NexSys (Next Generation Energy Systems)

Submission to Public Consultation on Accelerating Infrastructure

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Table of Contents

Introduction

NexSys (Next Generation Energy Systems) is an all-island, multidisciplinary energy research programme. Through this programme of research, 50 leading academics across 9 institutions are working in partnership with industry to tackle the challenges of energy system decarbonisation, developing evidence-based pathways for a net zero energy system.

NexSys is committed to engaging with national policy processes in order to provide evidence based research and policy insights in support of our net zero ambitions. Infrastructure delivery in key NexSys research areas represents a critical challenge for Ireland in the years ahead. This submission seeks to leverage NexSys expertise to offer information on key capacity constraints for infrastructure in the electricity, transport and water sectors.

Barriers to the delivery of transport, electricity and water networks in Ireland

a. Transport

i. *EV Charging Infrastructure*

Lack of available charging infrastructure has been noted as a major barrier to the uptake of EVs in Ireland[1]. While the EV infrastructure strategy has marked a positive step towards addressing the issue, further investment is needed, particularly in rural areas[2]. Without this critical infrastructure the goal of reaching 1 million EVs on the road by 2030 is unlikely.

ii. *Green Hydrogen for Transport End-use*

Green hydrogen will be integral for decarbonizing transport applications where EVs are not feasible. This includes heavy duty road vehicles but also marine transport and aviation through the production of e-fuels (synthetic hydrocarbons). Despite the ReFuelEU obligation for at least 1.2% of aviation fuel to come from synthetic SAF (sustainable aviation fuel) by 2030, there is no infrastructure for producing e-fuels at commercial or even pilot scale in Ireland, leaving the country vulnerable to import dependency.

b. Electricity

i. *Electricity Grid Infrastructure*

To meet emissions reductions goals while also satisfying growing electrical energy demand it is essential that the grid infrastructure be in place to get the generated renewable electricity to the demand centres. ESB networks has requested a baseline investment of €10.1 billion, with

[1] EV purchase slump due to 'perfect storm' of charger and pricing problems – The Irish Times
[2] Ireland won't reach its EV target of one million by 2030 – here's why – The Irish Times

the potential to grow to €13.4 billion under PR6, which aligns with the remaining term of the NDP (2026-2030)[3].

Sustained investment in offshore grids will also be necessary to harness Ireland's offshore wind potential[4].

ii. *Clean Dispatchable Electricity Generation*

Dispatchable electricity generation (currently largely provided by gas generation) will continue to be needed in the electricity system. As the system moves towards net-zero, the prioritisation of clean, net-zero dispatchable generation will require investment.

New capacity additions for gas-fired generation, which have been identified under the 2025 Climate Action Plan[5], should be capable of being modified to burn hydrogen blends[6], making investments future-proof for running them with a certain level of hydrogen blends[7].

iii. *Gas Grid Infrastructure*

Blending green hydrogen into Ireland's gas network is one strategy to utilise green hydrogen in the short term (Erdender et al, 2023). Raising the legal hydrogen blending limit from 0.1% to 20% by volume would allow hydrogen injections into establish the safety and existing pipelines. Investment in necessary research and testing activities should be made to technical standards for this process[8].

iv. *Large-scale Long Duration Storage*

Investment in long duration energy storage, ranging in duration from days to months is a critical supply-demand balancing technology needed in the decarbonised electricity system[9].

Hydrogen offers significant promise across a spectrum of applications, from energy storage and heavy transportation to backing up the electricity grid. Efficient hydrogen storage is imperative for a net zero economy. Geological hydrogen storage, utilising salt domes or bedded salt deposits for creating salt caverns, stands out for its potential to store hydrogen offering a scalable and economic solution to meet the fluctuating demands of a renewable energy system (Michalski et al, 2017). Globally, the exploration of salt caverns for hydrogen storage has advanced significantly (Taylor et al, 1986), (Ozarsalan, 2012), (HyUnder Project, 2014), (Kruck et al, 2013), (Le Duigou et al, 2017), (Tarkowski and Czapowski, 2018), (Saigustia and Robak, 2021).

