ENERGY POLICIES OF IEA COUNTRIES

Ireland

2019 Review

International Energy Agency
Secure Sustainable Together

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INTERNATIONAL ENERGY AGENCY

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.

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Foreword

The International Energy Agency (IEA) has conducted in-depth peer reviews of its member countries' energy policies since 1976. This process not only supports energy policy development but also encourages the exchange of and learning from international best practices and experiences. In short, by seeing what has worked – or not – in the "real world", these reviews help to identify policies that achieve objectives and bring concrete results. Recently, the IEA has moved to modernise the reviews by focusing on some of the key energy challenges in today's rapidly changing energy markets.

Ireland is successfully advancing the low-carbon transformation of its energy sector, and the power sector is leading the way for decarbonisation. In 2017, Ireland had the third-highest share of wind in electricity generation of all IEA member countries. I am pleased to see that, thanks to the country's substantial innovation capacity, the Irish electricity system is ready to accommodate an even larger share of wind generation. Despite the progress made, Ireland faces challenges in its short- and medium-term climate and energy targets. In this review, we recommend that the government set trajectories towards those targets and the means of achieving them. This could include building on the success of many new energy efficiency policies, which is something that will be explored in the fourth annual IEA Global Conference on Energy Efficiency to be hosted by Ireland in June 2019.

One of Ireland's main challenges towards a low-carbon energy future is the decarbonisation of heat in the housing sector. The IEA applauds that revised regulations require all new buildings from January 2019 onwards to install renewable energy systems. A similar push is needed in the rental market for existing houses, and we recommend that the government considers the introduction of minimum energy efficiency standards in the rental sector to give a push to renovation.

The aim of this report is to support Ireland in its quest for a secure, affordable, and environmentally sustainable transformation of its energy sector. It is my hope that it will guide Ireland in its energy transition and support its contribution to a cleaner, more sustainable, and secure global energy system.

Dr Fatih Birol

Executive Director

International Energy Agency

ENERGY INSIGHTS

ENERGY SECURITY

ENERGY SYSTEM TRANSFORMATION

ANNEXES

LIST OF FIGURES, TABLES AND BOXES

Figures

Tables

Boxes

1. Executive summary

Ireland has successfully advanced the transformation of its energy sector since the last International Energy Agency (IEA) in-depth review (IDR) in 2012. It had the third-highest share of wind in electricity generation of all IEA member countries in 2017. Ireland's electricity system is capable of accommodating up to 65% of instantaneous variable generation at any given time. This is a remarkable achievement and proof of the substantial innovation and research capacity of the Irish economy. Ireland has also improved its energy security through a significant increase in domestic gas production, a reduction of the share of oil in energy supply and by strengthening its oil emergency reserves system.

The Irish economy has recovered remarkably well from the economic crisis that started in 2008. It has been the fastest-growing economy among all IEA countries since 2014, when the gross domestic product (GDP) exceeded pre-crisis levels. Energy use has increased with GDP growth, but still remains under the 2006 peak, partly reflecting the structural shift in the economy. The shift towards an economy dominated by the services sector, especially the government's strategy to seek to establish Ireland as a preferred location for the global digital and data hosting industry, will potentially result in increasing electricity demand. This makes fast decarbonisation of the electricity system a necessity.

Ireland is not on course to meet its mandatory emissions reduction and renewable energy targets for 2020, despite the progress made. There are also questions about Ireland's ability to meet the 2030 emissions reduction targets, although the impact of the latest policies announced by the government is not yet reflected in the latest emissions pathway projections.

Transition to a low-carbon energy future

Ireland is committed to a substantial low-carbon transformation of its economy and energy sector. The 2015 White Paper "Ireland's Transition to a Low Carbon Energy Future 2015-2030" formally outlines the government's energy policy framework to 2030. It commits the country to reducing greenhouse gas (GHG) emissions in the energy sector by 80-95% relative to the 1990 level by 2050. A low-carbon energy system will ease security of supply (SoS) concerns resulting from limited indigenous energy resources and the limited direct interconnection with European energy markets due to Ireland's geographical location.

The country is an attractive location for highly skilled professionals, and the government expects the population to grow by 20% from 2016 to 2040. This will put substantial pressure on the support infrastructure and will raise issues of balanced regional development. It will require meeting future energy, housing and transport needs through low-carbon and energy-efficient solutions. The continuous decoupling of energy

consumption from economic growth and advancing a corresponding decoupling of energy consumption from population growth are of utmost importance to the government.

Ireland has made progress towards meeting its target of improving energy efficiency by 20% from 2005 by 2020. The IEA applauds the government for the significant funding increase for energy efficiency since 2016, in line with the economic recovery. This has allowed implementation of additional energy efficiency measures towards meeting the 2020 target. However, exploiting the energy efficiency potential towards 2030 will require a step change in policy efforts. The IEA encourages the government to maintain, if not increase, funding.

Ireland will miss its mandatory 2020 GHG emissions reduction target of 20% below the 2005 level by a large margin. The economic recovery since 2014 revealed energy consumption growth in the residential and transport sectors has not yet sufficiently decoupled from emissions growth. This is compounded by a strong rise in emissions from the agricultural sector that accounted for 33% of total GHG emissions in 2017.

Ireland is also likely to fall short of the 30% emissions reduction target for 2030 below the 2005 level without the urgent implementation of additional measures. This raises questions about the feasibility of meeting the 2050 targets. Ireland has a comprehensive framework of climate policies and plans, but needs to prioritise time-bound implementation of specific measures. Close monitoring of the progress made by setting interim milestones is needed to rectify the emissions trajectory.

Progress towards meeting Ireland's legally binding target of sourcing 16% of its final energy consumption from renewable sources is more encouraging. It is led by the electricity sector. However, the latest projections from Ireland indicate that it could fall short of the target, reaching 12.7-13.9% of renewable energy in final energy consumption by 2020.

Achieving a higher share of renewable fuels in the transport sector is daunting, as in many IEA countries. Ireland projects achieving 90% of its binding target of a 10% share by 2020, predominantly because of double counting according to European Union (EU) regulations. The strong economic recovery has resulted in increased private car ownership, which is the preferred mode of transport in a country with a highly dispersed population and limited public transport options. While some progress has been made in the roll-out of electric vehicles and the required charging infrastructure, this will not be sufficient to result in a significant increase by 2020. However, there is substantial and unexplored scope to facilitate modal shifting and alternative means of transport, and to advance public transport infrastructure, especially in urban areas.

Renewable energy accounted for 29% of Ireland's electricity generation in 2017. This is a significant increase since the last IDR, when renewables accounted for only 10%. There has been an acceleration in renewable generation connected to the grid in recent years. Network operators believe that by 2020, Ireland will achieve or be close to achieving the government's 2020 target of 40% renewable electricity. Delays in obtaining final planning consent approval and in grid building have caused project delays. Recent changes to the grid connection policy should improve the installation of renewable generation.

Stringent measures are required to ensure that Ireland narrows the gap towards its 2020 emissions and renewable energy targets and to put the country on track to achieving its medium and long-term targets to 2030 and 2050. Ireland is one of the few countries

globally that taxes all carbon fuels. However, the rate of the carbon tax has not been increased since 2014. With recovering living standards, the tax may no longer be having the desired effect on customer behaviour. As part of the government's deliberation to increase the tax rate, it could consider introducing an automatic upward adjustment of the tax rate if Ireland falls short of its emissions pathway. The government should also consider earmarking a part, or all, of the additional revenue from the tax increase for energy efficiency measures to provide support for heat decarbonisation in the residential sector, which has proven difficult to achieve (despite its policy not to earmark tax revenues).

Ireland has the highest share of peat in energy supply among IEA countries. The announcement in October 2018 to cease harvesting of peat for electricity generation in 2028 is a positive development and aligns with the government's announcement on ceasing the use of peat for power generation by 2030. The government has already announced the end of burning coal in the Moneypoint plant by 2025, but the IEA urges the government to decide on the form of generation that should replace the plant.

Planning consent and engagement with local communities

There is a large consensus among citizens and stakeholders in Ireland on the importance of transition to a low-carbon economy and the opportunities for Ireland to become a global leader in clean energy transition. However, the construction of critical infrastructure, including renewable generation assets, is experiencing delays. This increases costs, and can also affect the wider energy system and weaken the SoS. The government should take all necessary measures to speed up procedures and improve acceptance.

Greater certainty on timelines, effective cross-departmental and cross-agency co-operation, and collaboration on agreed policy objectives and early engagement by developers with affected communities and other stakeholders could reduce delays in building critical infrastructure. The IEA encourages the government to continue shortening and simplifying the planning permission consent process for energy infrastructure to provide greater clarity to all stakeholders.

Decarbonisation of heat

Ireland has a highly dispersed population reliant on individual oil-fired boilers for heating, which account for 41% of home heating. The government has a comprehensive policy framework and financial incentives to pursue the two ways to decarbonise heating in buildings: improving energy efficiency and switch from fossil fuels to renewable energy sources.

The government's policy principle "fabric first then fuel switching" ensures that the benefits of fuel switching are not compromised by insufficient building fabric standards. Ireland has achieved significant reductions in energy intensity for the residential sector, especially through improved insulation of the existing buildings stock. Ireland links decarbonisation of heat to the multiple benefits of energy efficiency, and is focusing on issues of fuel poverty through several dedicated support programmes.

With the highest share of fossil fuels in residential heating among IEA countries, Ireland is actively promoting fuel switching. The country is unlikely to reach the target of 12% renewable heat by 2020.

As of 1 January 2019, building regulations require that renewable energy systems are installed in all new buildings commencing construction. Strict enforcement of the new building codes is essential, and a solid monitoring system should be put in place. The IEA commends the government's decision to discontinue financial support for the replacement of oil or gas boilers to avoid possible lock-in of high-carbon heating systems and instead to offer support programmes for heat pumps.

A challenge in improving energy efficiency in buildings and promoting the decarbonisation of heat is the principal agent problem in the rental sector, as in most IEA countries. This is important due to the recent shift from owner-occupied to rental properties observed in urban areas. This might require the introduction of better incentives for landlords, because their uptake of available financial support programmes is low. The government should also consider introducing minimum energy efficiency standards in the rental sector. It may be possible to consolidate existing multiple support systems for the residential sector to make them more user friendly and effective in obtaining outcomes.

Options for decarbonisation of heat are constrained by the low population density, which renders a larger roll-out of district heating (DH) solutions and a wider coverage of the population under the natural gas system impracticable. There is potential for localised opportunities, which the government is committed to encouraging. Ireland has a modest amount of untapped potential for DH systems that utilise heat from waste to energy plants. This could be harnessed, especially if there is increasing installation of data centres. However, this will require a conducive regulatory framework to facilitate the necessary investments. The co-generation of heat and power is an efficient use of available resources, and support for renewable heat should be aligned with policies for renewable electricity.

Interconnections

Ireland's only gas and electricity interconnections are with the United Kingdom, due to its peripheral location at the north-west of mainland Europe.

All gas imports reach Ireland through two interconnectors via the single Moffat entry point in Scotland (United Kingdom). Ireland does not have a liquefied natural gas (LNG) facility. Ireland has sharply reduced its import dependency of natural gas since 2016 when domestic production from the Corrib gas field commenced. However, an equally sharp decrease in production from the field is expected by the middle of the 2020s, which can only be compensated through the Moffat entry point. Twinning of the onshore pipeline in Scotland was completed in 2018. Work is also ongoing to build independent compressor systems for the two gas interconnectors; this project is due for completion in 2020. Once completed, this infrastructure development would enhance the SoS of the Moffat entry point.

There is high reliance on a limited amount of gas infrastructure, raising concerns for security of gas supply in Ireland. This is independent of the future relationship between the United Kingdom and the European Union, following the vote of the United Kingdom

to leave the European Union. An option for diversification of gas supply routes would be the construction of an LNG import facility to provide Ireland with direct access to the global LNG market. The construction of an additional gas interconnector with the United Kingdom would allow Ireland to reduce its reliance on a single infrastructure and therefore enhance the SoS. However, it would give rise to other challenges.

Ireland's only cross-border electricity interconnection is with the United Kingdom through two electricity interconnectors. Both countries derive significant benefits from electricity trade. The single electricity market (SEM) on the island of Ireland covers Ireland and Northern Ireland, and involves significant cross-border flows of power between the two jurisdictions in a single bidding zone wholesale market. The new market design of the SEM became operational on 1 October 2018, in line with the requirements of the EU Third Energy Package. Ireland, the European Commission and the United Kingdom have expressed a commitment to maintain the SEM arrangements.

Interconnectors provide much-needed flexibility to electricity markets for the integration of a high share of intermittent renewables. This is particularly important for a small system such as that of Ireland. The government of Ireland recognises the important role of the electricity interconnections for transition to a low-carbon energy future. It published a national policy statement on electricity interconnection in July 2018, and is supporting three new interconnector projects. The first is a second interconnector with Northern Ireland that will reduce curtailment and increase efficiency in the SEM. The second is a merchant interconnector project linking Ireland with Wales, creating a third electricity interconnection with the United Kingdom. The proposed Celtic interconnector with France would ensure continuous direct market coupling with the EU electricity market, when the United Kingdom has exited the European Union.

Energy security

As a small, open economy, Ireland is dependent on international trade and influenced by developments in the global market. Ireland and the United Kingdom are close trading partners, including for energy. The vote of the United Kingdom to leave the European Union poses unique challenges, although the full impact on the energy sector of Ireland cannot yet be determined.

Maintaining beneficial energy relations between Ireland and the United Kingdom is in the interest of both countries. Ireland relies on the United Kingdom for supply of most of its oil product imports and for a significant volume of crude oil. Supply routes and the number of suppliers are increasingly diversified. Ireland consistently holds more oil stocks than required under the IEA stockholding obligation, and has progressively strengthened its stockholding system.

All of Ireland's natural gas imports flow through the existing gas interconnectors with Scotland, even if they are not sourced from the United Kingdom. Power generation is the largest gas-consuming sector. It accounted for 55.2% of the total consumption share in 2016, indicating an aligned correlation between gas and electricity demand. In the electricity sector, Ireland has become a small net exporter to the United Kingdom. The generation adequacy of Ireland exceeds that of Northern Ireland, with whom it shares an SEM.

Ireland is committed to maintaining the beneficial structures and efficiencies of the all-island SEM. Similarly, Ireland is electrically connected to the rest of the European Union via Great Britain. Ireland should try to maintain the most-efficient use of interconnections to facilitate cross-border electricity trade with the United Kingdom and European Union member states.

Key recommendations

The government of Ireland should:

- Prioritise improving the transparency of, and accountability for, meeting its emissions reduction targets. This includes publishing its draft National Energy & Climate Plan, setting trajectories towards meeting renewable and energy efficiency targets including the means of achieving them, and clarifying the contribution of those targets to meeting Ireland's emissions reduction targets under the EU Effort Sharing Regulation.
- Implement an automatic upward adjustment of the carbon tax when preset sectoral emissions targets are not met, and earmark a portion (or all) of the increased revenues for energy efficiency improvements and decarbonisation of heat in the residential sector (despite its policy not to earmark tax revenues).
- Improve the efficiency of the planning consent regime for energy infrastructure to ensure that decisions are taken on time and with due regard to environmental and other effects. The legal framework for planning permission should ensure that adequate consultation has taken place with all stakeholders and that the needs of local communities have been taken into account, before the consent decision is taken by the relevant authority.
- Develop a time-bound roadmap for decarbonising the heating sector through energy efficiency and fuel switching. The roadmap should establish clear scenarios and milestones for phasing out fossil fuels.
- Provide continuity and longer-term certainty in energy policies to avoid, or minimise, interruptions that could undermine investor confidence and the necessary investment to achieve clean energy objectives.

2. General energy policy

Key data

(2017 provisional)

TPES: 13.7 Mtoe (oil 45.7%, natural gas 31.5%, coal 7.8%, peat 5.2%, biofuels and waste 5.0%, wind 4.7%, hydro 0.4%, solar 0.1%, electricity exports -0.4%), -8% since 2007

TPES per capita: 2.9 toe/capita (IEA average 4.1 toe/capita)

TPES per unit of GDP: 43 toe/USD million PPP* (IEA average: 106 toe/USD million PPP)

TPES per unit of GNI*: 67 toe/USD million**

Energy production: 4.9 Mtoe (natural gas 58.7%, peat 15.8%, wind 13.2%, biofuels and waste 10.7%, hydro 1.2%, solar 0.3%), +245% since 2007

*Gross domestic product in USD million in 2010 prices and PPP (power purchasing parity).

**Gross national income in USD million in 2017 prices, without PPP.

Country overview

The island of Ireland is shared between Ireland and Northern Ireland, which is part of the United Kingdom. The total land area of Ireland is 70 273 square kilometres. It is bounded in the west and north-west by the Atlantic Ocean, in the south by the Celtic Sea, in the east by the Irish Sea and in the north-east by Northern Ireland. The climate is temperate maritime, strongly influenced by the North Atlantic Current. It consists of mild winters and cool summers, with a high degree of humidity throughout the year (Figure 2.1).

Ireland is a parliamentary democracy; there are 26 county councils, three city councils, and two city and county councils. Local authorities play a key role in meeting Ireland's energy targets, particularly for climate change and energy efficiency. The government of Ireland is a minority government of Fine Gael and independent members, and has been in place since June 2016. The next election has to be held by February 2021.

Ireland had a population of 4.75 million in 2016, of which slightly more than 1.3 million resided in Dublin city and county. This was an increase of 3.8% for the total population and 5.7% for Dublin city and county above the 2011 level. Other large urban centres include Cork on the southern coast, and Limerick and Galway on the western coast. Ireland is a sparsely populated country, and has the highest percentage of population living in rural areas in the European Union.

Figure 2.1 Map of Ireland

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Population growth in urban areas was 4.9% over the period 2011-16. This exceeded the national average and was spread out over more urban centres than in earlier periods. The Irish government expects the population to grow by 1 million by 2040.

The Irish economy has recovered rapidly from the consequences of financial crisis, which commenced in 2008. Nominal gross domestic product (GDP) in 2015 exceeded the pre-crisis 2007 peak level. However, this is partly the result of a statistical peculiarity in 2015 (see Box 2.1).

Box 2.1 GDP development and alternative measures of economic growth

Ireland has experienced an exceptionally high growth of the GDP in recent years, resulting from specific features of the country's economy. The annual growth in the real GDP went from 8.3% in 2014 to a staggering 25.6% in 2015, as several unique events happened simultaneously. One was the relocation of intellectual property assets of a few multinational enterprises to Ireland. This resulted in a substantial increase in the Irish capital stock in 2015, strongly influencing the GDP. Another factor was that Ireland's aircraft leasing industry, which is of global significance, was not included in the national accounts before 2015.

However, the real economic value from these activities does not (fully) accrue to Irish residents but (mainly) to the foreign owners of capital assets based in Ireland. The GDP methodological concept therefore overstated the living standards of Irish residents and rendered it an impractical indicator for the underlying economic activity in the country. The GDP concept is not useful to guide policy makers in such circumstances.

The high GDP growth in 2015 has implications for the energy sector, even though transfer of intellectual property and aircraft leasing do not affect energy use. Ireland's energy and carbon intensities measured per unit of GDP dropped markedly in 2015. This was mainly due to rapid GDP growth, rather than improvements in energy efficiency or emissions reductions. The Central Statistics Office of Ireland therefore convened an Economic Statistics Review Group in 2016 to explore an alternative measure for the GDP. The group recommended the use of a modified gross national income (GNI*) indicator to exclude globalisation effects that disproportionally affect measurement of the size of the Irish economy. The comparison of growth in the GDP and the GNI* in Table 2.1 shows the differences.

Table 2.1 Annual percentage growth/decline of GDP and modified gross national income, 2007-17

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	6.6	-4.8	-9.4	-1.4	2.0	2.4	2.7	8.5	34.4	4.1	7.6
GNI*	4.9	-5.2	-14.1	-4.4	-1.8	-0.1	8.3	8.6	8.6	9.0	3.0

Note: All in current market prices.

Sources: CSO (2017), *National Income and Expenditure 2017*, www.cso.ie/en/releasesandpublications/ep/p-nie/nie2017/mgni/; OECD (2018), *Economic Survey of Ireland 2018*, www.oecd.org/eco/surveys/economic-survey-ireland.htm.

The service sector accounted for about 63% of the GDP in 2017, the industry sector accounted for 36% and the agricultural sector for 1%. Yet, the agricultural sector, which is primarily grass based, is crucial to Ireland's economy. The agri-food sector is the most important indigenous manufacturing sector, accounting for 10.7% of Ireland's merchandise exports and employing 8.4% of the working population (DAFM, 2018).

Despite its low share of the GDP, the agriculture sector is the largest single contributor to Ireland's overall greenhouse gas (GHG) emissions, accounting for 33% in 2017.[1] Ireland's GHG profile is unique among European Union (EU) member states, with the highest national proportion of agriculture emissions. This presents a particular challenge for Ireland in meeting future GHG emissions reductions. However, there are promising pilot projects ongoing in relation to production of biogas (see the chapters on "Natural gas" and "Energy efficiency and residential heating").

As a small, open economy, Ireland is dependent on international trade and influenced by developments in the global market. Ireland and the United Kingdom are close trading partners. In 2017, 13.4% of overall Irish goods and services exports were destined for Great Britain and Northern Ireland. There is uncertainty how the decision of the United Kingdom to leave the European Union will affect the economy of Ireland, including in the energy sector. Ireland imports about 63% of oil products from the United Kingdom. All of Ireland's gas and electricity interconnectors are with the United Kingdom. This might raise issues of security and diversity of supply if the energy regulatory and market frameworks between Ireland and the United Kingdom diverge (see the chapters on "Natural gas" and "Electricity and renewable electricity").

Supply and demand

Ireland's energy system is characterised by a high share of fossil fuels, despite a rapid increase in renewable energy sources (Figure 2.2). Fossil fuels accounted for 90% of the total primary energy supply (TPES)[2] in 2017.

In 2016, the transport sector accounted for 37% of the total final consumption (TFC),[3] followed by the industry (25%), residential (24%) and commercial (14%) sectors. Natural gas and electricity are consumed across most sectors, with the largest demand in the commercial sector, whereas oil dominates in the transport sector. Ireland also consumes coal and peat, particularly in residential and industrial sectors.

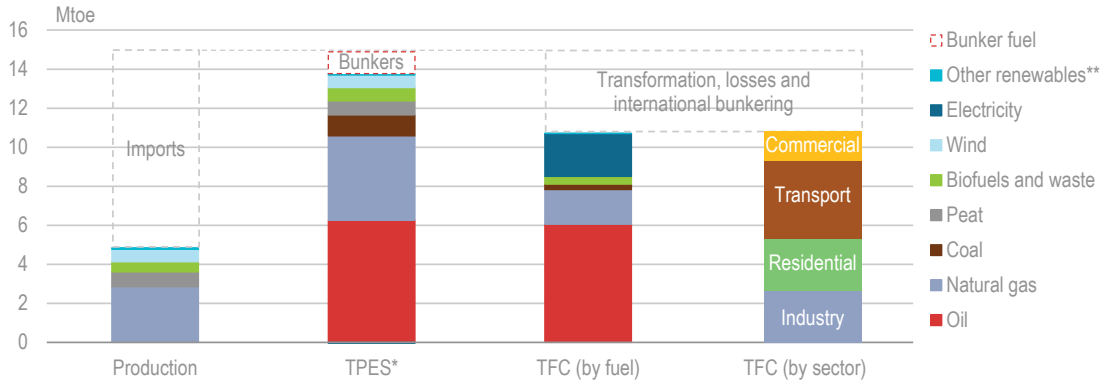
TPES declined in the aftermath of the global financial crisis in 2008. It dropped from 15 million tonnes of oil equivalent (Mtoe) in 2007 to 12.8 Mtoe in 2014, but has picked up in recent years. In 2017, TPES was 13.7 Mtoe, an 8% decline from 2007 but a 7% increase from 2014 (Figure 2.3).

[1] The energy sector, which includes transport and energy-related industry emissions, represented 62% of total GHG emissions.

[2] TPES is made up of: production + imports - exports - international marine and aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use.

[3] The TFC is the final consumption of energy (electricity, heat and fuels, such as natural gas and oil products) by end users, not including the transformation sector (e.g. power generation and refining).

Figure 2.2 Overview of Ireland's energy system by fuel and sector, 2016/17



Low domestic energy production makes Ireland dependent on energy imports.

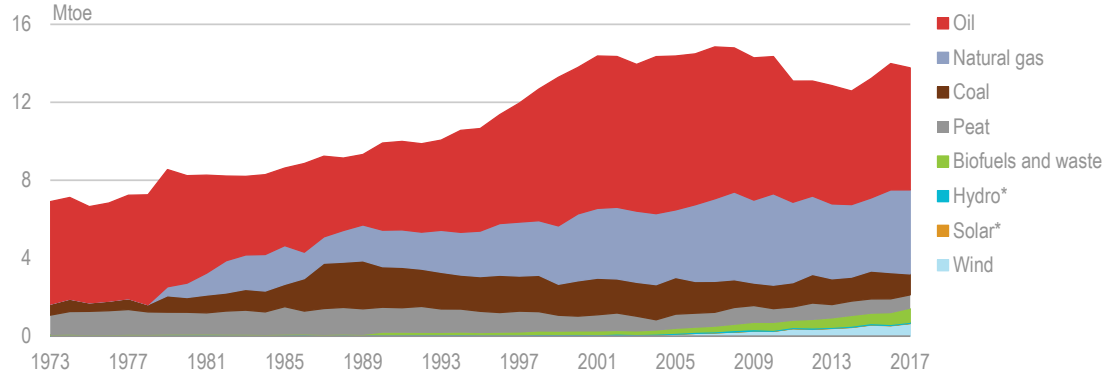
* Includes international marine and aviation bunker fuel (oil), which is not part of TPES.

** *Other renewables* includes hydro and solar.

Notes: Consumption data (TFC) are for 2016; supply data for 2017 are provisional. Mtoe = million tonnes of oil equivalent; TFC = total final consumption.

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Figure 2.3 TPES by source, 1973-2017



TPES slightly decreased in 2017 due to the decline of fossil fuel supply in the energy mix, mostly in electricity generation.

* Negligible.

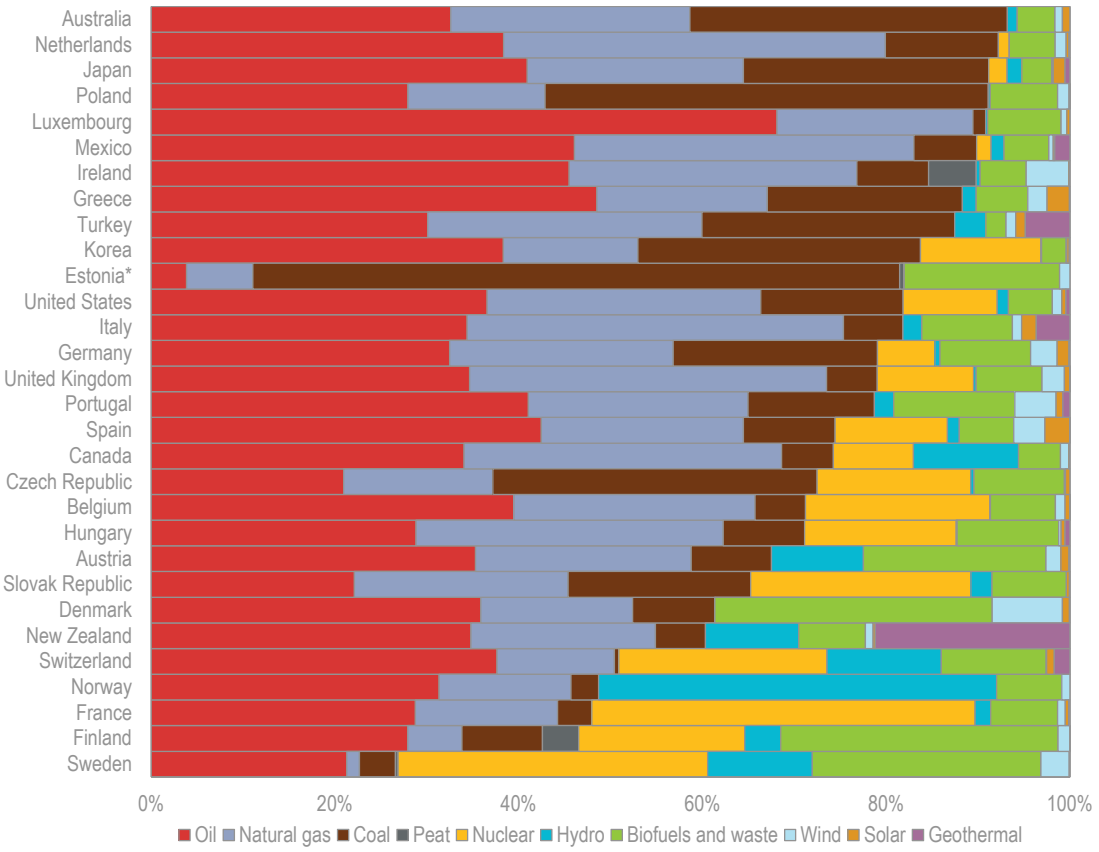
Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Oil is the largest energy source in Ireland, accounting for nearly half of TPES. Oil experienced the strongest impact of all fuels from the financial crisis, with a fall of 25% from 2007 to 2014. In recent years, oil supply has recovered slightly, by 7% from 2014 to 2017, due to growing demand in transport. Natural gas is the second-largest energy source, accounting for 32% of TPES. Domestic gas production has increased strongly since the beginning of operations of the Corrib gas field in late 2015. Ireland was nearly 67% self-sufficient in natural gas in 2017. The remaining energy supply came from coal, which accounted for 8% of TPES, peat (5%), biofuels and waste (5%), and wind and other renewables (5%).

Renewable energy has steadily increased over the last decade. In 2017, biofuels and waste represented the largest share of renewable energy in TPES, with a 5.0% share, just above wind at 4.7%. Biofuels and waste are used in several sectors, with the largest share in the industry and transport sectors, whereas wind power accounts for nearly a quarter of total electricity generation.

Despite the increased share of renewable energy in TPES in recent years, Ireland had the seventh-highest share of fossil fuels in TPES among International Energy Agency (IEA) member countries in 2017 (Figure 2.4). However, while Ireland had the second-highest share of wind in TPES (after Denmark), it also had the highest share of peat and fourth-largest share of oil in TPES of IEA countries.

Figure 2.4 Breakdown of TPES in IEA countries, 2017



Ireland had the seventh-highest share of fossil fuels in TPES among IEA countries, and the second-largest share of wind in 2017.

* Estonia's coal is represented by oil shale.

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Energy production and self-sufficiency

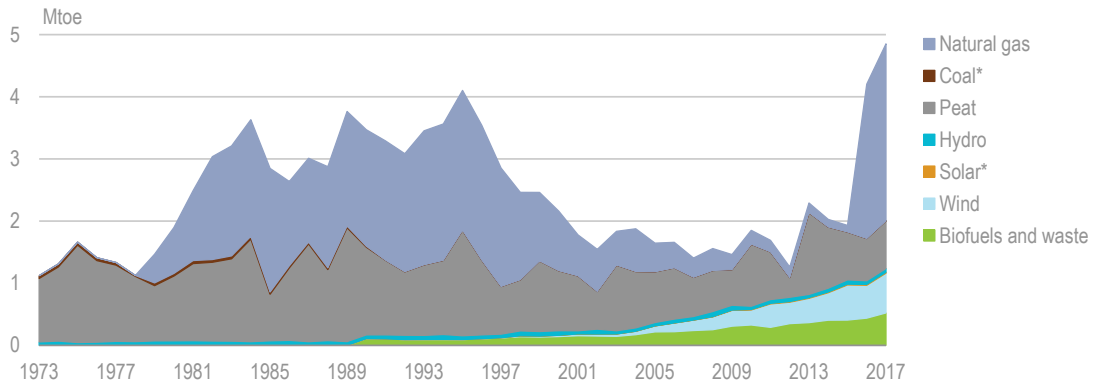
Ireland's total domestic energy production reached a new peak of 4.9 Mtoe in 2017 (an increase of 2.5 times since 2015) due to starting new natural gas production. However, Ireland still imports most of its energy needs, as energy production covers only 35% of TPES. The largest indigenous energy source is natural gas, which represented more

than half (59%) of the total domestic production in 2017. The rest was peat (16%), wind (13%), biofuels and waste (11%), and small shares of hydro (1%) and solar (0.3%).

Ireland has had a low total energy production over the last two decades due to a sharp fall in natural gas production. However, it picked up rapidly in 2016 owing to the opening of the Corrib gas field in December 2015 (Figure 2.5). Consequently, Ireland's total energy production as a share of TPES[4] increased from 15% in 2015 to 35% in 2017, which contributes to Ireland's energy security.

Peat production varies from year to year, but the 10 year average is around 0.8 Mtoe per year. Ireland has no domestic oil production, and relies completely on imports: crude oil from Norway and oil products from the United Kingdom. Furthermore, since 1995, Ireland's total annual coal supply of around 1.3 Mtoe has been imported, mainly from Colombia recently.

Figure 2.5 Energy production by source, 1973-2017



Total energy production has increased in the last decade due to growth in renewable energy production and a steep rise in natural gas in 2016.

* Negligible.

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Energy consumption

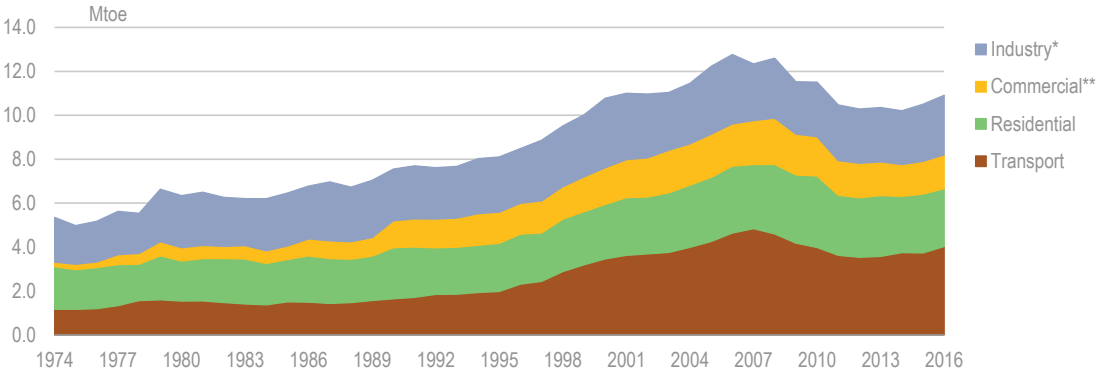
Ireland's TFC increased gradually in the 1990s, peaked at 12.8 Mtoe in 2006 and then declined to 10.3 Mtoe in 2012. The decline in energy demand was due to the economic downturn after the financial crisis that commenced in 2008. Since 2013, the TFC has picked up slightly to 10.9 Mtoe in 2016, as a result of higher energy consumption in the transport and industry sectors (Figure 2.6).

The transport sector is the largest energy consuming sector. It had a share of 37% in 2016, and road transport accounted for 97% of this consumption. The shares of the residential and industrial sectors each accounted for around a quarter of the TFC.

[4] TPES does not include bunker fuel for international aviation and international navigation.

As in TPES, oil is the largest energy source in Ireland's energy demand, at 57% of the TFC in 2016 (Figure 2.7). Most oil was consumed in the transport sector, but it accounted for a 38% share in the residential sector, which was the highest share among IEA member countries. Electricity was the second-largest source, at 21% of the TFC, followed by natural gas at 17%. Electricity and natural gas accounted for a considerable share in all sectors except transport. Coal accounted for 6% and peat for 7% in the residential sector, despite a declining trend.

Figure 2.6 TFC by sector, 1974-2016



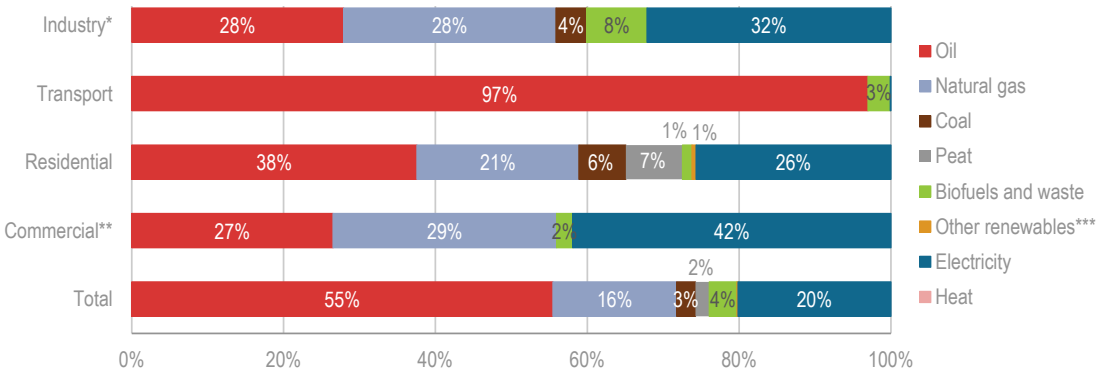
Total energy consumption has increased in recent years after a decline due to the financial crisis; the largest growth has been in the transport sector.

* *Industry* includes non-energy consumption.

** *Commercial* includes commercial and public services, agriculture and forestry.

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Figure 2.7 TFC by source and sector, 2016



Oil dominates Ireland's TFC, especially in the transport sector; electricity and natural gas account for considerable shares in all other sectors.

* *Industry* includes non-energy consumption.

** *Commercial* includes commercial and public services, agriculture and forestry.

*** Negligible share in the residential sector.

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Institutions

The **Department of Communications, Climate Action and Environment** (DCCAE) is the lead government department with responsibility for setting Ireland's overall energy, climate and environment policies. It replaced the former Department of Communications, Energy and Natural Resources (DCENR) in mid-2016, and continues to collaborate with relevant government departments and bodies under its aegis.

The **Sustainable Energy Authority of Ireland** (SEAI) advises the government on: policies related to the reduction of GHG emissions in the energy sector; promoting and administering programmes for renewable energy, energy efficiency and for the development and demonstration of new energy technologies; developing certification schemes for biomass, geothermal, heat pumps and solar systems; and producing Ireland's energy statistics. On a practical level, it works with local and regional authorities on policy implementation, such as on community energy schemes and liaison with local energy agencies.

The **Commission for Regulation of Utilities** (CRU) is Ireland's independent energy and water regulator. Originally established as the Commission for Energy Regulation in 1999, it changed its name to the CRU in 2017. Its mission is to regulate the gas and electricity markets, and gas, electrical and petroleum safety. The CRU does not regulate supplier prices. However, it is responsible for monitoring the Irish electricity and natural gas retail markets to ensure that competition continues to develop. Moreover, the CRU participates in regulation of the single electricity market (SEM) as part of the Single Electricity Market Committee (SEMC) (see below).

The **Electricity Supply Board Networks** (ESBN) is the state-owned electricity transmission asset owner responsible for the construction, operation and maintenance of all the electricity transmission and subtransmission networks in Ireland. It is also the distribution asset owner and the distribution system operator, and funds all investment in the distribution system in Ireland. The ESBN is a ring-fenced subsidiary of the Electricity Supply Board group.

EirGrid is the state-owned electricity transmission system operator (TSO) and market operator. It is responsible for planning and developing the transmission system, scheduling and dispatching generation, operating the electricity market and ensuring system stability. It also plans development of the transmission network.

The **SEMC** is the decision-making authority for all SEM matters. It aims to protect the interests of consumers of electricity by promoting competition among persons engaged in, or in commercial activities connected with, the sale or purchase of electricity through the SEM. Its membership comprises the CRU, the Utility Regulator in Northern Ireland and independent members.

The **National Oil Reserves Agency** (NORA) is a state body under the aegis of the Minister for Communications, Climate Action and Environment. The main functions of NORA are to maintain Ireland's 90 day strategic oil reserve, in line with the state's stockholding obligations to the European Union and the IEA, and to administer the Biofuels Obligation Scheme.

Policy framework

Ireland has revamped its energy policy framework since the last in-depth review (IDR), and several positive reforms have progressed. While the new policy framework maintains the three core objectives of sustainability, security of supply (SoS) and competitiveness, the overarching need for a transition to a low-carbon economy has taken priority. This is even more urgent in light of the strong economic recovery since 2014, the positive outlook on sustained future economic growth and significant changes in the structure of the economy. A low-carbon energy system will support Ireland's SoS concerns, given its limited indigenous hydrocarbon resources and its relative geographical isolation, which makes full integration into the larger European energy markets challenging.

The 2015 White Paper

Ireland has formally outlined its energy policy in the 2015 White Paper entitled "Ireland's Transition to a Low Carbon Energy Future 2015-2030" (DCENR, 2015). This sets the framework for the government's energy policy over the period 2015-30, taking into account climate change objectives and agreements, and the social, economic and employment priorities of Ireland. Central to the White Paper is a commitment to reduce GHG emissions in the energy sector by 80-95% relative to 1990 levels by 2050. The White Paper sets out a vision for a profound transformation of the Irish energy systems by:

- moving to lower emissions fuels and lower reliance on fossil fuels
- significantly increasing renewable generation
- achieving a step change in energy efficiency performance
- implementing smart and interconnected energy systems
- having strong regulatory structures and markets to underpin these changes
- repositioning energy consumers to play a more active role within the energy sector.

Project Ireland 2040

Project Ireland 2040 is the government's policy and planning framework for the social, economic and cultural development of Ireland. It includes a 20-year National Planning Framework (NPF), which lays out broad ambitions for Ireland, and a detailed capital investment plan for a ten-year period, the National Development Plan (NDP) 2018-27. The NDP seeks to address the deficits in Ireland's infrastructure following the economic crisis and sets out the critical infrastructure plan for the short to medium term. Almost one-fifth of the total expected expenditure of EUR 116 billion (euros) will be allocated to the "transition to a low-carbon and climate-resilient society", which is one of the priority areas of Project Ireland 2040.

Project Ireland sets out how to address the challenges of the expected 20% population growth from 2016 to 2040, the continuous urbanisation and the evolution of the ways in which Irish citizens will work and live in the future. A key feature of Project Ireland is alignment of spatial planning with investment decisions. The government plans that 75% of the future population growth will be outside of Dublin. This raises issues of connectivity; in terms of transport, digitally and for energy supply. The provision of the estimated 550 000 homes needed to accommodate the additional 1 million residents will

be a challenge for the support infrastructure. However, it also offers opportunities to increase the energy efficiency of the existing buildings stock, facilitate the shift to low-carbon heat and deploy new digital solutions for electricity consumers. These will have profound implications for the energy demand growth, sector planning and policy choices available for decarbonisation of the energy sector.

Ireland's long-term climate policy framework is set out in its first National Mitigation Plan, released in 2017. This lays the foundation for the transition of Ireland towards a low-carbon, climate-resilient and environmentally sustainable economy by 2050. It does not provide a complete roadmap to achieve the 2050 objective, but begins the process of the development of choices for medium to long-term mitigation for the next and future generations. The policy framework Our Sustainable Future supports the country's long-term national vision for environmental policy.

Ireland also regularly publishes a National Energy Efficiency Action Plan and a National Renewable Energy Action Plan, in line with the country's EU commitments. These plans are described in Chapter 6 ("Energy and climate") and Chapter 7 ("Energy efficiency and residential heating"). In addition, Ireland publishes other subsector-specific policy documents targeting the building and transport sectors. Many financing and support programmes with sometimes narrow eligibility criteria complement these policy documents.

The government submitted the first draft National Energy & Climate Plan (NECP) for the period 2021-30, to the European Commission in December 2018. The plan will include trajectories for national emissions, renewable energy and energy efficiency, alongside the measures required to achieve these trajectories.

Energy transition

The Irish energy system is undergoing a significant transformation. Reliance on fossil fuels in TPES has dropped by 5 percentage points since the last IDR, but remains high compared to other IEA members at 90%. Renewable energy has steadily increased, accounting for just over 10% of TPES in 2017, up from 4.6% in 2010 at the time of the last IDR.

However, the most visible change has taken place in the electricity sector where the share of renewable electricity of total generation nearly tripled in a decade, from 10% in 2007 to 29% in 2017. Wind generation accounted for almost one-quarter of the total generation. The all-island electricity network is already capable of accommodating up to 65% instantaneous penetration of wind, with the aim of reaching 75% by 2020, in anticipation of an increasing share of variable generation sources in future years (see the chapter on "Electricity and renewable electricity").

The new rules for the SEM across the island of Ireland became operational on 1 October 2018, bringing it in compliance with the EU target model for the electricity sector. The new market rules are expected to bring lower costs for consumers, improve the SoS and support further transition to a low-carbon electricity sector (see the chapter on "Electricity and renewable electricity").

Ireland is not on the trajectory needed to meet is 2020 target of sourcing 16% of its energy consumption from renewable energy sources. SEAI latest projections estimate that Ireland will reach 12.7-13.9% by 2020 (SEIA, 2018). Admittedly, that target was set

from a low base (the share of renewables was 3.2% in 2005), and the sharp economic downturn following the 2008 economic crisis was not conducive in achieving the target.

Ireland is also expected to miss, by a large margin, its target of a 20% reduction in GHG emissions in sectors that are not covered under the emissions trading system (ETS) in 2020 compared to 2005 levels, notably because of growth of the agriculture sector. The latest projections by Ireland's Environmental Protection Agency for 2020 show only a 0-1% reduction in non-ETS emissions.

The government is therefore shifting its attention to meeting its 2030 and 2050 targets while working to close the gap to the 2020 targets to the maximum possible extent. This would achieve the most advantageous starting point for the post-2020 period. The electricity sector will play a key role in decarbonisation of the energy sector and in meeting Ireland's climate targets.

Electricity sector

The Irish government recognises that decarbonisation of the power sector in line with its long-term goals to 2030 set out in the White Paper (DCENR, 2015) will proceed progressively. As a first step, peat and coal power generation will be phased out, and are likely to be replaced by gas and renewable electricity sources. Renewable electricity sources are eventually expected to account for the largest share of installed and generated electricity. However, the precise milestones towards the overall decarbonisation target set out in the White Paper have not yet been finalised.

Decarbonisation of heat is a key policy objective of the Irish government. The shift towards heat pumps will influence future electricity consumption. Policies to improve overall energy efficiency in the buildings sector and upgrading of the building fabric will partially mitigate the impact on electricity demand (see the focus area section on "Decarbonisation of heat"). The efforts to support the transition to electricity mobility, for individual and public transport, will also affect future electricity demand. A key policy concern is the expected strong growth of electricity consumption of data centres (see Box 2.2).

A rapidly falling share of renewable electricity in overall generation could be an unwelcome side effect of the shift towards an electrified energy sector and the expected fast increase in energy demand. This would also increase Ireland's future energy-related emissions. Ongoing strong government action to support sustainable electricity deployment will be critical to ensure that Ireland meets its 2030 renewable energy and emissions targets. It will be important to provide certainty to project developers about the availability of support programmes and avoid long gaps between the closing of old programmes and the rolling out of new programmes.

Successful transition will require a supportive infrastructure including a diversified generation fuel mix, investments in maintaining system stability and large-scale investments in new infrastructure. Ireland plans to invest EUR 21.8 billion over the next 10 years in energy efficiency, the deployment of electric vehicles (EVs), transforming domestic heating and exploiting the significant potential for marine energy – offshore wind and wave and tidal (once commercially viable).

Box 2.2 Ireland as a potential global host for data centres

A key driver for future electricity demand in Ireland will be the expected connection of data centres to the grid. A significant proportion of this extra load may materialise in the greater Dublin region. Data centres accounted for around 5% of total electricity consumption in 2016.

To estimate the impact of data centres on the future electricity demand in Ireland, EirGrid, the Irish TSO, developed several scenarios to forecast electricity demand. According to the latest forecast from EirGrid for the period 2018-27, up to 31% of electricity demand could originate from data centres and other large energy users by 2027. The demand for electricity in the other sectors (industrial, commercial and residential) is expected to remain stable for the next ten years.

Meeting the increased demand presents an opportunity to diversify the electricity generation portfolio and generate more electricity from more renewable sources. There are several options for the development of variable renewable sources. The electricity demand could be satisfied in part by co-generation* plants using landfill or biogas, or by using power generated from wind farms.

The potential installation of data centres in Ireland, specifically in the metropolitan Dublin area, could place pressure on the resilience of the electricity system.

The ongoing effort of the government to spread the installation of data centres across the country is challenging due to the connectivity requirements of these facilities (e.g. access to a fibre network and physical connection to telecom providers). Regional authorities are actively trying to meet these needs to make them more attractive as locations. For example, the project to develop fibre connectivity in Cork is a way to meet data centre requirements and encourage geographical spread of the facilities.

* *Co-generation* refers to the combined production of heat and power.

Sources: Host in Ireland/SEAI (2017), *Ireland's Data Hosting Industry 2017*, www.seai.ie/resources/Irelands-Data-Hosting-Industry-2017.pdf; EirGrid (2018), *All-Island Generation Capacity Statement 2018-2027*, www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_2018.pdf.

Like most countries, Ireland faces challenges ahead with planning for new infrastructure. It is expected that in the future, consistent with industry best practice guidelines (such as those already issued by the Irish Wind Energy Association), project developers will need to ensure projects will be of enduring economic benefit to the concerned communities, through the provision of a "community dividend". However, Ireland faces particular challenges with the planning procedures and also with connection of new generation assets to the grid. The CRU recently launched a new grid connection policy, which should help facilitate grid connection of renewable generation assets.

