Irish Offshore Operators' Association (IOOA)

Irish Offshore Operators' Association

VALUE OF THE INDIGENOUS OIL AND GAS INDUSTRY TO IRELAND

pwc

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Contents

Foreword

In shaping a coherent, realistic, fully-costed and structured national policy and plan to transition to a low carbon future, the Irish Offshore Operators' Association (IOOA) believes that a new and informed energy conversation needs to begin. This should be evidence-based and supported by robust information. It should examine the current and future outlook for energy supply and demand, together with the issues surrounding Ireland's energy security, as well as the composition, values and economic impact of the constituent parts of the overall energy mix. The three crucial, and sometimes conflicting, ingredients of energy security, sustainability and affordability need to be considered together within an overall framework in order to provide an informed and integrated understanding.

In order to inform the energy conversation, the IOOA commissioned PwC to produce this report, "Value of the Indigenous Oil and Gas Industry to Ireland". The aim of the report is to present the facts in relation to energy supply and demand in Ireland, the place of oil and gas within that context, and the contribution our sector can make during Ireland's energy transition.

In Ireland, our geographical location at the edge of Europe makes us extremely vulnerable to potential interruptions in energy supplies, highlighted by our very significant reliance on imported energy. The members of IOOA are working to provide safe, clean, affordable and reliable indigenous energy for the Irish economy whilst reducing greenhouse gas emissions. Our members and our industry, both globally and locally, are committed to facing the climate challenge and being part of the solution. We believe that hydrocarbons will continue to play a vital role in meeting the world's and Ireland's energy needs in the transition to a low carbon future. In particular, we recognise the benefits of natural gas, and believe it will play an increasingly important role in the energy mix, both globally and in Ireland, helping to reduce greenhouse gas emissions and achieve the objectives of the Paris Agreement.

The Atlantic Margin Frontier Licensing Round of late 2015 led to a significant uptake in exploration acreage in the Irish offshore and to the entry of a number of new entrant major global players to Ireland. The majority of the Licensing Options awarded in that Round have now been converted to Frontier Exploration Licences and a new phase of exploration drilling is anticipated to commence in 2019. This will result in a significant investment in the Irish offshore.

Exploration success in the past has made a major contribution to the Irish economy. Forty years ago, the Kinsale Head field came on stream and had a transformative effect on the Irish energy landscape. It was the catalyst for the national gas grid, and made sustained contributions to regional and local economies. The Corrib gas field provided over 60% of Ireland's gas needs in 2016/17 to heat our homes, power our industries across the country, and also provides the necessary baseload backup for intermittent renewable energy sources. New discoveries would have the potential to make a similar significant contribution to securing Ireland's energy independence, as well as providing an additional revenue stream to support the energy transition.

As part of the new energy conversation in these challenging and uncertain times, this new analysis of the value of the indigenous oil and gas industry to Ireland is an important source of information. It details the overall energy context, the role of oil and gas in the current and future energy mix, the value of a secure energy supply, and the current and future potential economic impact of oil and gas in Ireland. The report draws on a wide range of publications and data sources and shows the very significant potential economic benefits in terms of revenue and employment that can flow from a successful and vibrant indigenous oil and gas sector.

Professor Pat Shannon
Chairman, Irish Offshore Operators' Association

Introduction & context

At the request of the Irish Offshore Operators' Association (IOOA), PwC has, in association with Professor Anthony Foley and Professor Edgar Morgenroth, prepared an analysis of the "Value of the Indigenous Oil and Gas Industry to Ireland". Anthony Foley is an Emeritus Associate Professor, Dublin City University Business School, and prepared a paper "Economic Impact on the Irish Economy of Offshore Oil and Gas Sector". Dr Edgar Morgenroth is a Professor of Economics, Dublin City University Business School, and prepared a paper "Quantifying Energy Security Risk". These papers form the basis for the related content in this overall summary report and are available on request from IOOA. Dr Paul Deane who is a senior researcher with University College Cork's Energy Policy and Modelling Group also reviewed the report and provided expert input.

The overall purpose is to demonstrate the significant value of the oil and gas industry to Ireland's economy, and to analyse its future potential. The economic analysis draws on data provided by IOOA members, available research and data, and the application of an economic methodology.

Structure of this report

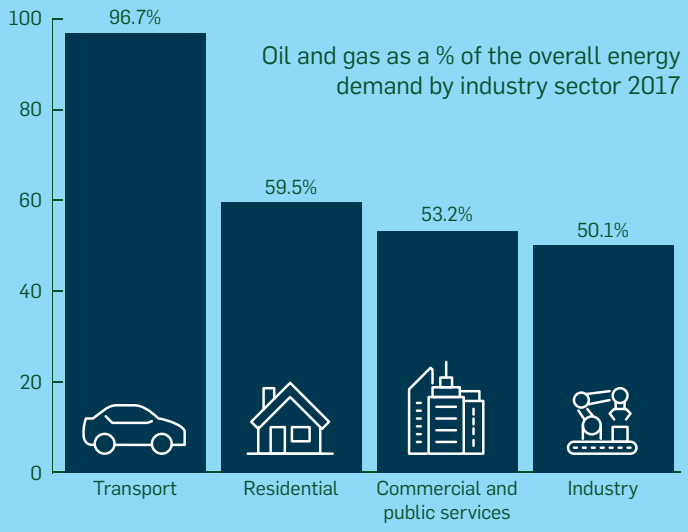
The report is structured as follows:

1. Foreword and introduction
2. Report at a glance
3. Executive summary
4. Setting the context
5. The oil and gas industry in Ireland
6. The contribution of oil and gas to Ireland's energy mix
7. The value of a secure energy supply
8. Economic impact of oil and gas
9. The future outlook

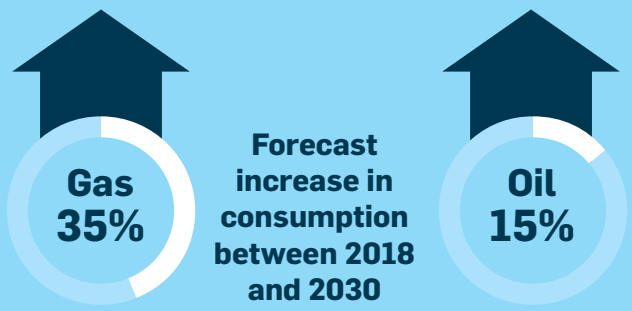
REPORT AT A GLANCE

Oil and gas remain essential to Ireland's energy supply and future growth

Oil and gas are vital to all major industry sectors in the Irish economy



Electricity demand is forecast to grow by up to 57% in the next 10 years

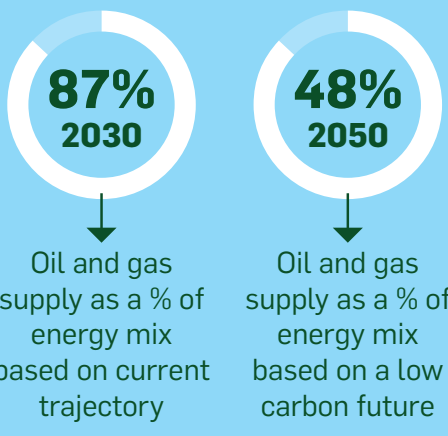


The transition to a lower-carbon future will take time and investment

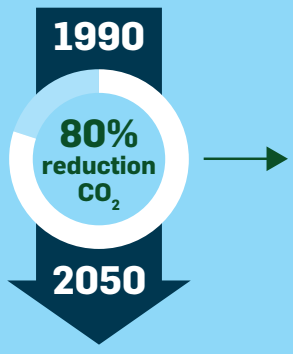
Oil and gas emitted less CO_2 than peat and coal during electricity generation in 2017

Gas is 67% less carbon intensive compared to peat and 61% less intensive compared to coal

Oil is 33% less carbon intensive compared to peat and 20% less intensive compared to coal



Low carbon future



Achieving an 80% reduction in CO_2 by 2050 relative to 1990 levels requires

€8.6 billion

additional investment in energy generation and energy using infrastructure and low carbon technologies

A secure energy supply is of critical value for Ireland

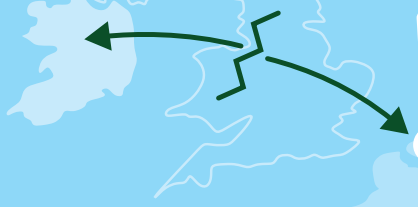
100% of Ireland's oil is imported

100% of Ireland's gas will be imported by the end of 2031 (31% in 2016/17)

Emissions associated with indigenous and European oil and gas are 30% less than those from imports outside of Europe

Ireland will have no direct connection to the main EU energy infrastructure post Brexit

Gas supply disruption could have a significant impact



€850m
Potential cost of a total blackout in Ireland for a day

An interruption in Russian gas supply could result in a

22.9% increase in gas prices and a

15.5% increase in electricity prices

Europe's gas supply
36% from Russia

The economic potential of oil and gas is significant

Value of the Corrib field:

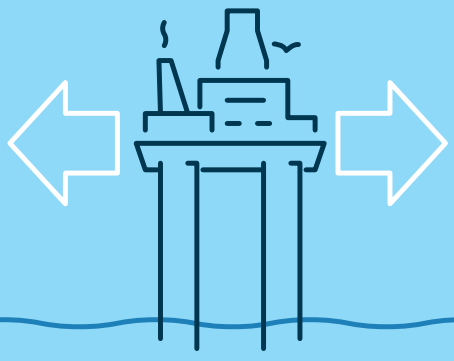
€6bn
Impact on GDP

Over **1,000** full time jobs during construction from 2006 to 2015

Over **€1bn** spent directly with Irish companies
150 direct long-term jobs

62% share of gas demand supplied by Corrib in 2016/2017

Over the project lifecycle, one oil find = €16.25bn expenditure and up to 1,200 jobs per annum* and €8.5bn corporation tax



Over the project lifecycle, one gas find = €2.3bn expenditure and up to 380 jobs per annum* and €2.42bn - corporation tax

* Assumes Irish enterprises have the capacity to increase the supply of goods and services to the oil and gas industry

Headline figures

Oil & gas meet **96.7%** of energy demand in transport and **50%+** in all other major industry sectors in the Irish economy

On our current trajectory, oil & gas will account for **87% of the energy mix by 2030** (78% currently)

Gas is **67%** less carbon intensive than peat and **61%** less than coal

Oil is **33%** less carbon intensive than peat and **20%** less than coal

The transition to a lower carbon future requires **€8.6bn additional investment**

An **80% reduction in CO_2** by 2050 relative to 1990 would still result in oil & gas accounting for **48%** of the energy mix by 2050

Corrib met **62%** of gas demand in 2016/17, will have a **€6bn** impact on GDP, and generated **1,000** jobs during construction

100% of Ireland's oil is imported

Ireland will become **100%** dependent on imports of gas during **2031**

Emissions associated with indigenous and European oil and gas are **30% less** than those from imports outside of Europe

36% of Europe's gas supply is from Russia

An interruption to Russian gas supply to Europe would result in increases of **22.9% and 15.5%** to gas and electricity prices

€850m potential cost of total blackout in Ireland **for a day**

A single oil find could result in **€16.25bn** expenditure, up to **1,200 jobs per annum** and €8.5bn corporation tax over the project

A single gas find could result in **€2.3bn** expenditure, up to **380 jobs per annum** and €2.42bn corporation tax over the project

EXECUTIVE SUMMARY

Oil and gas industry context

Ireland's energy policy is driven by energy and emissions targets mandated at global, European Union (EU) and national level aimed at facilitating the transition towards a low carbon future.

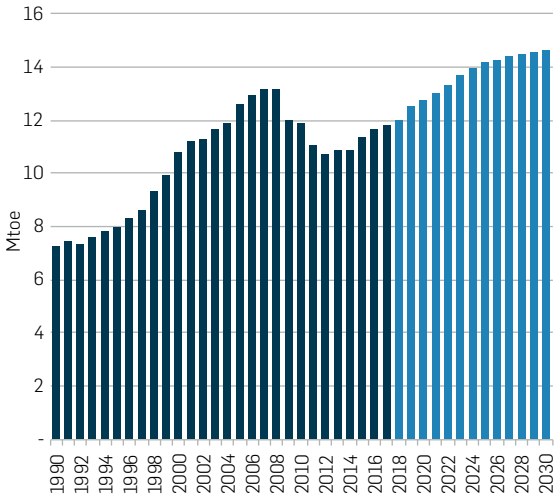
At the Paris climate conference in December 2015, 195 countries adopted the first-ever legally binding global climate deal to enhance decarbonisation efforts with the aim of limiting the increase in the global average temperature to no more than 2˚C above pre-industrial levels.

In Ireland this commitment is set out in the Climate Action and Low Carbon Development Act (2015), which also provides for the preparation of five-yearly National Mitigation Plans (NMPs) specifying the measures required to reduce emissions in line with EU and international regulations. The first NMP was published in July 2017 and was followed in December 2018 by a draft Integrated National Energy and Climate Plan for Ireland for the period 2021-2030 that, when finalised, is expected to operationalise the policy measures identified in the NMP.

Demand for energy in Ireland is growing, driven by population growth and economic growth.

Analysis of final energy usage in Ireland by the Sustainable Energy Authority of Ireland (SEAI) indicates that demand for energy in Ireland is projected to continue to climb each year to 2030, and further still by 2050 according to the Economic and Social Research Institute (ESRI). Energy demand from 2018 to 2030 is expected to grow by 22%.

Final energy usage 1990 - 2030



Source: SEAI

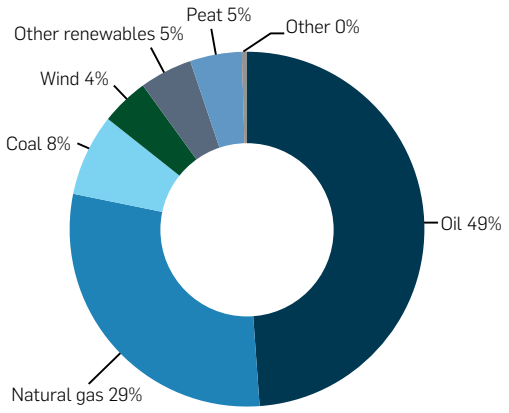
Even in a low demand scenario, the International Energy Agency (IEA) predicts world energy demand to increase in 2025 and 2040.

Oil and gas in the energy mix - current

Oil and gas have historically been the primary components of the Irish energy mix and are consumed across all major sectors of the Irish economy.

The SEAI forecasts an increase in renewables of 51% by 2030. This equates to about 12% of total energy supply. Per SEAI, on our current trajectory, oil and gas will account for 87% of total energy supply by 2030. Oil, and particularly gas, will be part of Ireland's energy mix for many decades to come, even in a low carbon scenario. Additional investment required to limit carbon emissions to 80% below 1990 levels is estimated at €8.6bn (relative to business as usual).

Ireland's primary energy supply 2017 by fuel group



Source: SEAI

Oil and gas account for 78% of current energy supply.

As well as their importance in meeting energy demand in Ireland (particularly in the transport sector, which is entirely dependent on imported oil), oil and gas are used in a huge variety of everyday items produced by the petrochemicals industry that are integral to a modern society: mobile phones, computers, pharmaceuticals, detergents, clothing, toys, carpets and upholstery, fungicides and asphalt, among many other items.

The fundamental importance of oil and gas to the global petrochemicals industry is identified by the IEA as one of the major blind spots in the global energy debate

The value of a secure energy supply

In considering Ireland's energy security we focus on energy availability, infrastructure, energy prices, geopolitical risk and potential societal effects of a shortage of energy. Energy security needs to be considered in the context of changing energy mix and the drive to reduce emissions.

Low carbon scenarios involve a shift towards renewable energy and in particular wind energy. While the SEAI forecasts an increase in renewables by some 51% by 2030, this equates to about 12% of total energy needs. Recent research by Glynn et al (2018)[1] highlights the role of natural gas as a bridging fuel even in very ambitious decarbonising scenarios, where onshore wind and natural gas dominate electricity generation until 2030 after which natural gas is slowly replaced. Global IEA estimates, in a scenario which aims to limit temperature increases to 2°C would see oil and gas at as much as 45% of world primary demand by 2040.

Given that wind is a variable energy source, energy security would be significantly reduced if it is not complemented by other energy sources as a back-up.

Accordingly, gas is particularly important in electricity generation where it represents both an important transition fuel in the medium term, and acts as a backup for wind generation. 49% of electricity was generated by gas over the period 2012 – 2016[2].

According to Eirgrid, electricity demand could grow by up to 57% in the next 10 years[3]. With the installed capacity of wind generation increasing in Ireland, back up with gas generation plant will need to be available, and this will require a secure supply of gas. New domestic gas fields would significantly improve energy security.

While mainland Europe has invested in significant volumes of electricity interconnectors our Island geography makes this more costly. Gas fired power generation is the most suitable cost effective backup technology to complement wind.

Ireland is highly dependent on a small number of infrastructure facilities for energy imports, disruption to which would have significant consequences. On top of this, almost one third of Ireland's emergency oil stocks are held outside Ireland.

The risk to energy security is also recognised in the proposed Celtic Interconnector, an electrical link, which would enable the movement of power between Ireland and France.

Ireland is 100% reliant on imports to meet its demand for oil, with imports of natural gas accounting for c. 31% of gas demand in 2016/17[4]. While indigenous sources of natural gas from the Kinsale and Corrib fields accounted for almost 70% of supply in 2016/17, the Kinsale gas field will be depleted during 2020 and gas production from Corrib is already declining and expected to be depleted by 2031 without the addition of hydrocarbon reserves[4].

This means that **without new finds, Ireland will become 100% dependent on imports during 2031**.

