Engineers Ireland Submission on: 'Review of the security of energy supply of Ireland's electricity and natural gas systems'

For the attention of the Department of the Environment, Climate and Communications
Dated: 28 October 2022.

Introduction

Engineers Ireland welcomes the opportunity to provide input on Ireland's security of energy supply of electricity and natural gas systems. Energy security is crucial to the combination of energy challenges we face, along with affordability, and sustainability. Ireland's energy security can be seen in two ways; one in a political sense and the other in a physical sense. Ireland's physical infrastructure has been developed to a good standard based on a mix of energy sources with a reliance on natural gas and renewables, with a plan to decarbonise before 2050.

The variable output nature of renewable electricity generation requires a complementary dispatchable or firm energy source; prior to the EU energy crisis, this was met largely by relatively cheap and secure supplies of natural gas. If gas supply is disrupted, this will impact direct gas use in heating and also potentially disrupt the electricity supply. Alternative dispatchable electricity sources are challenging to deploy in the near term. Some diversification of natural gas supply, combined with storage, will be needed to face the near-term challenges. In longer-term challenges, dispatchable zero-carbon electricity may be achieved through a mix of alternative energy sources, particularly offshore wind combined with large-scale storage mediated through green hydrogen. There are also important roles for demand side management, increased electricity interconnection and grid-scale batteries. Longer term, there may be a role for the domestic deployment of nuclear power. Robust and objective engineering analysis is and will remain a critical component of any effective response to these challenges. Engineers Ireland remains committed to playing its part in this urgent national task. The themes of energy security must focus on the following:

1) **A Systems approach to security** - it is both the electrical and gas systems that must be assessed as an integrated energy system to determine security. The systems consider other constraints, such as carbon and financial budgets. This system approach will have to expand to account for further integration of transport, heating and electricity.

2) **Technology dependence in exchange for fossil fuel** - as we decarbonise, we move our reliance onto the supply chains for the key new energy technologies, as against our current dependence on fossil fuels. This is a different security risk that must be managed over time.

3) **Government support** - we are in the initial stages of a large-scale energy system transformation, but there is a large-scale journey ahead. The Government should support existing infrastructure to support this transition, where applicable. The Government should identify and support critical infrastructure (such as the FRSU if required) to meet our national energy security requirements.

4) **Infrastructure commission** - if a system approach to security is taken, then an overarching entity should be in place to ensure it is delivered. This would support carbon budget constraints and ensure that assets are built with all constraints in mind to achieve an affordable, secure, and sustainable energy future.

Key Recommendations:

- To balance the risks of natural gas supply to Ireland, it is prudent in the near term to deploy one or more LNG floating storage and regasification units (FSRU) to achieve diversification of natural gas supply routes
- The impact of expanding development of Large Energy Users (LEUs) on energy demand should be minimised where possible through increased energy efficiency and the increased use of renewable energy. An enduring, fact-based, and robust policy solutions must be developed in an expedited manner which are consistent with inter alia firm electricity generation adequacy, security of natural gas supply and, crucially, compliance with the relevant carbon budgets and Sectoral Emissions ceilings.
- Undertake a detailed review of the reliability of the current fleet of conventional generation plants. Units approaching the end of life may have reduced maintenance levels. This situation should be actively monitored to prevent unplanned maintenance
- Encourage the earliest possible migration from fossil fuel to hydrogen use for energy uses that are unsuitable for electrification
- Ensure potential gas for storage facilities which could be used for both operational and strategic purposes and provide a pathway for future migration from natural gas to hydrogen storage.
- Consideration should be given to removing the current statutory barriers to domestic nuclear power deployment. While any such deployment is unlikely before 2030, the current legal barriers inhibit robust analysis of its long-term potential.
- Government should develop a clear policy statement for the intended pathway of fossil fuel consumption, specifically including natural gas, over a (rolling) 10-year horizon, that is constrained to be consistent with relevant elements of the statutory carbon budgets.
- All potential pathways to large-scale (TWh+) hydrogen energy storage should be investigated and characterised in the context of an overall national hydrogen strategy. The Irish Government should seek to promote North-South collaboration in definitively establishing the technical and economic feasibility of a salt cavern gas storage facility in Northern Ireland (Islandmagee), initially for natural gas and potentially transitioning to hydrogen.

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1. Are there any other security of supply risks that you can identify in addition to those set out in section 6?

Risks associated with separate components of our evolving energy supply are generally well represented. However, there are also distinct *systemic* risks potentially arising from the interactions and interdependencies of different components.

Delays in progressing key technology deployment and scale-up may pose significant risks to both security of supply and decarbonisation objectives. Based on current energy policy priorities, relevant key technologies include floating offshore wind energy and very large-scale energy storage (multi-TWh), such as compressed methane/hydrogen in salt caverns, or conversion of hydrogen to liquid ammonia. On the assumption of any significant reliance on green hydrogen as an energy vector, scaling of electrolysis and hydrogen-to-power (100% H2 gas turbines, hydrogen fuel cells) technologies will also be critical.

A separate general contributor to the risks of delay in technology deployment and scale-up is Ireland's planning and permitting regime. The European Commission, in its annual 2022 Country Report – Ireland, also highlighted this:

> *"Removing bottlenecks to the above investments will be necessary for reducing Ireland's dependence on fossil fuels. Challenges remain with the planning and permitting system, particularly the long timeframe in granting planning permission, which is also linked to the appeal procedures for planning applications. Advancing reforms in these areas would foster greater roll-out of renewables, thus helping diversify the energy mix."*

Certain risks in the planning and permitting system may cascade: e.g., grid connection uncertainties may delay obtaining planning permission. Other delay risks include technology supply chain constraints and appropriate workforce availability.