The White Paper recognises that it will be consumers who ultimately drive the transition by adopting lower-carbon options for transport and heating, investing in smart home technologies and generally choosing to use less energy. A comprehensive strategy to engage with consumers to facilitate their contribution to the energy transition will be important. Such a strategy must include options for customers to easily shift their transport modes, generate their own electricity, act as prosumers (individually or through community-led projects), and facilitate the creation of microgrids and access to smart metering.

Close engagement with local governments to ensure integration of energy issues into local area planning and proposing locally appropriate solutions is equally important. The IEA encourages the government to continue shortening and simplifying the planning permission consent process for energy infrastructure to provide greater clarity to all stakeholders.

Security of supply

Ireland has seen substantial improvement in its energy security of supply (SoS) since the last IDR. However, the decision of the United Kingdom to leave the European Union poses new challenges to Ireland, even if the full impact of the decision cannot yet be determined. Hence, this section presents the status quo of Ireland's SoS, outlines the potential impact of the exit of the United Kingdom from the European Union and describes possible actions Ireland could consider to prepare for all eventualities.

Oil

Oil remains the dominant energy source in Ireland, representing 46% of the country's TPES in 2017, which was the fourth-highest share among IEA countries. Oil is expected to remain the single largest fuel source in Ireland's TPES to 2035.

Ireland has no indigenous oil production and no oil pipelines with neighbouring countries. The country is entirely dependent on shipping for all crude and product imports. Crude oil is imported to Ireland's only refinery, which supplies about 44% of the total Irish product consumption, excluding aviation fuel. In 2017, the single largest share of crude imports at over 60% came from Norway and the second-largest share with 24% came from the United Kingdom.

The United Kingdom supplied 62% of all refined products in 2017. Approximately half of the product imports pass through Dublin Port. A disruption to Dublin Port could constitute a major risk to the country's oil supply, as the capacity of the remaining ports in Ireland is not sufficient to compensate for Dublin Port. However, when looking at the island of Ireland as a whole, the existing port facilities are sufficient to compensate for a possible disruption at Dublin Port. Ensuring continuous access to products imported through the ports of Northern Ireland is therefore of key importance in ensuring the SoS.

Ireland meets its stockholding obligation to the IEA through public stocks owned by NORA. Since April 2013, Ireland has fulfilled the IEA 90 day obligation mostly through physical stocks held by NORA. As of June 2018, Ireland held 109 days of net imports, of which 39% were stored abroad.

The vote of the United Kingdom to leave the European Union brings uncertainty to Ireland. The EU Oil Stocks Directive is more prescriptive than the IEA stockholding obligation for storage locations. EU member states can hold stocks in other EU member states only. Ireland holds 20% of its emergency stocks in the United Kingdom, with 9% located in Northern Ireland. It is unclear how the European Union will treat this following the exit of the United Kingdom from the European Union.

Ireland has been pursuing a policy of rebalancing its emergency oil reserves by maximising stocks stored in Ireland. NORA is proactively looking for additional storage capacities in Ireland by developing projects to refurbish storage locations. Work on a first additional facility will be completed sometime in 2019 and will add storage for 11 days of diesel or gasoil and 7 days of jet or kerosene. Work on the refurbishment of a second additional facility is in the planning phase. The IEA believes that this is a prudent plan of action and encourages early completion of the work.

Gas

Ireland ranked third among IEA countries in terms of reliance on gas for energy supply, with natural gas accounting for 31.5% of TPES in 2017 and for over 50% of electricity production. Ireland's self-sufficiency in gas supply reached 67% in 2017 due to production from the Corrib gas field. However, with production from Corrib expected to reduce sharply over the next decade, Ireland will need to secure new supply sources, either domestically or through imports. Gas imports from/through the United Kingdom could again become the dominant gas supply source as early as in 2019.

All of Ireland's gas imports come through two interconnectors via the Moffat entry point in Scotland (United Kingdom). Ireland does not have a liquefied natural gas (LNG) regasification terminal. Therefore, compensating for the domestic production decline will only be possible by increasing imports from/through the United Kingdom. The development of LNG import facilities would substantially improve gas supply security in Ireland by providing direct access to the global LNG market.

This is even more so the case as Ireland is not meeting the N-1 infrastructure standard[5] on a national basis due to the singular importance of the Moffat entry point. The N-1 target is only met when calculated on a regional basis through a joint risk approach where Ireland and the United Kingdom are treated as a single region. With the exit of the United Kingdom from the European Union, it will be crucial to maintain a strong regional collaboration for Ireland's gas SoS.

Ireland has had no gas storage facility in operation since 2017. EirGrid can instruct gas-fired power stations to switch to secondary fuel to prevent or respond to a gas emergency, in the case of a temporary gas supply shortage. Baseload gas-fired generators are required to have access to 5 days of secondary fuels, typically distillate oil, and mid-merit generating units are required to have access to 3 days of secondary fuel stocks.

Electricity

The SEM has been operating in Ireland and Northern Ireland as the single all-island wholesale electricity market since 2007. It covers the two jurisdictions with one set of rules and regulations, and greatly benefits both countries (see the chapter on "Electricity and renewable electricity"). The North–South interconnector is crucial for operating the SEM as one unconstrained system, but it is reaching its capacity limits. Construction of a second North–South interconnector will start in 2020. Ireland's other interconnector is also with the United Kingdom, linking Ireland with Wales, and through which electricity is also traded. Ireland has no direct electrical interconnections with the rest of Europe. There is a proposal for an interconnector with France, which is an EU project of common interest. An investment request was made by the project promotors, the Irish and French TSOs, to the Irish and French regulatory authorities in September 2018 (see the focus area section on "Interconnectors").

Ireland is a small net exporter of electricity to the United Kingdom. Electricity generation adequacy is currently higher in Ireland than in Northern Ireland. Hence, the continued close electricity co-operation is equally in the interest of Ireland and the United Kingdom.

[5] The standard N-1 evaluates a country's ability to satisfy total gas demand in case of a disruption of its single largest gas infrastructure on the day of exceptionally high gas demand.

Ireland's energy transition to a low-carbon energy sector and the expected strong demand growth might place stress on the resilience of the electricity system. It is important to carry out regular assessments of the power networks to ensure adequacy of the existing infrastructure to accommodate the growing demand in Ireland, to maintain the SoS.

The decision of the United Kingdom to leave the European Union poses challenges to Ireland's energy security. It is crucial for Ireland that stable and efficient energy trading takes place between the two countries, particularly for cross-border gas and electricity flows. Ireland should continue working to maintain the beneficial structures and efficiencies of the SEM. Ireland should also try to maintain the most-efficient form of interconnection to facilitate cross-border trading with the United Kingdom and EU member states.

Assessment

Ireland has experienced significant changes in the energy landscape since the last IDR in 2012. In particular, it has made notable progress towards decarbonisation of the electricity sector through the successful deployment of onshore wind. Ireland had the third-highest share of wind generation among IEA countries with almost 25% in 2017. More impressively, the Irish grid is already capable of accommodating up to 65% instantaneous penetration of wind. Hence, Ireland's reliance on fossil fuels has dropped from 95% in 2012, but remains high compared to other IEA member countries at 90%.

Ireland's energy system will need to undergo a fundamental transformation to achieve the country's energy and climate objectives. The Irish government set an ambitious 2050 target in its 2015 White Paper to reduce its GHG emissions by 80-95% below the 1990 level, with fossil fuels replaced by renewable energy.

After the last general election in 2016, responsibilities for climate action and environment were transferred from the DCENR to the newly formed DCCAE. This is a welcome development as it allows maximising synergies among closely related areas for the transition of the Irish economy and society.

Ireland has many policies and plans that are relevant for the energy sector and span different periods. Not all of these include detailed and time-bound action plans. This number of plans is time intensive to prepare and poses challenges in terms of maintaining overall consistency and monitoring progress. The draft NECP for the period 2021-30, published for public consultation in December 2018, will result in a simplified policy framework and allow for easier monitoring.

Having set the policy landscape and defined the expected outcomes, it is now opportune to shift attention to implementation and close monitoring of the progress made. A simple, consistent and transparent monitoring system will enable early corrective measures, if needed. There is potential benefit in simplifying the number of financial support programmes, for example in energy efficiency, to encourage greater uptake.

Ireland's GDP has increased significantly since the 2012 IDR, and the country now has the fastest-growing economy in the European Union. This has had an adverse effect on Ireland's emissions performance. Ireland is forecast to miss both its GHG emissions reduction target in the non-ETS sector and its renewable energy target for 2020. The

latest projections show that Ireland will likely achieve only a 1% reduction of its non-ETS emissions compared with a 20% reduction target for 2020 below the 2005 level. Ireland is forecast to reach 12.7-13.9% of energy consumption from renewable sources in 2020 compared with a 16% target, up from a base of 3.2% in 2005.

Ireland's population is expected to grow by 1 million by 2040, requiring 500 000 new homes. Coupled with electricity demand from economic growth and electrification of heat and transport, this makes continuous action to decouple energy usage and emissions from economic and population growth imperative. Ireland faces particular issues in meeting these challenges given its dispersed population and small and peripheral energy market.

In 2018, the government of Ireland published its NPF to 2040 to help ensure that anticipated population growth is managed in a sustainable manner. The framework is complemented by a plan for significant investment in renewable energy sources and future technologies, and the promotion of less-energy-intensive/low-carbon heating and transport solutions.

The Irish government, which is committed to diversifying the mix of renewable electricity generation technologies, is developing a new support programme for renewable electricity. This is a welcome and urgent development as the previous support programme closed for new applications in 2015, and the lack of a successor has caused some uncertainty among renewable energy developers. However, energy system transformation must not only occur on the supply side, but it must be complemented by changes on the demand side through increased energy efficiency and investment in future demand-side technologies.

A successful transformation of the energy system requires close and sustained engagement with customers to ensure they are aware and supportive of the ongoing change, and benefit to the maximum extent. The Irish government is keen to ensure that consumers drive the required energy transition including by choosing to use less energy and adopting lower-carbon transport and heating. Incentives to use EVs and to decarbonise heating have been introduced, alongside a planned roll-out of smart meters. Engagement with consumers, including support for those in fuel poverty, will play an important role in meeting Ireland's energy objectives.

Planning consent remains a significant obstacle to the deployment of the generation and network infrastructure required to meet Ireland's renewable energy ambitions. This was also mentioned in the 2012 IDR. Delays in energy infrastructure projects make them costlier and can also affect the wider energy system and weaken the SoS. More-effective cross-departmental and cross-agency co-operation and collaboration on agreed policy objectives and early engagement by developers with affected communities and other stakeholders should reduce delays in building critical infrastructure.

Ireland has made impressive progress with the SoS since the last IDR through the sharp increase in domestic gas production, the implementation of new rules for the SEM since 1 October 2018 and better interconnection. Ireland now faces new challenges related to the decision of the United Kingdom to leave the European Union. The gas and electricity regulatory framework of the United Kingdom might diverge from EU regulations, which will continue to be applicable in Ireland. Efficient trading must be maintained on the interconnectors. Ireland is proactively developing additional storage in Ireland in compliance with the EU oil directive with regard to the EU oil stockholding obligation.

Recommendations

The government of Ireland should:

- Provide continuity and longer-term certainty in its energy policies to avoid, or minimise, hiatuses that could damage confidence and deter the necessary investment to achieve its clean energy objectives.
- Prioritise improving the transparency of, and accountability for, meeting its emissions reduction targets. This includes publishing the draft NECP, setting trajectories towards energy targets and the contribution of those targets to meeting Ireland's emissions reduction targets under the EU Effort Sharing Regulation, and specifying the means for achieving them.
- Strengthen engagement with consumers to support the energy transition including through communication, close monitoring of programmes to ensure they are meeting their objectives and promoting community involvement in local energy projects.
- Improve the efficiency of the planning consent regime to ensure that decisions are taken on time and with due regard to avoiding or mitigating environmental and other effects.

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3. Oil

Key data

(2017)

Crude oil production: nil since 1973

Net imports of crude oil: 2.9 Mt* (3.2 Mt imported, 0.3 Mt exported), -15% since 2007

Oil products production: 3.2 Mt

Net imports of oil products: 4.1 Mt* (6.0 Mt imported, 1.9 Mt exported), -18% since 2007

Share of oil: 45.7% of TPES and 0.5% electricity generation, -12% and -97% since 2007

Consumption by sector (2016): 6.5 Mtoe** (transport 61.8%, residential 15.7%, industry 12.0%, commercial 6.5%, other energy 2.9%, heat and power generation 1.1%)

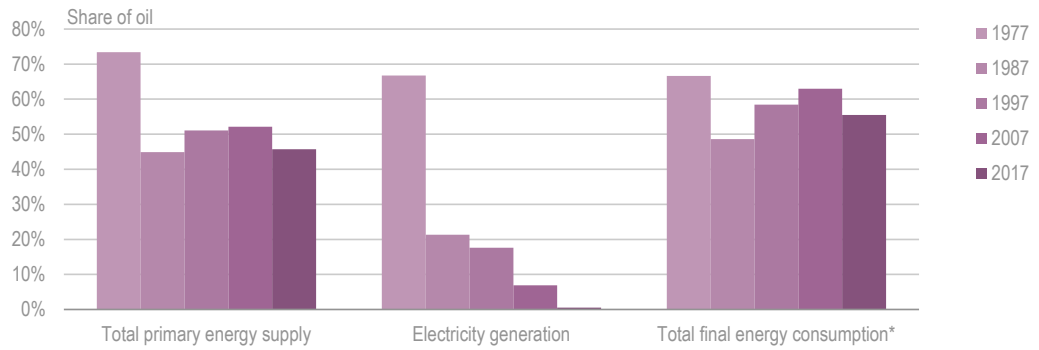
* Supply data are presented in volumes (Mt).

** Demand data are presented in energy units (Mtoe) to be comparable over different fuels and sectors.

Overview

Oil remains the most important source in Ireland's energy system despite its declining shares in supply and demand (Figure 3.1). Ireland ranked fourth highest in the share of oil in total primary energy supply (TPES) among International Energy Agency (IEA) member countries in 2017.

Figure 3.1 Share of oil in Ireland's energy system, 1977-2017



The share of oil has decreased in the past decade, especially in electricity generation, but oil remains the largest energy source in Ireland's energy mix.

* The latest data available for total final energy consumption are for 2016.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

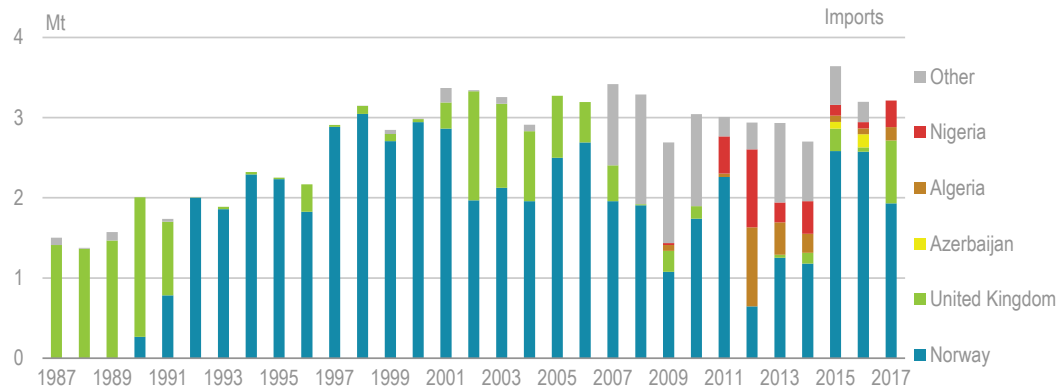
With no domestic production of oil, Ireland depends solely on imports. Security of oil supply is therefore a key priority for the government. There has been notable progress in diversifying the oil import sources while reducing the demand. Oil consumption in power generation has virtually been phased out in recent years. However, with the domestic economy recovering fast from the financial crisis in 2008, total oil demand has been on the rise since 2014, mainly driven by transport and industry. Oil is expected to maintain its dominance in Ireland's energy mix up to 2035, to fuel the country's economic development.

Supply and demand

Production, import and export

Oil accounted for 45.7% of TPES in 2017, which was the largest share. There was no domestic crude oil production in the country, and 3.2 million tonnes (Mt) of crude oil were imported in 2017. Over the last few decades, Ireland has exported a small volume of associated gas liquids, usually under 0.1 Mt. However, export increased to 0.3 million tonnes (Mt) in 2017, most of which headed to the United Kingdom.

Figure 3.2 Crude oil imports per country, 1987-2017



Ireland is entirely dependent on crude oil imports, mainly from Norway.

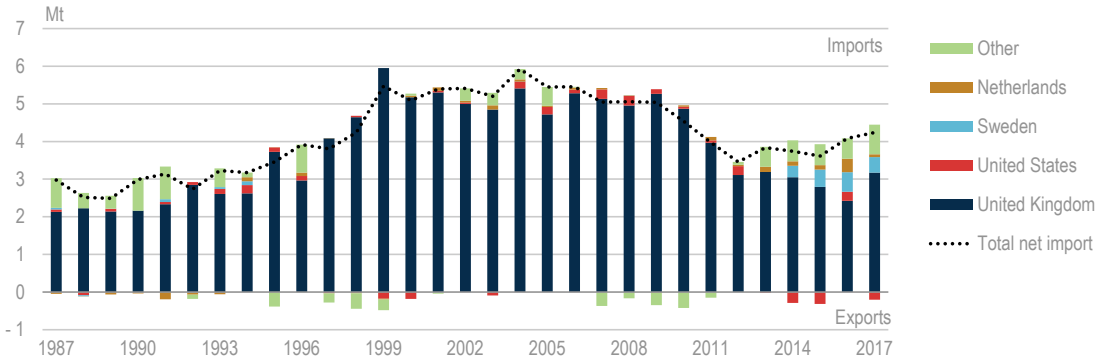
Source: IEA (2018b), *Oil Information 2018*, www.iea.org/statistics/.

In 2017, 61% of the total crude oil imports came from Norway, with the rest sourced from the United Kingdom (24%), Nigeria (10%) and Algeria (5%) (Figure 3.2). Over the last decade, Ireland's import sources have greatly diversified and expanded, from the North Sea to as far as North and West Africa. However, deliveries from the new import countries show strong annual fluctuations, and the supplies from the United Kingdom and Norway remain dominant. The share of Norwegian oil dropped by 25% in 2016-17, which was covered by deliveries from the United Kingdom. The crude oil supplies flow into the Whitegate refinery – the only Irish refinery – located in the county of Cork with a capacity of 75 thousand barrels per day (kb/d). Ireland's refining output was 65 kb/d in 2017, covering about 40% of the domestic oil demand, and the rest was covered with imports of refined products.

Ireland is also a net importer of oil products. Ireland's net import of oil products was 4.1 Mt in 2017 (Figure 3.3). The total volume of oil product imports was 6.0 Mt, of which 62% came from the United Kingdom and the rest from Sweden and the Russian Federation (7% each), the United States (6%) and the Netherlands (4%); minor shares from countries like France and Norway accounted for the remaining 14%. Increasing shares of oil products were delivered from Sweden and the Netherlands, while trade with the United States fluctuated visibly. This is because Ireland also exports oil products, mainly residual fuel oil, to the United States.

Ireland exported 1.9 Mt of oil products in 2017. Most went to the United Kingdom (32%) and the United States (30%), followed by Norway (12%), the Netherlands (11%), Canada (7%), France (5%) and some minor shares to African countries (3%). Ireland has a positive balance of 0.2 Mt of net export to the United States. Ireland mostly imports middle distillates and exports residual fuel oil.

Figure 3.3 Net imports and exports of oil products per country, 1987-2017



The United Kingdom accounts for most of Ireland's oil product imports, but Ireland's trade relations have greatly diversified in recent years.

Source: IEA (2018b), *Oil Information 2018*, www.iea.org/statistics/.

Oil and gas exploration and production

The Irish offshore is extensive at over 880 000 square kilometres (km^2), but it is also relatively underexplored. There have been several oil discoveries in the Irish offshore, but no commercial discoveries. Ireland competes with other jurisdictions for exploration investment.

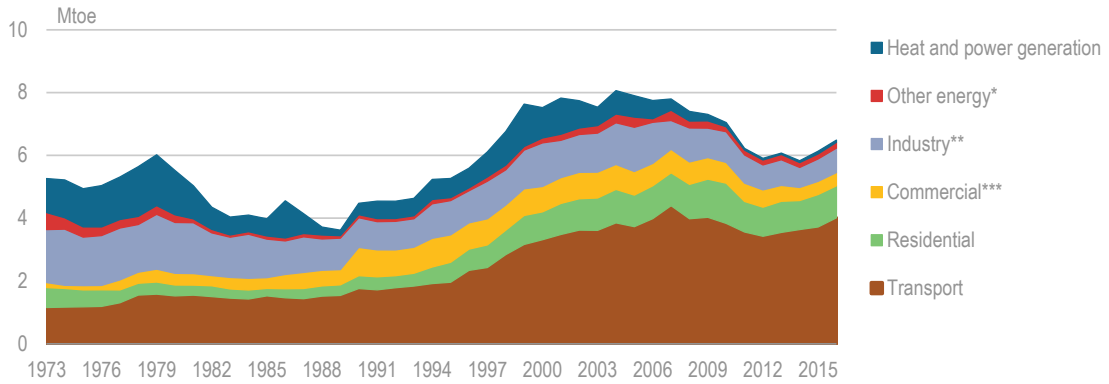
The government of Ireland encourages investment in exploration and production through measures such as deepening knowledge of Ireland's oil and gas potential. This is done through data acquisition and supporting key research projects, making sure that the regulatory regime is fit for purpose, and offering attractive and innovative licensing opportunities such as the Atlantic Margin Licensing Round, which was launched in June 2014. The number of applications received in this round was the largest received for any licensing round held in the Irish offshore. There is a strong industry interest in exploring the Irish offshore. Evaluation of applications received under the round resulted in the award of 28 new licensing options.

Oil consumption

Ireland's total oil consumption was 6.5 million tonnes of oil equivalent (Mtoe) in 2016, 20% below its historical high in 2004 (Figure 3.4). In the aftermath of the financial crisis, the total oil demand declined until 2014, when it started to pick up again, with growing demand from transport and industry. In contrast, oil consumption for heat and power generation dropped by 88% over the last decade, being increasingly replaced by renewable energy sources.

The transport sector is the largest oil-consuming sector, accounting for 62% of the total oil consumption in 2016, followed by the residential (16%), industry (12%), commercial (6%), other energy (3%) and heat and power generation (1%) sectors.

Figure 3.4 Oil consumption by sector, 1973-2016



Oil consumption has decreased since its historical peak in 2004, but has shown strong recovery in recent years.

* *Other energy* includes consumption in refineries.

** *Industry* includes non-energy consumption.

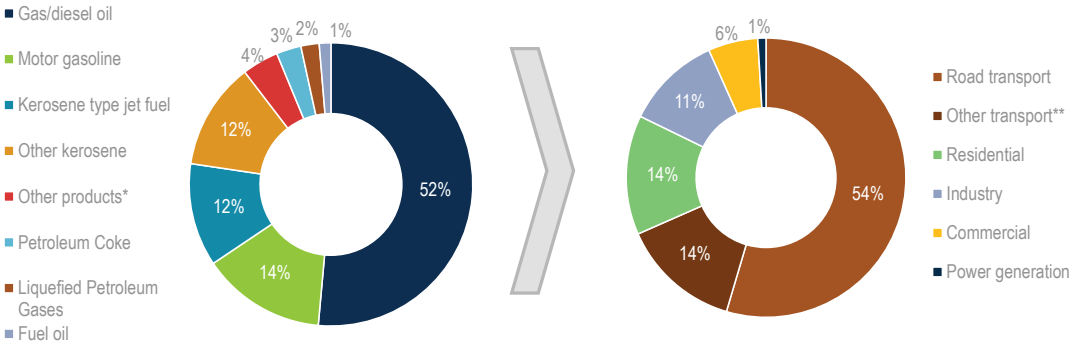
*** *Commercial* includes commercial and public services, agriculture, forestry and fishing.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

For oil consumption by fuel type, diesel is the dominant product for road transport (Figure 3.5). It has a wide spectrum of demand from private vehicles to road freight, rail and domestic navigation. Gasoline has been used for road transport, mainly private cars and taxis, and has been declining. Diesel consumption has continuously increased, even during the economic crisis. The growth rate of diesel was faster than that of gasoline, and diesel represented 60% of the total market share in 2016. This fuel switching from gasoline to diesel is attributable to the vehicle registration tax and motor tax programmes introduced in 2008.

Jet kerosene is utilised for aviation (mainly international), while other kerosene products are widely used for industry and residential sectors. The residential sector is the second-largest oil-consuming sector, and consumes gas oil and predominantly kerosene for household heating. As district heating (DH) is not widely adopted in Ireland, individual heating from kerosene with oil-fired boilers is still dominant, particularly for residents outside urban centres. Industrial oil consumption consists of liquefied petroleum gas and petroleum coke, while the commercial sector mostly uses gas oil.

Figure 3.5 Oil supply by product and consumption by sector, 2016



Most of the oil supply is used for transport, particularly road transport.

* *Other products* includes bitumen, lubricants, paraffin waxes and white spirit.

** *Other transport* includes international and domestic aviation, rail and domestic navigation.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Ireland's oil demand averaged 154 kb/d in 2017 and is expected to continue growing up to 2035. Given its dominant share, transport oil consumption will be a key element. As the country has a dispersed population with a high level of vehicle use, reducing the absolute volume of oil for transport remains a significant challenge. Oil is expected to remain the dominant fuel for transport up to 2020 and beyond. In the mid to long term, the Irish government plans to promote biofuels as an alternative, to accelerate the country's transition to low-carbon energy.

Biofuels

Biofuels and waste accounted for 3% of the total energy consumption in transport in 2016. This is a significant improvement from a decade ago when biofuel consumption was almost non-existent. Under the Biofuels Obligation Scheme (BOS), road transport fuel suppliers and large consumers are obliged to have a specific percentage of their fuels produced from renewable sources. In 2018, the biofuel target was 8% (by volume), which meant that 8% (by volume) of the motor fuels, typically diesel and petrol, placed on the Irish market had to be produced from renewable sources (e.g. ethanol and biodiesel). Obligated parties must pay a levy of EUR 0.02 (euros) per litre on their biofuel disposals to receive one BOS certificate from the National Oil Reserves Agency (NORA). If biofuel is produced from wastes and residues, two BOS certificates per litre may be granted.

The obligation can be met by either meeting the biofuel target or purchasing BOS certificates from other certificate holders. Ten companies, including Irving Oil Whitegate Refinery Ltd, were identified in 2017 as obligated parties of the BOS, and four biofuel producers/suppliers received BOS accounts (NORA, 2018). If the obligation is not met, the company is liable to pay a buy-out charge, which is set at EUR 0.45 per litre.

Biofuels have displaced up to 6% of the gasoline and diesel consumption since operation of the BOS in 2010 (DCCAE, 2017). The total amount of biofuels disposed in the market was 226 million litres in 2017, a 30% increase from 2016 (Table 3.1). The BOS obligation increased to 10% with effect of 1 January 2019 and to 11% in 2020. Enactment in legislation for the second increase is expected in early 2019.

Table 3.1 Record of the BOS, 2017 (million litres)

Total disposal of petroleum-based road transport fuel	**4 439**
Of which diesel	3 293
Of which gasoline	1 146
Total disposal of biofuel for road transport	**226**
Of which biodiesel	167
Of which bioethanol	58

Source: NORA (2018), *The Biofuels Obligation Scheme Annual Report 2017*, www.nora.ie/_fileupload/457-18X0074%20-%20BOS%20Annual%20Report%20for%202017.pdf.

As Ireland consumes more diesel than gasoline, biodiesel will continue to dominate the biofuel market in the coming years. Biodiesel sales accounted for 74% of the total biofuel sales in 2017, with the remaining 26% from bioethanol.

A key issue for biofuels in Ireland is the country's high dependency on imports. There is no domestic production of biogas and only a small amount of production of biodiesel, mostly from recycled cooking oil. In 2016, when the BOS target was met with 174 million litres of biofuels, only 30 million litres were domestically produced. It is expected that there will be more opportunities in Ireland to develop commercial production of biofuels as the obligation rate increases. The biofuels obligation has been met each year since its introduction. Import dependency remained high at 81% in 2017. The country's largest biofuel blending facility is the Whitegate refinery (see the section on "Refining" below).

Oil heating

The residential sector consumes gas oil and predominantly kerosene for household heating. Two-fifths of Irish households depend on individual oil-fired boilers, especially in rural areas. The government recognises the importance of decarbonising residential heating as a vital component to the energy transition and is implementing several projects to promote low-carbon transition in the heating sector. This includes district heating in two new districts in Dublin, encouraging the replacement of oil-fired boilers with electric heat pumps and the planned provision of solar rooftops for at least 170 000 homes.

Market structure

The Irish government promotes market flexibility and competition as a means to ensure security of supply (SoS). Ireland's downstream industry is fully privatised and deregulated. The Irish market has seen the exit of international oil companies and the entry of new medium-sized players since the last IEA in-depth review in 2012. Irving Oil has acquired the Whitegate refinery from Phillips 66, and Vermilion is now the operator of the Corrib gas field after taking over from Shell.

There are six large companies in the oil wholesale market: Circle K, Maxol, Inver, Top Oil, Valero and LCC. LCC imports into Northern Ireland; Total imports aviation fuels and provides most of the demand for airports.

There are eight large companies in the oil retail sector: Circle K (formerly Topaz), Applegreen, Maxol, Emo, Inver, Top Oil, Tesco and Valero, which run about 1 800 retail stations in Ireland. Circle K is the dominant player, which together with the next big

players Applegreen and Maxol, take two-thirds of the Irish retail sector. According to the Irish Petroleum Industry Association 25% of filling stations are company owned. The rest are franchised or run by independent operators. Another noteworthy trend is the tendency towards unmanned filling stations.

Topaz proposed an acquisition of Esso Ireland in late 2014. The Competition and Consumer Protection Commission (CCPC) raised concerns over an excessive concentration of the Dublin fuel market and its retail service. Topaz committed to divest 50% of Esso Ireland's assets in Dublin Port fuel terminal and three retail stations. The CCPC agreed that such measures were sufficient to address competition concerns and approved the proposed acquisition, which allowed expansion of the Topaz network in Ireland.

The Canadian company Irving Oil, the incumbent owner of Whitegate refinery, signed an agreement in August 2018 to acquire an Irish energy marketing and distribution organisation, Tedcastle, which operates under the name Top Oil. The acquisition will allow Irving Oil to expand its business across the Atlantic basin, as the company is not yet present as a retailer in the wholesale market for oil products. CCPC cleared the acquisition in January 2019.

Prices and taxes

There is no direct regulation of oil product prices, but the government sets basic policy frameworks to ensure price competition and consumer protection. Ireland's domestic oil product prices are determined by various factors including market fundamentals, exchange rate (EUR/USD [United States dollars]) and refining capacity. The levies and taxes applied on petroleum products make up about 60% of the retail price.

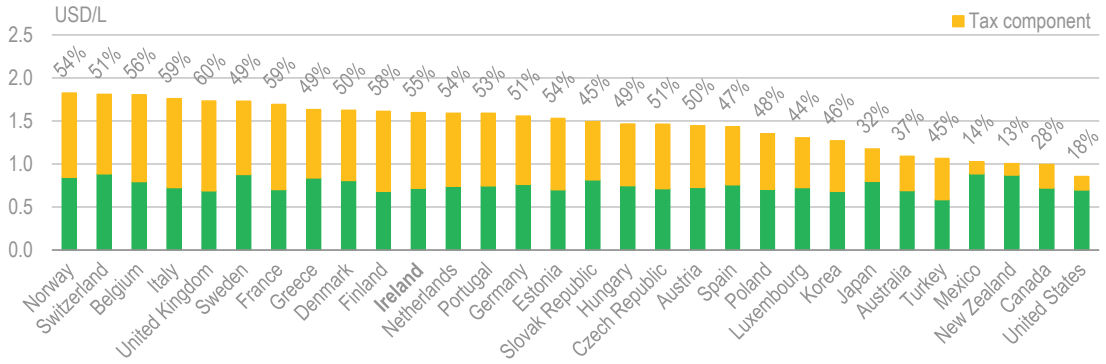
The tax receipts associated with motor fuel consumption are an important revenue source for the government. EUR 2.9 billion of excise duties (mineral oil tax), value-added tax and carbon tax on oil, which together consist of the total tax on the fuel, were paid to the Exchequer in 2016 (IGEES, 2017). The revenue from taxes on diesel has recovered from the financial crisis and continues to grow quickly, indicating an increased transport demand overall and a notable fuel switching from gasoline to diesel.

Since their peak in 2012 (diesel: USD 2.03 per litre; gasoline: USD 2.15 per litre), domestic oil product prices have continued to decline, driven by market factors. However, the combined tax and duty receipts from oil remained stable at just under EUR 3 billion per annum. From 2017, oil product prices started to pick up, and in the third quarter of 2018, the price for automotive diesel in Ireland was USD 1.6 per litre, the eleventh-highest among IEA member countries (Figure 3.6).

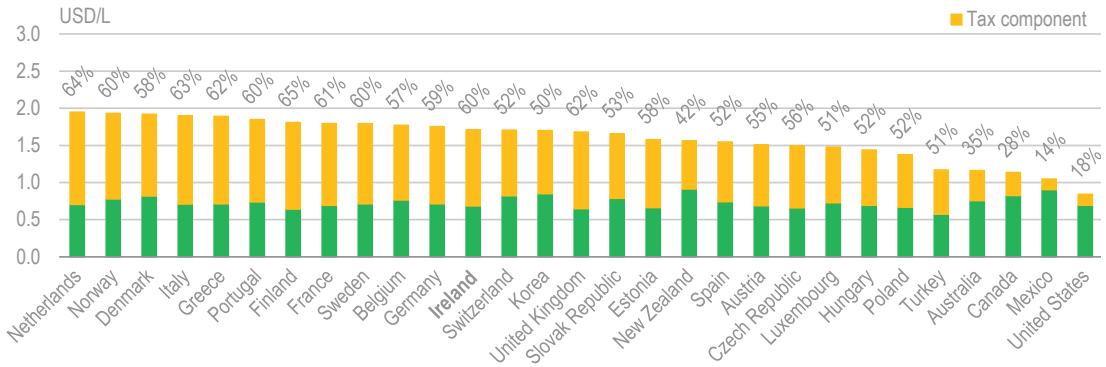
Taxes accounted for 55% of the total automotive diesel price. The gasoline price was slightly higher than diesel at USD 1.7 per litre, of which 60% was taxes, ranking the twelfth-highest gasoline price in the IEA comparison. Ireland stood relatively low, the seventh lowest, in the IEA ranking for light fuel oil price. The light fuel oil price was USD 0.87 per litre, consisting of 28% tax components.

Figure 3.6 Oil fuel prices in IEA countries, third quarter 2018

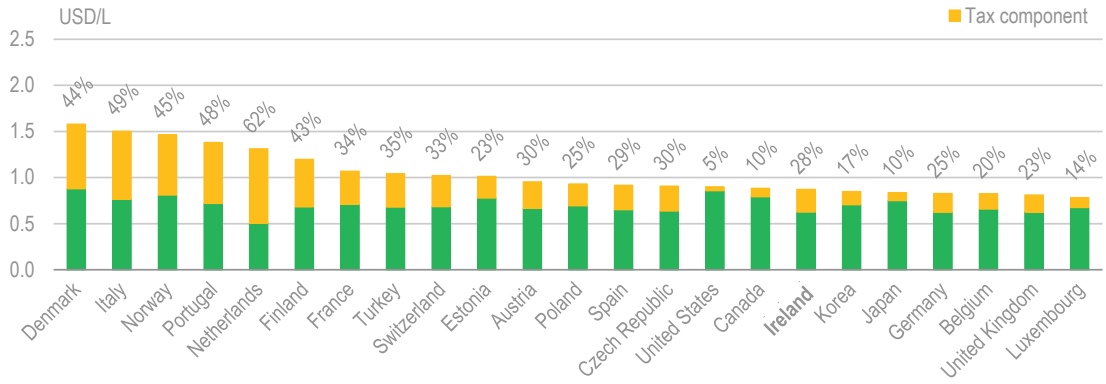
Automotive diesel fuel



Premium unleaded gasoline (95 RON)



Light fuel oil



Ireland's oil prices are close to the median among IEA countries, despite relatively high tax shares.

Notes: Data unavailable for gasoline in Japan, and light fuel oil in Australia, Greece, Hungary, Mexico, New Zealand, Slovak Republic and Sweden. L = litre; RON = research octane number.

Source: IEA (2018c), *Energy Prices and Taxes 2018, Quarter 3*, www.iea.org/statistics/.

Fiscal incentives for oil and gas exploration and production

There are several fiscal incentives for investment in oil and gas exploration and production. The following three principal incentives are in place:

- **A competitive corporation tax rate of 25%** applied to all profits a company may have from producing fields in Ireland. A field-based **petroleum production tax** (PPT) was introduced in 2015 in respect of petroleum authorisations issued from June 2014. This is linked to profitability of discoveries with a minimum PPT of 5% of revenues as soon as a field goes into production. PPT payments are deductible when calculating corporation tax, resulting in a maximum marginal rate of 55%.
- **A complete write-off of the capital cost** from exploration and development. If an exploration is unsuccessful, the costs can be written off against profits from future successful explorations.
- **Low level of exploration licence application and rental fees.** The rental fee for a licensing option is EUR 29 per annum, per km^2, and the application fee for a licensing option is EUR 1 520.

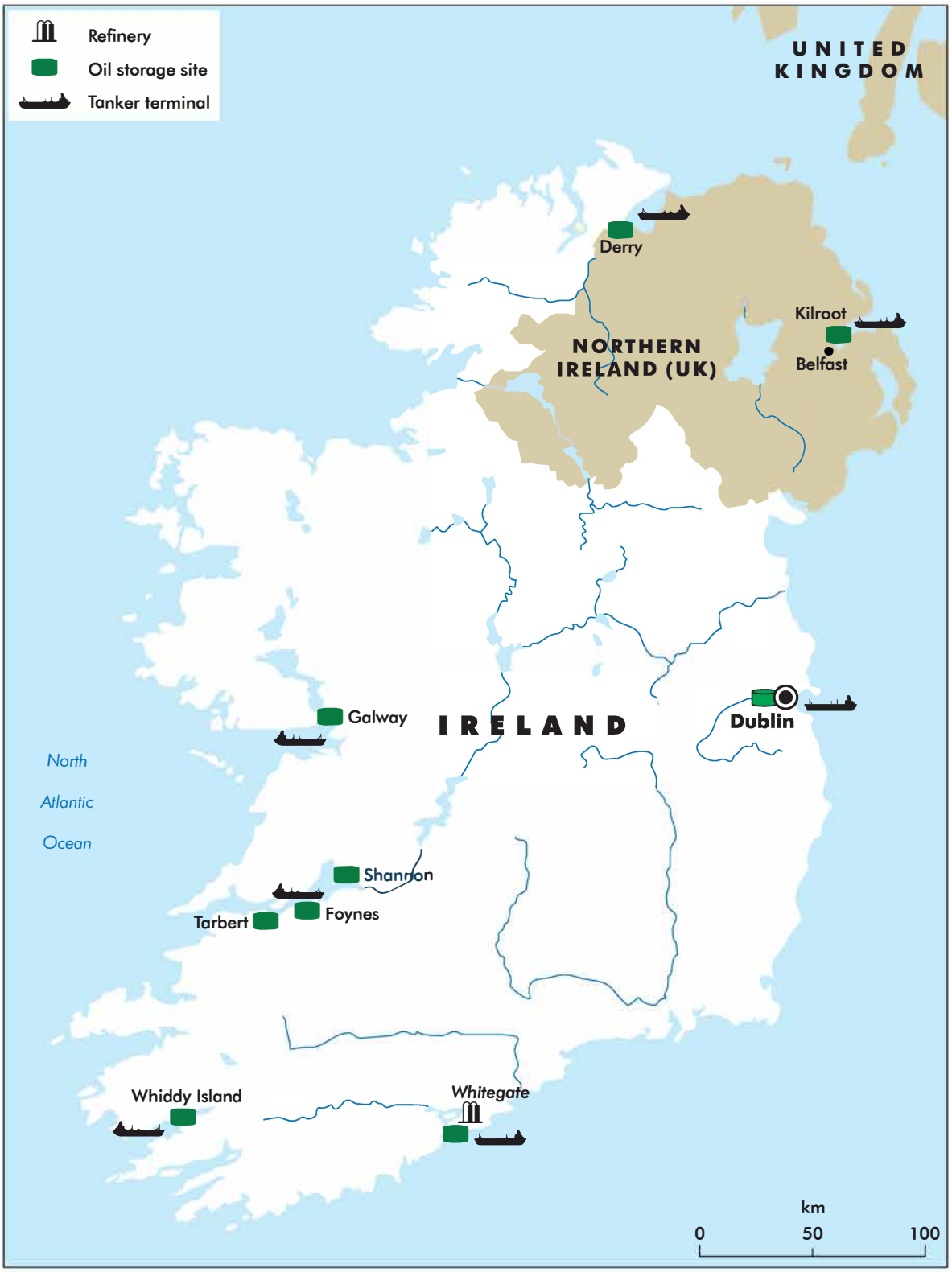
Infrastructure

Refining

The Whitegate refinery is Ireland's only operating refinery with a distillation capacity of 75 kb/d (Figure 3.7). It was commissioned in 1959. The Irish National Petroleum Company sold the refinery to Tosco Corporation in 2001, which was acquired by ConocoPhillips. Phillips 66 took over operation of the refinery in 2012, when ConocoPhillips split its downstream operation into refining and marketing. It then sold the refinery to the Canadian company Irving Oil in September 2016.

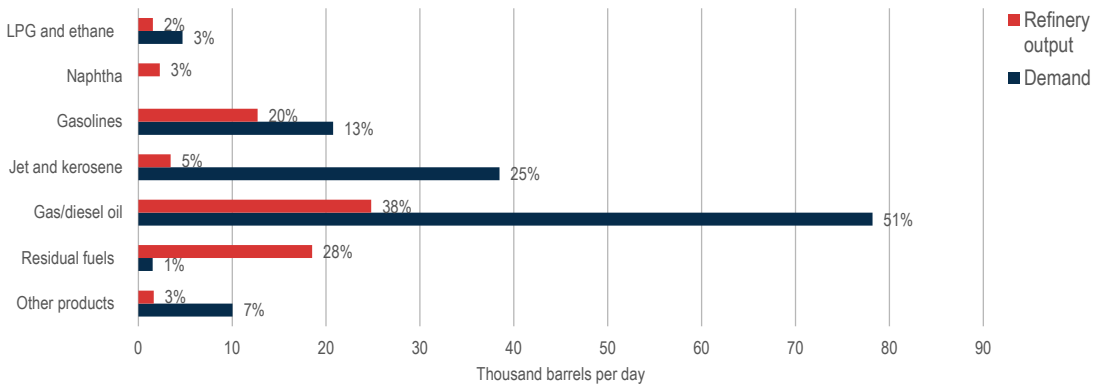
In 2012, the average production was 56 kb/d. Production output increased to around 70 kb/d in 2017 since Irving Oil took ownership (Figure 3.8). The demand for gasoline halved from 2007 to 2017, while the demand for diesel fuel increased by 10%. Except for naphtha and residual fuel oil, refining outputs for gas/diesel oil, jet and kerosene, gasoline and liquefied petroleum gas fell short of total domestic demand, with gas/diesel oil showing the largest gap. Only residual fuel oil had a significant surplus output, which was mostly exported to the United States; its supply was 18.5 kb/d, well above its daily demand of 2 kb.

Figure 3.7 Ireland's oil infrastructure, 2018



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Figure 3.8 Refinery gross output and demand by products, 2017



Ireland depends on imports for diesel and kerosene, but is a net exporter of fuel oil.

Source: IEA (2018b), *Oil Information 2018*, www.iea.org/statistics/.

To meet the increasing demands for diesel and light oil products, Irving Oil approved an investment programme to enhance production capacity in January 2018. It is due to be completed in the first quarter of 2020. Biofuel production has already been built up over the last few years at the Whitegate refinery, and Irving Oil has expressed a strong commitment to remain a leader of liquid biofuel research and development in Ireland.

Ports and road network

Ireland is entirely dependent on shipping for all oil imports. The four ports in Ireland with oil terminals that accept oil product imports for commercial distribution are: Dublin, Whitegate, Foynes and Galway (Table 3.2). Dublin Port supplies approximately half of the petroleum products coming into the Irish market.

A potential disruption to Dublin Port would cause a risk to the country's oil supply, as the capacity of the three remaining ports to increase their throughputs is not sufficient to provide an alternative route for supply. However, a major supply disruption may be avoided if the two ports in Northern Ireland (Belfast and Derry) could be mobilised. Belfast could make a significant contribution as it typically operates at about half its maximum oil transit capacity.

Table 3.2 Capacity of main ports on the island of Ireland

	Dublin (Ireland)	Whitegate (Ireland)	Foynes (Ireland)	Galway (Ireland)	Derry (Northern Ireland)	Belfast (Northern Ireland)
Maximum throughput capacity per week (kilotonnes [kt] of refined products)	101 040	45 500	26 300	17 085	36 400	89 200

Note: Expressed in kilotonnes of refined products: gasoline, kerosene and diesel/gas oil.
Source: Purvin & Gertz Inc. and Byrne O'Cleirigh (2012), *Study of the Strategic Case for Oil Refining Requirements on the Island of Ireland*, www.dccae.gov.ie/en-ie/energy/publications/Documents/9/StrategicCaseforOilRefiningIrelandRedactedfin.pdf.

Ireland's inland distribution is dependent on road transport because there is no oil pipeline infrastructure. This improved significantly with the development of the motorway network between 2000 and 2010. There are around 900 vehicles involved in oil products delivery. Big importer companies (predominantly Reynolds Logistics Ltd) operate a fleet of trucks under licence to deliver products from oil terminals to retail stations and to supply independent oil companies operating in the heating sector.

Storage

Ireland's total storage capacity was 16 million barrels in 2017, of which 15% was for crude oil storage. Ireland's major storage facilities are located in Bantry on Whiddy Island, which accounts for almost half of the country's total storage capacity, and the Whitegate refinery in Cork. NORA ensures that there are sufficient stocks to meet the stockholding obligation. It fulfils this duty through storage contracts in port terminals including Bantry, Dublin, Foynes, Galway and Whitegate (Table 3.3). Of the five main storage facilities, only Bantry and Whitegate hold crude and refined oil products. There are also storage facilities in Derry and Kilroot (near Belfast) in Northern Ireland, with whom NORA has storage contracts.

Table 3.3 Storage capacity of main ports on the island of Ireland

	Dublin	Whitegate	Foynes	Galway	Bantry
Storage capacity (kt)	200	530	80	80	1 030

Source: Ireland country submission, 2018.

NORA rents and uses about half of the facilities on Whiddy Island. It is continuing its 20 year long-term plan to build storage capacity in Ireland (see the section on "Oil emergency reserves" below).

An average filling station has a retail storage capacity of up to 3 days of normal business, which is an average capacity of around 25 000 litres of storage per station.

Emergency response policy

The Fuels Control of Supplies Acts of 1971 and 1982 provide the framework around Ireland's oil security and response to an oil supply emergency. Under the 1971 act, the Minister of Communications, Climate Action and Environment is empowered to make orders to regulate the acquisition, distribution, supply and marketing of fuels for the maintenance and provision of supply. The 1982 act specifies the main petroleum products supplied to the Irish market.

NORA was established as a non-commercial state body under the National Oil Reserves Agency Act of 2007. It has responsibility for the management of Ireland's obligations under the IEA and European Union (EU) stockholding obligation, to hold 90 days of net imports as a contingency against interruption of oil supply.

The operational decision-making structure and process for the day-to-day management of the stocks form a core part of NORA's day-to-day activities. NORA activities are funded by a levy imposed on oil products. Marine bunker oils and aviation fuels are exempt from the levy as required under international obligations. The levy is

EUR 0.02 per litre on oil products. Major oil consumers that hold 55 days of their previous year's consumption throughout the year (referred to as "55 day consumers") may apply for an exemption from the levy.

The Department of Communications, Climate Action and Environment (DCCAE) will liaise with NORA and the oil industry if there is an oil supply disruption. A recommendation is made to the Minister for Communications, Climate Action and Environment by departmental officials when a stock release is warranted. The minister informs cabinet colleagues of the decision and instructs NORA to release stocks, specifying the product categories, volumes and location from which the stocks have to be released.

The procedures for dealing with an oil emergency are outlined in the oil emergency handbook, updated in April 2018. If there is a domestic disruption requiring stock drawdown, the department will inform the IEA of its actions and make arrangements with NORA, including a time frame for the replenishment of stocks. In the case of IEA collective action, stocks would be released in accordance with agreed procedures. NORA maintains a stock drawdown plan. It also has memoranda of agreement with five shipping companies, which considerably strengthen the agency's ability to ship products from storage locations within Ireland and abroad, to where needed if there is a shortage of supply.

Oil emergency reserves

Ireland meets its stockholding obligation to the IEA through a combination of public stocks owned by NORA, in Ireland and other IEA member countries, and commercial stocks held by Irish industry. Since April 2013, the 90 day obligation has been fulfilled mostly by stocks held by NORA. Ireland has been pursuing a policy of rebalancing its emergency oil reserves by maximising stocks stored on the island of Ireland, composed of stocks held in Ireland and Northern Ireland.

Ireland held 109 days of net imports as of June 2018. Public stocks accounted for 91 days of net imports, including stock tickets for 2 days covering stock refreshment, and the remaining 18 days were covered by industry stocks.