Given that energy imports almost exclusively arrive in Ireland via the UK, and the UK is dependent on an increasing share of imported energy, **geopolitical risk is a key risk to Ireland's energy security. Brexit increases energy security concerns.** Post Brexit, Ireland will not have a direct connection to the main EU energy infrastructure.

Relative price stability is another important aspect of energy security. Supply reductions, expectations of supply reductions and exchange rate volatility can all result in increased energy prices.

A recent paper by Deane et al. (2017)[5] showed that **if the supply of Russian gas into Europe was to be interrupted for a year, gas prices in Ireland would rise by 22.9%, with a 15.5% increase in electricity prices.** This highlights the integrated nature of gas supplies and the dependence on gas supplies to generate electricity.

The cost of disruption in energy supplies is significant and reputational losses from negative events can be significant.

With estimates of the value of lost load at €10/KWh, **the potential cost of a total blackout in Ireland for a day is estimated at €850m**.

Leahy et al. (2012)[6] estimated that the daily economic cost for Ireland of losing gas-fired electricity in 2008 ranged from €100m to €1,000m and that an outage over a 90 day period could cost as much as 50% of annual Gross Domestic Product (GDP) **(€147bn).**

Any concern about energy security could have a significant impact on investment decisions and foreign direct investment (FDI) flows.

1 Glynn, J., Gargiulo, M., Chiodi, A., Deane, P., Rogan, F., and B. O'Gallachoir (2018) "Zero Carbon Energy System Pathways for Ireland Consistent with the Paris Agreement", Climate Policy, in press
2 Source: "A Look at the Irish Gas Market", Ervia
3 Source: "All-Island Generation Capacity Statement 2018 – 2027", Eirgrid
4 Source: "Network Development Plan 2018", Gas Networks Ireland
5 Deane, J.P., Ó Ciarán, M. and Ó Gallachóir, B.P (2017) "An integrated gas and electricity model of the EU energy system to examine supply interruptions", Applied Energy, Vol. 193, pp. 479-490
6 Leahy E., Devitt, C., Lyons, S., and R. Tol (2012) "The cost of natural gas shortages in Ireland", Energy Policy, Vol. 46, pp. 153–169

Economic impact of oil and gas

A significant oil or gas find in Ireland would be expected to generate a number of economic benefits for the country, including: employment; Gross Value Added (GVA) (measure of the value of goods and services); and taxation receipts and licence fees.

Employment in exploration and extraction of natural gas in 2016 is estimated at **571 direct and indirect jobs**[7]. The Corrib field is estimated to contribute €6bn[8] to GDP. The Corrib field is reported to have sustained more than 1,000 full time jobs during construction from 2006 to 2015, with over €1bn spent directly with Irish companies, as well as sustaining 150 direct long-term jobs[9].

A total spend of €16.25bn across the oil lifecycle (exploration, development, production, decommissioning) yielding a commercial find of 550 - 600 million barrels of **oil** could result in **GVA of €1.6bn - €3.2bn*. Expenditure of €2.3bn** resulting in a commercial find of 800bn standard cubic feet of **gas** could generate **GVA of circa €0.85bn - €0.94bn*.**

Expenditure in the Irish economy by the oil and gas industry as a proportion of total expenditure by the oil/gas industry (which determines GVA) compares reasonably well with the overall multinational sector.

The economic impact of a single find is substantial in terms of Exchequer receipts and employment. This is relevant to policy decisions under consideration.

A single oil find could generate in the order of 600 - 1,200* jobs per annum over the full 32 year project lifecycle, with a **single gas** find generating in the region of **320** – 380* **jobs per annum over a similar period.**

Most of the direct jobs and a substantial proportion of the indirect jobs would be expected to be located in regional enterprises and contribute to regional economic development. Such employment would compare favourably to recent IDA announcements and Irish Times Top 1,000 Companies in similar regions.

Overall employment associated with the sector is characterised by above average skills and earnings.

Such an oil find could generate corporation tax receipts of €8.5bn over 20 years (net present value (NPV) of €3.75bn at 4%) and income tax receipts of €15m per annum. The value of the **corporation tax** take from a gas find is estimated at **€2.42bn** over the 19 year production period (**€1.18bn** NPV at 4%) and income tax (including pay related social insurance (PRSI) and universal social charge (USC)) of circa €8m per annum. Oil and gas projects generate a higher taxation return in that no Government grants are given and these companies pay 25% corporation tax plus petroleum production tax.

Larger exploration efforts may result in more discoveries which would generate larger economic gains.

As an **illustrative** example, **five oil** finds could result in **3,000** - 6,000* **jobs, €8bn -** €16bn* in GVA, **corporation tax** receipts of **€42.5bn** (**€18.75bn** NPV) and income tax of circa €75m per annum. Similarly, **five gas** finds could result in **1,600** – 1,900 jobs, **€4.25bn** - €4.7bn in GVA, **corporation tax** receipts of **€12.1bn** (**€5.9bn** NPV) and income tax of circa €40m per annum. In the illustrative examples, tax would also be higher if domestic enterprises supply more goods and services to the industry.

As a means of continuing on the journey towards energy efficiency and emissions reduction, revenues from oil and gas extraction could be used directly to fund energy transition measures which are significant. The SEAI estimates that the Irish energy retrofit market is worth over €35 billion to the Irish economy between now and 2050.

7 Source: "Economic Review of the Irish Geoscience Sector", Indecon, 2017
8 Source: "Economic Benefits of the Corrib Gas Project", Goodbody Economic Consultants, 2012
9 Source: IOOA Submission to the Joint Oireachtas Committee on Communications, Climate Action and the Environment, 14 June 2018

*Where domestic enterprises have the capability to increase the supply of goods and services to the oil and gas industry, then GVA and employment will increase, as will taxation receipts.

Oil and gas in the energy mix – future outlook

2030

The latest energy projections by the SEAI for the period out to 2030 ("Ireland's Energy Projections", 2017) show that the share of total energy supply in Ireland accounted for by gas will increase from 30% in 2018 to 43% by 2030. The share of energy accounted for by oil is set to remain roughly the same (from 45% in 2018 to 44% in 2030).

Total gas and oil consumed over the period 2018 to 2030 is set to increase by 35% and 15%, respectively.

2050

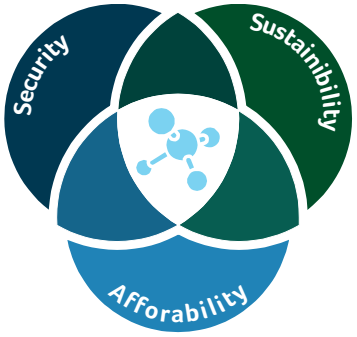
Analysis by the ESRI ("Low Carbon Energy Roadmap for Ireland", 2013) for the period out to 2050 projects that total energy consumption will increase by 45% relative to 2017 levels in a business as usual scenario, and natural gas and oil will together still account for 79% of all energy used. Even in a low carbon scenario modelled by the ESRI, Ireland will still require significant gas past 2050.

The analysis by the SEAI and ESRI highlights that oil and gas will be part of Ireland's energy mix for many decades to come, even in a low carbon transition scenario. IEA estimates confirm this trend globally.

According to the Environmental Protection Agency (EPA), "Ireland is not currently on the right track to meet its 2020 targets, nor is it on the right emissions trajectory to meet future EU targets or our national 2050 decarbonisation goals".

Failure to meet the targets imposed by the EU could result in fines, additional expenditure on carbon credits and / or referral to the European Court of Justice.

For Ireland to realise its 2050 decarbonised objective, a holistic and cross sectoral approach is required. The Energy Trilemma proposes that energy security, affordability and sustainability should be considered to enable multi-dimensional thinking and an integrated understanding of energy issues.



SETTING THE CONTEXT

Low carbon milestones for Ireland and targets for energy efficiency and renewable energy are mandated at global, EU and national level.

At the Paris climate conference in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal to enhance decarbonisation efforts with the aim of limiting the increase in the global average temperature to no more than 2˚C above pre-industrial levels and to pursue efforts to limit the increase to 1.5˚C. This international initiative is part of a suite of legislation and policies aimed at facilitating the transition towards a low carbon future.

EU targets form the basis for legally binding emissions targets for Ireland and the other Member States. Milestone dates and targets for energy efficiency and renewable energy on the road to Ireland's low carbon future are set out below.

EU target	To be achieved by	2020	2030	2050
Increase in renewable energy	40% renewable electricity 12% renewable heat 10% renewable transport	20% (Ire: 12%)	27%	
Improvement in energy efficiency	20% general energy efficiency 33% public sector energy efficiency	20%	27%	
Reduction in greenhouse gas emissions	21% reduction in Emissions Trading System (ETS) sectors 20% reduction in non ETS sector	20%	40%	80%

The 2020 Climate and Energy Package committed the EU to reducing its greenhouse gas (GHG) emissions by 20% (relative to 1990) by 2020.

The 2030 Climate and Energy Framework requires the EU to achieve at least a 40% cut in GHG emissions by 2030 (relative to 1990). This target is binding on each member state and currently Ireland is behind on meeting these targets as noted by the EPA, particularly in the transport and heating sectors.

In the longer term the EU and Ireland are committed to reducing GHG emissions by at least 80% compared to 1990s levels and transitioning to a low carbon economy by 2050. In Ireland this commitment is set out in the Climate Action and Low Carbon Development Act (2015), which also provides for the preparation of five-yearly National Mitigation Plans (NMPs) specifying the measures required to reduce emissions in line with EU and international regulations. The first NMP was published in July 2017.

A draft Integrated National Energy Climate Plan for Ireland for the period 2021 - 2030 was published in December 2018. When finalised, this plan is expected to operationalise the policy measures identified in the NMP.

The low carbon policy context is being developed in the context of increasing demand for energy in Ireland.

Demand for energy in Ireland is on the rise

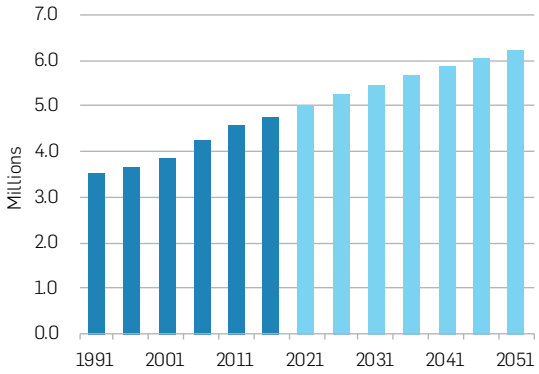
Analysis of final energy usage in Ireland by the SEAI indicates that demand for energy in Ireland is projected to continue to climb each year to 2030. Final energy demand dropped in the period 2009 – 2013 as a result of the effects of the 2008 economic crash but has been steadily increasing since then.

Ireland experienced GDP growth of 5.1% in 2016, while GNI* grew by 9.4%:

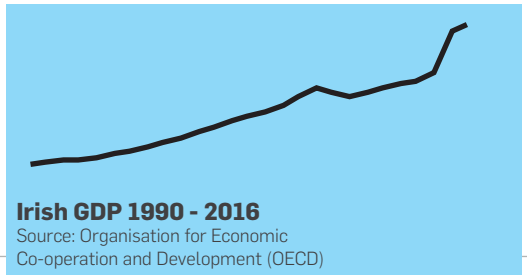
Source: SEAI, "Energy in Ireland" report 2017

Modified Gross National Income (GNI*) was introduced by the Central Statistics Office (CSO) in 2017 to assess the level of activity in the Irish economy by excluding the large and distorting flows of foreign-owned multinational enterprises. GNI* is defined as GNI less the effects of the profits of re-domiciled companies and the depreciation of intellectual property products and aircraft leasing companies.

Population of Ireland 1991 - 2051

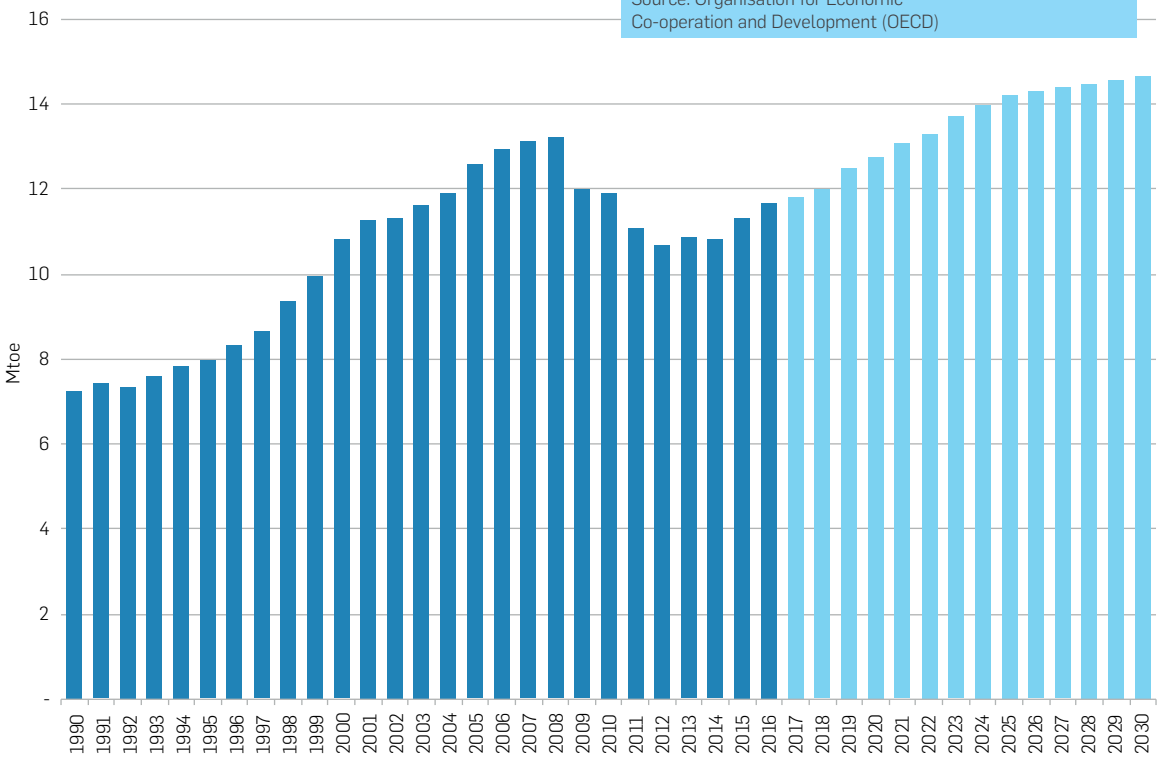


Source: Central Statistics Office (CSO) and OECD



Irish GDP 1990 - 2016
Source: Organisation for Economic Co-operation and Development (OECD)

Final energy usage 1990 - 2030



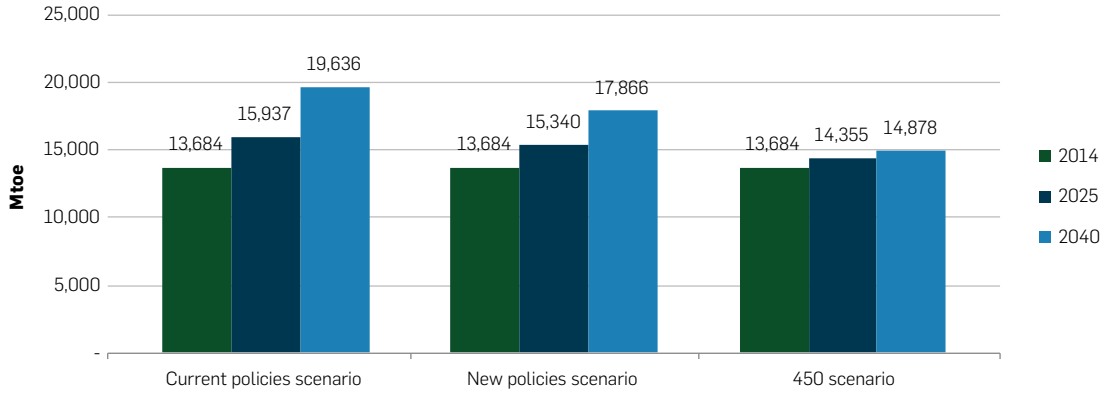
Source: SEAI

Even in the best (low demand) case scenario projected by the International Energy Agency, world primary energy demand is projected to increase in 2025 and 2040.

Growth in energy demand in Ireland is consistent with worldwide trends. Worldwide demand for energy has followed a steady upward trend since 1990, with oil and natural gas accounting for the majority of final global energy consumption.

According to Wood Mackenzie, a global supply gap in the order of 23 million barrels of oil per day (circa 25% of total current supply) is projected by 2027, as a result of increasing demand and a decline in existing production fields. In the absence of technological breakthroughs, this means that new oil discoveries will be required. Given that the number of exploration wells drilled globally has fallen since 2013 and 2014 (Westwood Energy 2018 State of Exploration) and there is a considerable time lag between exploration and production, this implies that efforts will need to be intensified in order to ensure reserves replacement. As energy demand, including oil and gas is projected to grow, substantial exploration efforts are required in the future even to maintain current production levels.

Projections of world primary energy demand by 2025 and 2040



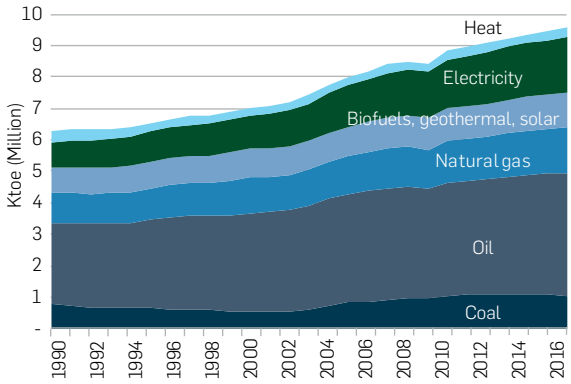
Source: IEA "World Energy Outlook 2016"

Current policies scenario: Reflects policies supported by specific implementing measures in place by mid 2016.

