

First Look: Ireland's Energy Supply and Security of Supply in 2023

Part A - Key Insights



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July 2024

ID: FLESSS-A-2023-1.0

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Sustainable Energy Authority of Ireland

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

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1 Background and Scope

This report is part of the new '*First Look*' series of publications from the Energy Statistics Team in SEAI. These *First Look* publications aim to rapidly disseminate the key energy insights that can be extracted from SEAI's regular data releases, such as:

- The national energy balance,
- SEAI's monthly energy web-updates
- Other energy data submitted to Eurostat to satisfy Ireland's international reporting obligations.

There is an increasing need for the effective dissemination of this timely and trusted data to inform evidenceled energy policy and determine the pace of progress against binding energy and climate targets. To facilitate a rapid turn-around in publication, the *First Look* series focusses on quantitative reporting over explanatory reporting. The series focuses on using plots and graphs to convey observed trends in energy and emissions, rather than narrative text that describes the policy, behaviour, technology, or market forces that might have driven those trends. The fuller context and explanation for the trends identified in *First Look* publications will be addressed in SEAI's definitive annual reports, such as *Energy in Ireland*, which is published in December of each year.

This *First Look* report provides key insights into Ireland's energy supply and the security of that energy supply in 2023. The primary data source for these insights is the 2023 interim national energy balance, published by SEAI on 1st of May 2024. Supplementary data is taken from SEAI's monthly updates on electricity, gas, and oil supply, and data publicly available from the Eurostat database.

For convenience, this report is published in two separate PDFs, both available from the SEAI website:

- Part A is 25-pages long and provides key insights on the trends in energy supply and security of supply
- **Part B** is 100-pages long and provides detailed plots and graphs spanning all energy products and supply streams relevant to the Irish market, as well technical definitions, and underlying data

The *energy supply*¹ insights in this report include:

- Breakdowns of Irelands national energy requirement by energy product and time
- Breakdowns of Ireland's electricity supply by source and the role of interconnector electricity imports
- Trends in solar generation from rooftop panels and utility scale solar-farms
- Trends in road transport energy demand, including biofuel blending
- SEAI estimates of energy-related emissions in the context of carbon budget sectoral emission ceilings

The security of energy supply insights in this report include:

- Breakdown of Irelands energy requirement by supply stream, *i.e.* by imports, indigenous production, etc.
- 2022-to-2023 changes in net imports and indigenous production by energy product
- Ireland's overall energy import dependency and product specific import dependencies
- The refinery dependence of gasoline, diesel, and kerosene delivered to the Irish market
- Country of origin for key oil-products like crude oil, diesel, gasoline, and kerosene
- The emergency and commercial oil stocks held by Ireland in EU member states

¹ This report does not include significant energy demand insights for 2023, because a sectoral breakdown of energy demand is not yet available. That data will become available with the publication of the full national energy balance for 2023 in early-September 2024. This will also allow for first estimates of renewable energy share (RES) results for electricity, transport, and heating.

This SEAI report speaks specifically to energy supply and the security of that energy supply. A fuller assessment of Ireland's energy security requires additional insights and considerations beyond those in this report, such as:

- Risks of supply chain and market disruptions
- Physical interruptions to supply and delivery
- Age, maintenance, and appropriateness of energy infrastructure
- Integration and balancing of supply and demand distributions
- Capacity and storage planning
- Long-term sustainability of the energy system
- Affordability of energy to all sectors of the economy and citizenry

National agencies other than SEAI are best placed to speak to these additional broader energy security considerations, due to the relevance and specialisation of their subject matter expertise:

- Eirgrid, ESB-Networks, and Gas Networks Ireland (GNI) with responsibility for the operation and maintenance of the national electricity and gas grids
- The Commission for Regulation of Utilities (CRU) with responsibility for regulating the use and connection of the national electricity and gas grids
- The National Oil Reserve Agency (NORA) with responsibility for maintaining Ireland's emergency and commercial oil stocks in line with European and international obligations, and administering Ireland's Renewable Transport Fuel Obligation (RTFO)
- The Environmental Protection Agency (EPA) with responsibility for regulating emissions from electricity generation plants and from heavy industry

Combining the security of energy supply insights from this report with the broader energy security considerations from these other agencies will help build an overview compatible with the International Energy Agency's (IEA) definition of energy security as *"the uninterrupted availability of energy at an affordable price"*. In November 2023, the Department of the Environment, Climate and Communications (DECC) published the *Energy Security in Ireland to 2030, Energy Security Package'*², highlighting where Ireland can enhance energy security, and providing context and possible approaches to making those enhancements.