The consultation paper notes the forthcoming decommissioning of some existing conventional dispatchable power plants. EirGrid's Capacity Outlook 2022-2031 provides a comprehensive list and timetable of plants/units expected to close /retire in the immediate future (Ireland Capacity Outlook 2022-2031, October 2022, page 38). We note that these plant closures may reduce the diversity of secondary fuels in the electricity generation sector. Delays in deploying new dispatchable generation plants are clearly a key ongoing risk in electricity supply security. In this respect, the failure of the existing design of the Capacity Remuneration Mechanism (CRM) is a central concern.

Given recently extended outages on some existing generation plants, there is also a risk of an increased rate of unanticipated outages on such older plants.

To the extent that the energy system may evolve to incorporate greater reliance on biomass fuels, there is a particular risk arising around the availability of biomass fuel that complies with the proposed sustainability criteria in the Renewable Energy Directive. The recent European Parliament vote on the text of the Renewable Energy Directive includes a cap on the use of woody biomass to count towards renewable energy production, and some restrictions on its use in power generation. The potential of increased competition for non-woody biomass, and possible import dependence raise specific security of supply risks.

Sectoral interactions add additional complexity to the assessment of the security of supply risks. CEPA's assessment acknowledges it has been carried out under the assumption that

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the Government's renewable electricity penetration targets are reliably met. EirGrid's 2030 projections predict there will be significant new additional load from the heat and transport sectors as they are electrified, in line with Government targets set out in the Climate Action Plan 2021 (Ireland Capacity Outlook 2022-2031, October 2022). However, in that eventuality of rising electricity demand, if the renewable electricity penetration targets are not met, then there is a risk of electricity generation being even more reliant on natural gas supply, with consequent amplification of the impact of any natural gas supply disruption.

More generally, we suggest that it is misleading and unhelpful to classify "Electrification of heat and transport" as a demand-side "risk". The shift of significant heat and transport demand from direct fossil fuel use into electricity use is an *intended* and *planned* policy objective. Indeed, it is an essential aspect of achieving significant decarbonisation of those sectors. In this case the material "risk" is rather that such increases in electricity demand for heating and transport may *not* arise sufficiently quickly or at sufficient scale to meet the relevant climate action objectives. It remains critically important to mitigate *that* risk as much as possible. This will be best done firstly by proactive policy measures to minimise energy consumption as far as possible across all sectors, but secondly by continuing to encourage and incentivise migration of *essential* transport and heating demand into the electricity sector.

By contrast: "Significant increased demand from Large Energy Users (LEUs)" is no longer a "risk", but has rather become a reality that is already tangibly materialising, and is significantly impacting both adequacy of firm electricity generation capacity and (more seriously) achieving energy decarbonisation consistent with the approved carbon budgets and sectoral ceilings through to 2030 (most critically in the budget period 2021-2025).

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2. If there are other risks that you have identified, could you outline some mitigation options to address the risk(s)?

Mitigating risks of Large Energy User (LEU) demand expansion

The impact of LEU expansion on electricity security of supply (via increased peak demand) may be substantially mitigated through short-term measures ensuring that this demand can be managed down, including by price, voluntary demand management, and potentially by TSO instruction (under a declared supply emergency) in case of a transient (weekday peak hours) shortfall in generation capacity; and indeed this is now being addressed in the short-term in the case of new LEU connections via *CRU Direction*. Insofar as possible, similar measures should be applied to pre-existing LEUs.

Engineers Ireland recommends that enduring solution(s) be developed in an expedited manner to mitigate this, which solution(s) are consistent with firm generation adequacy, upstream security of natural gas supply and, crucially, compliance with the relevant carbon budgets and sectoral ceilings.

This will clearly require the increased deployment of intermittent renewables to supply all demand, including LEU's backed-up with dispatchable renewables and storage.

Mitigating risk of increased outage rate on older generating plant

It would be sensible to undertake a detailed review of the reliability of the current fleet of conventional generation plant. It appears that a number of these units are approaching end of life. It may be that the maintenance levels are also being reduced. This situation should be actively monitored.

Mitigating risks of delay to hydrogen technology deployment

Ireland has an exceptional per capita variable renewable energy resources, but this requires coupling with green hydrogen energy carrier infrastructure to maximise both energy supply security and wider economic benefits. Engineers Ireland has recently documented its strong support for strategic development of green hydrogen in Ireland in its submission to the consultation on developing a hydrogen strategy for Ireland. Here we briefly summarise some of the key elements of that submission as they relate to mitigating the risk of delay in hydrogen deployment (with consequent risks to wider energy security).

The European Commission's REPowerEU plan recently emphasised the EU's intention to support indigenously produced green hydrogen as a key zero-carbon energy carrier. We suggest that Ireland should advocate for additional supports for green hydrogen production, in the framework of geographic diversity, capacities, national targets and resources of each EU member state. In the immediate term, this could accelerate hydrogen technology deployment domestically in Ireland. In the medium to long-term, it could facilitate hydrogen export to member states who will not have adequate indigenous hydrogen production capacity. In this way, Ireland can make a key contribution to building long term strategic energy security at EU level.

