15}$ | femto (f) | $10^{-15}$ |
| exa (E) | $10^{18}$ | atto (a) | $10^{-18}$ |

## Calorific values

| Fuel | NCV toe/t | NCV MJ/m³ | NCV MJ/kg |
|---|---|---|---|
| Crude Oil | 1.023 | - | 42.81 |
| Gasoline (Petrol) | 1.065 | - | 44.59 |
| Kerosene | 1.056 | - | 44.20 |
| Jet Kerosene | 1.053 | - | 44.10 |
| Gas oil / Diesel | 1.034 | - | 43.31 |
| Residual Fuel Oil (Heavy Oil) | 0.985 | - | 41.24 |
| Milled Peat (2022) | 0.154 | - | 6.43 |
| Sod Peat | 0.313 | - | 13.10 |
| Peat Briquettes | 0.443 | - | 18.55 |
| Coal | 0.665 | - | 27.84 |
| LPG | 1.126 | - | 47.16 |
| Petroleum Coke (2022) | 0.740 | - | 31.00 |
| Natural gas (2022) | - | 35.43 | - |
| | **Conversion Factor** | | **Conversion Factor** |
| Electricity (2022) | 86 toe/GWh | | 3.6 TJ/GWh |

## Emission factors

| Liquid Fuels | t $CO_2$/TJ (NCV) | g $CO_2$/kWh (NCV) |
|---|---|---|

| | | |
|---|---|---|
| Motor Spirit (Gasoline) | 70.0 | 251.9 |
| Jet Kerosene | 71.4 | 257.0 |
| Other Kerosene | 71.4 | 257.0 |
| Gas/Diesel Oil | 73.3 | 263.9 |
| Residual Oil | 76.0 | 273.6 |
| LPG | 63.7 | 229.3 |
| **Solid Fuels and Derivatives** | | |
| Petroleum Coke (2022) | 95.8 | 345.0 |
| Coal | 94.6 | 340. 6 |
| Milled Peat (2022) | 132.1 | 475.6 |
| Sod Peat | 104.0 | 374.4 |
| Peat Briquettes | 98.9 | 355.9 |
| **Gas** | | |
| Natural Gas (2022) | 56.7 | 204.0 |
| **Electricity** | | |
| Electricity (2022) | 92.2 | 332.0 |

## Appendix 6: Data sources

SEAI gratefully acknowledges the co-operation of all the organisations, agencies, energy suppliers and distributors that provide data and respond to its questionnaires throughout the year:

- Applus+ (National Car Test)
- Central Statistics Office
- Department of the Environment, Climate and Communications
- Department of Housing, Local Government, and Heritage
- Department of Transport
- EirGrid
- Environmental Protection Agency
- ESB Networks
- European Commission DG TREN
- EU-funded ODYSSEE Project
- Eurostat
- Gas Networks Ireland
- International Energy Agency
- Met Éireann
- National Grid UK
- Revenue Commissioners
- Road Safety Authority (Vehicle Registration Unit)
- US Energy Information Administration
- Vehicle Certification Agency UK.

# Appendix 7: Bibliography


Central Statistics Office (2023), *Annual National Accounts 2022*. Available from: https://www.cso.ie/en/statistics/nationalaccounts/nationalincomeandexpenditureannualresults/

Central Statistics Office (2023), *Census of population 2022*. Available from: https://www.cso.ie/en/statistics/population/censusofpopulation2022/

Central Statistics Office (2017), *Quarterly National Accounts Quarter 1 2017*. Available from:

https://www.cso.ie/en/statistics/nationalaccounts/quarterlynationalaccounts/

Central Statistics Office (2023), *Road Freight Transport Survey Quarter 4 and Year 2022*. Available from: https://www.cso.ie/en/statistics/transport/roadfreighttransportsurvey/

EirGrid & SONI (2022), *All-Island Generation Capacity Statement 2022 – 2031*. Available from:

https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid_SONI_Ireland_Capacity_Outlook_2022-2031.pdf

EirGrid, Connected and Contracted Generators - Ireland. Reports available from: https://www.eirgridgroup.com/customer-and-industry/general-customer-information/connected-and-contracted-generators/

Environmental Protection Agency (2023), *Ireland's Provisional Greenhouse Gas Emissions 1990-2002*. Available from https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report_Final_v3.pdf

ESB Networks, Connected and Contracted Generators – statistics. Reports available from: https://www.esbnetworks.ie/new-connections/generator-connections-group/generator-statistics

European Environment Agency (2020), *Monitoring $CO_2$ emissions from new passenger cars and vans in 2018*. Available from: https://www.eea.europa.eu//publications/co2-emissions-from-cars-and-vans-2018