² <u>https://www.gov.ie/en/publication/5c499-energy-security-in-ireland-to-2030/</u>

2 Key Trends in Energy Supply and Security of Supply in 2023

2.1 Trends in Energy Supply

In 2023, Ireland's national primary energy requirement remained heavily fossil dependent, with 82.8% of energy requirement satisfied by fossil fuels. Over three-quarters of Ireland's energy requirement came from the sum of its oil (48.8%) and natural gas (29.4%) needs. Renewables accounted for 14.0% of Ireland's energy requirement in 2023, up from 12.9% in 2022.

Fig 2.1 – 2023 breakdown of Ireland's national energy requirement by energy product and energy type in 2023 (IcE and NRW stand for net imported interconnector electricity and non-renewable wastes, respectively)



Ireland's use of fossil fuels reached its lowest level in 2023 for over 20 years, outside the exceptional year of 2020, when COVID-related travel restrictions significantly reduced demand for petrol, diesel, and jet kerosene. Conversely, 2023 saw record high use of renewable energy in Ireland.



Fig 2.2 – Time series of Ireland's energy requirement by energy type, with detail of Ireland's Renewable Energy Requirement.

In 2023 Ireland's overall energy requirement was 164.1 TWh, down 1.7% on 2022 levels. Ireland saw a drop in demand for all fossil fuels in 2023, with drops of 0.38 TWh in natural gas, 0.30 TWh in coal, 0.05 TWh in peat, and 0.03 TWh in oil. Conversely, 2023 saw demand increases of 0.30 TWh in the net-import of Interconnector Electricity (IcE), 0.14 TWh in renewable energy, and 0.02 TWh in non-renewable waste (NRW).





The renewable element of Ireland's energy requirement was 23.0 TWh in 2023. Wind accounted for just over half (50.8%) of Ireland's renewable energy, followed by biodiesel (13.6%), biomass (11.2%) and renewable wastes (8.0%). In 2023, the renewable energy (*i.e.* ambient heat) delivered by the heat-pumps installed in homes and businesses across the country exceeded the renewable energy from hydro-electricity. The renewable element of Ireland's energy requirement was 23.0 TWh in 2023. Wind accounted for just over half (50.8%) of Ireland's renewable energy, followed by biodiesel (13.6%), biomass (11.2%) and renewable wastes (8.0%).



Fig 2.4 – Breakdown of Ireland's Renewable Energy Requirement in 2023, where 'Other' is the summed contributions of landfill gas, biogas, bioethanol, and solar thermal.

2.1.1 Trends in Electricity Generation and Supply

In 2023, 40.7% of Ireland's gross electricity supply (which is the sum of indigenous generation and net imports) was renewable. This is a positive leading indicator that Ireland's RES-E result will be higher in 2023 than it was in 2022. Ireland's 2023 Renewable Energy Share of Electricity (RES-E) will be calculated following the publication of the full Energy Balance in September 2024, in accordance with the EU Renewable Energy Directive and accompanying methodology³. Ireland set a record for wind generation in 2023, generating 11.7 TWh of renewable electricity, up 4.1% on 2022 levels. In 2023, Ireland produced more wind energy than it extracted from its natural gas reserves (10.9 TWh) for the first time.



Fig 2.5 – Percentage breakdown of Ireland's gross electricity supply by source in 2023.

The net import of interconnector electricity (IcE) was the third largest source of electricity in 2023, after natural gas (44.3%) and wind (33.7%). Interconnector electricity accounted for 9.5% of electricity supply in 2023, compared to 0.7% of electricity supply in 2022. Net imports through interconnectors in 2023 provided more electricity than the sum of coal, peat, hydro, biogas, solar, and oil generation combined.

³ The RES-E calculation differs from the gross final consumption value because it includes additional adjustments, including the normalisation of wind and hydro production, and a formal accounting for the sustainability status of various biomass fuels.

