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Taighde, Idirphlé, Comhairle
Research, Dialogue, Advice

COUNCIL

No.169 July 2025

International Trade Dependencies and the Energy Transition

National Economic & Social Council
Constitution and Terms of Reference

1. The main tasks of the National Economic and Social Council shall be to analyse and report on strategic issues relating to the efficient development of the economy and the achievement of social justice.

2. The Council may consider such matters either on its own initiative or at the request of the Government.

3. Any reports which the Council may produce shall be submitted to the Government, and shall be laid before each House of the Oireachtas and published.

4. The membership of the Council shall comprise a Chairperson appointed by the Government in consultation with the interests represented on the Council, and

   - Three persons nominated by agricultural and farming organisations;
   - Three persons nominated by business and employers organisations;
   - Three persons nominated by the Irish Congress of Trade Unions;
   - Three persons nominated by community and voluntary organisations;
   - Three persons nominated by environment organisations;
   - Four other persons nominated by the Government, including the Secretaries General of the Department of Finance, the Department of Business, Enterprise and Innovation, the Department of Housing, Planning and Heritage, the Department of Public Expenditure and Reform.
   - Seven people possessing knowledge, experience and skills which the Taoiseach considers relevant to the functions of the Council

5. Any other Government Department shall have the right of audience at Council meetings if warranted by the Council's agenda, subject to the right of the Chairperson to regulate the numbers attending.

6. The term of office of members shall be for three years. Casual vacancies shall be filled by the Government or by the nominating body as appropriate. Members filling casual vacancies may hold office until the expiry of the other members' current term of office.

7. The numbers, remuneration and conditions of service of staff are subject to the approval of the Taoiseach.

8. The Council shall regulate its own procedure.

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International Trade Dependencies and the Energy Transition

COUNCIL PAPER

No.169 July 2025

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Abbreviations

AC	Alternating Current
CAP	Climate Action Plan
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism
CCAC	Climate Change Advisory Council
CCUS	Carbon Capture Utilisation and Storage
CEN	Continental European Network
CEPA	Cambridge Economic Policy Associates
CFDs	Contracts for Difference
CISE	Common Information Sharing Environment
CO_2	Carbon dioxide
CSIP	Critical Seabed Infrastructure Protection
CRS	Congressional Research Service
CSO	Central Statistics Office
CUIC	Critical Undersea Infrastructure Co-ordination Cell
DAFM	Department of Agriculture, Food & the Marine
DECC	Department of the Environment, Climate & Communications
DETE	Department of Enterprise, Trade & Employment
DoD	Department of Defence
DoE	Department of Energy (US)
EC	European Commission
ECT	Energy Charter Treaty
EEZ	Economic Exclusion Zone
EHO	European Hydrogen Observatory
EIA	US Energy Information Administration
ESB	Electricity Supply Board
ESR	Effort Sharing Regulation
EU	European Union
EU27	27 Member States of the EU
ETS	Emissions Trading System
EWIC	East West Interconnector
FSRU	Floating Storage & Regasification Unit
GB	Great Britain
GNI	Gas Networks Ireland
GW	Gigawatt
GWh	Gigawatt hour
HVDC	High-Voltage Direct Current
IEA	International Energy Agency
IEM	Internal Energy Market (EU)
IFAC	Irish Fiscal Advisory Council
IRENA	International Renewable Energy Agency
KTOE	Thousand Tonnes of Oil Equivalent
kV	Kilovolt
LCOH	Levelised Cost of Hydrogen
LNG	Liquefied Natural Gas
Mb/d	Million barrels per day
MoU	Memorandum of Understanding
MW	Megawatt
MWh	Megawatt hour
NATO	North Atlantic Treaty Organization
NESC	National Economic & Social Council
NESO	GB National Energy System Operator
NI	Northern Ireland
NORA	National Oil Reserve Agency
NSIC	North-South Interconnector
PESCO	Permanent Structured Cooperation
PtX	Power-to-X
PV	Photovoltaic
RED	Renewable Energy Directive
RoI	Republic of Ireland
SEAI	Sustainable Energy Authority of Ireland
SEM	Single Electricity Market (Ireland)
SONI	System Operator for Northern Ireland
SUMED	Suez-Mediterranean
TCA	Trade and Cooperation Agreement
TEN-E	Trans-European Networks for Energy
TSO	Transmission System Operator
TWh	Terawatt hours
UK	United Kingdom
US	United States
UN	United Nations
VAT	Value Added Tax
WTO	World Trade Organization

Acknowledgements

This research has been informed by over fifty consultations with leading experts, academics, practitioners, policymakers and industry stakeholders in the energy sector. The Council and its Secretariat are grateful to these individuals for their contributions.

Executive Summary

This report examines Ireland's international trade dependencies in the energy sector and how these will evolve over the course of the energy transition. Ireland is currently among the most fossil-fuel import-dependent countries in Europe. This reliance on imported fossil fuels presents several disadvantages including high levels of CO_2 emissions, exposure to supply disruptions and price volatility on international markets, financial outflows, inefficient fossil-fuel subsidies, and negative impacts on air quality and human health.

The sheer extent of Ireland's current reliance on imported fossil fuels means that we will continue to be exposed to international security-of-supply risks over the medium term, including geopolitical tensions involving major oil and gas transit chokepoints, and events such as technical faults or sabotage affecting gas interconnection infrastructure. Ireland requires strategic energy reserves to act as a buffer in the event of a major international supply disruption but currently has no strategic gas reserves. This heightens our exposure to potential future supply disruptions. A state-owned liquefied natural gas (LNG) strategic reserve has been approved as an interim measure to mitigate the risk of an interruption to gas supplies, on condition that it does not increase gas demand and that it complies with Ireland's climate obligations. However, Ireland will ultimately require other forms of strategic energy reserves based on zero-carbon alternatives. The Council believes it is essential to formulate a long-term national plan for strategic clean-energy reserves. Ireland's system of strategic energy reserves should be reformed to deliver on national commitments to decarbonise the energy system and eventually phase out fossil fuels.

The Republic of Ireland's trade in electricity across interconnectors (two existing and three planned) is critical to bolster security of energy supply and to develop export markets for Irish renewable electricity. There are strategic issues that require further policy action in the context of cross-border trade in electricity, in particular cost-competitiveness challenges and uncertainties that must be acknowledged and addressed if Ireland is to become a significant net exporter of renewable electricity on the scale envisaged in current Government plans. There are also regulatory challenges associated with Brexit and the implementation of the EU Carbon Border Adjustment Mechanism (CBAM), which could result in market inefficiencies and unintended consequences in the context of electricity imported to the island of Ireland from Great Britain (GB). A further risk to the security of electricity supply is the vulnerability of undersea interconnection infrastructure to adverse events such as sabotage, cybercrime, accidental damage and destructive weather events.

Ireland's green hydrogen potential presents an opportunity to address several of the strategic challenges arising from the country's international trade dependencies in the context of the energy transition. Reducing current reliance on imported fossil fuels and the achievement of net zero emissions by 2050 can be supported through the production of green hydrogen and its derivatives for use in hard-to-decarbonise sectors. Green hydrogen is also a storable and dispatchable form of clean energy, providing a means to build resilience in the context of Ireland's high degree of reliance on intermittent renewables through use in long-duration grid balancing.

While green hydrogen presents an opportunity to reduce reliance on imported fossil fuels and build system resilience, the sector is not yet price-competitive and has yet to achieve technological maturity. The development of a viable green hydrogen sector in Ireland necessitates achieving economies of scale that will exceed domestic demand. Building a viable green hydrogen sector that can support major infrastructure, electrolyser investment, and supply-chain development will require fostering strategic partnerships with countries that will be major sources of green hydrogen demand in future, such as Germany, the Netherlands and Belgium.

This report provides recommendations and policy actions to address strategic policy issues relating to the international trading environment in the energy sector, enabling us to better adapt to factors beyond our borders that will shape the energy transition. The Council makes five strategic recommendations.

This Council report is accompanied by a supplementary NESC Secretariat research paper titled *Strategic Supply Chain Issues & Ireland's Energy Transition* (NESC, 2025a). This paper examines three thematic areas: (1) the international wind technology supply chain, (2) carbon emissions embedded in trade, and (3) the international biofuel supply chain. This paper and further details can be found at www.nesc.ie.

Chapter 1: Introduction

The energy transition is one of the most crucial and most difficult challenges facing Ireland today. Decarbonisation requires a transformation whereby our reliance on imported fossil fuels is minimised and the level of energy sourced from renewables is dramatically increased. Analysis and commentary on the energy transition often highlights the potential for Ireland to achieve energy independence by harnessing our vast renewable energy resources, most notably from offshore wind (DECC, 2022; DETE, 2022; DoT, 2022, 2023; WEI, 2024a, 2024b).

Rather than achieving energy independence, Ireland's international trade dependencies in the energy sector are set to persist and evolve over the course of the energy transition, shifting away from current reliance on imported fossil fuels towards a more complex mix of energy vectors, security-of-supply vulnerabilities and cost-competitiveness challenges, presenting both new strategic risks and industrial opportunities. This report makes clear that Ireland's energy strategy must adapt to the reality that strategic trade dependencies will not cease but will instead take new forms.

In the context of energy trade, import dependency refers to how much a country relies on foreign suppliers of energy. Conversely, energy exporters can also be reliant on external demand to sustain industrial activity and commercial viability. Energy import dependency exposes countries to price volatility on international markets, supply disruptions and concentration risk. Reliance on international demand necessitates the production and export of energy commodities at internationally competitive prices.

The nature and extent of these dependencies will substantially shape our energy security and economic resilience over the course of the energy transition. Examining the evolution of Ireland's international trade dependencies in the energy sector provides important insights to guide planning and policy decision-making in the context of the transition to a net zero economy and society.

Chapter 2 of this report examines specific strategic challenges arising from Ireland's fossil-fuel import dependency and how these can be addressed. It describes the extent of Ireland's current reliance on imported fossil fuels and where we are importing fossil fuels from. Chapter 2 also examines the level of financial outflows associated with purchasing fossil fuels from other countries, the high subsidisation costs associated with fossil-fuel usage, and the risk of EU fines for failing to meet our greenhouse-gas emission reduction targets.

Chapter 2 also describes the risk of geopolitical tensions affecting key oil and gas transit chokepoints which threaten the security of our energy supply, and highlights concentration risks arising from reliance on gas supplies from the United Kingdom (UK) and crude oil supplies from the United States (US). It closes by arguing that the current lack of strategic gas reserves and gas dependency is a critical risk factor. Ireland's system of strategic energy reserves will need to evolve and adapt over the coming years to integrate renewable fuels such as green hydrogen, ammonia and biomethane to align with our climate obligations.

As a further step to reducing our reliance on imported fossil fuels, Ireland also needs to undertake a review to identify options to reduce inefficient fossil-fuel subsidies in a fair and equitable manner. Doing so will accelerate the energy transition and assist in shifting economic incentives towards investment in renewables.

Chapter 3 provides a focussed examination of strategic policy issues in relation to the outlook for international trade in electricity. It examines the increasingly important role of imports over interconnectors in meeting electricity demand, highlighting both the benefits and strategic risks arising from this. Recent trends in cross-border trade in electricity illustrate the fundamental importance of cost-competitiveness as a determinant of electricity trade flows. Irish wholesale electricity prices are currently more expensive than in neighbouring interconnected markets. These markets also have ambitious plans to develop renewable energy resources, as well as plans to expand their nuclear capacity. Such factors highlight uncertainties about future demand for Irish electricity exports in these markets and the need to address cost-competitiveness challenges.

The UK's departure from the EU has presented strategic risks for cross-border trade in electricity, arising from the full implementation of the EU Carbon Border Adjustment Mechanism (CBAM), from January 2026. This report highlights the need to establish a comprehensive EU-UK Linking Agreement based on actual emissions reporting to effectively differentiate between low- and high-carbon electricity imports, avoid unintended consequences and safeguard price competitiveness on the island of Ireland.

In light of the increased importance of electricity trade for energy security and economic resilience, policy action is also required to protect Ireland's undersea electrical interconnection infrastructure. This report recommends establishing enhanced structures to monitor and protect this vital infrastructure.

Chapter 4 examines the potential for green hydrogen to address several challenges identified in this report. While hydrogen has limited potential in sectors such as space heating and passenger vehicles, where electrification is more economic, the sector can play an important role in hard-to-decarbonise sectors, in long-term grid balancing and as a strategic fuel reserve. However, to develop a commercially viable green hydrogen sector, Ireland must scale its production beyond domestic demand by exporting green hydrogen to major centres of future demand on continental Europe. This necessitates the advancement of strategic partnerships with key international partners to develop export markets for green hydrogen. In addition, it is necessary to create the enabling conditions for a green hydrogen economy to support its development and to provide certainty to investors. This report recommends the provision of incentives in the form of higher-value financial supports to industry to drive the displacement of fossil fuels by green hydrogen.

In Chapter 5, the Council provides five recommendations to Government to address the strategic challenges arising from Ireland's international trade dependencies in the energy sector.

Chapter 2: International Trade – Fossil Fuels

2.1 Introduction

Ireland is highly dependent on imported fossil fuels to meet its energy needs. This presents multiple disadvantages, including:

- high levels of CO_2 emissions, which causes climate change;
- air pollution linked to particulate matter from solid-fuel combustion and nitrogen dioxide from vehicle emissions;
- exposure to international supply disruptions and energy commodity price volatility;
- financial outflows paid to foreign suppliers of fossil-fuel commodities; and
- financial penalties arising from failure to meet EU emissions reduction targets.

Several key policy commitments focus on reducing reliance on imported fossil fuels. These are outlined in the Climate Action and Low Carbon Development (Amendment) Act 2021, the National Energy and Climate Plan (NECP) 2021–2030; the National Energy Security Framework, and the National Development Plan 2021–2030 (Government of Ireland, 2021b, 2022).

While Ireland must rapidly reduce and ultimately phase out the use of fossil fuels, we remain, at present, heavily reliant on foreign suppliers of fossil fuels to meet energy requirements. This exposes households and business to risks in terms of security of energy supply and price volatility on international markets.

Ireland remains acutely vulnerable to potential future oil supply disruptions due to its near-total reliance on imported petroleum products and the absence of domestic refining capacity beyond the Whitegate refinery in Cork, which operates on a limited scale.

The fact that Ireland holds no domestic gas reserves is a particular issue of concern and distinguishes Ireland from most other EU member states. The Department of the Environment, Climate & Communications (DECC) 2023 report *Securing Ireland's Gas Supplies* identified five strategic risks that could threaten the security of gas supplies to Ireland for both demand-side and supply-side shocks. These are:

- technical disruption;
- sabotage and physical attack;
- reduced availability of gas from the UK;
- inability to meet peak gas demand; and
- geopolitical supply-chain risks for renewables components that present a risk to climate action delivery.

The 2023 review identified several potential mitigation measures (discussed in Section 2.5). The Council argues there is a need to consider how these could be built upon to better align our system of strategic energy reserves with our climate ambitions. The Council emphasises the need to reform Ireland's strategic reserves in the context of a rapidly evolving energy landscape by integrating renewable fuels such as hydrogen, ammonia and biomethane.

This chapter is structured as follows:

- **Section 2.2:** Reliance on imported fossil fuels
- **Section 2.3:** Import dependency & geopolitical tensions
- **Section 2.4:** Gas import dependency & security-of-supply risk
- **Section 2.5:** Lack of domestic gas reserves

2.2 Reliance on Imported Fossil Fuels

2.2.1 Introduction

Ireland is heavily dependent on imported fossil fuels – a long-standing structural vulnerability in the energy system. Despite growing renewable energy deployment, especially from wind, Ireland still imports most of its primary energy in the form of oil, natural gas and coal, much of which is used for transport, heating and electricity generation. The transport sector remains largely dependent on oil-based fuels, around 40 per cent of households rely on oil boilers for heating, and natural gas fuels approx. half of electricity generation.[1]

This dependence exposes Ireland to global energy price volatility, financial costs, supply-chain disruptions and geopolitical shocks. It also conflicts with Ireland's climate commitments, as fossil-fuel use accounts for most of the country's greenhouse-gas emissions.

2.2.2 Fossil Fuel Import Dependency by Fuel Type

Ireland's level of fossil-fuel import-dependency is among the highest in Europe. Approximately 80 per cent of Ireland's total energy requirement was sourced from imports in 2024, a level that is well above that for the EU as a whole, at 58.2 per cent (Eurostat, 2024a).[2] Most of these energy imports are fossil fuels, with high levels of import dependency for oil (100%), coal (100%) and gas (77.4%) (see Figures 2.1–2.4).[3]

Oil accounts for approximately half of all final energy consumption in Ireland, all of which is imported, primarily for use in transport, heating and industry. At 51 per cent, the share of oil in final energy consumption in Ireland is the fifth highest in the EU, behind only Cyprus (55.2%), Luxembourg (55%), Malta (54.6%) and Greece (54.1%).[4]

1 Market share for new vehicles in 2024 saw petrol account for 30.31 per cent, diesel 22.80 per cent, hybrid 20.92 per cent, electric 14.41 per cent, and plug-in hybrid 10.02 per cent. Petrol remains the most popular engine type for 2024, while electric, hybrid and plug-in hybrid account for over 45 per cent of the market (SIMI, 2025).

2 2023 is the latest year for which EU27 and Euro Area comparative data is available at time of writing. Ireland's total energy import dependency stood at 78.3 per cent in 2023, before rising to 79.7 per cent in 2024 (Eurostat, 2024a; SEAI, 2025c).

3 '48 per cent of the energy used in 2022 was from imported oil and nearly 31 per cent from natural gas. 74 per cent of Ireland's natural gas came from imports through two interconnectors from the UK' (Government of Ireland, 2023a: 8).

4 'Import dependency in individual fuels is the share of a country's need for that fuel that is met by imports from other countries. Total energy import dependency is the share of the total energy needs of a country met by imports from other countries. A negative dependency rate indicates that a country is a net exporter of energy while a dependency rate in excess of 100 per cent indicates that energy products have been stocked in a given year' (Eurostat, 2024a).

Figure 2.1: Import dependency (%) in oil & petroleum products

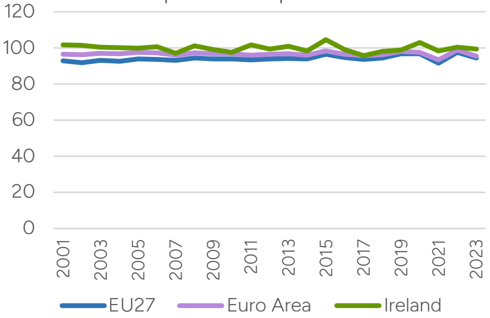


Figure 2.2: Import dependency (%) in natural gas

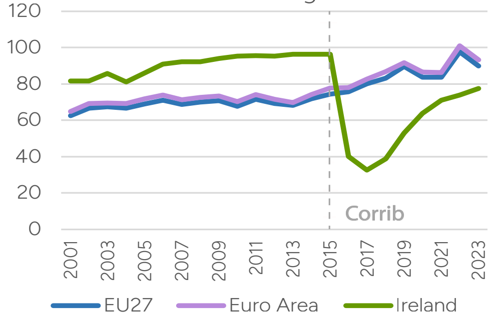


Figure 2.3: Import dependency (%) in solid fossil fuels

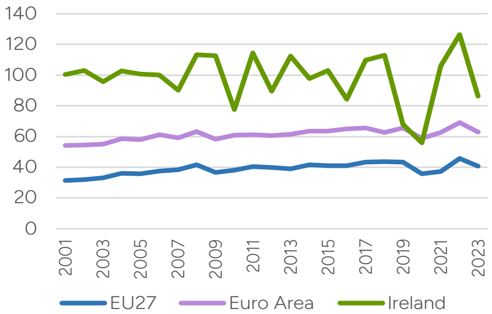
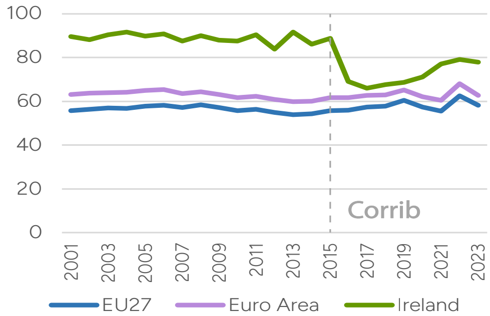


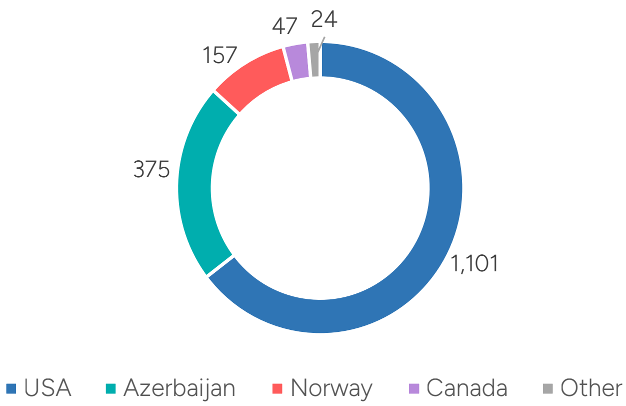
Figure 2.4: Total energy import dependency (%)



Source Data: Eurostat, 2024a.[5]

In 2023 Ireland imported 2.6m tonnes of crude oil, with a value of €1.7bn. The USA was by far the largest exporter of crude oil to Ireland in 2023, supplying 64.6 per cent of all imports, with a value of €1.1bn (see Figure 2.5).

Figure 2.5: RoI imports (€m) of c rude oil by source country 2023



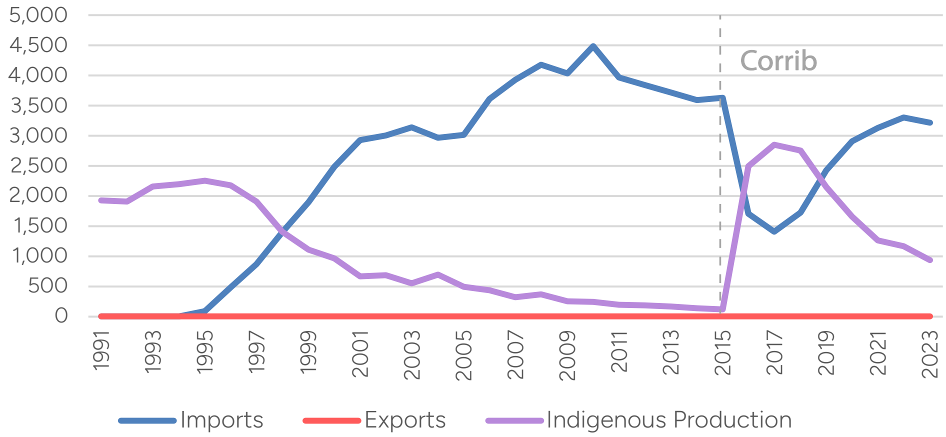
Source Data: CSO, 2024.[6]

5 Latest available EU comparative data at time of writing (CSO, 2023).

6 Provided through data request. Latest full-year data available at time of writing, provided through information request.