The entire stock obligation is met with physical products. Approximately 59% of the stocks held by NORA are in storage located in Ireland, and 41% are stored abroad. Most are held in the United Kingdom (20%), and the rest in Denmark, Spain and Sweden (see Table 3.4).

Table 3.4 NORA storage locations

Location	Stocks (tonnes)	Share (%)
Ireland	1 000 993	59
United Kingdom (of which Northern Ireland)	343 740 (145 302)	20 (9)
Denmark, Spain and Sweden	354 629	21
Total NORA stocks	1 695 596	100

Source: Ireland country submission 2018.

The DCCAE informs NORA every March of the stocks volume required for the upcoming year based on the IEA calculation.

Storage services for NORA are predominantly procured through third parties on a competitive basis. The biggest storage facility (Bantry on Whiddy Island) has a total storage capacity of 1 030 kt (7.6 million barrels), which can be used for storing all three categories of products (gasoline, distillates and fuel oil) and crude oil. Stocks stored by companies on behalf of NORA are held in oil storage tanks near the principal ports: Dublin, Whitegate (Cork), Foynes and Galway in Ireland, and Derry and Kilroot (near Belfast) in Northern Ireland.

At present, some 20 days of stocks are held in primary storage facilities that provide direct access to the market by road tanker trucks. NORA ensures the availability of stocks held in secondary storage facilities (oil terminals with jetties from which oil may be transported by ship to primary storage) through contracts with shipping companies. All the NORA storage facilities can load products onto vessels for export. If there is a domestic supply disruption, NORA stocks on the Whiddy Island would first have to be loaded onto vessels and shipped to one of the oil ports in Ireland. Then the NORA stocks would be transported by road tanker to where they are needed. In the case of IEA collective action, NORA stocks on Whiddy Island can be shipped to global markets. In extreme weather conditions, the loading of the products might be temporarily unavailable, but this situation might last only a few days.

The stocks held by NORA are either segregated or co-mingled with commercial stocks. In 2017, 83% of stocks were segregated and 17% co-mingled with commercial stocks. NORA continues to maximise the level of stocks held on the island of Ireland, subject to storage availability and costs. At the beginning of 2018, the stocks comprised 72% of middle distillates, 24% of motor gasoline and 4% of crude oil. The ratio between refined products and crude oil is greatly in favour of refined products (96%). With continuation of refinery activity, there might be financial incentives to increase the volume of crude oil as part of the emergency stocks, because crude oil is cheaper to store.

All storage in Ireland is in above-ground tanks. The refurbishments of Ringsend, Kilroot and Tarbert facilities since 2014 have provided NORA with an increase of 320 kt of storage (Table 3.5).

Table 3.5 Storage refurbishment projects completed since 2014

Location	Stock (tonnes)	Product	Project status
Ringsend, Dublin (Ireland)	65 000	Diesel	Completed
Tarbert (Ireland)	130 000	Diesel and kerosene	Completed
Kilroot (Northern Ireland)	125 000	Diesel	Completed

Source: Ireland country submission 2018.

NORA is refurbishing storage facilities in Dublin Port, at the site of the former Poolbeg power plant, on the south side of Dublin Port. This is scheduled for completion in late 2019. The facility will provide storage for 100 kt of diesel or gas oil (representing 11 days of average consumption) and 20 kt of jet or kerosene (representing 7 days of average consumption). Another project at Great Island, located 180 kilometres (km) south of Dublin, will add 55 kt of storage capacity. These two projects conducted by NORA will result in an increased capacity of more than 175 kt by 2020.

The vote of the United Kingdom to leave the European Union brings uncertainty to Ireland. The EU oil directive (2009/119/EC) is more prescriptive than the IEA stockholding obligation with regard to storage locations. EU member states can hold stocks in other EU member states only. Ireland holds 20% of its emergency stocks in the United Kingdom, with 9% located in Northern Ireland. It is unclear if the European Union will grant an exception for Ireland to keep using storage locations in the United Kingdom, be it Great Britain or Northern Ireland.

Assessment

Oil remains the dominant source in Ireland's energy mix, although its share in TPES and total final consumption has gradually declined over the last decade. Oil demand has started to pick up since 2014 and rose to 154 kb/d in 2017.

There has been no commercial production of crude oil up to now. However, the Irish government continues to support investment in exploration and production, which has recently shown progressive achievements. For instance, the Atlantic Margin Licensing Round 2015 received the largest number of applications in any licensing round held in the Irish offshore. The Irish government should continue to promote exploration opportunities while ensuring that these opportunities lead to successful production.

The future of oil demand depends on the transport sector, which accounts for around two-thirds of Ireland's total oil consumption. The government has set up various ambitious plans to decarbonise the transport sector, including promotion of electric vehicles, compressed natural gas infrastructure and alternative fuels (see Chapter 6 on "Energy and climate"). The BOS is the primary measure to increase the share of biofuels in the transportation fuel mix; the obligation has been met each year since the BOS commenced. A key challenge for biofuels in Ireland is the low level of domestic production and high reliance on biofuels imports (81% in 2017). It is expected that there will be more opportunities in Ireland to develop commercial production of biofuels as the BOS increased to 10% in 2019 and set to reach 11% in 2020. Industry should plan to ensure sufficient imports to meet the anticipated increase in demand for biofuels.

The residential sector is the second-largest oil consumer. The government notes the importance of decarbonising home heating (mainly through replacement of individual oil boilers) as a vital component in the energy transition. However, the government's decarbonisation plan lacks clear and comprehensive long-term targets. Access to realistic and updated forecasts would allow private sector companies in the oil sector to better manage their risks and build business models around the low-carbon energy future, without a detrimental effect on the security of oil product supply.

Given the country's heavy reliance on oil imports, the government underpins market flexibility as being key to the SoS, and promotes a privatised, deregulated and competitive fuel market. The acquisition of the only refinery in the country (Whitegate by Irving Oil in 2016) was therefore a positive development that contributed to enhancing Ireland's refining capacity. The development project that aimed to increase the production of diesel and lighter products is highly recommendable. The IEA encourages the government to ensure there are no barriers to exploitation of the potential of biofuels, for the SoS and low-carbon transition purposes.

Around two-fifths of domestic oil product demand is covered by the Whitegate refinery; the rest is imported, mainly from the United Kingdom. The island of Ireland (Northern Ireland and Ireland) has six commercial oil terminals, with delivery orbits of 150 km covering the whole territory of the island, and with capacities exceeding present import needs. This creates flexibility for the fuel market and allows mitigation of potential supply constraints in case of outages at the Whitegate refinery.

Ireland meets its IEA stockholding obligation through public stocks owned by the Irish stockholding agency NORA. Commercial stocks held by industry and public stocks are counted. The use of domestic stocks is critical to Ireland's emergency response policy, as Ireland is entirely dependent on shipping for all oil imports, and the dominant share of oil supply comes from the North Sea via its only refinery in Cork. Ireland has therefore been pursuing a policy of rebalancing its emergency oil reserves by maximising NORA stocks stored in Ireland. At present, some 20 days of stocks are held in primary storage facilities that provide direct access to the market by road tanker trucks. The availability of stocks held in secondary storage facilities (oil terminals with jetties from which oil may be transported by ship to primary storage) is ensured by contracts from NORA with shipping companies.

Recommendations

The government of Ireland should:

- ☐ Develop a transparent and predicable decarbonisation policy for the transport sector, to inform investment decisions in the oil, gas and electricity sectors.
- ☐ Identify the risks raised by a high dependence on biofuel imports and take mitigating actions to ensure security of supply.

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4. Natural gas

Key data

(2017 provisional)

Gas production: 3.5 bcm (2.8 Mtoe), +26.6% since the production peak year in 1995

Net imports: 1.7 bcm (1.4 Mtoe), -68.4% since the peak demand in 2010

Share of gas: 31.5% of TPES, 51.1% of electricity generation, 16.3% of TFC*

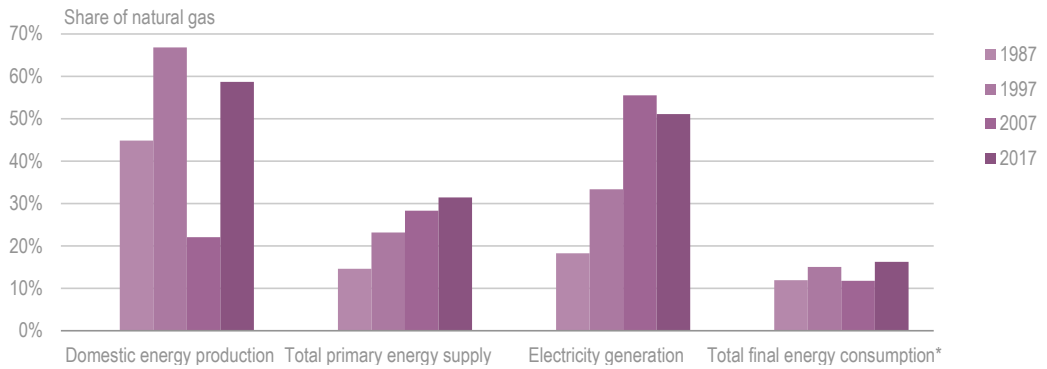
Gas consumption by sector*: 5.2 bcm (4.2 Mtoe), power and heat generation 55.2%, industry 18.0%, residential 13.3%, commercial 10.8%, other energy 2.7%

* Consumption figures are from 2016 data.

Overview

Natural gas was the second-largest energy source in Ireland in 2017, representing 31.5% of the total primary energy supply (TPES), and the third-largest share of total final consumption (Figure 4.1). Ireland ranked the third highest among all International Energy Agency (IEA) countries in terms of reliance on gas for energy supply.

Figure 4.1 Share of natural gas in different energy metrics, 1987-2017



The importance of natural gas in Ireland's energy mix has increased over past decades, and it now accounts for over half of electricity generation.

* Latest available consumption data are from 2016.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Since commercial operation of the Corrib gas field began in December 2015, Ireland's gas self-sufficiency jumped from 3% to 67% in 2017, replacing gas imports from the United Kingdom. However, with Corrib gas production anticipated to drop by half in the

next decade, securing new indigenous sources or reliable imports is essential for Ireland's future gas supply. Introducing liquefied natural gas (LNG) as an alternative import source and developing domestic renewable energy sources such as biogas could enhance the country's gas security in the middle to long term.

Natural gas has become essential for power generation as an alternative to oil since the late 1990s, and accounted for more than half of the energy supply for electricity in 2017. Gas will remain the mainstay of Ireland's security of supply (SoS) as the country accelerates its transition to a low-carbon energy system.

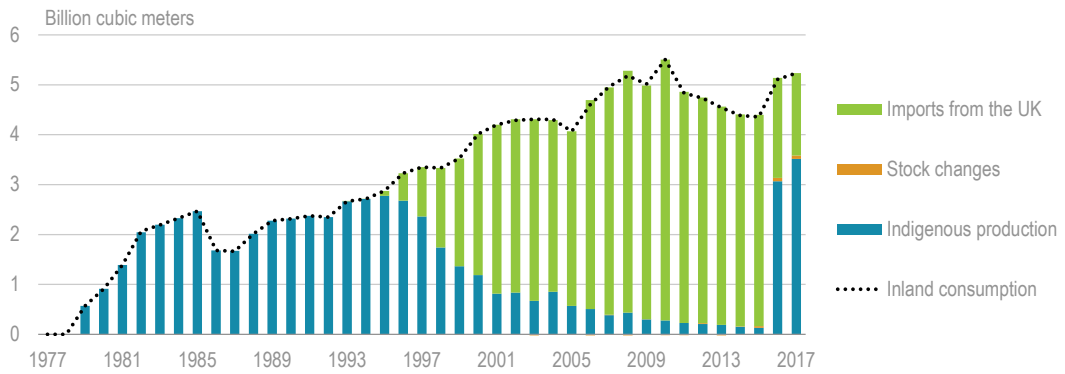
Supply and demand

Production and import

Ireland's first domestic gas production was from the Kinsale Head gas field, located offshore of the south-east of Ireland in 1979. Kinsale Head production started to decline in the late 1990s, but this was partly offset by productions of other gas fields nearby: Ballycotton (1989), Southwest Kinsale (1999) and Seven Heads (2003).

Since the peak in domestic production at 2.8 billion cubic metres (bcm) in 1995, gas fields have been producing at an increasingly lower rate. Ireland has become more dependent on imports from the United Kingdom to meet its rising gas demand. Southwest Kinsale became depleted in the late 1990s, and was used as seasonal gas storage between 2001 and 2017. This left only three gas fields still operating in the south: Ballycotton, Kinsale Head and Seven Heads.

Figure 4.2 Natural gas supply by source, 1977-2017



Gas production from Corrib has made Ireland less dependent on gas imports from the United Kingdom.

Notes: *Stock changes* reflects the difference between closing stock level and opening stock level for stocks held on national territory.

Source: IEA (2018b), *Natural Gas Information 2018*, www.iea.org/statistics/.

The declining trend for Irish gas production changed with the opening of the Corrib gas field, located in the north-west of Ireland. It was discovered in 1996 and production started in late 2015. Corrib is estimated to represent approximately 50% of the size of the Kinsale Head field, and it has significantly changed the country's balance of gas supply since 2016 (Figure 4.2).

In 2017, total gas supply was 5.2 bcm. Domestic production was 3.5 bcm, with Corrib field accounting for 95% and the rest from Kinsale Head and the nearby fields of Ballycotton, Southwest Kinsale and Seven Heads. Operation of the Corrib gas field allowed Ireland to reach the highest level of self-sufficiency at 67% since its first gas imports in 1995, which was followed by a constant drop of self-sufficiency down to a historical low of 3% in 2015.

The remaining 1.7 bcm of total gas supply in 2017 was imported from the United Kingdom through two interconnectors via the Moffat entry point in Scotland. The projection from Gas Networks Ireland (GNI), the Irish transmission system operator (TSO), indicates that imports through Moffat will replace Corrib and Inch as the dominant supply point from as early as 2018/19, and the share of gas imports will account for about 73% of Ireland's total gas demand by 2025/26 (GNI, 2017), (Table 4.1).

Table 4.1 Ireland's gas production outlook (maximum annual supply)

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Corrib (TWh per year)	35.84	31.61	31.94	30.66	24.49	20.26	17.19	14.45	15.26
Inch (TWh per year)*	5.44	2.96	1.97	1.46	0	0	0	0	0
Renewable gas (TWh per year)**	0.02	0.09	0.31	0.71	1.15	1.61	2.16	2.82	3.56

The anticipated decline in domestic gas production implies Ireland's dependence on imports in the medium term.

* *Inch* refers to Kinsale gas fields: Kinsale Head, Ballycotton, Southwest Kinsale and Seven Heads.

** *Renewable gas* refers to energy from biomethane.

Note: The forecast is based on "gas year", which starts on 1 October and ends on 30 September of the following calendar year. A terawatt (TW) is equal to one trillion (10^{12}) watts. Power used world wide is commonly measured in TW. Gas production is commonly expressed in TW per hour (TWh) per year.

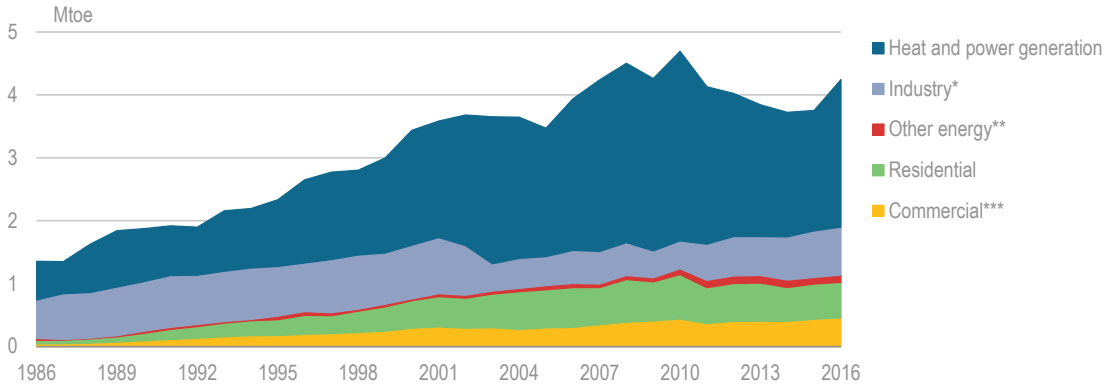
Source: GNI (2017), *Network Development Plan 2017 – Assessing Future Demand and Supply Position*, www.gasnetworks.ie/corporate/gas-regulation/system-operator/publications/GNI-Network-Development-Plan-2017.pdf.

Consumption

In 2016, Ireland's total gas consumption was 4.2 million tonnes of oil-equivalent (Mtoe) (5.2 bcm). This was slightly lower than its historical peak of 4.7 Mtoe (5.5 bcm) in 2010, but up 14% since 2014 when gas consumption started to pick up again (Figure 4.3). Power generation is the largest gas-consuming sector, accounting for 55.2% of the total consumption in 2016; the rest was from the industry (18%), residential (13.3%), commercial (10.8%) and other energy industries (2.7%) sectors.

Gas consumption increased by 49% in the commercial sector and 45% in industry from 2006 to 2016. Consumption declined in the power generation (3%) and residential sectors (10%). The sharp increase in total gas consumption since 2014 was driven by accelerated power generation. Gas demand for electricity jumped by 18% between 2014 and 2016 despite recent growth in wind power generation. This increase is attributed to growing domestic power demand to fuel the country's recent economic recovery, and, to a lesser extent, the start of electricity exports to the United Kingdom due to the carbon price floor in 2015 (see Chapter 5 on "Electricity and renewable electricity").

Figure 4.3 Natural gas consumption by sector, 1986-2016



A sharp increase in gas demand for power generation is the main driver for total gas consumption growth since 2014.

* *Industry* includes non-energy consumption.

** *Other energy* includes the energy sector's own consumption and losses in oil and gas production and refineries.

*** *Commercial* includes commercial and public services, agriculture and forestry.

Note: There is no gas consumption for the transport sector.

Source: IEA (2018a), *World Energy Balances* 2018, www.iea.org/statistics/.

Outlook

Ireland's annual gas demand is expected to grow by a maximum of 23% by 2026 according to the GNI (2017) projection. Gas demand for power generation initially reduces between 2016 and 2026 owing to increased renewable power capacity, but it is projected to increase from early 2020. There are several reasons for this: wind production growing at a slower rate, coal plant production running low due to Industrial Emissions Directive restrictions and increased electricity exports to the United Kingdom due to a high carbon price floor. The level of electricity exports to the United Kingdom is likely to be sustained up to the mid-2020s.

Over the same ten-year horizon, gas demand for industry and commercial sectors is anticipated to show a growth of 9.6%. Electricity demand could significantly increase as Ireland potentially emerges as a globally attractive destination for data centres. Demand for gas, including renewable gas production and co-generation[1] capacity, could also increase given Ireland's reliance on gas for power generation.

In the residential sector, the GNI plans to connect around 125 000 new residential customers to the gas distribution network by the end of the National Development Plan period in 2027. This implies substantial fuel switching from oil to gas for heating. However, the forecasted growth in gas demand for the residential sector would be counterbalanced by improved energy efficiency, so gas demand is expected to remain at the current level throughout the next decade.

[1] *Co-generation* refers to the combined production of heat and power.

Biogas

In 2017, Ireland produced 56.3 thousand tonnes of oil equivalent (ktoe) of biogas (Box 4.1). Around 70% of this came from landfill gas and the rest from wastewater sludge and other organic wastes. Irish biogas production remained at a low level due to limits in the feedstock supply chain combined with a lack of biogas processing plants. Ireland has the highest potential for biogas production per capita in Europe according to the European Commission, and could achieve total production of 13 terawatt hours (TWh) per year by 2030 in theory (EC, 2017).

Upstream development

The 2015 White Paper on energy policy (DCENR, 2015) recognises the continued role of gas in securing Ireland's future energy supply and encourages fully privatised offshore exploration and production through a range of policy measures such as:

- provision of cost-effective entry licensing mechanisms by keeping licence application and rental fees at a low level
- modernisation of Ireland's regulatory and fiscal frameworks such as the Petroleum (Exploration and Extraction) Safety Act 2015 and the revised fiscal terms in the Finance Act 2015
- promotion of Ireland as an attractive exploration country by representatives attending international trade conferences in Singapore and the United States, and by hosting several data sharing sessions (known as "data rooms").

The Irish government also supports research projects such as establishment of the new Irish Centre for Research in Applied Geosciences, and encourages seismic data acquisition projects (two and three-dimensional data acquisition surveys), which are key records for exploration activities.

The Irish government has been proactive in engaging the private sector in exploration and production activities, as demonstrated in the Atlantic Margin Licensing Round 2015. Launched in June 2014, it opened all major Atlantic basins for a two-year licensing option. By the end of the licensing round in September 2015, 43 applications had been received from 17 companies, both major and small to medium companies. This was the largest number of applications ever received for an offshore licensing round in Ireland. The first evaluation in February 2015 reported 14 new licensing options awarded; another 14 licensing options were awarded in the second evaluation in June 2016.

Within the authorised two years of the licensing option, companies have to convert their options into an exploration licence, for which there are three categories: 1) standard exploration licence for water depths up to 200 metres (m), 2) deepwater exploration licence for water depths exceeding 200 m and 3) frontier exploration licence for areas specified by the minister of Communication, Climate Action and Environment (DCCAE, 2018). If a commercial discovery has been established, it is possible to register for a petroleum lease. If there has been no commercial discovery but an expectation of one in the foreseeable future, it is possible to apply for an extension of the lease.

There have been few drilling activities in recent years, despite a successful licensing round. Of the 160 wells drilled up to now, over two-thirds took place between 1970 and 1980, with only 18 cases since 2005. The Corrib gas field is the latest project that

increased gas SoS in Ireland. However, it took more than 20 years to start commercial production since its discovery in 1996, due to strong resistance from local communities (see Box 4.2).

Box 4.1 Causeway Project: Promoting renewable gas in Ireland

Biogas can be used directly in heat and power generation, or it can be purified to biomethane to be injected into the natural gas network. There is no biomethane production in Ireland, but the government is examining its potential.

The Causeway Project is one of the measures to decarbonise the transport sector by promoting renewable gas as an alternative fuel (see the chapter on "Energy and climate"). The GNI will lead the project from February 2016 to December 2020, with EUR 6.5 million (euros) of financial support from the European Union (EU) Connection Europe Facility and EUR 12.8 million from the Commission for Regulations of Utilities (CRU) Innovation Fund. Key objectives of the Causeway Project include: 1) formation of a national compressed natural gas (CNG) network, 2) promotion of a CNG Vehicle Fund and 3) demonstration of the feasibility of renewable gas injection into the grid.

In 2017, the first public fast-fill CNG station was installed in Circle K, Dublin Port. This was a strategic point to roll out a national CNG network. The station opened for public refilling in January 2019. It has a capacity to charge up to 70 heavy goods vehicles in less than 5 minutes per truck. This CNG station marks the first of 70 stations proposed by the GNI to materialise its 10 year vision of having 10% of heavy trucks and buses in Ireland powered by renewable gas. Ireland's first private CNG station at Clean Ireland Recycling in Shannon was also completed in 2017, with support from the CRU Gas Innovation Fund, a financial support programme used for gas research and demonstration projects.

The GNI launched the CNG Vehicle Fund in February 2017 to promote a range of CNG-fuelled commercial vehicles, including trucks and buses, in Ireland. Up to EUR 20 000 worth of subsidy was provided for purchase of a new natural gas vehicle, and the fund made EUR 700 000 available to Irish transport operators. It was supported by the Commission for Energy Regulation and co-financed by the EU Trans-European Transport Network* Programme under the Connecting Europe Facility as part of the Causeway Project (GNI, 2018a).

The Causeway Project also has an objective to demonstrate the feasibility of the country's first installation to inject renewable gas into the grid. The GNI aims to have at least 20% of renewable gas in the network by 2030, equivalent to around 11.6 TWh of supply. The government is examining upscaling anaerobic digestion in agriculture (grass silage) and the commercial waste industry sector. At its full potential scale, this could provide biogas production of around 1 044 ktoe by 2050, equivalent to 28% of Ireland's total gas supply in 2015. The GNI designed a network entry facility with an injection capacity of up to 108 gigawatt hours (GWh) per annum (1 200 cubic metres per hour) of renewable gas into the distribution network in co-operation with Green Generation (an Irish company that develops anaerobic digestion facilities). Ireland anticipates the country's first deployment of renewable gas by a private company in its national gas network in 2019, pending approval from CRU (GNI, 2018a).

* The Trans-European Transport Network is a European Commission policy directed towards the implementation and development of a Europe-wide transport network.

A potential turning point in Ireland's future oil and gas exploration is the private members' bill entitled Petroleum and Other Minerals Development (Amendment) (Climate Emergency Measures) Bill 2018. In addition to the enactment of the Prohibition of Onshore Hydraulic Fracturing Act 2017, this bill aims to prohibit all future licensing of oil and gas exploration in Ireland's territory and the exclusive economic zone to address climate change. It was introduced into the Irish Parliament and passed the second stage of the 11-stage legislative process in February 2018. The bill passed to pre-legislative scrutiny (policy discussion) by the Committee on Communications, Climate Action and Environment in July 2018. The Irish government opposes the bill and government policies in respect of climate action, energy and offshore exploration, and the application of such policies remains unchanged.

Box 4.2 Corrib gas field: From discovery to commercial production

A deepwater exploration licence covering four blocks in the Slyne Trough was granted in January 1993 for 11 years to Enterprise Oil and its partners. Corrib gas field was discovered in 1996; it was the first reported commercial natural gas discovery in Ireland since discovery of the Kinsale Head gas field in 1971.

The field is a sandstone reservoir, situated approximately 70 kilometres off the Mullet peninsula in the north-west of Ireland. The gas field is at a depth of 350 m of water and 3 500 m below the seabed, and represents approximately 50% of the volume of the Kinsale Head field. The recoverable gas volume is projected to be 0.87 trillion cubic feet (24.6 bcm), which consists of 97% methane and ethane (Dancer et al., 2005). The field does not contain hydrogen sulphide, and carbon dioxide is only 0.3% of the total amount of gas.

In 2002, Shell acquired Enterprise Oil. Shell developed the Corrib field as a subsea production facility with onshore processing, without an offshore production platform. The assets include offshore wells, subsea facilities and a pipeline, an onshore pipeline and a gas terminal at Bellanaboy, in the county of Mayo.

Corrib gas field had its first production in December 2015, and commissioning was completed in June 2016. Corrib field has been running at full capacity since then (35.84 TWh per year in 2017/18), which has significantly lowered Ireland's reliance on imports.

However, domestic gas supplies from the Kinsale fields (Kinsale Head, Ballycotton, Southwest Kinsale and Seven Heads) and the Corrib field are decreasing. Corrib production is due to reduce by more than half between 2017 and 2026. Southwest Kinsale was converted into a storage facility; it is now in its final production phase and is due to be decommissioned in 2021. The Environmental Protection Agency indicated an option to flatten Corrib production below its maximum capacity, and permit an increase in production if there is a disruption in the interconnector from the United Kingdom (EPA, 2012).

In July 2017, Shell reached an agreement, subject to regulatory approval, with Canada Pension Plan Investment Board to divest its interest in the Corrib joint venture and hand over field operation to Vermilion, which is already a partner in the joint venture.

Institutions

In the natural gas sector, the **Department of Communications, Climate Action and Environment** is responsible for transposing EU directives into national law and for corporate governance of state-owned energy companies, except for GNI (see below).

The **CRU** is the independent regulator of natural gas and electricity. Previously named the Commission for Energy Regulation, its mission is to regulate the gas and electricity markets and gas, electrical and petroleum safety. The CRU also has the authority to take necessary actions in case of power or gas emergency situations.

Ervia is a state-owned multi-utility company responsible for delivery of gas and water infrastructure in Ireland, and was established in 2014. The **Department of Planning, Housing and Local Government** is responsible for corporate governance of Ervia, which includes the GNI and Irish Water as subsidiaries.

The **GNI** is Ireland's TSO. It was created in 2014 as a stand-alone gas network business within Ervia. The GNI holds two licences from the CRU for operation of Ireland's gas transmission and distribution systems. The GNI builds and develops Ireland's gas infrastructure, operating over 13 954 kilometres (km) of gas pipelines. The GNI has a wholly owned subsidiary, **GNI (UK) Limited**, which operates the interconnectors and most of the pipelines in Northern Ireland. The **Competition and Consumer Protection Commission** is a government body that enforces Irish and European competition law. It co-operates with the CRU on matters related to electricity and natural gas sectors as formalised under their memorandum of understanding.

Market structure

The Irish wholesale market is governed by the EU gas network codes. In February 2005, the CRU approved the implementation of a new code of operations. This governs the rules for the transmission and distribution networks. The latest code (version 5.02) was published in April 2018. The Irish gas market has undergone several changes in recent years. In line with the EU 2009 Gas Directive, as part of the EU Third Energy Package, Bord Gáis Éireann was certified in 2013 under the independent transmission operator model. Bord Gáis Éireann, the vertically integrated utility responsible for the gas networks, and with activities in power generation and in the electricity and gas supply markets, dominated the retail gas market up to 2014.

The government sold Bord Gáis Éireann's electricity and gas supply and power generation businesses to Centrica in 2014. Ireland's natural gas transmission and distribution networks are retained in public ownership as strategic national assets and are owned and operated by the GNI. The GNI was certified as a full ownership unbundled entity in 2016, again in accordance with the 2009 Gas Directive.

There were six large companies operating in Ireland's gas retail market in the first quarter of 2018 according to the *Electricity and Gas Retail Markets Report* (CRU, 2018a). Bord Gáis Energy was the dominant retail player and had the largest market share of 46% in terms of customer numbers and volume of sales (GWh). Bord Gáis Energy is a private limited company under Centrica Group, a British multinational energy and services company. Electric Ireland held the second-largest number of customers with a 21% market share, followed by Airtricity (14%), Energia (8%), Flogas and PrePayPower (5% each), with small players such as Vayu taking the rest of the shares.

Facilitating customer switching is essential to keep the gas market competitive. The CRU provides customers with information that is readily accessible on line to ensure that customers are well informed of their best available options. In the first quarter of 2018, there were 35 332 customers switching. This is equivalent to a 5.1% switching rate, and a 15.7% increase from the first quarter of 2017. The total number of customers switching in 2017 was 124 419 – a 9% increase from 2016. While Bord Gáis Energy remains the dominant player, it also saw the sharpest market share decline of 3.7% between 2017 and 2018, falling below 50% of the total market share for the first time. Energia absorbed the big portion of this market segment to increase its share by 1.7% (CRU, 2018a).

Prices and tariffs

There are no regulated prices in the wholesale and retail gas markets in Ireland, although the CRU is responsible for the regulation of gas network tariffs. In 2017, industry players paid USD 36.2 (United States dollars) per megawatt hour (MWh), which was the seventh highest among IEA member countries. Households paid USD 78.3/MWh, which was above the median in the comparison (Figure 4.4).

Figure 4.4 Natural gas prices in IEA countries, 2017

Ireland's industry pays a relatively high price for gas among IEA member countries; its household gas price is close to the median.

* Tax information unavailable for the United States.

Notes: For industry, data are unavailable for Australia, Greece, Mexico and Norway; for households, data are unavailable for Australia, Greece, Italy, Japan, Mexico and Norway.

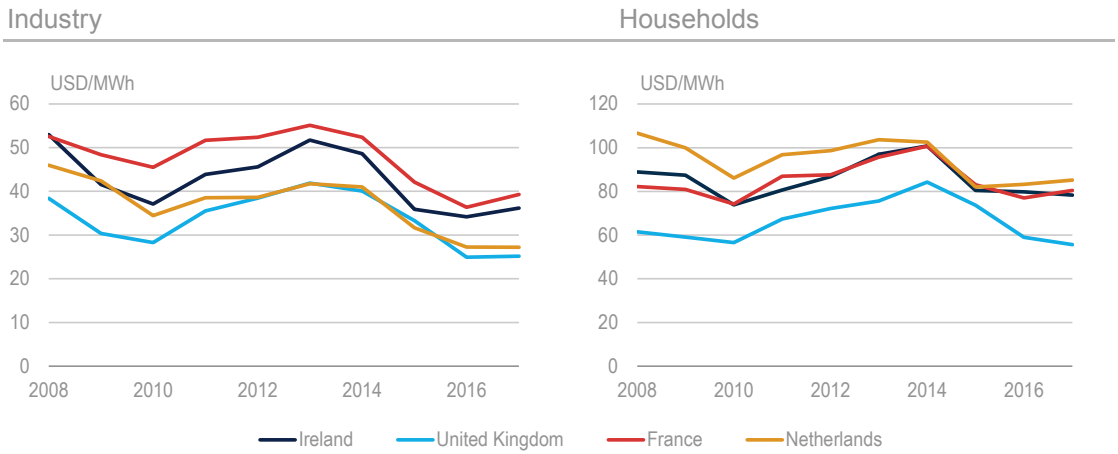
Source: IEA (2018c), *Energy Prices and Taxes 2018, Quarter 1*, www.iea.org/statistics/.

Since the last IEA in-depth review (IDR) in 2012, the tax rate for industry gas price has increased substantially from 7% to 12%, while taxes for households have remained stable.

Gas prices have declined by 26% for industry and by 22% for households since 2014, when total gas consumption in Ireland started to pick up again. This trend of declining gas prices is shared with neighbouring countries (Figure 4.5).

The gas price is expected to retain its competitiveness against oil or liquefied petroleum gas in the commercial and industrial sectors up to 2021 due to the abundance of the gas supply and the expansion of gas networks (GNI, 2017).

Figure 4.5 Natural gas price trends in selected IEA countries, 2008-17



Ireland's gas prices for industry and households have declined by 26% and 22% since 2014.

Source: IEA (2018c), *Energy Prices and Taxes 2018, Quarter 1*, www.iea.org/statistics/.

Irish balancing point

Ireland's wholesale gas price includes a price set at the United Kingdom national balancing point (NBP) plus the transport cost of the interconnectors. All commercial contracts are linked to the NBP. The contracts remain linked to the NBP price in pounds sterling even in the case of a physical disruption at Moffat entry point. This fails to fully reflect the scarcity of gas supply in Ireland and is also affected by the EUR/GBP (British pound) currency fluctuations. The introduction of a new electronic trading platform – Energy Broking Ireland – in October 2017 marked a positive development against this background.

Most of the largest players in the Irish gas market have already started using Energy Broking Ireland, enhancing price transparency while reducing transaction costs for trading. Most importantly, the development of a wholesale price at the Irish gas trading point – the Irish balancing point (IBP) – would ultimately benefit domestic consumers and reinforce the Irish wholesale market liquidity. Experience with the new IBP platform suggests a strong correlation between IBP and NBP prices. If there is a failure of the interconnectors, gas at the IBP would be sold to the market at a significant premium to the NBP price. This would help the market to achieve a new balance between supply and demand.

Price regulation for the gas network

The CRU conducts a review of gas network costs every 5 years to set a 5 year revenue allowance for GNI transmission and distribution. This 5 year allowance is determined by reviewing the expenditures incurred by the network companies and the new business proposals, followed by a public consultation. Once the amount is fixed, the allowance is split into annual allowances that can be recovered through network tariffs with flexibility of adjustments. On average, around one-third of a domestic customer's gas bill relates to distribution tariffs and 10% to transmission tariffs (CRU, 2018b).

The price control for gas – price control 4 – covers from October 2017 to September 2022, during which the CRU will monitor network companies' compliance through their licence conditions.

Additionally, the CRU has set up targets to ensure more-efficient cost control. The targets are normally set at a 1% increase in cost efficiency. However, there could be an annual 0.75% addition based on GNI review. The CRU introduced a fiscal incentive that warrants a bonus if the connection target is exceeded, and a penalty for failure, to encourage more ambitious gas network connections for price control 4.

Gas entry/exit tariff reform

With operation of the Corrib gas field, the interconnectors between Ireland and the United Kingdom are no longer the primary supply source of gas, at least in the medium term. The reduced Moffat throughput implied an increase in its entry tariff per unit, pushing up the wholesale gas price in Ireland. The CRU therefore implemented a reform of the existing gas entry/exit tariff methodology, and a new regime has been in place since October 2015. Key changes include:

- An entry/exit tariff split implemented at a 33/67 ratio instead of a 50/50 ratio.
- Commodity charges apply as a single rate for all entry points and a separate single rate for all exit points. Commodity charges were previously calculated separately for each entry/exit point. The newly applied single rate is based on the new entry/exit tariff split (33/67).
- A capacity/commodity split maintained at a 90/10 ratio, with an exit tariff.[2]

Infrastructure

Gas networks

The GNI operates the transmission (2 427 km) and distribution networks (11 527 km) in Ireland. The transmission network transports gas from the entry points at Moffat, Inch and Bellanaboy to the distribution networks and connected loads (e.g. gas-fired power generators). The GNI transmission network also supplies gas to Northern Ireland and the Isle of Man, which are both part of the United Kingdom (Table 4.2).

[2] The tariff consists of a capacity and commodity charge that applies for use of the Northern Ireland transmission network system.

The Moffat entry point connects the GNI network to the national grid gas network in the United Kingdom and allows for gas imports to Ireland via two subsea interconnectors (IC1 and IC2) (Figure 4.6) The existing interconnectors do not allow Ireland to export gas to the United Kingdom because they are unidirectional. The landfall installations for the interconnectors entering Ireland are located close to Loughshinny for IC1 and Gormanston for IC2, in the east of Ireland. The Inch entry point connects Kinsale and Seven Heads gas fields to the onshore GNI network, and the Bellanaboy entry point connects the Corrib gas field to the onshore GNI network. The Northern Ireland gas network connects to the GNI network at Twynholm in Scotland and delivers gas to Northern Ireland via the Scotland Northern Ireland Pipeline (SNIP). The South-North Pipeline (SNP) is an onshore gas transmission pipeline from Gormanston to Northern Ireland.

The distribution network delivers gas to over 680 000 customers across Ireland, and the network has been extended to Nenagh and Wexford towns. GNI completed extension of distribution to Listowel in the south-west of Ireland in late 2018. Additionally, GNI also completed the network extension to Center Parcs in the county of Longford in late 2018.

Table 4.2 Major gas network infrastructure in Ireland

Infrastructure	Function	Capacity (GWh/d)
Moffat entry point (Scotland, United Kingdom)	Entry point to GNI system serving Ireland via the onshore system in Scotland and subsea interconnectors IC1 and IC2 Also serves Northern Ireland via Twynholm installation and SNIP Physically unidirectional	342
South-North CSEP (Ireland)	Exit point to Northern Ireland, supplied from IC2	66.3
Corrib gas field (Ireland)	Domestic production facility, began commercial operation in December 2015	103.5
Southwest Kinsale storage (Ireland)	Underground storage facility (depleted gas field), due to decommission in 2021	27.3

Notes: CSEP = connected system exit point. GWh/d = gigawatt hours per day.

Source: Ireland country submission, 2018.

LNG terminal

Ireland does not yet have an LNG terminal. There is a commercial proposal to construct the country's first LNG regasification terminal in the Shannon Estuary, on the south-west coast of Ireland. Shannon LNG Ltd received planning permission in 2008 for its proposed LNG terminal and for the associated transmission pipeline to deliver gas into Ireland's transmission system. In 2017, the Shannon LNG terminal was included in the European Commission's third list of the projects of common interest (PCIs).If Shannon LNG Ltd decides to take a final investment decision in 2018, the earliest possible start date for commercial operation of an onshore facility would be 2021. The initial phase will include construction of the LNG processing tanks and regasification facilities, with a maximum export capacity of up to 191.1 GWh/d (17.0 million standard cubic metres per day).

Figure 4.6 Map of natural gas infrastructure

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

In July 2017 NextDecade (an LNG export company in the United States) signed a memorandum of understanding with the Port of Cork company to study the possible development of a floating storage and regasification unit (FSRU) and the associated LNG import terminal infrastructure in Cork, in the south of Ireland.

The development of an LNG import terminal, either an onshore facility or an FSRU, would substantially improve the SoS in Ireland by providing direct access to the global LNG market and diversifying gas imports.

Storage facilities

The Southwest Kinsale storage facility was a gas production and seasonal storage facility located off the southern coast of Ireland with a working volume of 230 million standard cubic metres, about 5% of Ireland's annual gas consumption in 2016/17. After it was depleted, the Southwest Kinsale field became Ireland's first offshore gas storage facility and operated from 2001 to 2017. Gas injection has ceased since then, and production of cushion gas is also expected to cease in 2020; the field will be decommissioned in 2021. There was no other gas storage facility in operation in Ireland as of 2018.

The decision to stop gas storage operation in the Kinsale reservoirs was a commercial one. The GNI and EirGrid conducted a long-term resilience study in 2018 to assess Ireland's resilience to a prolonged gas supply disruption. This was to feed into an evaluation of risks and options to deal with gas supply disruptions, including the possible role of gas storage (GNI, 2018b).

Infrastructure developments

The European Commission supports key energy infrastructure projects known as PCIs to improve gas supply security and create an integrated energy market. One Irish gas infrastructure project was on the first PCI list and was completed at the end of 2018. There are two projects on the current third PCI list (Table 4.3).

Table 4.3 Irish gas infrastructure development projects under the PCI, 2017

Project	Project promoter	Aim	Status
Twinning of South West Scotland Onshore System (SWSOS) (first PCI list)	GNI (UK) Ltd	Twin unparalleled section of pipeline Increase Moffat capacity to 375 GWh/d	Funding provided by Connecting Europe Facility (30%) and regulatory capital allowance
Physical reverse flow at Moffat (third PCI list)	GNI (UK) Ltd	Make Moffat entry point bi-directional	Feasibility study ongoing Funding provided by Connecting Europe Facility (50%)
Shannon LNG (third PCI list)	Shannon LNG	Construct LNG process tanks and regasification facilities with a maximum export capacity of 191.1 GWh/d	Planning permission received Earliest commissioning in 2022, if a final investment decision is taken by in 2019

Source: Ireland country submission, 2018.

Another project under consideration is the physical reverse flow (bi-directional) of the SNP, led by GNI (UK) Ltd, but not as part of the PCI. The decision of the United Kingdom

to leave the European Union poses challenges to Ireland's energy security. It is crucial for the Irish government to ensure stable energy trades between the two countries, particularly cross-border gas and electricity flows. The British government announced in October 2018 that mechanisms governing the cross-border trades would not change fundamentally, but adjustments may be required.

In addition to twinning of the SWSOS between Cluden and Brighouse, work is ongoing to build independent compressor systems for IC1 and IC2. The project is due for completion in 2020.

Emergency response

Policy and organisation

Ireland has set up a legal framework for gas security based on the following act and regulations:

- Gas (Interim) (Regulation) Act 2002 and amendments made by Statutory Instrument 697/2007 specify that the Natural Gas Emergency Plan (NGEP) should set out procedures for the declaration and handling of an emergency. The NGEP also defines roles of the various bodies involved in an emergency event and provides measures to ensure that supplies to vulnerable customers, as determined by the CRU, are protected.
- Statutory Instrument 336/2013 gave legal effect to EU Regulation 994/2010. EU Gas Security of Supply (SoS) Regulation 2017/1938, repealing Regulation 994/2010, came into force in November 2017 to ensure all necessary measures are taken to safeguard an uninterrupted supply of gas throughout the European Union. Solidarity and enhanced regional co-operation among EU member states are the guiding principles of this new regulation.

The EU gas SoS Regulation has three levels of emergency crisis:

- Early warning: if an event is likely to result in significant deterioration of the gas supply situation.
- Alert: if a supply disruption results in a significant deterioration of supply, but the market is still able to manage that disruption without the need to apply non-market-based measures.
- Emergency: if a major gas supply disruption results in significant deterioration of supply and market measures and non-market-based measures are introduced to safeguard gas supply to protected customers.

Overall responsibility for security of gas and electricity supply lies with the CRU, which is statutorily obliged to monitor the SoS in Ireland and to take any measures necessary to ensure continuity of supply. The regulator role includes the appointment of a National Gas Emergency Manager, whose role is pivotal in the management of an emergency event. The GNI was appointed to this role of manager, and its duties include development of the NGEP.

Network resilience

The Common Arrangements for Gas Project commenced in 2008 between Northern Ireland and Ireland. It aimed to harmonise technical operations of the gas transmission networks in both jurisdictions. The project was suspended and replaced with new EU internal gas market network codes, now being implemented by the GNI.

The new EU gas infrastructure standard N-1 evaluates a member state's ability to satisfy total gas demand in case of a disruption of its single largest gas infrastructure on the day of exceptionally high gas demand, which has a statistical probability of once in 20 years. The EU infrastructure standard is met when the N-1 value is greater than or equal to 100%. Ireland and the United Kingdom apply a more severe criterion to ensure that their markets are able to meet at least a once-in-50-years peak demand. In Ireland, the CRU places an obligation on shippers and suppliers to book capacity for a 1-in-50 peak day at the network exit point, as set out in Ireland's network code of operations. The GNI (Irish TSO) has oversight of the gas activity and ensures the capacity is booked.

The 2016 National Risk Assessment identified the Moffat entry point (with the two subsea interconnectors IC1 and IC2) as the single largest piece of infrastructure. The risk assessment reconfirmed that if a failure happens at Moffat, Ireland is unable to meet the N-1 infrastructure standard as set out in Regulation 2017/1938. The result of the N-1 calculation was 35% (28% without market-based measures). This calculation was done with the median supply and demand scenario set out in the GNI 2016 Network Development Plan. The analysis is based on production figures for the year 2018/19. The CRU agreed a regional approach with the competent authorities in the United Kingdom and Northern Ireland and a joint risk assessment and preventive plan. With a joint risk assessment between the United Kingdom and Ireland, the combined N-1 calculation equals 134%.

In case of a gas supply emergency, Ireland is likely to call for solidarity from its EU neighbouring countries (under the EU gas SoS Regulation 2017/1938). Although it is uncertain how the solidarity mechanism will function when the United Kingdom leaves the European Union, it is important for Ireland to maintain close co-operation on this regional risk-based approach.

Completion of the project to have independent compressor systems for IC1 and IC2 at Brighouse Bay in 2020 will result in a revision of the largest piece of gas infrastructure for Ireland as defined in the EU gas SoS Regulation 2017/1938. N-1 failure will constitute a partial disruption of IC1 or IC2, instead of a complete disruption with failure of IC1 and IC2, as considered at the moment in the 2016 joint risk assessment.

Emergency response measures

There are no public stocks of natural gas in Ireland, and since 2017 there has not been a storage site in operation. If there is a gas supply emergency, Ireland relies on supply-side measures (import flexibility via pipeline and increased domestic production) and demand-side measures (interruptible contracts, fuel switching and load shedding).

Ireland's gas interconnectors (IC1 and IC2) provide a level of line pack security. If there is a loss of supply at the Moffat gas entry point, the line pack in IC1 and IC2 could potentially supply Irish gas demand on a 1-in-50 winter for 5 days. However, this provision of 5 days is based on the assumption that all gas-fired power stations could switch fuel, from gas to diesel, within 5 hours, and no line pack is diverted to Northern Ireland through the SNP via IC2.

Indigenous gas supplies are mostly at maximum production, which implies that no additional indigenous supply is available in an emergency. Biomethane production and injection into the natural gas network in Ireland is at an early stage of deployment and will not contribute to the SoS in the near term.

The wholesale gas price in Ireland is linked to the gas trading hub (NBP) of the United Kingdom plus the transport cost to Ireland via the subsea interconnectors. If there is a gas supply emergency (e.g. a failure of the subsea interconnectors), Ireland relies on demand-side measures: interruptible contracts, fuel switching and load shedding (voluntary and forced) of major industrial users and households. During such events, demand and supply from the Irish market participants would be handled through the IBP, based on indigenous production, as that would be the only available supply. The wholesale gas price would likely rise to find a new balance between domestic demand and limited available supply. The government should investigate how demand restraint would work to limit gas demand in the case of an Irish-only gas shortage, when the IBP price is relevant.

Protected customers are given priority if there is an emergency. If load-shedding measures have to be applied, the order of load shedding to reduce gas demand is:

- power generators
- large daily metered customers, with an annual gas quantity metered higher than 57.5 GWh (e.g. large industrial consumers)
- daily metered customers, with an annual gas quantity metered of 5.55-57.5 GWh
- protected customers, as defined in EU Regulation 2017/1938 (e.g. emergency services, domestic load).

Volumetric savings resulting from this load shedding are used to protect the non-daily meter sector. Non-daily meter refers to less than 5.55 GWh of annual gas quantity metered. This covers small industrial or commercial customers and residential properties.

Gas-fired power stations in Ireland cover over 55% of gas demand. They can be instructed by EirGrid to switch to secondary fuel to prevent or respond to a gas emergency situation. Baseload gas-fired generators are required to have access to five days of secondary fuels, which are typically distillate oil. Mid-merit generating units are required to have access to 3 days of secondary fuel stocks. This secondary fuel obligation is an EirGrid grid code requirement. The latest version of the grid was updated in 2015. However, there are operational and technical risks associated with switching to secondary fuels or continued operation on secondary fuels for an extended period.

Assessment

The Irish government acknowledges that natural gas is essential to the security and sustainability of Ireland's energy system. Since the last IDR in 2012, the share of natural gas in TPES has remained stable at around 31%, but the share of indigenous gas in total gas supply has significantly increased due to the Corrib gas production at the end of December 2015. The high level of self-sufficiency in gas supply is expected to decrease significantly. Corrib gas production is projected to more than halve by 2026, and gas imports from the United Kingdom will be restored as the dominant supply source by as early as 2019.

