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Reply to:

Consultation on the offshore renewable energy (ORE) Future Framework Policy Statement February 2024

Dear Minister Ryan & the Department of Environment, Climate and Communications Team,

I am a [redacted] in [redacted] completing a masters in [redacted]. I am writing as a citizen of Ireland, [redacted] and interested stakeholder.

As part of the [redacted] I have undertaken multiple modules in the areas of [redacted] and as such have a strong grounding in relevant topics. I am undertaking an investigation into the impact of increased renewable energy penetration on electricity markets as part of my flagship project.

I am an active member of [redacted] and frequently attend events relating to the Irish Energy System including future proofing our grid, storage solutions, role of hydrogen and solar focused webinars and conferences. I attended the [redacted] focused on the topics of [redacted], and was presented with a Certificate of Achievement upon completion of the course.

In the past I have worked as a [redacted] including Crude and Refined Oil products, Carbon and Natural Gas products on multiple exchanges. In addition to this I was active across other commodity asset classes including Grains, Softs and Metals developing a strong understanding of global commodity trade and risk analysis.

With a rural upbringing on a small farm, I have first-hand experience and exposure to the impact and interconnections of the natural world. The health and productivity of the farm is inextricably linked to that of the ecosystem surrounding it and efforts to protect the health of this environment have filtered through to the health and productivity of the livestock. I am thus a wholehearted believer in the responsibility and stewardship we have as humans in our position in the animal kingdom, not only for the health of the biodiversity surrounding us, but also for the prosperity and safeguarding of the ecosystems for future generations.

I have also completed a [redacted] with a major in [redacted] as well as being active member of [redacted].

Kind regards,

[redacted]

Executive Summary

- Storage has an important role in reliability, addressing intermittency and export profitability and thus requires more attention.
- An explicit prioritisation and timeline for urgent actions is required to achieve ambitions set out in Future Framework.
- More detailed risk analysis can be used to minimise risks and generate competitive advantages by increased attention direction towards tiers of mitigatory and contingency actions.

- Development of renewable technologies in our oceans should be viewed as an opportunity to enhance them and not just with a view to minimize damage, with more detail needed on how this may achieved.
- Information and education can be a powerful tool in a strategic toolkit and can aid in the achievement of a timely transition.
- Optimising with respect to economics is appropriate currently but consideration to future zero/low growth or alternative scenarios can provide benefits

Supporting Information

This response has been compiled with respect to the following goals in relation to the ORE Future Framework Policy Statement;

- Link relevant components of the energy system,
- Streamline ORE consenting process,
- Integrate key priorities,
- Optimise economics of the transition.

I acknowledge and recognise this is a strategy framework working towards a plan encompassing specifics actions and implementation plans, and the trade-offs and challenges in developing a plan of this nature, including the difficulties in balancing careful consideration with need for swift development and implementation of the technologies and infrastructure discussed.

Firstly, I am happy to see a comprehensive plan incorporating and highlighting the economic opportunities the transition presents and putting in place the foundations required to facilitate the installation of the required technologies. The establishment of the OWDT is a strong action to deliver the objectives as planned. The development and inclusion of DMAP as core ingredient in planning process is positive action with respect the significant resource that is the Irish marine environment. The establishment of MARA responsible for the new maritime consenting scheme is encouraging. The ambition shown across the plan for a relatively short timeframe is a strong positive.

From my exploration of the Future Framework, I have identified a number of areas which may benefit from increased attention or emphasis and will discuss these with reference to relevant supporting information in the coming framework.

The first subject I'd like to draw attention to is Storage. In Workstream 1 it is stated that 97% of all generation is derived from the intermittent sources of on and offshore wind and solar. This high level of intermittency introduces significant challenges in matching supply and demand. To ensure stable and secure supply, these intermittent resources must be complemented by dispatchable generators, storage mechanisms, interconnectors or some combination of the above. The DNZ scenario complements this with 3% of thermal dispatchable generation from hydrogen and natural gas. Although I have no doubt the quantities can be met, the fluctuations in generation are likely to create challenges in stability. Shaner et al highlight the difficulties in achieving high reliability with solar and wind contributing greater than 80% of total electricity demand and the requirements for strategic combinations of storage, flexible generation, demand management and overbuilding of capacity [1]. It suggest at least a storage capacity of 32 days as depicted in Figure 1 to ensure stable supply once small levels of demand management and flexible generation are accounted for.