In terms of natural gas, Ireland was less reliant on imports of natural gas until the Kinsale Head gas field began to deplete in the late 1990s, which led to a substantial increase in import volumes over the 2000s (see Figure 2.6). Indigenous production of natural gas rose in 2015 after the Corrib gas field commenced production, resulting in a corresponding fall in import volumes. The reserves of gas remaining in the Corrib field are expected to run out over the next decade (CEPA, 2023), meaning that Ireland will have no domestic reserves of gas. This is a particular concern as around half of electricity generation in Ireland relies on gas.

Figure 2.6: RoI international trade and indigenous production in natural gas (ktoe)



Source Data: CSO, 2025a.

While the share of electricity generation derived from gas has remained relatively constant since the early 2000s, the volume of gas used in electricity generation has increased in line with growth in electricity demand, principally driven by growth in data centres (GNI, 2022a). Electricity demand from data centres has grown at an annual rate of almost 22.6 per cent since 2015, compared to 0.4 per cent for other sectors (Daly, 2024a: 3). Electricity use from data centres increased by 10 per cent between 2023 and 2024 (CSO, 2025b).

In the Climate Action Plan, the Government has set a target of adding at least 2 GW of new, flexible, gas-fired generation by 2030 to provide secure generation of electricity at times of low renewable output and/or high demand.

Global fossil-fuel prices can be subject to high levels of volatility and supply insecurity due to geopolitical tensions, natural disasters or disruption to key infrastructure. When fossil-fuel prices rise, countries that are heavily import-dependent can experience high levels of inflation, economic volatility, a loss in industrial competitiveness and falling levels of household disposable income.

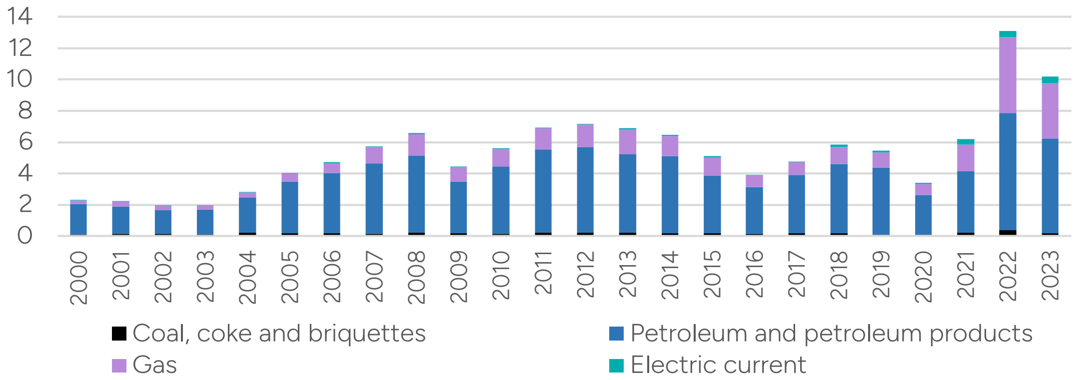
The fact that Ireland is highly dependent on imported fossil fuels means there is little that governmental or commercial actors can do to control or counteract high fossil-fuel prices on global markets (Deane, 2024a). While measures such as electricity credits and reductions in excise duty rates for fossil fuels may mitigate higher costs for consumers, these come at an expense for the Exchequer and present opportunity costs.

2.2.3 Financial Outflows

To meet energy requirements, countries that are heavily dependent on imported fossil fuels must transfer large amounts of capital to overseas suppliers at prices set on global markets. Unlike countries with domestic production, countries that are heavily import-dependent in fossil fuels do not benefit from job creation, investment or tax revenues associated with fossil-fuel extraction.

Ireland's reliance on imported fossil fuels came at a cost of €10.2bn in 2023 (see Figure 2.7), amounting to approx. €1m per hour (Deane, 2024a). These financial outflows support employment and economic activity overseas, as distinct from investment in local domestic renewable energy industries and infrastructure.

Figure 2.7: RoI value (€bn) of energy imports

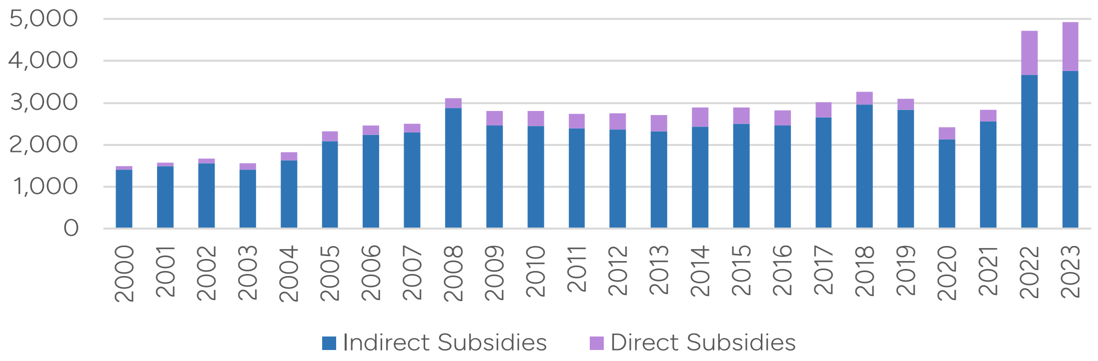


Source Data: CSO, 2024.

Fossil-fuel consumption is supported internationally through direct and indirect subsidies (WTO, 2023). Direct subsidies are those provided through targeted (cash-based) payments, such as loans or tax preferences. Indirect fossil-fuel subsidies refer to economic advantages received by an industry or consumer due to the distortions created by subsidies applied elsewhere in the fossil-fuel supply chain. These may result in artificially lower input costs (e.g. cheaper energy or raw materials) or higher revenues (e.g. market advantages from subsidised energy use), even if the recipient does not receive a direct payment or tax break.

Fossil-fuel subsidies have the 'declared objective to enhance economic growth, support low-income groups, or promote specific sectors' (Droste *et al.*, 2024: 2). Fossil-fuel subsidies rose considerably in Ireland in 2022, reaching €4.7bn, before rising further to reach €4.9bn in 2023 (see Figure 2.8). This increase was mainly due to the introduction of temporary government support measures in the form of direct energy subsidies to households and businesses, and tax reductions on petrol and diesel. These temporary measures were introduced to address the global spike in energy prices on global markets due to the war in Ukraine.

Figure 2.8: RoI annual fossil fuel subsidies (€m)



Source Data: CSO, 2025c.

In terms of the €1,153m in direct fossil-fuel subsidies in 2023, the largest categories were:

- Household energy credit at €663m (57.6%)
- Fuel allowance at €200m (17.4%)
- Temporary business energy support scheme at €120m (10.4%)
- Electricity allowance at €114m (10%)

In terms of the €3,767m in indirect fossil-fuel subsidies in 2023, the largest categories were:

- Jet kerosene excise exemption at €606m (16.1%)
- Reduced VAT rate on energy products at €461m (12.2%)
- Tax differential excise rate on road diesel at €401m (10.6%)
- Capacity remuneration mechanism/capacity payment mechanism at €363m (9.6%)
- Free Emissions Trading System (ETS) permits for stationary installations at €337m (9%)

Fossil-fuel subsidies artificially lower the cost of imported fossil fuels and encourage their consumption. Reducing such subsidies can make fossil-fuel consumption less attractive and help to level the playing field for renewables. While specific subsidies are intended to make energy more affordable for low-income households or sensitive industries, fossil-fuel subsidies come with significant environmental, economic and social costs (IEA, 2024b). By lowering the cost of fossil fuels, subsidies incentivise higher levels of fossil-fuel consumption, contributing to climate change.

Fossil-fuel subsidies also contradict commitments under agreements like the Paris Agreement to reduce emissions and limit global warming. Importantly, fossil-fuel subsidies absorb available fiscal resources that could be invested in local deployment of cleaner technologies.

2.2.5 EU Fines

The EU Effort Sharing Regulation (ESR) is an EU climate policy that sets binding national greenhouse-gas emission reduction targets for EU member states in sectors not covered by the EU Emissions Trading System (ETS). Under the ESR, Ireland must reduce its non-ETS emissions by 42 per cent by 2030 as compared to 2005 levels (European Commission, 2025a). Failure to meet these targets results in the need to purchase carbon credits from other EU countries.

Ireland has the highest per capita emissions gap relative to its ESR target in the EU, suggesting that Ireland will face higher ESR-related costs on a per capita basis and greater challenges in meeting its targets (IFAC & CCAC, 2025: 18).

When other potential EU fines related to renewable energy, land use and forestry are included, analysis by the IFAC and the CCAC suggests that 'Ireland could potentially have to pay out €8 to €26bn to its EU partners if it does not step up climate action swiftly' (*ibid*: 4).

The prospect of paying such financial penalties underscores the need to reduce non-ETS emissions and to accelerate renewable energy deployment to avoid transferring capital abroad that could be invested domestically to meet our climate targets.

2.3 Import Dependency & Geopolitical Tensions

2.3.1 Introduction

Energy security is a product of three energy system aspects: reliability of resources and infrastructure, capacity to respond to disruptions, and the degree of exposure to geopolitical threats. Other aspects of energy security include affordability, safety and sustainability (IEA, 2022). In discussion of energy supply insecurity, an important distinction is that between a physical interruption, where supplies of energy commodities are cut off, and a price risk, where energy commodities are available but become expensive (Deane, 2023).

The most significant risk in terms of the security of supply of fossil fuels to Ireland takes the form of geopolitical tensions and conflict affecting key oil and gas transit chokepoints.
The effects of geopolitical events on supply security were clearly evident in 'the transformative impact on energy markets arising from the invasion of Ukraine by Russia and the EU's decision to decouple the European energy market from Russian energy supplies' (McCarthy, 2023: 4).
The price of wholesale gas rose sharply in 2022 as a result of the outbreak of conflict in Ukraine (IGEES, 2023). While Ireland does not import gas directly from Russia, reductions in Russian gas supplies to Europe led to increased competition for alternative sources across Europe, driving up prices.

The fact that approx. 50 per cent of Ireland's electricity is produced from gas-fired power plants made Irish electricity prices among the most exposed in Europe to resulting regional gas market volatility.

This section looks at four areas where geopolitical tensions are currently raising concerns about energy security:

- Strait of Hormuz
- Danish Straits
- Suez Canal
- Transatlantic energy trade

2.3.2 Strait of Hormuz

One of the critical oil and gas transit chokepoints marked by heightened geopolitical tensions more recently is the Strait of Hormuz. Located between Oman and Iran, the Strait of Hormuz is the world's most important oil transit route, with 20 million barrels per day (mb/d) passing through the strait. This amounts to 30 per cent of world oil trade and around 45 per cent of all OPEC exports (IEA, 2023).

The Strait of Hormuz is also the transit route for approx. 20 per cent of global shipped natural gas trade, meaning that disruptions would have a serious impact on global gas prices. As around half of Irish electricity production relies on gas, disruptions to the flow of energy commodities through the Strait of Hormuz would have a significant impact on Irish electricity prices. However, such disruption would be likely to have a larger impact on petrol and diesel prices in the short to medium term as compared to gas prices (Deane, 2024b).

Recent events in the Middle East highlight the risk of disruption to the supply of oil and gas via the Strait of Hormuz. These include:

- In October 2024, the US imposed new sanctions targeting Iran's petrochemical and oil industries, aiming to curb its financial capabilities related to missile programmes and support for militant groups (US Department of the Treasury, 2024).
- Escalating tensions between Israel and Iran have raised concerns about potential disruptions, given Iran's strategic position encircling the Strait of Hormuz. One notable risk is the potential for an Iranian imposed blockade in response to Israeli action in the West Bank and the Gaza Strip (Book *et al.*, 2024). A wider-scale conflict involving Israel and Iran would be likely to significantly disrupt the supply of oil and gas through the Strait of Hormuz, resulting in substantial price increases on global markets (Deane, 2024b).
- The wider region has witnessed incidents affecting commercial shipping, including vessel seizures and attacks, which underscore the persistent risks to the free flow of oil and other goods through the strait (Fechner *et al.*, 2024).

2.3.3 Danish Straits

Another strategically important oil transit chokepoint that has seen heightened geopolitical tensions in recent years is the Danish Straits, the maritime passages connecting the Baltic Sea to the North Sea.

The Danish Straits are an important route for Russian seaborne oil exports to Europe, as well as exports from Norway and Egypt (EIA, 2024). In response to international sanctions, Russia has increasingly relied on a 'shadow fleet' of ageing oil tankers to transport oil through the Danish Straits (Cook *et al.*, 2024). The Danish Defence Intelligence Service has expressed concerns that Russia may deploy naval warships to escort these shadow fleet tankers through the Danish Straits, risking an escalation in tensions with NATO member countries in the region (Bloomberg, 2024).

2.3.4 Suez Canal

The Suez Canal, SUMED pipeline and Bab el-Mandeb Strait are also key transit routes in the Persian Gulf for oil and LNG from the Middle East and Asia to Europe. About 11 per cent of total seaborne oil and 8 per cent of LNG shipments passed through the region in 2023 (EIA, 2024). Since late 2023, Houthi rebels in Yemen have been targeting oil and gas tankers and other commercial vessels in the Red Sea, disrupting traffic through the Suez Canal (WEF, 2024). Geopolitical tensions have heightened in the region in recent years, with the potential for conflict and instability involving Israel, Iran, Yemen, Egypt and Sudan. The outbreak of conflict, embargoes or increased levels of piracy could negatively impact upon security of oil supplies and lead to price volatility.

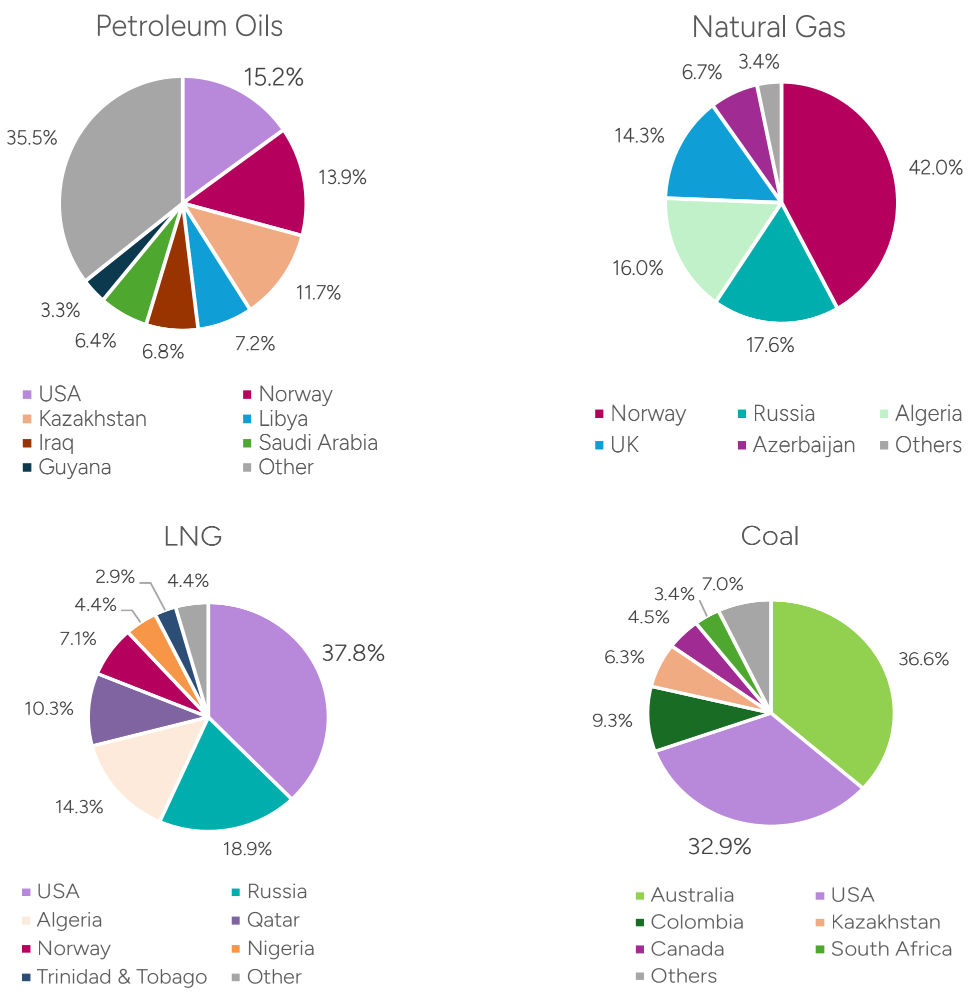
2.3.5 Transatlantic Energy Trade

In response to the energy crisis following Russia's invasion of Ukraine, the EU has mandated minimum gas storage levels (European Commission, 2022). Countries with no domestic gas storage, such as Ireland, rely either on regional agreements or LNG imports. Countries such as Germany, Italy, Austria and the Netherlands have made significant investments in underground gas storage and now see it as a core part of energy resilience policy. As a consequence of the war in Ukraine and efforts to reduce reliance on Russia, the EU has become increasingly dependent on the US as a supplier of energy commodities, particularly LNG.

By 2023, EU imports of LNG from the US had tripled relative to 2021, making up half of all EU LNG imports in that year (European Council, 2025). Using more recent quarterly data, Figure 2.9 displays EU imports of different energy commodities by partner country in Q3 2024. The US is a substantial supplier of petroleum oils (15.2% in value terms), LNG (37.8%) and coal (32.9%) to the EU.

The EU's increased dependence on the US as a supplier of energy commodities exposes the EU to the risk of supply disruptions in US exports. In the event of a major international energy supply shortage affecting the US, exports could be restricted in order to prioritise domestic needs (Congressional Research Service, 2014). This occurred in 1973 when the US introduced energy export restrictions in response to the Arab oil embargo, which led to widespread shortages in the US (Council on Foreign Relations, 2014). In 1978, the US Natural Gas Policy Act imposed limits on natural gas exports, prioritising domestic consumption (U.S Congress, 1978).

Figure 2.9: EU imports of energy products Q3 2024 (% share of value)



Source Data: Eurostat, 2024b.

In terms of the EU's reliance on the US as a supplier of LNG, analysts have highlighted that 'this growing dependency is exposing the EU to vulnerabilities linked to US domestic policy shifts and the political landscape. The Trump Administration is likely to use it as a pressure tool on Europe … LNG imports then turn into a bargaining tool to pressure the EU to make trade concessions' (Kouam, 2024). In April 2025, US President Donald Trump suggested that the EU should commit to buying more oil and LNG from the US as a means of balancing the US trade deficit in goods with the EU (Sheftalovich, 2025). Reports subsequently emerged of EU efforts to reach an agreement on a demand aggregation scheme based on pan-European orders with the aim of achieving more competitive rates (Gavin, 2025). Such a strategy presents a dilemma for the EU, in that buying even larger volumes of LNG from the US would weaken the EU's strategic energy autonomy. According to Corbeau (2025), 'EU countries value LNG because of the diversity in suppliers. Increasing imports and moving to an 80–90 percent share of US LNG in total LNG imports would undermine this benefit of diversification from a security of supply perspective.'

As the EU increases its reliance on US oil and LNG supplies, this exposes the EU to the risk that such dependence can be used to force concessions on other issues such as agriculture trade, digital services taxes, defence spending, or environmental regulations such as the EU's Carbon Border Adjustment Mechanism (CBAM).

2.4 Gas Import Dependency & Security of Supply Risks

Reducing gas consumption and dependency is fundamental to meeting Ireland's climate obligations. Analysis by Daly (2022) examined the role of natural gas in the energy transition consistent with Ireland's carbon budgets up to the period to 2050 across a number of scenarios. Gas demand sees a significant reduction of between 68 and 78 per cent from 2030 to 2040, depending on the scenario considered (*ibid*: 32). This demonstrates the significant reduction of natural gas use anticipated, reducing the reliance on imports during this period and its limited role in our energy system as we reach 2040 (Government of Ireland, 2023d: 9).

The two Moffat Interconnectors with Scotland are the dominant supply route for Irish gas imports (Khammadov *et al.*, 2025). For winter 2024/25 (October 2024 to March 2025) indigenous gas supply sources (i.e. Corrib and biomethane) were forecast to meet 19% of RoI gas demand, with imports from GB through the Moffat Entry Point accounting for the balance of 81% (GNI, 2024).[7]

Ireland's high degree of import dependency, concentrated from a single supply point, is a strategic concern as there are currently no domestic gas storage facilities in Ireland. This creates vulnerability to potential supply disruptions such as a gas undersupply emergency in GB or damage to a gas interconnector.

Interconnector 1 (IC1) and Interconnector 2 (IC2) were designed with a degree of operational redundancy, supporting security of gas supply in the event of certain faults or emergencies. The two pipelines connect the Moffat supply point in Scotland to Ireland and share common upstream infrastructure (compressor stations at Beattock and Brighouse Bay). This upstream infrastructure also supplies NI via the Scotland to NI pipeline. While they share upstream infrastructure, each interconnector is physically distinct: IC1 was commissioned in 1991 and IC2 (which supplies both Ireland and the Isle of Man) was built in 2002. This means that a disruption to one subsea interconnector does not necessarily compromise the integrity of the other (CRU, 2022). Disruption to upstream infrastructure in Scotland would constitute a shared exposure.[8]

Before leaving the EU, the UK was bound by the EU's *Regulation on measures to safeguard the security of gas supply* (EU, 2017), which safeguards security of gas supply by ensuring the continuous functioning of the internal market in natural gas. It also includes exceptional measures that place obligations on member states to reduce gas supplies to non-household customers to meet the needs of interconnected neighbouring member states that invoke a solidarity measure due to supply shortages.

