Irish Academy of Engineering
Review of Government Report on:
Security of Energy Supply of Ireland's Electricity and Natural Gas Systems

Introduction

Ireland's Green House Gas (GHG) emissions[1] amount to 0.15% of the global total. Even though the percentage is very low, Ireland takes its responsibility to decarbonise its energy supplies very seriously. Despite its relatively isolated position in energy terms, it has legislated for some of the most ambitious carbon reduction targets in the world.

On the 15th of November 2019, the Irish Minister with responsibility for energy announced a major review[2] into the security and sustainability of Ireland's energy supply. Minister Bruton said,

> *"As we phase out coal and peat and move towards generating 70% of our electricity from renewable sources, we need to make sure we are prepared for when the wind isn't blowing, and the sun isn't shining. We will look at the best mix which will maintain energy security, while ensuring we are meeting our climate commitments."*

The resulting report, prepared for the Department of the Environment, Climate and Communications (DECC) by Cambridge Economic Policy Associates (CEPA), was published on the 19th of September 2022 as part of a consultation by the Government with a view to developing appropriate medium term and long term national energy policies.

In the intervening 34 months:

- The Irish Academy of Engineering[3] published a number of reports calling for urgent action to ensure that electricity demand could be met and gas supplies, particularly for backup generation, could be guaranteed. These were mainly ignored.

- EirGrid's annual Generation Capacity Statements have consistently forecasted likely insufficient generation capacity for more than 4 years. Despite this, capacity auctions

[1] https://edgar.jrc.ec.europa.eu/report_2021
[2] https://www.gov.ie/en/press-release/59a050-minister-bruton-initiates-major-review-into-irelands-energy-supply/
[3] http://iae.ie/publications/?themes=energy

designed by the CRU failed to deliver the necessary capacity and the country has had to resort to leasing "emergency generation" in order to meet peak demand.

- The risk of not meeting electricity demand has escalated to a level where large foreign direct investors in the Irish economy have expressed concern to the Industrial Development Authority (IDA) about future investments given the perceived risk to electricity supplies.

- The planned retirement of Ireland's most CO_2 intensive power generation facility (Coal fired plant at Moneypoint) has had to be postponed beyond 2025 to some indefinite date.

- Two large international energy investors (Equinor and Shell) have walked away from projects aimed at building major capital-intensive offshore renewable generation facilities. Equinor confirmed[4] that its reasons for withdrawal were based on frustration with Irish permitting regulations. There is speculation that similar concerns may have contributed to Shell's decision.

- A war has broken out in Europe leading to major energy market disruptions, particularly in the European gas market. This has led to huge surges in gas prices and consequent surges in electricity prices where such prices are determined in the current market by the marginal price of electricity produced in gas fired plant.

- Despite the issue being raised over and over again by prospective investors, little progress has been made by Government to streamline Irish planning legislation and judicial review processes. This is leading to a major infrastructure "gap" in areas such as high voltage network expansion and onshore wind farm development.

- Prior to the current crisis Ireland had established itself as the European country with the highest (pre-tax) electricity prices.

[4] https://www.businesspost.ie/news/exclusive-shell-withdraws-from-major-irish-offshore-wind-projects/

Summary Response.

Following its 34 month gestation, the Government has allowed a period of 5 weeks for comment prior to then proceeding to develop its plans. Given the complexity of the issues involved, this period is far too short. It is quite impossible to provide a comprehensive response in that time.

However, even a cursory reading of the report indicates major technical shortcomings and inadequacies that, in the opinion of the Academy, thoroughly invalidate its use to underpin Government policy going forward.

The CEPA report employs conventional economic analysis to assess risk to energy supply. The methodology is standard and the assumptions underlying the risk analysis appear reasonable.

However, the report goes on to list a number of technical options which may be considered in order to meet energy demand in 2030. The Academy has selected three of these as examples of quite unreliable techno-economic analysis and has outlined the reasons underpinning that opinion in the appendix *(Technical Inadequacies)* to this report.

The Academy also notes the simplistic arguments underlying the exclusion of options such as Liquified Natural Gas (LNG) import facilities. These arguments are further analysed in the next section, (*LNG Importation)*.

It is worthwhile contrasting the very different responses from Ireland and Germany to the European gas supply crisis. No country is more committed to the development of green hydrogen technology to replace fossil fuels than Germany, yet German leaders are realistic about the likely timescale of such development.

Germany enacted legislation on 1st June 2022 to accelerate the importation of LNG and plans to have 5 new floating import facilities (FSRUs) in operation by the end of 2023 – including 2 by the end 2022/beginning 2023

The new German legislation, recognising the seriousness of the energy emergency, exempts FSRU development from public procurement processes and removes the requirement for an Environmental Impact Assessment (EIA) for such facilities. This temporary legislation expires in 2025.