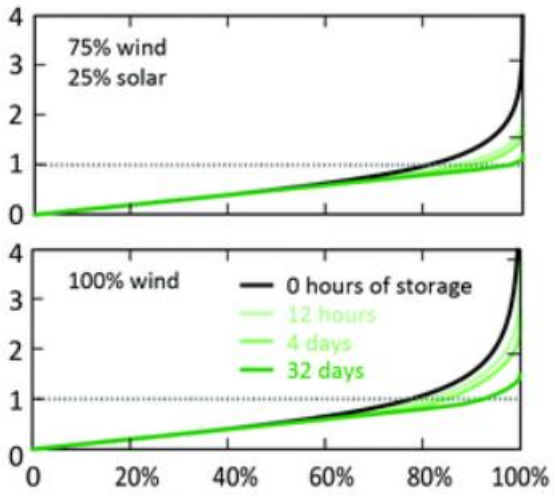

Figure 1: Reliability as a function of energy storage and generation in high wind fuel mixes, X axis: fraction of electricity demand met by solar, wind and storage, Y axis: Mean solar and wind generation divided by mean electricity demand. Source: Shaner et al [1]

Brown et al discuss the advantages associated with methanol storage in combination with carbon cycling [2]. Some of the key advantages include the flexibility in location, the economics and the ability to repurpose existing infrastructure. For these reasons it may provide another alternative worthy of consideration, suitable for Irish situation. The need for long duration storage is again highlighted through an examination of the decadal cycles and strong inter-annual variability in wind. Figure 2 demonstrates the economic advantages posed by methanol storage in locations where salt cavern storage is unavailable.

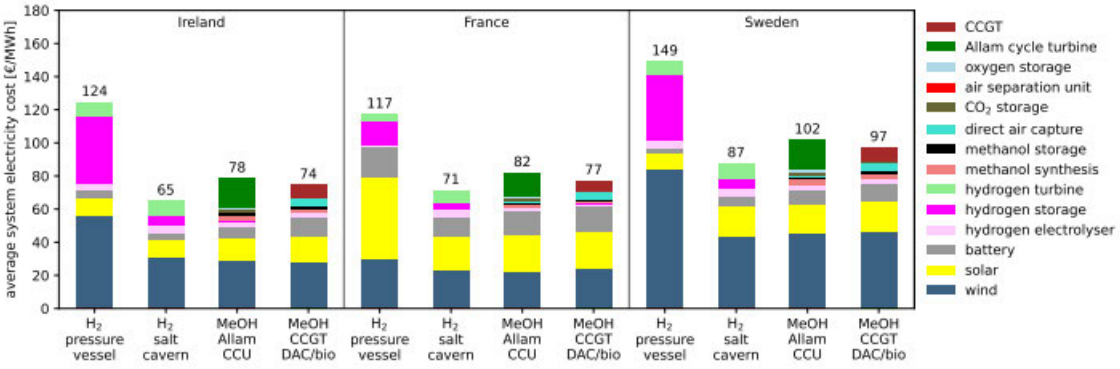

Figure 2: Average electricity costs for solar and wind based systems, Source: Brown et al [2]

Allam cycle turbines are not yet widely commercialized but a working example exists in Texas, operating a closed carbon loop, recycling CO_2 repeatedly through the system (98% of CO_2). One of the major advantages of this technology is that the energy dense liquid can be relatively easily transported and stored in existing infrastructure. A 200,000 m^3 cylindrical tank (40m high, diameter 80m) can store 880GWh of methanol, a substantial contribution to a countries energy usage. In addition to this a more geographically diverse set of storage tanks has been developed for security and transportation reasons.