7 Most up-to-date estimate at time of writing. The Corrib gas field accounted for 9 per cent of Gas Networks Ireland (GNI) system peak day gas demand in 2023/24, while imports from Moffat accounted for the balance of 91 per cent (GNI, 2023).

8 In the event that one interconnector is disrupted, the other could, under normal conditions, compensate to an extent. DECC analysis indicates that in a scenario of loss of IC2 for 30 days and a one-in-20 weather event, 'demand is met through a combination of utilising Interconnector 1 fully, switching to secondary fuel-use in power generation and the use of gas linepack in the network' (Government of Ireland, 2023d: 19). The CRU also noted: 'In the event of loss of supply at Moffat the linepack in IC1 and IC2 could supply the Irish demand on a 1-in-50 winter for five days.' This includes an allowance of gas to enable fuel switching of a number of power stations. It should be noted that this does not provide for supply to NI through the South North Pipeline, which is connected to IC2 (CRU, 2022).

Notably, the regulation stipulates that member states are obliged to supply gas to another member state that invokes the solidarity measures if they are connected via a third country, unless flows are restricted in the third country. Post-Brexit, Ireland's gas network is now connected to the wider EU gas market via a third country (Delivorias, 2023).

Concerns were raised about the implications of Brexit for security of gas supply from the UK to Continental Europe when reports emerged in the summer of 2022 that the UK government was developing an emergency plan to restrict gas supplies via GB's interconnectors to the Netherlands and Belgium in the event that the UK market experienced supply shortages (Thomas & Sheppard, 2022). While such restrictions did not transpire, the episode highlights the potential of Brexit to disrupt EU–UK gas flows in the event of a major supply shortage in the UK.

The EU-UK Trade and Cooperation Agreement (TCA) establishes a framework for continued cooperation between both parties on security of supply for both gas and electricity. However, the TCA does not provide clarity on the issue of EU member states' obligations in the event that Ireland were to invoke the solidarity mechanism under the *Regulation on measures to safeguard the security of gas supply* (Delivorias, 2023: 4).

GNI and GB National Gas have an established joint protocol for load shedding at the Moffat interconnection point in the event of a gas supply emergency. This protocol persists post-Brexit and sets out that, in the event of a shortage of natural gas supply in the UK that could affect supplies in Ireland, any reductions would be on a proportional basis across the UK and Ireland. In September 2023 the Irish and UK governments signed two memoranda of understanding (MoUs): one to increase renewable energy development cooperation and electricity interconnection, and a second on security of gas supply (DECC, 2023). The MoU on gas supply commits to continuing and strengthening cooperation with the UK on natural gas security of supply matters.

Ireland has not experienced a major interruption in gas supplies from the UK, and the risk of a prolonged disruption is low. However, policymakers need to avoid complacency and carefully consider the strategic risks that could potentially disrupt Ireland's gas supplies from the UK in future. According to DECC's 2023 review, 'the Department's view is that the level of risk presented by a UK supply risk (excluding import infrastructure) over the next decade is low, although this outlook could change depending on a number of variables' (Government of Ireland, 2023d: 26).

Ireland remains exposed to the risk of an unforeseen disruption to supplies of gas from the UK in the form of either a technical malfunction or deliberate sabotage by malign actors (see Box 1), which could be catastrophic (Deane, 2023).

Box 1 – Vulnerability of Gas Import Infrastructure

Gas import infrastructure, including undersea gas interconnector pipelines, is vulnerable to hybrid warfare attacks such as physical sabotage and cyberattacks by malign actors.

In September 2022, three of four strands of the Nord Stream pipelines were damaged by explosions at a depth of approx. 80 meters in the Baltic Sea. Preliminary findings of a German investigation into the incident suggest that the perpetrators acted without government support and managed to detonate explosives on the pipelines using only basic diving gear (Bewarder *et al.*, 2024). The apparent ease with which this was achieved demonstrates the vulnerability of gas interconnection pipelines to sabotage.

Concerns have been raised about Russian naval activity near Irish waters, as gas interconnectors or undersea cables could be targeted through hybrid warfare. In 2023 Russian ships were monitored by the Irish Air Corps and naval service off the Irish coast (Houses of the Oireachtas, 2023). General Hans-Werner Wiermann, head of NATO's Critical Undersea Infrastructure Co-ordination Cell (CUIC), has described it as a 'fair assumption' that Russian ships had carried out extensive mapping of undersea pipelines and cabling in Irish-controlled waters (O'Connor, 2023).

There are a number of EU initiatives in development focused on protecting critical offshore infrastructure, including a new Critical Seabed Infrastructure Protection (CSIP) project within the EU's Permanent Structured Cooperation (PESCO) framework, in which Ireland holds observer status. Separately, NATO has established a Critical Undersea Infrastructure Coordination Cell (CUIC) which is expected to be open to non-NATO members, such as Ireland, as well as industry and civilian stakeholders. Ireland's participation is under active consideration (Houses of the Oireachtas, 2023).

2.5 Lack of Domestic Gas Reserves

The National Oil Reserve Agency (NORA) manages Ireland's strategic oil reserves. Ireland holds no strategic gas reserves domestically. This is in contrast with the approach taken in most other EU member states.

As outlined in this chapter, Ireland's high dependence on imported fossil fuels, geopolitical risks in key oil and gas transit chokepoints, the concentration of Irish gas supplies via the UK, and the absence of domestic strategic reserves of gas expose the country to the risk of external supply shocks.

As noted, analysis by DECC in 2023 identified strategic risks and supply-side mitigation measures (Government of Ireland, 2023d). These potential measures were:

- reopening of the Irish offshore for new gas exploration;
- underground gas storage;
- a third gas interconnector to the UK;
- a permanent onshore facility (LNG storage tanks and import capabilities); and
- an offshore Gas Emergency Reserve (a floating storage and regasification unit).

The option recommended in the 2023 review was a floating storage and regasification unit (FSRU); a large vessel with the ability to store, transport, and regasify LNG and distribute natural gas to the national gas network. It would be moored on a purpose-built jetty. Such an option is recommended as a Strategic Emergency Gas Reserve, as distinct from a commercial facility. This would mean ownership and operation of the facility by a state-owned entity; the review noted the gas transmission system operator (TSO) as a possibility, i.e. GNI. The FSRU option is proposed by Government as the least impactful method of mitigating the risk of an interruption to gas supplies until alternatives based on renewables are at sufficient scale.

An analysis commissioned by DECC to examine the cost of the proposed FRSU facility has estimated that it will cost €900m over a ten-year period, inclusive of capex, annual lease and operating costs (CEPA, 2025: 22). A review is ongoing to assess the implications of the proposed facility in terms of its potential impact on household energy bills.

In March 2025 the Government approved plans to proceed with the development of a state-led strategic gas emergency reserve in the form of an FSRU as a temporary measure on condition that it does not increase gas demand and that it complies with Ireland's climate obligations. The facility will be owned on behalf of the State by GNI and will be introduced in line with specific criteria and requirements determined by DECC, including not inadvertently increasing gas demand and compatibility with the Climate Act 2021 (DECC, 2025; Government of Ireland, 2023d).

While the development of a state-led floating LNG facility will diversify Ireland's strategic energy reserves, concerns have been raised about the risk of fossil-fuel lock-in and the environmental impact of LNG (CCAC, 2025: 17).[9] Experts have also called for safeguards to prevent commercial LNG operations in Ireland and to ensure the facility does not conflict with the Government's commitment to radically reduce fossil-fuel reliance and meet legally binding carbon budgets (Daly *et al.*, 2025).

The facility represents a new investment in fossil-fuel infrastructure that could potentially be covered by investor protections under the Energy Charter Treaty (ECT), which includes a 20-year sunset clause. Ireland is one of several EU member states that has indicated the intention to withdraw from the ECT, aiming to do so in coordination with other EU countries. However, not all EU member states have committed to withdrawing from the ECT, making the timeline for Ireland's eventual withdrawal uncertain (Houses of the Oireachtas, 2024b). As a result, investor protections under the ECT could apply to the proposed LNG facility for 20 years after withdrawal from the ECT (EPRS, 2023).

The Council believes it is essential to formulate a long-term plan for strategic clean energy reserves in Ireland. Ireland's system of strategic energy reserves should be reformed to deliver on national commitments to decarbonise the energy system and eventually phase out fossil fuels. Ireland's system of strategic energy reserves must be enhanced in the coming years in the context of a rapidly evolving energy landscape by integrating renewable fuels such as green hydrogen, ammonia and biomethane.

9 These include the total emissions associated with LNG production, including the upstream release of methane where LNG is sourced via fracking (*ibid*). LNG infrastructure is also subject to specific security risks (CRS, 2008).

Rolling out strategic energy reserves based on zero-carbon fuels in Ireland represents a complex and multi-phase national project, necessitating a coordinated national plan to guide the development of regulatory frameworks, major infrastructure investment and complex stakeholder coordination.

Several initiatives are underway to progress long-term clean energy storage solutions in Ireland based on zero-carbon fuels. The *National Biomethane Strategy* commits to supporting delivery of up to 5.7 TWh of indigenously produced biomethane by 2030 and acknowledges the potential immediate role for biomethane in electricity back-up generation (DAFM & DECC, 2024: 31; CCAC, 2025: 17). The ESB has announced plans to transform the Moneypoint site into a green energy hub towards the end of the decade, including investment in a green hydrogen production, storage and generation facility (ESB, 2021). Green hydrogen will be produced from renewable energy and used for power generation as part of the *Green Atlantic at Moneypoint* project.

One way of enabling low-carbon strategic energy reserves is through developing European hydrogen storage facilities and infrastructure to operate in tandem alongside existing fossil-fuel-based strategic reserves. Hydrogen Europe has called on the EU to initiate, invest in and manage an EU strategic hydrogen reserve equivalent to at least 90 days of net imports, by 2030 (van Wijk *et al.*, 2022). According to Frank Wouters, director of Mediterranean Green Electrons and Green Molecules Network,[10]

> We should create a strategic reserve for hydrogen, similar to what exists for fossil fuels. By redirecting part of the funds from these fossil fuel reserves, we could immediately stimulate demand for clean hydrogen and kickstart the projects that are ready to go … Europe could for example start with a volume of 5 million tonnes by 2030, which would create immediate demand (MED-GEM Network, 2024b: 3).

Given our considerable natural endowments in the offshore wind sector, the Council believes that Ireland could play a strategic role in future as a producer and exporter of hydrogen to Europe. Chapter 4 examines this potential in further detail.

The development of strategic energy reserves based on low carbon fuels should be pursued in tandem with the development of a portfolio of long-duration energy storage solutions to build system resilience, including pumped-storage hydroelectric, compressed air storage, liquid air energy storage, and emerging long-duration battery storage technologies based on iron and sodium (Foley *et al.*, 2024:33; Houses of the Oireachtas, 2024c). Other measures include the retention as an available backup of Moneypoint in oil-fired mode for longer than previously anticipated, and the potential to increase the feasibility of distillate operation of gas plants, including by increasing storage and by connecting power plants to existing storage at suitable locations (Houses of the Oireachtas, 2024d).

10 The MED-GEM Project, supporting Green Electrons and Molecules' (GEM) development in the Southern Mediterranean Neighbourhood, is an initiative funded by the European Union that aims to create and operate a sustainable and self-sustaining network in the region (MED-GEM Network, 2024a).

Chapter 3: International Trade – Electricity

3.1 Introduction

International trade in electricity over interconnectors is widely recognised as enhancing the resilience and efficiency of electricity markets. Interconnectors improve market efficiency by increasing the number of suppliers in interconnected markets, enabling electricity to flow from regions with surplus supply to undersupplied regions. This helps to reduce price disparities between connected markets and stabilises prices by reducing volatility, helping to prevent sharp price spikes (ACER, 2022: 21).

Electrical interconnectors enhance resilience and security of electricity supply by allowing countries to trade electricity during times of need such as unexpected demand spikes, disruptions to infrastructure or other supply disruptions. The added resilience and security of supply provided by electrical interconnectors was illustrated in the aftermath of the invasion of Ukraine, following which Ukraine and Moldova sought emergency synchronisation of their electricity grids with the Continental European Network (CEN). Through CEN integration, Ukraine and Moldova gained access to the interconnected European electricity market, enabling imports of electricity from EU countries to stabilise supply in response to Russian attacks on energy infrastructure (Energy Community, 2024; IEA, 2024c).

Electrical interconnection also supports renewable energy integration. With increased reliance on variable and intermittent renewable sources of energy such as wind and solar, electrical interconnection offers a means of balancing demand while decreasing the need for backup capacity and curtailment (Boyle *et al.*, 2024). According to Brinkerink et al. (2019), 'with growing penetration of variable renewables, an alternative or complementary approach to tackle the variability challenge is by interconnecting adjacent power systems to be able to import or export electricity during peaks and lows in generation' (*ibid*: 275).

An analysis of EU member states' power systems by Mac Domhnaill and Ryan (2020) found that:

> the ability of a country to export excess renewable electricity during periods of above average supply increases its capacity to incorporate renewable energy into electricity production. Conversely, if a country's electricity grid is isolated from the grids of other countries, it is unable to develop renewable electricity for reasons of supply security and unfeasible electricity storage. This result offers a clear implication to policymakers: electricity grid interconnection between countries should be developed in order to maximise the potential use of renewable electricity (*ibid*: 962).

This chapter examines strategic policy issues in relation to international trade in electricity. It is structured as follows:

- **Section 3.2:** Irish & European policy context
- **Section 3.3:** Irish trade in electricity
- **Section 3.4:** Risks associated with electrical interconnectors
- **Section 3.5:** UK policy divergence & CBAM
- **Section 3.6:** Carbon intensity of imported electricity
- **Section 3.7:** Future outlook for electricity trade

3.2 Irish & European Policy Context

The Irish Single Electricity Market (SEM) is a single wholesale market that encompasses both the Republic of Ireland (RoI) and Northern Ireland (NI). The SEM integrates the all-island and European electricity markets, enabling free trade across borders without discrimination between internal and cross-border transactions (Semo, 2024). EirGrid and the System Operator for Northern Ireland (SONI) jointly operate the electricity grid across the island of Ireland.

There is currently one operational 220 kV AC overhead transmission line between NI and the RoI. The fact that the RoI and NI are connected on a single transmission line presents a strategic risk, as any problems or disruptions affecting this infrastructure could result in widespread power failures (EirGrid, 2024b). To increase transfer capacity, reduce congestion and enhance the overall stability of the island's electricity grid, an additional 400 kV AC North-South Interconnector (NSIC) between the RoI and NI was proposed upon the establishment of the SEM in 2007. Despite being identified as a critical infrastructure project, the NSIC has faced delays due to planning procedures, legal challenges and public opposition, with commissioning expected to take place in the coming years. Establishing an NSIC will facilitate better market integration, lead to more efficient dispatch of low-carbon electricity and enable more efficient rebalancing of generation and load across the island (Curtis *et al.*, 2014).

Box 2 provides an overview of the existing and planned electrical interconnection infrastructure linking the island of Ireland to overseas markets.

The existing interconnectors that link the island of Ireland to overseas markets provide a combined capacity of 1,500 MW. The additional planned interconnectors will add a further 2,150 MW, meaning the total interconnection capacity between the island of Ireland and overseas markets will reach 3,650 MW.

Ireland's *National Policy Statement on Electricity Interconnection* (Government of Ireland, 2023c) sets the goal of further increasing electricity interconnection capacity and explores new interconnection opportunities with countries such as Spain, Belgium and the Netherlands, as well as the prospect of further interconnection with both GB and France.

Box 2 – Ireland's Electricity Interconnectors

Existing

- **Moyle Interconnector** is a 500 MW connection between NI and Scotland.
- **East West Interconnector** (EWIC) is a 500 MW connection between Ireland and Wales.
- **Greenlink Interconnector** is a 500 MW connection between Ireland and Wales which became operational in January 2025.

Planned

- **Celtic Interconnector** is a planned, European Commission-supported, 700 WM electricity connector with France, which is expected to be completed in 2026.
- **MaresConnect Interconnector** is a proposed 750 MW between Dublin and Denbighshire in Wales.
- **LirIC Interconnector** is a proposed 700 MW HVDC connection between NI and Scotland.

EU policy aims to ensure that member states have sufficient cross-border electricity interconnection capacity to facilitate a fully integrated and resilient European energy market, with the aim of promoting integration of renewable energy across borders and reducing reliance on fossil fuels.[11]

The EU has set an electrical interconnection non-binding target of at least 15 per cent by 2030, meaning EU member states should have electricity interconnectors in place to allow cross-border trade at volumes equivalent to at least 15 per cent of installed electricity production capacity by 2030 (European Commission, 2024a).

Scheduled for completion in 2026 (EirGrid, 2024a), the 700 MW Celtic interconnector with France will amount to less than half of Ireland's 15 per cent interconnection target. Ireland's progress in meeting the 15 per cent target is thus unclear in light of the fact that our existing interconnectors (East–West and Moyle) connect to GB, and the UK is no longer an EU member state.

In addition to promoting greater interconnection among EU member states, EU policy encourages the expansion of electrical interconnection with neighbouring non-EU countries. According to the second report of the Commission Expert Group on Electricity Interconnection Targets (European Commission, 2019), in general EU member states should expand their interconnection with neighbouring non-EU countries where this aligns with EU policy aims on environmental protection, decarbonisation, fair competition, security of supply and grid stability.[12]

11 EU funding and support for the development of cross-border energy infrastructure projects are guided by the Trans-European Networks for Energy (TEN-E) Regulation. This regulation introduced the concept of Projects of Common Interest, which are strategically important interconnection projects eligible for EU funding.

12 Expansion of electrical interconnection should be promoted with neighbouring countries with a high level of regulatory convergence and well-grounded environmental cooperation with the EU (EC, 2019, p.7). In terms of decarbonisation, interconnection with non-EU countries should help to increase the consumption of electricity from renewable sources in the EU while encouraging renewable generation and consumption in the neighbouring countries, meeting long-term decarbonisation objectives in the EU and elsewhere (p.8).

Ireland is a particularly noteworthy case in the context of the EU's policy on interconnection with neighbouring non-EU countries. At the time of writing, Ireland is the only EU member state whose operational electricity interconnectors are exclusively linked to a non-EU jurisdiction. Other noteworthy characteristics of Ireland's energy system as compared to other European countries are the relatively large share of electricity derived from intermittent renewables (mainly wind), the absence of nuclear, the high share of electricity generation derived from gas, Ireland's challenging maritime development context and our distance from potential energy partners.

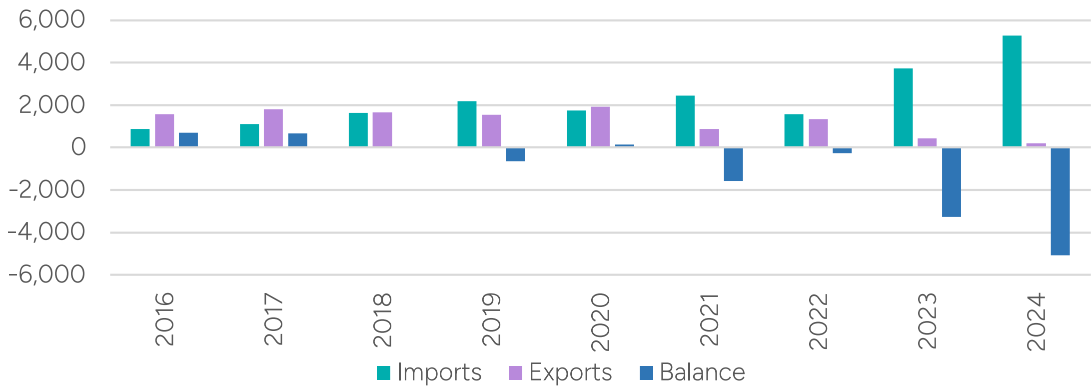
The evolving landscape of European energy policy reflects a marked shift toward greater regionalisation of energy planning, infrastructure delivery and market integration. This trend has considerable implications for Ireland, in terms of both its domestic energy strategy and its broader role within the European energy system. Increasingly, collaborative structures such as the North Seas Energy Cooperation (NSEC) and policy instruments like the European Grids Package, part of the Affordable Energy Action Plan, are shaping the way in which energy infrastructure is conceived, justified and financed across EU member states.

3.3 Irish Trade in Electricity

Patterns of cross-border trade in electricity can be influenced by multiple complex and interrelated factors, including the availability of renewables, the cost of fossil-fuel inputs, the capacity of available interconnectors and supply-demand conditions (Gasprella *et al.*, 2023). At a fundamental level, the principal determinant of electricity trade-flow patterns is price differences (price arbitrage), driven by the varying costs of electricity generation, and real-time supply and demand imbalances. The EU electricity market operates on a marginal pricing model, allowing for the cheapest energy to be deployed first, with more expensive sources added depending on demand (European Commission, 2024b).

While the RoI and NI constitute a single electricity market, the CSO publishes statistics on the RoI's external trade in electricity, including trade with NI. Figure 3.1 displays the RoI's total exports, imports and net balance of trade in electricity in volume terms from 2016 to 2024.

Figure 3.1: RoI external trade in electricity (GWh)



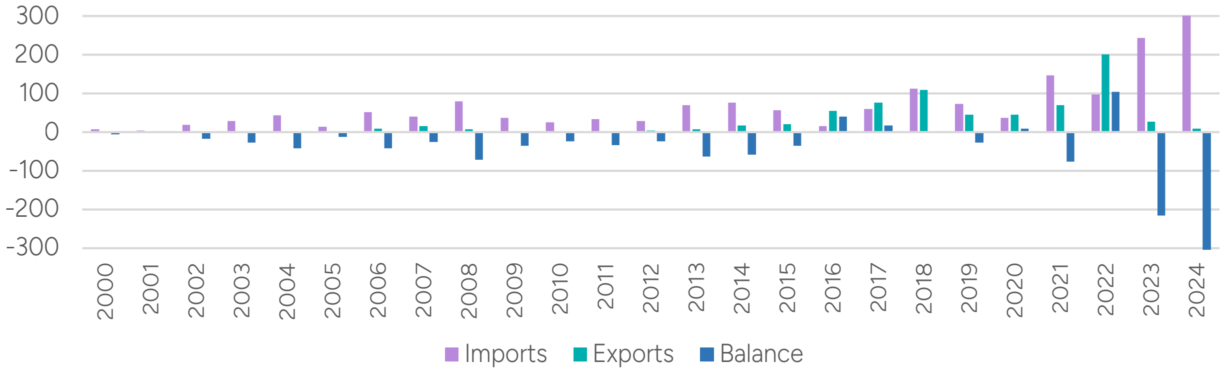
Source: Data provided by CSO through data request.