New policies scenario: Based on new policies consistent with commitments made under the Paris Agreement in Dec-17.

450 scenario: Reflects policies aimed at limiting global warming to 2°C, including increased deployment of renewables in power generation and profound changes to the efficiency and carbon intensity of end uses.

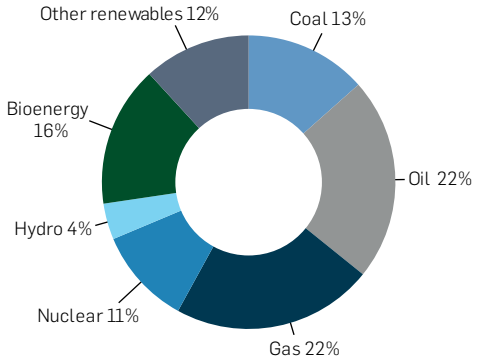
Global final energy consumption by fuel type



Source: IEA "World Energy Outlook 2016"

The International Energy Agency's World Energy Outlook 2016 projects future global energy trends across a number of different scenarios.

World primary energy demand 2040 - 450 scenario

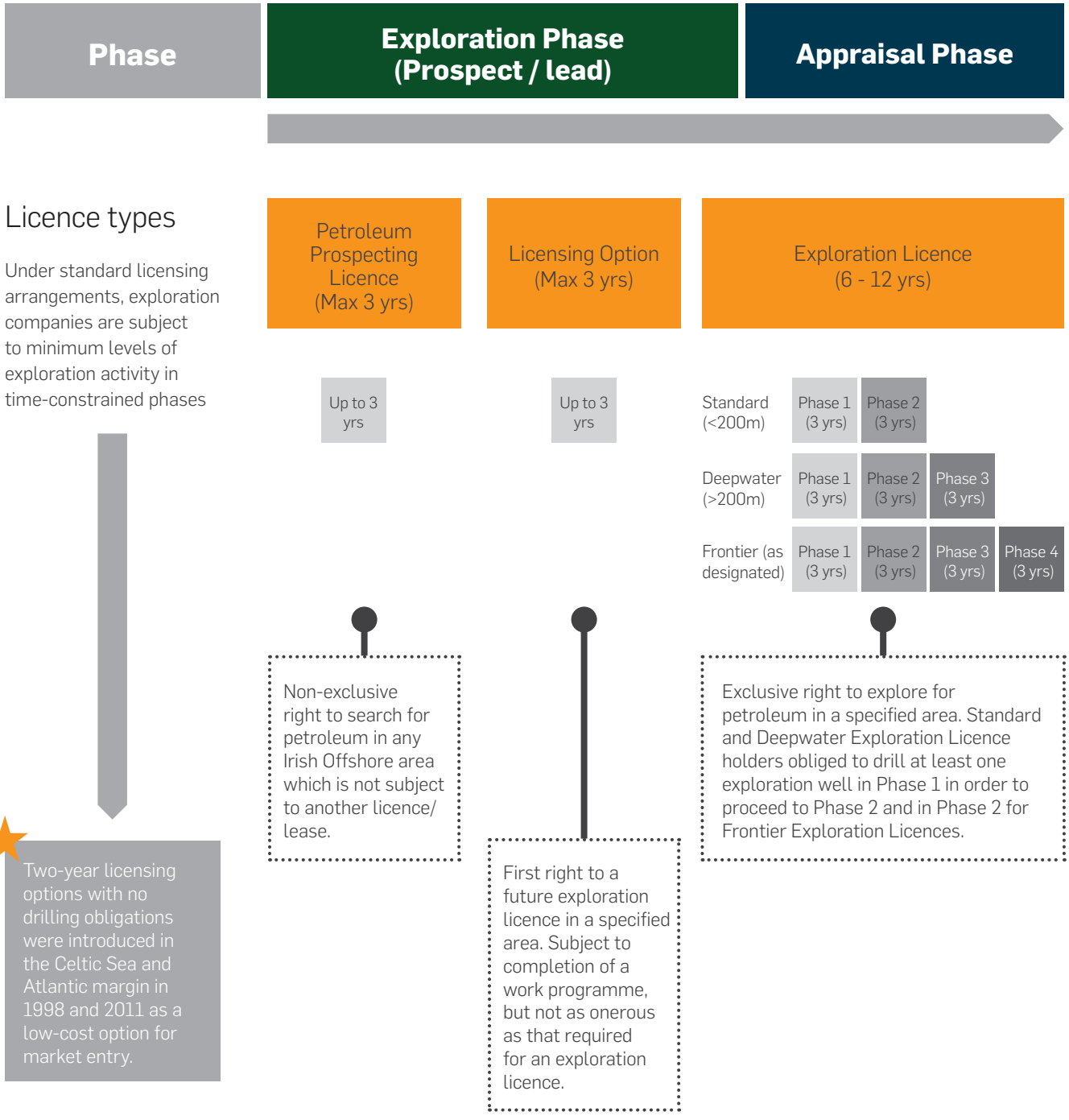


Even under the best case 450 scenario, energy demand is set to grow by 9%, with oil and gas continuing to account for as much as 45% of world primary energy demand by 2040 (see above).

Source: IEA "World Energy Outlook 2016"

THE OIL AND GAS INDUSTRY IN IRELAND

Exploration activity in Ireland is governed by a licensing regime, whereby the operator assumes full exploration risk in return for lease on the resources, the profits from which are subject to a specialist tax regime.




Development Phase (Commercial Discovery)
Production Phase (Commercial Discovery)
Petroleum Lease (as determined by the Minister)
Lease Undertaking
Reserved Area Licence
Exclusive right to produce petroleum from a lease area, once declared commercial. Discoveries that were deemed not commercially viable can be re-appraised years later with new data or reprocessing existing data, new technologies, rising prices. Production need not begin until 6 years after the expiration of an exploration licence.
Lease undertaking may be granted when discovery not declared commercial during period of the licence, but when this is expected in the foreseeable future (Oil: 4 years / Gas: 6 years).
Reserved Area Licence grants Petroleum Lease holder a licence in respect of an area adjacent to / surrounding the leased area which is not subject of an authorisation other than a Petroleum Prospecting Licence.

The 2015 Atlantic Margin Licensing Round has had a positive impact on the level of lease and licence activity for offshore oil and gas in Ireland.

Atlantic Margin Licensing Round

The 2015 Atlantic Margin Oil and Gas Exploration Licensing Round represented a major step forward for the industry in Ireland. It opened for licensing all of Ireland's major Atlantic basins: Porcupine, Goban Spur, Slyne, Erris, Donegal and Rockall.

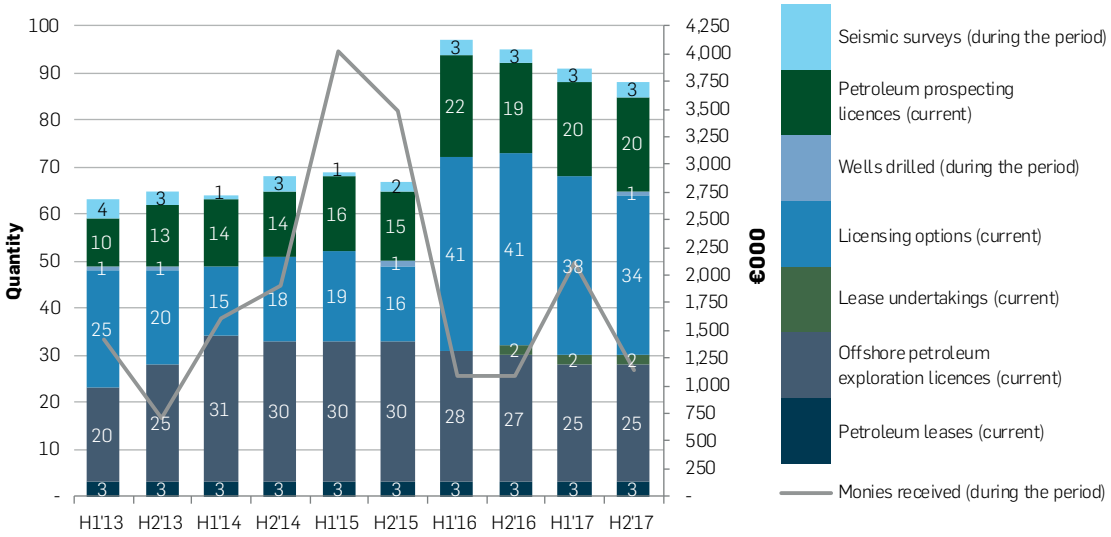
During 2016, 28 Licensing Options were awarded following a very positive response to the round, 43 applications for Licensing Options received by the deadline of September 2015. The Licensing Options are for a maximum period of two years.

This was by far the largest number of applications received in any licensing round held in the Irish offshore and, in the context of very low oil prices, the strong interest in the Licensing Round was considered to be very positive. At the time of announcing the licensing awards, the Irish Government commented that: "Industry's response to the Round demonstrates the perceived positive exploration opportunity of Ireland's offshore and highlights confidence in the Irish regulatory process and the ability of industry to do business in Ireland."

Where holders of Licensing Options wish to move forward to seek an exploration licence, the licence on offer will be a Frontier Exploration Licence of fifteen years duration, with a first phase of three years, and three subsequent phases of four years.

The impact of the Atlantic Margin Licensing Round is illustrated in the upturn in lease and licence activity below.

Petroleum development in Ireland 2013 - 2017



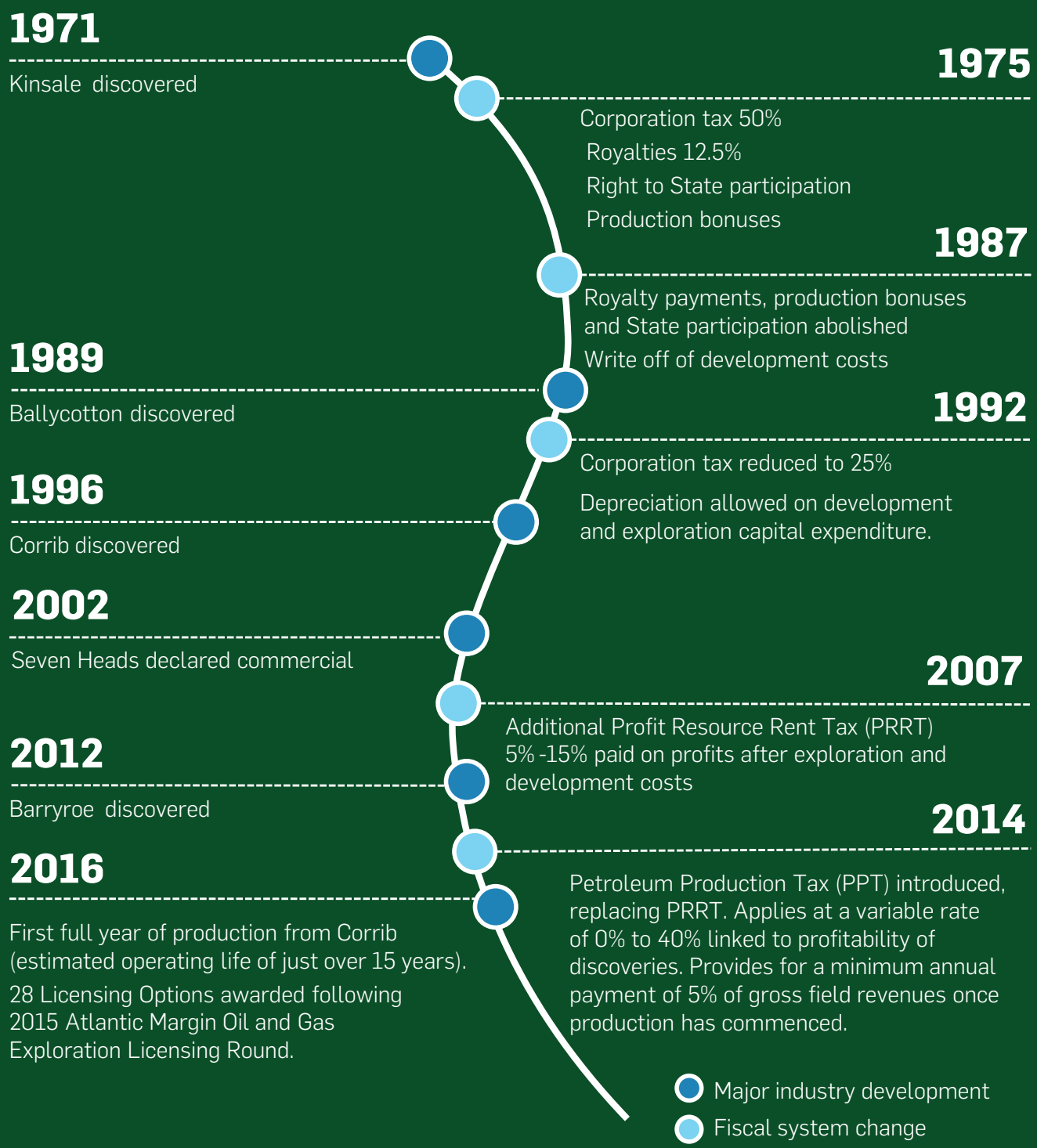
Source: Activity reports published by The Department of Communications, Climate Action and Environment and presented to the Houses of the Oireachtas

The number of exploration authorisations in place is running at the highest levels ever since exploration began in the Irish offshore four decades ago. Arising from these levels of licensing and lease undertakings, a number of wells have been drilled and seismic surveys completed.

While there was no drilling activity during 2016, a number of companies continue to carry out work in assessing areas covered by the licensing options granted in the 2016 Licensing Round. Industry activity in 2016 included four 3D seismic acquisition surveys located primarily in the Porcupine Basin. The Druid / Drombeg well was drilled in 2017. Details of offshore oil and gas areas subject to licence are presented in Appendix 1.

Over the five year period from 2013 to 2017 (inclusive) circa €18.5m was received in rental and other payments.

History of the oil and gas industry in Ireland



The first major discovery in Ireland was the Kinsale gas field in 1971. Current participants in the Irish offshore oil and gas market are a mix of proven global players and indigenous companies.

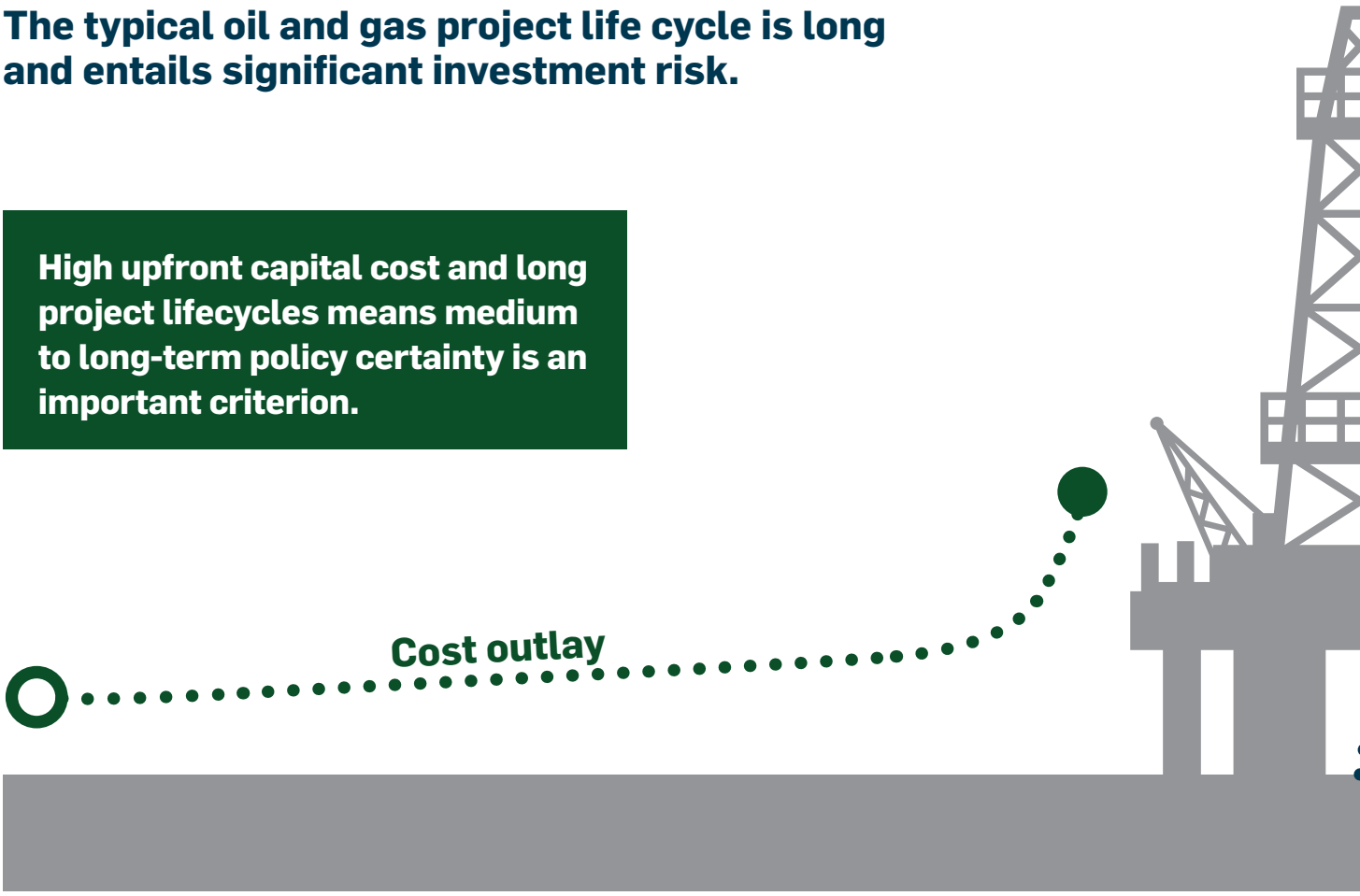
Since the discovery of the Kinsale Head gas field in 1971, several other commercial gas discoveries have been made (Ballycotton, Corrib, Seven Heads).