Contrast this approach with that suggested in the DECC consultation document which assesses the option of a floating LNG terminal for Ireland as "*possible but challenging by 2025*"!

Based on its preliminary reading the Academy is satisfied that the report as published should not be used to underpin any future energy policy development.

Today in Ireland we ban nuclear power but have no qualms about constructing a large interconnector to France –70% of French electricity comes from nuclear plants. We currently refuse to import "fracked" gas to an Irish terminal and yet are satisfied to effectively import the same gas from the UK and European gas grids as imports of US fracked gas to Europe double and treble over the next few years.

This policy development by "wishful thinking" is unworthy of a wealthy economy called on to support EU energy policy at a time of international crisis Ireland, with a presence on the UN Security Council, must move on from the days of an "Irish solution to an Irish problem". At a time of major international crisis, the country requires political leadership grounded in reality –and not on some simplistic belief that we can defy the laws of economics –if not of physics!

The Irish economy is uniquely exposed to a medium term energy crisis arising from its single point connection to a non-EU gas grid in Scotland. The Government's own National Risk Assessment for Ireland 2020[5] identifies a disruption in gas supply from the UK as a major and increasing risk.

The increase in this risk is almost palpable as we listen to the CEO of the UK National Grid (Mr. Fintan Slye, recruited from EirGrid in 2018!) explain why that country may have difficulty avoiding load shedding[6] this winter (2022) as Russian gas supplies dry up.

Holding a consultation on options which have not been technically or financially examined is totally inappropriate in a context where the likely cost will be measured in billions and the consequences of doing nothing are likely to result in major load shedding across the country.

Based on its assessment the Academy is satisfied that the CEPA report, and the Department's document, should not be used to underpin future energy policy development.

The Academy would very much welcome a response from Government to the views expressed in this document and feels that constructive public debate based on realistic assumptions is now critically important if Ireland is to continue the successful industrial development policy pioneered by the Industrial Development Authority (IDA) over the past two or more decades.

Such a fact-based debate, led by Government, will be essential to maintaining societal support for the country's ambitious decarbonisation targets. Without such support these targets will not be achieved.

If we continue to base critically important policy decisions on popular, aspirational and entirely unattainable targets, we will ultimately, in the immortal words of Blanche Dubois, come to *"depend on the kindness of strangers*".

[5] https://www.gov.ie/en/press-release/5e685-national-risk-assessment-for-ireland-2020/

[6] https://www.theguardian.com/business/2022/oct/06/national-grid-warns-households-could-face-three-hour-power-cuts-this-winter?CMP=share_btn_link

Liquified Natural Gas (LNG) Importation.

Ireland is connected to the European gas grid via the UK and currently imports approximately 70% of its gas from the European system via a single gas terminal at Moffat in Scotland.

As the country decarbonises, it will become ever more dependent on electricity as the predominant energy vector.

The country's electricity system will, in turn, become ever more dependent on gas backup generation for its reliability –for when the wind doesn't blow for example. This will certainly not change by 2030 and indeed is likely to continue into the 2040s.

By 2030, the Corrib field is likely to be fully depleted and Ireland will import 100% of its gas from Europe.

The situation on the EU gas grid has changed dramatically over the past year. It is now almost certain that Europe will abandon Russia as its primary gas supplier. Russia supplied approximately 40% of EU gas via various pipelines. Europe must rapidly source large quantities of gas from elsewhere. This gas will mostly arrive as LNG from different sources around the globe.

Europe already has a substantial LNG import[7] infrastructure –countries like the UK and Spain have long imported large quantities of LNG. With the exception of Ireland, all Atlantic seaboard countries in Europe possess LNG import terminals.

Many EU countries have already commenced work on a rapid expansion of LNG import facilities. This is strongly supported by the European Commission. Almost 20 new import facilities are planned or underway in Europe. Germany has commenced work on 5 of these, 1 will be completed by year end.

The pace of planning and construction of new LNG import facilities is frenetic as the continent weans itself off Russian gas and EU leaders everywhere take major and urgent action to assure new gas supplies.

Concurrent with the infrastructure expansion, EU and Government officials are scouring the world for new gas supplies. At the beginning of 2021 approximately 6.5% of EU gas arrived as LNG from the USA. It is reasonable to assume that practically all of this is shale gas and is primarily produced using hydraulic fracturing ("fracking").

At a recent meeting between Ursula von der Leyen, Olaf Scholz and Joe Biden, the US President, responding to urgent requests from the EU, agreed to double US gas exports[8] to the EU by year end[9]. By the time the EU fully disengages from Russian supplies it is likely that more than 20% of EU gas will be sourced in the US[10] and most of this will be "fracked". This is not a concern of any EU Government –except Ireland.