There has been a steady decline in total electricity export volumes from the RoI in recent years; exports fell to 446 GWh in 2023 before reaching just 210 GWh in 2024. At the same time, electricity imports have grown, reaching 3,721 GWh in 2023 and 5,272 GWh in 2024. This resulted in a net balance of -3,274 GWh for RoI external trade in electricity in 2023 and -5,061 GWh in 2024.

Increases in electricity imports to the RoI have been driven by the availability of low-cost electricity from GB – particularly during periods of surplus renewable generation in GB — and by growing curtailment of domestic renewable energy in Ireland due to transmission constraints and system stability limits. These grid constraints have led to dispatch-down of Irish wind generation, creating greater reliance on imported electricity to balance supply and demand. As a result, total RoI domestic electricity generation has fallen in recent years even while domestic electricity demand has continued to increase. Higher net imports have filled the gap. Net imports of electricity have come to account for an ever-increasing share of RoI gross electricity supply, increasing to 9 per cent in 2023 before reaching 14 per cent in 2024 (SEAI, 2023: 5; SEAI, 2024a: 26-27).

Figure 3.2 displays the *value* of trade in electricity between the RoI and GB, representing trade over the EWIC. Noteworthy trends include the increasing value of imports in recent years and the atypical net surplus of €103m for trade in electricity across the EWIC in 2022.[13] The unusually high value of exports to GB in 2022 arose in the context of high and volatile wholesale electricity prices in GB in that year.

Figure 3.2: ROI-GB value (€m) of trade in electricity

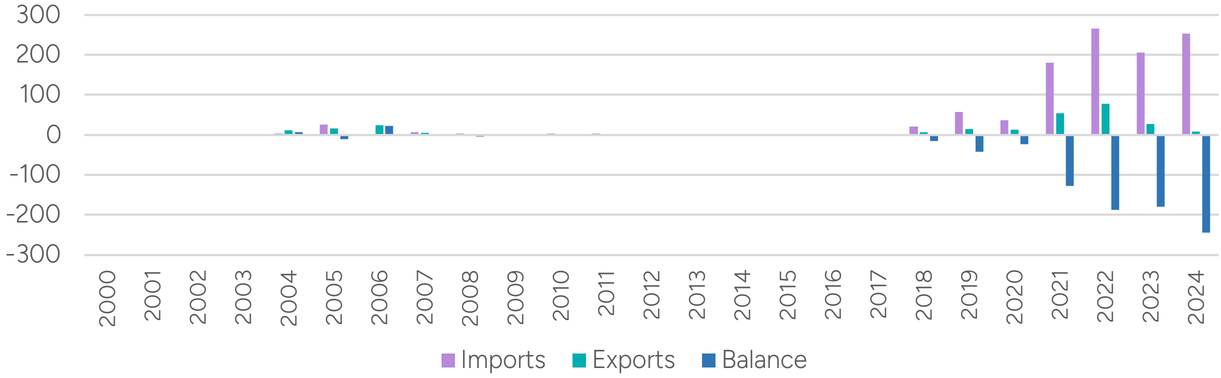


Source: Data provided by CSO through data request.

13 High wholesale prices in GB in 2022 arose due to multiple factors. The outbreak of war in Ukraine led to a global spike in gas prices, and 38.5 per cent of the electricity produced in GB in 2022 was derived from gas. The situation in GB was exacerbated by electricity generation being more exposed to the global LNG market, as LNG prices surged due to the Russia-Ukraine war. Increases in wholesale prices in GB were also driven by a spell of cold weather in December and high demand for electricity imports in France (House of Commons Library, 2024: 42-44; NESO, 2023).

The value of imports of electricity to the RoI from NI has also seen notable increases since 2021 (Figure 3.3).

Figure 3.3: ROI-NI value (€m) of trade in electricity



Source: Data provided by CSO through data request.

The growth in the *value* of cross-border trade in electricity in recent years displayed in Figures 3.2–3.3 is partly attributable to higher wholesale electricity prices resulting from higher natural gas prices. Figures 3.4–3.5 display the *volume* of RoI trade in electricity with GB and NI.

Figure 3.4: RoI-GB volume (GWh) of trade in electricity

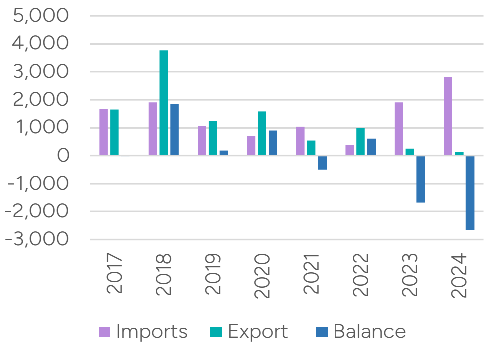
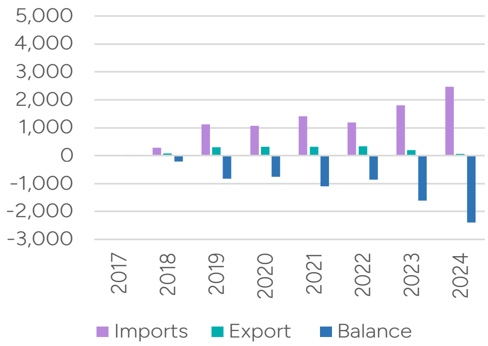


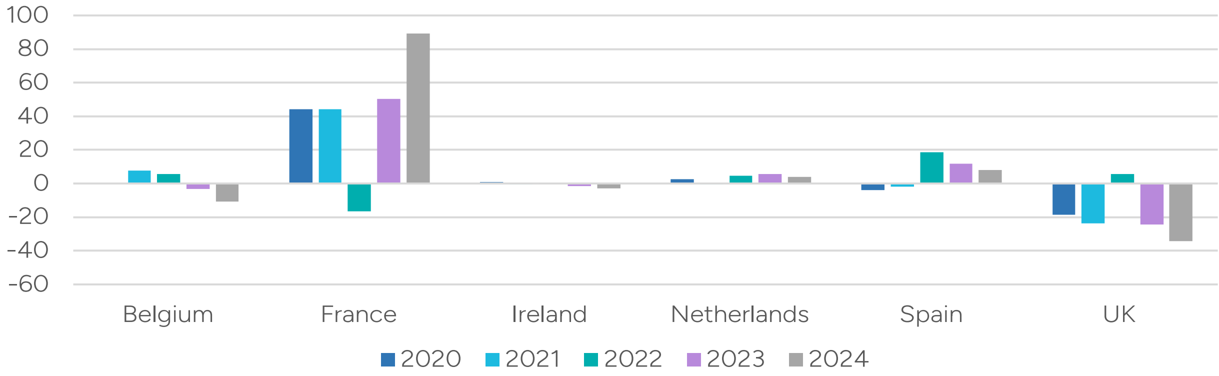
Figure 3.5: RoI-NI volume (GWh) of trade in electricity



Source: Data provided by CSO through data request.

Electricity trade flows between Ireland and GB are affected by market and supply-demand conditions, not just on these islands, but also in neighbouring interconnected markets. Figure 3.6 displays the net balance of trade in electricity in volume terms for the RoI, the UK and France, as well as the other countries identified by DECC in the *National Policy Statement on Electricity Interconnection* (Government of Ireland, 2023c) as high-potential candidate countries for consideration to expand Ireland's interconnection capacity with, i.e. Belgium, the Netherlands and Spain.

Figure 3.6: Annual net balance (TWh) of trade in electricity

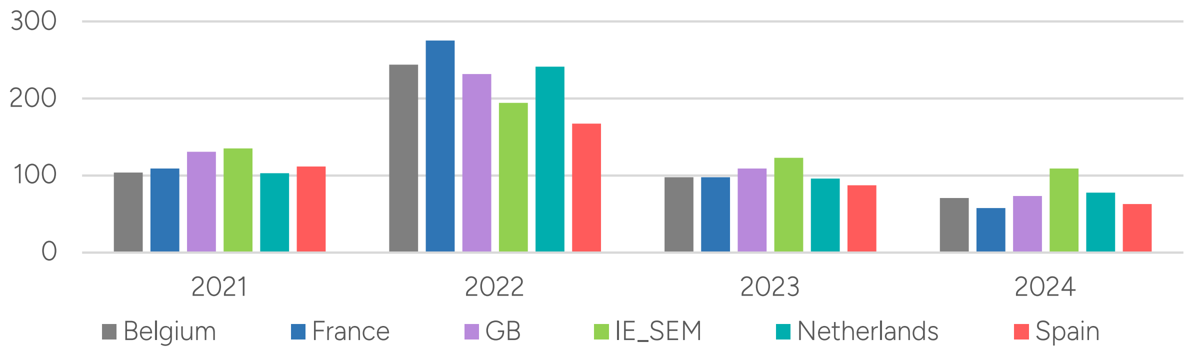


Source Data: Entso-e, 2025.

The net balance of electricity trade between these interconnected markets was atypical in 2022, partly as a result of widespread outages in the French nuclear fleet in that year. This resulted in unusually high demand for imported electricity in France and led to high levels of exports from GB to France. As a result, the UK was a net exporter of electricity in 2022 for the first time in more than forty years, with net exports totalling 5.2 TWh. Following resolution of issues in the French nuclear sector, the UK returned to being a substantial net importer of electricity in 2023 as the price spread between these interconnected markets returned to historical norms, due in large part to France's highly cost-competitive nuclear sector. The UK was a net importer of electricity with all interconnected jurisdictions in 2023 bar one – the RoI.[14]

Recent trends in cross-border trade in electricity indicate that RoI wholesale electricity prices have typically not been price-competitive vis-à-vis larger neighbouring markets. Figure 3.7 displays the annual average day-ahead wholesale electricity prices in the SEM, GB and France, as well as the other potential candidate countries identified in DECC's 2023 electrical interconnection policy statement. Average day-ahead wholesale electricity prices are highest in the SEM in all years bar 2022.

Figure 3.7: Annual AVG day-ahead wholesale electricity prices (€/MWh)



Source Data: Eurelectric, 2025.

14 The UK had net electricity imports totalling 23.8 TWh in 2023, the highest level on record. 'The France-UK interconnectors accounted for 12.9 TWh of net imports, followed by Norway-UK with 8.5 TWh of net imports … The Belgium-UK interconnector accounted for 3.0 TWh of net imports and the Netherlands-UK interconnector 2.7 TWh … The Ireland-Wales interconnector saw net exports of 1.7 TWh and the Northern Ireland-Ireland interconnector contributed 1.6 TWh of net exports.' (Martin, 2024)

While Irish electricity prices are often not cost-competitive vis-à-vis GB, the price spread between Irish and French wholesale electricity prices is usually wider. Approx. 70 per cent of France's electricity comes from nuclear power, which provides a stable, low-cost source of energy. According to the World Nuclear Association, 'France is the world's largest net exporter of electricity due to its very low cost of generation, and gains over €3bn per year from this … France now claims a substantial level of energy independence and an extremely low level of carbon dioxide emissions per capita from electricity generation, since over 80 per cent of its electricity is from nuclear or hydro' (World Nuclear Association, 2025).

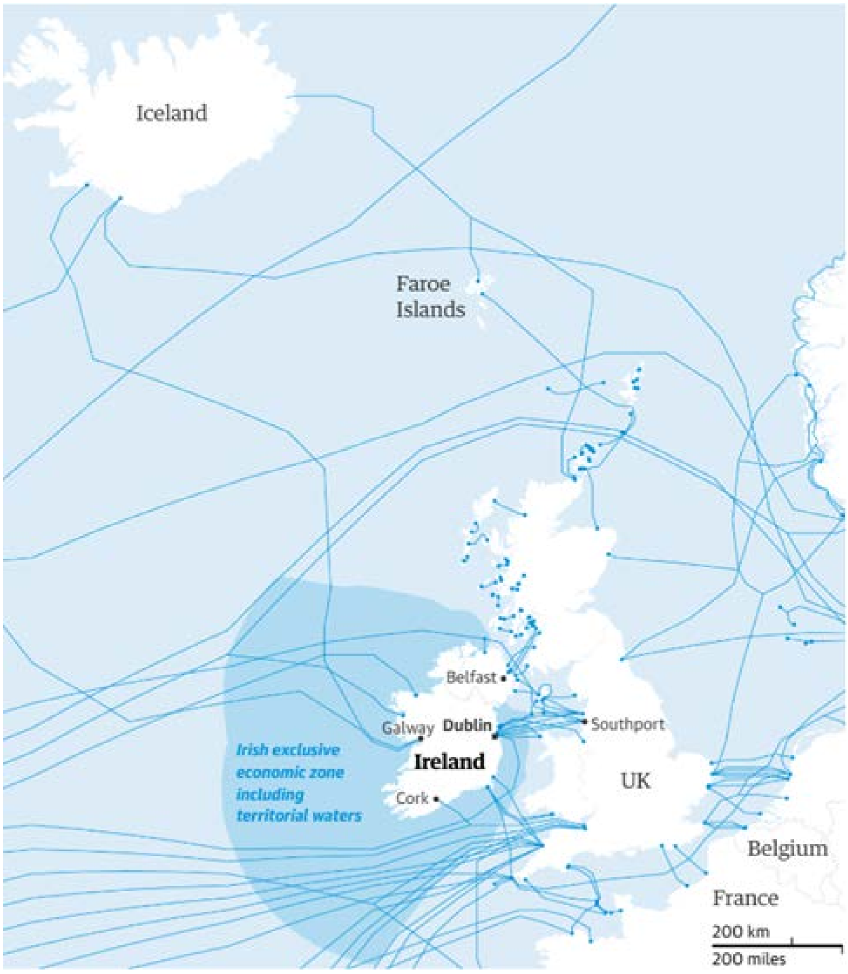
The Celtic Interconnector will link the RoI directly to France's electricity grid from 2026, diversifying electricity imports and reducing dependence on imports from GB and NI.

3.4 Security of Electrical Interconnectors

Ireland is a strategically important hub for undersea cable infrastructure due to its geographic location, large maritime area and strong digital economy. As the closest EU country to North America, Ireland is a natural landing point for transatlantic subsea data cables (see Figure 3.8). An estimated 75 per cent of transatlantic undersea cables pass through or close to Ireland's Economic Exclusion Zone (EEZ) (Afloat, 2025).

Given its vast maritime area, Ireland's ability to adequately patrol, monitor and secure its EEZ is constrained by limitations in naval and air defence capabilities. The sheer size and strategic importance of this area make constant surveillance logistically complex and resource intensive. The Air Corps and Naval Service lack adequate military radar systems and have limited access to real-time satellite surveillance. The Air Corps also has limited long-range maritime patrol capability (Óglaigh na hÉireann, 2023). Further challenges have arisen as the Defence Forces (Army, Air Corps, Naval Service) have consistently operated below their target personnel levels (Houses of the Oireachtas, 2024a).

Figure 3.8: Undersea cables around the island of Ireland



Source Data: TeleGeography, 2025.

By 2030 Ireland is expected to have five operational electricity interconnectors with GB and France. Damage to these interconnectors could result in severe disruption to Ireland's energy system, which would have serious economic and social consequences. Electrical interconnector cables can take months or years to repair due to potential supply-chain constraints and a shortage of available ships to perform cable laying and repair works.

As with gas interconnectors and fibre-optic telecommunication cables, undersea electrical interconnectors are vulnerable to hybrid warfare attacks such as physical sabotage and cyberattacks by malign actors, including the deliberate cutting of cables to disrupt electricity flows.

As noted in Chapter 2, concerns have been raised about Russian naval activity near Irish waters, as undersea cables could be targeted through hybrid warfare. In 2023 Russian ships were monitored by the Air Corps and Naval Service off the Irish coast, and senior NATO officials said it was a 'fair assumption' that Russian ships have carried out extensive mapping of undersea cabling and pipelines in Irish-controlled waters (Houses of the Oireachtas, 2023; O'Connor, 2023). In April 2025, the *Viktor Leonov*, a Russian navy intelligence-gathering ship, was tracked passing through Irish-controlled waters. The ship was tracked by the *LÉ Samuel Beckett* as it sailed through the Irish EEZ and was monitored by an Irish Air Corps maritime patrol aircraft and an RAF surveillance aircraft (Gallagher, 2025).

In June 2025 the Department of Defence (DoD) announced a multi-million-euro investment contract for the provision of towed sonar monitoring and surveillance capabilities, with a focus on subsea communication cables and gas pipelines (DoD, 2025a).

3.5 UK Policy Divergence & CBAM

As noted in Chapter 2, a particular risk arising from the UK's departure from the EU is the potential for future EU-UK policy divergence and regulatory misalignment. EU-UK policy divergence could affect the efficient operation of cross-border energy markets and the development, funding and regulation of existing and future electrical interconnection projects.

The EU-UK Trade and Cooperation Agreement (TCA) establishes a framework for continued cooperation between both parties on security of both electricity and gas supply (see Chapter 2). The provisions of the TCA on trade in electricity are especially relevant for Ireland, which is not interconnected to the rest of the EU internal energy market at the time of writing but will be at the point at which the Celtic Interconnector becomes operational (European Commission, 2021a).

An impact of Brexit on electricity trading has been in the operation of the day-ahead markets. Before Brexit, the UK was part of the EU's Internal Energy Market (IEM), which allows for efficient cross-border trade in electricity. However, since leaving the IEM, trade over electricity interconnectors between the EU and GB is no longer managed through existing single market mechanisms, such as EU market coupling, as these are reserved for EU countries (Delivorias, 2023). However, NI remains within the single electricity market along with the RoI, as this is provided for in the Withdrawal Agreement.[15]

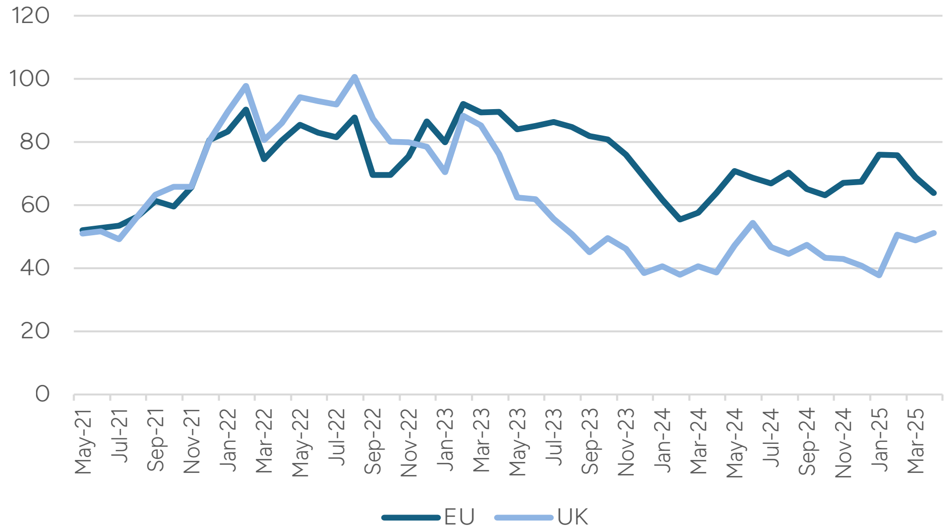
Importantly, post-Brexit the UK now sets its own carbon pricing policies separate from the EU Emissions Trading System (ETS). UK carbon prices fell substantially from 2023, due in part to a surplus of allowances entering the market and weak auction demand, which lowered the trading value of UK emissions permits (see Figure 3.9) (McGrath, 2025).

The full implementation of the EU Carbon Border Adjustment Mechanism (CBAM) from January 2026 presents several challenges in terms of the operation of the SEM and electricity trade between the island of Ireland and GB (EU TAXUD, 2023).

CBAM is designed to top up differentials in the cost of carbon to ensure fair competition with electricity generated in the EU. Because the RoI participates in the EU ETS for electricity, any electricity imported from GB to the RoI must account for the difference in carbon pricing between the EU and the UK.

15 The Trade and Cooperation Agreement between the EU and the UK includes a section on energy (European Union, 2020).

Figure 3.9: EU and UK ETS prices (€/tonne)



Source Data: International Carbon Action Partnership, 2025.

Under the CBAM, the calculation of embedded emissions for imported electricity is designed to reflect the carbon intensity of the electricity generation in the exporting country. The methodology allows for two primary approaches:

- **Default Emission Factors:** In cases where necessary data is unavailable, importers can use default emission factors provided by the European Commission. These factors are based on average emission intensities for each exporting country or region. This approach simplifies reporting but may not accurately reflect the actual carbon content of the imported electricity (European Commission, 2023).
- **Actual Emissions Data:** Importers may opt to report actual emissions associated with imported electricity. This requires the provision of detailed information about the electricity's source, verifying that the electricity was generated and consumed within the same hour (time-matching), and evidence that the electricity was transmitted without congestion or mixing with other sources (Decerna, 2024).

The time-matching requirement implies that, for actual emissions reporting, the carbon intensity should be calculated on an hourly basis to accurately reflect the emissions at the time of import. This granular approach ensures that application of CBAM accurately accounts for the real-time carbon content of imported electricity, aligning with the mechanism's goal of preventing carbon leakage and promoting cleaner energy sources (European Commission, 2021b: Section 5.2.8).

However, implementing hourly calculations of CBAM obligations poses challenges, including the need for sophisticated tracking systems and real-time data exchange between importers and exporters. Despite these complexities, achieving hourly emission calculations is important for the CBAM to effectively differentiate between low- and high-carbon electricity imports. Where CBAM charges are calculated based on default emissions factors, this may not accurately reflect the true carbon intensity of electricity exports to the SEM from GB. Such an approach could lead to an overestimation of emissions associated with electricity imports from GB, especially during periods when GB exports low-carbon electricity based on wind or nuclear. The potential inability to account for actual emissions on an hourly basis may result in higher CBAM charges than warranted, leading to unduly high electricity prices in the SEM.

In May 2025, the UK and the EU announced plans to link their respective ETSs as part of a broader initiative to strengthen post-Brexit cooperation (UK Cabinet Office, 2025a). When the EU and UK ETSs are ultimately aligned, this will result in a step-up in the price of electricity imported from GB due to CBAM's implementation, as the UK's carbon price is expected to be increased to align with that of the EU (Energy UK, 2025). While both parties have committed to aligning carbon pricing mechanisms to prevent double carbon taxation and promote trade efficiency, the methodology for calculating embedded emissions in traded electricity is subject to ongoing negotiations.

