NexSys (Next Generation Energy Systems)

Submission to Consultation on the National Development Plan Review

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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 research covers 5 thematic strands (Energy Systems, Water, Offshore Wind, Transport, Cities & Communities) which have significant relevance to the National Development Plan. This submission seeks to leverage the Programme's research and expertise to provide evidence-based insights to how investment should be prioritised from 2026-2030 to ensure sustainable development of Ireland's strategic infrastructure.

Relevant Sectors for Additional Investment

The Review of the National Development Plan will be focused to ensure that economic infrastructure can be prioritised to deliver 300,000 additional homes by 2030 and to support international competitiveness. In that context, which sectors should be a national priority for additional investment? Why should these sectors be a national priority for additional investment?

1. Energy

a. *Port Infrastructure & Offshore Wind*

Ireland's Climate Action Plan[1] acknowledges that offshore renewable energy will be critical for the decarbonisation of Ireland's energy system. However, the NDP does not currently provide funding for the development of the required port infrastructure to support the proposed rollout of offshore renewable energy projects.

The NDP acknowledges the importance of the role of ports in offshore wind (p.108). It states that,

"The significant role that ports can play in the facilitation of the development of the Irish offshore renewable energy sector going forward is recognised and will be factored into the work undertaken in reviewing our National Ports Policy. The Department in conjunction with the Irish Maritime Development Office is currently engaging with the ORE sector and international ports to assess options for our ports facilitating the ORE sector."

The revised NDP needs to follow a plan-led approach and assign a dedicated funding stream to provide the port infrastructure required to deliver offshore wind.

[1] Climate Action Plan 2024

The National Planning Framework (NPF), First Revision (April 2025)[2] and the National Development Plan (NDP) are intrinsically linked within Project Ireland 2040, with the NPF providing the strategic vision and the NDP outlining the investment to achieve that vision. The NPF sets the long-term spatial strategy, guiding development and investment over a 20+ year period, while the NDP is a 10-year investment strategy that supports the NPF's objectives. These documents cannot therefore be considered in isolation. In reviewing these documents alongside other relevant plans[3][4][5] for offshore renewable energy, there is consistent reference to port requirements in each, but no identification of additional resourcing.

b. 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 the potential to grow to €13.4 billion under PR6, which aligns with the remaining term of the NDP (2026-2030)[6].

Sustained investment in offshore grids will also be necessary to harness Ireland's offshore wind potential[7].

c. 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 existing pipelines. Investment in necessary research and testing activities should be made to establish the safety and technical standards for this process[8].

d. Large-scale Long-Duration Energy Storage

Investment in long duration energy storage, ranging in duration from hours to seasons is a critical supply-demand balancing technology needed in the decarbonised electricity system[9]. Long duration storage will require financial incentives and routes to market in order to be viable[10].

[2] National Planning Framework First Revision – April 2025
[3] Future Framework for Offshore Renewable Energy
[4] Powering Prosperity – Ireland's Offshore Wind Industrial Strategy - DETE
[5] Offshore Renewable Energy | Technology Roadmap| SEAI
[6] Minister O'Brien announces new measures to enhance the electricity grid and to increase its resilience
[7] EirGrid announces €1 billion procurement programme for offshore electricity grid
[8] Injecting green hydrogen blends into Ireland's gas network | Gas Networks Ireland
[9] Electricity Storage Policy Framework
[10] Review of Deployment of Long Duration Energy Storage in the Electricity Sector in Ireland

e. Clean Dispatchable Electricity Generation Plant

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 planned for gas-fired generation should be capable of being modified to burn hydrogen blends, making investments future-proof for running them with a certain level of hydrogen blends.

2. Transport

a. EV Charging Infrastructure

Lack of available charging infrastructure has been noted as a major barrier to the uptake of EVs in Ireland[11]. While the EV infrastructure strategy has been a good step towards addressing the issue, further investment is needed, particularly in rural areas[12]. Without this critical infrastructure the goal of reaching 1 million EVs on the road by 2030 is unlikely.

b. Hydrogen end-uses

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[13], there is no infrastructure for producing e-fuels at commercial or even pilot scale in Ireland, leaving the country vulnerable to import dependency.

3. Higher Education and Research

Ireland has one of the lowest percentages of government investment in research and development (R&D) in the EU, at less than 1% of GDP[14]). This is a major concern and hinders Ireland's ability to foster innovation. Ireland should increase spending on R&D to at minimum the European average (2%). To be competitive with the countries with highest research and development spending such as Germany, Austria, Sweden and Belgium, at least 3% of GDP should be spent on R&D.