Assuming a strategic long-term role for green hydrogen in Ireland's decarbonised energy system, it is critical that the *initial* development of a strong domestic green hydrogen supply chain should be supported today, in a similar approach to that taken previously for the wind

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industry. Specifically, for energy uses that are unsuitable for electrification, policy measures are needed to encourage the earliest possible migration from fossil fuel to hydrogen use. This requires a specific hydrogen policy and regulatory framework, incorporating robust safety standards.

Geographical clustering of variable renewable energy infrastructure (onshore and offshore wind with hydrogen production, storage and end use) in so-called *hydrogen valleys* can facilitate more rapid and cost-effective scale up of hydrogen use, strengthen more local security of energy supply, and attract low emissions inward investment.

3. Are the five shock scenarios that were considered, and the additional scenarios related to the Russian invasion of Ukraine, sufficiently broad?

We agree generally with the appropriateness of the five shock scenarios presented. However, we would recommend consideration of a further sensitivity in relation to scenarios 1, 2 and 3. The basis for the choice of a 2-week period of Dunkelflaute conditions (i.e. low wind combined with low temperatures) is not clear. A recent study on these events in North-western Europe does find that the typical event lasts less than 150 hours or about 6 days. However, when assessing a mitigation for Dunkelflaute which involves storage, it is important to note that multiple Dunkelflaute events can occur *within a single Winter season*. That means that storage used to mitigate the impact of these events may not have the opportunity to refill between events and so sizing the storage facility should reflect this.

Scenario 2 considers a risk of extended outage of the single largest electricity interconnector. Given the concerns noted in regard to the aging of the conventional generation fleet, we suggest that this scenario should be considered in combination with outage of the single largest firm electricity generation plant.

Separately, we suggest that it would be prudent to add assessment of variants of shock scenarios 4 and 5 in which they are combined with the more severe weather assumptions of scenario 1. Some consideration should also be given to scenarios of significant natural gas supply disruption in excess of 30 days.

In relation to the role of natural gas linepack in responding to the scenarios, we note that in the recent supply disruption event in Texas, the low air temperature reduced overall pipeline pressures and therefore the ability to draw on linepack. Considering the increased interdependency of the gas and electricity networks during cold weather periods, and the potential for climate-change related extreme weather events, these kinds of risk interactions should be considered as far as practicable.

The shock scenarios do not consider the possibility of simultaneous failure affecting *both* natural gas pipeline interconnectors to Great Britain (Moffatt). While such *accidental* or *technical* failure is generally regarded as very low probability, the recent events in the Baltic, which saw co-ordinated failure in both Nord Stream pipelines (presumably due to deliberate attack, most likely involving a nation state actor) highlights the possibility of such infrastructure being deliberately targeted in a context of international conflict — even when an affected country is not itself a direct party to such conflict. It may be appropriate to at least carry out some contingency analysis of the potential effects of such a disruption, even if it does not merit dedicated mitigation.

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Mitigation Options

4. Do you have any additional mitigation options that you think should be considered?

EU context for operation of gas storage facilities

The various mitigation options should be examined against the backdrop of the recently revised EU Gas Security of Supply Regulation (EU) 2022/1032. This made several notable amendments, including:

- requiring underground natural gas storage on Member States' territory be filled to at least 80% of their capacity before the winter of 2022/2023 and to 90% in subsequent winters;
- market participants in Member States without storage are required to have agreements in place with other Member States for storage equivalent to 15% of annual consumption subject to physical limitations or by way of derogation from the 15% requirement, burden sharing arrangements in place with other Member States with storage facilities;
- natural gas storage facilities designated as *critical infrastructure.*

CEPA's findings did not shortlist the commercial operation of a natural gas storage facility in Ireland, citing the impact on the future role of natural gas in the energy sector, potentially undermining Ireland's domestic carbon budget constraints. However, this should not discount the potential for storage facilities which could be used for both operational and strategic purposes and provide a pathway for future migration from natural gas to hydrogen storage. Such storage facilities would now be designated as EU critical infrastructure, defined as "an asset, system or part thereof located on EU territory, which is essential for the maintenance of vital societal functions, health, safety, security, economic or well-being of people, and the disruption or destruction of which would have a significant impact on at least two Member States, as result of the failure to maintain those functions". Given this new categorisation of gas storage, it may be appropriate to reconsider the short-listing.

Mandating policy consideration of potential future domestic nuclear power generation

Ireland already relies on some limited use of nuclear electricity generation via the generation mix associated with imports over interconnectors to Great Britain. This role is likely to increase when the Celtic interconnector to France is commissioned.

The feasible lead time for the development of domestic nuclear generation would likely be a minimum of 10 years, and rely on the commercial availability of so-called small modular reactors (SMRs). These are in active development but are unlikely to be available for delivery before 2030. Costs remain uncertain. However: if SMRs prove technically successful and cost-effective, they can provide for firm, very low emissions, electricity generation which, in principle, could complement the variability of wind and solar sources and reduce overall system costs. Because they remain thermal power plant there would also be a possibility of coupling with the heating sector (via already proposed district heating networks which might already be deployed by then) to further support heat decarbonisation and reduce overall system costs. While Ireland has no domestic supply of nuclear fuel, such fuel can be feasibly stockpiled for significant advanced durations and would still provide diversity and enhancement of overall energy supply security.