The Irish government has been proactive in engaging with the private sector in exploration and production activities. The outcome of the Atlantic Margin Licensing Round 2015 has demonstrated a strong interest from oil and gas companies to prospect the Irish offshore. Although fiscal and regulatory incentives have been introduced, reflecting on the extended time it took for Corrib gas field to start production from its

discovery 22 years ago, the Irish government can benefit from streamlining the regulatory procedures and engage as early as possible with all local stakeholders to improve social acceptance.

Development of indigenous renewable gas would also provide Ireland with flexibility to optimise the role of gas. There is no production of biomethane in Ireland, but the country has the highest potential for biogas production per capita among EU member states. Ireland would benefit greatly from upscaling its limited biogas processing facilities. For promotion of renewable gas in the transport sector, the Causeway Project is a noticeable achievement that the Irish government should continue to closely monitor and support to reach the ambitious target of at least 20% of renewable gas injected into the network by 2030. More support programmes should be introduced to promote decarbonisation in the transport sector in the long term. The Irish government should conduct a comprehensive cost and benefit study to allocate necessary resources and accelerate the development of renewable gas in Ireland.

Ireland's annual gas demand has increased since 2014, and is expected to grow by 23% to 2026. Electricity generation will remain a dominant driver of the anticipated growth. Gas consumption for the residential sector will depend on the outcome of gas distribution network development, although it is also expected to grow.

The natural gas market has experienced several positive developments in recent years. The unbundling of the previous vertically integrated utility Bord Gáis Éireann and the sale of its retail unit Bord Gáis Energy have greatly improved the liquidity of the Irish gas market. More-balanced market shares among diversified companies and the increasing number of switching customers in the retail market are positive signs of increased competition.

There are still some challenges ahead for Ireland regarding the SoS. The United Kingdom remains its only gas import source, and there has not been a gas storage facility in operation in Ireland since 2017. The European supply standard (N-1 target) is met only due to the joint risk approach between Ireland and the United Kingdom. It is crucial for Ireland's gas SoS to maintain a strong regional collaboration when the United Kingdom leaves the European Union. Building LNG import facilities soon would improve gas supply security in Ireland, as the country is not yet connected to the global LNG market.

Recommendations

The government of Ireland should:

- Ensure a stable and streamlined regulatory framework, and conduct regular licensing rounds, to encourage exploration activities and, subsequently, develop domestic reserves.
- Optimise the role of gas in the transition to a low-carbon-energy system, including encouraging, through appropriate regulation and policy, the development of an LNG import facility and seasonal gas storage. A cost-benefit analysis should be used when deciding on any public infrastructure investments and developing programmes for gas demand in the heating and transport sectors.
- Subject to a cost and benefit analysis, introduce and promote, through a robust support scheme, the production of biomethane as an indigenous and sustainable form of gas that will contribute to the security of supply and sustainability targets.

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5. Electricity and renewables

Key data

(2017 provisional)

Electricity generation: 30.7 TWh (natural gas 51.1%, wind 24.3%, coal 11.9%, peat 7.1%, biofuels and waste 2.9%, hydro 2.3%, oil 0.5%, solar 0.01%), +10% since 2007

Electricity net exports: 0.7 TWh (imports 1.1 TWh, exports 1.8 TWh)

Installed capacity (2016): 9.9 GW

Electricity consumption (2016): 25.7 TWh (industry 39.5%, residential 30.6%, commercial 29.2%, transport 0.2%, other energy 0.4%)

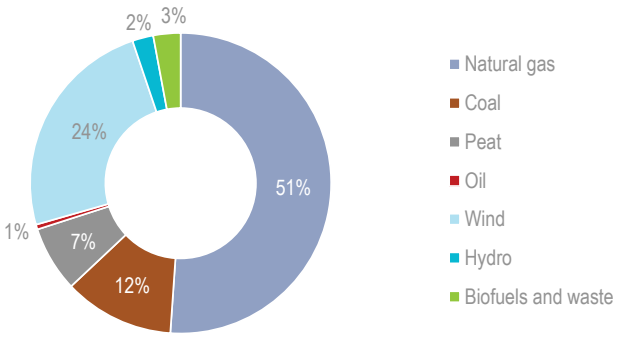
Renewable electricity*: 8.9 TWh (28.9% of electricity generation), IEA total 24.7%

* Excluding non-renewable waste.

Overview

Ireland has seen significant changes in the electricity sector since its last in-depth review (IDR) in 2012. The share of wind generation reached almost 25% of total electricity generation in 2017, up from 10% in 2007. Despite the strong increase in wind power, Ireland had the eighth-highest share of fossil fuels in power generation among International Energy Agency (IEA) member countries, at 71% in 2017. Natural gas accounted for over half of the total electricity generation (Figure 5.1).

Figure 5.1 Electricity generation by fuel source, 2017



Fossil fuels dominate electricity generation, but the share of wind power has increased rapidly, and accounted for a quarter of total generation in 2017.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Ireland is interconnected with the United Kingdom and has had increased electricity trade in the last five years. Ireland went from being a net importer of electricity to a net exporter in 2016.

New wholesale market rules became effective on 1 October 2018, bringing the electricity market in alignment with the European Union (EU) target model.

Supply and demand

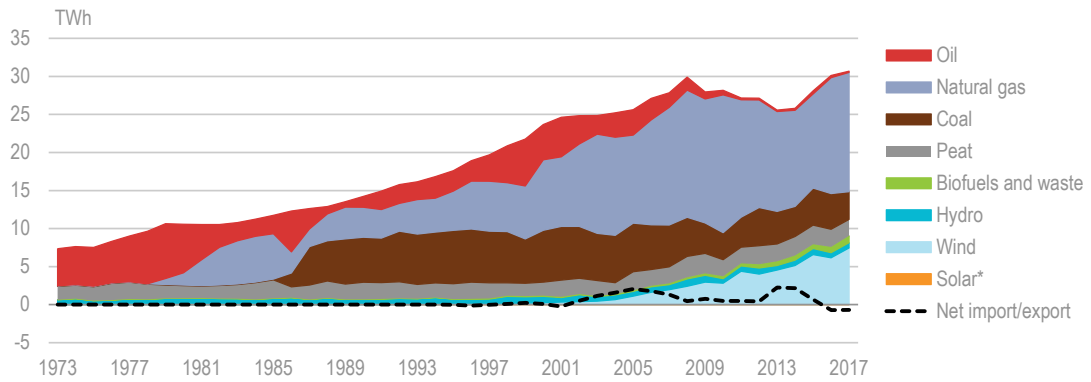
Generation and trade

Electricity generation has increased steadily in Ireland over several decades, except for the years following the economic crisis in 2008-13. Electricity generation has picked up again since 2014. It reached a record 30.7 terawatt hours (TWh) in 2017, a 19% increase in the three years from 2014 (Figure 5.2).

Natural gas is the largest power source in Ireland, accounting for 51% of total electricity generation in 2017. The total share of fossil fuels was 71%, down from 90% in 2007. The use of coal has decreased, but the share of peat has remained stable over the past decade at 7%. The role of oil in electricity generation remains small at 1%.

Electricity generated from renewable sources of energy (renewable electricity) is rapidly increasing in Ireland. The share of renewable electricity almost tripled in a decade, from 10% in 2007 to 29% in 2017, driven principally by growth in wind power. In 2017, wind accounted for 24% of total electricity generation. It was the second-largest source of electricity after natural gas and the third-highest share of wind generation among all IEA countries. Other renewables were hydro (2%), biofuels and waste (3%, of which 0.5% was non-renewable waste), plus a minuscule share of solar (0.02%).

Figure 5.2 Electricity generation by source and electricity trade, 1973-2017



Shares of natural gas and renewable energies have increased, and Ireland became a net exporter of electricity in 2016.

* Negligible.

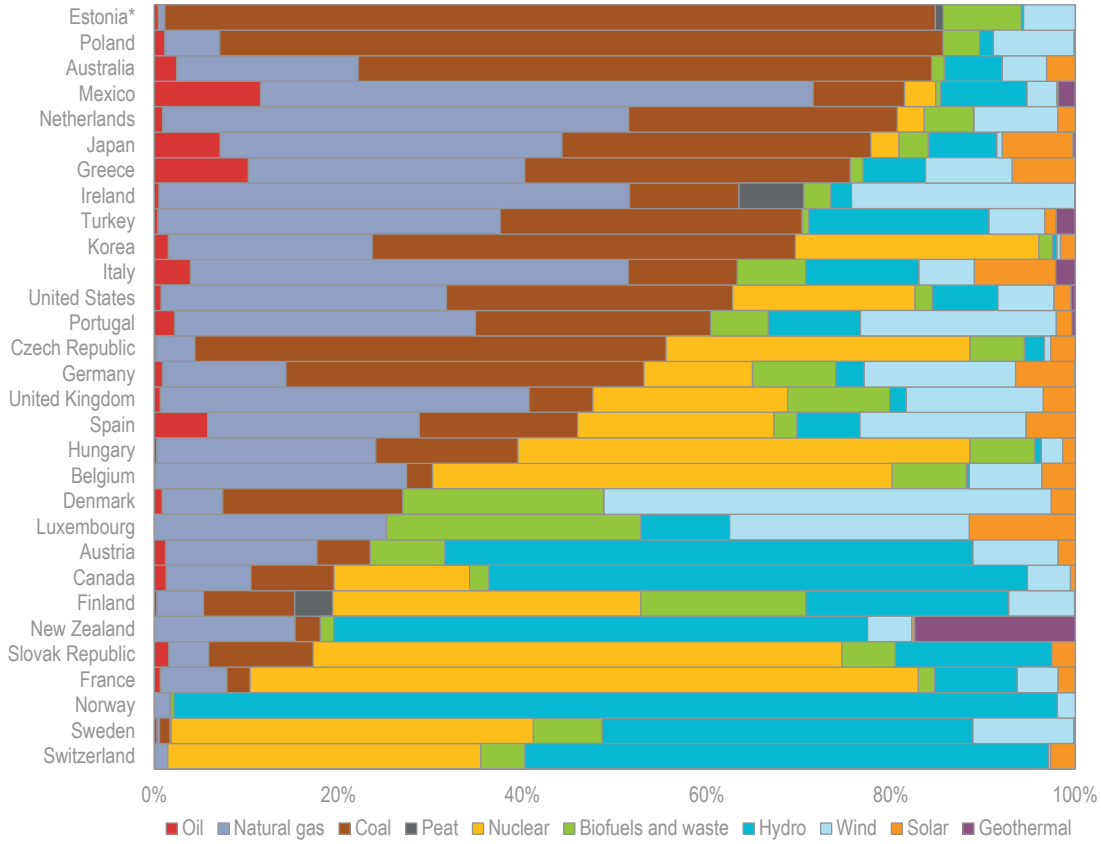
Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

All of Ireland's electricity trade is with or through the United Kingdom. Ireland was a net importer of electricity from 2002 until 2015; however, this shifted to a net exporting status in 2016 (see Figure 5.2).

This reversal from importer to exporter was due to two factors. First, Ireland increased domestic generation, mainly from increased wind power. And second, the application of a higher carbon floor price of 18 pounds per tonne of carbon dioxide in the United Kingdom since 2016 pushed the interconnector with Ireland up the merit order in the United Kingdom at the expense of coal-fired generation in the United Kingdom.

Ireland's share of fossil fuels in electricity generation was the eighth highest among IEA member countries in 2017, despite the increase in wind power (see Figure 5.3). Ireland had the highest share of peat and second-highest share of natural gas after Mexico.

Figure 5.3 Electricity generation by source in IEA countries, 2017



Ireland has the highest share of peat and the third-highest share of wind among IEA countries.

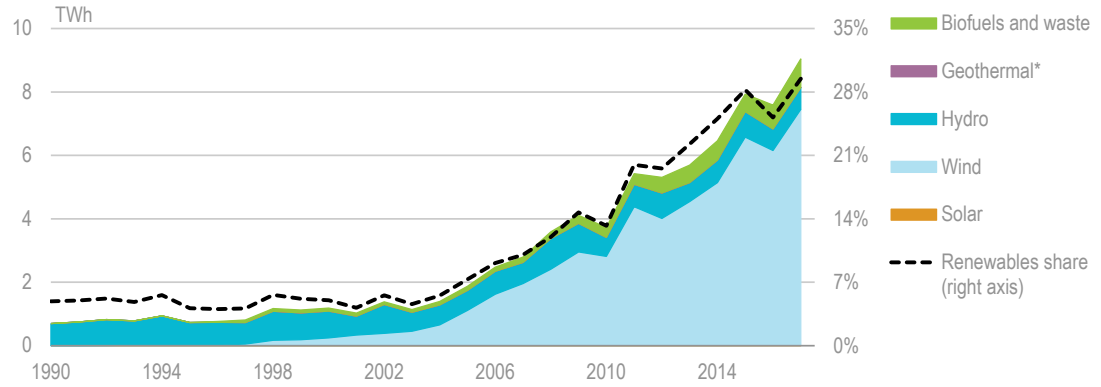
* Estonia's coal represents oil shale.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Renewable electricity

Ireland generated 8.9 TWh of electricity from renewable energy sources in 2017. This accounted for 29% of the total electricity generation, up from 10% in 2007 (Figure 5.4). Hydro was the largest source of renewable electricity in Ireland until the early 2000s, but wind power has rapidly increased to the point where it accounted for 82% of the renewable electricity generated in 2017. Wind power is weather dependent, and production declined slightly in 2016 due to poor wind conditions, despite more installed power. Wind power increased again significantly in 2017, by over 20%.

Figure 5.4 Renewable energy and waste in electricity generation, 1990-2017



After a drop in 2016 due to poor wind conditions, renewable electricity generation picked up again in 2017, and continued on the rapid growth trend of the last decade.

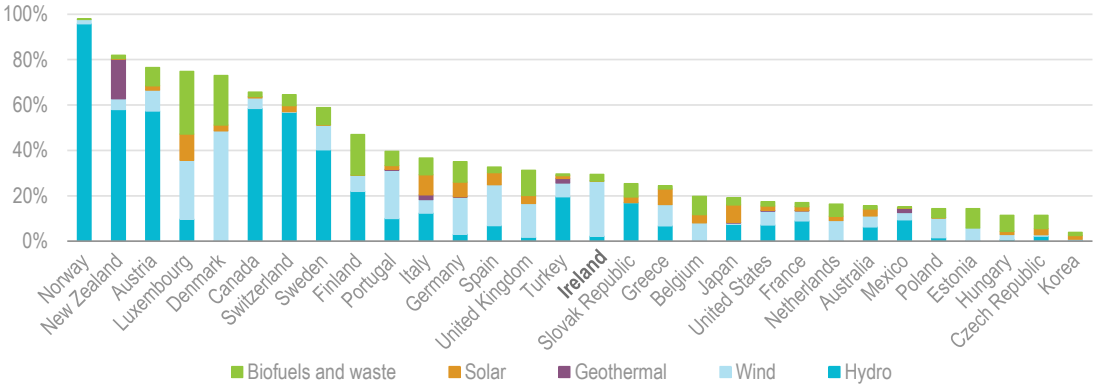
* Negligible.

Note: Includes non-renewable waste of around 0.160 TWh in 2017.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Ireland has around the median share of renewables in electricity generation among IEA member countries (Figure 5.5). Its share of wind power is the third highest after Demark and Luxembourg.

Figure 5.5 Renewable energy in electricity generation in IEA countries, 2017



Ireland's share of renewable energy in electricity generation is around the median among IEA countries.

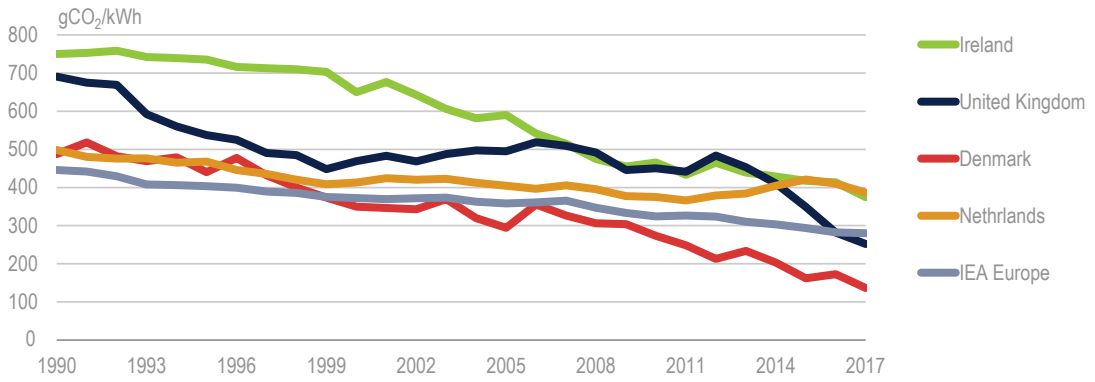
Note: Includes non-renewable waste.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Carbon intensity of electricity supply

Ireland's electricity generation is becoming less carbon intensive as a result of the switch from coal to natural gas and the strong increase in renewables. The carbon intensity of power and heat generation has halved from 750 grammes of carbon dioxide (gCO_2) per kilowatt hour (kWh) in 1990 to 375 gCO_2/kWh in 2017 (see Figure 5.6). This was the same level as the IEA total, but 34% above the total among IEA European countries.

Figure 5.6 Carbon intensity of power and heat generation in Ireland and selected IEA countries, 1990-2017



The carbon intensity of Ireland' electricity generation has halved since 1990, but remains higher than the IEA European total.

Note: 2017 data are estimated.

Source: IEA (2018b), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

Installed capacity

Ireland's total installed power-generating capacity increased from 6.4 gigawatts (GW) in 2006 to 9.9 GW in 2016, equivalent to a 54% growth (see Table 5.1). Installation of wind farms has seen rapid growth in recent years, and the share of renewables in the total installed capacity has nearly tripled over the last decade.

Table 5.1 Installed electricity-generating capacity, 1990-2016 (megawatts (MW))

Energy source	1990	2000	2005	2010	2011	2012	2013	2014	2015	2016
Hydro	513	528	526	237	237	529	529	529	529	529
Wind	0	119	517	1 374	1 631	1 764	1 941	2 211	2 440	2 827
Combustible fuels	**3 294**	**4 064**	**5 132**	**6 407**	**6 427**	**6 295**	**6 327**	**6 342**	**6 586**	**6 583**
Steam	2 608	2 858	2 768	2 268	2 268	2 283	2 291	2 296	2 085	2 085
Gas turbine	359	423	804	1 790	1 790	1 800	1 807	1 807	2 271	2 271
Combined cycle	258	735	1 481	2 240	2 240	2 075	2 083	2 087	2 085	2 082
Other*	69	48	79	109	129	137	146	152	145	145
Total capacity	**3 807**	**4 711**	**6 175**	**8 019**	**8 296**	**8 589**	**8 798**	**9 084**	**9 557**	**9 945**

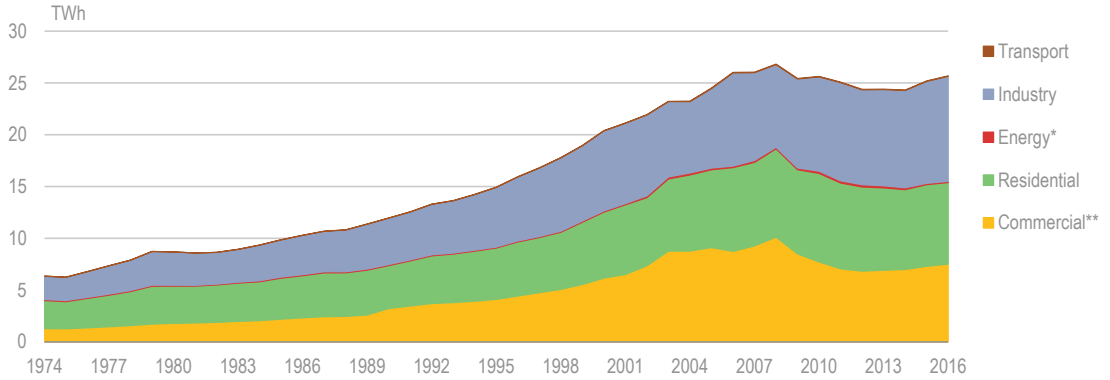
* *Other* includes internal combustion engines and other types of generation.

Source: IEA (2018c), *Electricity Information 2018*, www.iea.org/statistics/.

Demand

Ireland consumed 25.7 TWh of electricity in 2016. This was a 2% increase from 2015, but a 3% decline from 2006 (see Figure 5.7). The industry sector dominates electricity consumption. In 2016, industry represented 39.5% of the total consumption, including around 5% for data centres (Host in Ireland/SEAI, 2017), followed by the residential sector (30.6%) and commercial sector (29.2%). The shares of the transport (0.2%) and energy sectors (0.4%) were negligible.

Figure 5.7 Total final electricity consumption by consuming sector, 1974-2016



Final consumption of electricity slightly increased in 2016 compared to 2015, with a growth in all sectors.

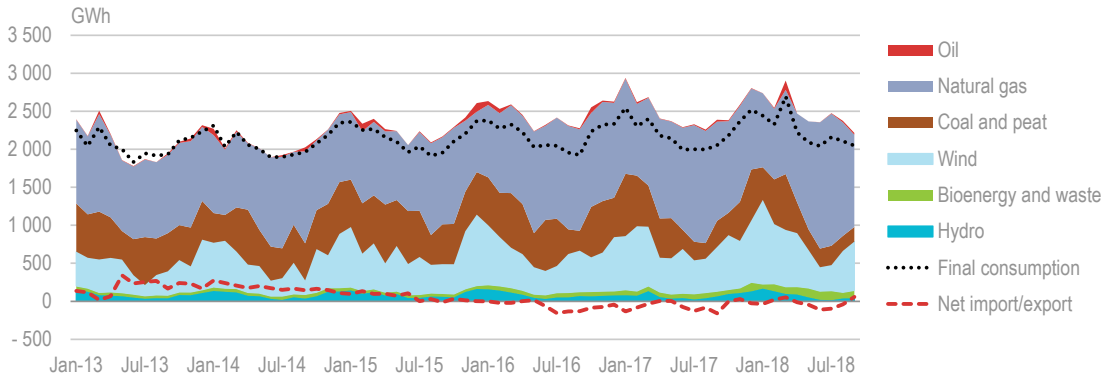
* *Energy* includes petroleum refineries and brown coal briquettes plants.

** *Commercial* includes commercial and public services, agriculture and forestry.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

There are significant seasonal variations in consumption and generation of electricity. Ireland's electricity consumption peaks in the winter (see Figure 5.8). The monthly electricity production profiles show that power generation is matched well with the seasonal demand. Wind power generates more electricity in the winter than in the summer, but coal and gas remain essential to cover the higher demand during winter.

Figure 5.8 Monthly electricity generation by source, January 2013-September 2018



Wind power generation is largest in the winter and matches the demand profile, but coal and natural gas are required to cover variations in seasonal demand.

Source: IEA (2018d), *Monthly Electricity Statistics 2018*, www.iea.org/statistics/.

Retail prices and taxes

Retail market and prices

Ireland's consumers pay relatively high electricity prices among the IEA member countries. In 2017, Ireland's electricity price for industry was the eighth highest in the comparison.[1] The household price was the seventh highest (including 12% tax) and the third highest (excluding tax), after Spain and Australia (Figure 5.9).

The countries that have the most similar electricity price trends to Ireland are the Netherlands, the United Kingdom, France and Germany. Industrial electricity prices in those countries decreased between 2014 and 2017, while household prices increased slightly between 2016 and 2017 (see Figure 5.10).

A public service obligation (PSO) levy is imposed on all electricity users in Ireland. The levy covers the additional costs associated with producing renewable electricity to support environmental protection and subsidises electricity produced from domestic peat that enhances security of supply (SoS). The PSO benefits from EU approval for state aid. The subsidisation of peat via the PSO levy will end in 2019.

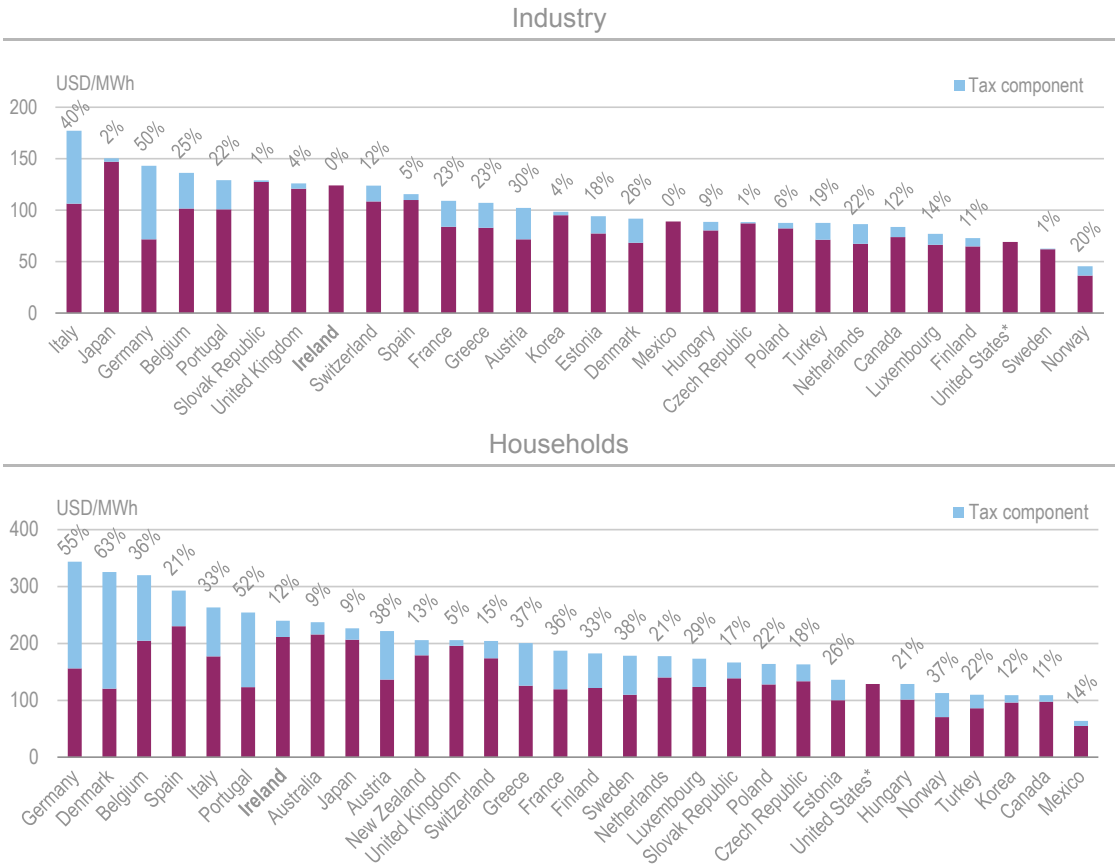
The Commission for Regulation of Utilities (CRU) determines the PSO levy annually. The levy varies annually depending on the extent of renewable deployment, the production of wind, and the difference between the wholesale price of electricity and the guaranteed price in the renewable and peat SoS programmes.

For the period October 2018 to September 2019, the total PSO was set at EUR 209 million (euros), a 56% decrease from the previous year (CRU, 2018a). However, this compares to a total PSO levy of EUR 92 million for the year 2011/12, at the time of the last IDR. The phasing out of the peat subsidy will remove this subsidy from the PSO levy. The levy is set at different levels for the different customer groups. It is not based on consumption, but paid for each electricity account according to the customer category and capacity of connection. The yearly levies for the different customer groups are as follows:

- domestic households pay EUR 41.71 for 2018/19, down from EUR 92.28 in 2017/18 but up from EUR 19.33 in 2011/12
- small commercial customers pay EUR 144 for 2018/19, down from EUR 319 in 2017/18 but up from EUR 57 in 2011/12
- medium and large customers pay EUR 15.8 per kilovolt ampere (kVA) annually, down from EUR 43.7/kVA in 2017/18, but up from EUR 8.58/kVA in 2011/12.

[1] Includes taxes paid by the consumer as part of the transaction and which are not refundable. This excludes value-added tax (VAT) paid in many European countries by industry (including electric power stations) and by commercial end users for all goods and services (including energy). In these cases, the VAT is refunded to such purchasers, because for VAT purposes, they are considered intermediate, not final, consumers. The refund usually takes the form of a tax credit.

Figure 5.9 Industry and household electricity prices in IEA countries, 2017



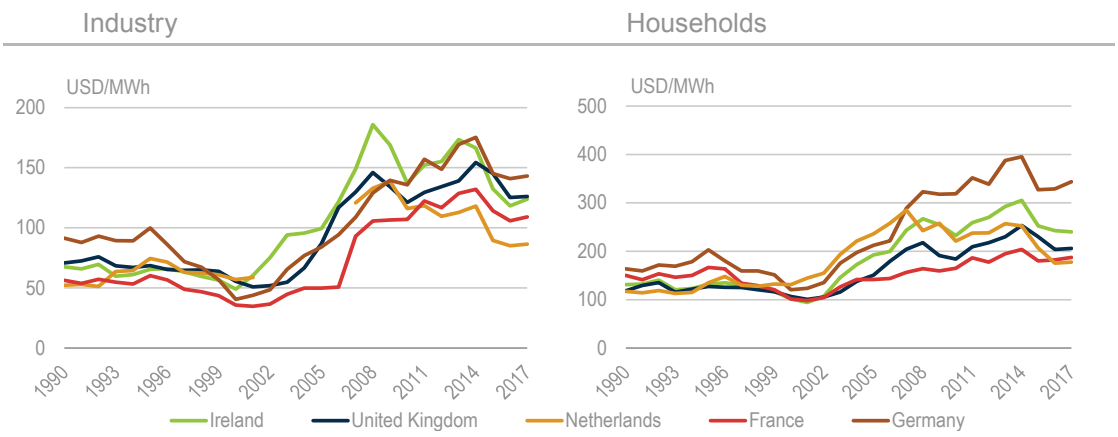
Industry electricity prices (excluding tax) show that Ireland's industry pays the fourth-highest price among IEA countries; Ireland's household prices (including tax) rank the sixth highest.

*Tax information unavailable for the United States.

Notes: Industry data are missing for Australia and New Zealand.

Source: IEA (2018e), *Prices and Taxes 2018*, www.iea.org/statistics/.

Figure 5.10 Electricity prices in Ireland and selected IEA countries, 1990-2017



Ireland's electricity prices are often higher than those in neighbouring countries, but have followed similar trends in recent decades.

Source: IEA (2018e), *Prices and Taxes 2018*, www.iea.org/statistics/.

Institutions

The **Department of Communications, Climate Action and Environment** (DCCAE) is the lead government ministry with responsibility for energy policy. It determines policy in relation to the three energy policy pillars of energy security, competitiveness and sustainability. If there is a national-level electricity emergency, the department leads the National Emergency Co-ordination Group.

The **CRU** is the independent regulator of natural gas and electricity. Previously named the Commission for Energy Regulation, its mission is to regulate the gas and electricity markets and gas, electrical and petroleum safety. The CRU also has the authority to take any necessary actions in power or gas emergency situations. The CRU participates in the regulation of the single electricity market (SEM) as part of the Single Electricity Market Committee (SEMC) (see below).

EirGrid is the state-owned electricity transmission system operator (TSO) and market operator. It is responsible for planning and developing the transmission system, scheduling and dispatching generation, operating the electricity market and ensuring system stability. It also plans the development of the transmission network. EirGrid Group owns the System Operator Northern Ireland (SONI), the Northern Ireland Electricity Transmission Operator and the East–West interconnector.

The **Electricity Supply Board Networks** (ESBN) is the state-owned electricity transmission asset owner responsible for the construction, operation and maintenance of all electricity transmission and subtransmission networks in Ireland. It is also the distribution asset owner and the distribution system operator, and funds all investment in the distribution system in Ireland. The ESBN is a ring-fenced subsidiary of the Electricity Supply Board (ESB) group.

The **SEMC** is the decision-making authority for all SEM matters. It aims to protect the interests of consumers of electricity by promoting competition among persons engaged in, or in commercial activities connected with, the sale or purchase of electricity through the SEM. Its membership comprises the CRU, the Utility Regulator in Northern Ireland and independent members.

Market structure

State-owned companies still play a dominant role in the generation and retail markets. However, competition is steadily increasing, with the number of actors in the generation and supplier markets growing. This is resulting in more-balanced market shares held among competing companies. Changes in electricity market design since October 2018, the anticipated retirement of part of the generation fleet, smart metering and the introduction of provisions for prosumers will contribute to an increase in competition.

Generation and generation adequacy

The state-owned ESB is a vertically integrated company and owns about 47% of the generation capacity in Ireland. It has a generation portfolio that includes the country's only coal-fired power station (Moneypoint), two peat-fired power stations, several gas units and an increasing portfolio of renewable generation.

The Moneypoint plant is Ireland's single largest power station, with a total capacity of 915 MW. It accounted for almost 12% of the total generation in 2017. The plant underwent a EUR 500 million environmental retrofit in 2016 to reduce emissions of particulate matter of nitrogen and sulphur oxides. The Moneypoint plant is essential for ensuring the SoS, providing stability to an electricity system that is increasingly integrating intermittent generation. It is also critical for supplying electricity to the greater Dublin area, as it connects to the starting point of a 400 kilovolt (kV) transmission line serving the metropolitan area.

However, as part of the government's commitment to decarbonisation of the power sector, the Moneypoint power station will stop using coal by the end of 2025 and may be converted to a lower-carbon technology. Moreover, the three Irish peat-fired generation stations are expected to phase out peat gradually and to cease burning it by 2030 at the latest. Together, they account for 346 MW of capacity. The government is working through the implications of the conversion of Moneypoint, the replacement of the three peat plants and the practical steps needed to be taken, and is committed to reaching a decision before 2020.

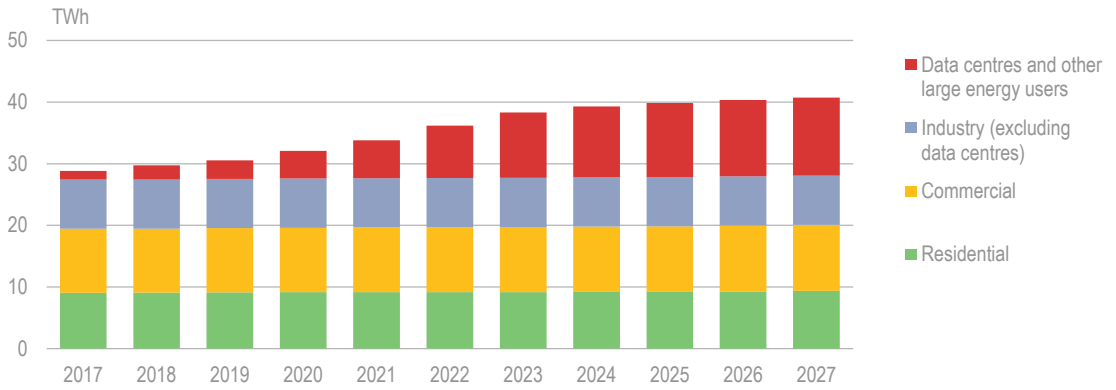
EirGrid notes in its generation capacity statement 2018-27 that there are no plans for potential new conventional generators to come on line. Moreover, EirGrid points out that several older generating stations are due to be decommissioned, mainly due to emissions restrictions. Two stations (Marina CC and Aghada), with a total capacity of 353 MW, were closed in August and September 2018. An additional 786 MW of capacity is scheduled to cease operations in 2022 and 2023 (EirGrid, 2018a). If all these closures go ahead, Ireland could lose about 2.4 GW of installed thermal capacity by the mid-2020s.

EirGrid projects the installation of an additional 2.6 GW of wind power by 2027. It assumes several solar photovoltaic (PV) and biomass co-generation[2] plants will come on stream. The Irish generation system was in a position of significant generation capacity surplus at the beginning of 2018. However, this surplus is continuously being eroded, as plants are shut down and electricity demand increases. Deficits in the Irish generation market are possible from 2024 under the high demand growth scenario set out by EirGrid (EirGrid, 2018a).

A key driver for electricity demand in Ireland is expected to be the connection of data centres to the grid. A significant proportion of this extra load could potentially materialise in the Dublin region (see the chapter on "General energy policy"). EirGrid based its electricity demand forecast on several scenarios to estimate the impact of data centres on future electricity demand in Ireland. Data centres and other large energy users could account for 31% of the total demand by 2027 in its median demand scenario (EirGrid, 2018a). The demand for electricity in the other sectors (industrial, commercial and residential) is expected to remain stable (see Figure 5.11). Such a scenario might place stress on the resilience of the electricity system. It will require regular assessments of the power networks to identify required improvements of the existing infrastructure in the short, medium and long terms to meet the growing demand in Ireland.

[2] *Co-generation* refers to the combined production of heat and power.

Figure 5.11 Annual demand forecast 2018-27, median demand scenario



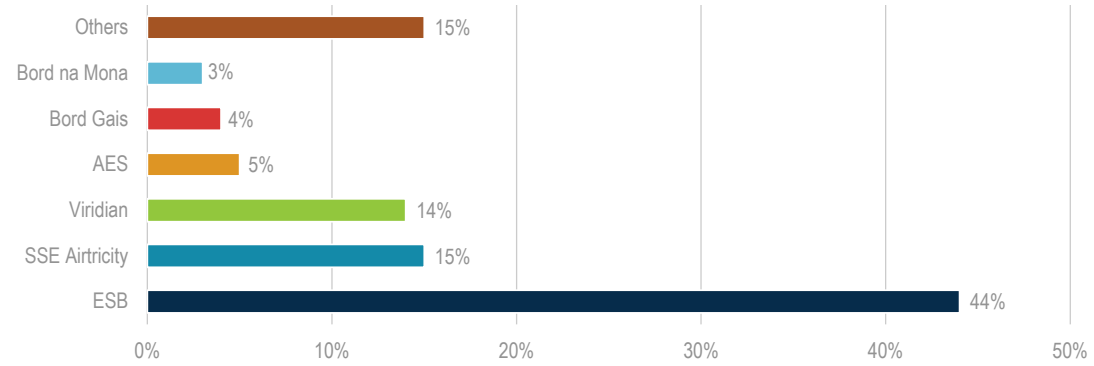
Data centres and other large energy users are projected to grow rapidly and account for nearly one-third of total electricity demand by 2027.

Source: EirGrid (2018a), *All-Island Generation Capacity Statement 2018-2027*, http://www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_2018.pdf.

Wholesale market

There are over ten companies active in the wholesale market of the SEM. The ESB is the largest player in the SEM and accounted for 44% of generation in the first quarter of 2018 (Figure 5.12). The next two largest companies are private, with SSE Airtricity accounting for 15% and Viridian for 14% of the total wholesale market. There are several other smaller players, such as Tynagh (privately owned), Aughinish (privately owned) and the semi-state-owned Bord na Móna, each accounting for 5% or less of generation in 2017. Imports via the interconnection with Northern Ireland accounted for 1% (SEMC, 2018a).

Figure 5.12 Electricity wholesale market share by company, first quarter, 2018



The ESB is the largest player in the all-island wholesale market, with nearly half of the total market share.

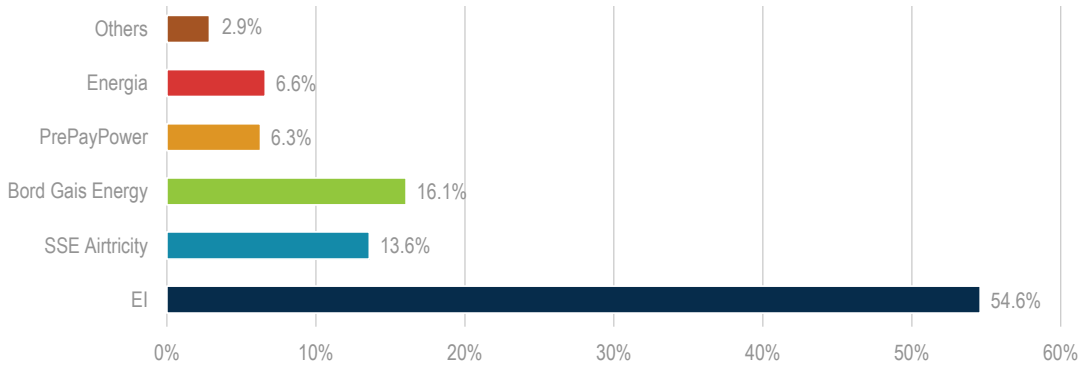
Source: SEMC (2018a), *SEM Monitoring Report: Q1 2018*, www.semcommittee.com/sites/semc/files/media-files/SEM-18-033%20-%20MMU%20quarterly%20report%20Q1%202018_0.pdf.

Retail market

The CRU does not regulate supplier prices as part of its functions. It is responsible for monitoring the Irish electricity and natural gas retail markets to ensure that competition continues to develop. Competition in the electricity retail market is continuously increasing. Twelve suppliers were active in 2017, compared to eight at the time of the last IDR. Not all are serving the domestic and business market segments; seven suppliers serve the business market. Two new suppliers entered the domestic electricity market in 2017, bringing the total to ten. Seven suppliers are "dual suppliers", offering electricity and gas.

The domestic market share (measured in consumption) of Electric Ireland (EI), the ring-fenced supplier arm of the ESB, fell below 50% in 2017 for the first time and stayed below this level in the first quarter of 2018 (CRU, 2018b). (EI had a market share of 58% in 2010.) Bord Gáis Energy continued to hold the second-largest domestic market share in 2017 with 17.8%, followed by SSE Airtricity with 15.3%. The remaining suppliers were Energia (7.9%), PrePayPower (5.9%), Panda (1.5%) and Pinergy (1.4%). Only suppliers with a market share above 1% are reported separately in the regular market monitoring report of the CRU (CRU, 2017a). Expressed in the total number of domestic customers, the EI share was almost 55% of the retail market, with Bord Gáis Energy having a share of 16% and SSE Airtricity 14% (Figure 5.13).

Figure 5.13 Retail market share by company, fourth quarter 2017



EI is the largest retailer, accounting for over half of the total market share.

Source: CRU (2017a), *2017 Electricity and Gas Retail Markets Annual Report*, www.cru.ie/wp-content/uploads/2018/07/CRU18126-2017-Electricity-and-Gas-Retail-Markets-Annual-Report.pdf.

The business segment is divided into three submarkets: small and medium-sized business markets and large energy users. EI was the single largest supplier in terms of consumption in those three markets. It had the highest share in the medium-sized market at 39%. However, the other suppliers are steadily gaining market share, especially Energia and SSE Airtricity.

The Herfindahl-Hirschman index (HHI) is a commonly used metric to measure market concentration. The European Commission considers an HHI above 2 000 to signify a highly concentrated market. The HHI in the Irish electricity market is above that threshold for all four market segments, indicating a high level of market concentration dominated by the incumbent supplier (CRU, 2017a). Overall, the level of concentration in the non-domestic market segments is lower than in the domestic market segment (CRU, 2017b).

In the 2015 White Paper, the CRU committed to undertaking a consumer-focused assessment of the development of competition in the electricity and gas retail markets (DCENR, 2015). The final report (CRU, 2017b) identified measures to enhance transparency, competition and consumer engagement. One such measure relates to the revision of the new registration process (NRP) that favours EI over the other market players. Under the NRP, any consumer who does not initially choose a supplier will be allocated to EI as the default supplier. The CRU is planning to replace the NRP in 2019 with a new system.

The CRU has been crucial in safeguarding the customer switching process, ensuring that it is reliable, transparent and simple for customers. The Irish domestic electricity market therefore had the fifth-highest switching rate in 2016 compared to other EU member states (CRU, 2017a).

The switching rate was 14% in 2017, a decrease of 1.2% from 2016. However, about 8% of customers renegotiated with their existing supplier, bringing the total switching rate to 22% for 2017. Switching is encouraged by retailers who offer low prices on an initial 12 month contract. Once that contract expires, clients automatically move to a higher-priced standard contract, unless they either renegotiate the contract with their existing supplier or switch to another supplier. The CRU found low levels of repeat switching in its 2017 survey: 65% of domestic customers who had switched suppliers in the last 12 months had been reverted to the standard contract (CRU, 2017b). The CRU identified factors that possibly prevent customers from switching. These included the absence of clear information, complexity of tariffs and lack of trust in the market.

As an immediate response to those findings, the CRU amended the supplier handbook, which defines minimum standards of protection for all consumers. This was the first revision since publication in 2012, as it became necessary to ensure that regulatory requirements on suppliers remain reflective of the fast-evolving market conditions. One of the amendments requires suppliers to issue a written annual notification to prompt consumers who have been on the same tariff or a non-discounted tariff for more than 3 years to consider switching (CRU, 2017a).

All suppliers have been free to offer electricity prices without any prior consultation with or approval by the CRU since the ending of the CRU setting of EI prices for domestic consumers in April 2011. Suppliers now offer a wide range of tariff plans, allowing domestic customers to choose among different tariffs that comprise standing and unit charges. In some instances, a daily service charge independent from consumption is used for prepaid meters. Other tariff plans link electricity rates to the method of payment or billing (e.g. paperless, on line, direct debit, etc.). All suppliers are required to publish details of their tariff plans.

There are two CRU-accredited price comparison websites that provide transparent comparisons for domestic consumers: bonkers and switcher. However, there are none for non-domestic consumers. This may result in lower transparency in that market segment and could affect small businesses (CRU, 2017b). The increasing nature of bespoke tariff plans offered by suppliers challenges the price comparison tools to capture all differences. This can prevent customers from easily understanding the various parts of their bills and reduce transparency and willingness to switch. Moreover, overly complex tariff and billing arrangements can make it difficult for customers to adapt their consumption behaviour to reduce energy consumption.

Smart metering

The ESBN plans to roll out 2.25 million smart meters by 2025, in three phases as part of the National Smart Metering Programme (NSMP). This is a multi-year investment project including the roll-out of new digital electricity (and gas) meters, a communications network to support them and investment in new information technology systems. The CRU is responsible for the overall co-ordination of the NSMP in the electricity (and gas) sectors. The ESBN is responsible for the day-to-day implementation of the NSMP roll-out in the electricity sector (CRU, 2017c). The total project cost is estimated at EUR 1.2 billion. Customers will not pay upfront charges for installation of smart meters, but costs will be recovered through regulated infrastructure charges on electricity bills.

The ESBN will install 250 000 smart meters in the first phase (2019-20). Priority is to be given to those consumers who explicitly request smart meter installation and to the replacement of old meters that are approaching the end of their technical life. Smart services such as time-of-use tariffs and smart bills will become available at the end of 2020, so that consumers can benefit from the additional services provided before the entire NSMP has been delivered.

The ESBN will then install approximately 500 000 meters in each of the four subsequent years. In the second phase (2021-22) additional functionalities of the smart meters will include a new form of smart prepayment. Consumers will be able to pay for their energy up front without the need for an additional meter in their homes, as the meter can be controlled remotely. In the third phase (2023-24), the ESBN will make a home area network available to allow consumers to access real-time data on their household's energy usage via a device in their home (CER, 2017c). The rationale for the phased implementation is to reduce the technical complexities, to undertake regular reviews of the progress made and to take any remedial action necessary. Once fully implemented, the NSMP will transform the way the electricity market operates (CRU, 2017d).

Smart meters will facilitate introduction of innovative products and services, providing more choice to consumers in terms of usage and tariffs, eliminating the need to use estimated meter readings and facilitating the switching process. The smart functionality does not occur at the meter itself, rather at the central level, thus enabling, for example, seamless switching among suppliers by customers. The smart meters will allow for a read-out every 30 minutes and can thereby facilitate time-of-use pricing. Dynamic time-in-use tariffs for customers are the cornerstone of the Smart Metering Programme design. The CRU has announced the introduction of a standard smart tariff by requiring suppliers to offer customers three different time-of-use rates: a peak rate, a day rate and a night rate (CRU, 2017b). Many households should be able to save 2.5-3% on their electricity bills by using a smart meter.

Smart meters will also facilitate better network planning. This is of increasing importance for EirGrid in light of the move towards decentralised and intermittent electricity generation. The roll-out of smart meters at the distribution level is mirrored by the introduction of a smart grid at the transmission level (see the section on "Networks" below). Smart meters and smart grids are critical to support the policy targets set in the 2015 White Paper for a transition to a low-carbon energy sector with more competition, energy efficiency and renewable generation.

Market design

Ireland's electricity market entered a new and more competitive phase when the new all-island wholesale electricity market, the integrated single electricity market (I-SEM), went live on 1 October 2018. The I-SEM replaced the existing market arrangements of the SEM to bring the electricity wholesale market into compliance with the EU Third Energy Package through the introduction of the "target model", the common set of rules and standards for the wholesale markets, and the capacity allocation mechanism regulation.

It is important to note that the all-island electricity market is still called the SEM, even after the introduction of the new market rules. The I-SEM was the name of the project to develop and introduce the target model modalities. However, to avoid confusion, this chapter refers to the old market rules as the SEM and the new rules as the I-SEM.

From the SEM….

The SEM has been operating since 2007 as the all-island wholesale electricity market covering two jurisdictions, Ireland and Northern Ireland (part of the United Kingdom), with one set of rules and regulations.

The SEM was operated as a mandatory pool until the end of September 2018. All electricity generated (above 10 MW) or imported had to be sold in the SEM. And all electricity for consumption or export had to be purchased from the SEM. Bids for generation were made once daily for the day ahead and matched with demand to arrive at the single island-wide system marginal price (SMP). In addition, generators received a capacity payment if they were available to generate (even if not called upon), and they received constraints payments if delivered and scheduled generation differed due to technical operating constraints of the SEM.

The market operator, the single electricity market operator (SEMO), settled the market based on the SMP as there was no separate balancing market. The SMP was therefore an ex post clearance price, and market participants did not know in advance what price they would receive or pay. However, they were also not exposed to the risk of having to use a balancing market to meet their commitments.