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[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1043321/Diversity_and_security_of_gas_supply_in_Europe__2020_.pdf

[8] https://www.reuters.com/business/energy/us-lng-exports-europe-track-surpass-biden-promise-2022-07-26/

[9] https://www.eia.gov/todayinenergy/detail.php?id=51358#:~:text=The%20United%20States%20became%20Europe's,%2C%20and%20Russia%20with%2020%25.

[10] https://www.nature.com/articles/s41560-022-01054-1

Since Ireland is connected to the European gas grid and, and as North Sea gas production declines and LNG imports from the US provide an increasing percentage of European supplies, we must assume that our gas imports will increasingly be fracked gas, supplied to the European gas grid and imported to Ireland via the UK.

For this reason, it matters not the slightest whether we import fracked gas via an Irish terminal or via a terminal elsewhere in Europe; precisely the same amount of "fracked" gas is going to enter the European gas grid.

A proper land based Irish terminal would, however, greatly increase Irish security of energy supply, contribute to solving EU supply difficulties at a time of great crisis, and do it in the most efficient way. The policy decision to exclude such a project is not based on any logic, but rather on a populist reaction to the term "fracked".

Ireland appears to be the only EU country to suffer from this confusion at a policy level.

CEPA assessed the impact of introducing strategic gas storage to Ireland during a disruption to Russian gas supplies. The CEPA assessment is very much informed (or misinformed) by supposed Government policy. CEPA lists the following rationale for not shortlisting this option:

> *"The introduction of commercial LNG would result in the importation of fracked gas to Ireland. This would be in direct contradiction to Government's opposition to the use of natural gas produced from fracking.*
>
> *Additional energy requirements associated with LNG relative to natural gas supplies would adversely affect the Government's decarbonization targets*
>
> *There would be no guarantee stored volumes would be sufficient …etc"*

In short, the LNG option was eliminated due to Government policy.

But this is not what Government policy states. The Policy Statement on the Importation of Fracked Gas (May 2021) references the ongoing review of the security of Ireland's energy supply and stated that:

> *"The review will inform whether it would be appropriate, or not, to develop LNG terminals in Ireland and, if any such terminals were to be developed, whether they should only be in order to provide a contingency supply in the event of failure of existing natural gas supply infrastructure".*

CEPA should have examined the LNG option in an objective manner.

It makes absolutely no sense to rule out an Irish land based LNG terminal on the basis of reduced imports of fracked gas. Precisely the same quantity of fracked gas will be delivered to the EU gas grid one way or another and we in Ireland will soon be 100% dependent on that gas.

Irish policymakers must be informed by the strategic needs of the country; we must stop relying on simple exhortations such as "*We are a long way from Russia*" and understand that this emergency applies at the EU gas grid level –and by 2030 we will be 100% dependent on this gas to keep Irish lights on.

Appendix 1 Technical Inadequacies

Example 1. Hydrogen Plant Conversion (Section 7.2.5)
The final paragraph in the section states:

> *"There is significant uncertainty in terms of the deployment potential, costs of hydrogen production, storage and power generation technologies by 2030.A mature market for hydrogen does not currently exist therefore timescales for deployment and cost estimates are highly uncertain."*

Despite the foregoing this option is shortlisted for 2030 commissioning.

The Academy notes the following:

- The report assumes the connection of a 1,620MWe PEM (Polymer Electrolyte Membrane) electrolyser to the power system by 2030, at a cost of €0.97bn. A unit of that size is **eighty** times the size of the largest PEM electrolyser currently in operation anywhere

- Such a single load is quite impossible to contemplate on the Irish power system. The report does allow for separate smaller units with presumably higher per unit cost. The capital cost of the PEM units will almost certainly exceed €1bn.

- While a modular approach is feasible, the commercial scale up of this type of equipment is likely to take decades. Global electrolyser production capacity at present remains limited; the supply chain for the necessary raw materials is a major constraint.

- Hydrogen fuelled CCGT plant currently exists only in special cases in refineries. The conversion of gas turbine plant from natural gas to hydrogen is feasible but complex. There remains considerable uncertainty as to whether such plant will be available at commercial scale by 2030.

- The modelling assumes that the required primary electricity is all produced at zero cost during periods when wind generation is constrained. There is *no* basis for this assumption. It is almost certainly wrong.

- Assuming production mainly during periods of high wind generation, large amounts of hydrogen must be stored.

- Hydrogen storage is a hugely problematic issue. The only reliable technology for large scale hydrogen storage at present involves the use of salt caverns. The only remotely suitable storage on the Island of Ireland is near Larne, in Northern Ireland. The report does not consider a storage option in Northern Ireland.