European Union (2003), *Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC*. Available from: https://eur-lex.europa.eu/legal-content/

European Union (2008), *Directive 2008/28/EC of the European Parliament and of the Council amending Directive 2005/32/EC establishing a framework for the setting of ecodesign requirements for energy-using products, as well as Council Directive 92/42/EEC and Directives 96/57/EC, as regards the implementing powers conferred on the Commission.* Available from https://eur-lex.europa.eu/legal-content/

European Union (2008), *Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics*. Available from: https://eur-lex.europa.eu/legal-content/

European Union (2009), *Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*. Available from https://eur-lex.europa.eu/legal-content/

European Union (2016), *Regulation (EU) 2016/1952 of the European Parliament and of the Council on European statistics on natural gas and electricity prices and repealing Directive 2008/92/EC.* Available from https://eur-lex.europa.eu/legal-content/

European Union (2018), *Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)*. Available from https://eur-lex.europa.eu/legal-content/

European Union (2018), *Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council directives 2009/119/EC and (EU) 2015/652 and repealing Regulation(EU) No 525/2013 of the European Parliament and of the Council.* Available from https://eur-lex.europa.eu/eli/reg/2018/1999/oj

European Union (2018), *Regulation (EU) 2018/842 of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.* Available from https://eur-lex.europa.eu/eli/reg/2018/842

European Union (2020), *Commission Implementing Decision (EU) 2020/2126 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council.* Available from https://eur-lex.europa.eu/eli/dec_impl/2020/2126/oj

European Union (2023), *Directive (EU) 2023/2413 of the European Parliament and of the Council amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652*. Available from https://eur-lex.europa.eu/legal-content/

Eurostat (2020), *Energy, transport and environment statistics – 2020 edition*. Available from: https://ec.europa.eu/eurostat/en/web/products-statistical-books/-/ks-dk-20-001

Gas Networks Ireland (2021), *Network development plan 2021*. Available from: https://www.gasnetworks.ie/corporate/company/our-network/network-development-plan/

Government of Ireland, DECC (2020), *Ireland's National Energy and Climate Plan 2021-2030*. Available from https://www.gov.ie/en/publication/0015c-irelands-national-energy-climate-plan-2021-2030/

Government of Ireland, DECC (2021), *Climate Action Plan 2021*. Available from https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/

Government of Ireland, DECC (2022), *Climate Action Plan 2023*. Available from https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/

Government of Ireland, DECC (2022), *S.I. No 350/2022 – European Union (Renewable Energy) Regulations (2) 2022*. Available from https://www.irishstatutebook.ie/eli/2022/si/350/

Holttinen, Hannele *et al*. (2014), *Estimating the reduction of generating system $CO_2$ emissions resulting from significant wind energy penetration.* 13th International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants. Berlin: Energynautics.

International Energy Agency/ OECD/Eurostat (2004), *Energy Statistics Manual*, Paris: OECD/International Energy Agency. Available from: https://www.iea.org/reports/energy-statistics-manual-2

International Energy Agency (2023), *OECD Energy Prices and Taxes quarterly*. Available from https://www.iea.org/data-and-statistics/data-product/oecd-energy-prices-and-taxes-quarterly

National Oil Reserves Agency (2022), *Biofuel Obligation Scheme Annual Report 2022*. Available from: https://www.nora.ie/_files/ugd/ca930b_4567bf99895c4d03bb7f19388c51f5af.pdf

National Oil Reserves Agency (2022), The Renewable Transport Fuel Obligation. Available from https://www.nora.ie/rtfo

Sustainable Energy Authority of Ireland, *Electricity & Gas Prices.* (Biannual report) Available from https://www.seai.ie/data-and-insights/seai-statistics/key-publications/

Sustainable Energy Authority of Ireland (2014), *Quantifying Ireland's Fuel and $CO_2$ Emissions Savings from Renewable Electricity in 2012.* Available from https://www.seai.ie/publications/Quantifying-Irelands-Fuel-and-CO2-Emissions-Savings-from-Renewable-Electricity-in-2012.pdf

Sustainable Energy Authority of Ireland (2014), *Renewable Energy in Ireland 2012.* Available from https://www.seai.ie/publications/Renewable-Energy-in-Ireland-2012.pdf

Sustainable Energy Authority of Ireland (2020), *Combined Heat and Power in Ireland – 2020 Update*. Available from: https://www.seai.ie/publications/CHP-Update-2020.pdf

Sustainable Energy Authority of Ireland (2020), *Energy Security in Ireland – 2020 Report*. Available from: https://www.seai.ie/publications/Energy-Security-in-Ireland-2020-.pdf

Sustainable Energy Authority of Ireland (2020), *Renewable Energy in Ireland – 2020 Update*. Available from: https://www.seai.ie/publications/2020-Renewable-Energy-in-Ireland-Report.pdf

Sustainable Energy Authority of Ireland (2022), *Annual Report 2022 on Public Sector Energy Performance.* Available from https://www.seai.ie/publications/Public-Sector-Annual-Report-2022-English.pdf

## Appendix 8: Energy statistics revisions

Some changes, revisions and corrections to the historic energy balance data were implemented during 2023. The most significant of these are listed below.