In 2018, Providence Resources announced it had partnered with Chinese group Apec to develop the Barryroe oil find declared commercial in 2012.

Participants in the Irish offshore oil and gas market are a mix of proven global players and indigenous companies (see Appendix 2).

The typical oil and gas project life cycle is long and entails significant investment risk.

High upfront capital cost and long project lifecycles means medium to long-term policy certainty is an important criterion.



Licensing

State grants a licence to explore for and develop a field

Exploration

Process of locating oil and natural gas resources

Companies begin by reviewing existing geological and geophysical data (including seismic data) to learn more about potential reservoirs. Environmental and safety considerations are also taken into account. Once the data is compiled and analysed, companies make an economic calculation which considers factors such as geological risk, financial returns that might be earned, taxes and royalties etc., to determine whether a geological prospect is worth drilling. If an exploration is successful, further appraisal wells may be drilled to establish if the discovery will be large enough to be commercial.

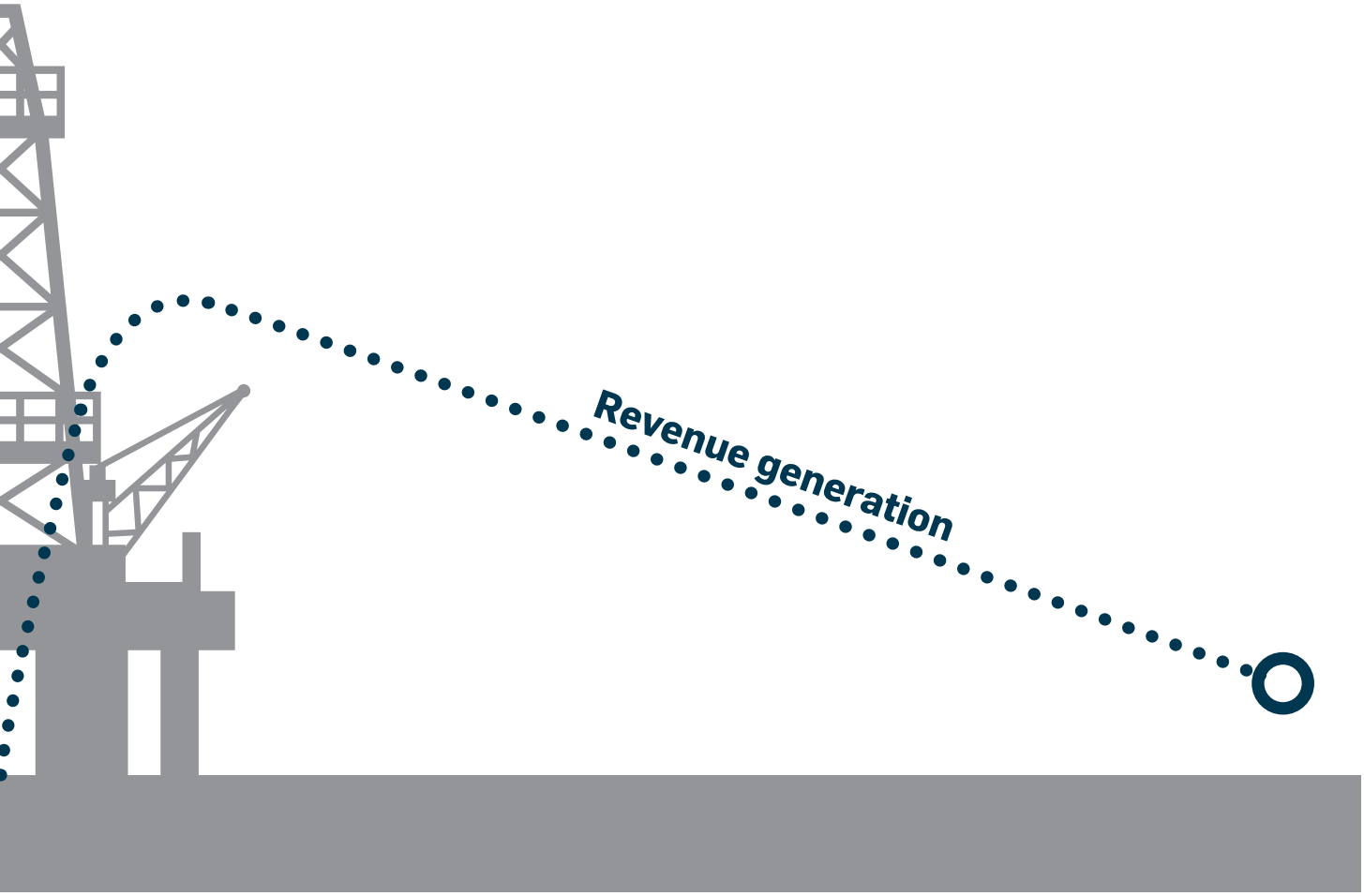
Appraisal

Data gathering to determine whether the discovery is commercially viable

Development

Bringing the underground oil or gas to the production phase

The company develops a series of plans which outline exactly how it will produce the oil and natural gas in a particular reservoir, the environmental protection measures that will be put in place to minimize any environmental impact, the safety measures that will be used on the project, and the benefits of the project to the relevant communities and country as a whole (including employment, revenues, contracts, etc.).



Production

The point at which the oil / gas is ready to be extracted and sold

Producing oil and natural gas offshore is a complex process due to the challenges of operating in a remote and sometimes harsh environment. Several key activities happen on a production facility:

- Drilling and maintaining the wells;
- Processing and separating the produced mixture of oil and natural gas;
- Storing produced liquids for transport to markets or to a trans-shipment terminal; and
- Gathering and processing gas and natural gas liquids.

Decommissioning

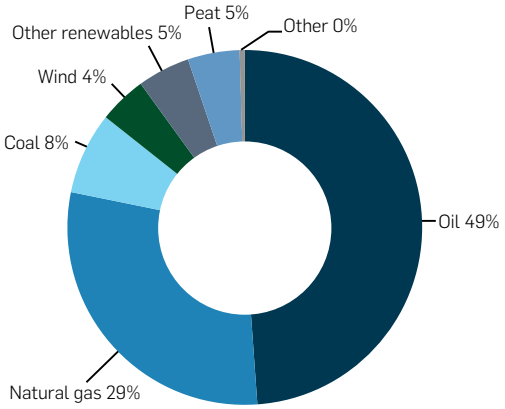
Decommissioning at the end of the useful life of the field

An offshore oil and natural gas field can produce for decades, depending on its size. Once all of the accessible oil and natural gas reserves in a field have been produced, the project can be safely decommissioned. Decommissioning activities are monitored by the regulator.

THE CONTRIBUTION OF OIL AND GAS TO IRELAND'S ENERGY MIX

Oil and gas are the primary components of the Irish energy mix and are consumed across all major sectors of the Irish economy.

Ireland's primary energy supply 2017 by fuel group



Source: SEAI

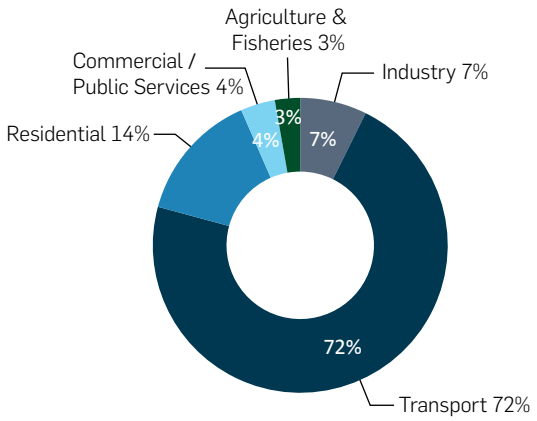
In 2017 oil and gas accounted for the vast majority of Ireland's total primary energy requirements (78%).

Renewables accounted for 9% of total energy supply in Ireland (wind: 4% and other renewables: 5%).

Renewables have intermittency challenges and account for a small element of the overall Irish energy mix at present, although this is growing. There is a need to invest in technologies that are complementary to our renewable strategy and build on intermittent power generation assets.

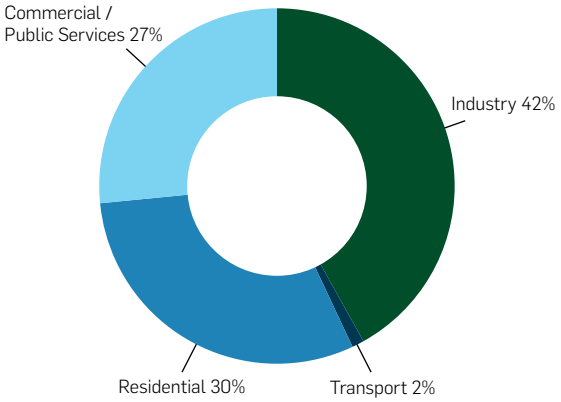
Oil and gas have provided a consistent, affordable and secure source of energy to fuel growth in the Irish economy. Analysis of oil and gas consumption in 2017 indicates that oil and gas are consumed across all major sectors of the Irish economy.

Ireland final oil consumption in 2017 by sector



Source: SEAI

Ireland final gas consumption in 2017 by sector

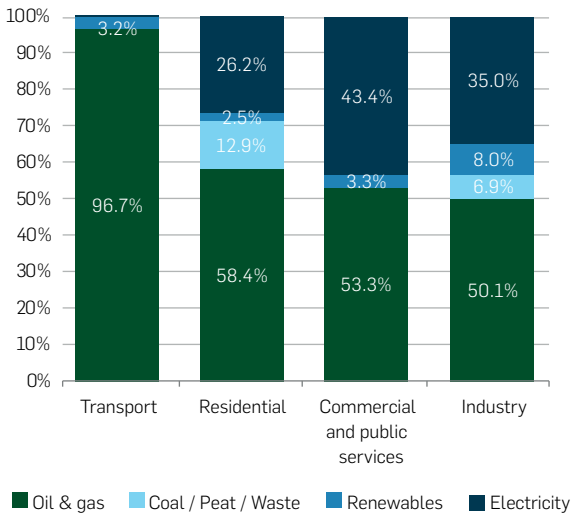


Source: SEAI

Key sectors of the Irish economy are highly dependent on oil and gas, as illustrated below.

In particular, the transport sector is entirely dependent on imported oil to fuel its energy demands (96.7% in 2017). The uptake on electric vehicles has been slow to date with charging infrastructure seen as a constraint.

Energy mix (consumption) by industry sector 2017



Source: SEAI

Since the early 1990s, oil and gas have been the largest components of the Irish energy mix.

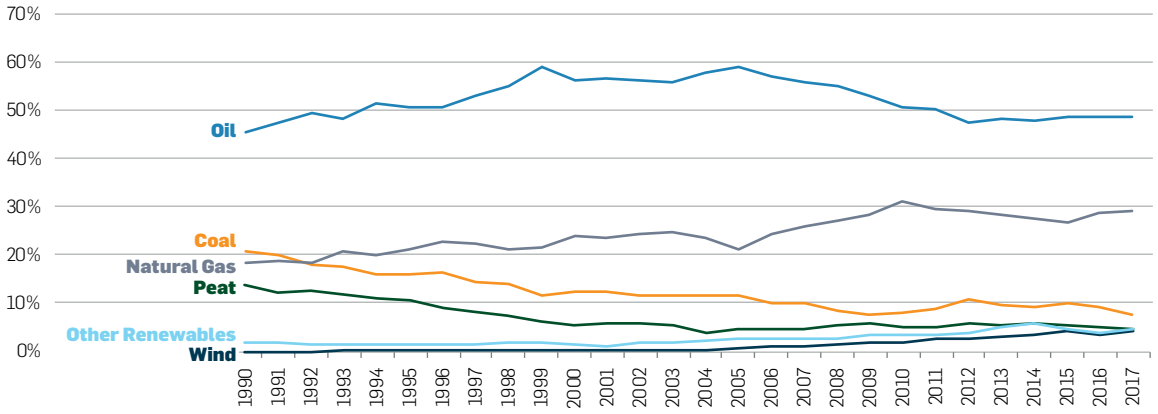
Over time the composition of energy supply in Ireland has changed significantly. In 1990 over 20.6% of energy supply was accounted for by coal and a further 13.6% were accounted for by peat. By 2017 their share had fallen to 7.5% and 4.7%, respectively.

The share of oil increased over the period but more recently has been decreasing although the share accounted for in 2017 is still larger than in 1990. Renewables have increased their share (9%). In particular, wind has emerged to account for 4.3% of energy supply.

Oil and gas have played a key role in the changing energy mix since 1990.

Also, and very much part of the energy security position, existing indigenous gas sources are declining – without new finds, Ireland will become 100% dependent on imports during 2031 – by which time the Corrib gas field will be depleted following depletion of the Kinsale gas field in 2020.

Evolution of energy shares 1990 - 2017



Source: SEAI

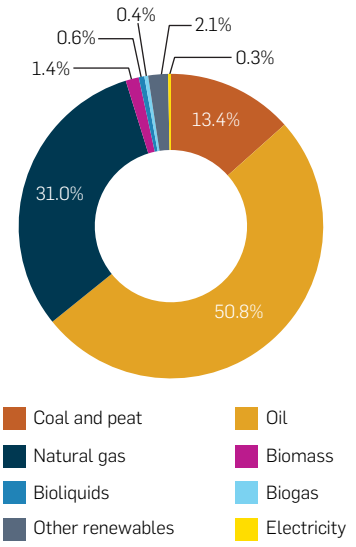
Oil and particularly gas will be part of Ireland's energy mix for many decades to come and even in a low carbon transition scenario.

Ireland has signed up to binding commitments to reduce GHG emissions, the future energy mix has been considered in a number of reports. In a report on a low-carbon sector roadmap for Ireland, Deane et al (2014) developed alternative scenarios for energy use in 2050.

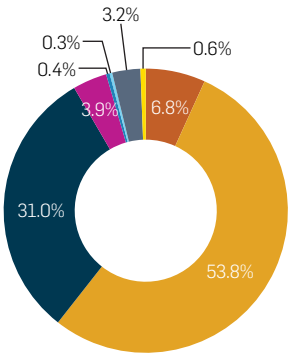
Under their 'business as usual' scenario total energy consumption would increase by 45% relative to 2017 levels, and natural gas and oil would together still account for 79% of all energy supplied.

They consider two alternative low carbon scenarios where CO_2 emissions are limited to no greater than 80% and 95% below their 1990 levels in 2050. These scenarios encompass significantly reduced energy supply and very different energy mixes compared to the 'business as usual' scenario. In particular they envisage the elimination of coal and peat in the energy mix.

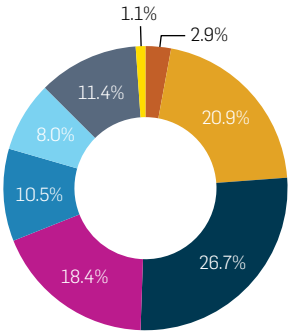
Total primary energy supply by fuel (2010)



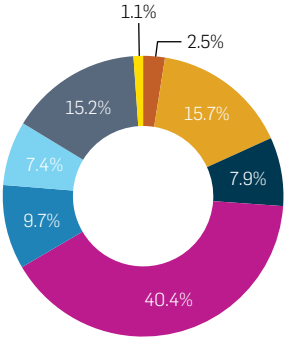
Business as usual 2050



CO_2 - 80 scenario 2050



CO_2 - 95 scenario 2050



Source: Deane, P., Curtis, J., Chiodi, A., Gargiulo, M., Rogan, F., Dineen, D., Glynn, J., FitzGerald, J., and B. O'Gallachoir (2013) "Low Carbon Energy Roadmap for Ireland". Report prepared by ESRI, E4sma and UCC

Natural gas accounted for 49% of the fuel used in electricity generation from 2012 to 2016 ("A Look at the Irish Gas Market" – Ervia / Gas Networks Ireland).

Additional investment required to limit carbon emissions to 80% below 1990 levels compared to a business as usual scenario is estimated at €8.6bn.

Under the two low carbon scenarios energy supply would increase by between 3% and 11% by 2050 compared to 2017. Under the CO_2-95% scenario, oil supply would decrease by 64% while under the CO_2-80% scenario it would be reduced by 55%. Gas supply would be reduced by 71% under the CO_2-95% scenario but just 7% under the CO_2-80%.

Under both scenarios oil and gas would still make up a significant share of energy supply of either 23.6% or 47.6% by 2050. The additional investment required under the CO_2-80% compared to a business as usual scenario was estimated to be €8.6bn.

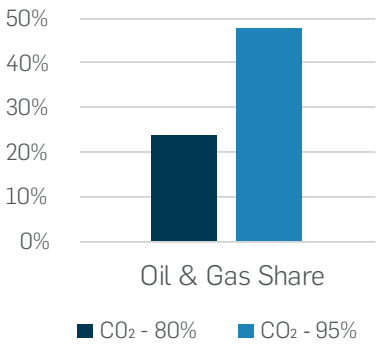
Similar simulations (Vaillancourt et al, 2018) conducted show that additional new hydrocarbon finds would be available for export and would thus not change the energy mix and GHG emissions significantly. Under the 80% scenario a more balanced energy mix is achieved than either under the 'business as usual' or the CO_2-95% scenario.