The SEM lacked flexibility as it allowed trading in only one market and was not designed to best accommodate the sharply increasing production from variable renewables. As part of Ireland's commitment to integrate the SEM with European electricity markets through market coupling, the I-SEM project has been pursued under the general supervision of the SEMC, to reform the existing market structure towards the target model.

…to the I-SEM

The I-SEM market rules went live on 1 October 2018. The I-SEM is now coupled with the other EU member states via Great Britain using single day-ahead market coupling. This has facilitated Ireland's participation in the EU internal energy market.

The new arrangements provide the benefits of European market integration, by maximising the efficient use of interconnectors and through competitive outcomes. The impact assessment of the new market design indicates that it will deliver reduced curtailment of variable generation and more-efficient flows across the interconnectors, dictated by the price signals.

The I-SEM consists of five markets: forward, day ahead, intraday, balancing and capacity. Each of the five markets covers different periods with a separate, but related, clearing and settlement mechanism, covering energy and non-energy supplies. However, prices in the *ex ante* and balancing energy markets make up the bulk of the wholesale electricity price in Ireland. There is a possibility that rising wholesale gas prices will continue to feed through to higher wholesale electricity prices in coming months.

The forward market is operated as a financial market only where no physical trade will take place. The SEMC, which remains the decision-making body for the I-SEM, commissioned several consultation papers to assess the benefits and challenges of a physical forward market. It eventually concluded that the small size and relative isolation of the Irish market made its introduction challenging. Instead, physical trading should be concentrated on the day-ahead and intraday markets to ensure maximum transparency of the markets.

The new I-SEM day-ahead market offers hourly contracts and complex orders. Furthermore, three intraday auctions have been set up. Two of them will be coupled with Great Britain, and one remains local within the I-SEM. The I-SEM also offers a local continuous trading platform for electricity.

It might be prudent to closely monitor the functioning of the I-SEM on a regular basis, in particular price volatility, and to reconsider the introduction of a physical forward market if market participants appear unable to satisfactorily deal with uncertainties.

The I-SEM is expected to provide a range of benefits to the Irish consumers and the energy system. The new and more competitive trading arrangements will allow better use of existing infrastructure assets in the electricity system, and will ensure that the interconnectors operate in the most-efficient way, especially for system balancing. Moreover, the I-SEM is expected to send clearer signals to investors and to reward those generators that are best meeting the needs of the Irish market. The I-SEM will also facilitate continued growth of renewable generation, which is expected to reduce prices for consumers and which is critical for long-term decarbonisation of the Irish energy system.

The new capacity remuneration mechanism (CRM) is a competitive auction that determines the value of capacity in the market. It introduces penalties for generators that receive reliability option payments after a successful bid but are then not available to produce. In systems with high variable electricity production, such as in Ireland, energy-only markets can make it difficult for the thermal capacity to recover long-term investment as they are called upon last in the merit order and therefore earn less revenue. This is of particular concern for isolated island markets such as the Irish one. Yet, the electricity system still needs thermal capacity in periods of high demand and low renewable output.

The regulatory authority and the SEMC estimated a savings potential of EUR 200 million for 2018-19 from the competitive bidding compared to the earlier procedure of market-wide capacity payments. Only those capacity providers with successful bids will receive payment in the CRM. All suppliers pay the cost of purchasing capacity; however, capacity providers are obliged to refund revenues above a regulated maximum price back to suppliers. The capacity market also allows the aggregation of small or intermittent generators.

The European Commission approved the CRM in November 2017. The first auction under the CRM took place in December 2017 for capacity for May 2018 to September 2019 (T-1 time frame), and the results were announced in January 2018. Out of 100 bids received, contracts were awarded to 93 for a total of 7 774 MW, with a clearing price of EUR 41 800/MW, which was well below the price cap of EUR 123 190/MW. The seven unsuccessful bids represented a total capacity of 1 230 MW. In addition, 619 MW of demand-side response, including 245 new demand-side units, were successful in the auction.

Some of the companies behind the seven unsuccessful bids are considering closing down the concerned coal and gas-fired units. In Ireland, 353 MW of capacity (owned by the ESB) has already notified intention to close, either because of unsuccessful bids or because the plants were approaching the end of life and had intended to close anyway (EirGrid, 2018a).

The CRM also includes provisions for a T-4 auction, an auction for delivery in four years' time. The purpose of the T-4 auction is to allow for efficient entry and exit from the market. The first T-4 auction will take place in March 2019 for delivery in 2022/23 (SEMC, 2018b).

Networks

The European Commission certified EirGrid as the independent state-owned TSO for Ireland in 2013. EirGrid also holds the licence as market operator in Ireland. It is the owner of SONI, the licensed TSO and market operator in Northern Ireland. The SEMO is part of the EirGrid Group and operates the SEM on the island of Ireland. EirGrid is responsible for day-to-day operation, system planning and management of the all-Island transmission grid. It offers regulated third-party access to market participants for connection to and use of the transmission system. The CRU regulates those conditions.

The ESB owns the Irish transmission and distribution systems through its ring-fenced subsidiary ESBN. The ESBN holds the licence as transmission asset owner. This is in line with the government's position in its 2015 White Paper that the country's electricity networks are strategic national assets that will not be sold. The ESBN also owns the distribution system and holds the distribution system operator (DSO) licence. The ESB owns Northern Ireland Electricity, the Northern Ireland distribution and transmission network owner.

Wind power will constitute the main source of renewable electricity generation towards meeting Ireland's 2020 target of 40%. This implies operating the electricity system on the island of Ireland with up to 75% of instantaneous demand from non-synchronous generation. Not many countries have reached such levels of non-synchronous renewable penetration, and a small isolated system that has no synchronous interconnection to other European systems adds to the technical challenges. The electricity system is already capable of accommodating up to 65% instantaneous demand from non-synchronous generation. This is a remarkable achievement and is the outcome of substantial innovation and research undertaken by EirGrid.

EirGrid launched a comprehensive pioneering technical analysis in 2011, the Delivering a Secure Sustainable Electricity System (DS3) programme. This involves all stakeholders in the Irish electricity system, including policy makers, regulators, TSOs and

DSOs, generators and key industry stakeholders, to deal with the challenges in the resilience of the power system in the integration of large shares of variable renewables. This challenge is compounded by the relative isolation of the Irish electricity system. The three key elements of the DS3 are: enhanced operational policies and grid/network code standards, network control centre tools and enhanced ancillary/system services (see Box 5.1).

Box 5.1 DS3 System Services

The strand of work focusing on enhanced ancillary services is called the DS3 System Services. Ancillary services typically include frequency control, and spinning and operating reserves to ensure that there is enough electricity flow to meet demand continuously. Generators have traditionally provided those services by using a limited set of proven technologies and receiving compensation through regulated prices. The value of the ancillary services provided in the all-island market was estimated at approximately EUR 60 million annually up to 2015. However, with the fast increase of intermittent generation, a different set of equipment and technologies is needed, and the mode and mechanism for remunerating ancillary services needs to be adapted.

The DS3 System Services is rolled out in phases. The first phase started on 1 October 2016 and ran until April 2018. It increased the number of services from seven to 11, provided by 107 units that were paid regulated tariffs. The budget for ancillary services is being gradually increased from EUR 75 million in 2016 to a maximum of EUR 235 million in 2020, when renewable electricity is expected to account for 40% of the total electricity generation. A transparent procurement process is held instead of bilateral contracts. The process is either based on regulated tariffs or a competitive mechanism, depending on the level of competition for each service. However, all contracts were based on regulated tariffs during the first phase while the SEMC examines options for the development of a competitive procurement process in the future.

The second phase of the DS3 System Services commenced in May 2018. The TSO executed a panel-based procurement process for new contracts for the 11 services; this was open to existing and new units who passed a qualification process. In addition, the TSO undertook a separate procurement process for three additional ancillary services in the second half of 2018, bringing the total number of services to 14. The procurement process will encompass all 14 services as of 2019, and will be continuously open for new participants to bid in their services. The DS3 System Services also includes an incentive mechanism for the TSO to reduce constraints on the network and enable increased integration of renewables.

At the DSO level, the ESBN is also working on smart grid technologies. It launched a pilot project on the Dingle peninsula in April 2018, in which the ESBN will deploy a range of technologies to understand how evolving technologies will interact with the electricity network of the future. A key component of the Dingle pilot project is the work with the local community in discovering what opportunities the future of energy can unlock for end customers. Under the project, smart devices on the network will help in monitoring and predicting the network events better, to ensure less outages and more resilience on the distribution network. Exploring the potential for enhanced energy efficiency measures among the local business community as part of the smart solution will also be pursued.

Transmission

The transmission system comprises approximately 6 400 kilometres (km) of high-voltage overhead lines and underground cables, and over 200 substations. Electricity generated in power plants is transformed to higher voltage levels – 110, 220, 275 and 400 kV – and fed into the transmission system (see Figure 5.14). The Dublin area is an exception as the 100 kV lines and cables and some of the 220/110 kV transformer stations belong to the distribution system.

EirGrid is working on two extensions to the transmission system, both related to expected strong demand increase in the greater Dublin area. The West Dublin Project includes the installation of a 220/110 kV gas insulation switchgear substation that will connect to an existing 220 kV double circuit line. The project is responding to a significant increase in demand associated with the growth of multinational companies in a business park in western Dublin. It is scheduled for completion in 2019 and is sized to accommodate potential future demand growth.

The Kilkenny-Laois reinforcement project will resolve SoS problems resulting from strongly growing demand and projected growth. The project comprises a new 400/110 kV substation near Portlaoise (which will be connected to the existing 400 and 110 kV lines), a new 110/38 kV substation in Kilkenny and new 110 kV overhead lines that link with the new substation near Portlaoise. The project is scheduled for completion in 2021.

Focus area: Interconnectors

Existing interconnectors

Ireland's geographical location causes challenges in interconnection with neighbouring countries. Ireland is exclusively connected to the United Kingdom through two electricity interconnectors that are also used for electricity trading. These are the 300 MW north–south interconnector, linking the electricity systems of Ireland and Northern Ireland, and the 500 MW east–west interconnector, connecting Ireland and Wales (United Kingdom). EirGrid owns and operates both interconnectors. Ireland is not meeting the indicative EU electricity interconnection target of at least 10% of installed capacity by 2020; its level of interconnection is 7.4%. Ireland will not have a direct electrical interconnection with the rest of the European Union when the United Kingdom leaves.

Interconnectors present benefits for the electricity markets such as improved SoS, diversification of electricity supply and increased flexibility for the integration of a high share of intermittent renewables. This is particularly important for a small system such as the Irish one. Ireland's policy position on interconnection as outlined in the 2018 *National Policy Statement on Electricity Interconnection* (DCCAE, 2018a) emphasises the important role of interconnection in transition to a low-carbon energy future. It may have a variety of wide-ranging benefits to the Irish consumer, including lower long-term costs of electricity through connection to a larger market and diversity of electricity supply.

Ireland's transmission network can safely absorb a level of renewable production generation of up to 42% of total electricity generated without affecting the SoS. Higher penetration levels, to which Ireland aspires, would require significant additional interconnection or energy storage. Further interconnections will be necessary.

Figure 5.14 Map of electricity infrastructure

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Developing interconnectors in Ireland

Ireland is pursuing three new projects for interconnectors: the second North–South interconnector, the Greenlink interconnector and the Celtic interconnector. All three projects are on the third list of the EU projects of common interest that are considered of national priority and important infrastructure projects for Europe. Only the Celtic interconnector would ensure continuous market coupling with the European Union once the United Kingdom has exited the European Union (table 5.2).

The existing North–South interconnector is running at full capacity and creates a bottleneck in the SEM. The construction of a new 400 kV alternating-current/1 500 MW overhead-line North–South interconnector is planned to improve the security of electricity supply across the island of Ireland, and to improve grid capacity and reliability in Ireland and Northern Ireland. The increased capacity will also facilitate connection of additional renewable capacity to the grid and help reduce curtailments. This is important in Ireland's commitment of 40% of electricity consumption from renewable resources by 2020.

Based on trading data since SEM has been in place in 2007, the electricity demand has been considerably higher than the current 300 MW capacity. There is a regular demand for cross-border transfer of more than 750 MW, with peak demand reaching 1 100 MW (SONI, 2016). The second North–South interconnector project has received planning permission in both jurisdictions, Ireland and Northern Ireland, but legal challenges to the planning consent have slowed progress. Construction is expected to begin in 2020, and the commissioning of the interconnector is planned for 2023.

The Greenlink project is a proposed 500 MW interconnector between Ireland and the United Kingdom. The proposed route runs from the Great Island substation, in Ireland, to the Pembroke substation, in Wales. Element Power, a private investor, promotes the project. The construction is planned to start in 2020, with the interconnector becoming operational in 2023. The CRU made an initial assessment of the Greenlink project in October 2018 and determined that it is in the public interest (CRU, 2018c). The CRU expects to undertake consultation in 2019 on the proposed regulatory regime to support Greenlink following the submission of sufficiently detailed financial and technical information from the Greenlink developer. The CRU is also closely liaising with the regulator for gas and electricity markets in Great Britain in the final project assessment process.

The Celtic interconnector is a proposed 700 MW connection between the south coast of Ireland and the north-west coast of France. EirGrid is developing this project in partnership with the French TSO. The length of the Celtic interconnector would be approximately 600 km, which is about three times longer than the existing East–West interconnector. The two TSOs lodged an investment request with the Irish and French regulatory authorities in September 2018. A decision is expected in March 2019. Construction is scheduled to commence in 2023 for completion in 2025-26.

The case for building the Celtic interconnector between Ireland and France is strengthened by the vote of the United Kingdom to leave the European Union. If built, this project will be the only direct electricity connection between Ireland and the EU electricity market. It could potentially benefit from higher funding through the Connecting Europe Facility than anticipated at the start of the project.

Table 5.2 Proposed extension projects of interconnectors in Ireland

Proposed infrastructure	Capacity (MW)	Connecting countries	Project promoter	Expected start date
Second North–South interconnector (EU project of common interest)	1 500	Ireland and the United Kingdom (Northern Ireland)	EirGrid	2023 (planning permission received)
Greenlink interconnector (EU project of common interest)	500	Ireland and the United Kingdom (Wales)	Greenlink	2023
Celtic interconnector (EU project of common interest)	700	Ireland and France	EirGrid	2025

Source: Country submission.

The National Policy Statement on Electricity Interconnection reflects the increasing importance of interconnection to national and EU policy. The statement outlines the drivers and benefits of interconnection and the potential impact electricity interconnection may have on the wider energy policy, market and system. The policy guides the CRU in determining its regulatory approach for electricity interconnections by setting out key policy parameters for consideration in the evaluation of interconnection projects. This will augment policy certainty for potential project developers.

Renewable electricity

Ireland is committed to reaching a share of renewable electricity of 40% by 2020 towards meeting its legally binding target of sourcing 16% of its total energy requirements from renewable sources under the 2009 EU Renewable Energy Directive. Reaching the 2020 target for renewable electricity generation will be challenging on the current trajectory. Recent policy initiatives by the government could accelerate the build-up of renewable generation capacity and contribute to closing the gap to the 2020 target.

Ireland has been supporting the installation of renewable energy through three consecutive renewable energy feed-in tariff (REFIT) programmes. The REFIT objective is to offer certainty to renewable electricity generators by providing a minimum price for each unit electricity fed into the grid over a period of 15 years. The REFIT programmes are funded by the PSO. EUR 145 million is allocated to support 3 835 MW of installed renewable capacity in 2019. This is a significant reduction from the 2018 allocation of EUR 374 million for 3 317 MW capacity (CRU, 2018a).

REFIT 1 supports 1 450 MW of small and large-scale onshore wind, biomass and landfill gas and small hydro. REFIT 2 supports 4 000 MW of large and small-scale onshore wind, biomass landfill technologies and small hydro. REFIT 3 supports 310 MW of diverse biomass technologies, including anaerobic digestion (co-generation and non-co-generation), other biomass, biomass combustion and co-firing (with peat). All three programmes are now closed for new applications. Construction of the last installations under REFIT 2 is ongoing until the middle of 2019 and under REFIT 3 until the end of 2019. The original deadlines for construction were extended as several investors had problems in completing the planning permission procedures, including obtaining grid access.

Enduring Connection Policy

The planning and grid connection process in Ireland can take several years to complete, as in most IEA countries. Applicants have frequently complained about the lengthy procedure to get a network connection. Connection to the transmission system is facilitated by a "gate procedure". This is designed for generators above 40 MW capacity in which applications are grouped on a first-come, first-served basis, independent from the status of the project approval process. The decision of whether a project is accepted depends only on the date of its application.

The gate procedure was first established in 2004, and has provided significant levels of wind onto the system. The last gate procedure closed in 2009. A separate connection procedure was established in 2009 for certain smaller renewable and other innovative low-carbon technologies to connect to the system. However, this non-gate process quickly became oversubscribed, in recent years with many solar PV project applicants, as there were no preconditions for a grid connection.

This has resulted in many projects waiting to receive connection offers. The CRU stated that the total volume of applications amounted to 36 000 MW. However, it noted that many of those projects are possibly speculative in nature and could be holding up genuine projects from being realised (CRU, 2018d). The outstanding applications should be seen in the context of the total grid-connected installed capacity, the capacity of the transmission and distribution system, and the level of peak demand.

The CRU therefore launched a new connection policy, the Enduring Connection Policy (ECP). The first stage, ECP-1, opened on 27 April 2018 for all generating and storage technologies and closed on 28 May 2018. The key change in the ECP is that generators are now required to be "shovel ready", meaning they have obtained a valid planning permission for their installation before they are eligible to apply for a grid connection. Alternatively, applicants that can provide certain DS3 ancillary system services are being prioritised as they offer needed system services. A 400 MW threshold for DS3 services was set based on advice from EirGrid on the volume of system services it might need to procure over the coming years to bring down curtailment levels. The successful applicants for the first ECP batch were announced in August 2018 and included 591 MW of projects with planning permission and 371 MW of DS3 applicants (EirGrid, 2018b). The CRU plans to invite applications for the second stage in 2020.

Renewable Electricity Support Scheme

The government is finalising details for a new Renewable Electricity Support Scheme (RESS). Its primary aim is meeting Ireland's renewable energy contribution to the EU-wide target for 2030 of 32% of renewables in total final consumption. Key decisions relate to the diversity and scale of supporting commercial renewable technologies and the overall costs of the programme. While wind power is expected to account for the largest increase in renewable electricity generation, the RESS aims specifically to broaden the renewable technology mix in Ireland.

The RESS is expected to become operational in 2019, subject to receiving state aid clearance from the European Commission. The new programme has been developed in accordance with the 2014 EU state aid guidelines for national RESSs. Under these, support levels must be set through a competitive bidding process, an auction system. In addition, all new programmes should offer a premium in addition to the market prices,

instead of setting a fixed price as under earlier programmes. The RESS will therefore see a series of renewable technology competitive auctions run throughout its lifetime. The RESS high-level design was approved by the government in July 2018 and contains an indicative auction roadmap. The exact quantities of new renewable generation capacity to be procured in each auction round will be informed by Ireland's National Energy and Climate Plan for 2021-30. It is expected that the first auction in 2019 will invite bids for 1 000 gigawatt hours and that this will sharply increase for the second auction in 2020.

The RESS design includes a focus for increased community-based ownership of and participation in renewable energy installations, in line with the ambitions laid out in the 2015 Energy White Paper to involve citizens in the energy transition in Ireland. A distinct "community" category will be included in the second RESS auction, accounting for a maximum of 10% of the total capacity auctioned. The designated share will be reviewed regularly. The DCCAE will work with the CRU to identify measures to support and fast-track community-led projects through the grid connection process (DCCAE, 2018b).

The government is developing a national policy for micro-generators and auto-producers that aims to deal with the challenges identified before designing a specific support programme for microgeneration. A pilot programme supporting solar PV installation and self-consumption among domestic consumers was launched in 2018. This focuses on the role of technology, including battery storage, and the impact of microgeneration on consumer's energy behaviour. The findings will feed into the design of future phases for support for microgeneration.

Ocean energy prospects

Most wind power in Ireland is generated onshore (apart from a single 25 MW offshore windfarm operational since 2003), although the country has some of the best offshore renewable energy resources in the world. The potential is estimated at approximately 4 500 MW of fixed offshore wind and about 1 500 MW of wave and tidal generation (mainly wave), once technologies become commercially viable. The Irish government set out its policy for sustainable development of the country's abundant offshore renewable energy resources in its 2014 Offshore Renewable Energy Development Plan. The plan identified policy actions and enablers required for development of the sector. These included provision of increased funding for research, development and demonstration, introduction of an initial market support tariff and development of infrastructure.

However, a key obstacle needs to be resolved before these measures can be effective. A modern and coherent planning and consent framework does not exist for offshore renewable energy development beyond the foreshore area of 12 nautical miles. The Minister for Planning, Housing and Local Government has proposed new primary legislation to streamline the development consent process, including the onshore and offshore elements of strategic infrastructure developments. This legislation is progressing through the various legislative stages in the Oireachtas (the Irish Houses of Parliament).

Assessment

Wholesale market

A new chapter in the Irish electricity sector was opened when a new market design under the I-SEM project was applied to the all-island wholesale electricity market, the SEM. The new market design became operational on 1 October 2018, introducing the EU target model and Capacity Allocation and Congestion Management regulations. The I-SEM design introduced new trading rules for the wholesale electricity markets, as expressed in the EU Third Internal Energy Market Package. The SEM has been in operation across the two jurisdictions (Ireland and Northern Ireland) on the island of Ireland since 2007.

Important changes compared to previous mechanisms include: the establishment of day-ahead, intraday and balancing markets; the possibility for producers, suppliers and large consumers to participate; the determination of an ex ante clearing price; and the obligation on participants to take on their own imbalances. Ireland and Northern Ireland have also set targets to achieve 40% renewable electricity by 2020.

The electricity incumbent, the state-owned ESB, continues to own and operate almost half of the total dispatchable generating capacity. The state-owned EI holds more than 50% of the domestic retail market. Continuous and well-resourced market monitoring and enforcement by the regulatory authority (CRU) will continue to be critical to regulate the market after implementation of the I-SEM.

A well-functioning ancillary services market is critical to maintain the SoS in an isolated electricity system with a high penetration of intermittent production. The DS3 programme contains three key elements: enhanced operational policies and grid/network code standards, network control centre tools and enhanced ancillary services. These new services should improve the quality of supply and reduce the curtailment of renewable energy.

The redesigned wholesale market will likely bring greater volatility of prices and uncertainties to market participants. The necessity and feasibility of implementing a physical forward market should be regularly reviewed so that participants can manage their risks, and to increase the liquidity of the electricity market.

The regulations for connecting new generation capacity to the grid have been cumbersome. Project developers can apply for a connection well before their project has all the approvals needed to start construction, thereby securing a place on the waiting list for connections. The network companies treat the applications on a first-come first-served basis, thereby making reservations for connections for projects that might not materialise. This can affect the level of competition in the wholesale markets, the fulfilment of renewable energy targets and the restrictions of the networks.

The CRU has published a new ECP. According to this policy, for the first batch, projects that have secured all permits, including planning permission and are considered “shovel ready” get priority for a connection. As new projects can also be hampered by lack of support from the general public, the CRU could give priority access to projects that are supported by local communities.

Retail market

There are 12 suppliers operating in the Irish electricity retail market, compared to eight at the time of the last IDR in 2012. Ireland had the fourth-highest rate of households switching electricity supplier within the European Union in 2016. Switching is encouraged by retailers who offer low prices on an initial 12 month contract. Once that contract expires, clients are moved to a higher-priced standard contract, unless they end their contract and move to another supplier or renegotiate with their supplier. Consumers that have never switched are most likely on higher-priced contracts.

Network costs for transmission and distribution are charged to the suppliers, and retailers can choose how to pass them on to customers. Retailers have a variety of tariff structures. Some retailers charge a relatively low fixed rate to their consumers, and a relatively high price per kilowatt hour. This makes price comparison difficult for consumers. Recent changes introduced by the CRU that require suppliers to include information on the impact of transmission and distribution charges on a typical bill are a move in the right direction. However, the approach to standing charges could be seen as making price comparison difficult for consumers. Close monitoring and corrective action might be required to ensure that consumers can easily identify the various standing charges on their electricity bills.

Customers are charged a PSO levy, which is imposed by government on all electricity users. The proceeds of this levy cover the additional costs associated with producing sustainable and renewable energy in Ireland. And for reasons of SoS, the PSO also subsidises electricity produced from domestically sourced peat. The levy for the period October 2010 to September 2011 was EUR 157 million. It increased to EUR 472 million for the period 2017/18 and decreased to EUR 209 million for the period 2018/19. This reflects the potential for the levy to significantly fluctuate year on year, given the interaction with variable wholesale market prices. The new subsidy programmes for renewables will be financed by the levy, possibly resulting in upward pressure.

In many IEA countries the network costs (as set by the regulator) are passed directly on to the consumers and are visible on the bill, as they are not in the remit of the retailer. These costs are partly fixed (standing charge) and partly variable. In such a system, it is much clearer for the consumer to identify cost items across retailers, seeing which items are identical and which tariff components are priced competitively. The consumer is then better able to control total costs, by monitoring actual electricity consumption.

Smart meters and grids

Ireland is planning for a smart meter roll-out. Some 250 000 meters will be installed during 2019-20 and 500 000 meters in each of the 4 years thereafter. Smart services, like dynamic time-in-use tariffs, are central to smart metering programme design and will be phased in gradually.

Smart meters on a smart grid will allow for dynamic tariffs and for end consumers to participate in balancing services via aggregators. A smart grid would also facilitate the introduction of prosumers, and smart charging of electric vehicles, once they reach a high penetration in the car market. An investment in smart grids can also reduce the curtailment of renewable energy.

The DS3 programme at the transmission level will need to be closely linked to the roll-out of smart meters to maximise the benefits from implementing a smart grid. The potential energy savings for consumers may be reduced if deployment is not accompanied by other measures (dynamic tariffs or a demand response mechanism). Before the roll-out of the smart meters beyond the first phase, a cost-benefit analysis of the first phase of instalments could be carried out to assess whether "simple" smart meters bring the anticipated benefits.

Focus area: Interconnectors

Ireland derives significant benefits from trade in electricity through interconnectors with the United Kingdom. The related trading arrangements give access to lower prices in the continental electricity wholesale markets, thus increasing the competitiveness of the Irish economy. The flexibility provided to the electricity system by interconnections also allows the accommodation of greater levels of variable renewable electricity. The United Kingdom leaving the European Union would reduce the Irish-EU interconnection level from 7.4% to 0%. This has clear implications for the completion of the EU internal energy market, as Ireland would only have an interconnection with a non-EU country.

The legal basis for the SEM that is in place across the two jurisdictions on the island of Ireland is set in Ireland and United Kingdom law. However, it is not clear on what basis the SEM would continue to operate if there was regulatory divergence between Ireland and the United Kingdom. The future security of electricity supply situation in Northern Ireland is dependent on links between Ireland and Northern Ireland, including the proposed construction of a second interconnector between the two jurisdictions.

Two more subsea interconnectors are being proposed: one connecting to France and the other to Wales. It is unlikely that there will be a future surge in interconnection due to the small size of the Irish market and the large capital investment required for interconnection. A comprehensive assessment of the available options is therefore of highest importance. The policy paper on interconnections set out by the DCCAE is a welcome initiative to facilitate this assessment.

There is a risk that the decision of the United Kingdom to exit the European Union could lead to a change in the regulatory or trading arrangements between the United Kingdom and EU member states. Given the benefits derived by the United Kingdom, and by countries neighbouring the United Kingdom, from the current framework, any change will need to be considered carefully. This is creating uncertainty in the market. It will also likely to lead to project developers factoring in a higher level of risk, which could result in higher capital costs or investment decisions being deferred or potentially cancelled.

Renewable electricity

Renewable energy sources had a share of almost 29% of Ireland's electricity generation in 2017, mostly from wind, hydro and bioenergy. Wind power has grown considerably over recent years. It accounted for 24% of the total electricity generation in 2017, the third-highest share among IEA member countries after Denmark and Luxembourg. The Irish grid system has been efficient in dealing with such a high share of intermittent renewables. The IEA congratulates Ireland and EirGrid in particular for this achievement. The EirGrid DS3 programme aims to ensure that the system can be operated securely and efficiently with the share of intermittent renewables growing.

Ireland had several feed-in tariff support programmes (REFIT), which closed for new applications in 2015. Projects under REFIT 2 and 3 can still be built until the end of 2019, in recognition of the problems encountered by some promotors to receive planning consent and grid connection. Grid connections have been facilitated through the gate procedure.

The CRU has developed a new procedure – the ECP. The first round was undertaken in August 2018. In the final decision on the ECP, the CRU recognises that the connection policy can have a wide-ranging impact on the electricity system, including facilitating meeting the renewable energy targets.

Ireland is developing a new support programme – the RESS – to bring on projects after REFIT, especially to address the 2020 target. The RESS was approved by government in July 2018. It will set up a competitive bidding process (auctions) and set out a clear roadmap for these auctions to signal to investors that they can rely on the framework in coming years.

The government has identified the policy objectives that the design of the support programme needs to address (e.g. diversification of the technology mix and involvement of local communities to enhance public acceptance of renewable energy infrastructure). Objectives have also been identified that might be better dealt with outside the RESS (e.g. microgeneration, which is being targeted by a pilot programme). Pilot programmes outside the RESS might be an option for facilitating development of less-mature renewable energy technologies (e.g. floating offshore wind or wave and tidal energy), as they might strike a balance between the cost-efficient support programme and diversification of the technology mix in the long term.

Offshore renewables do not yet play a role in the Irish energy system, despite the enormous potential for offshore wind (fixed and floating) and ocean energy, and ongoing research and development for these technologies. There is no planning and consent framework for offshore renewable energy projects and connecting infrastructure beyond the foreshore limit of 12 nautical miles. Such an architecture would be a core requirement for the development of commercial projects. The existing regime for the foreshore area should be reviewed and possibly aligned with or integrated into the new regulatory framework when setting up this new architecture.

Recommendations

The government of Ireland should:

- After implementing the I-SEM arrangements for SEM, continue the procedure whereby the regulatory authority (CRU) periodically assesses the competitive conduct of market participants and, where appropriate, proposes or implements measures to counteract or eliminate any issue emerging.
- Noting the need to prioritise upcoming challenges for energy policy-making, including those arising out of the exit of the United Kingdom from the European Union, if deemed necessary and appropriate by the government, reconsider again the ownership structure of ESB's non-strategic power generation plants.

- Implement a policy to facilitate early connection to the grid of projects that are at an advanced stage of planning and financing. For priority access, consideration should also be given by the regulator to community energy projects.
- Consider undertaking an impact analysis after the first phase of the smart meter roll-out to inform further deployment.
- Ensure the regulator promotes a billing practice that is more transparent for consumers and reflects actual costs.
- Co-operate across government and with other stakeholders to get renewable electricity projects built (e.g. work with the regulator on grid connection). Within their respective statutory remits, it should be ensured that local authorities and authorities responsible for planning consent decisions consult with, and take due consideration of the needs of, local communities before making planning consent decisions. Meeting the targets for 2020 and beyond should be a joint effort.
- Tap into the potential for offshore renewable energies. These should be considered for financial support in the RESS, and impediments to development such as the planning and consent regime for offshore wind and ocean energy projects beyond the 12 nautical mile limit should be addressed.

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6. Energy and climate

Key data

(2016)

GHG emissions without LULUCF*: 61.5 $MtCO_2$-eq, +11% since 1990, -11% since 2005

GHG emissions with LULUCF*: 66.5 $MtCO_2$-eq, +7% since 1990, -12% since 2005

Energy-related CO_2 emissions

CO_2 emissions from fuel combustion: 37 $MtCO_2$, +22% since 1990, -17% since 2005

CO_2 emissions by fuel: oil 49.6%, natural gas 26.1%, coal 14.8%, peat 8.8%, other 0.7%

CO_2 emissions by sector: power and heat generation 33.8%, transport 32.3%, residential 15.9%, industry 10.7%, commercial 6.3%, other energy industries 1.0%

CO_2 intensity: 0.13 $kgCO_2$/USD GDP** (IEA average 0.24 $kgCO_2$/USD)

* Land use, land-use change and forestry.

** In 2010 USD and PPP (purchasing power parity).

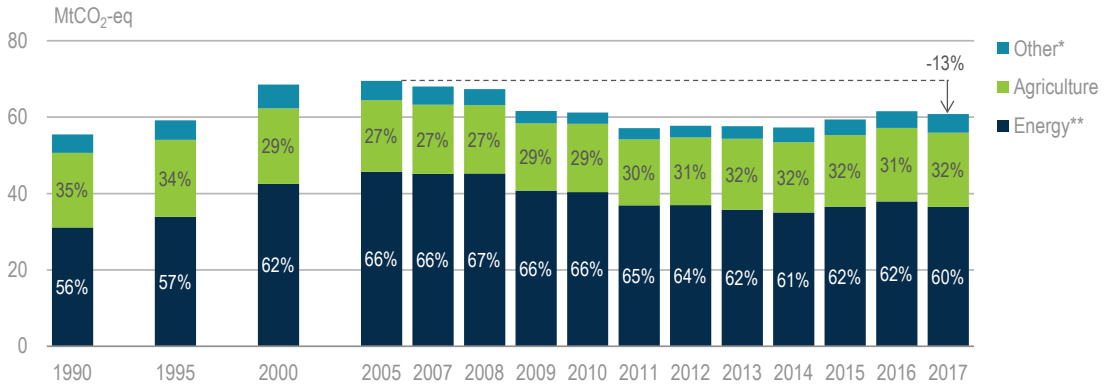
Overview

Ireland is not on track to meet its statutory 2020 greenhouse gas (GHG) emissions reduction target of 20% below the 2005 level. By 2016, GHG emissions had decreased by 11%. But with expectations for strong economic growth and a related increase in fossil fuel consumption, Ireland is expected to reduce emissions by just 1% from 2005 to 2020 (EPA, 2018a). However, the impact of the new policies, measures and funding put in place by the Irish government since the beginning of 2017 have not yet been taken into consideration. These may potentially narrow the gap between the projections and the target values. In the long term, Ireland is committed to an aggregate emissions reduction of at least 80% (compared to the 1990 level) by 2050 in the electricity, building and transport sectors and to achieve carbon neutrality in the agriculture and land use, land-use change and forestry (LULUCF).

Ireland's total GHG emissions, excluding LULUCF, were 61.5 million tonnes of carbon dioxide equivalent ($MtCO_2$-eq) in 2016. GHG emissions grew by 25% from 1990 to 2005, but then decreased significantly after the 2008 financial crisis (Figure 6.1). However, since 2014, Irish GHG emissions have been growing again across all sectors. The energy sector, which includes transport and energy-related industry emissions, represents 62% of the total GHG emissions. Agriculture is the single largest contributor to Ireland's overall GHG emissions, accounting for 31% of the total GHG emissions in 2016 compared to 20% from the energy sector. Ireland's GHG profile is unique among

European Union (EU) member states as it has the highest proportion of agriculture emissions. This presents challenges for Ireland in meeting future GHG emissions reduction targets (EC, 2018a).

Figure 6.1 GHG emissions by sector, 1990-2016



Ireland's total GHG emissions declined by 13% in 2005-17; energy-related emissions accounted for 60% of total emissions in 2017.

* *Other* includes emissions from industrial processes and the waste sector.

** *Energy* includes emissions from transport and stationary combustion in different sectors.

Notes: Percentages provide variations of total GHG emissions. Data for 2017 are provisional.

Source: EPA (2018b), *Ireland's National Inventory Report 2018*, https://unfccc.int/documents/65675; SEAI (2018a), *Energy in Ireland, 2018 Report*, https://www.seai.ie/resources/publications/Energy-in-Ireland-2018.pdf.

Energy-related carbon dioxide emissions

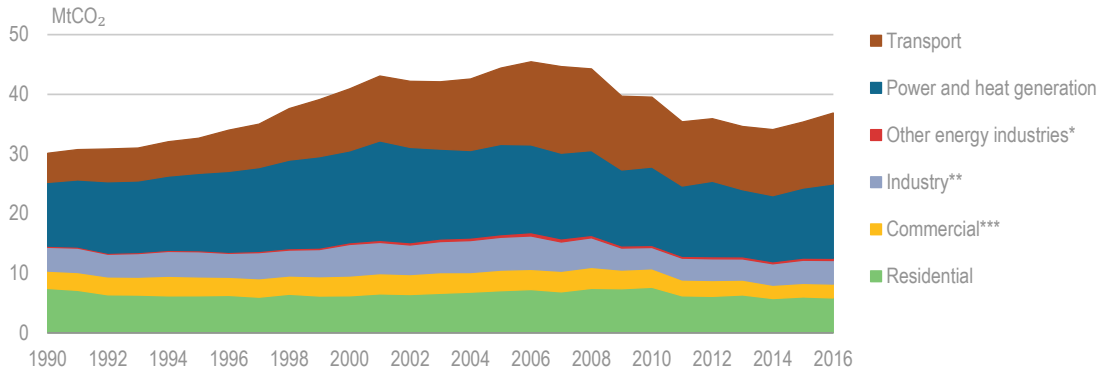
Emissions by sector and fuel

Ireland's energy-related carbon dioxide (CO_2) emissions were 36.9 million tonnes of carbon dioxide ($MtCO_2$) in 2016. This is a decrease of 8% since 2005; however, emissions have grown by 7% since 2014. Power and heat generation accounted for the largest share of energy-related CO_2 emissions, with 33.8% in 2016, up from 16.5% in 1990 but down from 34.1% in 2005. The transport sector accounted for the second-largest share in 2016, at 32.3%, followed by the residential (15.9%), industry (10.7%), commercial (6.3%) and other energy (1%) sectors (Figure 6.2).

Emissions have increased most prominently in the heat and power generation and transport sectors since 1990. By 2017, CO_2 emissions from power generation had increased by 17% compared to 1990 due to the significant increase in total electricity generation. This was despite Ireland having the third-highest share of variable electricity generated from renewable sources of energy (renewable electricity) among International Energy Agency (IEA) member countries in 2017.

Emissions in the transport sector have decreased by 7% since 2005, but more than doubled since 1990. The emissions in transport are mostly due to diesel and gasoline. Diesel accounted for approximately 76% of transport emissions in 2016, and was mainly used for road and rail transport. Residential energy-related CO_2 emissions fell by 17% since 2005 despite an increase in the number of households in Ireland in the same period. This was driven by the increase of efficient new houses.

Figure 6.2 Energy-related CO_2 emissions by sector, 1990-2016



Energy-related CO_2 emissions dropped by 8% between 2005 and 2014, but increased again after then.

* *Other energy industries* includes emissions from oil refineries, blast furnaces and coke ovens.

** *Industry* includes CO_2 emissions from combustion at construction and manufacturing industries.

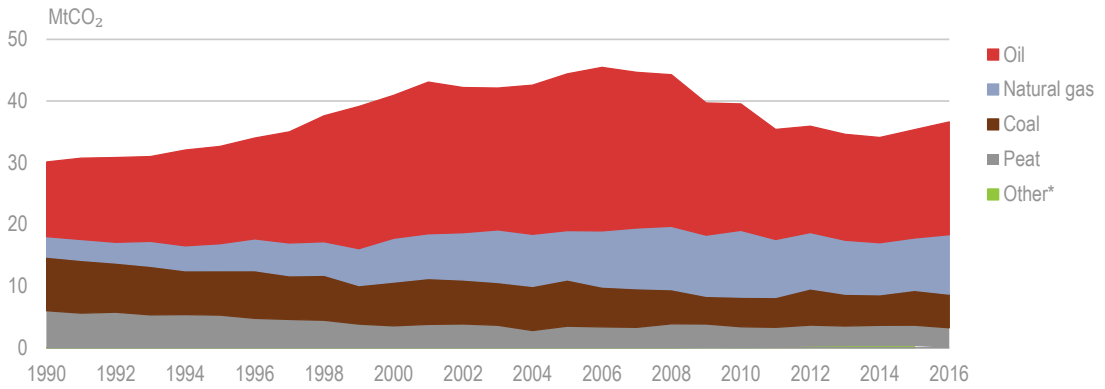
*** *Commercial* includes commercial and public services, agriculture/forestry and fishing.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

Oil accounted for half of total energy-related CO_2 emissions in 2016, followed by natural gas at 26% (Figure 6.3). CO_2 emissions from natural gas grew by 6% between 2006 and 2016, driven by increased use of natural gas in electricity generation.

Since 2006, CO_2 emissions from coal and peat use in electricity generation have decreased by 16% for coal and 4% for peat, but total emissions related to coal and peat have remained stable since 2013. Oil is used primarily in transports and the residential sector. CO_2 emissions from oil decreased between 2006 and 2014, but have picked up again slightly since.

Figure 6.3 Energy-related CO_2 emissions by source, 1990-2016



Oil dominates energy-related CO_2 emissions; the increase of total CO_2 emissions is driven by higher use of natural gas in electricity generation.

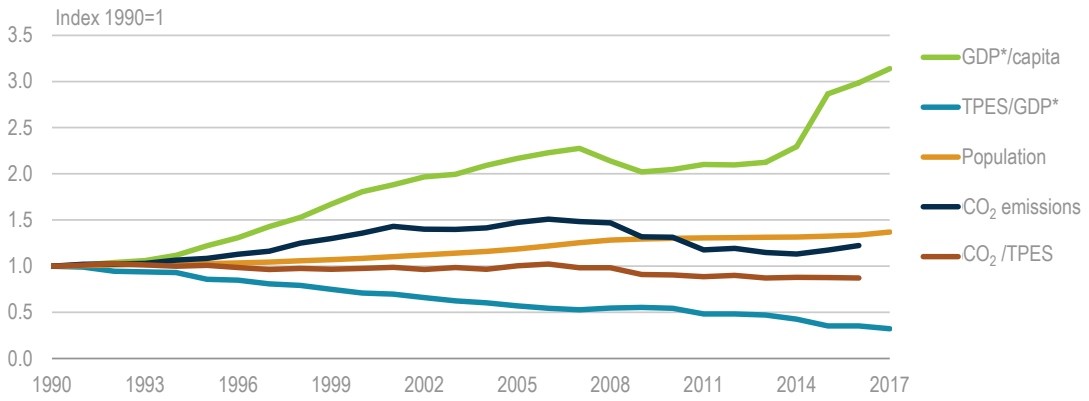
* *Other* includes emissions from peat and non-renewable waste combustion.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

CO_2 drivers and carbon intensity

Total CO_2 emissions in a country are related to the size of the population, gross domestic product (GDP), energy intensity of economy and carbon intensity of energy supply (Figure 6.4). The GDP is the traditional measure for economic development. However, this measure is now straightforward in Ireland where economic growth since 2015 has been strongly influenced by the transfer of intellectual property from multinationals and lease contracts for aeroplanes, which had no effect on energy use (see Box 2.1). Owing to this recent growth in GDP, Ireland's economy is one of the least CO_2 intensive among IEA countries. Ireland is slightly above the median in an IEA comparison of CO_2 emissions per capita (Figure 6.5).

Figure 6.4 Energy-related CO_2 emissions and main drivers, 1990-2017



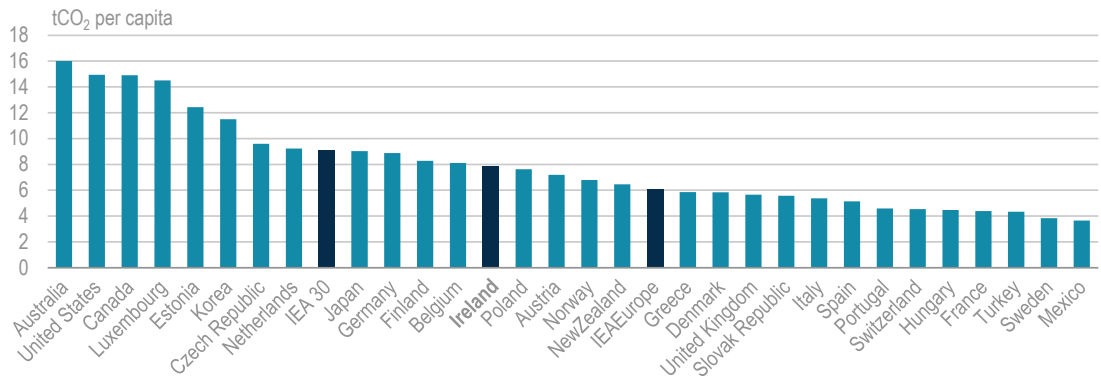
Ireland decoupled economic growth from carbon emissions from 2009 to 2014, but emissions have since increased again.

* Real GDP in 2010 USD (United States dollars) prices and purchasing power parity. This does not take into account the issues of the non-energy-related GDP growth in 2015, as explained in the text and in Box 2.1 in Chapter 2 on "General energy policy".

Note: Latest available CO_2 emissions data are for 2016.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

Figure 6.5 Energy-related CO_2 emissions per capita in IEA countries, 2016



Ireland's carbon intensity per capita is lower than the IEA average, but higher than the IEA European average.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

Institutions

Climate policy in Ireland is the responsibility of the **Department for Communications, Climate Actions and Environment** (DCCAE) with support from other government ministries and agencies. Policy co-ordination and implementation oversight is the responsibility of the High Level Climate Action Steering Group consisting of senior officials from all concerned government departments and agencies and chaired by the Minister of the DCCAE.

The **Environmental Protection Agency** (EPA) is a statutory public body responsible for implementing the EU Emissions Trading Directive in Ireland. It regularly publishes the national emissions inventory report.

A statutorily independent **Climate Change Advisory Council** (CCAC) was established in 2016 with its membership appointed by the government. It assembles eminent researchers on several subject areas and provides assessments and recommendations on the design and implementation of climate and clean energy policy.

Engagement among central and local government, civil society and the wider public will be underpinned by a structured process of dialogue and engagement through the National Dialogue on Climate Action, established by the government in 2017. This aims at a two-way flow of information and awareness building. Ireland has a high degree of social consensus on the need to move forward with climate action, and the dialogue is a means to create awareness and engagement at the local and regional levels.

Climate policy framework and targets

As an EU member state, Ireland's climate policy is guided by the framework of the EU climate policies, the 2020 climate package and the 2030 climate framework. EU member states are jointly committed to reducing EU-wide GHG emissions by 20% below 1990 levels by 2020 and by at least 40% by 2030.

Emissions from power and heat generation and from large, energy-intensive industries are covered under the European Union Emissions Trading System (EU ETS), which represents around 45% of the total EU GHG emissions. The EU-wide target for emissions from ETS sectors is 21% below the 2005 level by 2020 and 43% by 2030, and is applicable to all EU member states (EC, 2018b).

Non-ETS emissions are those from the transport, residential and commercial sectors, from waste and agriculture, and from industry and commercial undertakings that are not included in the ETS. They are covered under the EU Effort Sharing Decision (ESD). The EU-wide targets for GHG reductions in the non-ETS sectors are 10% by 2020 and 30% by 2030 compared with 2005 levels. While the EU ETS target applies for the European Union as a whole, the emissions reduction targets for non-ETS sectors are set individually for each EU member state with binding annual targets for the period 2013-20.

Ireland has a target to achieve a 20% reduction in non-ETS sectors by 2020 and a target of a 30% reduction by 2030, both relative to 2005 levels of emissions (EC, 2018c). Ireland's non-ETS target to 2020 is the highest of all EU member states, jointly with the targets for Denmark and Luxembourg.

In 2016, 29% of Ireland's total GHG emissions and 47% of its energy-related CO_2 emissions were in the ETS (SEAI, 2018b). These are much smaller shares than the EU average. Ireland has the fourth-highest share of non-ETS emissions among EU member states due to its agricultural sector (EEA, 2017) and small ETS sector. The Irish agricultural sector accounted for 45.4% of total non-ETS emissions in 2016, compared to a share of 18% of non-ETS emissions for the European Union. Therefore, measures to mitigate emissions from non-ETS sectors are of critical importance for Ireland's climate mitigation objectives.

Progress towards the climate targets

Ireland was able to meet its annual CO_2-equivalent/GHG emissions targets in the non-ETS sectors up to 2015. Emissions exceeded their annual binding level starting in 2016. Ireland still met its annual targets up to 2017 using the flexibility mechanisms provided for under the ESD. These allow banking of unused allowances in one year and counting them towards targets in future years and the trading of allowances among countries. Banked credits were exhausted from 2018 onwards. The government is preparing a purchase compliance strategy because, for 2018-20, Ireland's cumulative emissions are expected to exceed the annual targets.

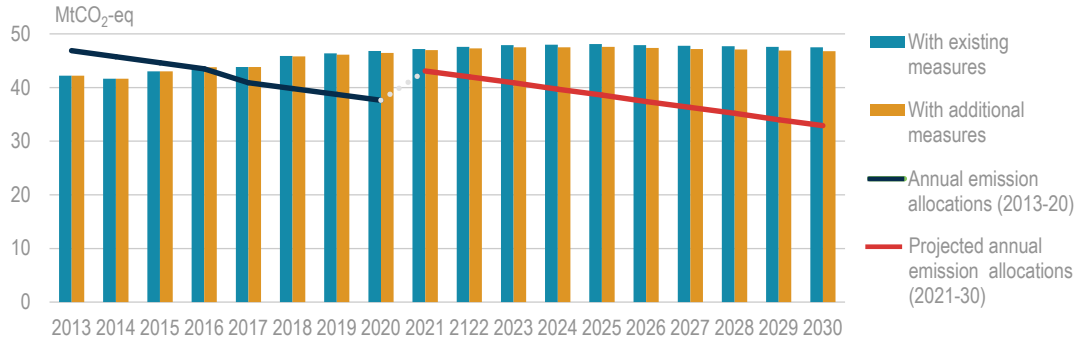
The EPA makes annual emissions projections (currently covering the period up to 2035) using two scenarios. In the latest projections published in May 2018, the scenario "with existing measures" took into account only those measures that were in place at the end of 2016, when the latest national GHG inventory was prepared. This was therefore the most conservative scenario. The scenario "with additional measures" assumes implementation of additional policies and measures including those set under the National Renewable Energy Action Plan and the fourth National Energy Efficiency Action Plan (see Chapter 7 on "Energy efficiency and residential heating").