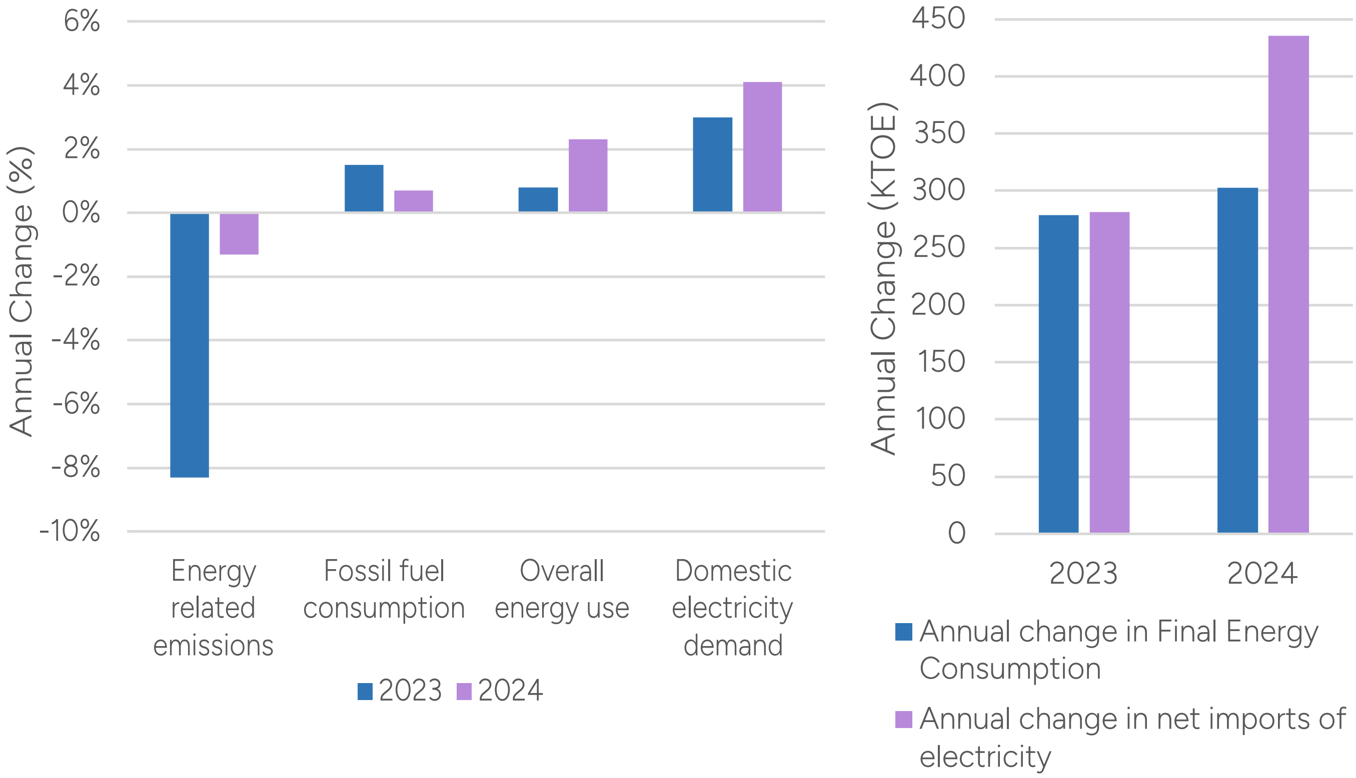
Mechanisms should be put in place to facilitate the reporting of actual carbon intensity in real time and the avoidance of reliance on default emissions factors. Without such mechanisms, electricity imported to the SEM from GB could result in unduly high CBAM charges through the use of default values, even when low-carbon electricity is being imported.

3.6 Carbon Intensity of Ireland's Imported Electricity

As noted previously, net imports of electricity have come to account for an increasing share of gross electricity supply in Ireland, rising to 9 per cent in 2023 and 14 per cent in 2024. One of the key implications of increased net electricity imports in recent years is that the RoI burns fewer fossil fuels in domestic electricity generation. On the basis of conventional production-based carbon accounting methods, any CO_2 emissions associated with electricity that is exported is recorded as part of the emissions inventory of the exporting country. This has several implications in terms of assessing Ireland's progress towards reducing carbon emissions.

Despite the fact that domestic fossil-fuel consumption, domestic electricity demand and overall energy use levels have increased in Ireland in recent years, domestic energy related emissions have fallen. These mutually contradictory trends can be explained, in part, by increases in net imports of electricity, which have outstripped annual increases in final energy consumption (see Figure 3.10).

Figure 3.10: Annual change in key metrics



Source Data: SEAI, 2023, 2024a, 2025a-c.[16]

While higher net electricity imports do contribute towards reducing the total amount of carbon emitted domestically in the RoI, electricity imported from neighbouring jurisdictions is not wholly derived from renewables.

Electricity imported to Ireland from the UK is made up of a constantly changing mix of generation sources, including natural gas, wind, nuclear, solar, hydro and occasionally coal. As a result, the carbon intensity of electricity imported from the UK differs depending on meteorological conditions and the generation mix on the UK grid at a given point in time.

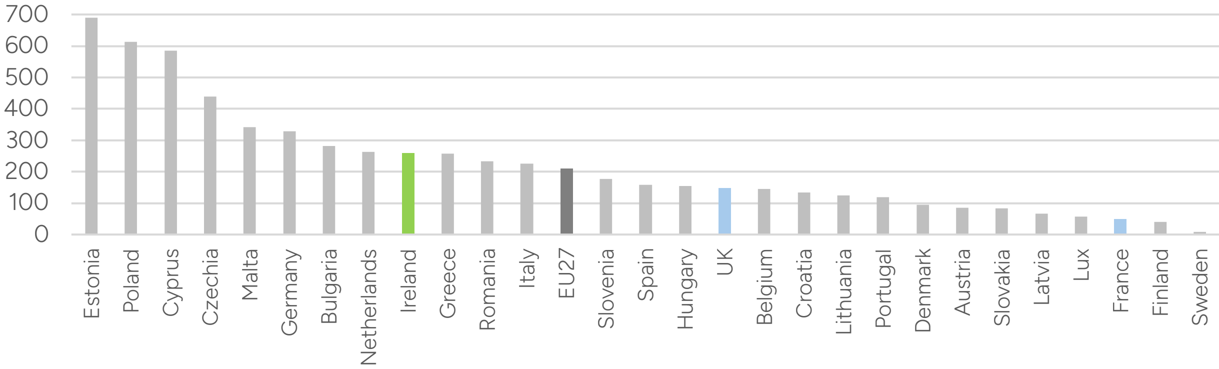
In 2023, 34.7 per cent of UK electricity generation was derived from gas and 1.2 per cent from coal.[17] Any CO_2 emissions associated with the production of electricity in the UK that is then exported to the RoI is accounted for in the UK's emissions inventory. As a result, while importing electricity at a given point in time can reduce Ireland's territorial emissions by displacing carbon-intensive domestic generation, global emissions are only reduced to the extent that total emissions are reduced across interconnected markets.

Figure 3.11 displays the greenhouse-gas emission intensity of electricity generation in Europe. Electricity generation has a lower carbon intensity in both the UK and France as compared to Ireland.

16 Earlier years excluded due to the impacts of the Covid-19 pandemic.
17 Nuclear provided a further 13.9 per cent of electricity generation in the UK (Martin, 2024: 5).

The Celtic Interconnector with France presents the prospect of access to substantially less carbon-intensive imported electricity, stemming from the large share of French electricity generation derived from nuclear energy, which has a minimal carbon footprint. While far less carbon-intensive than alternatives such as coal or gas,[18] nuclear energy presents a distinct set of environmental and security concerns.

Figure 3.11: Greenhouse gas emission intensity of electricity generation (grams of CO_2 equivalent per kilowatt-hour) 2023



Source Data: European Environment Agency, 2024; National Grid, 2024.[19]

This analysis highlights the importance of the carbon intensity of electricity generation in interconnected markets, as well as the merits of consumption-based carbon accounting methods.[20] Reporting on trends in national carbon emissions that does not take account of the emissions associated with imported electricity risks overstating the extent of progress in emissions reductions taking place domestically in Ireland.

3.7 Future Outlook for Electricity Trade

Ireland has set ambitious targets to develop 5 GW of offshore wind capacity by 2030, increasing to 20 GW by 2040 and 37 GW by 2050. This is in addition to renewable energy capacity targets for 2050 of 9 GW for solar and 9 GW for onshore wind, totalling 55 GW of renewable energy capacity by 2050 (see Figure 3.12).[21] Analysis commissioned by DECC assumes domestic net zero would be achievable by 2050 with 16 GW of installed offshore wind capacity (BVG Associates, 2024).

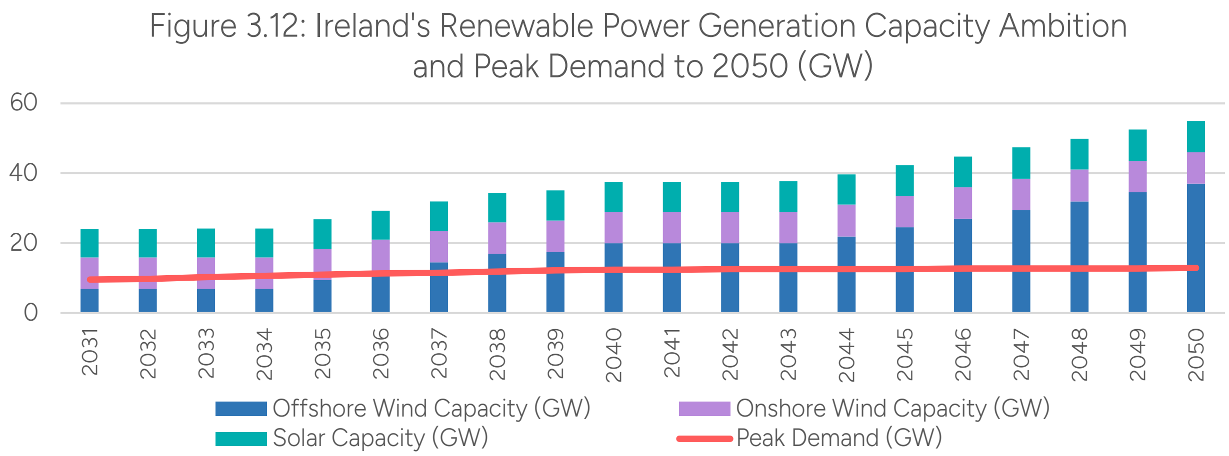
The target of 37 GW of offshore wind capacity is pursued with the aim of making Ireland a significant net exporter of energy, principally in the form of exports of renewable electricity over interconnectors (BVG Associates, 2024; Government of Ireland, 2024b; SEAI, 2024b).

18 'The UN Intergovernmental Panel on Climate Change has provided a median value among peer-reviewed studies of 12g CO_2 equivalent/kWh for nuclear, similar to wind, and lower than all types of solar.' (World Nuclear Association, 2024)

19 UK data from National Grid.

20 Consumption-based carbon accounting is a method of measuring greenhouse-gas emissions based on what a country or region consumes, rather than what it produces.

21 This is in addition to 12 GW of electrical interconnection capacity in a 'well connected' scenario (BVG Associates, 2024: 6).



Source: Data provided to NESC by EirGrid.

In NESC report No.167 (2025b), *Ireland's Future Power System and Economic Resilience*, the Council called for clarity on how Ireland will be able to price surplus renewable electricity competitively for export, both in terms of the price relative to that of other countries, and relative to other technologies in the international market.

The generation of competitively priced surplus energy is a key consideration for successful policy in relation to cross-border electricity trade. The main challenge associated with the goal of making Ireland a significant net exporter of renewable electricity is that wholesale electricity prices are currently typically lower in larger neighbouring markets than in the SEM.

Electricity generation costs are generally high in Ireland due to a combination of factors, including:

- Ireland sources approx. half of its electricity from gas. The existing marginal pricing model means that the highest-cost generating unit needed to meet demand sets the price for all electricity, leading to elevated prices when gas-fired plants are the marginal producers (EAI, 2025).
- Curtailment of wind energy due to grid constraints.
- Ireland's electricity market is relatively small, leading to less competition in electricity generation.
- High grid development and maintenance costs due to planning delays and objections, as well as Ireland's dispersed housing settlement pattern.
- Ireland is geographically isolated, leading to relatively high interconnection capital expenditure (CAPEX) costs.
- Ireland does not have nuclear power, which can provide stable, low carbon baseload electricity.

While policy interventions can address some of these factors, many are fundamentals which will contribute towards higher electricity generation costs over the longer-term. The fact that wholesale electricity prices are currently generally higher in the SEM as compared to neighbouring interconnected markets highlights the challenges associated with making Irish electricity exports cost competitive in future.

Neighbouring markets such as GB and France have similarly ambitious plans to expand their renewable energy capacity, including harnessing their offshore wind resources. The island of Ireland, GB and the north of France also tend to have comparable meteorological conditions, meaning that periods of low or high output in renewables generation, most notably for wind energy, are likely to occur simultaneously in each of these interconnected markets. To mitigate these risks, Ireland needs to consider strategies to diversify export timing via storage, hydrogen production or demand-shifting sectors.

Ireland's export ambitions rely on being able to justify and finance infrastructure based on regional benefits, not solely national needs (NESC, 2025b). This will require alignment with EU initiatives such as the European Grids Package, which aims to create new models of cost allocation, planning and permitting for cross-border projects. Ensuring Ireland's inclusion in Projects of Common Interest and Ten-Year Network Development Plans will be essential for unlocking EU funding opportunities to support large-scale infrastructure investment.

While the export of renewable electricity remains a valuable component of Ireland's strategy for the energy transition, the Council believes there is a need to place a strategic focus on maximising domestic use of available renewable energy resources.

Chapter 2 argued for greater focus on reducing Ireland's dependence on imported fossil fuels and for alternatives such as green hydrogen and its derivatives to be developed as zero-carbon strategic energy reserves. In addition, there is scope to examine how domestically produced green hydrogen could underpin industrial decarbonisation and support a just transition through sustainable enterprise growth and regional job creation.

Maximisation of domestic use of available renewable energy resources, including through the production of green hydrogen and other hydrogen-derived zero-carbon commodities, presents a potential pathway to use available renewable energy resources while retaining more economic value within the national economy. This would further reduce reliance on costly and environmentally damaging imported fossil fuels. Chapter 4 examines green hydrogen in more detail.

Chapter 4: International Trade – Green Hydrogen

4.1 Introduction

Green hydrogen refers to hydrogen produced through the electrolysis of water using electricity from renewable energy sources such as wind, solar or hydro power. It can serve as a feedstock, fuel or energy carrier, and is also a key input in the production of other synthetic fuels. So-called Power-to-X (PtX) technologies convert renewable electricity into energy carriers like green hydrogen, ammonia or e-fuels.

While more expensive than alternatives such as grey hydrogen,[22] green hydrogen is far more sustainable than grey hydrogen because it is produced without emitting carbon, thus supporting the transition to a net zero economy and society. PtX technologies have the potential to substitute for fossil fuels in hard-to-decarbonise industries, serving as a strategic complement to other decarbonisation pathways.

Ireland's green hydrogen potential presents an opportunity to address several strategic challenges:

1. **Reduce dependence on fossil fuels:** Reducing current reliance on imported fossil fuels in hard-to-decarbonise sectors and the achievement of net zero emissions by 2050 necessitates a role for zero-emissions gases, in particular biomethane and green hydrogen (Government of Ireland, 2021a: 88).
2. **Decarbonise industrial development:** Green hydrogen production offers a clean energy alternative for industries that are difficult to decarbonise with electricity alone such as heavy industry, fertiliser, shipping, jet aviation, heavy road transportation and chemical industries.
3. **Improve energy resilience:** Green hydrogen provides a means to build resilience in the context of Ireland's high reliance on intermittent renewables in the form of wind and solar. Green hydrogen production can harness excess renewable electricity which would otherwise need to be curtailed, as hydrogen can be stored physically as either a gas or a liquid. This offers long-term and seasonal grid-balancing capabilities.
4. **Diversify Ireland's strategic energy reserves:** Hydrogen can provide a low-carbon means of diversifying Ireland's system of strategic energy reserves to enhance resilience to disruptions to international energy supply.

The 2021 Climate Action Plan (CAP) establishes a target of 1–3 TWh of zero-emissions gases by 2030, mainly in the form of green hydrogen and biomethane (Government of Ireland, 2021a: 33). The CAP also establishes the goal of introducing incentives for electrolyser production and grid connection of green hydrogen.

22 The green hydrogen production process generates no direct CO_2 emissions, making it the cleanest form of hydrogen. Blue hydrogen is produced from natural gas (usually via steam methane reforming or SMR), but the resulting CO_2 emissions are captured and stored using carbon capture and storage (CCS) technology. Grey hydrogen is also produced from natural gas using steam methane reforming, but without carbon capture. Green hydrogen is expensive relative to alternatives such as oil and natural gas, costing 2–3 times more to produce as compared to these reference fossil fuels.

This chapter examines the potential role of green hydrogen in underpinning the energy transition. It considers the opportunities presented by green hydrogen production, challenges in terms of cost-competitiveness, and the need for financial incentives and support to create the enabling conditions for the development of a domestic green hydrogen sector. It is structured as follows:

- Section 4.2: Strategic options and decarbonisation pathways
- Section 4.3: Domestic uses for green hydrogen
- Section 4.4: Export potential
- Section 4.5: Strategic challenges

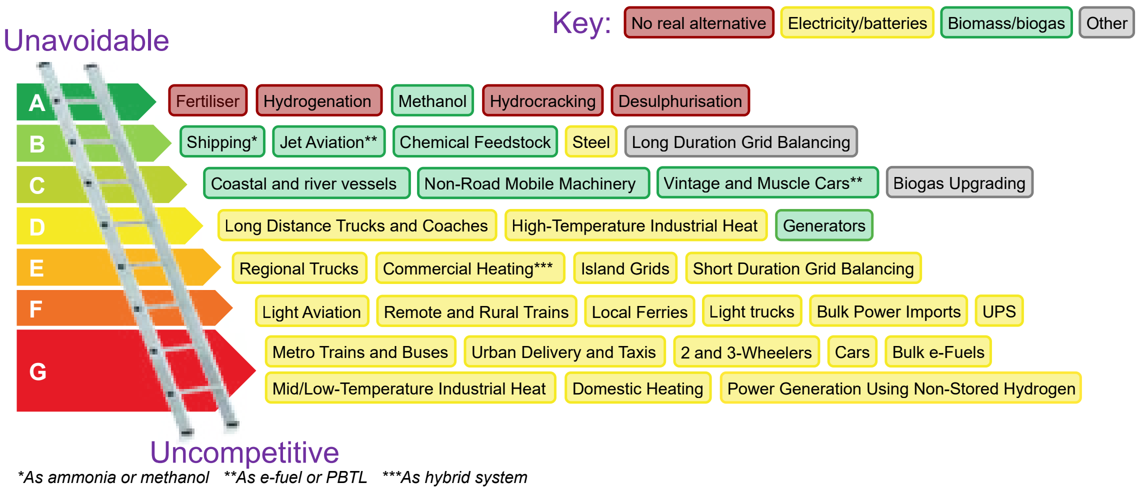
4.2 Strategic Options and Decarbonisation Pathways

Ireland's strategy to decarbonise necessitates a multifaceted approach to transform its energy system, economy and emissions profile in line with legally binding carbon budgets and the achievement of net zero by 2050. Electrification is the central mitigation lever that will be the main driver of further decarbonisation of heating, transport and industry (Daly *et al.*, 2024: 4; ESB Networks, 2021). Biomethane, produced through anaerobic digestion of organic waste or agricultural residues, offers a renewable drop-in replacement for natural gas in many industrial processes (GNI, 2025). Reducing energy demand through improved efficiency across buildings, transport and industry will also be crucial. Reducing final energy demand will necessitate 'compact urban development, modal shift in transport, and shifting support to less carbon-intensive economic activities, [providing] an important complement to technology transitions' (Daly *et al.*, 2024: 4). Although still at an early stage of development, Carbon Capture Utilisation and Storage (CCUS) is expected to play a role post-2030 in decarbonising hard-to-abate industrial emissions and in supporting negative emissions technologies (SEAI, 2022: 10). Each of these decarbonisation pathways plays an essential role in reducing emissions and fossil-fuel dependency.

While electrification is a cornerstone of Ireland's decarbonisation strategy, it presents limitations in terms of the potential to fully substitute fossil fuels in harder-to-abate sectors (Government of Ireland, 2021a: 88). Some sectors are inherently difficult or inefficient to electrify. Heavy-duty transport (e.g. long-haul trucking, shipping, jet aviation), high-temperature industrial processes (such as in cement or steel) and some agricultural operations require dense energy sources that electricity alone cannot easily or economically provide (WEF, 2024). According to the findings of a study commissioned as part of the NESC Energy Transition Research Programme, Khammadov *et al.* (2025) note that 'the industry sector faces limitations in electrification options to fully eliminate gas consumption, particularly for medium- and high-grade heat demand … Therefore, renewable gases are expected to become crucial in the energy system beyond 2030' (p.12). In the absence of zero/low-carbon alternative fuels, these sectors risk continued reliance on fossil-based liquid or gaseous fuels.

A succinct summary of sectors where hydrogen can play an important role in the energy transition is provided by the Hydrogen Ladder, developed by Liebreich Associates (see Figure 4.1) (Liebreich, 2023). This is a conceptual framework that ranks potential uses of hydrogen from 'unavoidable and efficient' at the top, to 'wasteful and uneconomic' at the bottom. It is designed to guide policy and investment by helping stakeholders focus on where hydrogen makes the most sense — technically, economically, and environmentally — and where it does not.

Figure 4.1: The Hydrogen Ladder



Source: Liebreich, 2023.

The top rungs include hard-to-abate sectors where hydrogen and its derivatives are essential or appropriate and cannot be easily replaced by direct electrification or other alternatives. These include fertiliser (ammonia) production, refining and chemicals, steel production, high-temperature industrial heat, shipping (via ammonia or methanol) and jet aviation (via synthetic fuels). Hydrogen can play a potential role in these sectors due to either the chemical requirements or extreme process conditions. Sectors in the middle rungs are those where hydrogen may play a role, but only if alternatives like electrification prove to be impractical or too expensive. Sectors in the lower rungs are where hydrogen is technically possible but ultimately inefficient, often due to high energy losses, high costs or better alternatives already being available.