The overall result is that energy security is improved under a lower carbon scenario.

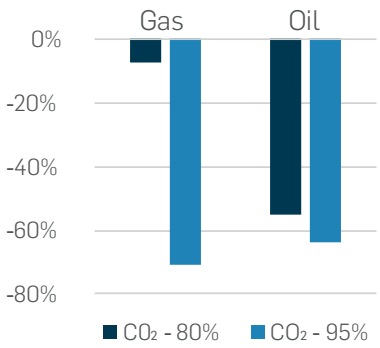
As a means of continuing on the journey towards energy efficiency and emissions reduction, revenues from oil and gas extraction could be used directly to help fund energy transition measures which are significant. The SEAI estimates that the Irish energy retrofit market is worth over €35 billion to the Irish economy between now and 2050.

Source: Vaillancourt, K., Bahn, O., Roy, P-O., and V. Patreau (2018) "Is there a Future for New Hydrocarbon Projects in a Decarbonizing Energy System? A Case Study of Quebec (Canada)", Applied Energy, Vol. 218, pp. 114-130

Oil & Gas Share of Energy Supply by 2050



Oil & Gas Supply Reduction by 2050



Gas is particularly important in electricity generation where it represents both an important transition fuel in the medium term, and acts as a backup for wind generation. For these reasons, gas will continue to play a key role

While mainland Europe have invested in significant volumes of electricity interconnectors our Island geography makes this more costly. Gas fired power generation is the most suitable cost effective backup technology to complement wind.

Low carbon scenarios involve a shift towards renewable energy and in particular wind energy. The SEAI forecasts an increase in renewables by 51% by 2030. Renewable energy will replace more carbon intensive energy sources in the first instance (in their projections the SEAI show that coal will be virtually eliminated as an energy source).

In the UK, total CO_2 emissions in 2017 fell to levels last seen in 1890. In recent years, emissions reductions have been driven by significant reductions in coal use (52% drop in 2016 followed by a 19% drop in 2017). This has been achieved by replacing the use of coal in electricity generation with renewable energy, in particularly wind energy.

The share of energy supply accounted for by oil is set to remain roughly the same (from 45% in 2018 to 44% in 2030). The volume of oil consumed over the period 2018 to 2030 is set to increase by 15%.

The increase in renewables of 51% by 2030 forecast by the SEAI equates to about 12% of total energy needs. Recent research by Glynn et al (2018) highlights the role of natural gas as a bridging fuel even in very ambitious decarbonising scenarios, where onshore wind and natural gas dominate electricity generation until 2030 after which natural gas is slowly replaced. This is likely to be dependent on the impact of technology in terms of advancements in batteries and storage capabilities and affordability of same.

Source: Devlin, J., Li, K., Higgins, P., and A. Foley (2017) "Gas Generation and Wind Power: A Review of Unlikely Allies in the United Kingdom and Ireland", Renewable and Sustainable Energy Reviews, Vol. 70, pp. 757-756

Also, oil and gas emit less CO_2 than peat and coal during electricity generation in 2017

- Gas is 67% less carbon intensive compared to peat and 61% less compared to coal.
- Oil is 33% less carbon intensive compared to peat and 20% less compared to coal.

Source: SEAI

Electricity demand is projected to grow by up to 57% over the next 10 years according to Eirgrid.

The shift towards renewable energy and wind energy has a number of implications given that wind is a variable energy source, which if not complemented by other energy sources as a back-up would reduce energy security significantly.

Devlin et al (2017) showed that there is an important, and often overlooked, complementarity between wind energy and gas electricity generation as gas generation is a more efficient and sustainable backup to wind generation which by its very nature is variable. Gas generation is more flexible, and can adjust to changing demand and emits significantly less GHGs than coal or oil.

CSO statistics on fuels used in electricity production show that in 2016, 49.1% of electricity was produced with natural gas. A further 0.4% of electricity was produced with refinery gas.

According to Eirgrid, electricity demand could grow by up to 57% in the next 10 years. Reflecting the importance of gas as a transition fuel and as a backup to variable wind generation, the latest SEAI Energy 2017 Projections for the period to 2030 show that the share of total energy supply in Ireland accounted for by gas will increase from 30.4% in 2018 to 43.1% by 2030.

Total gas consumed over the period 2018 to 2030 is set to increase by 35%.

In the absence of economically viable storage technologies for renewable energy (hydrogen, power to gas, carbon capture, grid scale battery, etc.), natural gas will remain an important back-up and bridging fuel as part of Ireland's strategy for renewable energy.

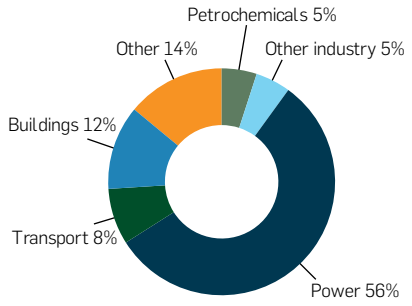
The importance of oil and gas in the production of petro-chemicals, which are integral to modern societies, is identified by the International Energy Agency as a major blind spot in the global energy debate.

The use of oil is intrinsic in our day to day lives, not only as an energy source, but in a huge variety of everyday items produced by the petrochemicals industry that are integral to modern societies.

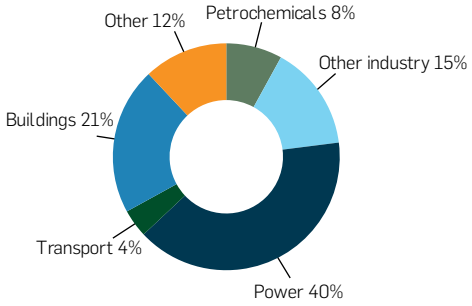
Not only this, the IEA identifies the use of petrochemicals products in the renewable energy system, including the blades on wind turbines, parts for electric vehicle, batteries, solar panels, and thermal insulation for buildings.

The fundamental importance of oil and gas to the global petrochemicals industry is identified by the International Energy Agency as one of the major blind spots in the global energy debate. According to the IEA, the petrochemicals industry accounts for 14% of the total primary demand for oil and 8% of the total primary demand for natural gas. Advanced economies currently use up to 20 times as much plastic and 10 times as much fertiliser as developing economies, indicating that as these economies develop further, this will have a significant impact on future energy trends.

Global primary oil demand in 2017 by sector



Global primary natural gas demand in 2017 by sector



Source: SEAI

Common uses of petrochemicals

- Pharmaceuticals
- Computers
- Detergents
- Clothing
- Mobile phones / tablets
- Thermal insulation
- Wind turbines / solar panels
- Fungicides
- Carpets and upholstery
- Asphalt

Global oil demand growth by sector 2017 - 2030

Source: IEA

Demand for primary chemicals is set to increase by circa 30% by 2030 and circa 60% by 2050. Even under a Clean Technology Scenario which helps to achieve several United Nations Sustainable Development Goals, demand for primary chemicals increases by almost 30% by 2030 and 40% by 2050. Despite its size the petrochemicals industry fails to attract the level of attention from policymakers that it merits.


KINSALE ENERGY
Kinsale B -West

THE VALUE OF A SECURE ENERGY SUPPLY

Energy security is defined as the uninterrupted supply of energy at a reasonable cost. A vital aspect of energy policy relates to energy security.

Source: Framework from Nang et al (2015)

Improved energy efficiency does not imply that the economy has become less dependent on energy inputs. Indeed, energy has become more essential to modern economies over time.

The importance of a secure supply of energy in modern economies is exemplified by the significant economic costs of blackouts.

Here we focus on energy availability, infrastructure, energy prices, geopolitical risk and potential societal effects of a shortage of energy.

Energy security is fundamentally about the availability of energy at some future point. The availability of energy not only depends on infrastructure but also on other market factors, including the interruptions due to geopolitical events such as wars or terrorism. Infrastructure availability and resilience are important to avoid interruptions. Energy prices can be affected by changes in geopolitical risk but also due to exchange rate changes and global demand changes.

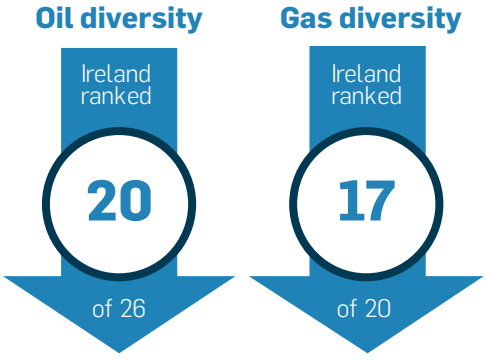
Existing indigenous gas sources are declining – without new finds, Ireland will become 100% dependent on imports during 2031.

Energy security needs to be considered in the context of changing energy mix, dependency on imports and the drive to reduce emissions.

Importantly, 100% of coal and oil and petroleum based products are imported, and in 2016/17, 31% of natural gas was imported. Gas production from the Corrib field accounted for over 60% of Ireland's demand for natural gas in 2016/17. Gas production from the Corrib field is already declining and given the increasing demand for gas, the Corrib field will account for a rapidly declining share of total gas supplies. Corrib will account for just 19% of gas demand in 2026/27, which implies that at that point 81% of gas demand will need to be met by imports. Thus, without new local finds Ireland will revert to being dependent on imports for 100% of its natural gas needs.

Also, in economic terms, (increasing) imports for a given level of exports reduces the balance of payments.

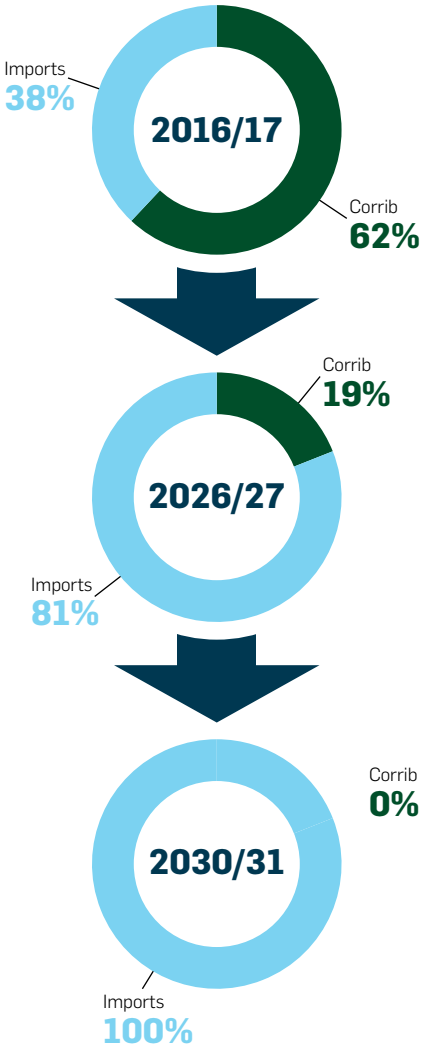
Cohen et al. (2011) identified Ireland as being among the countries with below average diversification in terms of sources of supply both for oil and gas. They ranked Ireland the 20th out of 26 countries for oil and 17th out of 20 for gas in terms of diversity of energy sources. Ireland's diversity of energy sources has not improved over time.



Source: Cohen, G., Joutz, F., and P. Loungani (2011) "Measuring Energy Security: Trends in the Diversification of Oil and Natural Gas Supplies", Energy Policy, Vol. 39, pp. 4860-4869

Existing indigenous gas sources are declining and will cease to exist - the Corrib field is only just over half the size of the Kinsale field which produced gas from 1978 peaking in 1995 and which will be depleted during 2020. The Corrib field has an estimated producing life of just over 15 years. Given that it started producing gas in 2016 it will be depleted during 2031.

Share of gas demand supplied by Corrib field



Source: "Network Development Plan 2018", Gas Networks Ireland

Given that energy imports almost completely arrive in Ireland via the UK, Ireland's energy security is dependent on UK energy security, which in turn is dependent on an increasing share of imported energy from the EU, Norway and Russia.

There is limited scope to extend natural storage facilities.

As of the end of 2017, total installed capacity of wind on the island of Ireland was 4,471MW. The average capacity factor in 2017 (amount of energy produced relative to the theoretical maximum) was 26%. In July 2017 the capacity factor fell to 18%. With the installed capacity of wind generation increasing in Ireland, back up with gas generation plant will need to be available, and this will require a secure supply of gas. While natural gas from the Corrib field currently accounts for a significant proportion of gas supply, in the near future Ireland will again be totally reliant on imports of gas. New domestic gas fields would significantly improve energy security.

During the hot summer of 2018 electricity generation from wind turbines decreased, with wind generation accounting for as little as 0.3% of electricity generation in July of 2018. The shortfall of wind generation had to be made up by gas fired electricity generation - see www.gasnetworks.ie/corporate/news/active-news-articles/natural-gas-generation-hits-all-time-high/.

Possible alternatives to gas generation back-up is through energy storage and/or through increased interconnection with the UK and France. Storage in Ireland is currently very limited with the largest facility, Turlough Hill, having a capacity of 292MW, representing 2.8% of total energy generation capacity in 2018. Other hydroelectric power generation capacity amounts to a further 2.1% of electricity generation. Thus, hydropower accounts for less than one twentieth of total capacity and this capacity would need to be scaled up by a large multiple to meet a significant share of electricity demand in the event of an outage due to a shortage of gas.

There is limited scope to extend natural storage facilities. Thus any additional storage would entail battery technology which is relatively short term. Interconnection, particularly with France, may be required in order to connect to the European electricity market, but research has shown that this will only have a positive effect on energy prices in Ireland if the cost remains under €45m per year, which are likely to be exceeded (DiCosmo et al). The current energy mix has been shown not to be the least cost mix. Research by Glynn et al (2014) suggested that an energy mix with a reduced share of oil and increased share accounted for by natural gas would result in lower costs. Their results also point to the importance of international supply and consequent price developments for the main energy sources, including oil and gas.

Apart from low wind conditions, demand could be well above the expected level due to extreme cold weather either in Ireland or in Europe, which could result in demand exceeding supply for short periods.

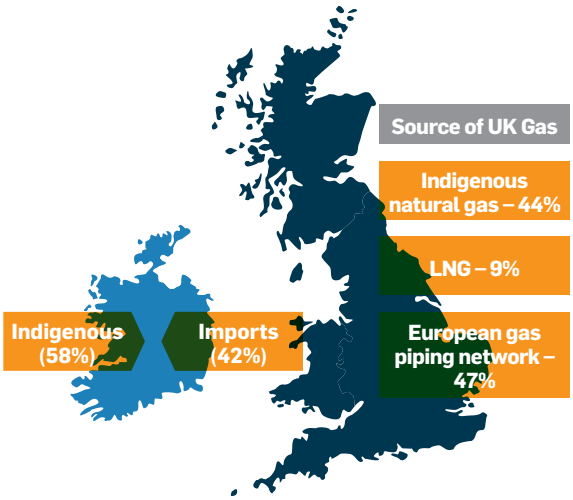
Source: DiCosmo, V., Collins, S., and P. Deane (2017) "The Effect of Increased Transmission and Storage in an Interconnected Europe: An Application to France and Ireland", Fondazione Eni Enrico Mattei Nota di Lavoro No. 37.2017

Glynn, J., Chiodi, A., Gargiulo, M., Deane, P., Brazilian, M., and B. O'Gallachoir (2014) "Energy Security Analysis: The Case of Constrained oil Supply for Ireland", Energy Policy, Vol. 66, pp. 312-325

Energy infrastructure plays a significant role in determining energy security. Ireland is highly dependent on a small number of infrastructure facilities for energy imports.

Energy infrastructure relates both to domestic infrastructure, as well as any infrastructure used in the importation of energy. In relation to imports three principal infrastructures are relevant and these are the electricity interconnectors, gas pipelines and ports. Domestic infrastructure includes the electricity transmission network including substations, power stations and other electricity generation structures, the gas transmission network, the Whitegate refinery and energy storage facilities.

When it comes to natural gas imports these come via the Moffatt pipelines from Scotland. This means that natural gas imports into Ireland are a function of the supply of gas available in the Britain. This includes North Sea gas from UK or Norwegian fields, supplies from the main European gas network which include Russian gas and imported (into the UK) liquefied natural gas (LNG). As North Sea oil and gas fields are declining in output an increasing share of Britain's gas supply will come from imports from further afield. 42% of Ireland's gas is imported through the UK and 47% of the UK's gas comes from the European gas network.