[11] EV purchase slump due to 'perfect storm' of charger and pricing problems – The Irish Times
[12] Ireland won't reach its EV target of one million by 2030 – here's why – The Irish Times
[13] ReFuelEU Aviation - European Commission
[14] EU Maps: How much are the EU27 countries spending on research?

4. Water

Sustainable / targeted investment in water infrastructure

Balanced and sustainable regional investment in water infrastructure will be necessary to meet the development targets outlined under the NDP. Growth should be targeted where capacity exists rather than in already severely constrained areas.

At present, water and wastewater capacity constraints represent a severe limitation on the feasibility of delivering 300,000 new homes by 2030, particularly if half of these homes are to be in the Greater Dublin Area[15]. 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 Uisce Éireann has published treatment plant capacity registers[16], these fail to capture the network-level constraints that often inhibit real development potential[17]. 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)[18][19] must be accelerated through the National Water Conservation Working Group (DHLGH) in parallel.

A cost-benefit analysis of setting water use targets[20] 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

[15] New housing targets present challenges - Uisce Éireann | RTÉ

[16] Capacity Registers | Connections | Uisce Éireann

[17] Addressing the housing crisis in Irish towns: an exploration of water infrastructure capacity challenges

[18] A Framework for Improving Domestic Water Conservation in Ireland

[19] Non-domestic Water Use; Learnings from International Data & Conservation Initiatives (Research Summary)

[20] Non-domestic Water Use; Learnings from International Data & Conservation Initiatives

up to €280 per year and household carbon emissions by 70 and 93 kg CO2 eq. in electrical energy savings.

Trade-offs and Constraints

In the context of the need to boost the delivery of infrastructure, what trade-offs and constraints should the government be aware of and how should these be managed as part of the Review of the National Development Plan?

1. Data centres

a. *Energy Intensity of Data Centres*

As mentioned in the consultation document, the "*energy intensity of (…) large-scale servers powering cloud / Artificial Intelligence*" constitute an important challenge for the drive towards carbon neutrality, energy security and equity in Ireland. The electricity use by data centres has long been increasing, from 5% of national electricity demand in 2015 to 21% in 2023. Since 2021-2022, we have seen a *de facto* moratorium on new connections in the Dublin region[21][22]. In 2025, CRU updated their policy requiring data centres to provide generation and/or storage capacity to match the requested site demand[23].

As a result, recent years have seen the installation of gas turbines capable of generating tens of MWs of electricity on new data centre sites. The use of such smaller-scale decentralised generation based on fossil fuels raises potential concerns about a decrease in overall energy conversion efficiency of the power system, as well as air and noise pollution in already congested areas. Additional investment in energy storage capacity to allow more renewable power generation, in combination with more efficient large-scale thermal power plants should therefore be considered at a national and all-island level.

Given the current trends in terms of growing data traffic volume and artificial intelligence, the energy consumption of data centres will only increase[24]. However, there are underutilised opportunities which could allow some technical challenges to be mitigated:

(i) Encouraging data centre operators to use the most efficient cooling methods for their IT equipment, e.g., liquid or hybrid liquid/air cooling, in conjunction with elevated data hall air temperatures. The increased heat transfer effectiveness would cut down on internal power consumption to drive air-based cooling infrastructure, allow for the

[21] CRU Direction to the System Operators related to Data Centre grid connection processing
[22] Dublin and data centers: The end of the road? - DCD
[23] Large Energy Users connection policy
[24] Silicon heatwave: the looming change in data center climates | Uptime Institute

installation of smaller heat exchangers and reduce water use (Testa et al, 2024), (Kennedy and Persoons, 2024).

(ii) Promoting the reuse of excess heat from DCs and the inter-connection of adjacent facilities (e.g., with sites requiring a constant heat demand such as hospitals, swimming pools, horticulture or farming) (Borland et al, 2023), (Gibbons et al, 2021).[25]

This would require national coordination and the involvement of both academic and industry experts, to identify best practices and outline appropriate investment goals. An independent committee with academic/industry/societal representation that has oversight on relevant performance metrics would be a very useful tool for Ireland, and the development of best practices for data centres as part of a larger energy ecosystem.

b. Water Use & 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[26]. There are 82 operational data centres in Ireland, with a further 14 under construction and planning permission granted for a further 40[27]. 88% of these are in Dublin, which is the region with the largest supply-demand deficit nationally[28] . 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.

2. Port Infrastructure & Offshore Renewable Energy

Ireland has a major deficit in port infrastructure which will be required to support the planned rollout of fixed bottom offshore wind farms. Current investment is inadequate, having to be raised from the balance sheet of Tier 1 and Tier 2 ports, and uncoordinated, and will result in an under-delivery on planned volumes of installed capacity. 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*[29], *Powering Prosperity – Ireland's Offshore Wind Industrial Strategy*[30] and the *SEAI Offshore Renewable Energy Technology Roadmap*[31].