Biomethane production has the potential to make a considerable contribution towards the displacement of natural gas supply, which is currently substantially reliant on imports. Biomethane production will help to diversify sources of gas supply and improve energy security, helping to shield against disruptions to international supply and price volatility on international markets (SEAI, 2017: xi). However, significant expansion in biomethane production presents environmental risks and constraints relating to land use, biodiversity, water quality, air emissions and feedstock sustainability (EPA, 2024; KPMG, 2021: 11; SEAI, 2024c: 51). Ireland already has pressure on land availability due to agricultural practices, as well as residential and commercial development (Government of Ireland, 2024a). Large-scale production of dedicated energy crops could negatively affect biodiversity and afforestation targets, and displace food production (Environmental Pillar, 2024). Furthermore, while digestate has a lower impact on water quality as compared to slurry, it has a higher potential for environmental contamination owing to excess nitrogen and phosphorus (Khammadov *et al.*, 2025: 16).

What distinguishes Ireland's potential in the hydrogen sector from biomethane is that decarbonising via green hydrogen from offshore wind offers a cleaner, more scalable solution, with a lower environmental impact. Decarbonisation via offshore wind-powered green hydrogen thus presents fewer environmental constraints than biomethane production, primarily because of the sheer scale of Ireland's offshore wind resource and because it avoids the constraints of intensive land use, nutrient management and biodiversity pressures associated with large-scale anaerobic digestion systems.

4.3 Domestic Uses for Green Hydrogen

Ireland's *National Hydrogen Strategy* (Government of Ireland, 2023b) outlines a national plan to integrate renewable hydrogen into the country's energy system. The strategy aims to decarbonise hard-to-electrify sectors, enhance energy security and position Ireland as a global leader in green hydrogen production.

Industrial applications where direct electrification is not feasible or cost-effective are expected to be the main focus for green hydrogen deployment, including high- and medium-grade heat in industrial manufacturing processes. The *National Hydrogen Strategy* notes that biomethane is considered as a solution for such sectors in the short term, with hydrogen taking on an increased role over time (*ibid*: 36).

An analysis commissioned by GNI concluded that more than 90 per cent of equipment powered across industries and large businesses in Ireland is currently capable of using hydrogen blends of up to 20 per cent (Ekhtiari *et al.*, 2023). Meeting this level of demand for hydrogen would require ~4.2 GW of renewable energy capacity dedicated to the production of green hydrogen (WEI, 2022: 4).

Another notable potential industrial use for green hydrogen in an Irish context is as a backup for large energy users such as data centres (Government of Ireland, 2023b: 13).

In the transport sector, hydrogen offers fast refuelling and longer range for heavy and long-distance transport uses where battery electrification is less efficient. Switching heavy goods vehicles and buses from diesel to green hydrogen would require at least 1.4 GW of renewable energy capacity, while synthesising half of shipping and aviation fuels would require a further 6.6 GW (Shannon Foynes Port, 2022: 30).

Another key source of expected hydrogen demand in Ireland is the need to meet seasonal flexibility requirements arising from high levels of variable renewables in the power supply (Khammadov et al., 2025).[23] Green hydrogen can be used to balance the grid by storing excess renewable energy and providing a backup energy source during periods of peak demand or low availability of renewables.

Fertiliser use is a major source of nitrous oxide (N_2O) emissions – a potent greenhouse gas. Given the high share of national greenhouse-gas emissions in the agricultural sector, the production of green ammonia-based fertiliser presents an opportunity to satisfy domestic demand and lower upstream emissions (AFRY, 2023c).

23 Storage of hydrogen as a gas typically requires high-pressure tanks while storage of hydrogen as a liquid requires cryogenic temperatures (US Department of Energy, 2025).

GNI is exploring the integration of green hydrogen into its natural gas network through blending (GNI, 2022b). This involves mixing green hydrogen with natural gas, potentially reaching up to 20 per cent hydrogen in the blend without requiring significant modifications to the existing network. While blending green hydrogen into the natural gas network can reduce carbon emissions by displacing natural gas as a transitional decarbonisation strategy, blending also supports the continued use of natural gas pipelines, appliances and boilers, presenting the risk of fossil-fuel lock-in. Such a strategy risks delaying the retirement of fossil gas assets, reducing incentives to shift to fully electrified solutions where appropriate.

The *National Hydrogen Strategy* considers it unlikely that hydrogen will play a significant role in commercial or residential space heating, where technologies such as heat pumps and district heating are considered to be a more cost-effective solution (Government of Ireland, 2023b: 37). According to Scheer (2022), a range of studies have shown that hydrogen will be too expensive and inefficient compared to alternatives when it comes to space heating.

The National Hydrogen Strategy also expects hydrogen will not have a role in the passenger car fleet as direct electric technologies are already at a much higher technology readiness level and are preferable where they are technically feasible (Government of Ireland, 2023b: 37).

4.4 Export Potential

The *National Hydrogen Strategy* emphasises the 'opportunity for Ireland to become a net exporter of renewable hydrogen in the long term where other European countries are actively looking to source new supply routes to import renewable hydrogen' (Government of Ireland, 2023b: 13).

As a relatively small country and economy, the domestic Irish market will face challenges in achieving the necessary economies of scale to make the production of green hydrogen internationally price competitive (Cummins & McKeogh, 2020). By contrast, countries such as Germany and Norway have both an availability of large quantities of low-cost renewables and high domestic industrial demand to consume large quantities of hydrogen (WEI, 2022: 4).

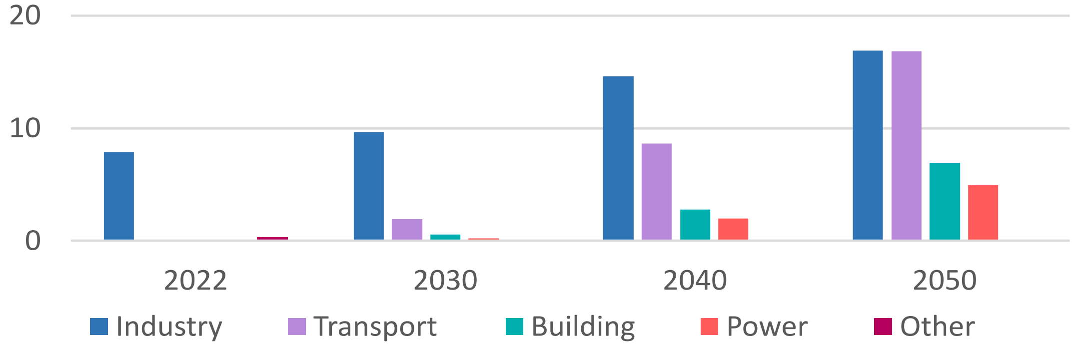
Khammadov *et al.* (2025) note that 'demand for hydrogen doubles when non-domestic energy needs such as international aviation and shipping are included' (p.47). This study also highlights that 'Ireland's potential to become a hydrogen exporter relies on the development of infrastructure capable of supporting hydrogen production beyond domestic needs. Achieving this would require over 8 GW of wind and 4 GW of electrolyser capacity dedicated to hydrogen production' (*ibid*).

International hydrogen demand is projected to increase considerably over the coming decades, with projections suggesting that clean hydrogen could provide up to 12 per cent of global final energy consumption by 2050.[24] Total demand for hydrogen in Europe stood at 8.19m tonnes (Mt) in 2022, mostly made up of demand from industry (European Hydrogen Observatory, 2023: 6).[25] This is projected to increase to 45.55 Mt by 2050, with increasing shares for transportation, buildings and the power sector (see Figure 4.2).

24 'Clean hydrogen' refers to both blue and green hydrogen (IRENA, 2022a).

25 According to global demand forecasts from the IEA (2024d), global hydrogen demand stood at 11,425 petajoules (PJ) in 2023, up from 11,129 PJ in 2022.

Figure 4.2: Projected hydrogen demand (Mt) in Europe by sector



Source Data: European Hydrogen Observatory, 2023.

The production of green hydrogen for export in an Irish context will necessitate production at internationally competitive prices. Doing so will depend on a number of factors.

First, the cost of electricity generation needs to be cost-competitive vis-à-vis international competitors. Ireland is currently one of the most expensive locations in Europe in terms of electricity generation costs. The expansion of offshore wind capacity could result in a growing number of low- or zero-marginal-cost hours, improving electrolyser efficiency if matched appropriately (AFRY, 2023a, 2023b).

Second, if renewables used to produce hydrogen are intermittent, the cost per kg of hydrogen increases due to underutilisation (Hordvei *et al.*, 2025). An electrolyser operates most cost effectively at full capacity, i.e. when being constantly fed electricity (U.S Department of Energy, 2024).

Complementing wind energy with solar PV and dispatchable renewables such as hydro can mitigate intermittency issues by providing a more stable and predictable renewable energy supply (*ibid*: 5). However, Ireland's geographic location results in relatively low levels of solar irradiance as compared to many other European countries. European countries such as Spain, Portugal and France have substantially higher solar irradiance, in addition to considerable wind energy natural endowments (Hordvei *et al.*, 2025: 13).

Ireland also has relatively low levels of solar penetration. An analysis by Malone (2025) has found that Ireland ranks twenty-first in Europe in terms of installed solar capacity per capita. At 220 watts, Ireland's per capita installed solar capacity is far lower than in countries such as the Netherlands (1,036 watts), Germany (980 watts), Belgium (750) and Austria (710) (*ibid*).

Ireland also has comparatively limited hydro capacity, particularly as compared to countries such as Norway and Sweden (Our World in Data, 2024). These factors highlight the challenges associated with achieving a consistent supply of renewable energy for green hydrogen production in Ireland.

Third, large scale infrastructure projects and higher capacity electrolyser facilities reduce the unit cost of hydrogen production (IRENA, 2021: 8). Studies have suggested that Ireland will need to create large-scale mega-plants[26] for production of green hydrogen in order to produce internationally competitive commodities (AFRY, 2023c).

Fourth, water is a key input in the hydrogen production process. Electrolysis requires approx. nine litres of purified water to produce 1 kg of hydrogen (Hydrogen Europe, 2020). Some other jurisdictions, most notably those with a strong comparative advantage in solar energy production, may have a comparative disadvantage in terms of the availability of suitable water resources.

Fifth, there needs to be a cost-competitive way to access export markets. In terms of export routes for hydrogen, the potential exists to connect Ireland to a future European hydrogen 'backbone' network. This backbone is intended to integrate regions with abundant supply potential with centres of demand. The first phase of Ireland's integration into this European network is expected to be facilitated via a repurposed subsea pipeline to the Moffat interconnector in Scotland (Energy Ireland, 2023). A key advantage of exporting green hydrogen via pipeline to Europe is the cost savings as compared to shipping. According to a study by AFRY (2023c), the process of exporting hydrogen via pipeline from Ireland would be cheaper as compared to the process of transportation via shipping that other global suppliers will rely on (p. 9).

If Ireland is to develop a viable green hydrogen sector, achieving large-scale production at internationally competitive prices will be essential. The long-term success of the sector will ultimately depend on the relative cost-competitiveness of hydrogen production in Ireland vis-à-vis other international suppliers.

The European Hydrogen Observatory (EHO) publishes estimates of the levelised cost of hydrogen (LCOH) production in Europe using different electricity sources – wholesale electricity, solar PV, onshore wind and offshore wind. The Observatory's LCOH calculator allows for the comparison of hydrogen production costs in the EU27 countries, Norway and the UK. Examination of the LCOH production across European countries gives an indication of the relative cost competitiveness of hydrogen production in Ireland by source vis-à-vis production elsewhere.[27]

The results indicate that Ireland has the lowest total LCOH for both onshore (€3.76/kg) and offshore wind (€5.92/kg) among all countries examined, due in the main to Ireland's especially high wind capacity factors. One noteworthy finding of the EHO data is that Ireland is cost-competitive vis-à-vis German hydrogen production in onshore (€7.87/kg) and offshore wind (€8.76/kg). Germany is expected to be a major centre of future demand for hydrogen and has published a dedicated hydrogen import strategy setting out strategic options to internationally source stable and secure supplies of hydrogen (Federal Government of Germany, 2024).

26 The term 'mega-plant' refers to facilities that integrate renewables on the scale of GWs to produce several hundred tonnes of green hydrogen per day.

27 The EHO LCOH primarily focuses on hydrogen production costs at the plant gate, i.e. the cost to produce hydrogen without considering how it gets to the end user. This means it does not fully include the cost of pipelines, storage systems, compression or liquefaction infrastructure needed for large-scale delivery or export.

The ESB has entered into a collaborative study with the German government to examine the potential for Ireland to become a future supplier of green hydrogen to Germany. The HYreland project will analyse the technological and economic potential of producing green hydrogen and its derivates in Ireland, as well as access to potential transportation routes for exporting surplus renewable energy to Germany. The project will be delivered together with the *Bundesministerium für Bildung und Forschung*[28] and DECC, marking the first project to action the Joint Declaration of Intent signed between Ireland and Germany which formalises cooperation in the field of green hydrogen (DECC & Federal Ministry of Education and Research of the Federal Republic of Germany, 2022). HYreland is due to be delivered in close collaboration with industry and research partners.

4.5 Strategic challenges

While green hydrogen presents significant potential to displace fossil fuels in Ireland's energy system, the sector faces several strategic challenges that require further policy action if the sector is to contribute towards the displacement of fossil fuels. The main challenges for hydrogen deployment include unclear demand signals, financing hurdles, delays to incentives, regulatory uncertainties, licensing and permitting issues, and operational challenges (IEA, 2024a).

Green hydrogen production is currently not cost-competitive vis-à-vis alternatives due to high electricity costs, electrolyser costs and infrastructural investment costs (Lee & Saygin, 2023: 3). Green hydrogen remains expensive relative to alternatives such as oil and natural gas, costing 2–3 times more to produce as compared to these reference fossil fuels (IRENA, 2022b).

Green hydrogen production costs are expected to fall over the coming years due to a combination of technological advancements, increased economies of scale, declining renewable electricity prices and the introduction of supportive policies (IRENA, 2020). According to Farrell (2022), 'most deployment will become cost-effective post-2030. Cost-effective deployment is most likely among transport, electricity storage and industrial applications' (p. 3).

Electrolysis and fuel-cell technologies need to advance further and achieve greater economies of scale to become price-competitive vis-à-vis alternatives. According to Kelly and Gallagher (2023), 'the EU hydrogen strategy notes that larger size, more efficient and cost-effective electrolysers (in the range of gigawatts) will be required to supply hydrogen to large consumers' (p. 14).

A key driver of expected improvements in efficiency is planned expansion in electrolyser manufacturing capacity in China, which currently accounts for 60 per cent of global electrolyser manufacturing capacity. 'China's continued expansion of manufacturing capacity is expected to drive down electrolyser costs, as has occurred with solar PV and battery manufacturing in the past' (IEA, 2024a).

Increased availability of low-cost renewable electricity, in combination with rising carbon prices, are also expected to make green hydrogen more cost-competitive vis-à-vis fossil-based alternatives (IEA, 2019; IRENA, 2024).

28 Federal Ministry of Education and Research.

A key strategic challenge in producing cost-competitive green hydrogen for Ireland will be load factor and utilisation in the context of a high degree of reliance upon intermittent wind resources. An electrolyser operates most cost-effectively at full capacity, i.e. when being constantly fed electricity (US Department of Energy, 2024). Facilities that rely heavily on intermittent renewables increase the cost of production due to underutilisation. The EU's Renewable Energy Directive (RED II) stipulates that for hydrogen to be certified as green hydrogen it must be produced using renewable electricity. This includes meeting criteria such as:

- Additionality: renewable electricity must be from new installations.
- Temporal correlation: electricity generation and hydrogen production must occur simultaneously.
- Geographical correlation: electricity must be sourced from the same or a connected region (European Commission, 2025b; European Parliament, 2023).

The Irish *National Hydrogen Strategy* emphasises the importance of interconnection import/export routes in ensuring security and price resilience of supply (Government of Ireland, 2023b: 5). However, the electricity mix in markets with which Ireland will be interconnected over the medium term, i.e. GB and France, will continue to include significant contributions from non-renewable sources such as gas and nuclear power at times of low availability of renewables. Using imported electricity from these interconnected markets at times when it is not wholly renewable would not meet the EU's criteria for green hydrogen certification.

Given these challenges, Ireland must explore strategies to align its green hydrogen production with EU certification requirements while addressing the intermittency challenge. This should include investment in on-site balancing in the form of battery storage solutions, demand-side management strategies to align hydrogen production with periods of high renewable generation, and potentially negotiating with the EU for more flexible certification criteria that consider the unique circumstances and renewable energy natural endowment profiles of member states.

Chapter 5: Five Strategic Recommendations

5.1 Introduction

Achieving a step-change in Ireland's dependency on imported fossil fuels is an enormous challenge. The Council's analysis points to considerable challenges that require further policy action which must be confronted. Doing so has the potential to greatly reduce our carbon footprint, reduce our vulnerability to external supply shocks, and create new transformative industrial opportunities.

The report makes five high-level recommendations to Government. This chapter discusses each.

5.2 Recommendation One: Review and Redirect Fossil Fuel Subsidies

The use of fossil-fuel subsidies in countries such as Ireland that are highly dependent on imported fossil fuels is a form of import subsidisation. While such subsidies help to address energy poverty by providing financial support to low-income households, they also distort market signals, making fossil fuels cheaper relative to cleaner alternatives.

The Council recommends a review of fossil-fuel subsidies to identify options to redirect fiscal resources towards supporting renewable energy development, greater energy efficiency, and other initiatives that reduce demand for fossil fuels.

This should be accompanied by the development of policy options for more targeted social programmes to help low-income households to adapt to resulting energy price adjustments.

Information on fossil-fuel subsidies in Ireland is fragmented; monitoring and reporting is undertaken by a range of national, EU and international bodies. There is no single comprehensive, accessible and fully transparent periodic public record that details the full scope, nature and environmental impacts of fossil-fuel subsidies in Ireland. Publishing comprehensive and accessible information on these subsidies would enable citizens, researchers and policymakers to understand exactly how much government financial support goes towards supporting the fossil-fuel industry and fossil-fuel consumption.

The Council recommends that work be undertaken to develop and publish a detailed and fully transparent periodic inventory of fossil-fuel subsidies in Ireland to identify inefficient subsidies that are economically or environmentally harmful.

5.3 Recommendation Two: Formulate a Long-term National Plan for Strategic Clean Energy Reserves

A combination of factors makes the current moment an opportune time to reform, diversify and future-proof Ireland's system of strategic energy reserves. Ireland's system of strategic energy reserves must remain relevant and effective in the longer term while delivering on national commitments to decarbonise the energy system and ultimately phase out fossil fuels.

As Ireland progresses towards net-zero emissions by 2050, its strategic energy reserves must be reformed to reduce dependence on imported fossil fuels while ensuring energy security and system resilience.

The Council recommends formulating a long-term national plan for strategic clean energy reserves. This should include a review of the mandate and functions of NORA to assess the potential to take on responsibility for managing strategic reserves of decarbonised fuels such as hydrogen, ammonia and biomethane in future years.

In addition, there is a need to review the role and function of other relevant state agencies and transmission system operators (TSOs) to develop and assess options for managing strategic energy reserves, ensure their readiness to integrate zero carbon fuels and technologies, and ensure compliance with climate obligations.

5.4 Recommendation Three: Enhance Structures to Monitor and Protect Subsea Energy Infrastructure

Ireland's subsea electrical and gas interconnection infrastructure is critical for our future energy security and economic resilience.

Ireland's ability to adequately patrol, monitor and secure its Exclusive Economic Zone (EEZ) is constrained by limitations in naval and defence capabilities. Increased investment is required in advanced radar systems, sonar arrays and unmanned aerial vehicles to bolster real-time detection of potential threats. Additionally, deploying underwater acoustic sensors along critical cable routes can provide early warnings of unauthorised activities.

Given the vital importance of Ireland's subsea energy infrastructure to energy security and the energy transition, NESC recommends a comprehensive review of the capacity of relevant public bodies to monitor, assess risks and protect sub-sea and marine energy infrastructure. This should include an assessment of:

- the scope to align monitoring activities, pool resources and share information with neighbouring countries;
- the role of industry in providing information on operational risks; and
- the scope to improve cooperation with public cybersecurity bodies.

There is a need to increase coordination and information-sharing between public bodies, semi-state agencies and commercial operators to enhance the security of undersea energy infrastructure. Undersea energy infrastructure is built, owned or maintained by private companies and semi-state companies, often involving public-private partnerships. Meanwhile, national security, regulatory oversight and maritime surveillance are the remit of public authorities such as the Defence Forces, DECC and the Commission for Regulation of Utilities (CRU). However, protecting critical subsea assets spans jurisdictional, operational and technological domains – none of which can be effectively managed in isolation. In the absence of joint protocols and real-time information-sharing, there is a risk of gaps in surveillance, delayed incident response and other vulnerabilities being overlooked.
Monitoring subsea infrastructure for anomalies, threats or intrusions requires technical capabilities and maritime presence, with resources often split across the Naval Service, Garda Síochána, Air Corps and private operators.

Ireland does not yet have a maritime security strategy, but one is under development. The development of such a strategy was one of the recommendations of the Commission on the Defence Forces (Commission on the Defence Forces, 2022).

In April 2025 the Government announced the Defence Forces' participation in the Common Information Sharing Environment (CISE), an EU initiative which enables structured and secure information-sharing among EU maritime authorities on maritime activities and threats at sea, including physical and cyber-attacks on critical infrastructure, drug trafficking and other illegal activities (DoD, 2025b). By integrating into this network, Ireland can access shared intelligence, coordinate responses to threats and align its security protocols with those of neighbouring countries.

Further collaboration through international structures could provide additional support and resources to safeguard undersea infrastructure.

It is essential to build strong government-to-government cooperative frameworks to strengthen international cooperation in the area of subsea energy infrastructure. In March 2025 the UK and Irish governments published a joint statement announcing increased collaboration on a range of issues, including the security of subsea energy infrastructure. The agreement commits to strengthening co-operation in the area of maritime security, with a particular focus on critical undersea infrastructure, which will require greater international co-operation (UK Government, 2025). Such cooperative initiatives should be built on and pursued with other neighbouring countries.