Source: www.britishgas.co.uk/the-source/our-world-of-energy/energys-grand-journey/where-does-uk-gas-come-from

www.ireland2050.ie/questions/where-does-irelands-gas-come-from-and-what-determines-its-price

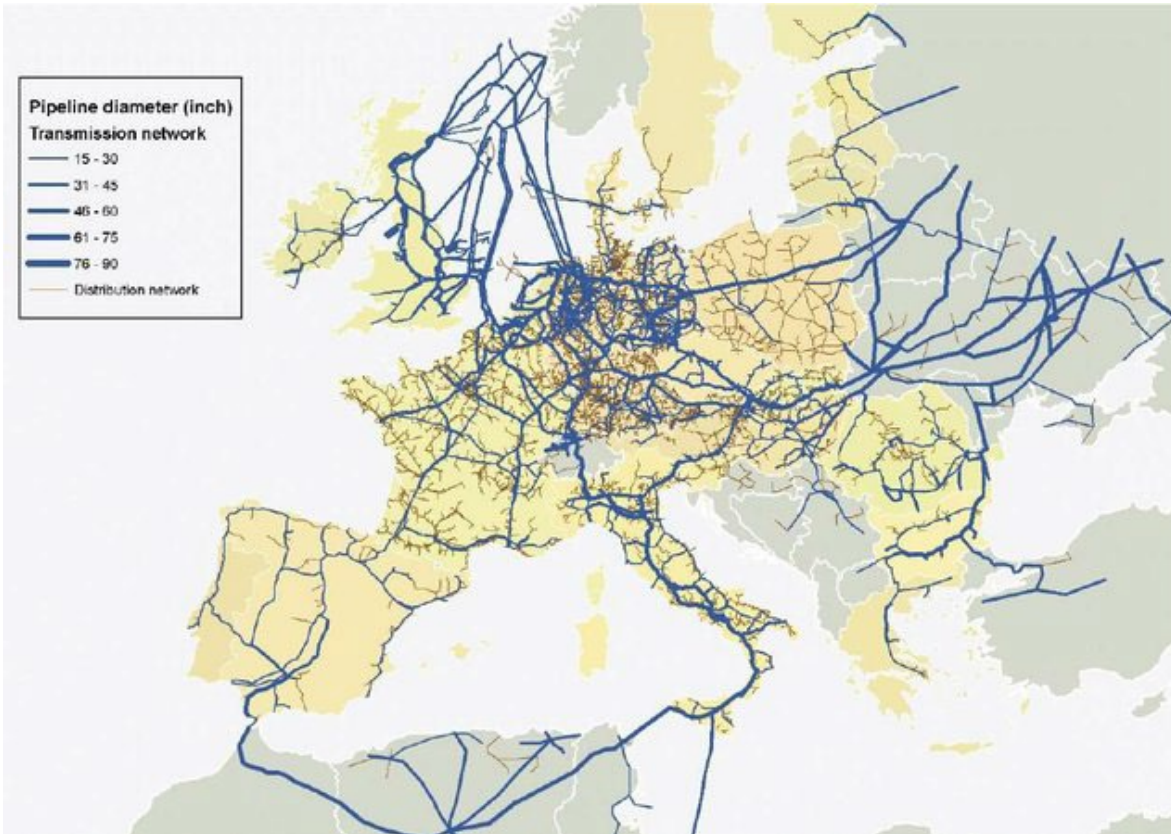
The map (below) shows the European gas transmission network. This shows that while Ireland is dependent on the connection to the UK, that the UK in turn is being supplied with gas not just from the North-Sea gas fields but also from Germany and France which in turn are connected to pipelines to Russia. 36% of Europe's gas comes from Russia and 21% from Norway. McKinsey's 'Global Gas & LNG Outlook to 2035' published in September 2018 projects that Russia will further increase its role as a key supplier to gas-scarce Europe.

A consideration of different scenarios for Russian gas in Europe by Mitrova and Boersma in 2016 concluded that in the absence of drastic policy interventions, Russian natural gas will continue to play a prominent role in the EU.

Source: www.britishgas.co.uk/the-source/our-world-of-energy/energys-grand-journey/where-does-uk-gas-come-from)

www.reuters.com/article/us-oil-opec-russia-gas/russian-gas-exports-to-boom-despite-u-s-pressure-and-rivalry-idUSKCN1MD0JC

Mitrova, T./ and Boersma, T. (2016), "Some future scenarios of Russian natural gas in Europe", Energy Strategy Reviews, 11-12. 19-28. 10.1016/j.esr.2016.06.001



Source: Carvalho, R. et al (2009) "Robustness of trans-European gas networks", Physical Review E. Vol. 80(1)

Ireland is highly dependent on a small number of infrastructure facilities for energy imports.

Disruptions of these supplies will thus impact on Ireland. An alternative means of importing natural gas would be to import LNG by ship, but this is currently not possible as there is no LNG terminal on the island of Ireland.

There have been plans to develop an LNG terminal in the Shannon Estuary, which would help in diversifying the sources of supply. However, it should be noted that the emissions profile of LNG is not as favourable as that of locally extracted gas. Emissions associated with indigenous and European oil and gas are 30% less than those from imports outside of Europe.

Five Irish ports have oil terminals; namely Dublin, Whitegate, Cork, Foynes and Galway, with Dublin being capable of handling large consignments of heating and transport fuel. While oil and oil based products play almost no role in electricity generation they are still the principal energy source for transport equipment and home heating. There are no internal or cross-border oil pipelines in Ireland. The Refinery (Whitegate, Cork), shipping, ports, oil terminal storage facilities, oil depots, road tankers and motorways represent critical infrastructure in terms of oil supply.

Ireland is 100% dependent on oil imports, this means Ireland imports all of the oil that it uses, both crude, unrefined oil and finished petroleum products. The majority of our oil is from the United Kingdom. Crude oil imports, accounting for about 53,000 barrels per day, come from Norway and the UK, with some North and Central African sources. The only oil refinery where imported crude oil is processed into final use products is Whitegate. This currently supplies around 40% of these products.

Emergency oil stocks 1,598,930 tonnes of refined product, and 70,000 tonnes of crude oil in 2018.

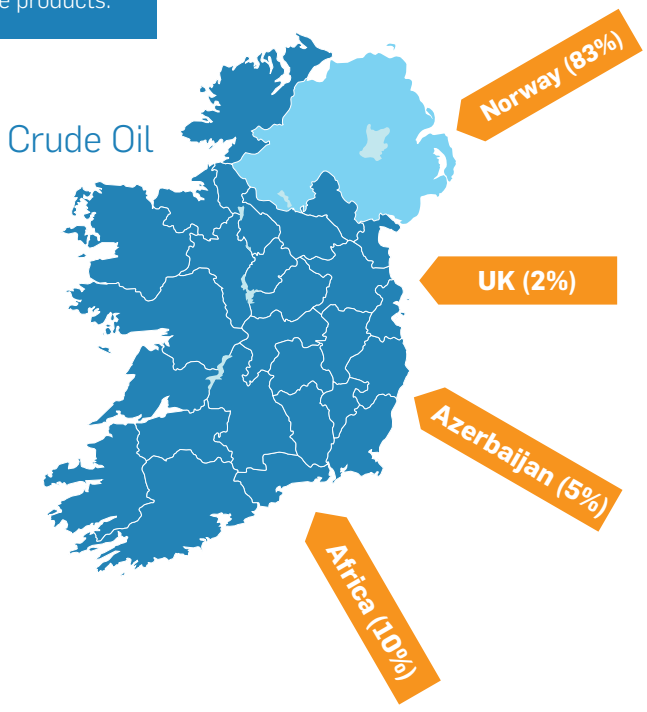
Ireland is also obliged by EU regulations to hold energy reserves. Emergency oil stocks are managed by the National Oil Reserve Agency (NORA). NORA holds an equivalent of 90 day stocks.

Approximately one third is held in the UK but the Irish government has decided that due to Brexit, it will move these stocks to Ireland and other EU members.

Furthermore, in so far as the stocks are held outside of Ireland in EU member states, these will be held further away from Ireland than if they were held in the UK. This implies that in the case of an emergency, extra transport time/cost needs to be allowed.

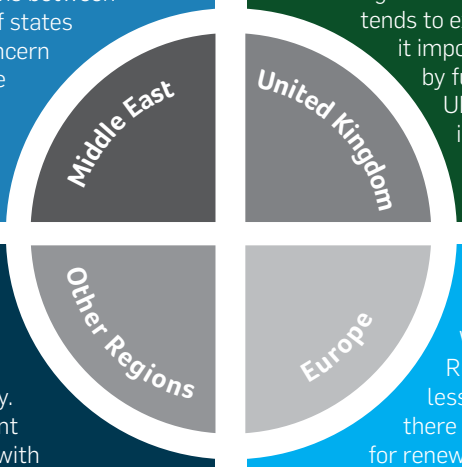
Electricity is traded between Ireland and Northern Ireland via the Moyle interconnector and between Britain and Ireland via an East-West interconnector. The Moyle interconnector has not been operating at full capacity after a fault developed in February 2017. Planning for a second high voltage North-South interconnector, required to safeguard electricity supply to Northern Ireland has been delayed and is facing continued challenge.

With Brexit, Ireland will not have a direct connection to the European electricity market, which impacts on energy security. The risk to energy security is also recognised in the proposed Celtic Interconnector, an electrical link, which would enable the movement of power between Ireland and France.



There is significant geopolitical risk to oil and gas supplies internationally, and Brexit increases energy security concerns.

Geopolitical risks are important in both price determination and ensuring continued supply. A significant number of recent events suggest that geopolitical risk is at the very least not decreasing and possibly increasing. The ongoing tensions in the Middle-East have intensified with the wars in Syria and Yemen, which involve Iran and Saudi Arabia (both major oil and gas producing countries). The increasing tensions between Saudi Arabia and other Arab Gulf states with Iran are also a cause for concern as a third of the world's maritime oil transport passes through the Straights of Hurmuz, which is controlled by Iran.



Brexit also constitutes a geopolitical risk as energy imports to Ireland largely come from or through the UK. Therefore, decisions about energy security taken in the UK can have an impact on Ireland. Two aspects in particular are relevant. Firstly, by altering energy policy in the UK, the UK energy mix is likely to change. As Northern Ireland is a part of the UK, any such policy changes can impact on the Irish Single Electricity Market. Currently, Ireland tends to export more electricity than it imports but this may be affected by future decisions taken in the UK. Secondly, as noted, Brexit implies that Ireland has no direct connection to the main EU energy infrastructure.

Venezuela has 20% of the world's oil reserves and ongoing internal political tensions which could impact on oil supplies from that country. Nigeria, which is also a significant oil producer, has had problems with local crime, piracy and sabotage in the oil producing region. More generally, maritime oil and gas shipping has been under threat from piracy not just in the Niger delta but also off the coast of Somalia and in other areas. According to the International Maritime Bureau there were 180 actual or attempted incidents, down from 264 in 2013.

Outside of the Middle East geopolitical risk also persists. While the frictions between Russia and the Ukraine are less high profile than they were, there is nevertheless the potential for renewed significant conflict. Importantly, a significant share of EU gas supply comes from Russia (as noted) via the Ukraine. That conflict has already resulted in disruption of gas supplies when the Russian gas supplier Gazprom cut off gas supplies to the Ukraine, which reduced gas supply to 18 other European countries.

Under EU rules Member States are obliged to equitably share energy resources in a crisis situation. Sharing gas or electricity resources without a direct connection would require UK co-operation.

Exchange rate volatility and the gradual weakening of the Euro relative to the US Dollar has increased energy prices in Ireland.

An important aspect of energy security is relative price stability. Anything that reduces supply even a little can have an impact on prices and indeed expectations of potential supply reductions can have immediate effects on prices. This implies that prices may change significantly without a full blown supply crisis.

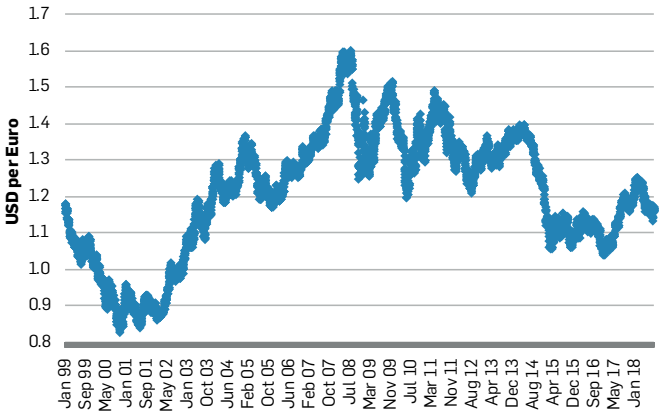
A recent paper by Deane et al. (2017) showed that if the supply of Russian gas into Europe was to be interrupted for a year, gas prices in Ireland would rise by 22.9%, with a 15.5% increase in electricity prices. This highlights the integrated nature of gas supplies and the dependence on gas supplies to generate electricity.

Source: Deane, J.P., Ó Ciarán, M. and Ó Gallachóir, B.P. (2017) "An integrated gas and electricity model of the EU energy system to examine supply interruptions", Applied Energy, Vol. 193, pp. 479-490

On the morning of 12th of December 2017, oil and gas prices surged after an explosion in Austria and disruption to supplies from the North Sea. In Italy, the government declared a state of emergency, as the power price more than tripled at one point (Source: Petroleum Economist, 15 December 2017) before flows restarted later the same evening and prices returned close to their pre-blast level the next day.

One driver of energy prices are exchange rates given that oil and gas are traded in United States Dollar (USD). Research has found that oil prices are a long-run determinant. Given that Ireland uses the Euro (EUR), exchange rate risk is a factor in determining price developments. Movements in the USD/EUR exchange rate since January 1999 are graphed opposite and show the very significant changes over longer periods and also significant short term volatility. The highest rate is over 93% higher than the lowest rate. Rate changes in excess of 10% over a small number of months are not uncommon. The broad trend since the financial crisis has been for the rate to drop.

Daily USD/Euro exchange rate ($ per €)



Source: Central Bank of Ireland. The rate is expressed as USD per EUR.

The correlation between the USD/EUR exchange rate and diesel and petrol retail prices in Ireland over the period 2012 to the middle of 2018 is 0.82 and 0.79 respectively showing the close relationship between the exchange rate and prices.

This is based on calculations using monthly exchange rates from the Central Bank of Ireland and the monthly national average unleaded petrol and diesel prices recorded by the CSO. Using monthly data eliminates the short term volatility in the series.

Transport costs are also a factor which impact price - "The wholesale price of natural gas in Ireland is quite similar to the UK. Generally Ireland's price is more expensive due to transport costs from the UK (the additional cost of transporting natural gas from the UK to Ireland)."

Source: "A Look at the Irish Gas Market", Ervia/GNI

The cost of disruption in energy supplies is significant.

Any doubt about energy security could have a significant impact on investment decisions and FDI flows.

Disruptions have a variety of effects, for example:

- Large companies (including manufacturing plants and service businesses) might have to shut down, which reduces output immediately, which however, may be made up at a later stage.
- Loss of consumer utility. Other impacts include the loss of refrigeration or freezing, resulting in food spoilage.
- Likewise, while hospitals typically have emergency electricity supply longer disruptions could result in a loss of life support systems in hospitals, nursing homes, and households.
- Electricity outages can result in loss of electronic data and possible damage to computer and other electronic equipment, which could be particularly costly in high value sectors such as financial services, advanced computer services and other professional services.

Sources: Leahy E., Devitt, C., Lyons, S., and R. Tol (2012) "The cost of natural gas shortages in Ireland", Energy Policy, Vol. 46, pp. 153–169
Leahy, E., and R. Tol (2011) "An Estimate of the Value of Lost Load for Ireland", Energy Policy, Vol. 39, pp. 1514–1520
Curtis, J., Morgenroth, E., and B. Coyne (2018) "A Method of Disaster Cost Assessment: A case study of the potential economic impact of a nuclear accident affecting Ireland", Journal of the Social and Statistical Inquiry Society of Ireland, (forthcoming)

Reputational losses from negative events can be significant over a longer period, and would add to the costs presented here.

Potential cost of a total blackout in Ireland for a day is around €850m.

- With estimates of the value of lost load at €10/KWh, the potential cost of a total blackout in Ireland for a day is estimated at €850m.
- Leahy et al. (2012) estimated that the daily economic cost for Ireland of losing gas-fired electricity in 2008 ranged from €100m to €1,000m depending upon the season, day of the week and availability of electricity plants on the system and that an outage over a 90 day period could cost as much as 50% of annual GDP (€147bn).
- In an earlier paper Leahy and Tol (2011) estimated that a daily electricity blackout would cost between 0.2% to 0.5% of Adjusted Gross National Income. This amounts to a financial loss of between €360m and €900m per day.

ECONOMIC IMPACT OF OIL AND GAS

Summary of key figures and messages

c. €18.5m – licence fees paid during the period from 2013 to 2017

571 – Direct and indirect jobs currently

Value of the **Corrib** field:

- ✓ **€6bn** - Impact on GDP
- ✓ Over **1,000** full time jobs during construction from 2006 to 2015
- ✓ Over **€1bn** spent directly with Irish companies
- ✓ **150** direct long-term jobs

Oil/gas projects generate a higher taxation return in that no Government grants are given and these companies pay 25% corporation tax plus a petroleum production tax.

Larger exploration efforts may result in more discoveries which would generate larger economic gains.

One oil find

- ✓ Spend of **€16.25bn**
- ✓ **GVA of €1.6bn - €3.2bn***
- ✓ **600 - 1,200* jobs** per annum
- ✓ **€8.5bn corporation tax receipts (€3.75bn in 2018 values)** and income tax receipts of c. €15m per annum

Five oil finds

- ✓ **€81.25bn** in expenditure
- ✓ **€8bn - €16bn* in GVA**
- ✓ **3,000 - 6,000* jobs** per annum
- ✓ **Corporation tax receipts of €42.5bn (€18.75bn in 2018 values)** and income tax of c. €75m per annum

One gas find

- ✓ Spend of **€2.3bn**
- ✓ GVA of approximately **€0.85bn - €0.94bn***
- ✓ **320 – 380* jobs** per annum over the project lifecycle
- ✓ **€2.42bn - corporation tax (€1.18bn in 2018 values)** and income tax of c. €8m per annum

Five gas finds

- ✓ **€16.5bn** in expenditure
- ✓ **€4.25bn - €4.7bn* in GVA**
- ✓ **1,600 – 1,750 jobs** per annum over a 32 year cycle
- ✓ **€12.1bn in corporation tax (€5.9bn in 2018 values)** and income tax of c. €40m per annum

* - Where Irish enterprises have the capability to increase the provision of goods and services to the oil and gas industry, then GVA and total employment will increase which would also have a further knock-on effect on the tax take – this is further explained in this section.