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,

[25] Heat Reuse: A Management Primer - Uptime Institute
[26] Water use by data centres: An Irish Context | An Fóram Uisce
[27] Data Centres in Ireland - Public Policy
[28] Non-domestic Water Use: Learnings from International Data & Conservation Initiatives
[29] Future Framework for Offshore Renewable Energy
[30] Powering Prosperity – Ireland's Offshore Wind Industrial Strategy - DETE
[31] Offshore Renewable Energy | Technology Roadmap| SEAI

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, while Shannon/Foynes will likely specialise in floating rather than fixed offshore wind. There are therefore only 2 ports identified which can support fixed offshore wind delivery, though 4 will be needed if the proposed volume of offshore wind capacity is to be delivered.

The Future Framework for Offshore Renewable Energy Policy identifies the NDP as a key plan supporting the proposed rollout of ORE, ''critical components of Ireland's offshore renewable energy system including generation, storage, ports, and grid infrastructure are informed by the NDP"[32]. A review of the NDP does mention ports and their future role in the offshore wind rollout; but the primary focus is on the traffic and goods and connectivity and highlights that *''ports do not receive Exchequer funding'"*. The NDP companion document the National Planning Framework – part of Project Ireland 2040, continues in the same theme with connectivity to the fore when it comes to ports. There is therefore a lacuna in existing planning documents as to how port capacity can be delivered to support critical ORE infrastructure.

The revised NDP should, therefore, identify the funding mechanism by which this infrastructure is to be delivered, in alignment with National Policy Objective 55 of the National Planning Framework:

"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."[33]

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[34] with an addition €530m grant secured by Government[35], and investment in the national grid, which will likely be between €10.1 and €13.4bn for the 2026-2030 investment cycle[36], with a €1bn and non-grid transmission infrastructure from ESB[37].

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"*[38].

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[32] Future Framework for Offshore Renewable Energy, p.14
[33] National Planning Framework First Revision, p.105
[34] Celtic Interconnector agreements signed between France and Ireland
[35] Government secures €530m EU grant for Celtic Interconnector
[36] Minister O'Brien announces new measures to enhance the electricity grid and to increase its resilience
[37] Scaling up: ESB Group's significant investment in renewable energy and infrastructure
[38] North Seas offshore wind port study 2030 - 2050 - Final report

The revised NDP should, therefore, identify the funding mechanism(s) by which this additional investment is to be delivered.

3. Use of Curtailed Renewable Energy & Green Hydrogen Production

At present, the dispatch-down of excess renewable energy represents a significant opportunity cost for Ireland's decarbonisation pathway. Renewable electricity currently curtailed represents a low-priced option for initiating green hydrogen production. Capital investment in green hydrogen demonstrator projects can unlock these opportunities. A hydrogen certification process will be necessary to facilitate this.

References

1. Borland, P. L., McDonnell, K., & Harty, M. (2023) Assessment of the potential to use the expelled heat energy from a typical data centre in Ireland for alternative farming methods, *Energies*, 16: 6704, doi: https://doi.org/10.3390/en16186704
2. Erdener, B, Sergi, B, Guerra, O, Chueca, A, Pambour, K, Brancucci, C & Hodge, B-M 2023, 'A Review of Technical and Regulatory Limits for Hydrogen Blending in Natural Gas Pipelines', International Journal of Hydrogen Energy, vol. 48, no. 14, pp. 5595-5617. https://doi.org/10.1016/j.ijhydene.2022.10.254
3. Gibbons, L., Persoons, T., & Alimohammadi, S. (2021) Techno-economic and sustainability analysis of potential cooling methods in Irish data centres, *Journal of Electronics Cooling and Thermal Control*, 10: 103003, doi: https://doi.org/10.4236/jectc.2021.103003
4. Kennedy, G., & Persoons, T. (2024) Enhancing controllability of forced convection cooling with minichannel heatsinks using pulsating flow, Proc. 30th International Workshop on Thermal Investigations of ICs and Systems (THERMINIC), Toulouse, France, 25-27 Sep 2024, doi: https://doi.org/10.1109/THERMINIC62015.2024.10732205
5. Testa, L., Stuart, P., O'Donnell, C., & Persoons, T. (2024) Impact of variation of the cooling system operating strategy on energy efficiency and waste heat quality: a preliminary investigation on a hybrid-cooled data centre, Journal of Physics: Conference Series, Volume 2766, 9th European Thermal Sciences Conference (Eurotherm 2024) 10-13 Jun 2024, Lake Bled, Slovenia, doi: https://doi.org/10.1088/1742-6596/2766/1/012057

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