### Total Final Energy Consumption

- Sectoral split revised to align with the latest data from the 2021 CSO Business Energy Use Survey (BEUS), including historic revisions. Please see full methodological changes from the CSO at https://www.cso.ie/en/methods/surveybackgroundnotes/businessenergyuse/
- The accounting of rail diesel was updated for all years from 2017 onwards. This resulted in an increase in consumption of road diesel in transport (unspecified subsector) for these years and a commensurate decrease in consumption of gas oil in the other sectors. The quantity of diesel used in the rail sector itself did not change. The total final consumption of diesel/gas oil remains unchanged.

### Transport

- The bottom-up modelling of private cars was updated to include plug-in hybrids and non-plug-in hybrids for 2015 to present. This changed the apportionment of petrol and diesel between the *road private car* and *unspecified* sub sectors. The addition of plug-in hybrids also increased the consumption of electricity in *road private car*.

### Gasoil consumption in agriculture and residential

All quantities of gasoil made available for final consumption in Ireland are reported by oil suppliers via the Oil Levy Assessment (OLA) database administered by the Department of Environment, Climate and Communications. SEAI collect total annual gasoil consumption data from this database. This total consumption is then apportioned between the sectors of the economy based on, amongst other data, the CSO's Business Energy Use Survey, tax rebate data, EU-ETS data, and a historic assessment of the level of consumption in the agriculture sector.

It has become apparent to SEAI that this legacy method of apportioning was producing timeseries of annual gasoil consumption in the residential and agriculture sectors that are not consistent with other known factors:

1. The actual usage of gasoil in the residential sector has decreased significantly as almost all modern domestic oil boilers use kerosene instead of gasoil.
2. SEAI's assessments of energy consumption in agriculture, using a bottom-up assessment and analysis of available statistics on farming output, indicate a level of consumption higher than the agriculture gasoil timeseries.

During 2023, SEAI sought and received information on the usage of gasoil in agriculture and residential sectors from industry groups. SEAI amended the methodology for the apportionment of gasoil between residential and agriculture for 2022 based on the best available data and the known trend in the consumption of other fuels in the residential sector.

This has been done as an interim measure while SEAI undertakes a programme to improve its assessment of energy demand in agriculture and strengthen bottom-up statistics on agriculture energy usage, to be completed in 2024. In parallel, a similar programme will be undertaken for residential energy, specifically gasoil and certain solid fuels.

Upon the completion of these programmes, it is likely that SEAI will revise the timeseries of gasoil consumption for the agriculture and residential sectors.

## Appendix 9: Electricity and gas price tables

SEAI collects and analyses electricity and gas prices every 6-months, in line with EU Regulation 2016/1952. SEAI calculates the **effective unit price** of energy (the revenue collected for energy delivered, divided by the total quantity of energy delivered) across **different consumption bands**, and then calculate the weighted average price, based on the market-share of each consumption band. Using data available from Eurostat, SEAI ranks the effective unit price paid by Irish consumers, compared to their European counterparts.

The tables below update the effective electricity and gas energy prices paid by residential and business consumers in Ireland for January – June 2023. The tables breakdown the effective unit price of energy in each band, the changes in that price over the last 12- and 24-months, Ireland's EU ranking of the price in that band, with a ranking of 1 meaning highest price, and the market share of each band.

Note: Domestic electricity customers, including pay as you go customers, received an account credit of €200 between January and February 2023 with a further credit of €200 paid between March and April 2023. These rebates are accounted for in the Residential Electricity Prices for the first half of 2023.