Total economic impacts include employment, GVA and taxation receipts.

Direct Employment	The industry employ staff directly (direct employment)
Indirect Employment	The industry purchases good and services from suppliers who employ staff
Induced Employment	Employment generated through the spending of incomes earned from direct and indirect employment

Gross Value Added

Gross value added is equal to the sum of the values of the goods and services (or parts thereof) produced in the country without deducting an amount in respect of capital consumption (i.e. depreciation).

Taxation Receipts

Taxation receipts such as corporation tax, indirect taxes and income taxes are paid on the income arising from these operations.

Licence Fees

Various types of licence fees are also paid to the State for the right to explore and produce - from 2013 to 2017 (inclusive) circa €18.5m was received.

Key Determinants

- Scale of project – level of expenditure on exploration, development and operation.
- Price of oil and gas and the euro/dollar exchange rate.
- Structure of economy/sector linkages/multiplier effect including capability of Irish enterprises to provide goods/services to the oil and gas industry.
- Displacement – extent to which the project displaces other employment/income.
- Deadweight – measures the extent to which the impact would result without the application of an incentive. There is no incentive therefore deadweight does not apply.

Corporation Tax and Petroleum Production Tax (PPT)

- ✓ The corporation tax rate in Ireland for petroleum related activities is 25%.
- ✓ The revised tax terms for upstream petroleum activities were enacted on 21 December 2015 and apply in the case of authorisations first awarded from 18 June 2014 and replaced the previous regime of Profit Resource Rent Tax (PRRT). PPT applies at variable rates of 0 to 40% linked to the profitability of discoveries.
- ✓ There is a minimum annual PPT payment of 5% of the gross revenues of a field once production has commenced. PPT is permitted as a tax deduction.

The economic impact of one oil find is substantial in terms of employment and Exchequer receipts... which is relevant to policy decisions under consideration.

	Impact of One Oil Find 550-600 million barrels of oil
Total Expenditure	€16.25bn
Total GVA	€1.6bn (1) - €3.2bn (2)
Total Employment (Annual Average) – Exploration to Decommissioning	600 (3) – 1,200 (2)
Taxation Receipts (4)	Corporation tax - €8.5bn or €425m per annum (production phase) NPV range - €265m (year 13) to €126m (year 31) or €3.75bn (over 32 years) Income tax per annum – circa €15m

Typical Project Phases Timeline	Spend (€bn)	Years (duration)
Exploration	0.3	4
Development	7.5	7
Production	7.5	20
Decommissioning	0.95	1
Total	**16.25**	**32**

Total expenditure of €16.25bn will result in:

- €1.6bn in GVA;
- 600 jobs per annum over the 32 year cycle;
- €8.5bn in corporation tax over the 20 year production period or €3.75bn in net present value terms.

If Irish enterprises have the capability to double the provision (domestic supply) of goods and services to the oil and gas industry, then GVA and total employment will also double which would also have a further knock-on effect on the tax take.

Socio-economic data for selected benchmark countries is set out in Appendix 4 which shows the importance of oil and gas to those countries.

Assumptions:

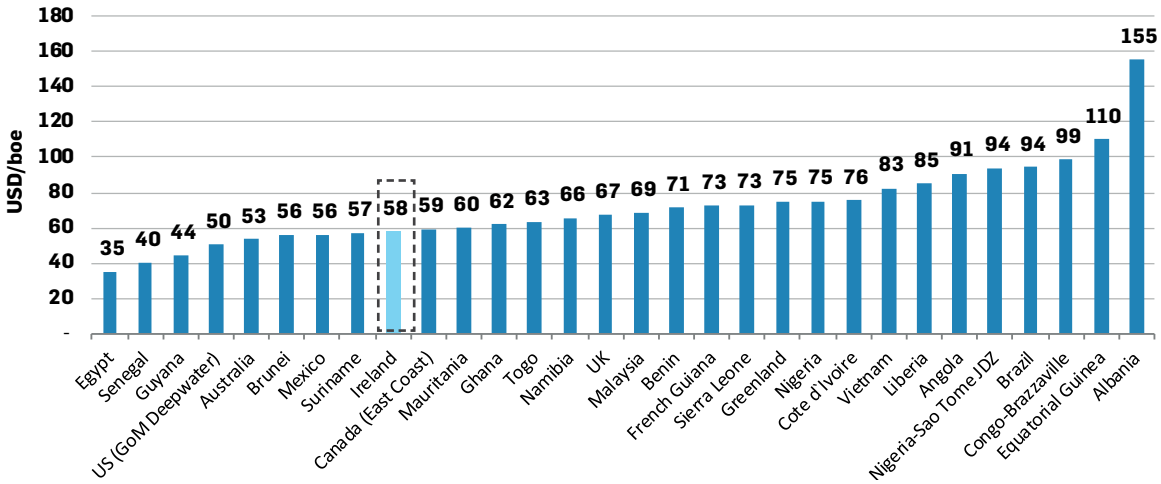
1. Based on industry information and data on import propensity – approximately 10% of the total oil spend (capital and operational) remains in the Irish economy (see Appendix 3 for the economic methodology and explanation of data calculations and assumptions).
2. Assumes Irish enterprises have the capability to double their share of total spend.
3. Average GVA is assumed to be €100k per worker. See Appendix 3.
4. Discount rate – 4%. This is the rate used in the NPV calculation.

The Annual Business Survey of Economic Impact undertaken by the Department of Business, Enterprise and Innovation calculates overall FDI direct expenditure in the Irish economy at only 14.8% of expenditure in 2016. Expenditure in the Irish economy by the oil and gas industry as a proportion of total expenditure by the oil/gas industry compares reasonably well with the overall multinational sector.

Analysis of average breakeven costs of offshore oil indicates that Ireland is competitive with deep water exploration areas in other countries worldwide.

- Analysis of average breakeven costs of offshore oil undertaken by Wood Mackenzie in 2017 indicates that Ireland is competitive with deep water exploration areas in other countries worldwide.
- At a recent presentation to the Joint Committee on Communications, Climate Action and Environment, Mr. Tim Gould, head of the world energy outlook team at the IEA, outlined that the costs of offshore oil exploration have reduced significantly in recent years and that companies are now reporting breakeven costs of $30 - $40 USD per barrel, rather than $70 USD per barrel a few years ago.

Average breakeven cost by country for medium size deepwater oil exploration



Sources: "Ireland Porcupine Exploration Basin", Wood Mackenzie, July 2016. Wood Mackenzie, www.woodmac.com

The economic impact of one gas find is substantial in terms of employment and Exchequer receipts... which is relevant to policy decisions under consideration.

	Impact of One Gas Find 800 billion standard cubic feet of gas
Total Expenditure	€2.3bn
Total GVA	€0.85bn (1) - €0.94bn (2)
Total Employment (Annual Average) – Exploration to Decommissioning	320 (3) – 350 (2) (32 years) 350 (3) – 380 (2) (29 years)
Taxation Receipts (4)	Corporation tax - €2.42bn or €127.5m per annum (19 years) NPV range - €86.1m (year 10) to €42.5m (year 28) or €1.18bn (over 29 years) Income tax per annum – circa €8m

Typical Project Phases Timeline	Spend (€bn)	Years (duration)
Exploration	0.1	3
Development	0.6	6
Production	1.5	19
Decommissioning	0.1	1
Total	**2.3**	**29**

Total expenditure of €2.3bn will result in:

- €0.85bn in GVA;
- 320 jobs per annum over the 32 year cycle. This figure would increase to 350 jobs per annum if the overall cycle fell from 32 to 29 years;
- €2.42bn in corporation tax over the 19 year production period or €1.18bn in net present value terms.

If Irish enterprises have the capability to increase the provision of goods and services to the oil and gas industry, then GVA and total employment would increase to about €0.94bn and to circa 350 jobs, respectively, per annum over a 32 year cycle. The tax take would also increase in this scenario.

Assumptions:

1. Based on industry information and data on import propensity – approximately 37% of the total oil spend (capital and operational) remains in the Irish economy.
2. Assumes Irish enterprises increase their share of total spend with a 10% resultant increase in total employment.
3. Average GVA is assumed to be €100k per worker.
4. Discount rate – 4% (used in NPV calculation).

Previous research and this new research all point to the potential for significant economic gain. With current resources set to cease in time, effort is required now to deliver on current opportunities.

Discoveries require effort, are expected and impactful

- Larger exploration effort may result in more discoveries which would generate larger economic gains.
- While no guarantee, the seismic data is supportive and industry expectation is such that commercial finds will occur if there is sufficient exploration.
- Such finds would have a very large impact on the national economy and the regional economies.

Displacement

- There will be a continuing need for additional future job creation because of expected population and labour force increases.
- In addition, the employment structure is characterized by continual change where existing sectors and enterprises decline because of national and international competiveness changes and structural change.
- Consequently, parts of the current stock of jobs will disappear and will have to be replaced by new jobs.

Job quality is above average

- Average hourly earnings per employee in mining and quarrying are €23.90 (CSO, 2018 Q1 data) which is above the national average. Information is not available for oil and gas and is included in mining and quarrying.
- The overall oil and gas sector has higher earnings per hour than mining and quarrying as a whole based on information from some enterprises.
- The indirect employment associated with the oil and gas sector has a strong representation in high pay sectors such as skill intensive manufacturing, software, insurance, scientific, and technical activities. Of course, there are also lower skills jobs such as security, construction operatives, basic administration, catering and security.
- Overall, however, the employment associated with the sector will be characterised by above average skills and earnings.

Local impact is high

- Most of the direct jobs and a substantial proportion of the indirect jobs will be located in regional enterprises and potentially contribute to regional economic development in areas such as Cork, Kerry and the West Coast.
- Employment compares favourably in employment terms to recent IDA announcements and Irish Times Top 1,000 Companies in similar regions.

Tax impact is high

Oil and gas projects generate a higher taxation return in that:

- No Government grants are given.
- Most enterprises would be on 12.5% corporation tax rate.
- Some enterprises would be on 25% corporation tax rate.
- Oil and gas production pay a 25% corporation tax plus the PPT.

Economic research

- The Corrib field is expected to add €6bn to GDP (Source: Goodbody Economic Consultants, 2012). The Corrib gas field will operate until 2031. More recently, it is reported by the IOOA that the Corrib Gas project sustained more than 1,000 full time jobs during its construction phase from 2006 to 2015, a period during which the Irish economy also experienced a recession. Over €1bn was spent directly with Irish companies (in excess of 300 Irish contracting companies) during the project. There are 150 direct long-term jobs.
- Oil and gas employment – 571 direct and indirect jobs (Source: Indecon, "Economic Review of the Irish Geoscience Sector", 2017).
- The Kinsale gas field will be depleted by 2020. As part of this project, Kinsale Energy provided information on its operating expenditure over the 2012 to 2017 period. Annual spend is in the region of €25m with a very high proportion being spent in the Irish economy. The company employs 60 persons.

The economic impact of five oil finds (illustrative) is substantial in terms of employment and Exchequer receipts... which is relevant to policy decisions under consideration.

	Impact of Five Oil Finds 550-600 million barrels of oil
Total Expenditure	€81.25bn
Total GVA	€8bn (1) - €16bn (2)
Total Employment (Annual Average) – Exploration to Decommissioning	3,000 (3) – 6,000 (2)
Taxation Receipts (4)	Corporation tax - €42.5bn or €18.76bn (NPV over project life) Income tax per annum – circa €75m

Total expenditure of €81.25bn will result in:

- €8bn in GVA;
- 3,000 jobs per annum over the 32 year cycle;
- €42.5bn in corporation tax over the 20 year production period or €18.75bn in net present value terms

If Irish enterprises have the capability to double the provision of goods and services to the oil and gas industry, then GVA and total employment will also double to €16bn in total and 6,000 jobs per annum, respectively, which would also have a further knock-on effect on the tax take.

Assumptions:

1. Based on industry information and data on import propensity – approximately 10% of the total oil spend (capital and operational) remains in the Irish economy.
2. Assumes Irish enterprises have the capability to double their share of total spend.
3. Average GVA is assumed to be €100k per worker.
4. Discount rate – 4% (used in NPV calculation).

The economic impact of five gas finds (illustrative) is substantial in terms of employment and Exchequer receipts...which is relevant to policy decisions under consideration.

	Impact of Five Gas Finds 800 billion standard cubic feet of gas
Total Expenditure	€11.5bn
Total GVA	€4.25bn (1) - €4.7bn (2)
Total Employment (Annual Average) – Exploration to Decommissioning	1,600 (3) – 1,750 (2)
Taxation Receipts (4)	Corporation tax - €12.1bn or €5.9bn (NPV over project life) Income tax per annum – circa €40m

Total expenditure of €16.5bn will result in:

- €4.25bn in GVA;
- 1,600 jobs per annum over a 32 year cycle;
- €12.1bn in corporation tax over the 19 year production period or €5.9bn in net present value terms.

If Irish enterprises have the capability to increase the provision of goods and services to the oil and gas industry by 10% in employment terms, then GVA and total employment would increase to about €4.7bn in total and to circa 1,750 jobs per annum, respectively. The tax take would also increase in this scenario.

Assumptions:

1. Based on industry information and data on import propensity – approximately 37% of the total oil spend (capital and operational) remains in the Irish economy.
2. Assumes Irish enterprises increase their share of total spend with a 10% resultant increase in total employment.
3. Average GVA is assumed to be €100k per worker.
4. Discount rate – 4% (used in NPV calculation).

Note - the five finds would occur at different times which would impact the illustration above.

THE FUTURE OUTLOOK

Oil and gas will continue to play an integral role in fuelling economic growth and supporting the long path to decarbonisation, in the 30+ years to 2050 and beyond.

According to the SEAI, on its current trajectory Ireland will not meet its 2020 emissions reduction targets and will also miss its binding EU target of achieving a 16% share of renewable energy in gross final energy consumption by the end of 2020 (falling short by up to 3%).

The expectation of strong growth for the Irish economy by the ESRI and continuing low oil prices leads to a projection of increased energy demand to 2020 and beyond by the SEAI ('Ireland's Energy Projections – Progress to targets, challenges and impacts 2017). This makes the task of meeting energy efficiency and renewable energy targets more challenging. In addition, renewable energy technology deployment would have to be significantly accelerated.

Substantial investment both from the private sector as well as government is needed to achieve the energy transition envisaged in the NMP. The NMP sets out a range of policy measures that are already in place or that can or need to be implemented. Many policy measures will come at a significant cost, however the NMP does not contain cost estimates for all measures.

While the Government has committed to transitioning to a low carbon economy by 2050, given that the country is not on track to meet its targets to date, and targets for future emissions reductions are even more ambitious, it is important to acknowledge that Ireland has a long road ahead on the path to decarbonisation.

At present, renewables meet only 9% of primary energy supply. While this is expected to grow significantly, even in the best case scenario currently projected by the ESRI, renewable energy is expected to make up less than three-quarters (72.8%) of the future energy mix for Ireland by 2050, with oil and gas continuing to play an integral role in fuelling economic growth and supporting the path to decarbonisation, in the 30+ years to 2050 and beyond.

Emissions associated with indigenous and European oil and gas are 30% less than those from imports outside of Europe largely due to a combination of improved production efficiency and lower transport energy. Substituting such imports with indigenous supplies can make significant emissions reductions.

Source: IOGP Report 2016e. "Environmental performance indicators - 2016 data." International Association of Oil & Gas Producers. November 2017. 83 pp. https://www.iogp.org

The Energy Trilemma proposes that energy security, affordability and sustainability should be considered holistically to enable multi-dimensional thinking and an integrated understanding of energy issues.

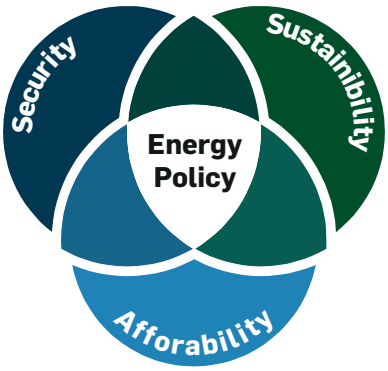
While the goal of decarbonisation is clear, the path to full decarbonisation is less so and achievement of ambitious targets will require political co-operation on a scale never before seen on a global level.

For Ireland to realise its 2050 decarbonised objective, a holistic and cross sectoral approach is required – there is no silver bullet to the issue of emissions reduction.

The energy trilemma provides a useful framework for energy policy development in the context of three critical, but at times, conflicting considerations:

- Energy security;
- Energy sustainability; and
- Energy affordability.