Fig 2.6 – Waterfall plot comparing 2022 to 2023 changes in Ireland's gross electricity supply by energy type and the overall net change in electricity supply.



Ireland's net import of electricity across interconnectors increased from 0.3 TWh in 2022 to 3.3 TWh in 2023 – a 12-fold increase – setting an annual record the use of imported electricity. Ireland's net import of electricity is given by the sum of positive-flow imports and negative-flow exports. In 2023, Ireland imported 8.3 times more the electricity than it exported.

Although Ireland's consumption of electricity increased by 3.0% in 2023, the generation of electricity within Ireland fell by 6.7%, due to an increased use of imported electricity through international interconnectors from the UK and Northern Ireland. In 2023, Ireland generated 3.3 TWh less electricity from fossil fuels than in 2022, balanced by 3.0 TWh more electricity imported through international interconnectors, and 1.0 TWh more renewable generation in Ireland. In total, Ireland's gross supply of electricity increased by 0.7 TWh in 2023.

Fig 2.7 – Time series of Ireland's net imports (imports less exports) of electricity summed across the North-South and East-West international interconnectors.

Net Import of Interconnector Electricity (IcE) (TWh)





Ireland has both North-South and East-West interconnectors, allowing for international trade and balancing of electricity to-and-from Northern Ireland (within the integrated Single Electricity Market, or SEM) and the UK mainland (outside the SEM). In 2023, 51.0% of Ireland's net import of electricity came across the East-West interconnector, and 49.0% from the North-South interconnector. In 2023, Ireland imported 7.7 times more the electricity than it exported across the East-West interconnector, and 8.9 times more than it exported across the North-South interconnector.



Fig 2.8 – Time series of Ireland's imports and exports of electricity across the North-South and East-West international interconnectors.

Ireland's solar photovoltaic (PV) electricity generation in 2023 was 334% higher than in 2022 and accounted for 1.9% of our gross electricity supply. Utility-scale grid-connected solar farms accounted for 64% of solar PV generation, with 36% coming from rooftop solar panels. Generation from solar farms increased 24-fold on the previous year, due to multiple sites being connected to the national grid in 2023. In parallel, electricity generation from rooftop solar panels increased by 74% in 2023.

Fig 2.9 – Time series of annual solar photovoltaic (PV) generation in Ireland, and monthly solar-PV generation from utility-scale grid-connected solar-farms in 2023.



Monthly Utility-Scale Solar Gen. in 2023 (GWh)



2.1.2 Trends in Transport Energy Supply

Demand for road diesel and road petrol for the transport sector increased by 1.0% and 7.7% in 2023, respectively. Demand for the blended diesel and petrol used on Irish roads in 2023 stood at 98.4% and 96.2% of pre-COVID 2019-levels, respectively. Ireland used 1.36 billion litres of jet kerosene in 2023 - the highest annual demand ever recorded and up 12.7% on the previous year.





Ireland set new records for biofuel blending into road petrol and road diesel in 2023. The annualised average biofuel-blend in road diesel was 8.4% in 2023, up from 6.5% in 2022, and the average biofuel-blend in road petrol was 4.2% in 2023, up from 3.2% in 2022. The increased blending of biofuel into road diesel acted to reduce the energy demand of fossil petrochemical diesel by 2.0% in 2023.





'Road Diesel' Bio-Blending Rate



2.1.3 Trends in Energy-related Emissions

SEAI estimates that Ireland's national energy-related emissions⁴ fell by 7.3% in 2023 and reached their lowest level in 30 years. Energy-related emissions in 2023 were lower even than in 2020, during the height of COVID impacts on travel.





The main driver of the drop in energy-related emission in 2023 was a reduction in emissions associated with electricity generation. Emissions from the electricity generation sector⁵ in Ireland were down by 20.9% in 2023, due to an increased use of electricity imported through international interconnectors and increased renewable generation in Ireland.