5.5 Recommendation Four: Engage EU-UK Negotiations on CBAM to Safeguard the SEM

In light of the full implementation of the Carbon Border Adjustment Mechanism (CBAM) from January 2026, it is crucial that the EU and UK ETSs be aligned effectively in the long term to safeguard market efficiency, security of supply, investor confidence and price competitiveness in Ireland. In particular, when calculating the emissions associated with imported electricity, it is essential that this be based on actual emissions data.

Mechanisms must be established to facilitate hourly emissions tracking to avoid calculation of CBAM charges on the basis of potentially higher default emissions factors. Without such mechanisms, imports of electricity into the SEM from GB could face unduly high CBAM charges when low-carbon electricity sourced from wind and nuclear power is being imported from GB. This will require facilitation of:

- hourly emissions tracking;
- source verification; and
- advanced coordination between UK and EU authorities on electricity carbon data.

As with many other issues related to Brexit, Ireland will need to emphasise our unique level of exposure, and work to influence negotiation between the EU and the UK. Ireland should proactively support the establishment of a comprehensive cooperative framework to link carbon prices in the EU and UK ETS over the long term, using sophisticated tracking systems and real-time data exchange.

The EU ETS Directive allows for linking, provided both systems are compatible and mandatory, and have absolute emission caps (EASA, 2025). Such a Linking Agreement has been established between the EU and Switzerland (European Union, 2017). In place since 2020, this agreement enables allowances from the EU and Swiss ETSs to be used for compliance to compensate for emissions occurring in either system. This framework mandates that both systems rely on actual emissions data rather than default emissions factors for compliance purposes and is subject to third-party verification to ensure accuracy and integrity.

The Electricity Market sections of the Trading and Cooperation Agreement between the UK and EU are up for review before the end of 2026 (NESC, 2025b: 76). The EU and the UK have also committed to working towards establishing a link between carbon markets by way of an agreement linking their ETS (European Commission, 2024c).

Given the considerable time pressures associated with the potential impacts of CBAM, adopting the template provided by the Swiss Linking Agreement provides a means of expediting the negotiation process.

The Council recommends that the Government engage UK and EU representatives to support the establishment of a comprehensive agreement to ensure long-term carbon price equivalency based on actual emissions data. In doing so, it recommends adopting the template provided by the EU-Swiss Linking Agreement.

5.6 Recommendation Five: Assess Financial Measures to Further Incentivise the Development of Green Hydrogen Projects

The Council believes that green hydrogen has the potential to play an important role in the energy transition in hard-to-decarbonise sectors. However, green hydrogen production is still at an early phase of deployment and has yet to achieve economies of scale in Europe. Much of the enabling infrastructure and policies are not yet in place, and green hydrogen remains more expensive than alternatives. If green hydrogen is to fulfil its potential in Ireland, the Council argues, further supports are needed to assist in displacing cheaper fossil fuels.

A key means of stimulating and developing the domestic market for green hydrogen is through the provision of higher-value decarbonisation supports to industry, in line with similar schemes in place in Germany and the Netherlands.

The Council recommends that specific financial measures should be assessed that would help to further incentivise the development and roll-out at scale of green hydrogen projects. This should include consideration of Contracts for Difference (CFDs) and other market measures to incentivise industrial decarbonisation.

The Council argues that investment in research and innovation should prioritise domestic use cases for green hydrogen, in tandem with closer collaboration with international partners to share expertise and to develop export opportunities.

It is also important to prioritise research efforts with a focus on containing and reducing costs in the hydrogen sector in Ireland, as well as market research on international demand and export opportunities for Irish exports of green hydrogen and its derivatives.

The Council also notes that there are existing gaps in regulations, licensing, permitting procedures and safety standards that need to be addressed. Further steps are needed to expedite approval processes across the entire decarbonised fuel supply chain to reduce time-to-market for green hydrogen projects.

In doing this, there is a need to continue to improve coordination among different regulatory bodies and provide training on hydrogen technologies to assist in efficient and consistent decision-making.

The Council also believes there is a need to take proactive steps to engage with local communities and stakeholders through public information programmes and early-stage consultations in the planning process for renewable fuel projects to support green hydrogen projects. Similarly, as green hydrogen deployment expands there is a need for enhanced coordination and the sharing of information with developers, the policy system and the public.

Bibliography

ACER (2022), *Final Assessment of the EU Wholesale Electricity Market Design* [online]. Available from: https://www.acer.europa.eu/sites/default/files/documents/Publications/Final_Assessment_EU_Wholesale_Electricity_Market_Design.pdf.

Afloat (2025), *Ireland and EU Urged to Prioritise Critical Undersea Structure Protection* [online]. Available from: https://afloat.ie/marine-environment/power-from-the-sea/item/66127-ireland-and-eu-urged-to-prioritise-critical-undersea-structure-protection [accessed 03/06/25].

AFRY (2023a), *Offshore Renewables Export Surplus WS2 – Electricity Interconnection Quantitative Assessment Report*. Dublin: AFRY.

AFRY (2023b), *Offshore Renewables Surplus Potential WS1 – Market Analysis: A Report to the Department of the Environment, Climate and Communications*. Dublin: AFRY.

AFRY (2023c), *Offshore Renewables Surplus Potential WS3 – Renewable Hydrogen*. Dublin: AFRY.

Bewarder, V.M., Flade, F., Götschenberg, M., Heil, G. & Schmidt, H. (2024), *First Arrest Warrant for Nord Stream Attacks* [online]. Available from: https://www.tagesschau.de/investigativ/ndr-wdr/nordstream-172.html [accessed 30/05/25].

Bloomberg (2024), *Denmark Warns Russia May Send Warships to Escort Oil Tankers* [online]. Available from: https://www.bloomberg.com/news/articles/2024-12-18/denmark-warns-russia-may-send-warships-to-escort-oil-tankers [accessed 29/05/25].

Book, K., Cahill, B., A., I., Alkadiri, R., Irié, K. & Palti-Guzman, L. (2024), *Experts React: Energy Implications of Escalating Middle East Conflict* [online]. Available from: https://www.csis.org/analysis/experts-react-energy-implications-escalating-middle-east-conflict [accessed 29/05/25].

Boyle, E., Revez, A. & Ó Gallachóir, B. (2024), *Why the Celtic interconnector is about more than just electricity* [online]. Available from: https://www.ucc.ie/en/eri/news/why-the-celtic-interconnector-is-about-more-than-just-electricity.html [accessed 02/05/25].

Brinkerink, M., Ó Gallachóir, B. & Deane, P. (2019), 'A Comprehensive Review on the Benefits and Challenges of Global Power Grids and Intercontinental Interconnectors'. *Renewable and Sustainable Energy Reviews*, 107: 274-87.

BVG Associates (2024), *Offshore Renewable Energy Export Potential for Ireland*. Workstream 4: Export Viability, Policy Considerations, Trade and Investment Opportunities. Dublin: Department of Environment, Climate and Communications.

CEPA (2023), *Review of the Security of Energy Supply of Ireland's Electricity and Natural Gas Systems* [online]. Available from: https://assets.gov.ie/276440/b61f648b-2746-47e3-854e-17fe1fcbc51c.pdf [accessed 27/05/25].

CEPA (2025), *Security of Energy Supply Study Update* [online]. Available from: https://assets.gov.ie/static/documents/CEPA_-_Energy_Security_of_Supply_Study_Update_v2.pdf [accessed 01/07/25].

Climate Change Advisory Council (2025), *Annual Review 2025: Electricity*. Dublin: CCAC. Available from: https://www.climatecouncil.ie/councilpublications/annualreviewandreport/CCAC-AR2025-Electricity-FINAL.pdf [accessed 23/06/25].

Commission for the Regulation of Utilities (2022), *National Gas Supply Emergency Plan 2023-27*. Dublin: CRU. Available from: https://energy.ec.europa.eu/document/download/bf1a5c96-40dd-41cb-bf18-b778e8a0fd38_en?filename=IE_DRAFT%202022%20National%20Gas%20Supply%20Emergency%20Plan%20for%20Ireland.PDF.

Commission on the Defence Forces (2022), *Report of the Commission on the Defence Forces*. Department of Defence. Dublin: Government of Ireland.

Congressional Research Service (2008), Liquefied Natural Gas (LNG) Infrastructure Security: Issues for Congress. Washington: Congressional Research Service. Available from: https://digital.library.unt.edu/ark:/67531/metadc822394/ [accessed 24/06/2025].

Congressional Research Service (2014), *U.S. Crude Oil Export Policy: Background and Considerations* [online]. Available from: https://www.energy.senate.gov/services/files/dfe108c9-cef6-43d0-9f01-dc16e6ded6b4 [accessed 30/05/25].

Cook, C., Sheppard, D., Foy, H. & Dubois, L. (2024), 'Europe Agrees Insurance Crackdown on Russia's 'Dark Fleet''. *Financial Times*, Available from: https://www.ft.com/content/8a485a6b-477e-4087-83f4-eca357082d71?utm_source=chatgpt.com [accessed 29/05/25].

Corbeau, A. (2025), *Bridging the US-EU Trade Gap with US LNG Is More Complex than It Sounds* [online]. Available from: https://www.energypolicy.columbia.edu/bridging-the-us-eu-trade-gap-with-us-lng-is-more-complex-than-it-sounds/ [accessed 02/05/25].

Council on Foreign Relations (2014), *U.S. Energy Exports* [online]. Available from: https://www.cfr.org/backgrounder/us-energy-exports [accessed 30/05/25].

CSO (2023), *Environmental Indicators Ireland 2023* [online]. Available from: https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2023/energy/ [accessed 27/05/25].

CSO (2024), *Value of Merchandise Trade* [online]. Available from: https://ws.cso.ie/public/api.restful/PxStat.Data.Cube_API.ReadDataset/TSA10/XLSX/2007/en [accessed 03/06/25].

CSO (2025a), *Environmental Indicators Ireland 2024* [online]. Available from: https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2024/energy/ [accessed 03/06/25].

CSO (2025b), *Data Centres Metered Electricity Consumption 2024* [online]. Available from: https://www.cso.ie/en/releasesandpublications/ep/p-dcmecdatacentresmeteredelectricityconsumption2024/

CSO (2025c), *Fossil Fuel Subsidies 2023* [online]. Available from: https://www.cso.ie/en/releasesandpublications/ep/p-ffes/fossilfuelsubsidies2023fossilfuelsubsidies/#:~:text=Fiscal%20Cost%20of%20Fossil%20Fuel%20Supports%202023,2023%20(see%20Table%202.2) [accessed 05/06/25].

Cummins, V. & McKeogh, E. (2020), *Blueprint for Offshore Wind in Ireland 2020-2050: A Research Synthesis*. MaREI Centre. Cork: University College Cork.

Curtis, J., Cosmo, V. & Deane, P. (2014), 'Climate policy, interconnection and carbon leakage: The effect of unilateral UK policy on electricity and GHG emissions in Ireland'. *Economics of Energy & Environmental Policy*, 3: 145–58.

Daly, H. (2022), *Irish electricity and gas demand to 2050 in the context of climate commitments*. Cork: MaREI. Available from: https://www.marei.ie/wp-content/uploads/2022/12/Friends-of-the-Earth-Research-Report.pdf

Daly, H. (2024), *Data centres in the context of Ireland's carbon budgets*. Cork: MaREI. Available from: https://www.friendsoftheearth.ie/assets/files/pdf/data_centrres_and_the_carbon_budgets_-_prof_hannah_daly_dec_2024.pdf.

Daly, H., Aryanpur, V., Suleimenov, B. & Deane, P. (2024), *Pathways for Ireland's energy system to 2050: Modelling analysis to support the Climate Change Advisory Council on the Second Carbon Budget Programme*. Dublin: Climate Change Advisory Council.

DAFM & DECC (2024), *National Biomethane Strategy*. Available from: https://assets.gov.ie/static/documents/national-biomethane-strategy.pdf [accessed 23/06/25].

Daly, H., Mann, M.E., Augustenborg, C., Wiltshire, K., Sweeney, J., Torney, D., McMullin, B., Stephens, J., Barry, J., Carton, J., Bresnihan, P., Ryan, L. & Pakrashi, V. (2025), *Letter to Government* [online]. Available from: https://www.marei.ie/wp-content/uploads/2025/03/Letter-to-Government25.pdf [accessed 30/05/25].

Deane, P. (2023), *How can Ireland Ensure its Gas and Energy Supplies are Secure?* [online]. Available from: https://www.ucc.ie/en/eri/news/how-can-ireland-ensure-its-gas-and-energy-supplies-are-secure.html#:~:text=A%20supporting%20study%20for%20the,disruption%20of%20gas%20into%20Ireland [accessed 29/05/25].

Deane, P. (2024a), *Expensive and Volatile: The Problems with Ireland's Energy Supply* [online]. Available from: https://www.ucc.ie/en/eri/news/expensive-and-volatile-the-problems-with-irelands-energy-supply.html [accessed 27/05/25].

Deane, P. (2024b), *Will Irish Gas Prices See a Sharp Increase this Winter* [online]. Available from: https://www.ucc.ie/en/eri/news/will-irish-gas-prices-see-a-sharp-increase-this-winter.html [accessed 29/05/25].

DECC (2022), 'Ireland moves a Step Closer to Energy Independence'. Press Release from Department of the Environment, Climate and Communications, 21 March. Available from: https://www.gov.ie/en/department-of-the-environment-climate-and-communications/press-releases/ireland-moves-a-step-closer-to-energy-independence [accessed 27/05/25].

DECC (2023), 'Minister Ryan Announces New Energy Cooperation Agreements with United Kingdom'. Press Release from Government of Ireland. Available from: https://www.gov.ie/en/press-release/eb0e4-minister-ryan-announces-new-energy-cooperation-agreements-with-united-kingdom/ [accessed 30/05/25].

DECC (2025), 'Government Approves Development of State-Led Strategic Gas Emergency Reserve'. Press Release from Department of the Environment, Climate and Communications, Available from: https://www.gov.ie/en/department-of-the-environment-climate-and-communications/press-releases/government-approves-development-of-state-led-strategic-gas-emergency-reserve/ [accessed 30/05/25].

DECC & Federal Ministry of Education and Research of the Federal Republic of Germany (2022), *Joint Declaration of Intent on cooperation in the field of green hydrogen* [online]. Available from: https://assets.gov.ie/278826/72255664-5dc3-4dea-a615-6c5139251dff.pdf [accessed 03/06/25].

Decerna (2024), *CBAM Electricity Import Calculator: Grid Intensity and Power Purchase Agreements* [online]. Available from: https://www.decerna.co.uk/cbam-electricity-import-calculator-grid-intensity-and-power-purchase-agreements [accessed 03/06/25].

Delivorias, A. (2023), *Post-Brexit EU-UK relations on energy and climate* [online]. Available from: https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/749801/EPRS_BRI(2023)749801_EN.pdf [accessed 30/05/25].

Denchak, M. (2019), *Fracking 101* [online]. Available from: https://www.nrdc.org/stories/fracking-101 [accessed 30/05/25].

DETE (2022), 'Minister Coveney launches "Powering Prosperity" – Offshore Wind Industrial Strategy'. Press Release from Department of Enterprise, Trade and Employment, 8 March. Available from: https://www.gov.ie/en/department-of-enterprise-trade-and-employment/press-releases/minister-coveney-launches-powering-prosperity-offshore-wind-industrial-strategy [accessed 27/05/25].

DoD (2025a), 'Tánaiste announces major new contract for Sonar Capability'. Press Release from Department of Defence, Available from: https://www.gov.ie/en/department-of-defence/press-releases/t%c3%a1naiste-announces-major-new-contract-for-sonar-capability/ [accessed 03/06/25].

DoD (2025b), 'Tánaiste approves Defence Forces participation in EU maritime information-sharing initiative'. Press Release from Department of Defence, Available from: https://www.gov.ie/en/department-of-defence/press-releases/t%C3%A1naiste-approves-defence-forces-participation-in-eu-maritime-information-sharing-initiative/ [accessed 03/06/25].

DoT (2022), 'Government launches updated Climate Action Plan accelerating ambition in reaching climate goals'. Press Release from Department of the Taoiseach, 22 December. Available from: https://www.gov.ie/en/department-of-the-taoiseach/press-releases/government-launches-updated-climate-action-plan-accelerating-ambition-in-reaching-climate-goals/ [accessed 27/05/25].

DoT (2023), 'Energy Summit at Government Buildings'. Press Release from Department of the Taoiseach, 6 July. Available from: https://www.gov.ie/en/department-of-the-taoiseach/press-releases/energy-summit-at-government-buildings [accessed 27/05/25].

Droste, N., Chatterton, B. & Skovgaard, J. (2024), 'A Political Economy Theory of Fossil Fuel Subsidy Reforms in OECD Countries'. *Nature Communications*, 15.

EAI (2025), *FAQs on Electricity Prices* [online]. Available from: https://www.eaireland.com/faqs-on-electricity-prices/ [accessed 03/06/25].

EASA (2025), *EU Emissions Trading System* [online]. Available from: https://www.easa.europa.eu/en/domains/environment/eaer/market-based-measures/eu-emissions-trading-system [accessed 03/06/25].

EIA (2024), *World Oil Transit Chokepoints* [online]. Available from: https://www.eia.gov/international/analysis/special-topics/World_Oil_Transit_Chokepoints [accessed 29/05/25].

EirGrid (2024a), *Celtic Interconnector: November Newsletter* [online]. Available from: https://cms.eirgrid.ie/sites/default/files/publications/Celtic-Interconnector-Newsletter-November-2024.pdf [accessed 03/06/025].

EirGrid (2024b), *North South Interconnector* [online]. Available from: https://www.eirgrid.ie/community/projects-your-area/north-south-interconnector [accessed 03/06/25].

Ekhtiari, A., Syron, E., Ryan, I., O'Dwyer, P. & Nolan, L. (2023), *Renewable Hydrogen and End-users' Considerations for the Transition to a Renewable Gas Network* (HyEnd). Dublin: Gas Networks Ireland.

Energy Community (2024), *Enhancing imports of electricity from the European Union to Ukraine* [online]. Available from: https://www.energy-community.org/dam/jcr:55f1ac5c-f53c-492b-9b56-d4623f5be23a/UA_MO_16_2024_import_to_Ukraine.pdf [accessed 03/06/25].

Energy Ireland (2023), *The gas network: Ireland's hydrogen-ready infrastructure* [online]. Available from: https://www.energyireland.ie/the-gas-network-irelands-hydrogen-ready-infrastructure/#:~:text=Green%20hydrogen%20is%20a%20carbon,Ireland's%20gas%20and%20electricity%20networks [accessed 03/06/25].

Energy UK (2025), *Borderline Confusion: Carbon Border Adjustment Mechanisms in Northern Ireland* [online]. Available from: https://www.energy-uk.org.uk/publications/borderline-confusion-carbon-border-adjustment-mechanisms-in-northern-ireland/ [accessed 03/06/25].

Entso-e (2025), *Power Statistics* [online]. Available from: https://www.entsoe.eu/

data/power-stats/ [accessed 03/06/25].

Environmental Pillar (2024), *Submission to the Consultation on Ireland's Draft National Biomethane Strategy* [online]. Available from: https://environmentalpillar.ie/wp-content/uploads/2024/07/Environmental-Pillar-and-the-Stop-Climate-Chaos-Ireland-Submission-to-the-consultation-on-Irelands-draft-National-Biomethane-Strategy-FINAL.pdf [accessed 03/06/25].

EPA (2024), *Stationary installations: Free allocation of emission allowances* [online]. Available from: https://www.epa.ie/our-services/licensing/climate-change/eu-emissions-trading-system-/emissions-trading-system---stationary-installations/free-allocation-of-emission-allowances/ [accessed 27/05/25].

EPRS (2023), *EU withdrawal from the Energy Charter Treaty* [online]. Available from: https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/754632/EPRS_BRI%282023%29754632_EN.pdf?utm_source=chatgpt.com [accessed 30/05/25].

ESB Networks (2021), *Electrification of Heat and Transport Strategy* [online]. Available from: www.esbnetworks.ie/docs/default-source/publications/electrification-of-heat-and-transport-strategy.pdf [accessed 03/06/25].

EU (2017), *Security of Gas Supply Regulation* [online]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02017R1938-20220701 [accessed 30/05/25].

EU TAXUD (2023), *The Carbon Border Adjustment Mechanism eLearning module: CBAM in the electricity sector* [online]. Available from: https://customs-taxation.learning.europa.eu/local/mvpdgtaxud/ajax/setcurrentlang.php?newlang=es&gotourl=/mod/resource/view.php?id=13466&forceview=1#:~:text=CBAM%20affects%20the%20electricity%20sector,practices%20and%20reduce%20carbon%20footprint. [accessed 03/06/25].

Eurelectric (2025), *Wholesale Electricity Price* [online]. Available from: https://electricity-data.eurelectric.org/electricity-price.html [accessed 03/06/25].

European Commission (2019), *Electricity Interconnections with Neighbouring Countries: Second Report of the Commission Expert Group on Electricity Interconnection Targets*. Brussels: European Commission.

European Commission (2021a), *The EU-UK Trade and Cooperation Agreement* [online]. Available from: https://commission.europa.eu/strategy-and-policy/relations-united-kingdom/eu-uk-trade-and-cooperation-agreement_en [accessed 03/06/25].

European Commission (2021b), *Impact Assessment Report accompanying proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism* [online]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021SC0643 [accessed 03/06/25].

European Commission (2022), *EU action to address the energy crisis* [online]. Available from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/eu-action-address-energy-crisis_en [accessed 29/05/25].

European Commission (2023), *Default values for the transitional period of the CBAM between 1 October 2023 and 31 December 2025* [online]. Available from: https://taxation-customs.ec.europa.eu/system/files/2023-12/Default%20values%20transitional%20period.pdf [accessed 05/06/25].

European Commission (2024a), *Electricity interconnection targets* [online]. Available from: https://energy.ec.europa.eu/topics/infrastructure/electricity-interconnection-targets_en [accessed 03/06/25].

European Commission (2024b), *EU Energy Markets and Energy Prices* [online]. Available from: https://ec.europa.eu/commission/presscorner/api/files/attachment/870207/Factsheet [accessed 03/06/25].

European Commission (2024c), *A renewed agenda for European Union – United Kingdom cooperation Common Understanding* [online]. Available from: https://ec.europa.eu/commission/presscorner/detail/en/statement_25_1267 [accessed 03/06/25].