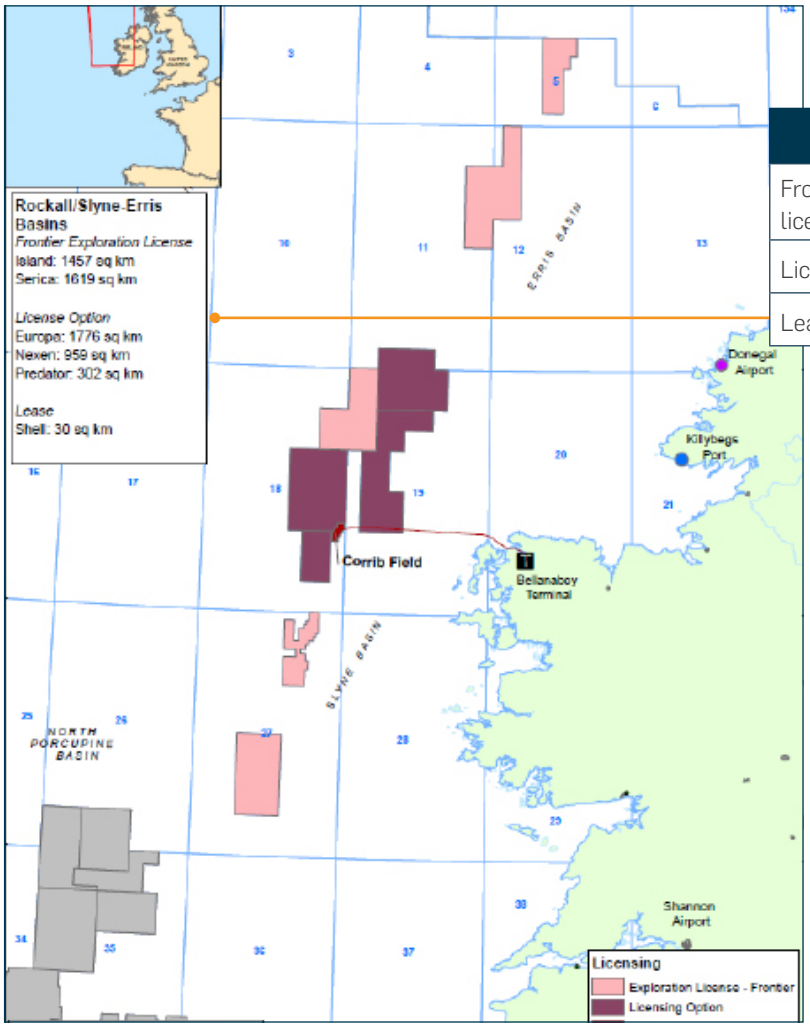
The individual components of security, affordability and sustainability should be considered within the overall framework to enable multi dimensional thinking and a holistic, integrated understanding of any energy problem.



Figures presented in this report shows that significant investment is required. Indigenous oil and gas sector can be leveraged to support the transition out to 2050 while potentially providing substantial taxation revenues to help fund the additional costs involved and at the time addressing security of supply.

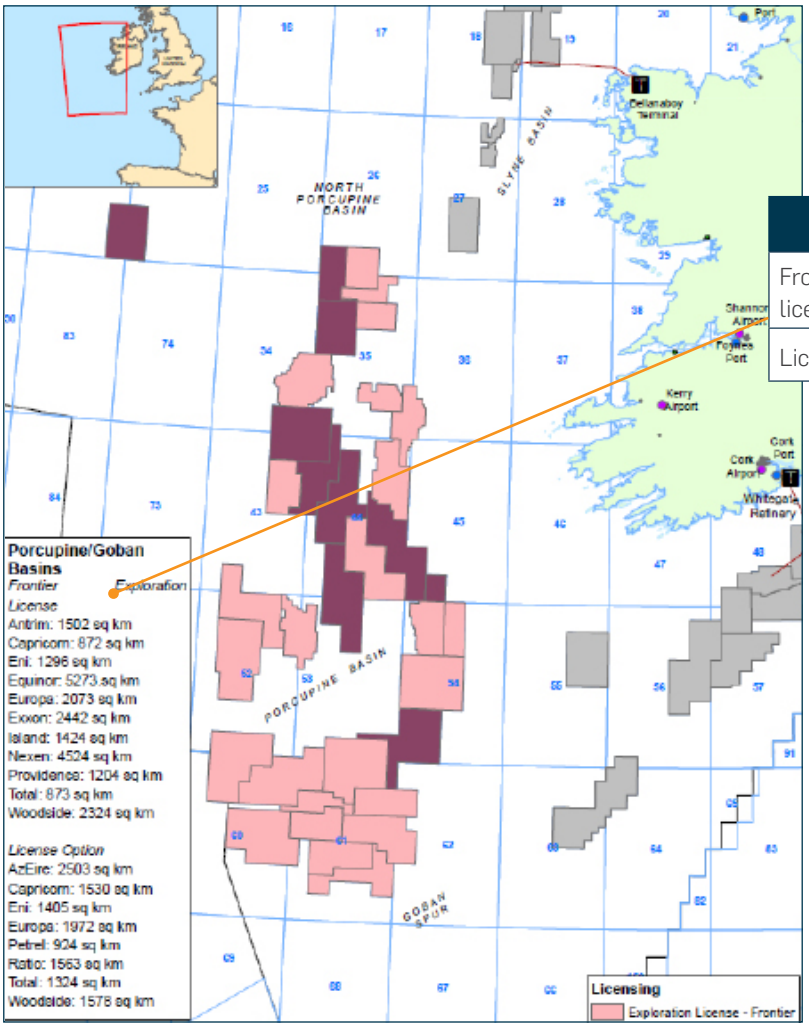
APPENDICES

Appendix 1A: Offshore concession map – Rockall Basin (4 October 2018)



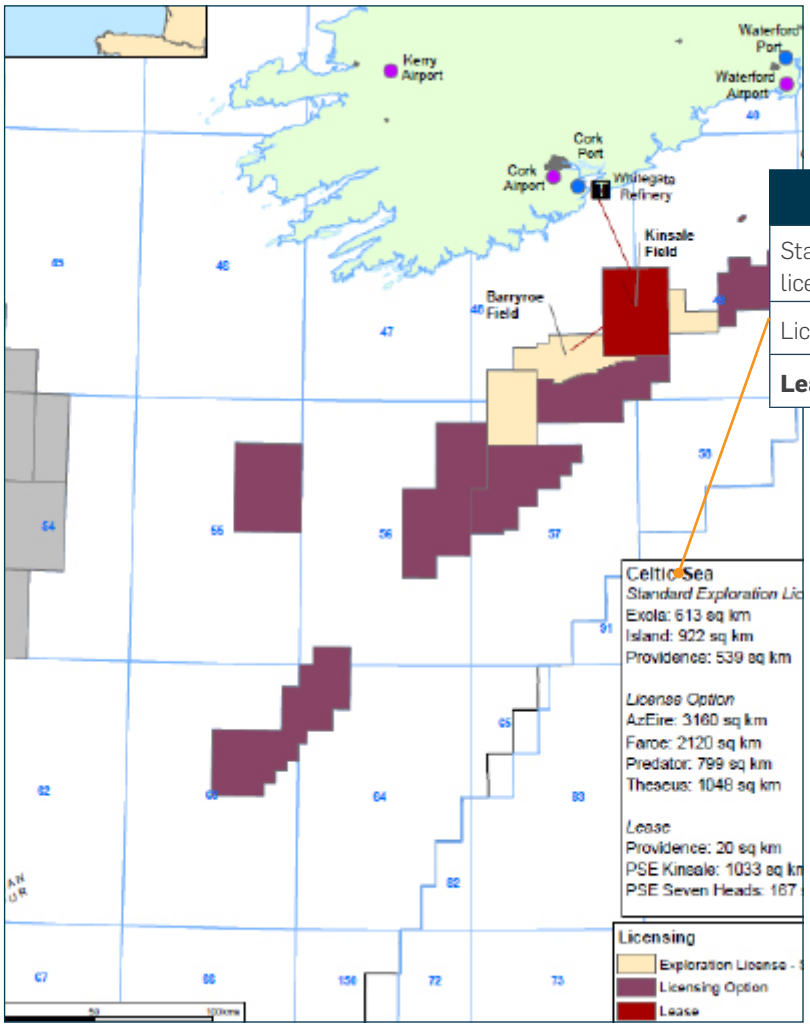
Rockall /Slyne-Erris Basins	
Frontier Exploration licences	3,076 sq km
Licence options	3,037 sq km
Leases	30 sq km

Appendix 1B: Offshore concession map – Porcupine Basin (4 October 2018)



Porcupine Basin	
Frontier Exploration licences	23,807 sq km
Licence options	12,799 sq km

Appendix 1C: Offshore concession map – Celtic Sea (4 October 2018)



Celtic Sea	
Standard Exploration licences	2,074 sq km
Licence options	7,127 sq km
Leases	1,220 sq km

Appendix 2: Market capitalisation of IOOA members 2018

Large operators with significant capital are investing in the industry in Ireland

Company Name	Parent Company	Market Capitalisation
AzEire Petroleum Ltd.	Private	N/A
Cairn Energy PLC		€1.58bn
Eni		€50.33bn
Equinor Energy Ireland	Equinor ASA	€74.83bn
Europa Oil & Gas		€12.45m
ExxonMobil E&P Ireland	ExxonMobil Corporation	€291.03bn
Faroe Petroleum (U.K.) Ltd.	Faroe Petroleum	€618.27m
Nexen Petroleum U.K. Ltd.	CNOOC Ltd.	€71.31bn
Providence Resources PLC		€71.11m
PSE Kinsale Energy Ltd.	PETRONAS	N/A
Serica Energy		€228.77m
Shell E&P Ireland	Royal Dutch Shell	€236.77bn
Total		€129.75bn
Vermilion Energy		€4.21bn
Woodside Energy (Ireland)	Woodside Petroleum	€34.64bn

Appendix 3: Economic methodology and explanation of data calculations and assumptions

1. Domestic GVA component of oil project expenditure

- Assumed total expenditure = €16.25bn based on industry and other information.
- Capital = €5bn and non capital = €11.25bn
- Information from industry shows domestic expenditure on non-capital between 10% and 25%: 18% used as industry average.
- One third of domestic expenditure is assumed to be on imports by supplying companies leaving 12% of project non-capital expenditure as domestic GVA. The 2014 CSO Supply Tables indicate that for the overall economy imports account for 29% of total supply at purchasers prices. This import share has probably increased since 2014. To avoid inaccurate overstatement we have assumed the import sale of the domestic supply of inputs is one third which reduces the 18% of Irish sourced expenditure to 12% of the Expenditure being Irish GVA. Capital share for domestic GVA=5% based on industry information.
- Domestic GVA from oil project= 12% of €11.25bn plus 5% of €5b= €1.6bn.

  Note – for gas, information was supplied on the expenditures and domestic contents of each of the four phases of the project. Production had a very high domestic content and was the largest expenditure of the four phases. Each phase's domestic content proportion was reduced by one third to reflect the import content of the domestic purchases. This resulted in GVA of €0.85bn which results in a weighted average relative to total expenditure of 37%.

2. Assumed increase in domestic supply capability

- On the assumption that Irish enterprises have the capability to double their share of total spend, the domestic supply capacity would double from €1.6bn to €3.2bn. See below for the conversion of GVA to employment. This increases total employment from 600 per year to 1,200 per year. However, the direct employment would probably be unchanged at 210. This implies that the indirect employment would have to more than double to compensate for the constant direct employment.
- The employment figures in this scenario are direct 210 (which is unchanged), induced 200 (which is based on the 0.2 multiplier) and indirect 790 (which is 1,200 less 210 less 200). Consequently domestic supply employment has increased from 290 to 790 which is an increase of 172% compared to the base line scenario total of 290 jobs. Consequently, to get a doubling of the overall domestic GVA component of the expenditure a much larger increase in the supply industry performance is needed. Alternatively, a doubling of the domestic supply capacity would result in a less than doubling of the overall GVA component of the expenditure.

3. Conversion of GVA to employment

- Average GNI modified per worker in 2017 was €83k. This, with adjustments, is used as the basis for converting the oil / gas GVA to employment. On the assumption of an annual 1% productivity gain for the 32 years of the project, the end project annual output per worker would be €114k relative to the current €83k. In year 16 it would be €97k. Based on the assumption of increasing productivity and a relatively high starting point of the current average of €83k the employment estimates are based on a GVA/ output per worker of €100k on average for the duration of the project. The average of year 1 and year 32 average outputs is €99k. To ensure a robust assessment of the employment impact and to avoid overstatement we have used a figure of €100k.

Note: Imports / Direct Expenditure

- The offshore oil and gas sector is characterized by high levels of imported inputs in contrast to low levels of domestic economy sourced inputs. The size of the sector's economic contribution might be criticized on the basis of the high import penetration. However, this comment also applies to the overall foreign direct investment sector attracted by the Industrial Development agency and, in particular, to certain sectors within overall foreign direct investment.
- Direct expenditure in the Irish economy is calculated as the sum of payroll, Irish services purchases and Irish materials purchases in the Annual Business Survey of Economic Impact undertaken by the Department of Business, Enterprise and Innovation. In the case of the overall foreign direct investment sector, direct expenditure in the Irish economy was only 11% of sales in 2016. The per cent in the chemicals sector was 8% and in the information, communication and computer services sector the Irish economy expenditure relative to sales was only 7% in 2016. 11.8% of materials and 5.2% of services were sourced in Ireland by foreign investment companies.

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Appendix 4:

Case studies of countries at various stages of maturity in the oil and gas industry lifecycle - benefits show the importance of the sector to the countries concerned.

Overview

Guyana basin is one of the world's offshore exploration hotspots.

Guyana currently does not produce oil, however, the first phase of development is expected to start producing in 2020.

Socio-economic impacts

- Liza Complex's lifetime value to Guyana government is estimated to reach **$27bn USD** in 2018 flat real terms (with a peak production in 2027). Over the 30-year producing life, this is a GDP increase of:
  - » **$7.2bn USD** per year;
  - » $**9,500 USD** per capita;
  - » Over **200%** increase.
- There is a lack of skilled people in the country and many traditionally emigrate.
- Oil revenue will boost growth from 2020 onwards. Extra income should reduce the country's deficit and provide resources for social and infrastructure investments.
- The Guyana basin is estimated to contain at least 7 billion oil-equivalent barrels. It is home to the 6.6 million acres Stabroek Bloc, operated by Exxon Mobil with its affiliate Esso Exploration and Production Guyana Limited.
- The Liza Complex is one of the many extraction projects in Stabroek Bloc. A first Floating production, storage and offloading vessels (FPSO) development is to start production in 2020 as part of Phase 1. Two other FPSO are planned to be developed on Phase 2.
- The UN International Tribunal ruling in September 2007 settled the maritime boundary dispute between Guyana and Suriname paving the way for full exploitation of the hydrocarbon resources within Guyana's Exclusive Economic Zone and Continental Shelf.

Overview

The United Kingdom is the 21st largest oil producer and the 18th largest oil exporter in the world.

Aberdeen is the main centre for UK Continental Shelf activities and is often referred to as the European oil capital. It is also a hub for many international operators.

Socio-economic impacts

- Employment in petroleum-related activities in Aberdeen City & Shire add up to 123,900.
- The average weekly wage in Aberdeen is approximately 11% higher than nationwide (Source: Andrew Carter and Paul Swinney, "Centre for Cities", report for BBC, May 2, 2018).
- In 2017-18, oil and gas fields in Scotland accounted for 96% of UK crude oil and natural gas liquids production, and 63% of UK natural gas production. The approximate sales value of oil and gas produced in Scotland is estimated to be £20.0bn. The sector contributed **£1.1bn** in tax receipts for 2017/18.

Note: This section is a summary of the information collected and focuses on the socio-economic aspects.

Overview

Canada is the 4th largest oil exporter and producer in the world. Newfoundland and Labrador produces 25% of Canada's conventional light crude.

St Johns is the largest city in the province and is recognised as a World Energy City.

Socio-economic impacts

- **CA$36m** or c. €24m invested by the industry over 4 years in local infrastructure and education facilities.
- Oil industry represents **12.4%** of the labour force and **36.1%** of the provincial economy.
- Since 1997, weekly wages have increased by **97%** and hourly wages have increased by **88%**.

Overview

Denmark is the 39th largest oil producer and the 37th largest oil exporter in the world.

Esbjerg is the 5th largest city in Denmark and is home to 60% of the sector's direct jobs.

Socio-economic impacts

- Employment in petroleum-related activities in Denmark are estimated to be **15,000**, including **1,700** direct jobs.
- In 2010, the sector's primary companies generated a gross value added (GVA) of approximately DKK 48bn or c. €6.4bn (November 2018 rate) (i.e. about 3% of Denmark's total GVA).
- Hydrocarbon tax and corporation income tax account for **57%** and **34%** of State revenue.

Overview

Norway is the 15th largest oil producer and the 11th largest oil exporter in the world. In coming years, Norway will supply approximately 25 % of Europe's gas requirements.

Stavanger is the 3rd largest city in Norway and is home to Statoil and the majority of key players in the oil and gas industry.

Socio-economic impacts

- Employment in petroleum-related activities represent 10% of the labour force nationwide, and 14% in Stavanger.
- The sector is Norway's largest industry responsible for 14% of GDP and 40% of total exports in 2018, which added up to NOK 442bn in 2017.
- In 2017, Norway's had the 4th highest GDP per capita (circa $61,500 USD) in the OECD.
- The average salary is $87,328 USD and the unemployment rate is 4.0%.
- The Government Pension Fund Global is one of the largest sovereign wealth funds in the world with $1 trillion USD worth of assets and benefits from all government petroleum revenue.

Glossary

bn	Billion
CSO	Central Statistics Office
EPA	Environmental Protection Agency
ESRI	Economic and Social Research Institute
ETS	Emissions Trading System
EU	European Union
EUR	Euro
FDI	Foreign direct investment
GDP	Gross Domestic Product
GHG	Greenhouse gas
GNI	Gross National Income
GNI*	Modified Gross National Income
GVA	Gross value added
IEA	International Energy Agency
IOOA	Irish Offshore Operators' Association
LNG	Liquefied natural gas
m	million
NMP	National Mitigation Plan
NORA	National Oil Reserve Agency
NPV	Net present value
OECD	Organisation for Economic Co-operation and Development
PRRT	Profit resource rent tax
PPT	Petroleum productive tax
PRSI	Pay related social insurance
SEAI	Sustainable Energy Authority of Ireland
USC	Universal social charge
USD	United States Dollar

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