Will domestic nuclear power will not feasibly contribute to Irish security of supply in the period to 2030, it could have significant potential over the following decade to 2040. However, domestic deployment of nuclear generation is currently barred on a statutory basis. This has the effect of inhibiting even *assessment* of its potential role in national energy policy. Given the lead times involved, we suggest that consideration be given to removal of the existing statutory barriers and formally mandating that long term *potential* for domestic SMR deployment, from 2030 onward, should be explicitly included in all future modelling and technical assessment of long-term energy security and decarbonisation policy.

Mitigating geopolitical risks to GB natural gas interconnection

As noted, the recent co-ordinated attacks affecting both the Nord Stream gas pipelines in the Baltic, indicate a new, low likelihood, but potentially high impact, risk affecting the natural gas interconnectors between the island of Ireland and Great Britain. We suggest that it would be appropriate to actively co-ordinate with the UK in relation to naval monitoring and protection of relevant sea areas, especially at any times of heightened geopolitical tension.

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5. Which gas supply mitigation options, if any, should be considered for implementation?

Need for policy pathway for natural gas consumption

It is clear that detailed assessment of natural gas supply security mitigation measures is contingent on the projected consumption trajectory; and the latter will be strongly constrained by compliance with the ongoing statutory carbon budget limits. We therefore recommend that the Government develop a clear policy statement for the intended pathway of natural gas consumption (and indeed consumption of all other fossil fuels) over a (rolling) 10-year horizon, that is constrained to be consistent with relevant elements of the statutory carbon budgets. Such a natural gas consumption pathway would provide a critical parameter for dynamic assessment of security of natural gas supply, on a continuous basis, over that rolling horizon. Note that this is related to, but still quite separate and distinct from projections of demand for gaseous fuels in aggregate (the evolving mix of natural gas, other fossil gases, and renewable gases including biomethane and hydrogen).

A dynamic mitigation portfolio (package) is required

There is no single effective mitigation option for current and projected risks to security of natural gas supply: a combination of various options will be required, and this will need to be flexible to adjust in time to both changes in the profile of natural gas in the domestic energy system, and changes in the overarching economic and geopolitical context. The consultation paper suggested one particular package configuration (natural gas storage, biomethane, green hydrogen and methane grid demand side response); we recommend these should all be maintained in scope, but we suggest that FSRU deployment should also be included, especially for near term (1-5 year) deployment).

Early FSRU deployment is a prudent mitigation measure

Engineers Ireland consider that, given the current balance of risks, there is a valid prudential case for near term deployment of one or more LNG floating storage and regasification units (FSRU) to achieve diversification of natural gas supply routes, and thus improve security of supply. This should be a fast-track solution implemented in collaboration with industry, but with full state oversight, and operated as a strategic (not for profit) security of supply facility.

FSRUs can serve to transport LNG and/or be refuelled from dedicated LNG vessels. They then have the onboard capability to vaporize and deliver the gas through specially designed offshore and near-shore receiving facilities. FSRUs can re-gasify and deliver at pipeline pressures up to and above 100 barg with flow rates ranging from 1.3 MSCMD[1] (14.6 GWh/day) to more than 26 MSCMD (289 GWh/day). FSRU projects are generally more easily financed than land-based terminals as the infrastructure is not permanent and can be relocated to new markets as commercial conditions dictate. While FRSU technology is relatively new, it is already relatively mature and widely deployed. Most new gas import terminals are using this rapid and flexible deployment strategy, sometimes in conjunction with onshore storage tanks[2].

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[1] MSCMD: Million standard cubic meter per day

[2] See this short document comparing FSRUs and land based LNG terminal facilities.

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A typical 160,000m³ FSRU would have the capability[3] to:

- Store approx. 94 MSCM of gas (6.7 days average Irish gas demand at 14 MSCMD)
- Deliver up to 26 MSCMD: potentially satisfying Ireland's peak day demand under the N-1 requirement in the EU Security of Supply Regulation
- Access diverse global supplies of gas
- Be re-filled in less than 24 hours

A model Engineers Ireland suggest following is the most recent collaborative gas supply diversification project now nearing completion in Europe under RePowerEU. Finland and Estonia have agreed to cooperate in the operation of the 150,900 m³ floating gas import terminal (FSRU) Exemplar. This was contracted by the Finnish Gas TSO Gasgrid Finland Oy just last May 2022 in a 10-year deal with Excelerate. Gasgrid has agreed a decision in principle with the two countries under which the FSRU will be moored in the port area of Inkoo in December 2022. It will have an import capacity of 55 TWh or 5 billion cubic meters (BCM). Finland and Estonia account for roughly 3 billion cubic meters of demand per year. Ireland by comparison has an annual gas demand of 5.5 BCM. Germany are likewise pursuing this mitigation option and are advancing 5 fast-track FSRU projects.

While supporting consideration of FSRU deployment, we also emphasise that it is not a panacea. Ongoing geopolitical disruption means that delivery timelines and costs for FSRU facilities have escalated significantly. Depending on the contracted arrangements, there may still be risks of asset stranding. Natural gas liquefaction involves energy losses, so that upstream emissions associated with LNG supply chains may be higher than for pipeline transport. There are also additional risks of upstream fugitive methane emissions. This is a particular concern if LNG were to be sourced from hydraulic fracturing (fracking): but this specific risk can be largely avoided by direct national and/or EU oversight and regulation.