**Figure 11.22: Residential Electricity Prices – January to June 2023 (includes 2 x €200 account credits)**

| Household electricity prices (all taxes included) | c/kWh S1 2023 | Change in 12 months | Change in 24 months | Ranking EU | Band Share of Market |
|---|---|---|---|---|---|
| Band DA Consumption < 1,000 kWh | 8.5 | -62.2% | -82.2% | 26 | 3.3% |
| Band DB 1,000 kWh < Consumption < 2,500 kWh | 15.2 | -31.7% | -54.7% | 24 | 10.3% |
| Band DC 2,500 kWh < Consumption < 5,000 kWh | 24.8 | 6.6% | -3.1% | 13 | 34.4% |
| Band DD 5,000 kWh < Consumption < 15,000 kWh | 28.5 | 24.7% | 33.4% | 9 | 43.7% |
| Band DE Consumption > 15,000 kWh | 29.1 | 34.2% | 62.4% | 9 | 8.3% |
| **Weighted Average** | **25.2** | **10.6%** | **5.4%** | | |

**Figure 11.23: Residential Gas Prices – January to June 2023**

| Household gas prices (all taxes included) | c/kWh S1 2023 | Change in 12 months | Change in 24 months | Ranking EU | Band Share of Market |
|---|---|---|---|---|---|
| Band D1 Consumption < 20 GJ | 15.9 | 66.8% | 126.9% | 7 | 7.2% |
| Band D2 20 GJ < Consumption < 200 GJ | 14.7 | 73.0% | 136.3% | 5 | 91.1% |
| Band D3 Consumption > 200 GJ | 11.5 | 45.7% | 100.9% | 8 | 1.7% |
| **Weighted Average** | **14.7** | **72.6%** | **135.4%** | | |

**Figure 11.24: Business Electricity Prices – January to June 2023**

| Business electricity prices (ex VAT) | c/kWh S1 2023 | Change in 12 months | Change in 24 months | Ranking EU | Band Share of Market |
|---|---|---|---|---|---|
| Band IA Consumption < 20 MWh | 37.1 | +23.0% | +47.6% | 6 | 6.7% |
| Band IB 20 MWh < Consumption < 500 MWh | 35.6 | +51.3% | +96.1% | 2 | 23.5% |
| Band IC 500 MWh < Consumption < 2,000 MWh | 28.3 | +30.0% | +87.1% | 4 | 10.6% |
| Band ID 2,000 MWh < Consumption < 20,000 MWh | 24.0 | +24.0% | +97.9% | 7 | 21.4% |
| Band IE 20,000 MWh < Consumption < 70,000 MWh | 22.9 | +21.7% | +110.1% | 7 | 7.8% |
| Band IF 70,000 MWh < Consumption < 150,000 MWh | 24.0 | +19.5% | +121.5% | 2 | 4.5% |
| Band IG > 150,000 MWh | 21.3 | -7.7% | +102.1% | 5 | 25.5% |
| **Weighted Average** | **27.3** | **+22.6%** | **+91.2%** | | |

**Figure 11.25: Business Gas Prices – January to June 2023**

| Business gas prices (ex VAT) | c/kWh S1 2023 | Change in 12 months | Change in 24 months | Ranking EU | Band Share of Market |
|---|---|---|---|---|---|
| Band I1 Consumption < 1,000 GJ | 12.9 | +70% | +198.8% | 5 | 12.4% |
| Band I2 1,000 GJ < Consumption < 10,000 GJ | 9.7 | +32% | +147.8% | 11 | 19.8% |
| Band I3 10,000 GJ < Consumption < 100,000 GJ | 7.6 | +14% | +131.1% | 18 | 21.7% |
| Band I4 100,000 GJ < Consumption < 1,000,000 GJ | 6.3 | +18% | +138.1% | 18 | 38.2% |
| Band I5 1,000,000 GJ < Consumption < 4,000,000 GJ | 5.5 | -25% | +127.0% | 12 | 7.9% |
| **Weighted Average** | **8.0** | **+22.3%** | **+154.5%** | | |

## Appendix 10: Version control

| Version | Date | Notes |
|---|---|---|
| 1.0 | 12/12/2023 | Internal only |
| 1.1 | 12/12/2023 | Internal only |
| 1.2 | 13/12/2023 | Published publicly on 13 December 2023 |
| 1.3 | 15/03/2024 | a) Revised text in section 1.1 to reflect SEAI's further analysis and understanding of imported electricity.<br>b) Corrected transposition errors in Tables 8.7 and 10.2<br>c) Updated figure 2.2 to include wind and solar within *electricity generation*, rather than as a direct flow (i.e. as *exchanges & transfers)* from primary to final energy.<br>d) Figures 9.4 & 10.2 – converted plots from kgoe/€ to kWh/€<br>e) Figure 8.17 – added secondary axis title<br>f) All sections – edited chart formatting and axis labels to improve consistency. |

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Rialtas na hÉireann
Government of Ireland

**Sustainable Energy Authority of Ireland**
Three Park Place
Hatch Street
Upper Dublin 2
Ireland
D02 FX65

**w:** www.seai.ie
**e:** info@seai.ie
**t:** 01 8082100