- Some experiments are underway elsewhere to store hydrogen in depleted gas fields. It is not at all certain that this can be done successfully as hydrogen is highly reactive and the very small hydrogen molecule can leak through rock fissures where methane will not. The extracted gas would, inevitably be contaminated with methane, thus preventing its use for fuel cell applications, as envisaged for emission free HGV transport.

- In addition, the cushion gas requirement would, in all likelihood, render the project wholly uneconomic. The cushion gas requirement for the now decommissioned Kinsale Field, Southwest Lobe storage project was five times the operational storage capacity.

- ESB is investigating possible storage in salt deposits offshore around the Irish coast. As yet there is no evidence that such deposits are viable for hydrogen storage. Ireland will not have viable hydrogen storage facilities by 2030. Indeed, unless we are very fortunate, Ireland may never have viable hydrogen storage facilities.

- The report does not identify any suitable location(s) for the project, ignores the almost certain planning difficulties with infrastructure and says nothing about the transport of the hydrogen to the storage facilities.

The inclusion of a project such as this in a short list for 2030 commissioning is entirely unrealistic. There is no possibility of deployment of such technology at the scale envisaged by 2030. It is only marginally more likely to be available by 2040, if indeed it can ever be contemplated in Ireland given the storage issues.

Example 2 Strategic LNG Floating Storage Regassification Unit (FSRU)

This proposal is for long term (strategic) storage of gas in a floating unit.

FSRU's are installed to transfer gas, reasonably quickly, into gas grids and land based storage. FSRU's are not designed for long term storage as such units, of necessity, lose up to 0.2% of their gas per day, due to the fact that LNG is stored at minus 162^{o}C. This is described as "Boil Off Gas" (BOG).This gas is normally injected into the gas grid.

An FSRU with a typical capacity of 160,000 m^3 could lose 20% of its cargo (32,000m^3) over a 4 month period. If long term storage is envisaged, BOG would need to be captured and injected into the gas grid to avoid venting to the atmosphere. In this case the FSRU becomes an import facility with an artificially constrained delivery.

A 160,000 m^3 FSRU gas storage capacity is only equivalent to 3.5 days Avg. Peak Day Demand and is thus, alone, inadequate for Ireland's needs. Larger onshore storage facilities are essential, to provide even minimal storage requirements.

This project would not meet Ireland's gas security requirements.

Example 3 Supply mitigation option using Southwest Kinsale reservoir

The small Kinsale Southwest Lobe gas field was developed, as a storage facility, by Marathon, for BGE in 2002. At the time output from the main Kinsale field was declining, Ireland's gas imports were increasing and were all supplied through a single pipeline in Scotland. The development of the storage facility offered increased gas supply security to BGE. The field contained an estimated 1.0 billion m^3 of natural gas and was to be operated at between 100% and 83 % of full storage capacity, to maintain a relatively high gas withdrawal capability.

The EU Directive (on security of gas supply) was transposed into Irish law by SI No 697 of 2007. The main provisions of the SI may be summarised as follows

- *The Commission on Energy Regulation (later the Commission for Regulation of Utilities) is responsible for monitoring and protecting the security of Ireland's gas supplies;*

- *The CER is responsible for establishing policies to ensure adequate levels of security of Supply*

The gas in Ireland's only gas storage facility was 'blown down' i.e., fully used, when the abandonment of the Kinsale complex was planned. This was completed in 2022, following Departmental approval, with the removal of the offshore production platforms and the onshore gas processing facility. This proposal is to resurrect the storage facility on the basis that it could meet the gas requirement for 85% of secured gas supplies.

In reality Gas Networks Ireland project an Avg. Peak Day Demand of 320GWh/d or 32 million m^3/day in the period to 2030. The Southwest Kinsale storage facility delivered 4 million m^3/day when full and this dropped by 33% when storage capacity dropped to 83%, its cushion gas level. The investment requirement to reinject the cushion gas, necessary to reactivate the facility, would be €1.5Bn, alone, at current Dutch TTF month ahead gas prices of €175/MWh.

DECC's consultation document describes this proposal, in terms of feasibility of implementation, as "possible but challenging by 2025". Given the fact that the Kinsale Field has been abandoned, this is a totally unrealistic assessment and shows a complete lack of understanding about both the Kinsale Field, the challenges associated with a major offshore gas development in Ireland and of the financial implications.

The Irish Academy of Engineering is an all-island body, concerned with long-term issues where the engineering profession can make a unique contribution to economic, social and technological development. Its members are Irish Engineers of distinction, drawn from a wide range of disciplines, and membership currently stands at 175. Drawing on the experience and knowledge of its distinguished members, the Academy works to facilitate communication and dialogue on engineering-related matters. It regularly publishes reports and analyses, some jointly with other learned and professional bodies.

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