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[3] Minister O'Brien announces new measures to enhance the electricity grid and to increase its resilience
[4] EirGrid announces €1 billion procurement programme for offshore electricity grid
[5] Climate Action Plan 2025, p.70
[6] H2-Ready Definition | EUTurbines
[7] Renewable Hydrogen and End-users' Considerations for the Transition to a Renewable Gas Network (HyEnd)
[8] Injecting green hydrogen blends into Ireland's gas network | Gas Networks Ireland
[9] Electricity Storage Policy Framework

The HyLIGHT project[10] strategically explored the potential for hydrogen production and its roadmap in Ireland, while the SEAI Hydrogen Salt Storage (HYSS) project[11] concentrated on the geological storage aspects. Together, these projects have highlighted the significant potential for suitable geological hydrogen storage on the island of Ireland and in the Irish Sea and Celtic Sea.

The HYSS project's refined mapping has revealed areas with Halite formations at depths of 1,500m and thicknesses exceeding 150m, ideal for salt cavern creation for hydrogen storage. The project has provided compelling evidence of this potential, with the Celtic Sea Basins identified as capable of hosting over 5,000 standard-sized salt caverns for hydrogen storage. If 1% of these are utilised this would translate to an estimated storage capacity of >7 TWh hydrogen, positioning Ireland at the forefront of a major energy transition opportunity.

Long duration storage will require government strategic energy planning as well as financial incentives and routes to market to enable the solution[12].

v. *Delivery of Offshore Renewable Energy (ORE) - Port Infrastructure*

Ireland has a major deficit in port infrastructure which will be required to support the planned rollout of fixed bottom offshore wind farms. The existing investment model for ports is inadequate and is uncoordinated, and will result in an under-delivery on planned volumes of installed capacity of offshore renewable wind energy (ORE). This under-delivery will result in the loss of economic benefits from offshore wind identified in the *Future Framework for Offshore Renewable Energy Policy statement*[13], *Powering Prosperity – Ireland's Offshore Wind Industrial Strategy*[14] and the *SEAI Offshore Renewable Energy Technology Roadmap*[15].

The goals identified in these documents are contingent upon the development of port capacity which has not yet been provided for in the existing NDP. The National Ports Policy 2013, currently under review, identifies 5 key ports across 2 tiers: (Tier 1: Dublin, Cork and Shannon/Foynes, Tier 2: Rosslare and Waterford). Of these ports, Dublin has opted out of offshore renewable energy delivery, and Waterford is not suitable (due to water depth), while Shannon/Foynes will likely specialise in floating wind rather than fixed bottom offshore wind. There are therefore only 2 ports identified which can support fixed offshore wind delivery, though 4 ports (have been identified by NexSys analysis), will be needed if the proposed volume of offshore wind capacity is to be delivered.

Future infrastructure investment should therefore align with National Policy Objective 55 of the National Planning Framework:

[10] HyLIGHT - MaREI
[11] Hydrogen Salt Storage Assessment (HYSS) | SEAI
[12] Review of Deployment of Long Duration Energy Storage in the Electricity Sector in Ireland
[13] Future Framework for Offshore Renewable Energy
[14] Powering Prosperity – Ireland's Offshore Wind Industrial Strategy - DETE
[15] Offshore Renewable Energy | Technology Roadmap| SEAI

"To support, the progressive development of Ireland's offshore renewable energy potential, the sustainable development of enabling onshore and off-shore infrastructure including domestic and international grid connectivity enhancements, non-grid transmission infrastructure, as well as port infrastructure for the marshalling and assembly of wind turbine components and for the operation and maintenance of offshore renewable energy projects."[16]

Of the above identified infrastructure, ports are unique in not yet having clearly identified funding support. This is in contrast to grid connectivity where, for example, co-funding for the Celtic Interconnector from Eirgrid and RTE (French TSO) has reached €1.6bn[17] with an additional €530m grant secured by Government[18], and investment in the national grid, which will likely be between €10.1 and €13.4bn for the 2026-2030 investment cycle[19], with a €1bn investment in non-grid transmission infrastructure from ESB[20].

To get an understanding of what type of financial investment is required in ports in Ireland, a 2023 report for the Netherlands Enterprise Agency estimated that, "*if Ireland wants to do all the main offshore wind activities in its own ports, a total investment of €2-3 billion would be required. If the focus is just on O&M and partial construction support, the investment needed is expected to be closer to €1 billion*"[21].

Ireland has an infrastructural deficit in the offshore wind ports sector, without which, Ireland will fail to deliver the potential economic altering benefits of offshore renewable energy as well as green energy security into the future.

c. Water Networks

i. Regional Constraints

At present, water and wastewater capacity is particularly constrained in larger urban areas across the state[22][23], including in the Greater Dublin Area, where half of all currently proposed housing is to be developed[24]. Many areas identified for high housing growth within the GDA or other cities in the National Planning Framework (NPF) are already experiencing infrastructure constraints. As such, there is a strong case for rebalancing housing targets towards larger towns (populations >10,000) that have existing capacity.