Three years into its first 5-year carbon budget, SEAI estimates that Ireland's electricity sector has emitted 27.4 MtCO₂e of its 40 MtCO₂e sectoral emission ceiling (SEC). At the end of 2023, exactly 60% through the 2021-2025 carbon budget time period, the electricity sector has already emitted 68% of its 5-year sectoral emission ceiling and therefore is on an 'over-emission' trajectory. If these estimates prove accurate, when the EPA publish Ireland's *National GHG Inventory Report*, then the electricity sector has only 12.6 MtCO₂e of allowable emissions left for the last 2-years of this carbon budget. To stay within this limit, the electricity sector would need to deliver two further compounding annual reductions of 11.9% in 2024 and 2025.

⁴ Ireland's national and sectoral emission totals do not include emissions associated with international aviation or maritime transport, which are calculated and reported separately in accordance with guidance from United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC).

⁵As the electricity generation sector is defined under the national Carbon Budgets.





National transport emissions, which exclude international aviation and navigation, were up by 0.2% in 2023. Three years into its first 5-year carbon budget, SEAI estimates that Ireland's transport sector has emitted 34.6 MtCO₂e of its 54 MtCO₂e sectoral emission ceiling. At the end of 2023, exactly 60% through the 2021-2025 carbon budget, the transport sector has already emitted 64.1% of its 5-year sectoral emission ceiling and therefore is on an 'over-emission' trajectory. If these estimates prove accurate, then the transport sector has only 19.4 MtCO₂e of allowable emissions left for the last 2-years of this carbon budget. To stay within this limit, the transport sector would need to deliver two further compounding annual reductions of 12.1% in 2024 and 2025.

Fig 2.14 – SEAI's estimate⁶ of transport emissions within the first carbon budget and remaining emissions within the sectoral emission ceiling for transport.



⁶ Coincident with the publication of this report, the EPA published provisional 1990-2023 greenhouse gas inventory data that provides more authoritative emission data than these SEAI estimates.

2.2 Trends in Energy Security of Supply

Ireland's energy requirement is satisfied by the sum of positive-inward flows, such as indigenous production, imports, and stock-draws, and negative-outward flows, such as exports, stock-builds, and marine-bunkering. Ireland imports 100% of its oil and coal requirement but satisfies its requirement for other energy products through a blend of (net) imports and indigenous production, *i.e.* the production or generation of energy within Ireland, from resources in Ireland. Ireland's largest energy exports are fuel-oil and gasoline, produced by the refining of imported crude oil at the Whitegate refinery in County Cork.



Fig 2.15 – Bubble plot showing the indigenous production, imports, and exports of the different energy products that sum to Ireland's overall energy requirement in 2023.

Ireland's total energy requirement dropped by 2.9 TWh in 2023, driven by drops in indigenous production (- 2.0 TWh) and net imports (-4.4 TWh), and a counteracting increase in stock draws (+3.3 TWh).



Fig 2.16 – Time series of Ireland's overall energy requirement by supply stream.

The overall drop in net imports in 2023 was driven by reductions in imported coal (-5.9 TWh), oil (-1.3 TWh), and natural gas (-1.1), with partially counteracting increases in the net imports of interconnector electricity (+3.0 TWh) and renewables (+0.8 TWh). The overall drop in indigenous production in 2023 was driven by a reduction in indigenous gas (-2.7 TWh), with partially counteracting increases in the indigenous production of renewables (+0.5 TWh) and non-renewable waste (+0.2 TWh).



Fig 2.17 – Waterfall plot comparing 2022 to 2023 changes in Ireland's net import of energy, and indigenous production of energy.

Energy import dependency is a common metric used to determine the dependency of a country on international energy imports. It is generally accepted that reducing import dependency acts to increase the security of energy supply, because it acts reduces a country's exposure to international market shocks, unexpected policy shifts, and delivery disruptions. Import dependency is defined as the ratio of net imports (imports less exports) to primary energy supply (including non-energy sub-products) less transfers to international marine bunkers. Ireland's overall energy import dependency in 2023 was 78.5%, which is down

Fig 2.18 – Time series of Ireland's overall energy import dependency.

on the value of 79.7% for 2022. By way of comparison, the average EU energy import dependency was 57.5% in 2020, the latest year for which a published value is available from Eurostat.