The latest projections made by the EPA show that Ireland will most likely exceed its compliance obligation to 2020 by a cumulative 17 $MtCO_2$-eq under the "existing measures" scenario and by 16.3 $MtCO_2$-eq under the "with additional measures" scenario (EPA, 2018a). These show that the proposed additional measures are not sufficient to change the emissions trajectory. The CCAC expressed concern about the pace and adequacy of government action in its 2018 annual report (CCAC, 2018).

Ireland is therefore not on course to meet its 2020 target; the same holds for its 2030 target of a 30% emissions reduction in non-ETS sectors. The EPA projects that based on the current trajectory, Ireland will exceed its carbon budget of 2030 by 47-53 $MtCO_2$-eq (EPA, 2018a). This is even after utilising the full range of the broadened flexibility mechanism for the period to 2030: the use of 4% of ETS allowances and 5.6% of the credit from actions undertaken in the LULUCF sectors (EC, 2018b). The projected emissions trajectory is due to the anticipated economic growth and associated growth in energy demand.

The latest EPA projections under both scenarios did not take into consideration the impact of the policies contained in the National Development Plan (NDP) of 2018 and included only some of the policies and measures contained in the 2017 National Mitigation Plan (NMP). Therefore, Ireland may still achieve larger emissions reductions than projected by the EPA. The 2019 emissions projections are expected to offer a better indication of the possible achievements by 2020 and 2030.

Figure 6.6 Non-ETS emissions trajectories under two scenarios, 2013-30



Ireland is not on a trajectory to meet the targets for non-ETS emissions.

Source: EPA (2018a), *Ireland's Greenhouse Gas Emissions Projections 2017-2035*, www.epa.ie/pubs/reports/air/airemissions/ghgprojections2017-2035/EPA_2018_GHG_Emissions_Projections_Summary_Report.pdf.

Domestic policy frameworks and targets

Ireland has put in place a comprehensive new framework of policies and targets to guide its climate policy to 2030, and to advance the long-term vision of becoming a low-carbon economy by 2050 as set out in the 2014 National Policy Position on Climate Action and Low Carbon Development. This has been done since the last in-depth review (IDR), and is in line with Ireland's commitment under the Paris Agreement.

The legislative framework is set by the Climate Action and Low Carbon Development Act 2015, and builds on the 2014 National Policy Position on Climate Action and Low Carbon Development. The 2014 national policy position towards 2050 aims for an aggregate reduction in CO_2 emissions of at least 80% (compared to 1990 levels) across electricity generation, built environment and transport. It also aims to become carbon neutral in the agricultural and LULUCF sectors, by 2050 (see Table 6.1).

The 2015 Climate Act contains legal obligations that include preparation of the NMPs, a National Adaptation Framework (NAF) and annual transition statements to allow regular monitoring of the progress made and to take corrective steps, if required. The first NMP was adopted in 2017 and aims to close the gap to Ireland's 2020 target and to prepare for the 2030 target. The NMP contains 70 specific mitigation measures and 106 individual actions across government ministries. It is cognisant about the challenges to meet the 2020 and 2030 targets.

Progress on the implementation of the NMP is reported in annual transition statements, which contain an overview of the latest climate measures and assess their achievements towards Ireland's 2050 national climate objective. The 2017 statement contains, for the first time, separate sectoral mitigation transition statements for the four sectors covered under the NMP and projections of future emissions.

In January 2018, the government published the first statutory NAF that builds on the principle of subsidiarity and sets the context for action by local authorities. Sectoral adaptation plans are being prepared to support implementation of the NAF, including for the electricity and gas networks. The sectoral adaptation plans and the local adaptation strategies will be prepared for approval in the second half of 2019.

Table 6.1 Ireland's climate policy framework strategies and targets, 2014-30

	Climate policy framework	Target/objective
2014	National Policy Position on Climate Action and Low Carbon Development	Reduction of at least 80% by 2050 (compared to 1990 level) in energy-related emissions and carbon neutrality in agriculture and land-use sectors
2015	Climate Action and Low Carbon Development Act 2015	Statutory basis for the national transition objective laid out in the national policy position
	Ireland's Transition to a Low Carbon Energy Future 2015-2030 (DCENR, 2015)	Complete energy policy update, which sets out a framework to guide policy until 2030
2017	NMP	Closes the gap to 2020 target and prepares for the 2030 target
	Annual transition statements	Contains an overview of climate change policies and the annual sectoral mitigation transition statement
2018	NAF	Provides sectoral adaptation plans to reduce the vulnerability of the negative effects of climate change
	Project Ireland 2040: including National Planning Framework (NPF) and NDP	Seeks to achieve the ten strategic outcomes of the NPF
	Developing a National Energy & Climate Plan (under preparation)	
2020	EU ESD	Twenty per cent of emissions reduction in non-ETS sector compared to 2005
2030	EU Effort Sharing Regulation	Thirty per cent of emissions reductions in non-ETS sector compared to 2005

Source: IEA, based on country submission.

Local authorities play a key role in advancing climate actions. The Irish government has allocated EUR 10 million (euros) for the period 2018-23 to support the establishment of four Climate Action Regional Offices. They will be offering expertise to local authorities in developing approaches for climate mitigation and to promote resilience for future climate risks. Creation of the local offices is one of the key actions under the NMP and the NAF.

Ireland has developed a strategic outlook for future development of the country under Project Ireland 2040. The project consists of two complementary streams: the NPF, which has a time horizon to 2040, and the NDP, covering the period 2018-27. The NDP sets out the investment priorities and foresees funding of EUR 21.8 billion for climate action for the 10 year period, of which EUR 7.6 billion would come from the Exchequer. The remaining investment would be made by Ireland's semi-state companies and by the private sector. In addition, EUR 8.6 billion of funding has been made available for sustainable mobility projects, mostly in public transport.

This substantial funding increase will facilitate upscaling of investments and implementation of actions needed to move the country towards the 2030 climate targets. The funding will support the implementation of energy efficiency and renewable measures in the electricity, transport and built environment sectors, especially for heating and cooling. In addition, the NDP contains a commitment to establish a new Climate Action Fund to leverage investment by public and private bodies. The new fund will have an initial allocation of EUR 500 million with an annual income of at least EUR 50 million.

To align energy and climate policy measures and planning towards 2030, the government is developing a National Energy & Climate Plan (NECP) for the period 2021-30. The draft NECP was submitted to the European Commission in December 2018, in line with the EU Governance of the Energy Union and Climate Action Regulation. The final version of the NECP has to be submitted 1 year later, together with a long-term strategy. The long-term strategy for GHG emissions reductions must have a perspective of at least 30 years.

The NECP will replace the existing plans and reporting structures such as the National Renewable Action Plan, the National Energy Efficiency Action Plan and the Climate Monitoring Mechanisms Regulation. It will include trajectories for national emissions, renewable energy and energy efficiency, and measures required to achieve these trajectories.

Taxation policy

Ireland is one of a few countries globally where all fossil fuels are subject to a carbon tax. Electricity generation and large, energy-intensive industry have been included in the EU ETS since 2005. A carbon tax for the non-ETS sectors was first introduced in 2009 for petrol and automotive diesel. It was extended to all mineral oils and natural gas on 1 May 2010, with solid fuels included in 2013, at a lower rate of EUR 10. The tax now applies to all non-ETS fuel combustion except for certain small exemptions (e.g. high-efficiency co-generation of heat and power).

Originally levied at EUR 15 per tonne of CO_2 emitted, the tax was increased to EUR 20 for natural gas and mineral oils in 2012 and for all fuels to EUR 20 in 2014. There has been no increase since. The tax is considered successful, but its impact has levelled off as it is has not been increased since 2014. The government calculates that the tax abates 325 kilotonnes of CO_2 equivalent annually at its current level.

Carbon pricing is a key element of the government's climate policy as it has substantial potential to drive energy efficiency improvements. A key action in the NMP is to examine the mitigation, distributive and economic impact of the carbon tax and to assess possible future tax rates. The Department of Finance undertook this review in 2018. A possible increase of the CO_2 tax was considered as part of the 2018 budgetary process but not implemented on this occasion. No carbon tax increase has been proposed by the government for 2019. However, the 2019 budget included a commitment to put in place a long-term trajectory for carbon tax increases to 2030. Work for this trajectory will be undertaken in 2019. Over EUR 3 billion has been collected in revenues from the CO_2 tax since its introduction in 2010. If the carbon tax were increased by EUR 5 per tonne of CO_2, it could yield an additional EUR 100 million per year and would add less than 2% to the price of diesel and petrol.

Revenues from the CO_2 tax revenues are not pledged for a specific purpose, but accrue to the central treasury. They are therefore not necessarily reinvested in climate mitigation measures.

Transport sector emissions

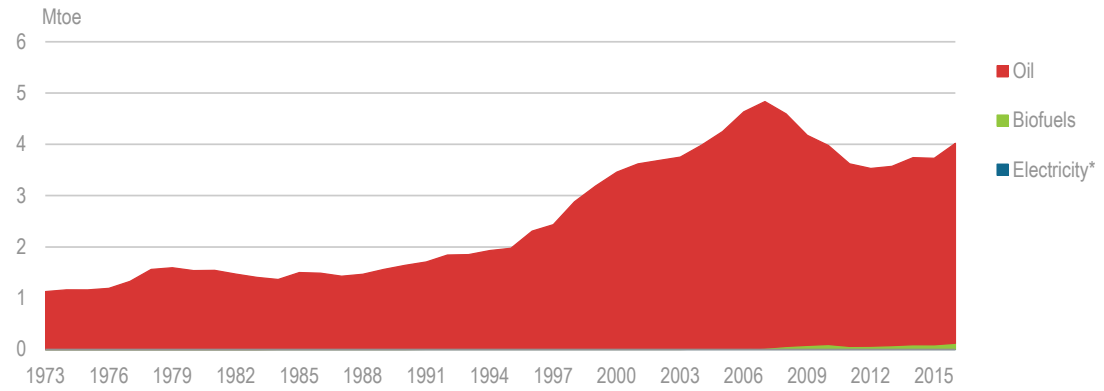
The transport sector is the second-largest emitter of energy-related CO_2 emissions in Ireland, with nearly a third of total emissions, just below those from the power sector.

Transport emissions can be reduced through fuel switching to biofuels or electricity, modal shifting (e.g. towards more public transportation) and improving the fuel economy of the vehicle fleet.

Energy consumption and emissions

Transport energy demand fell rapidly in the years after the economic crisis, but has picked up in recent years. The transport sector consumed 4.0 million tonnes of oil equivalent (Mtoe) in 2016, a 14% increase from 2012 but a 17% decline compared to the peak year of 2007 (Figure 6.7).

Figure 6.7 Total final consumption in transport by source, 1973-2016



Energy demand in transport increased by 14% in the period 2012-16, after a rapid decline in the previous 5 years.

* Negligible.

Source: IEA (2018b), *World Energy Balances 2018*, www.iea.org/statistics/.

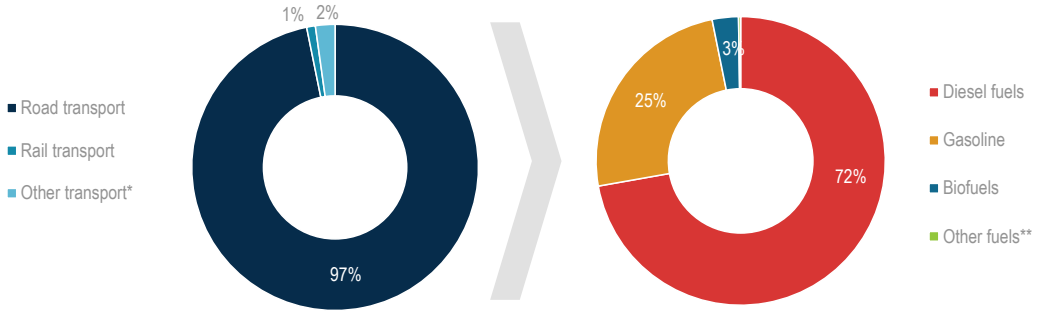
Oil accounts for 97% of transport energy demand. The remaining 3% is mainly from biofuels, and electricity accounts for only 0.1% of transport energy consumption. Diesel accounts for 72% of total transport fuels and gasoline for 25%. Road transport accounted for 97% of the total transport energy consumption in 2016. Rail energy consumption decreased by 9% between 2006 and 2016, and accounted for only 1% of energy consumption (Figure 6.8).

The contribution of the transport sector towards meeting Ireland's emissions and renewable targets for 2020 lags behind the target. Transport emissions peaked at 14.5 $MtCO_2$-eq in 2007, and then fell for five consecutive years in line with the contraction of overall economic activity to 10.5 $MtCO_2$-eq in 2012. Transport emissions have been increasing again since 2013, and their level in 2016 (11.9 $MtCO_2$-eq) was the same as in 2004 (Figure 6.9). This is due to the economic recovery and the subsequent increase in demand for transport services.

The strong increase in emissions from the transport sector reflects the strong proliferation in car ownership. This has gone from around 800 000 cars in 1990 to over 2 million in 2017, an increase of more than 150% (DCCAE, 2017a). Car use is also showing an upward trend, with the total annual vehicle kilometres for private cars increasing by 9.4% between 2011 and 2015 and by 3.5% from 2015 to 2016. Private

cars are the dominant transportation mode in Ireland, accounting for 74% of all journeys. The share is slightly larger outside the greater Dublin area with 76%, compared to 64% within Dublin (DCCAE, 2017a).

Figure 6.8 Transport energy demand by transport mode and fuel, 2016



Diesel accounts for the largest shares of total transport fuels, mostly used for road transport.

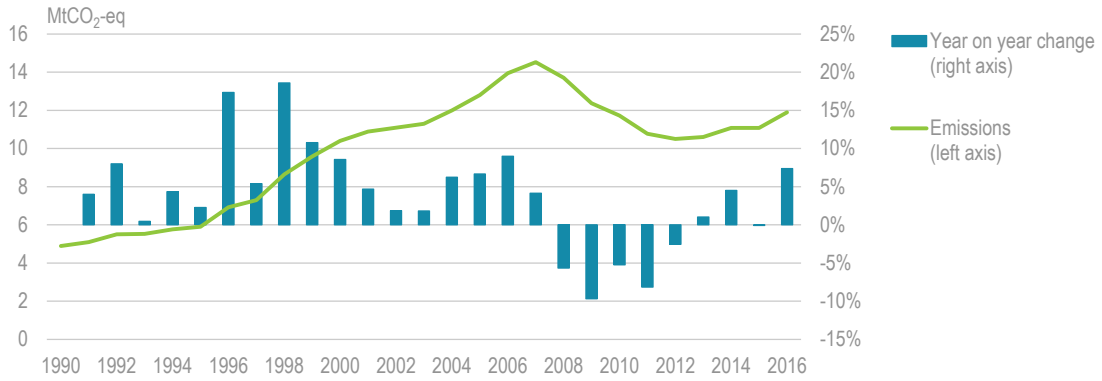
* *Other transport* includes domestic aviation and domestic navigation.

** *Other fuels* include natural gas, kerosene and other aviation fuels, electricity and liquefied petroleum gas.

Note: Excluding international aviation and navigation.

Source: IEA (2018b), *World Energy Balances 2018*, www.iea.org/statistics/.

Figure 6.9 Transport sector GHG emissions, 1990-2016



Transport emissions grew until 2007, after which they fell by 27% in five years, then increased again but at a slower rate.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

The EPA projects that if this trend continues, transport emissions will return to their 2007 peak level by 2022. They will continue growing until 2025 due to strong demand for diesel for individual and freight transport (EPA, 2018c). Emissions are projected to gradually decline from 2025 onwards following the impact of various policy measures.

The government is addressing emissions growth in the transport sector through a three-pronged policy: 1) expanding the use of alternative fuels and technologies, 2) modal shifting and 3) increasing the fuel economy of the vehicle fleet.

Expanding the use of alternative fuels and technologies

Ireland has a binding target to reach 10% renewable fuel in the transport sector by 2020. In 2016, 2.9% of total fuels were renewables. The EPA projects that Ireland will reach a share of 9.2% by 2020 in its "with additional measures" scenario (EPA, 2018a). The Biofuels Obligation Scheme of 2010 is Ireland's primary policy measure to increase the share of renewable energy in the transport sector. From an initial rate of 4%, the level of obligation has increased to 8% of motor fuels, typically diesel and petrol, placed on the Irish market to be produced from renewable sources. The rate increased to 10% on 1 January 2019. The government plans a further increase to 11% on 1 January 2020 and to continue the programme to 2030 in alignment with policy developments in the European Union. The biofuel obligation achieved savings of about 0.4 $MtCO_2$-eq in 2015 (DCCAE, 2017a). The NMP estimates that the biofuel obligation will achieve savings of 2.1 $MtCO_2$-eq between 2017 and 2020 and 9.8 $MtCO_2$-eq between 2017 and 2030 if the proposed rate increases are implemented (DCCAE, 2017a).

The government also plans to hold public consultations on the future development of the biofuel obligation. This could include an increase to at least 12% in 2022, and upward adjustments in the buy-out rate for industry and the introduction of an advanced biofuels obligation. The potential inclusion of the heat sector in the programme will also be considered, based on the level of use and the availability of suitable biofuels (Government of Ireland, 2018).

Ireland published its National Policy Framework on Alternative Fuels Infrastructure for Transport in May 2017. This focused on measures to support the uptake of low-emission vehicles and specifically on infrastructure requirements for electric and natural gas vehicles. The framework also set a target for all new passenger cars and vans to have zero emissions as of 2030.

Ireland is committed to sharply increasing the share of electric vehicles (EVs) in the passenger and light commercial vehicle stock by 2020. It has implemented several support measures, but the uptake of EVs remains below expectations. By October 2018, about 6 500 EVs were deployed in Ireland against the original target set in 2009 of about 200 000 EVs by 2020. The government has consequently adjusted the target downward to 20 000 by 2020.

There are multiple reasons for the low uptake of EVs. These include the high cost and limited choice of vehicle models, low consumer acceptance and awareness, and lack of an easily accessible charging infrastructure. The government set out how to scale up the ongoing support measures to overcome the identified barriers in the 2017 framework. EV deployment is expected to accelerate beyond 2025 based on these new measures, with 400 000 EVs on the roads by 2030.

The Electricity Supply Board (ESB), the state-owned electricity company, is responsible for nationwide installation of EV charging points. The Commission for Regulation of Utilities has allowed the ESB to invest up to a maximum of EUR 25 million in the charging infrastructure and to recover these costs from the distribution network charges.

Approximately 900 public charging points, including 79 fast chargers, had been installed by the end of 2017. Most towns with a population above 1 500 had at least one charging point. The government aims to have 1 500 public charging points installed by 2020.

By the end of 2017, the ESB had also installed over 2 000 private domestic charging points as part of an incentive programme to provide free charging points to qualifying EV purchasers by 2020. This support ceased at the end of 2017 and was replaced by a new grant of EUR 600 to support the installation of home chargers. This has been available to buyers of new and second-hand EVs since the start of 2018.

Grants of up to EUR 5 000 have been made available since 2011 to incentivise consumers to purchase a battery-electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV). At the end of 2018, 3 649 EVs had benefited from the grant for a total disbursement of EUR 172 million. BEVs and PHEVs also qualify for vehicle registration tax (VRT) relief of between EUR 2 500 and EUR 5 000. This provides for a maximum combined subsidy of up to EUR 10 000 in the case of a BEV and up to EUR 7 500 for a PHEV. BEVs will continue to benefit from VRT relief until the end of 2021 and PHEVs until the end of 2019, while the grant programme will continue. To incentivise the purchase of EVs, the government introduced a reduction of tolls for EVs from 1 July 2018 for the period until 31 December 2022 (Transport Infrastructure Ireland, 2018).

The government has launched several programmes to support EV uptake and deployment in the commercial sector. It introduced an accelerated capital allowance for energy-efficient equipment purchases by companies paying corporation tax. The tax is applicable to the purchase of BEVs, PHEVs, other hybrid vehicles and associated charging equipment. Moreover, taxi and small public service vehicle operators have been eligible for an EV purchase grant of up to EUR 7 000 per car since February 2018.

Electrification is not considered suitable for the freight sector. The government is therefore exploring alternative fuel types such as biogas, biofuels, hydrogen, compressed natural gas (CNG) and liquefied natural gas. The 2019 budget introduced a new accelerated capital allowance programme for gas-fired commercial vehicles and refuelling equipment to encourage their uptake as an economic and environment-friendly alternative to diesel.

The excise rate for natural gas and biogas used in transport has been set at the EU minimum rate of EUR 2.60 per gigajoule since 2015. It will be held at this level until the end of 2022. The government hopes that this will make natural gas and CNG more competitive in relation to diesel, the dominant transport fuel in the freight sector.

Gas Networks Ireland (GNI) is undertaking a study of the impact of installing 14 CNG refuelling stations and setting up a large-scale renewable gas injection point on the gas network in Ireland. The European Commission has provided funding support for the study. Construction of the stations will be completed in 2019, and the impact study will be completed in 2020. Provision of the biogas injection facility will enable indigenous renewable gas to become part of Ireland's future transport fuel mix. The GNI set up a Natural Gas Vehicle Fund as part of the study, with a capital of EUR 700 000 to support the deployment of dedicated CNG vehicles (DCCAE, 2017b).

The Department of Transport, Tourism and Sport established a Green Public Transport Fund in 2017 to support the uptake of low-carbon, energy-efficient technologies within the public transport sector. This was primarily for buses, to achieve the public sector energy efficiency target of 33% savings by 2020. The fund will also support measures to encourage transition of the national taxi fleet towards alternative technologies. For 2018, EUR 4 million was made available to support switching to alternative fuels (DCCAE, 2017b).

Public transport and modal shifting

In tandem with strong economic recovery, demand for transport services, and therefore also transport congestion, are increasing. The government is addressing these issues by investing in maintaining and expanding the public transport infrastructure. EUR 2.6 billion is allocated for investments in maintenance and asset renewal, and EUR 1 billion will be invested to target congestion and capacity issues, from a total capital allocation of EUR 3.6 billion for public transport for the period 2016-21 (DCCAE, 2017a). The investment in public transport will create viable alternatives to private car use.

The government has earmarked EUR 100 million for Smarter Travel Programmes. These aim to improve access to alternatives to private cars through the increased availability of public transport links and routes that are cycle and walk friendly. Those policies are having a clear impact. The percentage change in modal shift in Dublin has increased from 59% of journeys made through sustainable means in 2010 to almost 70% in 2017 (NTA, 2018).

Improving the fuel economy of the vehicle fleet

A combination of EU regulations for the fuel economy of passenger vehicles and the changes made to vehicle taxation since 2008 have had a quantifiable impact on the availability and deployment of fuel-efficient cars on the Irish market. Vehicles are categorised in seven graduating bands (A to G) based on CO_2 emissions levels. Lower emission vehicles are levied with lower VRT and motor taxes to influence purchase decision in favour of fuel-efficient vehicles.

In January 2013, band A (up to 120 grammes carbon dioxide per kilometre [gCO_2/km]) was split into four bands and band B (121-140 gCO_2/km) into two bands, and the VRT and motor tax were rebalanced accordingly. A zero emissions band for EVs was introduced in 2013 for motor tax purposes only.

The introduction of the tax differentiation has markedly changed the proportion of new passenger cars purchased within the different CO_2 bands. Only 12% of new passenger cars purchased were in the A band and 45% in the B band in 2009. But this rose to 54% of purchases in the A bands in 2012, with 38% of purchases in the B bands. Just 4.3% of all new passenger cars had CO_2 emissions of 140 gCO_2/km or higher in 2017 (CSO, 2018).

The government is carefully monitoring the need to rebalance taxes to stimulate future improvements in energy efficiencies and environmental effects associated with newly emerging vehicles types.

Power sector emissions

Emissions from the electricity sector are covered under the ETS. Ireland has seen a strong increase in renewable electricity and is one of the leading countries in integration of variable renewable energy. But the continuous use of peat and coal in the electricity sector will be a key determinant of future emissions from power generation (Box 6.1).

Emissions relating to the production of electricity consumed by industry accounted for 56% of the total industrial energy-related CO_2 emissions. This was more than all the other fuels used by industry combined (SEAI, 2018b). Emissions reductions in the power sector will therefore specifically affect the industry sector.

Box 6.1 Role of peat in Ireland's electricity generation

Ireland has the highest share of peat use among IEA member countries. Peat accounted for 7.7% of Ireland's electricity generation in 2016 and was responsible for 19.3% of CO_2 emissions from the electricity sector (figure 6.10).

Peat use for power generation is subsidised through a public service obligation (PSO) that will expire at the end of 2019 in line with the government's climate objective to move to lower-carbon generation sources. Peat is expected to be replaced by natural gas in the electricity mix.

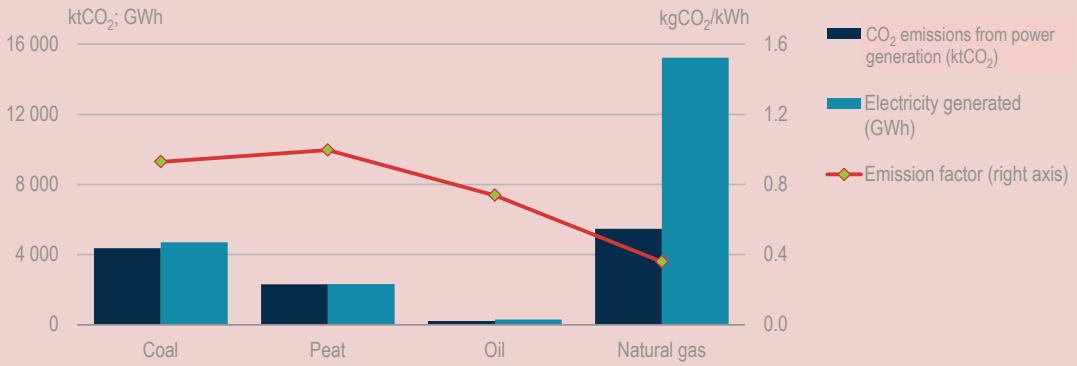
There are three peat-fired power stations operating in Ireland. The Bord na Móna's Edenderry peat-fired power station shifted to co-firing with biomass after its PSO support expired in December 2015. The plant is now receiving support under REFIT 3 (see the chapter on "Electricity and renewable electricity") for co-firing up to 30% of biomass. Bord na Móna announced in October 2018 that it plans to stop using peat for electricity generation by 2028 (2 years earlier than previously planned), and will instead use alternative energy sources.

The two other peat power stations (the ESB West Offaly and Lough Ree plants) will receive the PSO for peat until the end of 2019. It is expected that the termination of PSO support will provide an incentive to convert to alternative, low-carbon generation technologies. The two plants are eligible for support under REFIT 3 of up to 30%, provided they switch to co-firing with biomass and receive planning and environmental consents.

Peat is also used for residential heating; it accounted for 7.5% of the total residential energy demand in 2016. A portion of peat usage is not reflected in official statistics as it is not commercially obtained but harvested privately.

There is also one coal-fired plant in Ireland (Moneypoint), which is owned and operated by the ESB. The plant provides competitively priced baseload electricity generation. Coal accounted for 11.9% of the total electricity generation in 2017. Moneypoint will likely cease coal-fired generation in 2025, which will be replaced by a low-carbon generation technology. The decision about the future of Moneypoint will be taken before 2020.

Figure 6.10 CO_2 emissions from power generation by fuel source and electricity generated, 2016



Peat and coal represent a significant share of CO_2 emissions from power generation in Ireland, due to their high emission factors.

Note: GWh = gigawatt hour; $kgCO_2$ = kilogramme of carbon dioxide; kt = kilotonne; kWh = kilowatt hour.

Source: IEA (2018a), *CO_2 Emissions from Fuel Combustion 2018*, www.iea.org/statistics/.

Emissions from peat will surprisingly be higher through to 2026 under the EPA "with additional measures" scenario than under the "with existing measures" scenario. This is due to the expectations that peat-fired power plants will receive financial support under the REFIT 3 programme which facilitates co-firing of peat and biomass. The peat co-firing share would be up to 30% until the end of 2026 and then gradually reduce to zero by 2030. The decision to include peat co-firing under the REFIT 3 programme was made in April 2017. Hence, it was not included in the "with existing measures" scenario as the cut-off point for policies and measures was the end of 2016. Beyond 2030, emissions from electricity generation under the "with additional measures" scenario will be much lower than under the "with existing measures" scenario, with an accelerated phase-out of coal-fired generation and the expected introduction of additional interconnectors with the United Kingdom.

Total electricity sector emissions[1] are expected to decrease by 12% over the period 2017-20 (to 11 $MtCO_2$-eq) and to decrease by 40% over the period 2017-30 (to 7.4 $MtCO_2$-eq).

Assessment

Ireland is not on track to meet its climate target of a 20% reduction of non-ETS emissions by 2020 below the 2005 level. Although GHG emissions decreased by 11% to 2016, Ireland is set to miss the target by a large margin due to projected strong economic growth and a continuous high demand for fossil fuels. The latest EPA projections of 2018 indicate that the emissions reduction could be only 1% below the 2005 level by 2020.

Ireland has put in place several new frameworks and targets to guide its climate policy since the last IDR, in line with its commitment under the Paris Agreement. An NMP was adopted in 2017 following the 2014 National Policy Statement and 2015 Climate Action and Low Carbon Development Act. The NMP is the first in a series of plans required under the 2015 act. These plans will facilitate Ireland meeting its 2050 objective of an 80% GHG emissions reduction by 2050 compared to 1990 in the electricity, building and transport sectors, as well as an approach to carbon neutrality in agriculture and LULUCF by 2050. Many of the most effective measures for reducing emissions in the NMP are aimed at improving energy efficiency in all sectors and in encouraging an increased uptake of renewable energy technologies.

These objectives are supported by a range of measures and programmes, many of which are being rolled out over the period 2017-19 and which are embedded in the NDP 2018-27. These will guide the country's capital investment over the next decade in the Project Ireland 2040 framework, influencing overall strategic planning and investment.

One-fifth of the NDP budget is earmarked for measures related to the low-carbon economy. The government has established a Climate Action Fund with a proposed allocation of EUR 500 million.

[1] The EPA includes emissions from solid fuels, other energy industries and petroleum refining, and also fugitive emissions, in emissions from the energy industry. However, these accounted for only 3-6% of the total emissions from this sector over the period under consideration.

However, recent trends show that GHG emissions have been growing significantly since 2014 after their rapid fall linked to the 2008 financial crisis, in particular in sectors covered by the EU ESD. With the economic recovery, growth in sectors such as residential buildings and transport has not fully decoupled from GHG emissions. This has coincided with a strong rise of emissions in the agriculture sector related notably to the expansion of dairy farming.

Ireland is therefore set to miss its 20% ESD emissions reduction target for 2020 by a large margin. The current trajectory also indicates that without additional measures, Ireland is likely to fall short of the 2030 target that will be established under the new Effort Sharing Regulation. In addition, it casts serious doubts on the feasibility of the 80% GHG emissions reduction target that Ireland set itself for 2050.

Ireland's unique emission profile implies that tackling energy sector emissions alone will not suffice to meet the 2030 targets, and that a significant and sustained policy and funding effort for agricultural emissions is required. Urgent corrective measures will be needed in all sectors to rectify the trajectory of emissions reduction.

The new policies, measures and funding put in place by the Irish government since 2017 can potentially narrow the expected shortfall. However, the extent to which these new policies will contribute is determined by the speed of their implementation across sectors. The proposed new measures outlined in the NDP are still in an early phase and the set of actions put in place in 2018 in non-ETS sectors do not appear to reflect the urgency nor the magnitude of the expected shortfall. There is also a clear role for enhancing taxation and regulation, and for employing targeted behavioural change measures.

Ireland has a strong track record of developing detailed plans that comprehensively identify and focus on the challenges ahead so that the instruments of policies are finely tuned. However, there appears to be a gap between the elaboration of plans and frameworks and the time-bound implementation of specific measures and continuous monitoring of the progress made.

An example is the transport sector where the highly ambitious objectives for the roll-out of EVs had to be sharply cut back. Even the revised target, which is only 10% of the earlier target, appears difficult to meet. These objectives, together with an array of support programmes for electric cars and vans and the roll-out of charging infrastructure, have helped with a successful first stage of development, with about 6 500 EVs already on the road. The NDP aims at a minimum of 500 000 EVs on the road by 2030 and no new non-zero-emission cars and vans to be sold in Ireland after 2030. The NDP allocates EUR 200 million to this objective. However, limited investment in the roll-out and maintenance of EV charging infrastructure may be a barrier for development of the technology. The gradual increase of the biofuel obligation in transport is likely to remain the main contributor to emissions reductions in the transport sector in the medium term.

The transport sector is not on a low-carbon pathway. Ambition for a modal shift in transport to other modes is not being met with adequate progress. There is no clear policy to facilitate modal shifting and to explore alternative means of transport, especially in urban areas. Enhanced focus on cycling, walking and car sharing (to reduce commuter traffic) should be explored in a comprehensive manner. The structure of the Irish economy and the population growth focused on the greater Dublin area offer an opportunity for an integrated look at transport and on advancing the public transport infrastructure required.

Progress with decarbonisation of the electricity mix has slowed in recent years, despite the strong development in wind power. The Moneypoint coal power plant is scheduled to close down by 2025 and the remaining peat installations by 2030. However, the administration is still working through the implications of these decisions and the practical steps for taking them forward. The announcement of Bord ma Móna to advance the end of using peat for electricity generation by 2 years is a welcome development.

The possible impact on Ireland's electricity demand due to potential installation of large data centres in Ireland is unknown. EirGrid has undertaken various impact assessments through its scenario planning. Data centres may put additional stress on decarbonisation of the electricity mix.

Ireland has many success stories, including the carbon tax applicable to all fossil fuels. While the rate of the carbon tax increased from EUR 15 to EUR 20 in 2014, its impact has now dissipated, and it does not unlock significant emissions reductions in non-ETS sectors. A review of the programme took place in 2018, but the government decided against including a carbon tax increase in the 2019 budget. The Department of Finance remains committed to increase the rate of carbon tax in line with Ireland's climate change policy. A long-term trajectory for the carbon tax to 2030 will be developed during 2019.

The lack of clear signals about future increases of the tax and its long-term target level has failed to induce behavioural changes of investors and stakeholders. Other IEA countries have had encouraging experiences with CO_2 tax regimes with automatic upward adjustments when preset sectoral targets are not met. The IEA encourages the government of Ireland to study the applicability of such programmes.

In line with general taxation policy, there is no ring-fencing of revenues from the tax for CO_2 emissions reduction or energy efficiency measures. The IEA encourages the government to allocate incremental revenues from any future tax increases back into climate mitigation and energy efficiency measures to gain public support and to promote enhanced investments.

Progress made with climate mitigation at the local level and driven by community and individual business performance is noteworthy. Yet those achievements remain isolated at an accumulated level and do not add up to the large progress that needs to be made to meet the 2020 targets.

Ireland's continuous population growth and strong economic performance act simultaneously as enablers and hindrances in making progress towards climate goals. Other IEA member countries, notably Switzerland, have shown that even with continuous population growth, a country can decouple economic progress from energy consumption and carbon emissions.

There is a large consensus among citizens and stakeholders in Ireland on the importance of climate action and on the opportunity for Ireland to be a global leader in clean energy transition. This has helped adoption of ambitious objectives and the rapid roll-out of new mitigation measures. The government should leverage this consensus to implement policies more aggressively. The NMP would benefit from being accompanied by a detailed roadmap with specific timelines and milestones for emissions reductions and a close-meshed monitoring framework.

Recommendations

The government of Ireland should:

- Plot a clear trajectory, with interim points based on carbon budgets, between its current situation and the 2050 GHG targets to clearly identify and quantify the efforts needed in each sector, to ensure political ownership and accountability, and to guide full and efficient implementation of the NPF and NDP.
- Urgently implement measures turning plans and pilot programmes into actions designed to result in rapid and meaningful GHG emissions reductions in all sectors. This is necessary to bridge the gap to the emissions trajectory and to give a clear political signal to citizens, stakeholders and investors. Focus should be on actions that enhance energy efficiency and renewable energy actions, as these offer the main opportunity to reduce energy-related emissions.
- Raise the rate of the carbon tax and put in place a mechanism that allows for upward adjustments when preset sectoral GHG targets are not met.
- Strengthen funding for clean energy mobility, in particular for public transport, installation and maintenance of the EV charging system, and cycling and walking infrastructure.

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7. Energy efficiency and residential heating

Key data

(2016)

TFC: 10.9 Mtoe (oil 55.5%, electricity 20.2%, natural gas 16.3%, biofuels and waste 3.7%, coal 2.5%, peat 1.8), -15% since 2006

Consumption by sector: transport 36.8%, industry 24.9%, residential 24.2%, commercial 14.1%

Energy consumption (TFC) per capita: 2.3 toe (IEA average 2.9 toe), -22% since 2006

Energy intensity (TFC/GDP): 37 toe/USD million (2010 prices, PPP) (IEA average: 75 toe/USD million), -42% since 2006

Energy consumption for residential space and water heating (2015): 2.2 Mtoe (oil 42.5%, electricity 12.2%, natural gas 23.5%, biofuels and waste 3.4%, coal and peat 18.3%), -11% since 2005

Energy intensity for space heating (2015): 0.35 GJ/m^2 (IEA average 0.34 GJ/m^2), -34% since 2005

Overview

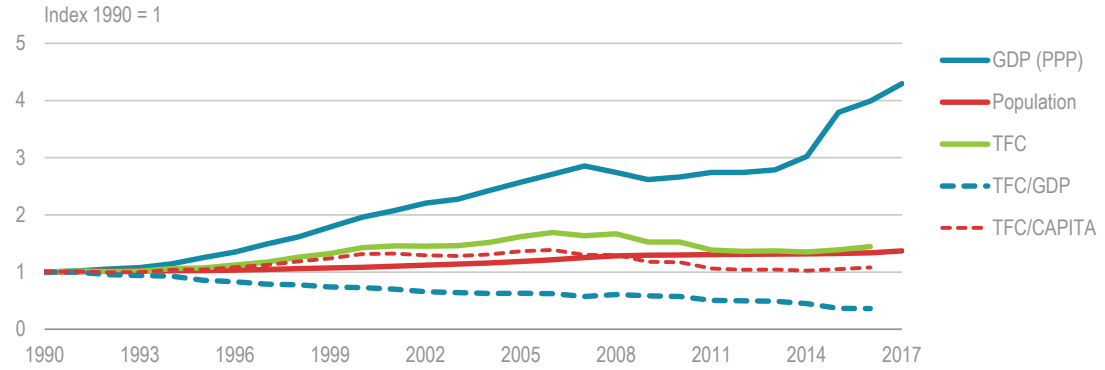
Ireland set a non-binding target to improve its energy efficiency by 20% by 2020 compared to average energy use during the period 2000-05. It had achieved 12% savings by the end of 2016. It is unlikely that Ireland will reach its target, although the impact of some policy measures that became effective in 2017 has not been fully reflected in projections to 2020. Ireland's economy was severely affected by the financial crisis of 2008, but has picked up in recent years, driven by investments from international technology and service companies. Ireland's gross domestic product (GDP) has been above the pre-crisis level from 2007 since 2014.

The strong economic growth resulted in Ireland having the lowest energy intensity, defined as total final consumption (TFC) of energy per GDP, among International Energy Agency (IEA) member countries in 2016.[1] Ireland's TFC also declined during the crisis years, followed by a slight increase in recent years. The TFC was 10.9 million tonnes of oil equivalent (Mtoe) in 2016, 15% lower than the peak in 2006 but 7% higher than in 2014. The TFC seems to have decoupled from economic growth, but less so from population growth (Figure 7.1).

[1] For a discussion of the methodological issues with measuring Ireland's economic growth, see the chapter on "General energy policy".

Improved building regulations have led to a reduction in energy demand in the residential and commercial sectors. However, fossil fuels account for most of the residential energy demand, and decarbonisation of heat in the residential sector is therefore an area that receives special attention in this chapter.

Figure 7.1 Energy demand and drivers, 1990-2017



Ireland's final energy consumption has decreased over the past decade, despite strong GDP and population growth.

Notes: GDP in 2010 USD (United States dollars) at purchasing power parity (PPP). Data are provisional for 2017. Data on TFC unavailable for 2017. For a discussion of the methodological issues with measuring Ireland's economic growth see the chapter on "General energy policy".

Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

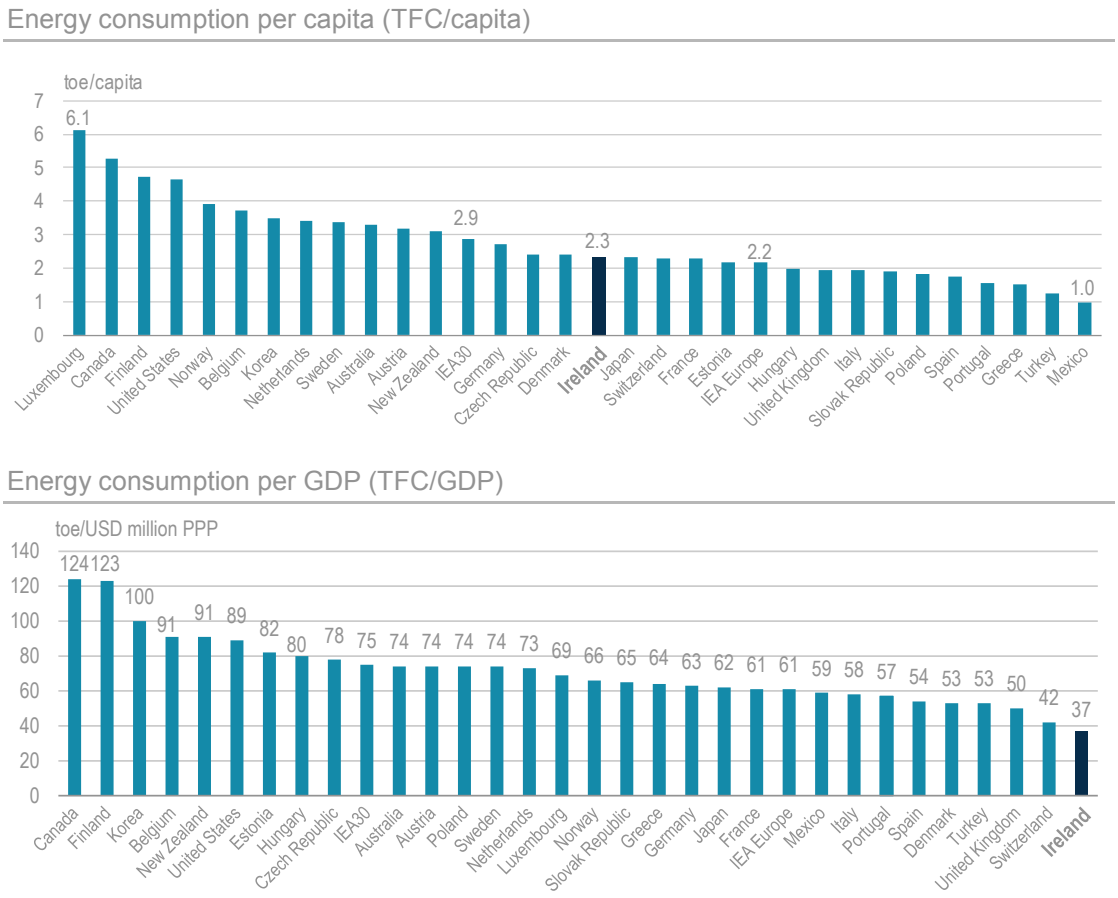
Energy consumption and intensity

Energy intensity per capita and GDP

Energy intensity can be measured as energy consumption (TFC) per capita and per GDP. In 2016, Ireland's TFC per capita was 2.3 tonnes of oil equivalent (toe), which placed Ireland around the median among IEA countries. Energy intensity per unit of GDP expressed in purchasing power parity was 37 toe per million United States dollars (USD) (Figure 7.2), which was the lowest among IEA member countries. In terms of modified total domestic demand, Ireland's energy intensity was 58 toe/USD million, which was the seventh lowest in the IEA and below the IEA average.

A country's energy intensity can be explained by the structure of the economy. Ireland's economy has shifted in the direction of high-value-added sectors such as pharmaceuticals, electronics and services. These growing sectors are not highly energy intensive relative to traditional industries such as steel production. Changes in the fuel mix of the final consuming sectors can also contribute to a decline of energy intensity. Fuel consumption in Ireland's industry sector has shifted from oil to more-efficient use of electricity and natural gas. Energy intensity will continue to show a decreasing trend if the economy becomes increasingly dominated by high-value-added, low-energy-consuming sectors. Further electrification of the TFC can also improve Ireland's energy intensity. Electricity end-use technologies are typically more energy efficient in providing the same service per unit of final energy than other technologies. This could then lead to an overall reduced demand for energy.

Figure 7.2 Energy intensity in IEA countries, 2016



Ireland has the lowest energy consumption per GDP, but is close to the median in terms of energy consumption per capita among IEA countries.

Notes: Energy intensity in final energy consumption, not including the energy transformation sector. For a discussion of the methodological issues with measuring Ireland's economic growth, see the chapter on "General energy policy".
Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Energy consumption by sector

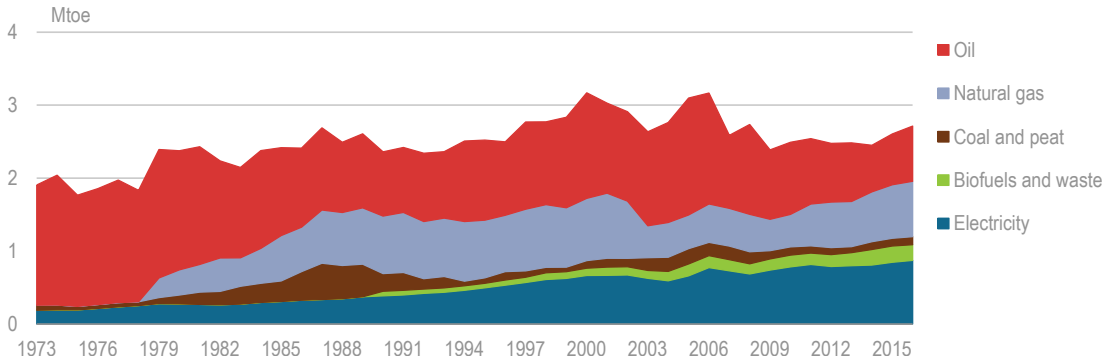
Ireland's energy consumption has been stable in recent years. Transport consumes the largest share, followed by the industry, residential and commercial sectors. The transport sector was assessed in Chapter 6 on "Energy and climate". This chapter will focus on energy efficiency in the other sectors.

Industry

Ireland's industry sector consumed 2.7 Mtoe in 2016, which accounted for 25% of the TFC. After peaking in 2006, industrial energy consumption declined by 25% in 3 years until 2009 due to the financial crisis (Figure 7.3). However, energy consumption in industry has picked up in recent years, and the level in 2016 was the highest since 2008. Electricity accounts for 32% of final consumption in the sector; oil, natural gas, coal and peat together represent 60% of energy demand. The remaining 8% is biofuel and waste (including primary solid biomass, biogases, municipal waste and industrial waste).

In the last decade, energy consumption has shifted from oil to electricity and natural gas. Oil consumption in the industrial sector fell by 50% from 2006 to 2016, whereas natural gas increased by 44% and electricity by 13%. Biofuels and waste consumption increased by 31% since 2006. The increase of biofuel consumption was due to the use of biomass in the wood processing industry and the use of the renewable portion of waste in cement manufacturing (SEAI, 2017a).

Figure 7.3 TFC in industry by source, 1973-2016

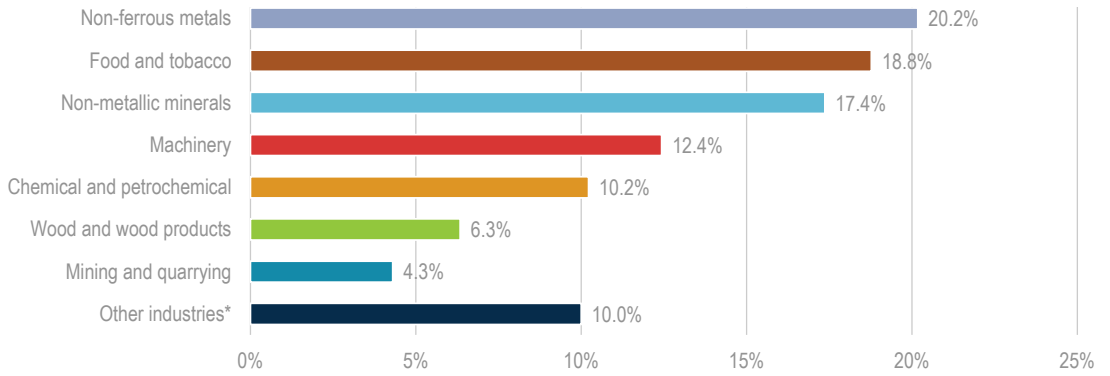


Industry energy consumption has decreased over the last decade, and there has been fuel switching from oil to natural gas and electricity.