A more spatially balanced development approach, informed by capacity audits, could ease pressure on overstretched urban infrastructure while supporting regional regeneration. While

[16] National Planning Framework First Revision, p.105
[17] Celtic Interconnector agreements signed between France and Ireland
[18] Government secures €530m EU grant for Celtic Interconnector
[19] Minister O'Brien announces new measures to enhance the electricity grid and to increase its resilience
[20] Scaling up: ESB Group's significant investment in renewable energy and infrastructure
[21] North Seas offshore wind port study 2030 - 2050 - Final report
[22] Council can't build houses until water issues sorted | Galway Advertiser
[23] Mind the (infrastructure) gap: Why rural proofing needs to be part of Housing Activation Office policy | Business Post
[24] New housing targets present challenges - Uisce Éireann | RTÉ

Uisce Éireann has published treatment plant capacity registers[25], these do not capture the network-level constraints that often inhibit real development potential[26]. Expansion of the current registers to include network level data would help to improve identification of potential development zones and facilitate better planning for infrastructure investment.

The two major projects listed under NSO 9 - the Eastern and Midlands Water Supply Project (Shannon Pipeline) and the Greater Dublin Drainage Project - are long-term, high-cost investments aimed at securing water resilience for the GDA. However, both are characterised by prolonged planning and implementation timelines, potentially leaving a significant gap in supply-demand balances in the near-to-medium term. To mitigate this, shorter-term, lower-cost conservation strategies (such as those outlined in research commissioned by An Fóram Uisce)[27][28] must be accelerated through the National Water Conservation Working Group (DHLGH) in parallel.

A cost-benefit analysis of setting water use targets[29] at the building scale found low-to-moderate cost water saving technologies would add less than €180 per new-build home to developer costs, and reducing water usage to 90 litres per person per day across the planned 303,000 new homes could save 2.2 million cubic metres of water per year nationally, which would cut approximately €9.7 million in costs for water and wastewater services to 2030. Furthermore, reduced hot water consumption could reduce household energy costs by up to €280 per year and household carbon emissions by 70 and 93 kg CO_2 eq. in electrical energy savings.

Constraints on water supply and treatment can be alleviated by (i) new and more rapidly built infrastructure, improved operation of existing infrastructure and reducing water use (as outlined above). The new EU Directive concerning urban wastewater treatment identifies a need to treat water for a larger population and a need to ensure the sector can meet targets as part of the drive to net-zero will stretch existing infrastructure even without demographic growth[30]. Thus infrastructure investment should be robust enough to enable these challenges to be met. This will make for far more flexible, efficient and adaptable facilities that can support Ireland's societal, environmental and economic goals.

ii. Climate Adaptation

Water supply and wastewater infrastructure should be planned with climate change in mind to prevent facility vulnerability to electricity outages and to be resilient to cope with climate change, including being designed to handle the impact of changing hydraulic loads due to changing rainfall patterns (Saikia et al, 2024).

[25] Capacity Registers | Connections | Uisce Éireann
[26] Addressing the housing crisis in Irish towns: an exploration of water infrastructure capacity challenges
[27] A Framework for Improving Domestic Water Conservation in Ireland
[28] Non-domestic Water Use; Learnings from International Data & Conservation Initiatives (Research Summary)
[29] Non-domestic Water Use; Learnings from International Data & Conservation Initiatives
[30] Directive - EU - 2024/3019 - EN - EUR-Lex

iii. Data Centres

One of the most pressing constraints in water infrastructure planning is the rising water demand from data centres, where high and often continuous water usage poses a direct trade-off with domestic and public sector needs. Some data centres use millions of litres per day creating acute pressures on local supplies[31]. There are 82 operational data centres in Ireland, with a further 14 under construction and planning permission granted for a further 40[32]. 88% of these are in Dublin, which is the region with the largest supply-demand deficit nationally[33] . This underscores the urgent need to integrate data centre water use into national water resource planning including mandatory efficiency standards and site selection criteria that avoid high-stress catchments. Without stronger governance, infrastructure delivery for housing and public needs may be compromised.

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[31] Water use by data centres: An Irish Context | An Fóram Uisce
[32] Data Centres in Ireland - Public Policy
[33] Non-domestic Water Use: Learnings from International Data & Conservation Initiatives

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