Prospects for very large scale (TWh+) energy storage should be actively investigated

Solution-mined salt caverns provide the a mature solution to large scale storage of natural gas, and are widely deployed and used where suitable geology is accessible[4]. Key advantages include that they can be developed incrementally, in defined volumes, with limited cushion gas requirement (unlike depleted natural gas fields); and that they can, in principle, be repurposed for storage of hydrogen. They do involve substantial capital costs, in locating and characterising site geology and in construction, There is currently no confirmed suitable geology within Irish territory (onshore or offshore).

There is known salt geology in Northern Ireland (Islandmagee), with an existing proposal for commercial development of a storage facility. There is also an existing South-North natural gas pipeline that could, in principle, be repurposed to facilitate connection of such a storage facility to the natural gas network in the Republic of Ireland. Development of such a facility *might* thus substantially improve security of natural gas supply for both jurisdictions; and be a critical enabler for all-island development of large-scale green hydrogen use to displace natural gas, particularly in the electricity generation sector. While there are wider political challenges in both Northern Ireland and the UK as whole, which have been exacerbated by Brexit, Engineers Ireland nonetheless advocates that the Irish Government should seek to promote North-South collaboration in definitively establishing the technical and economic

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[3] Fact sheet: Floating Storage and Regassification Units (AGL Australia, October 2017)
[4] Renewable energy storage in geological formations, Crotogino et al, 2018

feasibility of the development of a salt cavern gas storage facility in Northern Ireland, initially for natural gas and potentially transitioning to hydrogen,

Separately from the Northern Ireland locations, there are *some* indications of salt geology in Irish territorial waters in the Irish and Celtic Seas. If these could be proved feasible for cost effective salt cavern storage development, they might again potentially facilitate near term use for natural gas storage and/or long-term use for hydrogen storage (linked to projected offshore wind power development in the same areas), particularly again as a route to both secure and decarbonise fuel supply for firm power generation. Given the high strategic potential of such developments, that simultaneously address both climate and energy security objectives, Engineers Ireland suggest that the Government should actively support, and if possible, accelerate, characterization of these geological potentials; not least because, if they prove entirely unsuitable, that would also have very important implications for medium and long term development of hydrogen production and use in Ireland.

In any case, we recommend that *all* potential pathways to very large scale (TWh+) *hydrogen* storage should be investigated and realistically characterised in the context of an overall national hydrogen strategy. One significant possibility would be conversion of hydrogen to ammonia, which can be relatively easily liquefied and stored in tanks. Given the significant uncertainty in the geological potential and costs for salt cavern storage, it would be prudent for the Government to already actively support early stage/pilot deployment of green ammonia production and storage also.

Role of hydrogen and biomethane blending in natural gas network

Hydrogen blending in the natural gas network can likely be accommodated (without significant reconfiguration of end use equipment) up to 20% by volume (c. 7% by energy). Biomethane, being fully chemically interchangeable with natural gas, can be technically blended at arbitrarily high blending ratios. To the extent that hydrogen or biomethane can be sourced indigenously, this can contribute to diversifying and securing pipeline gas supply. The use of hydrogen blending can provide an important "anchor" market to promote early deployment of green hydrogen production.

While the absolute amounts are expected to be modest, nonetheless, both of these so-called *renewable gases* can be usefully included in the overall package of measures to mitigate risks to security of natural gas supply. Development of biomethane supply via anaerobic digestion must be carefully monitored and regulated to ensure emissions reductions are fully realised (across all three major greenhouse gases, carbon dioxide, methane and nitrous oxide).

In the medium to longer term (2025-2035) accelerated roll out of indigenous green hydrogen production could, in principle, be combined with repurposing of selected parts of the natural gas network to 100% hydrogen to displace natural gas in both power generation and large industrial uses. However, again, such developments will depend significantly on the feasibility of very large scale (inter-seasonably) hydrogen storage.

Integration with the European Hydrogen Backbone

The European Hydrogen Backbone (EHB) initiative proposes five large-scale hydrogen corridors. These will initially connect local supply and demand in different parts of Europe, before expanding and connecting Europe with neighbouring regions with export potential. The plan is largely based on repurposing existing natural gas infrastructure. Corridor C would meet demand from industrial clusters and ports in the UK, the Netherlands, Belgium and Germany enabling European partnerships that can potentially include Ireland. By definition such a shift from natural gas to indigenous green hydrogen use can directly mitigate natural gas security of supply risks on a pan-European basis.

Mitigation of gas demand arising from LEU demand expansion

As already discussed, continuing LEU expansion can increase natural gas consumption and thus exacerbate the impacts of any disruption of supply. This should be addressed in a manner consistent with firm generation adequacy, upstream security of natural gas supply and, crucially, compliance with the relevant carbon budgets and sectoral ceilings.

6. Which electricity supply mitigation options, if any, should be considered for implementation?

Conversion of a natural gas CCGT to indigenous green hydrogen

We support the general ambition to convert at least one natural gas CCGT to run on indigenous green hydrogen, within the timescale to 2030. A number of issues involved with such a conversion project was already presented in an Engineers Ireland Energy Environment and Climate Action Division Seminar in March 2022[5]. However, we note that while this would decouple some firm electricity generation from natural gas supply, it would not, in itself, *increase* firm generation capacity: that is, it would not mitigate the risk of a firm generation capacity shortfall. Furthermore, the other challenges in delivering such a project, specifically in deploying the required hydrogen production, transport, and storage infrastructure should not be underestimated. Nonetheless: this would be a critical milestone in scaling up green hydrogen deployment to displace natural gas usage in the electricity sector, so it should be progressed, in a co-ordinated way, as rapidly as possible.