Note: Includes non-energy consumption.
Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Ireland's industrial energy consumption is spread out over several sectors. Non-ferrous metals were the largest energy consuming industry in 2016 (including for non-energy-related purposes), representing 20% of the total industry consumption, followed by food and tobacco (19%) and non-metallic minerals (18%) (Figure 7.4).

Figure 7.4 Energy consumption in manufacturing industry sectors, 2016



Metals, food and minerals industries account for over half of industry energy consumption.

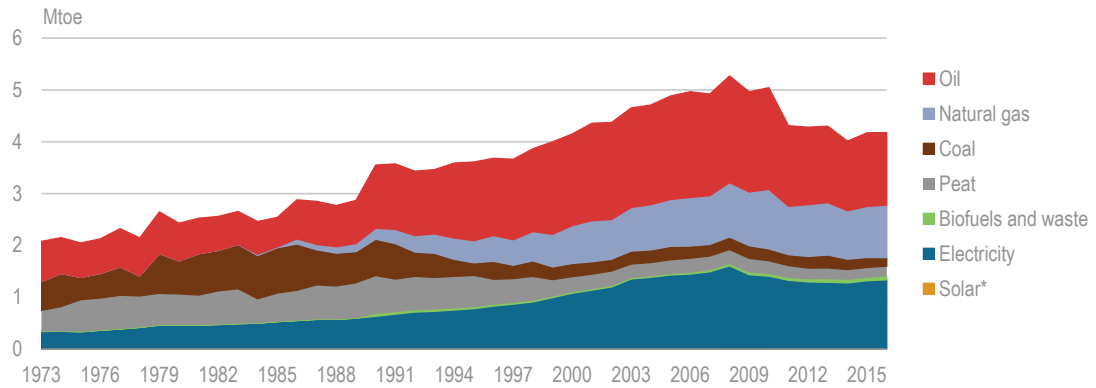
* *Other industries* include construction, textile and leather, paper, transport equipment and non-specified industries.
Source: IEA (2018), *World Energy Balances 2018*, www.iea.org/statistics/.

Residential and commercial

The residential and commercial sectors together consumed 4.2 Mtoe in 2016, which accounted for over one-third of the TFC (Figure 7.5). This was 16% lower than in 2006, despite a slight increase in recent years. Oil is the dominant fuel and accounts for a third of energy consumption in the two sectors. This is because many dwellings in rural areas are not connected to the gas grid and use oil-fired boilers for space and water heating (SEAI, 2017a).

Electricity is the other main energy source used in the sectors, with nearly 32% of the TFC. Peat and coal consumption have declined in the last decade, but still accounts for 9% of consumption in 2016, whereas renewable energy sources represent only 2%. District heating (DH) is not widely used in Ireland, with only a handful of communal or localised DH systems in use.

Figure 7.5 TFC in residential and commercial sectors by source, 1973-2016



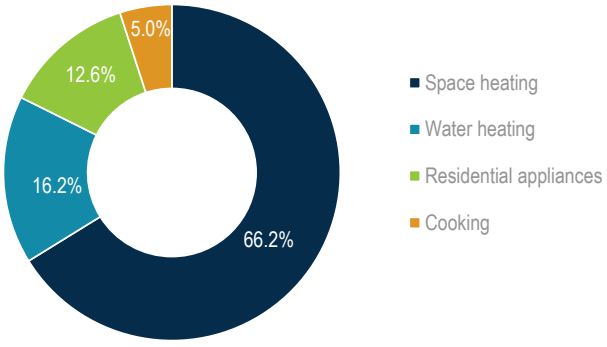
Oil and electricity are the main energy sources in the residential and commercial sectors; the shares of peat and coal are larger than the share of renewables.

* Negligible.

Note: The commercial sector includes commercial and public services, agriculture, forestry and fishing.

Source: IEA (2018a), *World Energy Balances 2018*, www.iea.org/statistics/.

Figure 7.6 Residential energy consumption by end use, 2016



Space and water heating account for over 80% of the total residential energy demand.

Source: IEA (2018b), *Energy Efficiency Indicators 2018*, www.iea.org/statistics/.

In the residential sector, space heating accounts for 66% of the total energy demand in 2016 and water heating represents another 17% (Figure 7.6). Residential appliances (11%) and cooking (5%) account for the remaining shares.

Institutions

The **Department of Communications, Climate Action and Environment** (DCCAE) is the lead ministry for the development of energy efficiency policies and oversees policy implementation. It also co-ordinates energy efficiency policies and measures across other institutions and is responsible for transposition of the European Union (EU) energy efficiency directives into Irish law.

The **Sustainable Energy Authority of Ireland** (SEAI) is a state agency under the DCCAE, and administers and implements most of the National Energy Efficiency Action Plans (NEEAPs) and other energy efficiency programmes. It is responsible for advising the government on policies related to energy efficiency, reduction of greenhouse gas (GHG) emissions, promoting renewable energy, and developing and demonstrating new technologies. SEAI responsibilities have expanded over time, and its staff resources have increased accordingly.

The DCCAE works closely with other government ministries with responsibility for implementing energy efficiency measures in the NEEAPs, including the **Department of Transport** and the **Department of Housing, Planning and Local Government**, which is responsible for improving energy efficiency requirements for buildings under the building regulations.

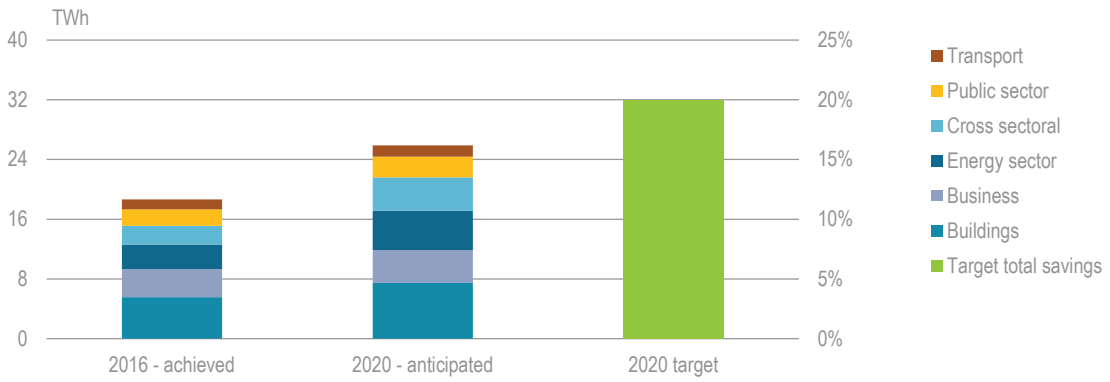
Energy efficiency targets

Ireland set a non-binding, national target to improve its energy efficiency by 20% by 2020. The target is calculated based on the average final energy used over the period 2001-05 and is equivalent to 31 925 gigawatt hours (GWh) of primary energy savings by 2020 (DCENR, 2009). The government set a separate target for the public sector to reach 33% energy savings by 2020, which contributes to the national effort towards the 20% target.

Ireland produces a NEEAP every three years in line with the EU Energy Efficiency Directive. The latest was in 2017. The 2017 report will be the last as energy efficiency reporting will be subsumed into the National Energy & Climate Plan 2021-2030 as from 2021. The NEEAP is Ireland's central energy efficiency policy document. It provides a comprehensive overview of the strategies and policies in place across all sectors and monitors developments. The energy efficiency policies implemented under the NEEAP 3, which ran from 2013 to 2016, and its two predecessors have resulted in substantial progress towards meeting the 2020 target.

Ireland achieved 12% energy savings by the end of 2016, corresponding to 18 654 GWh, which reduced carbon dioxide (CO_2) emissions by approximately 4.4 million tonnes (Mt) (DCCAE, 2017a). The savings represented over EUR 1 billion (euros) of reduced energy bills nationally (SEAI, 2016a). Ireland expects to reach energy savings of 16.2%, equivalent to 25 904 GWh by 2020, based on the policy measures in place up to the end of 2016 (Figure 7.7). This leaves a shortfall of 3.8% that would require additional measures.

Figure 7.7 Primary energy savings by sector, compared to 2020 target



In 2016, Ireland had achieved 12% of the 20% energy savings target by 2020; current measures will not be sufficient to reach the 2020 target.

Source: DCCAE (2017a), *National Energy Efficiency Action Plan for Ireland #4 2017-2020*, www.dccae.gov.ie/documents/NEEAP%204.pdf.

The expected shortfall against the 20% target could still be made up through the full and timely implementation of additional measures. These are set out in the NEEAP 4 that became effective in 2017 and covers the period up to the end of 2020. Additional policy and strategy documents such as the Public Sector Energy Efficiency Strategy of 2017, the first National Mitigation Plan of 2017, the Long Term Renovation Strategy (2017-2020) and the 2018 National Development Plan (NDP) complement the NEEAP 4.

Beyond 2020, the government has identified a technical potential to save a further 16 000 GWh by 2030. However, this will require deeper and more expensive measures, especially in the buildings sector, and decarbonisation of heat, as most simpler measures will have already been implemented. Scaling up energy efficiency will also require increasing policy efforts and sufficient levels of funding (DCCAE, 2017b).

Energy efficiency funding and advisory services

After a sharp reduction in public funding for energy efficiency due to the economic crisis, funding has increased markedly since 2016. The budget allocation available to the SEAI for 2018 was EUR 107 million. This compares to total funding of EUR 452 million for the period 2011-17, of which EUR 100.2 million was for 2017 and EUR 72.7 million for 2016. The projects funded from the 2018 budget are expected to result in savings of 483 GWh and 120 kilotonnes of carbon dioxide ($ktCO_2$) during 2018.

Financial incentives and support programmes are made available through several measures, and target specific sectors. An Energy Efficiency Fund was launched in 2014 to provide specialised financial services for large-scale energy efficiency projects in the non-residential sector. EUR 73.8 million was committed by investors, of which EUR 35 million was committed by the government as a minority shareholder. The investment period for the Energy Efficiency Fund closed on 8 May 2018. EUR 14 million for project investments called on the government's funding commitment, including for the Mater Hospital energy retrofit project, which is a EUR 10.5 million energy performance contract, fully funded by the Energy Efficiency Fund. The remaining balance of the

government's original commitment to the fund is due to be transferred to the newly established Climate Action Fund, which will support energy efficiency investments (see Chapter 6 on "Energy and climate").

An accelerated capital allowance programme has been operating since 2008 to encourage use of energy-efficient technologies. The list of eligible technologies is updated on an ongoing basis. Its purpose is to encourage businesses to purchase equipment and machinery that are highly energy efficient by enabling companies to write down the capital cost in the year of purchase instead of over the standard 8 year period for equipment not listed in the SEAI's Triple E (Energy Efficient Equipment) Register.

The Better Energy Financing programme supports applied research for developing innovative financing solutions for deeper levels of building upgrades, and investigates how to incentivise greater uptake of home retrofit programmes in the residential sector.

Offering access to advisory services is another enabler to enhance energy efficiency, as financing options alone are seldom sufficient to initiate action by decision makers. The government has therefore broadened the mandate of the SEAI and increased its resources. In 2018, 92 staff worked at the SEAI, up from 78 in 2017 and 56 in 2016. The SEAI set up the National Energy Modelling Group to assess the impact of government programmes and to provide policy advice on the evidence base obtained by the modelling.

The SEAI created a new research unit for behavioural economics in 2017 to raise awareness among the business and household sectors and to better understand their motivations in uptake of sustainable energy solutions. A technical bureau was also set up in 2017 to complement the range of programmes undertaken by the DCCAE and the SEAI. The SEAI also produces annual energy forecasts to inform the debate on future energy trends and to allow the government to take corrective measures.

A key aspect of SEAI activities is promotion of awareness of energy efficiency among suppliers and customers. The SEAI is also offering energy management training for small and medium-sized enterprises (SMEs), and free information and best practice guidelines on energy management.

Public sector targets and strategies

Ireland set a target of 33% improvement of energy efficiency for the public sector to demonstrate the government's leadership role on energy efficiency and climate action. Public bodies and schools achieved a 20% efficiency improvement by the end of 2016 compared to the baseline of 2009. The value of the cumulative energy savings up to 2016 was EUR 737 million and the cumulative avoided CO_2 emissions were over 2.7 million tonnes (Mt) (SEAI, 2017b).

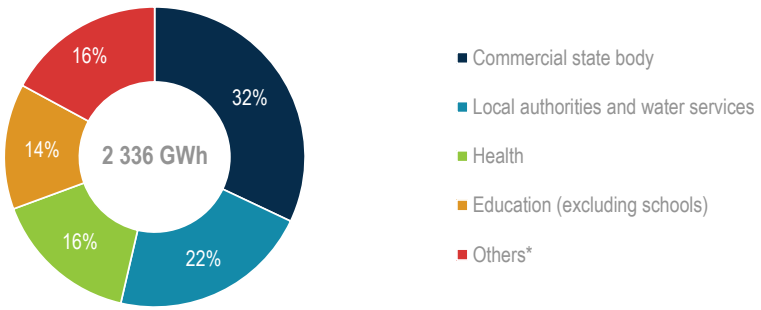
The 33% target would be equivalent to energy savings of 3.2 terawatt hours (TWh), or avoided CO_2 emissions of 5.9 Mt for the period 2009-20, and monetary savings of EUR 246 million by 2020 (DCCAE, 2017c).

The SEAI and the DCCAE have put in place an online energy monitoring and reporting system and publish an annual public sector energy efficiency performance report to track progress. Over 3 100 projects and measures were reported on in 2016, of which over half focused on structured energy management improvements, lighting, heating and

building fabric. Other areas targeted were information and communication systems, water services, onsite renewables and transport (SEAI, 2017b).

The combined primary energy savings of public bodies and schools in 2016 was 2 336 GWh, equivalent to 0.52 Mt of annual CO_2 savings (Figure 7.8). The value of the energy savings reported for 2016 was EUR 133 million. The public sector was estimated to annually spend EUR 565 million on energy (DCCAE, 2017b). Based on the savings obtained by the end of 2016, reaching the 33% target would require approximately 3 879 GWh of primary energy savings by 2020 (SEAI, 2017b).

Figure 7.8 Sources of energy savings in the public sector, 2016



In 2016, Ireland achieved around 20% of the targeted 33% public sector energy savings by 2020, mostly from commercial state bodies, local authorities and water services.

* *Others* includes non-commercial state agencies/bodies, civil services, justice and defence and schools (including educational training boards).

Source: SEAI (2017b), *Annual Report 2017 on Public Sector Energy Efficiency Performance*, www.seai.ie/resources/publications/2017_Annual_Report_on_Public_Sector_Energy_Efficiency_Performance.pdf.

Although the progress made to 2016 was substantial, there are significant challenges ahead for the public sector to meet the 2020 target. Savings have come from low-cost measures such as behavioural change campaigns, smarter use of energy and equipment upgrades. Progress from 2015 to 2016 plateaued, indicating that the potential for those measures is nearing exhaustion. Reaching the 2020 target will require additional effort, including an increase in capital investment and implementing complex and costly projects such as deep renovation of buildings, public lighting upgrades and construction of new nearly zero energy buildings.

The government therefore issued Ireland's first Public Sector Energy Efficiency Strategy in 2017 (DCCAE, 2017c). This identified savings potential and set out an institutional and regulatory framework to enable the public sector to identify, develop and implement the larger-scale energy efficiency projects that are needed going forward towards 2020. A centralised project pipeline is being developed as part of this process to provide the government with a strategic overview of investment opportunities, especially in energy-intensive public bodies. All public sector bodies are required to appoint energy performance officers at a senior level that have decision-making powers on finance, personnel and facilities.

Public sector bodies can retain the savings achieved from energy efficiency improvements and redeploy them within their organisation according to their priorities. The strategy provides clarity on the retention of savings, which is expected to encourage investment in energy efficiency.

Public procurement has a critical enabling role in helping public sector bodies achieve their energy efficiency objectives. Public bodies have explicitly requested additional support from the government in green procurement. The Environmental Protection Agency issued green public procurement guidance for the public sector in 2014 to respond to this request. The SEAI and the Office of Public Works are developing a procurement framework for medium to deep renovation, lighting upgrades and boiler replacements. The framework will be an important tool for aggregation of smaller-scale projects in publicly owned buildings.

A complementary initiative that focusses on capacity in small public bodies is the creation of a pipeline of medium to deep renovation projects by the Office of Public Works. This will be implemented as pilot projects to be replicated across the public sector. However, substantial capacity building across the public sector bodies and enhanced provision of energy services to the smallest public units (e.g. schools) will still be needed to ensure that the public sector energy efficiency potential is optimally exploited.

The National Public Lighting Upgrade Project is an inspiring example of the potential of project scaling. Ireland's 31 local authorities are co-operating under the project to enhance the efficiency of public lighting, which is one of the largest energy consumers at the local authority level and which also contains significant upgrading opportunities. Successfully implementing this project may allow local authorities to meet their 33% efficiency target (DCCAE, 2017b).

The government is already looking towards the period beyond 2020 and contemplating measures to exploit the economic potential of a further 1 400 GWh of energy savings in the public sector (DCCAE, 2017c). As a first step, the government will review the Public Sector Strategy in 2019 and issue a reviewed strategy for the period after 2020.

Industry and commercial sector policies

The industry and commercial sectors jointly account for 39% of the total final energy consumption in Ireland in 2016. By the end of 2016, the energy efficiency measures implemented in the two sectors, including SMEs but excluding the service sector, resulted in savings of 3 744 GWh, equivalent to 887 $ktCO_2$. By 2020, the savings are estimated to be 4 384 GWh and just over 1 Mt of CO_2 (DCCAE, 2017a).

Energy-intensive industry is organised through the Large Industry Energy Network (LIEN), which dates back over two decades. LIEN members represented 58% of the total industry sector consumption in 2016, or 20% of the total primary energy demand in Ireland. Since its creation LIEN members have achieved efficiency improvements of about 30%. They achieved energy savings of EUR 25 million and 147 $ktCO_2$ in 2015.

The Energy Efficiency Obligation Scheme (EEOS) was introduced in 2014, in compliance with the EU 2012 Energy Efficiency Directive. This requires all energy suppliers with annual sales above 600 GWh to achieve collective energy savings of 550 GWh per annum. Over the first phase of the programme (2014-17), energy suppliers were projected to have delivered energy savings of 1 850 GWh, just short of the 2 200 GWh required.

The EEOS was reviewed in 2016; the annual savings target was increased to 625 GWh for 2017 and to 700 GWh for 2018. The same target will also apply for 2019 and 2020. Obligated energy suppliers are required to achieve energy efficiency savings by a predetermined percentage in the non-residential (75%), residential (20%) and energy poverty (5%) sectors (see Box 7.1 for a definition of energy poverty).

Box 7.1 Fuel poverty and energy efficiency in social housing

About 28% of households in Ireland in 2015 were estimated to be living in energy poverty. A household is classed as energy poor when it spends more than 10% of its income on fuel. Energy poverty of households living in social housing was over 70% and they spent an average of 17% of their income on energy. Social housing made up 6.6% of the Irish buildings stock. However, in absolute numbers, homeowners accounted for most energy-poor households at over 250 000.

The energy efficiency rating of a house is a determining factor for energy poverty. Improving the building energy rating (BER) of a home from E1 to B2 can lead to energy savings of EUR 2 524 annually. A one-grade improvement in the BER is associated with a 4-10% change in household energy spending. People living in rented accommodation are twice as likely to live in a home that is rated E or lower than people in owner-occupied dwellings.

There is a significant level of untapped energy savings potential in the rental sector, particularly in the lower-cost accommodation sector that the Strategy to Combat Energy Poverty 2016-2019 aims to exploit.

Through the Better Energy Warmer Homes programme, a complement to the Better Energy Homes strand, the government provides free energy efficiency upgrades to homeowners who receive certain welfare payments and who live in, or are at risk of, energy poverty. The programme had upgraded over 135 000 energy-poor homes by the end of 2017. The grants were provided for improved insulation, ventilation, draught proofing, lagging jackets, energy efficiency light bulbs and energy advice.

The strategy also introduced a new grant programme for home renovations of those with chronic respiratory conditions, called the Warmth and Wellbeing Pilot Scheme. This was a joint initiative of the DCCAE and the Department of Health to provide insights into how energy improvements deliver tangible health and well-being gains. EUR 20 million was provided for the period 2016-18 to upgrade over 1 000 homes, either owner-occupied or social housing.

The Better Energy Communities (BEC) programme makes energy efficiency improvements available to those in energy poverty not captured by the Warmer Homes Programme (such as tenants) and to test the economies of scale by targeting clusters of homes in energy poverty. Furthermore, under the Residential Deep Retrofit programme, energy-poor households can receive grants of up to 95% of the capital costs of renovations.

Sources: Country Submission, DCCAE, *A Strategy to Combat Energy Poverty 2016-2019*, ESRI Working Paper 2014 – *Changes in Household Fuel Expenditure Associated with Improvements in Building Energy Efficiency*, John Curtis and Anne Pentecost, www.esri.ie/pubs/WP478.pdf.

The EEOS has contributed to the development of a market for energy efficiency services. The government launched the National Energy Service Framework in 2014. This was a guideline for undertaking energy performance contracting (EPC) that included a standard

form of contracts, procurement guides and templates. The objective was to develop investment-ready projects to stimulate the market for energy services companies (ESCOs). An ESCO would enter into an EPC with a business unit and the stream of income from the cost savings would pay the ESCO for its services, instead of an upfront payment. All forms of EPCs are promoted through capital grants programmes.

However, the ESCO market did not take off as expected. Successful projects had a long preparatory period, of up to three years in some cases before the ESCOs were paid. Moreover, the level of technical competence along the chain of entities involved was not uniform and showed a large scope for capacity building. The government still sees potential in the EPC mechanism and is exploring opportunities for use of the EPC to achieve sector energy efficiency upgrades as a testing ground to refine the EPC and ESCO model.

Key opportunities to improve energy efficiency in the industrial and larger commercial sectors exist through the mandatory energy audits in compliance with the EU Energy Efficiency Directive. All concerned enterprises had to complete the first audit by December 2015 and have to renew it every four years. The government is considering extending the mandatory energy audits for the commercial sector beyond the obliged enterprises.

The government has launched the Excellence in Energy Efficient Design (EXEED) programme since the last in-depth review (IDR). This supports energy management certification, primarily for commercial energy users. It aims to provide new best practices by applying a standardised process in energy-efficient design management. The 38 EXEED projects funded under a pilot grant programme achieved energy savings averaging around 28% of the baseline energy consumption. The achievements have resulted in growing interest, in particular from SMEs. Funding of EUR 10 million was allocated for the EXEED in 2018 to respond to the increased interest.

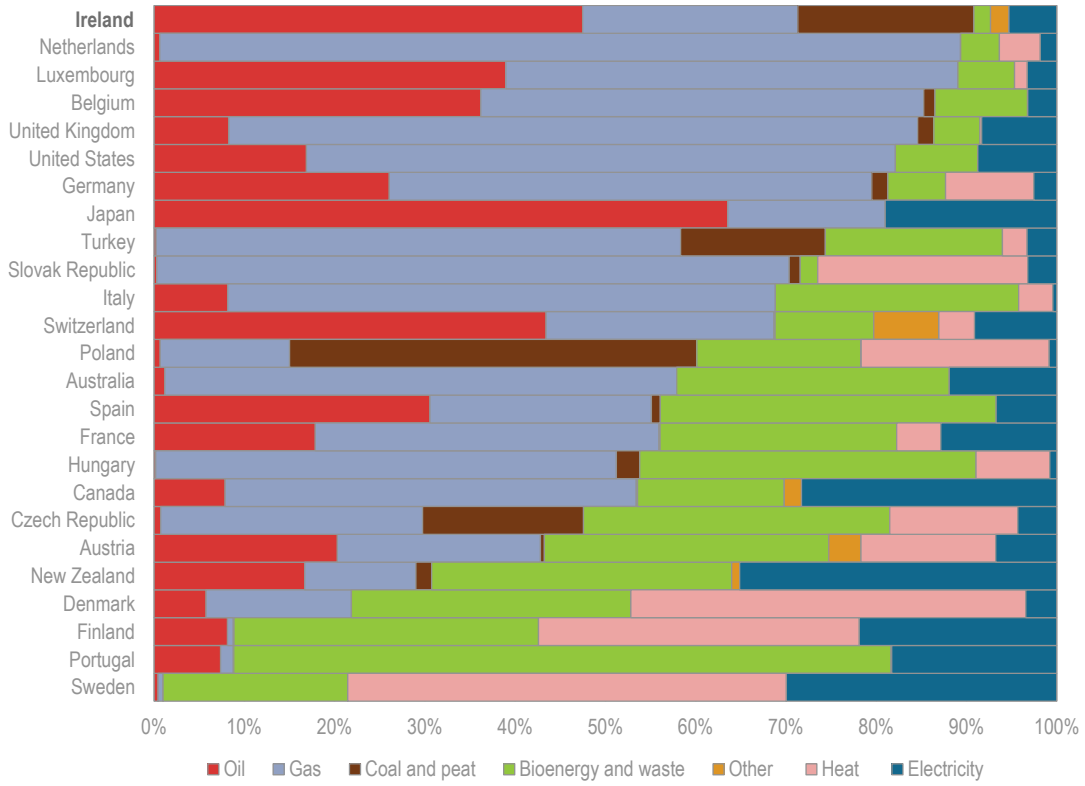
Ireland is in the top 20 locations for data centres globally. There is therefore potential for electricity consumption of data centres to rise sharply. The electricity consumption of data centres in 2016 represented less than 2% of the overall yearly electricity consumption of Ireland. However, it may rise to 31% by 2027 (see Box 2.2 in Chapter 2 on “General energy policy” and Chapter 5 “Electricity and renewable electricity”). Some measures, such as the EXEED programme, already target this potential rise and aim to ensure a high energy efficiency of existing data centres, as well of those in their design stage.

Focus area: Decarbonisation of heat

Ireland’s buildings sector relies heavily on fossil fuels for heating. Residential space and water heating accounts for over 80% of the total energy consumption in the sector; most of that is supplied by fossil fuels. Ireland had the highest share of fossil fuels in residential space heating among IEA member countries in 2016 (Figure 7.9).

There are two ways to decarbonise heating in buildings: by reducing energy demand and by lowering carbon intensity per energy use. The first option relates to the energy efficiency in buildings and the development of the total buildings stock. The second option relates to switching from fossil fuels towards renewable energy sources in heat production.

Figure 7.9 Energy use for residential space heating by IEA country and fuel, 2016



Ireland had the highest share of fossil fuels in residential space heating among IEA countries in 2016.

Note: Data unavailable for Greece, Korea, Norway, Estonia and Mexico.

Source: IEA (2018b), *Energy Efficiency Indicators 2018*, www.iea.org/statistics.

Most of the energy savings needed to reach Ireland's 2020 target and for the additional energy efficiency potential to 2030 will result from measures focusing on the buildings sector. The total energy efficiency potential in the buildings sector is estimated at 23 TWh to 2030 (SEAI, 2015a).

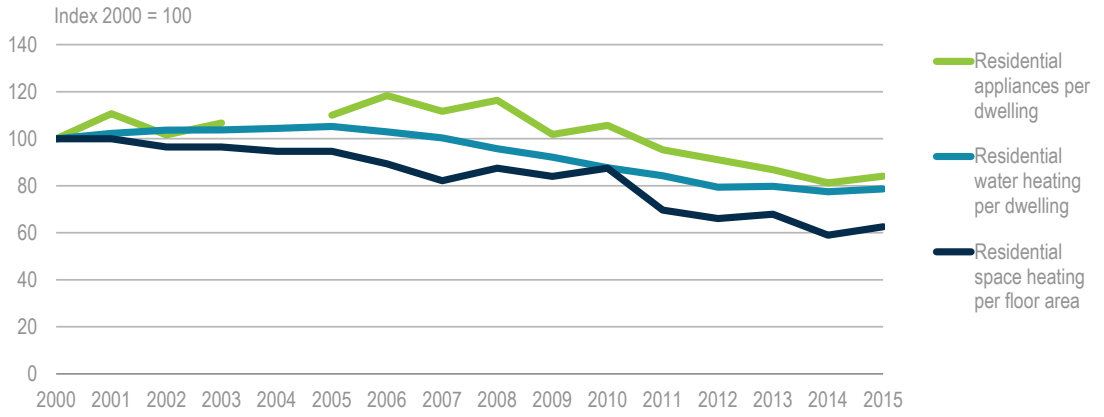
Energy efficiency in buildings

Improving energy efficiency in the buildings sector has been a key policy objective since the last IDR. The government has launched many new programmes and financial incentives while maintaining existing ones. A key objective is to provide long-term planning certainty and make legislative changes to accelerate the market transformation in the private buildings sector. This is supported by grant programmes and tax incentives for deeper building upgrading. The guiding policy document is the Long-Term Renovation Strategy that has been developed through a comprehensive engagement strategy led by the DCCAE, the SEAI and the Irish Green Building Council (DCCAE, 2017b).

Ireland has achieved significant reductions in energy intensity for the residential sector, especially through improved insulation. Energy intensity for space heating decreased by 47%, water heating by 21% and residential appliances by 16% between 2000 and 2015 (Figure 7.10). Beyond 2020, nearly 16 TWh, or 69%, of the 23 TWh total primary energy

savings potential in the buildings sector, remains to be exploited. Achieving these savings is becoming increasingly challenging as simpler measures are expected to have been taken up before 2020.

Figure 7.10 Energy intensities in the residential sector, 2000-15



Ireland has reduced the energy intensity in buildings, especially in residential space heating; improvements are becoming increasingly challenging.

Note: Data unavailable for 2004.

Source: IEA (2017), *Energy Efficiency Indicators 2017*, www.iae.org/statistics/.

Residential buildings stock and energy savings potential

The total energy savings potential in Ireland's residential buildings is estimated to 13.5 TWh. Over 30% of this potential exists in the heating sector (SEAI, 2015a). Research by SEAI forecasts the opportunity for a further 9.4 TWh of energy savings in the residential sector in the period 2021-30 (DCCAE, 2017b). This comes from measures such as external wall insulation and more-efficient heating technologies.

Ireland had a buildings stock of just over 2 million in 2016, of which over 97% had one dwelling only. This reflects the dispersed nature of settlements in the country. The residential housing stock grew by only 0.4% from 2011 to 2016, while the Irish population grew by 3.8% over the same period (Figure 7.11). This was the slowest addition of buildings stock since 1991. Population growth is expected to continue, and the government has ambitious plans to increase the housing supply by 25 000 homes annually in 2019 and 2020, and to then reach an annual level of 30 000-35 000 new homes up to 2027. Out of this, 112 000 units will be social housing.

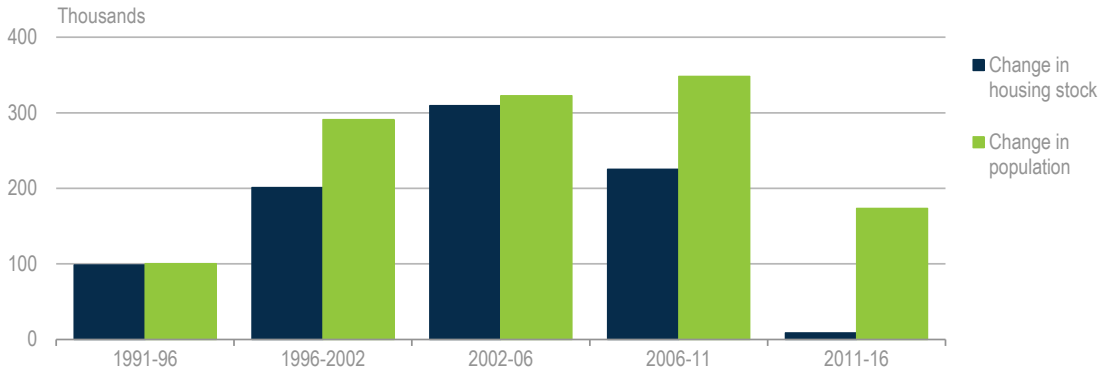
It will be important to avoid any lock-in of fossil fuels in the new buildings and to ensure that all new construction is in full compliance with the new building codes (see the section on "Building regulations below). Moreover, the introduction of DH systems should be pursued for new or rehabilitated urban areas.

Almost 33% of homes were rented in 2016 (an increase of 4.7% compared to 2011), and the increase of houses being rented from local authorities was 11%. Renting has overtaken ownership in urban areas, and accounted for 36% in 2016. Rental dwellings tend to have a lower BER than owner-occupied properties. This implies that people in rented properties are likely paying higher energy bills, which possibly increases their risk

of fuel poverty compared to people living in owner-occupied or local authority homes. Addressing the split incentives for energy improvements in rented homes is a key policy area for the government.

An interesting development has been observed in the housing market since 2011. The share of households with a mortgage reduced by 8% from 2011 to 2016. Close to 50% of residential buildings owners in rural areas did not have a mortgage or loan but owned their house in 2016. This offers an opportunity to incentivise homeowners to invest in energy upgrades, as some may have higher disposable incomes after having repaid their mortgages.

Figure 7.11 Change in population and housing stock, 1991-2016



Ireland's change in housing stock has not kept up with the growth in population over the last decade.

Source: CSO (2018), *Census of Population 2016 - Profile 1 Housing in Ireland*, www.cso.ie/en/releasesandpublications/ep/p-cp1hii/cp1hii/hs/.

Building regulations

Revised building regulations became effective on 1 January 2019. All new buildings will have to be nearly zero energy buildings after 31 December 2020, as will all buildings acquired by public bodies after 31 December 2018. Buildings would reduce their energy consumption by up to 60% under the revised regulations compared to current regulations. In addition, up to 20% of the final energy demand will need to be met by renewable energy. The share of renewables can be reduced to 10% of the final demand if a higher degree of energy efficiency is achieved.

Revised regulations for residential buildings will come into force on 1 April 2019, meaning that any residential building receiving planning permission after then must meet the new standards. All homes, irrespective of when they received planning permission, should achieve the new standard after 2020. The new building regulations also include provisions for existing domestic buildings undergoing renovations, requiring them to achieve an energy performance resulting in at least a B3 rating. However, a comprehensive monitoring and enforcement regime will be key to maximising their effectiveness.

It will be important to address the split incentives in the rental sector manifested in the low uptake of available grant programmes by landlords and the consequent lack of larger

energy efficiency improvements in the rental housing stock. The building regulations should include the introduction of minimum energy efficiency standards in the rental sector.

Building energy rating

Ireland uses a system of BER certificates that rates the building's energy performance on a scale from A (most efficient) to G (least efficient). Almost half of all residential buildings had been issued a BER certificate by October 2018. Anyone renting out or selling a property must include a BER rating in all sale and rental advertisements.

The government plans to introduce more consumer-friendly documentation for the BERs to help households better understand the results and the options for improving the energy performance of their homes. Pre and post-renovation BER certificates will allow measuring more accurately the increase in energy efficiency for individual houses. The revised documentation will include information on different improvement options and their likely costs. It will also provide information about the emissions levels associated with dwellings and how they could be reduced through efficiency upgrades (DCCAE, 2017b).

Energy efficiency programmes for buildings

Ireland's Better Energy Programme is the central measure for energy efficiency improvements in the buildings sector. It was introduced in 2011, and by the end of 2016, the programme had provided over 350 000 grants.

Better Energy Homes, one strand of the Better Energy Programme, provides grants to homeowners for a range of energy efficiency measures. These include grants for improving insulation, installing heat pump systems or solar thermal heaters, and upgrading building heating control systems. They typically cover 30% of the cost of the energy efficiency measure. Homeowners must conduct a BER assessment as part of the Better Energy Homes programme. Close to 14 616 homes had received grants for a total of EUR 16.33 million by the end of 2017. Grant support for replacement of an oil or gas boiler under the Better Energy Scheme was discontinued at the end of 2017. Instead, a grant programme for heat pumps of up to EUR 3 500 was introduced, but it is available only for individual homes that can reach a minimum standard of energy performance. The government increased the amount of grants available for insulation measures in 2018 to help homes reach this standard.

A guiding principle for Ireland's building renovation policy is "fabric first then fuel switching". This ensures that the benefits of fuel switching are not compromised by insufficient building fabric standards. The SEAI launched the Deep Retrofit Pilot Programme in 2017 to investigate the challenges of retrofitting to nearly zero energy standards in the residential sector. The programme targets community groups, local authorities, energy agencies and service providers, and is set to run until 2020. The aim is to identify how best to support renovation towards nearly zero energy standards and the switch from fossil fuels to renewable energy sources. Participating homes must reach a post-work BER rating of at least A3. Findings from the pilot programme will feed into Ireland's energy efficiency policy past 2020 and contribute towards the 2030 targets. The programme provides grants of up to 50% of capital cost for renovation projects. Funding for the programme was EUR 5 million annually for 2017 and 2018.

Individual homeowners have been able to claim tax relief on repairs, renovations and improvements of their main residential home or a rented property since 2014. This

incentive was extended in 2017 to tenants of local authority properties who have the consent to conduct improvement work.

Ireland is also funding energy efficiency improvements on a community level under the **Better Energy Communities** (BEC) and **Sustainable Energy Communities** (SEC) programmes. The BEC programme aims to encourage community-based partnerships to improve the thermal and electrical efficiency of the buildings stock and the implementation of more-challenging measures. The government allocated EUR 22.7 million to the BEC programme in 2017, with the aim to leverage additional private investment. Grant support for heat pumps is also available under the BEC programme, and the government has started a dialogue with participating communities towards phasing out all support for fossil fuel heating systems in 2019. The SEC programme helps to develop community partnerships from a small base to grow over time and to gradually pursue larger-scale energy projects. The SEC network contained 134 communities in 2017, with a total programme budget of EUR 0.5 million.

Commercial buildings stock and energy savings potential

There were approximately 109 000 commercial buildings in Ireland in 2015, of which more than 50% were constructed before 1992 (SEAI, 2015b). The estimated technical potential for energy efficiency upgrades in the commercial sector was estimated at 6 TWh in 2015, equivalent to over a third of the TFC in the sector (SEAI, 2015a). Significant energy savings can be obtained by basic upgrades. For example, in 2015, over 70% of commercial buildings did not yet use efficient lighting, and a significant number of retail outlets and restaurants had single-glazed windows. Using efficient lighting and double-glazed windows could result in savings of 1.8 TWh (DCCAE, 2017b).

Around two-thirds of commercial buildings use an electrical heating system; the share is over 80% for the retail sector. The commercial sector pays around EUR 0.21 per kilowatt hour (kWh), and reducing energy consumption would result in a large economic benefit (SEAI, 2015a). Installing heat pumps in commercial buildings could result in savings of 0.8 TWh, and the installation of more-efficient boilers could save another 0.39 GWh.

One of the challenges facing the sector is that a third of commercial undertakings rent their building space, and within this group only one-third of the tenants are the investment decision maker. The commercial sector is highly heterogeneous, with different business sizes and activities. Energy efficiency is frequently not a priority, especially among SMEs. Moreover, the provision of low-cost financing has proven not to be the main incentive for undertaking more complex upgrades with longer pay-back periods. Access to advice and project management support and raising awareness about the multiple benefits of energy efficiency are key enablers. Hence, the SEAI developed tailored policy approaches adapted to the specific needs of the sector.

Two pilot programmes were launched in 2017 to support energy efficiency upgrades in the commercial buildings sector. The SME pilot programme specifically offers advisory and financial support for lighting upgrades. The partnership initiative between the SEAI and the Agriculture and Food Development Authority (Teagasc) focuses on opportunities for dairy farms, which constitute a key part of Ireland's agricultural sector.

Renewable heat supply options and support

Ireland has a legally binding target of meeting 16% of its total final energy demand from renewable sources by 2020 under the 2009 EU Renewable Energy Directive. The heating sector is committed to a share of 12% renewable fuels in that year. Progress towards this goal is slow. Renewable energies accounted for only 6.8% of heating demand in 2016, though its share rose strongly from 2.4% since 2000.

The share of renewables is the result of a strong contribution from the industrial sector and smaller contributions from the residential and commercial sectors. The growth in renewable heat within industry is due to the increase in the use of traditional solid biomass in the wood products and food and beverages industrial sectors, which use production residues for heat generation. The recent growth of modern renewable heat in the residential and services sectors is the result of revised building regulations requiring a share of renewables for new buildings, and policy programmes offering financial incentives for installing new heating systems.

There are several renewable energy sources that can potentially replace fossil fuels used for heating. Important options are heat pumps based on renewable electricity, biomass fuels and biogas. Solar and geothermal heating can provide additional renewable heat, but the potential for a rapid scale-up is limited.

Ireland has a high share of oil use in household boilers, and a high share of coal and peat use in residential heating. It is not proposed to convert these to biomass due to the potential issues relating to air quality.

Biogas could replace natural gas in existing gas boilers. Ireland is considered an immature biogas market with a large potential to increase its biogas production (EC, 2017). The large agricultural sector can provide feedstock (e.g. manure) for biogas production. The use of organic municipal waste as biogas feedstock can also increase. Biogas production provides additional benefits in terms of waste treatment and also generates fertiliser material as a side product. However, the introduction of biogas would come at a significant cost.

Heat pumps provide highly efficient electric heating. They are becoming a more sustainable option in Ireland as the share of renewable electricity increases. They provide additional benefits in terms of not producing any local particle or nitrogen oxide (NO_x) emissions, unlike coal, peat, oil and biomass combustion in household boilers. This makes heat pumps particularly suitable in urban areas, where air quality can be challenged by local emissions from combustion boilers.

The NDP from 2018 to 2027 places particular importance on decarbonisation of heat generation. One proposed measures is the replacement of oil-fired boilers with heat pumps in at least 170 000 homes by 2027, for which EUR 700 million has been allocated. A grant programme for heat pumps (of up to EUR 3 500) was introduced in 2018. Such a programme will put the supply chain under pressure. The demand for heat pumps may give rise to exceptional growth beyond that which the supply chain can provide for in terms of delivery, installation, after sales services, maintenance, etc. Eligibility for the grant for heat pumps is contingent on the fabric of dwellings meeting a certain performance level. This is necessary to maximise their seasonal coefficient of performance.

Renewable heat in the non-residential sector

The government introduced the Support Scheme for Renewable Heat (SSRH) in 2018. This was a programme designed to support renewable heating systems in the non-emissions trading system (non-ETS) sector. Initially, the programme consists of two support mechanisms: an installation grant for heat pumps (which commenced in September 2018), and an operational support for biomass and anaerobic digestion heating systems (which is likely to commence in 2019). The support programme is state funded, with an indicative resource allocation of EUR 300 million up to 2027.

The operational support programme provides a subsidy payment up to 15 years per megawatt hour (MWh) heat for biomass or biogas boilers. The level of subsidy depends on the annual heat production, where smaller installations receive higher subsidies (Table 7.1). Biogas plants with an annual production above 2.4 GWh and biomass plants above 50 GWh are not supported.

The installation grant provides up to 30% of the cost of installing heat pumps. Participants must be commercial, industrial, agricultural, DH or other non-domestic heat users in the non-ETS sector. No support is provided to domestic users under the SSRH programme as they are already eligible for funding from other programmes.

Table 7.1 Subsidies for heat in the SSRH

Tier	Lower limit (MWh per year)	Upper limit (MWh per year)	Biomass heating systems tariff (cent/kWh)	Anaerobic digestion heating systems (cent/kWh)
1	0	300	5.66	2.95
2	300	1 000	3.02	2.95
3	1 000	2 400	0.50	0.50
4	2 400	10 000	0.50	0.00
5	10 000	50 000	0.37	0.00
6	50 000	N/A	0.00	0.00

Source: DCCAE (2017d), *Support Scheme for Renewable Heat*, www.dccae.gov.ie/documents/Scheme%20for%20Renewable%20Heat%20Scheme%20Overview.pdf.

District heating

District heating (DH) provides a small share of heating in Ireland, mainly just some small local systems, due to the dispersed settlements. One of the few examples of DH systems is in the town of Tralee in county Kerry, which is supplied by a one megawatt (MW) biomass boiler. There are plans to expand this system to include a co-generation[2] plant of up to 20 MW, of which 15 MW is thermal. Furthermore, there are plans for other DH systems including two in Dublin. The one in the Docklands area would use heat generated by the Dublin waste to energy plant and could generate 90 MW of DH.

[2] *Co-generation* refers to the combined production of heat and power.

DH would potentially provide the most cost-efficient low-carbon heat in urban areas. DH in Ireland faces several barriers to growth according to an SEAI study (SEAI, 2016b). These include the high initial investment cost and the lack of a regulatory framework, which create high risk and uncertainty when planning medium to large-scale systems. A national policy framework to encourage the development of DH is planned, as outlined in the national-level White Paper (DCENR, 2015).

Assessment

Ireland's total final energy consumption decreased over the decade 2006-16 due to the financial crisis. However, energy consumption has picked up again since 2014. It is important to urgently implement measures that ensure the continuous decoupling of energy consumption from economic growth, and to advance a similar decoupling of energy consumption from population growth.

Ireland's energy intensity measured in GDP is below the IEA average. It is declining faster than in neighbouring countries, even if GDP growth is corrected for the impact of transfer of intellectual property and aircraft leasing companies in 2015. This reflects the structural changes of the Irish economy, which is moving towards high-value-added but less-energy-intensive sectors. The rapid development of global data centres in Ireland since 2014 has the potential to contribute substantially to future energy consumption. It is important that the government liaises closely with investors from the outset to ensure that the highest standards of energy efficiency are adhered to and that the data centres combine energy efficiency with renewable energy.

Ireland has a non-binding, national target of 20% energy efficiency by 2020 from the average value 2000-05, which is equivalent to 31 925 GWh. It is on course to achieve 16% savings by 2020 based on the measures in place by the end of 2016. There is a chance of further progressing towards the 2020 target based on the measures that became effective in 2017. Beyond 2021, the government has identified a technical potential to save a further 16 000 GWh by 2030. However, this will require a step change in policy efforts towards deeper and more expensive measures, as the easier measures will have already been exploited.

The IEA applauds the government for the significant funding increase for energy efficiency since the last IDR. The allocated budget for 2018 was EUR 107 million, representing a 34% increase over the 2017 allocation. This underlines the earnestness of translating the policy documents approved since 2017 into concrete action. Another commendable development is the substantial increase in staff resources at the SEAI, from 56 in 2016 up to 92 in early 2018. This is enabling the SEAI to scale its provision of technical and advisory services, to implement new and expanded programmes and measures, and to broaden its analytical work to support evidence-based decision-making by the government.

Ireland set a 33% energy efficiency target to 2020 for the public sector to demonstrate its exemplar leadership role. The public sector had achieved 20% savings in 2016. Unlocking the additional potential towards 2020 requires a shift towards more complex projects, active energy management, additional investment, fabric upgrades and new delivery mechanisms. Public sector bodies have expressed strong interest in receiving more guidance and support to achieve energy efficiency outcomes through green procurement.

Development of a green public procurement framework is ongoing; the IEA encourages the government to ensure its timely entry into force. Ongoing efforts to develop centralised project pipelines and offer enhanced technical services and capacity building, especially for small public bodies like schools, are welcome but could be strengthened to partially close the gap towards the 2020 target. Less than 10% of the national budget for energy efficiency is allocated to the public sector. The government is encouraged to reassess the annual allocation to develop the project pipelines and the need to close the gap to 2020 and achieve efficiencies beyond 2020.

The buildings sector offers substantial potential for energy efficiency improvements at 23 TWh of its primary energy consumption, of which nearly 70% remains to be exploited beyond 2020. Noteworthy progress has been made in reducing energy consumption through building regulations and improved insulation. Ireland's buildings stock will expand considerably to 2027 due to continuous population growth. Strict compliance through tight monitoring and enforcement of the new building codes effective as of 2019 will be imperative to control energy demand in the buildings sector.

The inclusion of mandatory BER certificates for all rental and sale advertisements can act as an effective enforcement mechanism for implementation of the building regulations and can be easily monitored.

However, upgrading of existing buildings stock is the key challenge. Close to three-quarters of commercial buildings still use inefficient lighting and some have single-glazed windows. This offers an easy target for energy efficiency improvements, and the government should prioritise measures to exploit this potential. The challenge for the commercial sector and SMEs is often access to technical advice and management support for undertaking energy efficiency improvements, and not so much access to concessional funding. The IEA welcomes initiatives by the government to develop standardised processes for energy-efficient design management under the EXEED programme and to develop tailored policy approaches for small businesses that can be replicated easily.

Within the buildings sector, residential buildings account for over half of the total energy savings potential. Ireland is successfully implementing the Better Energy Programme that provides grants to home owners for energy efficiency improvements, paying particular attention to energy poverty. The IEA welcomes the recent inclusion of local authority houses under local authority housing upgrade programmes. However, there is a need to urgently address the split incentives in the rental sector and consider including energy efficiency standards for rental properties. This is important due to the continuous increase in the share of rented properties in the housing market.

A pilot programme launched in 2016 offers grants to show the multiple benefits of energy efficiency for renovations of homes with occupants who have chronic respiratory conditions. The IEA recommends that the budget of this programme is secured for at least 10 years.

Decarbonisation of heating in buildings

Decarbonisation of heating is a priority area for Ireland. Space heating and water heating account for over three-quarters of total residential energy consumption, and fossil fuels account for the largest part of residential energy demand. The NDP for 2018 to 2027 places particular importance on decarbonisation of heat generation.

There are two ways to achieve emissions reductions from heating: improve energy efficiency in buildings and switch from fossil fuels to renewable energy sources. Ireland has made much progress in terms of improving energy efficiency in buildings. The government should monitor the results of its ongoing programmes and continue its progress on energy efficiency. However, Ireland needs to actively promote fuel switching because it has the highest share of fossil fuels in residential heating among IEA member countries. The IEA lauds the government for discontinuing a previously offered grant for replacement of oil or gas boilers since the beginning of 2018 to avoid possible lock-in of high-carbon systems and for introducing support programmes for heat pumps instead.