Ireland's Overall Energy Import Dependency

2.2.1 Trends in Gas Supply and Imports

Despite importing less natural gas in 2023 than in 2022, Ireland's import dependency on gas increased to 77.5% in 2023. The step-change drop in import dependency on gas in 2016 corresponded to the connection of the Corrib gas-field to the national gas grid. As indigenous production from the Corrib gas-field continues to decrease, the relative proportion of imported gas needed to satisfy Ireland gas requirement will tend to increase.

Fig 2.19 – Time series of Ireland's import dependency for natural gas.



Import Dependency of Natural Gas Supply

2.2.2 Trends in Electricity Supply and Imports

In 2023, net imported interconnector electricity (IcE)) accounted for 9.5% of Ireland's gross electricity supply. Indigenous generation of electricity from imported energy sources⁷, which is the electricity generated in Ireland from imported gas, coal, oil, and biomass, accounted for 38.7% of gross electricity supply. Indigenous generation of electricity from indigenous sources, which is electricity generated in Ireland from Irish energy sources like wind, solar, and indigenous natural gas, and biomass supplies, accounted for 51.9% of gross electricity supply.

Fig 2.20 – Breakdown of the direct and indirect import dependency of Ireland's gross supply of electricity in 2023



For further details on the imported and exported interconnector electricity in 2023 see <u>Section 2.1.1</u> on *Trends in Electricity Generation and Supply*.

⁷ Where electricity is generated from a source that comes from a mixture of imported supply and indigenous production, *e.g.* in the case of natural gas, a representative proportion of the generated electricity is assigned to both 'electricity from imported energy sources' and 'electricity from indigenous sources'.

2.2.3 Trends in Renewable Supply and Imports

Ireland's overall import dependency on renewable energy remained relatively low in 2023 at 12.4%, due to 100% of Ireland's wind, renewable waste, ambient heat, hydro-electricity, solar photovoltaic (PV) generation, landfill gas, biogas, and solar thermal energy all come exclusively from indigenous production.

Fig 2.21 – Time series of Ireland's import dependency for renewable energy.



Import Dependency of Renewable Energy Supply

Ireland's energy requirements for biodiesel, bioethanol, and biomass are satisfied through a combination of indigenous production⁸ and international imports. In 2023, Ireland's import dependencies on biodiesel and bioethanol were 68.4% and 78.8% respectively, while Ireland's import dependency on biomass was 16.1%.

Fig 2.22 – Time series of Ireland's import dependency for biodiesel, bioethanol, and biomass.



Imp. Dep. of Bioethanol



Imp. Dep. of Biomass



⁸The indigenous production of biodiesel and bioethanol may itself be dependent on the import of biofuel feedstocks.

2.2.4 Trends in Oil Product Supply and Imports

All oil-products to the Irish market are ultimately sourced from international imports. However, the supply of refined fossil oil-products to the Irish market comes from both:

- The *direct import* of those oil-products into Ireland
- The refining of oil-products *in Ireland*, from imported crude oil, at the Whitegate refinery in Cork (Ireland's only oil refinery)

The available supply of gasoline to the Irish market is the sum of net-imports of gasoline, refinery output, and 'other' streams. In this case, the other streams consist of stock draws/builds, and its use as refinery feedstock. Refinery outputs generally account for most gasoline supplied to the Irish market. In 2023, Ireland's refinery dependence on gasoline, which is defined as the ratio of refinery output to supply available for consumption, was 86.6%.

Fig 2.23 – Time series of gasoline supply streams to the Irish market, and Ireland's 'refinery dependence' for gasoline.





Refinery Dep. of Gasoline

The available supply of diesel and gasoil to the Irish market is the sum of net-imports of diesel and gasoil, refinery output, and 'other' streams. In this case, the other streams consist of stock draws/builds, transfers to international marine bunkers, input to electricity generation, own use at the refinery, and other exchanges and transfers. Net imports generally account for most diesel and gasoil supplied to the Irish market. In 2023, Ireland's refinery dependence on diesel and gasoil was 29.9%.

Fig 2.24 – Time series of diesel and gasoil supply streams to the Irish market, and Ireland's refinery dependence for diesel and gasoil.