Additional pumped hydro storage[6]

In the context of the projected shortfall of peak time electricity generation capacity, Engineers Ireland considers that all technically feasible options to enhance grid-scale peak shifting storage should be actively investigated, and should be supported where they satisfy relevant criteria of cost effectiveness (properly assessed over the full asset lifetime) and deployment speed.

Electricity Mitigation Package (DSR and Batteries)

We very much support the exploitation of DSR and battery technology to improve security of electricity supply. Both offer a flexible and cost-effective means to flatten peak demand and thus significantly mitigate the risk of firm generation shortfall at peak times.

We note that the deployment of lithium-ion battery storage is relied on heavily in the modelled shock scenarios. However, we are concerned that the volumes of additional 6-hour batteries which the CEPA technical report forecasts in 2025 and 2030 (335MW and 180MW respectively) are currently at high risk of not being deployed due to the lack of a suitable market framework to support the investment in long duration storage (LDS). These issues were outlined in detail in a recent study commissioned by Energy Storage Ireland[7].

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[5] Presentation slides attached as Appendix 1.

[6] Note that a drafting error in this section was corrected on 3 November 2022.

[7] Game Changer, Baringa, 2022.

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Increased secondary fuel storage at gas fired power stations

We note the significant portion of conventional generation units which are deemed unreliable in being able to actually operate on secondary fuel per the grid code requirements. While we agree that increasing the store of secondary fuel at plant is a potentially valuable mitigation, it will only be as effective as the testing regime put in place to test the plant's ability to operate on secondary fuel. Therefore, we recommend a new testing regime is put in place to ensure compliance to this requirement with regular re-testing.

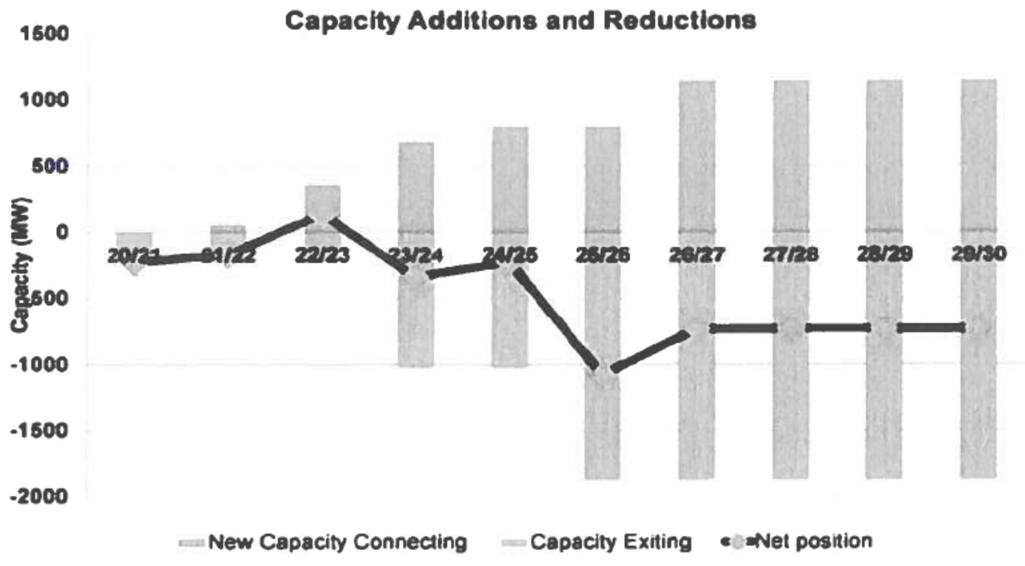
The indicated timelines appear challenging, as new planning permission may be required, which may trigger a full station EPA licence review. The impact of increasing secondary storage fuel obligations also needs to be assessed in light of the capacity payments mechanism CO_2 limits under the EU Electricity Regulation EU 2019/943. We note that there may be significant capital costs associated with bunding and tanks. It is also necessary to ensure continued adherence to applicable HSA Control of Major Accident Hazards involving Dangerous Substances (COMAH) regulations.

Additional dispatchable "low carbon" generation capacity

The consultation paper references the Climate Action Plan 2021 commitment to doubling indigenous biomass supply for the generation of heat and electricity. This appears very ambitious from a land use perspective, and would require strong policy measures to support delivery.

Delayed retirement of conventional plant

It appears from the most recent EirGrid capacity statement that up to 12 GW of firm generating capacity may be retired before 2030, based on the graph below:



Source: EirGrid's All-Island Generation Capacity Statement 2021 – 2030

Where technically and economically feasible, and consistent with carbon budget constraints, consideration should be given to delaying full retirement of existing conventional generation plant unless and until sufficient replacement firm generating plant is in place.

7. What measures should be considered on the demand side to support security of supply of electricity and gas?

Electricity Demand Side Management

As already identified in section 6, we support measures to expand use of DSM where feasible. However, this should focus on actual reduction of demand or use of battery backup, rather than switching to local fossil fuel backup generation. The latter will typically be of lower efficiency (higher emissions intensity) than grid-scale generating plant and should be deprecated for regular use.