European Commission (2025a), *Effort sharing 2021-2030: targets and flexibilities*. Brussels: DG Climate Action.

European Commission (2025b), *Renewable Hydrogen* [online]. Available from: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen/renewable-hydrogen_en [accessed 03/06/25].

European Council (2025), *D'où provient le gaz de l'UE?* [online]. Available from: https://www.consilium.europa.eu/fr/infographics/where-does-the-eu-s-gas-come-from/#:~:text=En%202022%2C%20les%2027%20pays,UE%20sont%20chauff%C3%A9s%20au%20gaz. [accessed 29/05/25].

European Environment Agency (2024), *Greenhouse gas emission intensity* *of electricity generation, country level* [online]. Available from: https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emission-intensity-of-1/greenhouse-gas-emission-intensity-of-electricity-generation-country-level?activeTab=570bee2d-1316-48cf-adde-4b640f92119b [accessed 03/06/25].

European Hydrogen Observatory (2023), *The European hydrogen market landscape* [online]. Available from: https://observatory.clean-hydrogen.europa.eu/sites/default/files/2023-11/Report%2001%20-%20November%202023%20-%20The%20European%20hydrogen%20market%20landscape.pdf [accessed 03/06/25].

European Parliament (2023), *EU rules for renewable hydrogen* [online]. Available from: https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747085/EPRS_BRI(2023)747085_EN.pdf [accessed 03/06/25].

European Union (2017), *Agreement between the European Union and the Swiss Confederation on the linking of their greenhouse gas emissions trading systems* [online]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.322.01.0003.01.ENG&toc=OJ:L:2017:322:TOC [accessed 03/06/25].

European Union (2020), *EU-UK Trade and Cooperation Agreement* [online]. Available from: https://commission.europa.eu/strategy-and-policy/relations-united-kingdom/eu-uk-trade-and-cooperation-agreement_en [accessed 03/06/25].

Eurostat (2024a), *Energy Imports Dependency* [online]. Available from: https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_ID/default/table?lang=en [accessed 27/05/25].

Eurostat (2024b), *EU Imports of Energy Products* [online]. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_imports_of_energy_products_-_latest_developments#:%7E:text=Norway%20was%20the%20largest%20supplier,the%20third%20quarter%20of%202023 [accessed 03/06/25].

Farrell, N. (2022), *Designing policy for sustainable technology* [online]. Available from: https://www.climatecouncil.ie/councilpublications/councilworkingpaperseries/Working%20Paper%20No.%2013.pdf.

Fechner, I., Luman, R. & Patterson, W. (2024), *Geopolitical conflict threatens yet another shipping choke point* [online]. Available from: https://think.ing.com/articles/shipping-gulf-oil-strait-hormuz-iran-trade/?utm_source=chatgpt.com [accessed 29/05/25].

Federal Government of Germany (2024), *Import Strategy for hydrogen and hydrogen derivatives* [online]. Available from: https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/importstrategy-hydrogen.pdf?__blob=publicationFile&v=7 [accessed 03/06/25].

Foley L., Boorman, A., Sengupta, R. & Cunningham, J. (2024), *Review of Deployment of Long Duration Energy Storage in the Electricity Sector in Ireland*. Dublin: Climate Change Advisory Council. Available from: https://www.climatecouncil.ie/councilpublications/councilworkingpaperseries/24-1366%20-%20Review%20of%20deployment%20of%20long%20duration%20energy%20storage%20in%20the%20electricity%20sector%20in%20Ireland%20-%20Cornwall%20Insight.pdf

Gallagher, C. (2025), 'Russian intelligence ship located in Irish-controlled waters not responding to communication'. *The Irish Times*, 10 April. Available from: https://www.irishtimes.com/ireland/2025/04/10/russian-intelligence-ship-located-in-irish-controlled-waters-not-responding-to-communication/.

Gasprella, A., Koolen, D. & Zucker, A. (2023), *The Merit Order and Price-Setting Dynamics in European Electricity Markets*. JRC Science for Policy Brief JRC134300. Brussels: European Commission.

Gavin, G. (2025), *EU will use Trump tariff freeze to push new fossil fuel deal* [online]. Available from: https://www.politico.eu/article/eu-will-use-donald-trump-tariff-freeze-push-new-fossil-fuel-deal/ [accessed 30/05/25].

GNI (2022a), *Gas Forecast Statement 2022* [online]. Available from: https://www.gasnetworks.ie/sites/default/files/docs/corporate/gas-regulation/Gas-Forecast-Statement-2022.pdf [accessed 03/06/25].

GNI (2022b), *Injecting green hydrogen blends into Ireland's gas network* [online]. Available from: https://www.gasnetworks.ie/sites/default/files/docs/renewable/Hydrogen-Feasibility-Study.pdf [accessed 03/06/25].

GNI (2023), *Winter Outlook 2023/2024*. Dublin: Gas Networks Ireland. Available from: https://www.gasnetworks.ie/sites/default/files/docs/corporate/gas-regulation/Winter-Outlook-2023.pdf

GNI (2024), *Winter Outlook 2024*. Dublin: Gas Networks Ireland. Available from: https://www.gasnetworks.ie/sites/default/files/docs/corporate/gas-regulation/Winter-Outlook-2024.pdf

GNI (2025), *Renewable Gas: What is renewable gas (biomethane)?* [online]. Available from: https://www.

gasnetworks.ie/business/renewable-gas/renewable-gas#:~:text=Biomethane%20is%20a%20carbon%2Dneutral%20renewable%20gas%20made,tanks%20(anaerobic%20digesters)%20into%20biogas%20and%20digestate [accessed 03/06/25].

Government of Ireland (2021a), *Climate Action Plan 2021: Securing Our Future*. Dublin: Department of the Environment, Climate & Communications.

Government of Ireland (2021b), *National Development Plan 2021-2030*. Department of Public Expenditure and Reform. Dublin: Government Publications.

Government of Ireland (2022), *National Energy Security Framework*. Dublin: Department of the Environment, Climate and Communications.

Government of Ireland (2023a), *Energy Security in Ireland to 2030*. Dublin: Department of the Environment, Climate and Communications.

Government of Ireland (2023b), *National Hydrogen Strategy*. Dublin: Department of the Environment, Climate and Communications.

Government of Ireland (2023c), *National Policy Statement Electricity Interconnection*. Department of Energy, Climate and Communications. Dublin: Government of Ireland.
Government of Ireland (2023d), *Securing Ireland's Gas Supplies*. Dublin: Department of the Environment, Climate and Communications.

Government of Ireland (2024a), *Ireland's 4th National Biodiversity Action Plan 2023-2030*. National Parks and Wildlife Service, (NPWS), Department of Culture, Heritage & the Gaeltacht. Dublin: Government of Ireland.

Government of Ireland (2024b), *Powering Prosperity: Ireland's Offshore Wind Industrial Strategy*. Dublin: Department of Enterprise, Trade and Employment.

Hordvei, E., Hummelen, S., Peterson, M., Backe, S. & Granado, P. (2025), *From Policy to Practice: Upper Bound Cost Estimates of Europe's Green Hydrogen Ambitions*. Economics. New York: Cornell University.

House of Commons Library (2024), *Domestic Energy Prices* [online]. Available from: https://researchbriefings.files.parliament.uk/documents/CBP-9491/CBP-9491.pdf [accessed 03/06/25].

Houses of the Oireachtas (2023), *Dáil Éireann Debate, Tuesday - 3 October 2023 - Questions (90, 103)* [online]. Available from: https://www.oireachtas.ie/en/debates/question/2023-10-03/90/ [accessed 30/05/25].
Houses of the Oireachtas (2024a), *Defence Forces: Analysing Ireland's Naval Service*. Parliamentary Budget Office. Dublin: Houses of the Oireachtas.

Houses of the Oireachtas (2024b), *Energy Policy: Dáil Éireann Debate, Tuesday – 5 March 2024* [online]. Available from: https://www.oireachtas.ie/en/debates/question/2024-03-05/136/ [accessed 30/05/25].

Houses of the Oireachtas (2024c), *Joint Committee on Environment and Climate Action debate – Long-Duration Energy Storage*. Available from: https://www.oireachtas.ie/en/debates/debate/joint_committee_on_environment_and_climate_action/2024-06-25/2/

Houses of the Oireachtas (2024d), *Energy Policy: Dáil Éireann Debate, Tuesday – 5 November 2024 - Questions (131)*. Available from: https://www.oireachtas.ie/en/debates/question/2024-11-05/131/?

Hydrogen Europe (2020), *Hydrogen production and water consumption* [online]. Available from: https://hydrogeneurope.eu/wp-content/uploads/2022/02/Hydrogen-production-water-consumption_fin.pdf [accessed 03/06/25].

IEA (2019), *The Future of Hydrogen* [online]. Available from: https://www.iea.org/reports/the-future-of-hydrogen [accessed 03/06/25].

IEA (2022), *World Energy Outlook 2022: Energy Security in Energy Transitions* [online]. Available from: https://www.iea.org/reports/world-energy-outlook-2022/energy-security-in-energy-transitions [accessed 29/05/25].

IEA (2023), *Strait of Hormuz – Factsheet* [online]. Available from: https://iea.blob.core.windows.net/assets/203eb8eb-2147-4c99-af07-2d3804b8db3f/StraitofHormuzFactsheet.pdf?utm_source=chatgpt.com [accessed 29/05/25].

IEA (2024a), *Global Hydrogen Review 2024* [online]. Available from: https://www.iea.org/reports/global-hydrogen-review-2024/executive-summary [accessed 03/06/25].

IEA (2024b), *Tracking the impact of government support: Fossil Fuel Subsidies* [online]. Available from: https://www.iea.org/topics/fossil-fuel-subsidies [accessed 27/05/25].

IEA (2024c), *Ukraine's energy system under attack* [online]. Available from: https://www.iea.org/reports/ukraines-energy-security-and-the-coming-winter/ukraines-energy-system-under-attack [accessed 03/06/25].

IEA (2024d), *World Energy Outlook*. Paris: International Energy Agency.

IFAC & CCAC (2025), *A colossal missed opportunity:*

Ireland's climate action and the potential costs of missing targets. Dublin: Irish Fiscal Advisory Council and Climate Change Advisory Council. Available from: https://www.climatecouncil.ie/news/a-colossal-missed-opportunity---irelands-climate-action-and-the-potential-costs-of-missing-targets.html [accessed 20/07/25].

IGEES (2023), *A Review of Electricity Prices and Supports in the Context of the Energy Crisis: Spending Review 2023*. Irish Government Economic and Evaluation Service. Dublin: Government of Ireland.

International Carbon Action Partnership (2025), *ICAP Allowance Price Explorer*.

International Carbon Action Partnership [online]. Available from: https://icapcarbonaction.com/en/ets-prices [accessed 05/06/25].

IRENA (2020), *Green Hydrogen cost reduction: Scaling up electrolysers to meet the 1. 5°C climate goal* [online]. Available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/%202020/Dec/IRENA_Green_hydrogen_cost_2020.pdf [accessed 03/06/25].

IRENA (2021), *Making the breakthrough: Green hydrogen policies and technology costs* [online]. Available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENA_Green_Hydrogen_breakthrough_2021.pdf?la=en&hash=40FA5B8AD7AB1666EECBDE30EF458C45EE5A0AA6#:~:text=With%20larger%20production%20facilities%2C%20design,economic%20development%2C%20make%20the%20leap [accessed 03/06/25].

IRENA (2022a), *Geopolitics of the Energy Transition: The Hydrogen Factor* [online]. Available from: https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transformation#:~:text=IRENA's%201.5%C2%B0C%20scenario,and%20carbon%20capture%20and%20storage [accessed 03/06/25].
IRENA (2022b), *Hydrogen* [online]. Available from: https://www.irena.org/Energy-Transition/Technology/Hydrogen [accessed 03/06/25].

IRENA (2024), *A Quality Infrastructure Roadmap for green hydrogen* [online]. Available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2024/Nov/IRENA_Quality_infrastructure_roadmap_green_hydrogen_2024.pdf [accessed 03/06/25].

Kelly, G. & Gallagher, M. (2023), *Hydrogen in Ireland Discussion Paper*. Working Paper No.14. Dublin: Climate Change Advisory Council.

Khammadov, K., Syron, E. & Ryan, L. (2025), *Future of the Gas Sector in Ireland*. Research Paper No.31. Dublin: National Economic and Social Council.

Kouam, A. (2024), *Donald Trump wins: what impact on European energy security?* [online]. Available from: https://strategicperspectives.eu/donald-trump-wins-what-impact-on-european-energy-security/ [accessed 30/05/25].

KPMG (2021), *Sustainability of biomethane production in Ireland* [online]. Available from: https://www.gasnetworks.ie/sites/default/files/biomethane-sustainability-report-2021.pdf [accessed 03/06/25].

Lee, M. & Saygin, D. (2023), *Financing cost impacts on cost competitiveness of green hydrogen in emerging and developing economies*. Environmental Working Paper Series No.227. Paris: OECD Publishing.

Liebreich, M. (2023), *Hydrogen Ladder Version 5.0* [online]. Available from: https://mliebreich.substack.com/p/hydrogen-ladder-version-50 [accessed 03/06/25].

Malone, M. (2025), *Comparing Solar PV Per Capita across Europe*. Energy Efficiency blog post [online]. Available from: https://energyefficiency.ie/blog/comparing-solar-pv-per-capita-across-europe/ [accessed 28/07/25].

Mac Domhnaill, C. & Ryan, L. (2020), 'Towards Renewable Electricity in the European Union'. *Renewable Energy*, 154: 955-65.

Martin, V. (2024), *Digest of UK Energy Statistics: Electricity*. London: UK Department for Energy Security and Net Zero.

McCarthy, D. (2023), *Independent Review: Security of Electricity Supply*. Independent Review on the Security of Electricity Supply. Dublin: Department of the Environment, Climate and Communications.

McGrath, D. (2025), 'EU-UK emissions trading deal could prevent spike in Irish electricity import costs'. *Business Post*, 3 February. Available from: https://www.businesspost.ie/article/eu-uk-emissions-trading-deal-could-prevent-spike-in-irish-electricity-import-costs/?utm_source=newsletter&utm_medium=email&utm_campaign=ESGNL.

Med-Gem Network (2024a), *About* [online]. Available from: https://med-gem.eu/about [accessed 30/05/25].

Med-Gem Network (2024b), *About creating a strategic reserve for hydrogen* [online]. Available from: https://med-gem.eu/H2-Strategic-Reserve [accessed 30/05/25].

National Grid (2024), *Energy Explained* [online].

Available from: https://www.nationalgrid.com/stories/energy-explained/how-much-uks-energy-renewable#:~:text=20%20April%202023%20saw%20the,achieved%20on%2018%20September%202023 [accessed 03/06/25].

NESC (2025a), *Strategic Supply Chain Issues & Ireland's Energy Transition*. Secretariat Research Paper. Dublin: National Economic and Social Council.

NESC (2025b), *Ireland's Future Power System and Economic Resilience*. Council Report No.167. Dublin: National Economic and Social Council.

NESO (2023), *Britain's Electricity Explained: 2022 Review* [online]. Available from: https://www.neso.energy/news/britains-electricity-explained-2022-review [accessed 03/06/25].

O'Connor, N. (2023), "Fair to Assume' Russia is Mapping Cables and Pipelines off Irish Coast, NATO General Says'. Available from: https://www.thejournal.ie/nato-cables-general-wiermann-6094957-Jun2023/ [accessed 30/05/25].

Óglaigh na hÉireann (2023), *Defence Forces Review 2023*. Dublin: Irish Defence Forces.

Our World in Data (2024), *Share of electricity production from hydropower* [online]. Available from: https://ourworldindata.org/grapher/share-electricity-hydro?utm_source=chatgpt.com [accessed 03/06/25].

Scheer, J. (2022), *Hydrogen has its place, but not in buildings* [online]. Available from: https://www.seai.ie/blog/hydrogen-has-its-place-not-buildings.

SEAI (2017), *Assessment of Cost and Benefits of Biogas and Biomethane in Ireland* [online]. Available from: https://www.seai.ie/sites/default/files/publications/Assessment-of-Cost-and-Benefits-of-Biogas-and-Biomethane-in-Ireland.pdf [accessed 03/06/25].

SEAI (2022), *Carbon Capture Utilisation and Storage: Suitability, Costs and Deployment Options in Ireland*. Dublin: Sustainable Energy Authority of Ireland.
SEAI (2023), *Energy in Ireland 2023 Report*. Dublin: Sustainable Energy Authority of Ireland.

SEAI (2024a), *Energy in Ireland 2024 Report*. Dublin: Sustainable Energy Authority of Ireland.

SEAI (2024b), *Offshore Renewable Energy Technology Roadmap*. Dublin: Sustainable Energy Authority of Ireland.

SEAI (2024c), *Onshore Wind Community Energy Resource Toolkit* [online]. Available from: https://www.seai.ie/sites/default/files/publications/Community-Toolkit-Onshore-Wind.pdf [accessed 03/06/25].

SEAI (2025a), *Energy-related greenhouse gas (GHG) emissions* [online]. Available from: https://www.seai.ie/data-and-insights/seai-statistics/co2#:~:text=Ireland's%20national%20energy%2Drelated%20emissions,of%20COVID%20impacts%20in%202020 [accessed 05/06/25].

SEAI (2025b), *Interim National Energy Balance 2024* [online]. Available from: https://www.seai.ie/news-and-events/news/seai-interim-national-energy-balance-2024 [accessed 05/06/25].

SEAI (2025c), *National energy balance* [online]. Available from: https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance#:~:text=Almost%20half%20(48.9%25)%20of,of%20its%20electricity%20in%202024 [accessed 27/05/25].

Semo (2024), *Developing the I-SEM* [online]. Available from: https://www.sem-o.com/markets/developing-the-i-sem/ [accessed 03/06/25].

Shannon Foynes Port (2022), *Vision 2041 Strategic Review* [online]. Available from: https://www.sfpc.ie/wp-content/uploads/2022/11/SFPC-Vision-2041-Strategic-Review-Final-Report.pdf [accessed 03/06/25].

Sheftalovich, Z. (2025), *Trump says EU must buy $350B of US energy to get tariff relief* [online]. Available from: https://www.politico.eu/article/donald-trump-says-eu-must-buy-350b-of-us-energy-to-get-tariff-relief/ [accessed 30/05/25].

SIMI (2025), *121,195 New Car Registrations in 2024; Electric Cars Reach 17,459* [online]. Available from: https://www.simi.ie/en/news/121-195-new-car-registrations-in-2024-electric-cars-reach-17-459 [accessed 27/05/25].

TeleGeography (2025), *Submarine Cable Map* [online]. Available from: https://www.submarinecablemap.com/ [accessed 03/06/25].

Thomas, N. & Sheppard, D. (2022), 'UK plans to cut pipelines to EU if Russia gas crisis intensifies'. *Financial Times*, 29 June. Available from: https://www.ft.com/content/175ef927-efa2-439e-8ede-1dfc7edd23a6.

US Congress (1978), *Natural Gas Policy Act of 1978* [online]. Available from: https://www.congress.gov/bill/95th-congress/house-bill/5289 [accessed 30/05/25].

US Department of Energy (2024), *Clean Hydrogen Production Cost Scenarios with PEM Electrolyzer Technology*.

US Department of Energy (2025), *Hydrogen Storage* [online]. Available from:

https://www.energy.gov/eere/fuelcells/hydrogen-storage [accessed 03/06/25].

US Department of the Treasury (2024), 'Treasury Expands Targeted Sanctions on Iranian Petroleum and Petrochemical Sectors in Response to Attack on Israel'. Press Release from US Department of the Treasury, Available from: https://home.treasury.gov/news/press-releases/jy2644 [accessed 29/05/25].

UK Cabinet Office (2025a), *UK-EU Summit – Common Understanding* [online]. Available from: https://www.gov.uk/government/publications/ukeu-summit-key-documentation/uk-eu-summit-common-understanding-html

UK Cabinet Office (2025b), *UK-EU Summit – Explainer* [online]. Available from: https://www.gov.uk/government/publications/ukeu-summit-key-documentation/uk-eu-summit-explainer-html [accessed 03/06/25].

UK Government (2025), 'Joint statement between Prime Minister Keir Starmer and Taoiseach Micheál Martin: 6 March 2025'. Press Release from UK Government, Available from: https://www.gov.uk/government/news/joint-statement-between-prime-minister-keir-starmer-and-taoiseach-micheal-martin-6-march-2025 [accessed 03/06/25].

van Wijk, A., Westphal, K. & Braun, J.F. (2022), *How to deliver on the EU Hydrogen Accelerator* [online]. Available from: https://hydrogeneurope.eu/wp-content/uploads/2022/05/How-to-deliver-on-the-EU-Hydrogen-Accelerator_Final.pdf [accessed 30/05/025].

WEF (2024), *Red Sea attacks: What trade experts are saying about the shipping disruptions* [online]. Available from: https://www.weforum.org/stories/2024/02/red-sea-attacks-trade-experts-houthi-shipping-yemen/ [accessed 29/05/25].

WEI (2022), *Hydrogen and Wind Energy; The Role of Green Hydrogen in Ireland's Energy Transition*. Naas: Wind Energy Ireland.

WEI (2024a), *Building Irish Energy Independence: Priorities for the next Dáil*. Dublin: Wind Energy Ireland.

WEI (2024b), *Delivering Irish Energy Independence*. An overview of wind energy: Contribution to Economy, Climate Action and Future Potential. Dublin: Wind Energy Ireland.

World Nuclear Association (2024), *Carbon Dioxide Emissions from Electricity* [online]. Available from: https://world-nuclear.org/information-library/energy-and-the-environment/carbon-dioxide-emissions-from-electricity#:~:text=Whilst%20estimates%20vary%2C%20the%20United,than%20all%20types%20of%20solar [accessed 03/06/25].

World Nuclear Association (2025), *Nuclear Power in France* [online]. Available from: https://world-nuclear.org/information-library/country-profiles/countries-a-f/france#:~:text=France%20is%20the%20world's%20largest,have%20been%20a%20significant%20export. [accessed 03/06/25].

WTO (2023), *Classification of Fossil Fuel Subsidies Measures* [online]. Available from: https://www.wto.org/english/tratop_e/envir_e/presentation_by_wto_secretariat_classification_of_ffs_measures.pdf [accessed 27/05/25].

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