Ref. Dep. of Diesel & Gasoil



All of Ireland's jet kerosene energy requirement is imported, and a proportion of that imported jet kerosene is typically re-classified to heating kerosene without undergoing a refining process. The available supply of kerosene to the Irish market is the sum of net-imports of heating and jet kerosene, refinery output of heating kerosene, and 'other' streams (in this case only stock draws/builds). Net imports generally account for most kerosene supplied to the Irish market. In 2023, Ireland's refinery dependence on kerosene was 14.3%, with jet kerosene accounting for 58.8% of the total kerosene supply, and heating kerosene accounting for the remaining 41.2%.

Fig 2.25 – Time series of kerosene supply streams to the Irish market, and Ireland's refinery dependence for kerosene.



Refinery Dep. of Kerosene



2.2.5 Country of Origin of Oil Products

The chemical composition of crude oil depends on its field-of-origin. 'Light' crude requires less processing and produces a greater percentage of gasoline and diesel oil-products than 'heavy' crude, and 'sweet' crude contains less sulphur than 'sour' crude. The variety of crude oil chosen as an input by a particular refinery will depend on how the processes in that refinery are optimised and the spectrum of refined oil-products being targeted. In 2023, 65.3% of crude oil imported into Ireland came from the USA, followed by 21.6% from Azerbaijan, and 8.8% from Norway.

Fig 2.26 – Percentage breakdown of crude oil imports in 2023 by country of origin.



In 2023, 33.1% of the diesel and gasoil imported into Ireland came from the USA, followed by 19.7% from the Netherlands, and 16.3% from the UK. The country of origin assigned to refined oil-products is determined by where that oil-product was refined, not from where the underlying crude oil originates.

Fig 2.27 – Percentage breakdown of diesel and gasoil imports in 2023 by country of origin.



In 2023, 80.4% of the gasoline imported into Ireland came from the UK, followed by 16.4% from the Netherlands, and 3.2% from Belgium.

Fig 2.28 – Percentage breakdown of gasoline imports in 2023 by country of origin.



In 2023, 95.4% of the jet kerosene imported into Ireland came from the UK, followed by 3.7% from the Netherlands, and 0.9% from Belgium and Netherlands.

Fig 2.29 – Percentage breakdown of jet kerosene imports in 2023 by country of origin.



In 2023, 93.3% of the heating kerosene imported into Ireland came from the UK, followed by 6.7% from the Netherlands.



Fig 2.30 – Percentage breakdown of heating kerosene imports in 2023 by country of origin.

Ireland maintains emergency and commercial oil stocks in line with European and international obligations, specifically EU Directive 2009/119/EC and the IEA Agreement on an International Energy Programme. The EU Directive obliges member states to maintain minimum oil stocks corresponding to at least 90 days of average imports or 61 days of average daily inland consumption, whichever is greater. For Ireland, this equates to 90 days of imports, which aligns with the IEA requirement on members to hold at least 90 days of net oil imports.

Ireland's oil stock obligation is administered by the National Oil Reserve Agency (NORA). Stocks administered by NORA can be stored in Ireland and other countries, under bi-lateral oil stockholding agreements, as physical stocks, or as 'stock tickets', which are short-term commercial contracts that include an option to purchase oil under emergency circumstances. Ireland holds oil stock and tickets in Ireland, in EU member states, and in Northern Ireland (which is outside the EU for the purpose of energy reporting, since Brexit came into force in February 2020).



Fig 2.31 – Monthly assessments of Irish oil stocks held within the EU in days equivalent of demand.

The quantity of oil stocks is often expressed in terms of days equivalent, which compares the *current* oil stock levels to *historic* oil demand in the previous reporting period, *i.e.* approximately one year earlier. In 2023, monthly assessments showed that Ireland maintained EU-based oil stocks of between 84- and 87-days equivalent of demand. The average days equivalent of EU-based oil stocks in 2023 across all 12-month assessments was 85.7 days. It is important to note that NORA maintains additional oil stocks, not captured in these EU-based stock statistics, in Northern Ireland⁹ to meet the 90-day requirement.

⁹ https://www.nora.ie/_files/ugd/b984d0_d5d61e9808e842eeb16e7c5b2ea62880.pdf

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 recent years, when energy suppliers have been asked to submit more data within shorter deadlines, as SEAI works to produce ever more timely energy insights to help inform government policy.





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