Electrification of Heating and Transport

Electrification of heating and transport are key strategies to support decarbonisation of those sectors. However, by increasing electricity sector demand this may exacerbate security of supply risks (both firm generation adequacy and coupled exposure to natural gas supply disruption). Accordingly, it is important to also undertake all possible demand side measures to limit the absolute amount of additional electricity demand that arises in this process. In the case of transport, this requires a strategy that goes beyond vehicle electrification to promotion of maximum modal switching: to active travel for short journeys (walking, cycling etc.) but especially shared mode transport for longer distances (bus, rail etc.). We recommend that the positive interactions of modal shift for *both* decarbonisation *and* mitigating security of supply risks should be actively communicated to wider society. In the case of heating, improving energy efficiency of the existing building stock (both residential and public/commercial) contributes to decarbonisation but is also an important security of supply policy objective particularly when coupled with electrification of heat sources (primarily heat pumps).

LEU demand expansion

As already discussed, continuing LEU expansion can increase natural gas consumption and thus exacerbate the impacts of any disruption of supply. This should be address in a manner consistent with firm generation adequacy, upstream security of natural gas supply and, crucially, compliance with the relevant carbon budgets and sectoral ceilings.

Smart meter deployment strategy

In principle, the deployment of electricity smart meters, in conjunction with so-called smart tariffs, can facilitate distributed behavioural change, particularly to limit peak demand. However, while the programme of physical smart meter installation is progressing well, there are significant concerns over the communication and interaction with consumers. There is clear evidence of a proliferation of complex tariff plans which actively obstruct tariff comparison for consumers; this is exacerbated by suppliers refusing reversion to conventional "non-smart" plans. These practices risk a significant consumer backlash against smart meter deployment. Separately, consumers are not yet being offered any simple, consistent, supplier-neutral, access to smart meter data, with user friendly facilities to analyse and compare the interaction with different supplier tariffs. Finally, the current design of a smart meters does not facilitate continuous *real time* information on consumer demand.

8. Do you have any views on how the mitigation options should be implemented?

Integration with Climate Action

Energy security should be strongly integrated with energy system decarbonisation, so that as far as possible, synergistic measures are identified that can both accelerate decarbonisation while also improving security. Accordingly, energy security measures should be incorporated into the climate action governance framework, and be specifically addressed in the rolling (annually updated) Climate Action Plan. Further, the interactions between decarbonisation, energy security and costs should be actively highlighted in public service communications, so that society as whole can fully understand and engage with these collective challenges.

Policy Measures

9. Do you support the policy measures proposed in section 8 of the consultation paper?

Engineers Ireland broadly supports the policy measures proposed in the consultation paper, but with some strengthening as indicated below.

Regular Energy Security Reviews

We recommend that the technical analysis on energy security should be updated *annually* (rather than every two years) and that this should be integrated with the statutory annual update of the Climate Action Plan. The energy security review should be carried out at least every three years (rather than four years as proposed).

Revisions to the EU Security of Gas Supply regulation

As noted in section 4, the recent EU designation of underground gas storage as critical infrastructure should be considered in the development new gas security of supply measures. This should be aligned with developing future strategic and operational infrastructure to support the appropriate deployment of hydrogen as an energy carrier, where that can contribute effectively to both decarbonisation and energy security objectives.

Proposed EU Hydrogen and Decarbonised Gas Market Package (Gas Package)

The objective of the gas package is to develop "... dedicated infrastructure, as well as efficient markets. It will remove barriers to decarbonisation and create the conditions for a more cost-effective transition." It notes the importance of avoiding stranded assets in the clean energy transition and the goal of reducing the dependency of the Union on external fossil fuel providers, and places specific obligations on LNG and storage system operators to regularly "assess market demand for new investment allowing the use of renewable and low carbon gases in the facilities"; and in planning new investments, LNG and storage system operators must "assess market demand and take security of supply into account." These considerations should be actively integrated in all relevant Irish energy security measures.

Alignment with EU Green Taxonomy

The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities. Being able to demonstrate compliance with the Taxonomy in terms of investment will be important for corporations who have to comply with the Corporate Sustainability Reporting Directive. The implementing legislation for the rules relating to the inclusion of nuclear and gas activities is still to be agreed (and now subject to legal challenge). The technical screening criteria ensure that any new gas-based power/heat plant (or refurbished combined heat and power plant or heat/cool plant) is either below the technology-neutral 100g CO_2/kWh lifecycle emission threshold (i.e. using Carbon Capture and Storage technologies) or meets a number of stringent conditions and obtains a construction permit by 2030. Importantly, the use of natural gas should act as a replacement of plants running on more polluting solid and liquid fossil fuels (e.g. coal), and the objective is to transition to zero-carbon fuels such as hydrogen.

Strategic use of depleted gas fields
Engineers Ireland does not consider that depleted gas fields in Ireland are likely to be suitable for cost-effective deployment as gaseous energy storage facilities (either natural gas or hydrogen) in the future. Both the cushion gas and flow rate requirements argue strongly against such use. Accordingly, we recommend that such fields should rather be designated for potential future permanent storage of *carbon dioxide*, whether arising from industrial processes (e.g. cement manufacture), fossil fuel CCS (in power generation or otherwise), or to support gross carbon dioxide removal from atmosphere via air capture or otherwise.[8]

10. What further tools and measures do you think would contribute the most to Ireland's energy security of supply?

National Hydrogen Strategy
Multiple medium to long term interventions to improve Ireland's energy security (while simultaneously delivering on stringent decarbonisation objectives) are currently contingent on rapid scaling up of infrastructure to support green hydrogen production, transport, storage and end use. Some required hydrogen technology elements are relatively mature; however, many elements are currently subject to major uncertainty. Accordingly, there should be a strong focus on putting in place a comprehensive national hydrogen strategy, with timelines to clarify and resolve key uncertainties as soon as possible, particularly where these also directly impact on energy security strategy. Central among these should be to resolve whether or where it will be feasible to develop large scale (multi-TWh) salt cavern storage facilities that can serve the whole island of Ireland; and if that proves infeasible, to advance alternative options, e.g., via derivative energy carriers such as ammonia or liquid organic hydrogen carriers (LOHC). For further elaboration on these points, see Engineers Ireland's recent submission to the consultation on developing a hydrogen strategy for Ireland.