The government should consider a more comprehensive support system for conversions from fossil fuel boilers to renewable heating alternatives in all buildings. It will be important to link supply-side measures to efficiency of buildings. Existing infrastructure should be utilised, when suitable, to achieve a rapid and cost-effective increase in renewable heating. Furthermore, policies designed to decarbonise heat should take into account the differences between urban and rural housing markets, to be able to target them effectively.

Policies should ideally be technology neutral, to promote decarbonisation in a cost-effective manner for the consumers and the state. CO_2 taxes with automatic upward adjustments when preset sectoral targets are not met have proven efficient in other countries and could be utilised by Ireland (see the chapter on “Energy and climate”). Taxation on other local emissions (e.g. NO_x) could also be considered. Furthermore, Ireland should continue to review the structure of support programmes, including the SSRH programme, to ensure that the most cost-effective solutions are supported.

The existing multitude of support systems for the residential buildings sector risks confusing owners instead of incentivising them to take action. While the idea to target specific population groups (e.g. those suffering from illness) is commended, simplification of the support programmes could be considered to make them more user friendly and effective in delivering outcomes.

Support systems can also consider additional benefits of certain options such as biogas, which produces a renewable fuel and also enables a waste treatment solution and production of biofertiliser. More of Ireland’s organic waste could be collected and processed into biogas. Strategies and policies for decarbonising Ireland’s heating should be aligned with waste management strategies to obtain mutual benefits.

DH based on biofuels and waste can provide renewable heat in urban areas, but requires large investments. Ireland has untapped potential for utilising heat as DH from waste to energy plants and industrial facilities, including from new data centres. The government should remove the barriers for DH and introduce a regulatory framework enabling new investments. Co-generation of heat and power provides efficient use of available resources, and support for renewable heat should be aligned with policies for renewable electricity.

Recommendations

The government of Ireland should:

- Establish a roadmap for meeting Ireland's energy efficiency targets for 2030 and 2050.
- Secure increased funding for energy efficiency programmes in the residential sector by earmarking a certain portion of expected increased revenues from the CO_2 tax.
- Give greater emphasis to energy efficiency in public procurement programmes by enhancing capacity in the public sector to use energy efficiency criteria effectively in procurement decisions.
- Build supply chain capacity to ensure meeting of targets for the roll-out of heat pumps.
- Initiate a large-scale deep renovation programme for residential buildings informed by the Deep Retrofit Pilot Programme. This would kick-start development of the supply chain and its necessary skill set, to achieve long-term energy savings and multiple co-benefits. Such a programme should also target publicly owned buildings and social housing.
- Develop a roadmap for heat decarbonisation that minimises GHG emissions throughout the supply and demand sides. This roadmap should establish clear scenarios and milestones for the phasing out of fossil fuel boilers to renewable heating alternatives such as biomass, biogas and heat pumps.
- Align strategies and policies for decarbonising residential heating with strategies for waste management, and ensure coherence with decarbonisation of the electricity supply.

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8. Energy technology research, development and demonstration

Key data

(2015)

Government energy RD&D spending: EUR 62 million (euro)

Share of GDP: 0.23 per 1 000 GDP units for 2015 GDP, 0.15 per 1 000 GDP units for 3 year average GDP 2013-15 (IEA median* 0.29)

RD&D per capita: USD 16.3 (IEA median* USD 16, IEA average* USD 18.4)

* Median of IEA member countries for which 2015 data are available.

Overview

The European Innovation Scoreboard 2018 considers Ireland as a strong innovator with steadily increasing performances since 2010 (EC, 2018). The scorecard highlights the strong impact that Irish research, development and demonstration (RD&D) has in terms of employment creation, where Ireland scores highest across all European Union (EU) countries. Ireland is also ranked as the overall EU leader in the innovators dimension.

Ireland's public spending on energy RD&D per unit of gross domestic product (GDP) in 2015 was slightly below the median among International Energy Agency (IEA) countries. When using a 3 year average value for RD&D spending, Ireland ranked among the lower RD&D investors in the IEA.[1] However, Ireland's strong ranking on the EU scoreboard in relation to the impact of Irish RD&D underlines the high quality of energy RD&D invested in it also reflects a successful prioritisation exercise and commitment to achieve the highest value out of the investments made.

The objective for public energy technology RD&D is to contribute to Ireland's transition to a low-carbon economy by: exploiting its domestic resource potential; accelerating the development and deployment of low-carbon energy technology products, processes and systems; and creating social and economic benefits. Ireland provides direct support to enterprises and academic institutions to enhance their energy and low-carbon RD&D and innovation activities.

[1] In 2015, the GDP of Ireland showed exceptional growth due to some country-specific features, including the transfer of intellectual property by multinational enterprises companies. This has led to issues when measuring economic growth in the GDP (see Chapter 2 "General energy policy").

Public energy RD&D spending

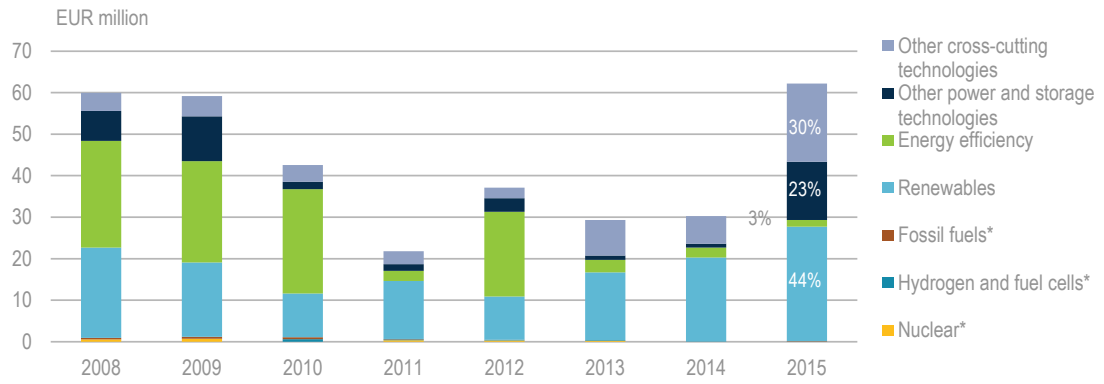
Ireland's public energy RD&D was almost halved from its 2008 level to around EUR 30 million per year in 2013 and 2014 (Figure 8.1) due to the financial crisis. With a strongly recovering economy, Ireland increased its public energy RD&D in 2015 to, and reached a 3 year average of EUR 40 million for 2013-15.[2]

Increased investments reflect the government's vision that strong energy RD&D capacities are required for the move towards a low-carbon economy and to bring associated long-term benefits to Irish society. This trend is expected to continue in coming years in line with government policy.

The Irish government has adopted an overall research and development (R&D) intensity target for Ireland of 2.5% of the gross national product (GNP) by 2020. The overall R&D intensity rate stood at 0.3% of the GNP in 2017 (DBEI, 2018). RD&D intensity is measured as the RD&D budget as a percentage of the GNP.

Research on renewable sources of energy received the largest share of the budget in 2015, accounting for 44% of the total energy RD&D funding, followed by cross-cutting technologies with 30%. The rest was spent on power and storage technologies (23%), energy efficiency (3%), and small shares for fossil fuels and hydrogen and fuel cells.

Figure 8.1 Government energy RD&D spending by category, 2008-15



Nearly half the energy RD&D funding in Ireland was allocated to renewable energy projects in 2015.

* Negligible.

Source: IEA (2018), *Energy Technology RD&D 2018*, www.iea.org/statistics/.

[2] Based on data uncertainties and a newly developed methodology for collecting RD&D data, Ireland decided to use a 3-year average of EUR 40 million in 2013-15, as an indicator of the latest energy RD&D spending.

Energy RD&D programmes

Institutional framework

The **Department of Communications, Climate Action and Environment** (DCCAE) is responsible for setting Ireland's energy RD&D policy and for providing funding for applied research, and research for policy, development, demonstration and innovation.

The **Sustainable Energy Authority of Ireland** (SEAI) allocates funding among the different RD&D programmes and co-ordinates the overall RD&D investment portfolio on behalf of the DCCAE. The SEAI also supports the DCCAE in policy development and in developing future energy research policies by generating the necessary evidence base.

The **Department of Business, Enterprise & Innovation** is the co-ordinator for science, technology, engineering and mathematics research and innovation in Ireland and has the largest budget for investing in research in Ireland.

The **Environmental Protection Agency** has statutory responsibility for co-ordinating environmental research in Ireland, with a particular focus on climate change, water and sustainability.

Energy RD&D is a cross-cutting field that involves various sectors and thus affects different government departments and agencies, including the following:

- Department of Planning, Housing and Local Government.
- Department of Transport, Tourism and Sport.
- Department of Agriculture, Food and the Marine.
- Marine Institute.
- Department of Business, Enterprise and Innovation.
- Department of Education and Skills.
- Science Foundation Ireland.
- Enterprise Ireland.

The Irish private sector also plays an important role in energy RD&D, either through stand-alone initiatives or in collaboration with public institutions. Private sector RD&D spending is helping to leverage public funds and also ensures the continued relevance of research to outcome commercialisation and practical applicability. For example, awards made under the SEAI RD&D funding programme often require varying levels of co-investment from the private sector.

A good example is the International Energy Research Centre that was established in 2013 with a funding commitment of up to EUR 20 million. The centre works with companies on research projects, primarily in demand-side management, and leveraged this with additional funding from industry and competitive funding calls.

Co-ordination among the multiple public and private actors involved in energy RD&D in Ireland has been significantly enhanced since the last in-depth review (IDR) in 2012.

However, a national inventory of all energy RD&D projects ongoing in Ireland does not exist. This potentially weakens possible synergies among the different initiatives and programmes.

The SEAI is creating a detailed national project inventory for energy RD&D projects that will enhance the knowledge base at the government level about the various ongoing activities covering the previous 3-5 years. It is developing a new methodology for future collection of data about national public investment in energy RD&D. The SEAI is also working closely with the IEA to investigate optimal approaches for the collection of national energy RD&D statistics.

SEAI efforts do not include data collection from the private sector, which could create a lacuna in the statistical output and potentially under-report the full extent of RD&D activity in the country. The SEAI investigation of possible methodologies for collecting data about private sector investment in energy RD&D is therefore a welcome development.

Policies and programmes

Ireland's RD&D strategy is guided by the 2015 White Paper and the 2016 Energy Innovation Ireland Strategy, with the objective of establishing the country as a leading European energy innovation hub. RD&D is seen as a key enabler for the country's energy transition to a low-carbon economy while also creating economic opportunities and employment. Energy is recognised as one of the six themes in Innovation 2020, Ireland's 5 year strategy on the R&D of science and technology. Over 40 different government programmes and strategies feed into Ireland's RD&D policy.

The 2016 Energy Innovation Strategy establishes a link among basic technology research and innovation in business models and service provisions, behavioural economics and energy modelling, and presents those as a holistic approach for Ireland's RD&D strategy (DCENR, 2016). It highlights the need to provide sustained funding to ensure sustainability for Irish research organisations to attract and retain skilled and experienced researchers. The strategy specifically mentions the need for enhanced monitoring and evaluation metrics to better assess the progress made and to allow for adjusting the RD&D strategy on time.

Building on this, the SEAI prepared its *Statement of Strategy 2017-2021* (SEAI, 2017a), which identifies the four key priorities of its energy RD&D activities as:

- increase funding of R&D projects and test sites with national and international impact
- enhance Irish engagement with the EU Horizon 2020 programme
- increase delivery of demonstration and innovation projects contributing to enterprise development
- increase mapping and co-ordination of Irish energy research, leading to a higher impact.

The SEAI decides on priority investments of its RD&D funds by applying a blended model of top-down and bottom-up priority setting. The top-down priority setting is undertaken through cross-sectoral consultations with important stakeholders to ensure that investments produce a tangible impact that meet the innovation, practice and policy needs of a range of cross-government sectors.

The SEAI is actively promoting the creation of co-funding partnerships with other government bodies, through its national energy RD&D funding programme. This allows the SEAI to leverage its investments allocated using the top-down approach. The approach results in a tangible impact by meeting cross-sectoral and cross-government research, innovation and policy needs. SEAI RD&D programmes in 2018 involved co-funding from organisations in the agriculture, environment, marine, meteorological and transport sectors.

The bottom-up priority setting model allows the energy RD&D community to apply for funding of projects that have not been identified in the top-down prioritisation exercise. This mixed prioritisation model provides the flexibility needed to ensure that Irish RD&D remains open to a broad range of possible investments and is not limited to the outcome of the top-down priority setting exercise. This caters for the fast-evolving energy transitions taking place nationally and internationally, and allows the Irish research community to actively engage in priority setting.

The SEAI launched several new initiatives in 2018. For the first time, it is now funding multi-year projects up to a value of EUR 650 000 and up to 4 years' duration to facilitate the implementation of longer, larger and more-effective projects. EUR 2.5 million was available under the SEAI funding programme for 2018. The SEAI plans to inaugurate an annual National Forum on Energy Research under the motto energy research meets policy in 2019 to enhance the link between technology and policy. The forum will bring together the Irish energy research community, industry and policy makers to share their experiences, priorities and ambitions relating to energy research and innovation.

An important objective of Ireland's national energy RD&D funding programme is to strengthen the national energy research and innovation capacity of academic institutions and industry. This will allow them to compete for other national and international RD&D funding programmes and allow the Irish energy research community to take leadership roles in international collaboration programmes. The focus of the RD&D portfolio is on supporting new sustainable energy technologies to better exploit and integrate indigenous renewable resources. This includes the development of wind power, bioenergy, solar power, smart grids, behavioural insights, energy efficiency and marine renewables, and the deployment of ocean energy devices and systems. Emerging international research areas such as those relating to hydrogen also offer potential benefits and align well with the Irish resource endowment and its energy sector policies.

Ocean energy

Ocean energy (including offshore wind, wave and tidal power) offers large potential for Ireland due to the country's long coastline with open water. Ocean energy is therefore a key priority research area for Ireland, and a comprehensive programme of activities is being implemented. The Offshore Renewable Energy Development Policy (OREDP) published by the DCCAE in 2014 indicated a potential of deploying 6 megawatts of offshore renewables by 2030.

The SEAI manages the Ocean Energy Programme to support the development of renewable ocean energy installations, under the auspices of the OREDP. The budget was EUR 4.75 million in 2018. The SEAI also funds various applied energy research and demonstration programmes through the Ocean Energy Programme and is continuing development of energy test site infrastructure. The focus of the programme is to provide

an innovation hub for the deployment of marine renewable energy technologies and services, and to create an early stage industry that includes the possibility of exporting electricity from these sources.

A focus of the programme is the Ocean Energy Prototype Development Fund to stimulate the development and deployment of ocean energy devices and systems. The fund supported 26 offshore renewable energy projects in 2018 (of which 12 were newly approved in the same year) and the continued development of energy test site infrastructure.

A group of research institutions with support from the Science Foundation Ireland established the Marine Renewable Energy Ireland (MaREI) Research Centre in 2013. Its primary focus was to advance the science, engineering and commercialisation of marine renewable energy by undertaking basic and applied research. The MaREI centre has a budget of EUR 55 million for the period 2013-19, with EUR 5 million contributed by industry. It has grown rapidly since its creation and now has 200 researchers across six academic institutions and over 45 industry partners. There is collaboration with 20 countries. The centre is co-ordinated by the Environmental Research Institute at University College Cork, and has submitted a funding request for post-2019. The new application would see the research base double to 12 institutions.

Ireland is actively engaging in international work and is applying its leadership capacity in this regard. The SEAI is a member of the Ocean Energy European Research Area Networks Cofund (OCEANERA-NET COFUND), a network of eight national and regional funders and managers of research and innovation programmes from six European countries. OCEANERA-NET co-ordinates funding programmes among European countries and regions to support research and innovation in the ocean energy sector. The SEAI is also a member of the Ocean Power Innovation Network (OPIN), which is a joint initiative of state bodies and key interests in Ireland, Northern Ireland and Scotland involved in ocean energy. Its aim is to collaborate on ocean energy technology development. Participating entities include the SEAI, Invest Northern Ireland, Scottish Enterprise, and Highlands and Islands Enterprise. The OPIN was awarded grant aid in the second half of 2018 by the European Union to expand operations to other EU member states and industry. The SEAI will lead this project.

Sustainable bioenergy

The SEAI spends about 20% of its total RD&D funding on bioenergy and biofuels. It awarded funding for eight RD&D projects in the bioenergy sector in 2017, two of which focused on the need to involve multiple stakeholders. The Enabling the Bioenergy Sector to Understand and Assess Life Cycle Sustainability project was led by the Irish Bioenergy Association. This research project focused on the generation of new industry knowledge and guidance on life-cycle analysis and its application to bioenergy. It also discussed sustainability criteria of local bioenergy supply chains in Ireland (IrBEA, 2017).

The ReBiogen project developed a viable business model supporting mobilisation and exploitation of Ireland's agri-food, marine, forestry and municipal waste residues for recovery of renewable energy. It focused on designing a community-based model across multiple stakeholders that can aggregate and mobilise supply of a range of feedstocks within a given locality and which deploys shared processing infrastructure to recover

renewable energy. The project findings could contribute to Ireland's renewable energy and climate change obligations, as well as broader sustainability and waste management issues (SEAI, 2017b).

The first National Policy Statement on the Bioeconomy was published in March 2018. It aimed to exploit the potential of the bioeconomy in promoting the more-efficient use of renewable resources while supporting economic development and employment in rural Ireland. The statement relates to the production of renewable biological resources and the conversion of these resources and waste streams into value-added products such as food, and bioenergy (Government of Ireland, 2018).

Hydrogen

Hydrogen is an increasingly promising element for future global energy supply. Research and pilot applications (including recent success in Austria) indicate that hydrogen is an important energy carrier and has considerable potential in energy supply, storage, mobility or industrial applications, for example.

A negligible share of government energy RD&D spending is targeting hydrogen, although Gas Networks Ireland has been undertaking research in this area. The Low Emission Vehicle Taskforce intends to consider the potential role of hydrogen in Ireland and the requirements for supporting infrastructure and other incentives. The government is aware that clean energy and mobility strategies need technical and innovative solutions that require exploring a wide range of options, including the use of hydrogen.

There is still uncertainty around the potential role that hydrogen may play in supporting the achievement of decarbonisation goals. It is important for Ireland to participate in research and collaborative work to support the evidence base in this area. Ireland's significant offshore wind resources offer potential opportunities for hydrogen production. In addition, the existing gas pipeline infrastructure and natural gas storage facilities offer potential for hydrogen transportation and storage.

In principle, hydrogen may also be added in certain percentages to existing gas infrastructure, subject to technical and safety considerations. The efforts to decarbonise the Irish gas infrastructure by the admixture of biomethane could potentially be supported by the use of hydrogen.

Ireland's energy RD&D prioritisation has sufficient flexibility to adapt to emerging sectors; hydrogen could be considered as one of those sectors.

Monitoring and evaluation

The SEAI has made good progress since the last IDR towards developing and adopting homogeneous metrics for pre-award RD&D project evaluation. The metrics consists of three principal criteria, each of which is broken down into sub-criteria:

- criterion 1: excellence and innovation
- criterion 2: relevance and impact
- criterion 3: quality and efficiency of implementation.

The SEAI is refining the evaluation metrics to ensure that selected investment projects continue reflecting the priorities and needs of the Irish energy and the low-carbon technology RD&D sector.

However, there remains the need to advance key performance indicators and project milestones that are set ex ante to project commencement. This will facilitate progress monitoring in each of the funded programmes and also allow for assessing the value obtained from the investments. Good progress in this was made in 2017 and 2018.

International collaboration

Ireland is continuously expanding its international RD&D co-operation. The country is a member in eight IEA technology collaboration agreements, with the SEAI acting as Ireland's signatory. Membership in the IEA Technology Collaboration Programmes (TCPs) reflects the Irish energy RD&D priorities (Table 8.1). The SEAI has undertaken a strategic review of Ireland's involvement in the TCPs and is actively encouraging the Irish RD&D community to propose participation in additional TCPs. Ireland is not a member of the Clean Energy Ministerial and Mission Innovation.

Table 8.1 Ireland's membership in IEA TCPs, 2018

TCP	Signatory entity	Since
Bioenergy	SEAI	September 2002
Ocean Energy System	SEAI	September 2002
Wind Energy	SEAI	September 2002
Energy Technology Systems Analysis	Department of Communications, Energy and Natural Resources	May 2009
Buildings and Communities	SEAI	September 2011
Smart Grids	SEAI	September 2011
Hybrid and Electric Vehicles	SEAI	September 2011
Demand-Side Management	SEAI	December 2015

Irish energy RD&D is also supported through the EU framework research programmes. The government has an ambitious target under the Horizon 2020 programme, aiming to receive EUR 85 million from the Horizon 2020 energy work programme. Ireland secured funding of approximately EUR 40 million for energy-related projects up to the end of 2016 (the first half of the Horizon 2020 funding programme), mainly in the areas of biofuels and ocean energy projects. Ireland has an above-average success rate with its applications for Horizon 2020 funding. Ireland has also joined the European Research Area Networks transnational funding programme in the areas of regional smart/distributed power systems and ocean energy since the last IDR in 2012.

Assessment

Ireland's three-year average (2013-15) of public investment in energy RD&D was equal to approximately EUR 40 million. This indicates recognition by the government of the benefits obtained through enhanced research activities, for the energy sector and also for the economy and society as a whole. The IEA congratulates the government for this.

Ireland has achieved world-class energy RD&D output, and the IEA encourages the authorities to maintain funding levels at the IEA average or above. The government's target to increase the investment in total RD&D to 2.5% of the GNP by 2020 is a welcome decision.

Renewable energy technologies receive nearly half of the total public energy-related RD&D spending. Other power and storage technologies, as well as cross-cutting technologies, receive most of the remainder. Increases in funding will help to scale up the country's energy modelling capacity and allow a stronger focus on technologies such as bioenergy and ocean energy, which have large potential but need development to become commercial.

Globally renewed interest in hydrogen has manifested in recent years, as it has proven to be an increasingly promising element for future energy supply. Its potential for mobility and industrial applications is of interest to the global research community.

The Irish government should intensify research on hydrogen and biogas, which could offer substantial potential benefits in terms of decarbonising the gas supply, act as a means for long-term storage of wind power and prolong use of the existing gas infrastructure. However, it is important to link any research to a clear understanding of the supply chain requirements, technical and safety considerations and cost-benefit assessment.

Energy research in Ireland is closely linked to the country's overall energy policy priorities, focusing on longer-term decarbonisation of the energy sector and sustainable living. The government seeks to ensure co-ordination among the numerous agencies and research institutions concerned with energy RD&D. The SEAI plays a key role in ensuring all parties work closely together, including through strategic cross-government partnerships. Closer co-ordination among government departments would increase synergies among the country's energy, environmental, climate change, transport, agricultural and land-use policies, and would support stronger outcomes for the funding employed.

There is no comprehensive overview of the focus areas and totality of energy-related projects funded by the many research agencies. This overview is lacking for energy RD&D undertaken in the private sector. The IEA therefore welcomes the ongoing efforts by the SEAI in creating a detailed national project inventory that will provide a consolidated overview of the full spectrum of ongoing energy RD&D in the country. The SEAI is refining the methodology for future collection of data about national public investment in energy RD&D. Such an inventory should ideally also cover the private sector to the extent possible to allow for the most complete knowledge base.

The IEA encourages Ireland to continue refining the development of key performance indicators set ex ante to facilitate reporting against the real progress made. These key performance indicators and the homogeneous metrics developed by the SEAI should also allow assessment of the value/outcome obtained for the funding deployed. This is of particular importance in light of the government's ambition to position the country as a leading European energy innovation hub, and to attract global companies to base (part of) their energy research activities in Ireland, as set out in the 2015 White Paper and the 2016 Energy Research Strategy.

Ireland is strongly engaged in international RD&D co-operation. International engagement is closely aligned with national research priorities. Ireland is a member in eight IEA TCPs and continues to be actively involved in the EU Strategic Energy Technology Plan Steering Committee, which is a forum relating to Horizon 2020. Ireland also participates in a range of IEA standing groups and committees.

Recommendations

The government of Ireland should:

- Bring the refinement of the evaluation of energy RD&D programmes and key performance indicators to an early conclusion to allow reporting against the expected outcomes and the value obtained against the funding provided.
- Ensure that public spending on RD&D on energy is sufficient to support the government's long-term energy sector targets.
- Expand RD&D activities and participation in research and collaborative work to support the evidence base relating to hydrogen and other emerging alternative technologies. The potential opportunities, subject to technical and safety considerations, for mixing hydrogen in the existing gas infrastructure to support security of supply and the decarbonisation of gas supply should be noted.

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ANNEX A: Organisations visited

Review criteria

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

Review team and preparation of the report

The IDR team visited Ireland from 28 May to 1 June 2018. It met with government officials, energy suppliers, market participants, interest groups, consumer representative associations, research institutions, and other organisations and stakeholders. The report was drafted based on the information obtained in these meetings, the team's preliminary assessment of Ireland's energy policy, the Irish government's response to the IEA energy policy questionnaire and information on subsequent policy developments from the government and private sector sources. The members of the team were:

IEA member countries

Mr Paul Hawker, United Kingdom (team leader)

Mr Iosif Athanasiadis, Greece

Mr Matthieu Ballu, European Union

Ms Susana Carrillo, Spain

Mr Richard Phillips, Switzerland

Ms Elżbieta Piskorz, Poland

Ms Sonja Röder, Germany

Mr Thomas Spörker, Austria

International Energy Agency

Mr Aad van Bohemen

Ms Lucie Girard

Ms Dagmar Graczyk (senior country analyst)

The team is grateful for the co-operation and assistance of the many people it met during its visit. The visit was highly informative, productive and enjoyable because of their kind hospitality, openness and willingness to share information.

The team expresses its gratitude to Mr Michael Manley, Assistant Secretary General for Energy, Department of Communications, Climate Action and Environment, for his personal engagement in the

meetings and for hosting the visit. The team is also grateful to Mr Martin Finucane, Principal Officer, Strategic Energy Policy Division, and Ms Una Dixon, Assistant Principal, both from the Department of Communications, Climate Action and Environment, for their tireless efforts and professionalism in planning and organising the review visit and their patience and diligence in supporting the team throughout the review process. Special thanks to Mr Jeremiah Higgins of the Department of Communications, Climate Action and Environment for the invaluable logistical support and to all the staff of the Energy Section of the ministry who participated in and contributed to the review.

The review was prepared under the guidance of Mr Aad van Bohemen, Head of the Energy Policy and Security Division, IEA. Ms Dagmar Graczyk managed the review and is the author of the report, except for the chapters on oil and natural gas. Ms Lucie Girard and Ms Selena Jihyun Lee wrote the chapters on oil and natural gas. Ms Lucie Girard provided substantial input to the focus area section on interconnectors and Mr Oskar Kvarnstrom to the focus area section on decarbonisation of heat. Ms Sol Yi Park provided substantial input to the general energy policy chapter.

Mr Oskar Kvarnstrom, Ms Selena Jihyun Lee and Ms Sol Yi Park prepared and drafted the sections on key data contained in each chapter. Helpful comments, chapter reviews and updates were provided by the following IEA staff: Mr Jean-Baptiste Dubreuil, Mr César Alejandro Hernández, Mr Kieran McNamara, Mr Gergely Molnar, Mr Brian Motherway and Mr Matthew Wittenstein.

Special thanks to the IEA Secretariat for data, publication and editing. Mr Oskar Kvarnstrom, Ms Selena Jihyun Lee, Ms Sol Yi Park and Mr Bertrand Sadin ensured preparation of the design of the report with figures, tables and maps. Ms Roberta Quadrelli and Mr Rémi Gigoux provided support on statistics. Ms Therese Walsh managed the editing process, Ms Astrid Dumond and Ms Katie Lazaro managed the production process. Mr Jad Mouawad supported the press launch.

Organisations visited

- Aughinish Alumina (aluminium producer/co-generation plant)
- Bonkers.ie (price comparison and switching site)
- Bord Gáis Energy (generator, electricity and gas supplier)
- Bord na Móna (electricity generator)
- Brookfield (electricity generator)
- Centre for Marine and Renewable Energy (research institute)
- Chambers Ireland (business network)
- Climate Change Advisory Council (independent advisory body)
- Commission for Regulation of Utilities (independent statutory regulator)
- Competition and Consumer Protection Commission (independent statutory body to enforce competition and consumer protection law)
- Consumers' Association of Ireland (independent non-governmental organisation working on behalf of consumers)
- Dairygold (business)

- Department of Agriculture, Food and the Marine (ministry)
- Department of Business, Enterprise and Innovation (ministry)
- Department of Communications, Climate Action and Environment (ministry)
- Department of Finance (ministry)
- Department of Housing, Planning and Local Government (ministry)
- Department of Public Expenditure and Reform (ministry)
- Department of Transport, Tourism and Sport (ministry)
- Diageo Ireland (business)
- Dublin Airport Authority (state-owned company responsible for Cork and Dublin airports)
- Dublin Cycling Campaign (non-governmental organisation)
- EirGrid Group (transmission system operator)
- Electric Ireland (electricity and gas supplier)
- Electricity Association of Ireland (industry body for electricity industry and gas retail sector)
- Energia Group (electricity generator, electricity and gas supplier)
- Energy Institute (research institute)
- Energy Research at the Economic and Social Research Institute (research institute)
- Engineers Ireland (representative association for engineers)
- Enterprise Ireland (state agency seeking the development and growth of Irish enterprises in world markets)
- Environmental Pillar (social partner representing environmental matters)
- Environmental Protection Agency (state agency for environmental protection and policing)
- ESB Generation (generator)
- ESB Networks (distribution system operator)
- Gas Networks Ireland (gas transmission system operator/distribution system operator)
- GSK Cork (business)
- IBEC (business representative association)
- IDA Ireland (state agency seeking investment in Ireland by foreign-owned companies)
- International Energy Research Centre (research institute)
- Irish Bioenergy Association (representative association for bioenergy industry)
- Irish Offshore Operators' Association (representative association for offshore energy industry)
- Irish Petroleum Industry Association (representative association for oil industry)
- Irving Oil – Whitegate Refinery (oil refinery operator)
- Johnson & Johnson Ireland Ltd (business)
- KPMG (business)

- Marine Renewables Industry Association (representative association for marine renewable energy industry)
- MSD Ireland (business)
- National Oil Reserves Agency (state agency responsible for Ireland's oil stocks)
- National Treasury Management Agency (state agency providing asset and liability management services to government)
- New Economy and Recovery Authority (state agency providing financial and commercial advice to government ministers)
- Renewable Energy Consumers and Producers Group (representative association for energy consumers and producers)
- Science Foundation Ireland (state agency for applied research)
- Single Electricity Market Committee (committee overseeing the single electricity market)
- Society of St. Vincent de Paul (non-governmental organisation)
- SSE Airtricity (electricity supplier)
- SSE Ireland (electricity generator)
- Sustainable Energy Authority of Ireland (state sustainable energy agency)
- Tipperary Energy Agency (local energy agency)
- Trocaire (non-governmental organisation)
- Tynagh Energy limited (electricity generator)
- UCD Energy Institute (research institute)
- Vayu (electricity supplier)
- Veolia Ireland (business)

ANNEX B: Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1973	1990	2000	2010	2015	2016	2017E
TOTAL PRODUCTION		**1.120**	**3.467**	**2.159**	**1.849**	**1.929**	**4.201**	**4.850**
Coal		0.045	0.016	-	-	-	-	-
Peat		1.020	1.411	0.965	0.997	0.770	0.679	0.766
Oil		-	-	-	-	-	-	-
Natural gas		-	1.873	0.958	0.224	0.106	2.483	2.848
Biofuels and waste[1]		-	0.108	0.141	0.327	0.406	0.437	0.521
Nuclear		-	-	-	-	-	-	-
Hydro		0.055	0.060	0.073	0.052	0.069	0.059	0.060
Wind		-	-	0.021	0.242	0.565	0.529	0.640
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	0.008	0.013	0.014	0.015
TOTAL NET IMPORTS[3]		**5.620**	**6.681**	**11.587**	**12.362**	**11.691**	**9.341**	**8.822**
Coal	Exports	0.073	0.019	0.006	0.007	0.011	0.009	0.010
	Imports	0.578	2.010	1.697	0.964	1.481	1.155	1.192
	Net imports	0.505	1.991	1.691	0.957	1.470	1.146	1.182
Oil	Exports	0.469	0.675	1.354	1.453	1.746	1.612	2.149
	Imports	5.917	5.734	9.506	9.111	9.179	9.026	9.403
	Int'l marine and aviation bunkers	-0.337	-0.366	-0.733	-0.805	-0.973	-0.994	-1.121
	Net imports	5.111	4.693	7.419	6.853	6.460	6.420	6.133
Natural Gas	Exports	-	-	-	-	-	-	-
	Imports	-	-	2.478	4.480	3.621	1.700	1.409
	Net imports	-	-	2.478	4.480	3.621	1.700	1.409
Electricity	Exports	0.002	-	0.006	0.025	0.093	0.136	0.154
	Imports	0.006	-	0.015	0.065	0.151	0.075	0.096
	Net imports	0.004	-	0.009	0.040	0.058	-0.061	-0.058
TOTAL STOCK CHANGES		**0.168**	**-0.237**	**0.057**	**0.178**	**-0.337**	**0.386**	**0.038**
TOTAL SUPPLY (TPES)[4]		**6.908**	**9.911**	**13.801**	**14.389**	**13.283**	**13.928**	**13.711**
Coal		0.565	2.083	1.811	1.203	1.431	1.347	1.075
Peat		1.020	1.313	0.790	0.738	0.766	0.739	0.713
Oil		5.263	4.475	7.521	7.045	6.132	6.488	6.265
Natural gas		-	1.873	3.436	4.692	3.752	4.242	4.313
Biofuels and waste[1]		-	0.108	0.141	0.370	0.496	0.572	0.689
Nuclear		-	-	-	-	-	-	-
Hydro		0.055	0.060	0.073	0.052	0.069	0.059	0.060
Wind		-	-	0.021	0.242	0.565	0.529	0.640
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	0.008	0.013	0.014	0.015
Electricity trade[5]		0.004	-	0.008	0.040	0.058	-0.061	-0.058
Shares in TPES (%)								
Coal		*8.2*	*21.0*	*13.1*	*8.4*	*10.8*	*9.7*	*7.8*
Peat		*14.8*	*13.2*	*5.7*	*5.1*	*5.8*	*5.3*	*5.2*
Oil		*76.2*	*45.2*	*54.5*	*49.0*	*46.2*	*46.6*	*45.7*
Natural gas		*-*	*18.9*	*24.9*	*32.6*	*28.2*	*30.5*	*31.5*
Biofuels and waste[1]		*-*	*1.1*	*1.0*	*2.6*	*3.7*	*4.1*	*5.0*
Nuclear		*-*	*-*	*-*	*-*	*-*	*-*	*-*
Hydro		*0.8*	*0.6*	*0.5*	*0.4*	*0.5*	*0.4*	*0.4*
Wind		*-*	*-*	*0.2*	*1.7*	*4.3*	*3.8*	*4.7*
Geothermal		*-*	*-*	*-*	*-*	*-*	*-*	*-*
Solar/other[2]		*-*	*-*	*-*	*0.1*	*0.1*	*0.1*	*0.1*
Electricity trade[5]		*0.1*	*-*	*0.1*	*0.3*	*0.4*	*-0.4*	*-0.4*

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1973**	**1990**	**2000**	**2010**	**2015**	**2016**	**2017E**
TFC	**5.113**	**7.552**	**10.778**	**11.512**	**10.504**	**10.912**	**..**
Coal	0.623	0.943	0.358	0.343	0.299	0.274	..
Peat	0.408	0.741	0.303	0.254	0.201	0.197	..
Oil	3.553	3.742	6.671	6.832	5.752	6.055	..
Natural gas	-	0.998	1.583	1.593	1.718	1.775	..
Biofuels and waste[1]	-	0.108	0.118	0.297	0.365	0.399	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	0.008	0.013	0.014	..
Electricity	0.529	1.021	1.745	2.186	2.156	2.199	..
Heat	-	-	-	-	-	-	..
Shares in TFC (%)							
Coal	*12.2*	*12.5*	*3.3*	*3.0*	*2.8*	*2.5*	..
Peat	*8.0*	*9.8*	*2.8*	*2.2*	*1.9*	*1.8*	..
Oil	*69.5*	*49.5*	*61.9*	*59.3*	*54.8*	*55.5*	..
Natural gas	-	*13.2*	*14.7*	*13.8*	*16.4*	*16.3*	..
Biofuels and waste[1]	-	*1.4*	*1.1*	*2.6*	*3.5*	*3.7*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	*0.0*	*0.0*	*0.0*	..
Electricity	*10.3*	*13.5*	*16.2*	*19.0*	*20.5*	*20.2*	..
Heat	-	-	-	-	-	-	..
TOTAL INDUSTRY[6]	**1.906**	**2.359**	**3.169**	**2.491**	**2.605**	**2.714**	**..**
Coal	0.069	0.242	0.104	0.113	0.106	0.110	..
Peat	-	-	-	-	-	-	..
Oil	1.648	0.881	1.447	0.989	0.697	0.757	..
Natural gas	-	0.788	0.853	0.445	0.733	0.759	..
Biofuels and waste[1]	-	0.063	0.100	0.161	0.223	0.215	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	-	-	-	..
Electricity	0.189	0.386	0.665	0.783	0.846	0.872	..
Heat	-	-	-	-	-	-	..
Shares in total industry (%)							
Coal	*3.6*	*10.3*	*3.3*	*4.5*	*4.1*	*4.1*	..
Peat	-	-	-	-	-	-	..
Oil	*86.5*	*37.3*	*45.7*	*39.7*	*26.8*	*27.9*	..
Natural gas	-	*33.4*	*26.9*	*17.9*	*28.1*	*28.0*	..
Biofuels and waste[1]	-	*2.7*	*3.2*	*6.5*	*8.6*	*7.9*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	-	-	-	..
Electricity	*9.9*	*16.4*	*21.0*	*31.4*	*32.5*	*32.1*	..
Heat	-	-	-	-	-	-	..
TRANSPORT[4]	**1.129**	**1.641**	**3.458**	**3.976**	**3.728**	**4.020**	**..**
OTHER[7]	**2.078**	**3.552**	**4.151**	**5.045**	**4.172**	**4.178**	**..**
Coal	0.555	0.701	0.254	0.230	0.193	0.163	..
Peat	0.408	0.741	0.303	0.254	0.201	0.197	..
Oil	0.776	1.221	1.768	1.964	1.420	1.400	..
Natural gas	-	0.211	0.731	1.148	0.986	1.016	..
Biofuels and waste[1]	-	0.045	0.017	0.043	0.055	0.066	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	0.008	0.013	0.014	..
Electricity	0.340	0.633	1.078	1.399	1.306	1.323	..
Heat	-	-	-	-	-	-	..
Shares in other (%)							
Coal	*26.7*	*19.7*	*6.1*	*4.6*	*4.6*	*3.9*	..
Peat	*19.6*	*20.9*	*7.3*	*5.0*	*4.8*	*4.7*	..
Oil	*37.3*	*34.4*	*42.6*	*38.9*	*34.0*	*33.5*	..
Natural gas	-	*5.9*	*17.6*	*22.8*	*23.6*	*24.3*	..
Biofuels and waste[1]	-	*1.3*	*0.4*	*0.9*	*1.3*	*1.6*	..
Geothermal	-	-	-	-	-	-	..
Solar/other[2]	-	-	-	*0.2*	*0.3*	*0.3*	..
Electricity	*16.4*	*17.8*	*26.0*	*27.7*	*31.3*	*31.7*	..
Heat	-	-	-	-	-	-	..

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1990**	**2000**	**2010**	**2015**	**2016**	**2017E**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	1.761	3.087	4.874	4.878	4.434	4.793	..
Output (Mtoe)	0.632	1.224	2.036	2.423	2.417	2.591	2.639
Output (TWh)	7.348	14.229	23.673	28.176	28.099	30.126	30.691
Output Shares (%)							
Coal	*1.0*	*41.6*	*28.8*	*12.6*	*17.3*	*15.6*	*11.9*
Peat	*23.9*	*15.8*	*7.5*	*7.7*	*9.0*	*7.7*	*7.1*
Oil	*66.3*	*10.0*	*19.6*	*2.1*	*1.4*	*1.0*	*0.5*
Natural gas	-	*27.7*	*39.1*	*64.3*	*44.0*	*50.6*	*51.1*
Biofuels and waste[1]	-	-	*0.4*	*1.1*	*2.0*	*2.5*	*2.9*
Nuclear	-	-	-	-	-	-	-
Hydro	*8.8*	*4.9*	*3.6*	*2.1*	*2.9*	*2.3*	*2.3*
Wind	-	-	*1.0*	*10.0*	*23.4*	*20.4*	*24.3*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
TOTAL LOSSES	**1.674**	**2.209**	**3.346**	**3.006**	**2.568**	**2.797**	**..**
of which:							
Electricity and heat generation[9]	1.129	1.864	2.838	2.456	2.020	2.202	..
Other transformation	0.357	0.042	0.066	0.061	0.074	0.112	..
Own use and transmission/distribution losses[10]	0.188	0.303	0.442	0.489	0.474	0.483	..
Statistical Differences	**0.121**	**0.150**	**-0.322**	**-0.128**	**0.210**	**0.218**	**..**
INDICATORS	**1973**	**1990**	**2000**	**2010**	**2015**	**2016**	**2017E**
GDP (billion 2010 USD)	42.42	83.33	163.41	221.95	316.11	332.36	358.29
Population (millions)	3.07	3.51	3.80	4.56	4.64	4.68	4.80
TPES/GDP (toe/1000 USD)[11]	0.16	0.12	0.08	0.06	0.04	0.04	0.04
Energy production/TPES	0.16	0.35	0.16	0.13	0.15	0.30	0.35
Per capita TPES (toe/capita)	2.25	2.83	3.63	3.16	2.86	2.97	2.86
Oil supply/GDP (toe/1000 USD)[11]	0.12	0.05	0.05	0.03	0.02	0.02	0.02
TFC/GDP (toe/1000 USD)[11]	0.12	0.09	0.07	0.05	0.03	0.03	..
Per capita TFC (toe/capita)	1.66	2.15	2.83	2.52	2.26	2.33	..
CO_2 emissions from fuel combustion ($MtCO_2$)[12]	20.8	30.1	40.9	39.5	35.4	36.9	..
CO_2 emissions from bunkers ($MtCO_2$)[12]	1.0	1.1	2.2	2.4	2.9	3.0	..
GROWTH RATES (% per year)	**73-90**	**90-00**	**00-10**	**10-14**	**14-15**	**15-16**	**16-17**
TPES	2.1	3.4	0.4	-2.9	4.1	4.9	-1.6
Coal	8.0	-1.4	-4.0	0.6	16.3	-5.9	-20.2
Peat	1.5	-5.0	-0.7	1.0	-0.4	-	-
Oil	-0.9	5.3	-0.7	-4.6	5.2	5.8	-3.4
Natural gas	-	6.3	3.2	-5.6	0.8	13.1	1.7
Biofuels and waste[1]	-	2.7	10.1	8.5	-3.3	15.3	20.5
Nuclear	-	-	-	-	-	-	-
Hydro	0.5	2.0	-3.3	4.1	13.1	-14.5	1.7
Wind	-	-	27.7	16.3	27.8	-6.4	21.0
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	10.7	8.3	7.7	7.1
TFC	2.3	3.6	0.7	-3.0	2.9	3.9	..
Electricity consumption	3.9	5.5	2.3	-1.3	3.9	2.0	..
Energy production	6.9	-4.6	-1.5	2.3	-4.8	117.8	15.4
Net oil imports	-0.5	4.7	-0.8	-4.4	12.8	-0.6	-4.5
GDP	4.1	7.0	3.1	3.2	25.6	5.1	7.8
TPES/GDP	-1.8	-3.4	-2.6	-6.0	-17.2	-0.2	-8.6
TFC/GDP	-1.7	-3.1	-2.4	-6.0	-18.0	-1.2	..

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes solar photovoltaic and solar thermal.
3. In addition to coal, oil, natural gas and electricity, total net imports also include peat and biofuels.
4. Excludes international marine bunkers and international aviation bunkers.
5. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
6. Industry includes non-energy use.
7. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
8. Inputs to electricity generation include inputs to electricity and CHP plants. Output refers only to electricity generation.
9. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for solar thermal and 100% for hydro, wind and solar photovoltaic.
10. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe per thousand US dollars at 2010 prices and exchange rates.
12. "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach from the 2006 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2013 and applying this factor to forecast energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX C: International Energy Agency "Shared Goals"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, the United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

BEC	Better Energy Communities
BER	building energy rating
BEV	battery-electric vehicle
BOS	Biofuels Obligation Scheme
CCAC	Climate Change Advisory Council
CCPC	Competition and Consumer Protection Commission
CNG	compressed natural gas
CO_2	carbon dioxide
CRM	capacity remuneration mechanism
CRU	Commission for Regulation of Utilities
DCCAE	Department of Communications, Climate Action and Environment
DCENR	Department of Communications, Energy and Natural Resources
DH	district heating
DSO	distribution system operator
ECP	Enduring Connection Policy
EEOS	Energy Efficiency Obligation Scheme
EI	Electric Ireland
EPA	Environmental Protection Agency
EPC	energy performance contracting
ESB	Electricity Supply Board
ESBN	Electricity Supply Board Networks
ESCO	energy services companies
ESD	Effort Sharing Decision
ETS	emissions trading system
EU	European Union
EU ETS	European Union Emissions Trading System
EUR	euro
EV	electric vehicle
EXEED	Excellence in Energy Efficient Design
FSRU	floating storage and regasification unit
GDP	gross domestic product
GHG	greenhouse gas
GNI	Gas Networks Ireland

GNI*	modified gross national income
GNP	gross national product
HHI	Herfindahl-Hirschman index
IBP	Irish balancing point
IDR	in-depth review
IEA	International Energy Agency
I-SEM	integrated single electricity market
LIEN	Large Industry Energy Network
LNG	liquefied natural gas
LULUCF	land use, land-use change and forestry
MaREI	Marine Renewable Energy Ireland
NAF	National Adaptation Framework
NBP	national balancing point
NDP	National Development Plan
NECP	National Energy & Climate Plan
NEEAP	National Energy Efficiency Action Plan
NGEP	Natural Gas Emergency Plan
NMP	National Mitigation Plan
NORA	National Oil Reserves Agency
NO_x	nitrogen oxides
NPF	National Planning Framework
NRP	new registration process
NSMP	National Smart Metering Programme
OCEANERA-NET COFUND	Ocean Energy European Research Area Networks Cofund
OPIN	Ocean Power Innovation Network
OREDP	Offshore Renewable Energy Development Policy
PCI	project of common interest
PHEV	plug-in hybrid electric vehicle
PPP	purchasing power parity
PPT	petroleum production tax
PSO	public service obligation
PV	photovoltaic
R&D	research and development
RD&D	research, development and demonstration
RESS	Renewable Electricity Support Scheme
SEAI	Sustainable Energy Authority of Ireland
SEC	Sustainable Energy Communities
SEM	single electricity market
SEMC	Single Electricity Market Committee
SEMO	single electricity market operator
SME	small and medium-sized enterprise

SMP	system marginal price
SNIP	Scotland Northern Ireland Pipeline
SNP	South-North Pipeline
SONI	System Operator Northern Ireland
SoS	Security of supply
SSRH	Support Scheme for Renewable Heat
SWSOS	South West Scotland Onshore System
TCP	Technology Collaboration Programme
TFC	total final energy consumption
TPES	total primary energy supply
TSO	transmission system operator
USD	United States dollar
VAT	value-added tax
VRT	vehicle registration tax

Units of measure

bcm	billion cubic metres
gCO_2/kWh	gramme of carbon dioxide per kilowatt hour
GJ	gigajoule
g/km	gramme per kilometre
GW	gigawatt
gWh	gigawatt hour
gWh/d	gigawatt hour per day
kb/d	thousand barrels per day
$kgCO_2$	kilogramme of carbon dioxide
$ktCO_2$	kilotonne of carbon dioxide
km	kilometre
km^2	square kilometre
kt	kilotonne
ktoe	thousand tonnes of oil equivalent
kV	kilovolt
kVA	kilovolt per ampere
kWh	kilowatt hour
m	metre
m^2	square metre
Mt	million tonne
$MtCO_2$	million tonnes of carbon dioxide
$MtCO_2$-eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
toe	tonne of oil equivalent
TWh	terawatt hour

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ENERGY POLICIES OF IEA COUNTRIES

Ireland

2019 Review

The International Energy Agency (IEA) has conducted in-depth peer reviews of the energy policies of its member countries since 1976. This process supports energy policy development and encourages the exchange of international best practices and experiences. This report on Ireland discusses the challenges faced as well as possible solutions to help the country's energy sector continue towards a secure and sustainable future.

Despite making substantial advances to transform its energy sector, Ireland is not on course to meet its 2020 greenhouse gas emissions reduction target. The decarbonisation of heating in buildings, one focus of this report, is a particular challenge.

In a more positive development, wind power accounted for around one-quarter of total generation in 2017 – the third-highest share of all IEA member countries. Additionally, this report suggests that Ireland has considerable scope to further advance alternative means of transport and public transport infrastructure, especially in urban areas.

In this report, the IEA provides recommendations for further improvements of Ireland's energy policy to help the country continue to transform its energy sectors in order to meet the emissions reduction target for 2030.