Improve Ireland's Energy Infrastructure Planning and Permitting Regime
Engineers Ireland fully supports rigorous and independent oversight of all planning aspects of infrastructural development, including proper and appropriate environmental assessment and authentic public engagement. However, as noted explicitly in section 1, deployment of new, large scale, energy infrastructure in Ireland currently experiences significant difficulties with cost, uncertainty, and delay in planning and permitting processes. It is critical that the already announced overhaul and consolidation of Irish planning processes provide for prioritization and the most rapid possible processing of planning and permitting for strategic energy infrastructure, while preserving appropriate and commensurate protections against

[8] See also: Assessing negative CO_2 emissions potential at national level, constrained by the Paris temperature goals: case study of Ireland, McMullin et al, 2022.

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undue environmental impacts and facilitating good-faith public and community communication, engagement and participation. We note especially the recent European Commission recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements (C/2022/3219 final) which states inter alia that:

> *Member States should ensure that the planning, construction and operation of plants for the production of energy from renewable sources, their connection to the electricity, gas and heat grid and the related grid itself and storage assets qualify for the most favourable procedure available in their planning and permit-granting procedures and are presumed as being in the overriding public interest and in the interest of public safety...*

Public communication and engagement with energy policy

We need to engage all of society in the effort to limit energy consumption generally (across all sectors and fuels) and to move electricity consumption in particular away from peak times where possible. This requires clear, consistent, communication, in plain English that acknowledges both the short term and longer-term challenges and constraints; but that explains the concrete measures that people can take as individual citizens and in their diverse roles in households, in companies, and in the public service.

General comments and Observations

Almost a century ago, the construction of the Ardnacrusha hydroelectricity station, and subsequent development of comprehensive national electricity grid were defining achievements of the fledgling independent Irish state. This national electricity infrastructure continued to grow and evolve and has served the nation well, delivering a very high level of security of supply, while leading the world in demonstrating the integration of very high levels of instantaneous wind energy penetration. Similarly, in more recent decades, we have successfully deployed an advanced, integrated, natural gas grid, with robust pipeline connectivity to Great Britain, serving large and small heat loads as well as fuelling the majority of firm electricity generation capacity.

However: in recent years some significant shortcomings have also emerged. In the electricity system, firm generation capacity is in danger of falling short of peak demand, driven particularly by a combination of rapid expansion of large energy users (primarily data centres), outages in an aging generator fleet, and failures to deliver timely development of new firm generating capacity. Separately, security of natural gas supply has been radically undermined by recent geopolitical developments, especially the illegal and unjust war initiated by Russia in Ukraine. And all of this now collides with the "long emergency" of global climate disruption, and the imperative to decarbonise all energy use within a rapidly dwindling window for effective action.

Radical actions are required in response. But that can understandably face strong public, planning and regulatory obstacles. There is limited social understanding or acceptance of the need for intrusive infrastructure development, whether that be in transmission lines, wind or solar farms, or gas pipelines and storage systems. The Government must take direct ownership of these issues, fund effective public information on the multiple and interacting challenges, and, where necessary, counter misinformation.

The integration of climate and decarbonisation with energy security policy in the current consultation is very welcome. The overriding objective for Irish energy policy, across all sectors and energy carriers, must be to decarbonise as rapidly as possible, and in any case at a rate consistent with the statutory carbon budget programme. But this poses both tensions and synergies with maintaining security of energy supply. It is important to be open and transparent in communicating these issues to wider society and to offer a credible pathway to a better future, specifically one that can combine climate and energy security with international solidarity and justice.

Nonetheless robust and objective engineering analysis is and will remain a critical component of any effective response to these challenges. Engineers Ireland remains committed to playing its part in this urgent national task.

ENDS

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Background to Engineers Ireland
With over 25,000 members from every discipline of engineering, Engineers Ireland is the voice of the engineering profession in Ireland. Engineers Ireland was established in 1835 making us one of the oldest and largest professional bodies in the country. Members come from every discipline of engineering and range from engineering students to fellows of the profession.

Our responsibility is to
- Promote knowledge of engineering
- Establish and maintain standards of professional engineering and engineering education
- Provide opportunities for Continuing Professional Development (CPD)
- Maintain standards of professional ethics and conduct
- Ensure that professional titles are granted to qualified candidates
- Act as the authoritative voice of the engineering profession in Ireland

Our Vision Statement
Engineers Ireland: a community of creative professionals delivering sustainable solutions for society.

Our Mission Statement
Engineers Ireland is an institution that enables the engineering community to progress their professional development and make a sustainable impact on society, advocates for the profession, quality assures education and encourages the future generations of engineers.

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