Economically, battery costs of €100-200/kWh are too expensive to be viable for long term storage options. Due to methanol's liquid state at ambient temperatures, it offers much better economic prospects thought to be in the region of €0.01-0.05/kWh which is similar to oil products used today,

and almost the equivalent of hydrogen storage in salt caverns [2]. As mentioned, Figure 2 provides an economic description of some of the possible storage mechanisms and how they vary by region.

The Royal Society has also published a report on large scale energy storage highlighting the need for storage solutions in Great Britain [3]. Figure 3 demonstrates the differences between supply and demand in a wind and solar system scaled to 570 TWh/year based on actual hour by hour data. It is highlighted how studies of periods of a decade or less can seriously underestimate the need for storage and how this decadal variability is an important consideration. Another valuable technique worthy of consideration is pre-emptive demand management. It is described as using long term weather forecasts to reduce energy consumption in the lead up to a low renewables/wind event (<80% of average values) and is thought to reduce the need for storage by up to 10%.

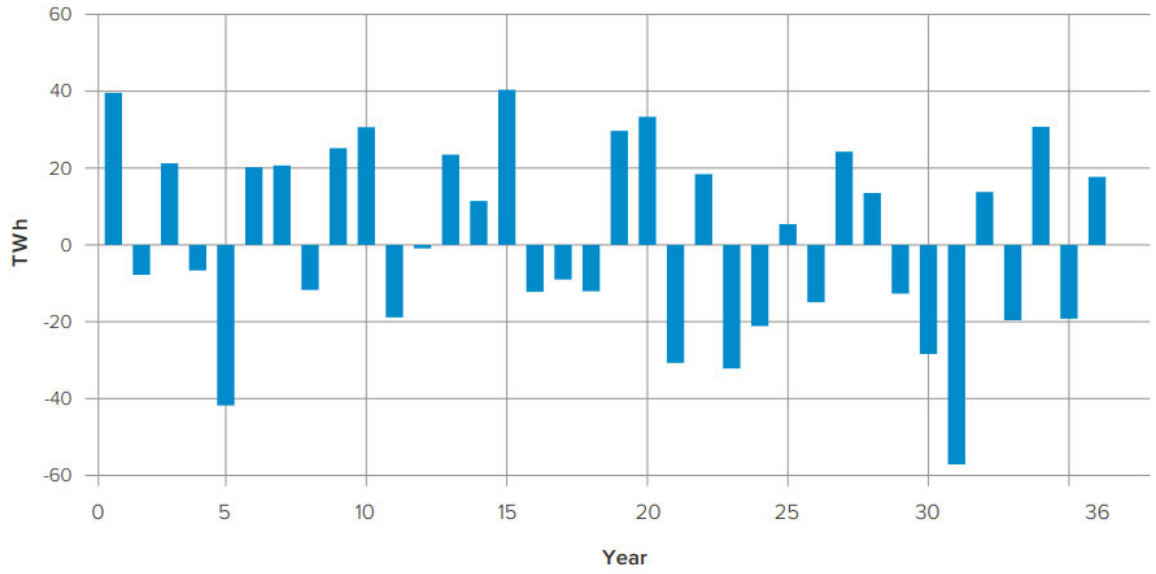

Figure 3: Modelled Annual Difference between wind plus solar supply and electricity demand, Source: Royal Society [3]

Batteries tend to be used for ancillary services over storage (charged when supply is plentiful and discharged when supply is low). Ancillary services are those which help ensure the reliable operation of grid such as frequency regulation. The quantity of batteries relative to power generation is likely to remain fixed due to profitability erosion at higher levels so it is likely the use of batteries as a short term storage mechanism may remain limited. Figure 4 describes the proportion of revenue in ERCOT derived from ancillary service and arbitrage for battery operators. It is worth noting however that revenue does not equal quantity of energy stored and this battery fleet is still moving significant volumes of energy. Alternatively, this may suggest that ancillary services may be a good potential source of funding to expand the fleet. However, it remains that the need for ancillary services is likely to grow with higher levels of renewables and will most likely reduce the capacity of battery storage.

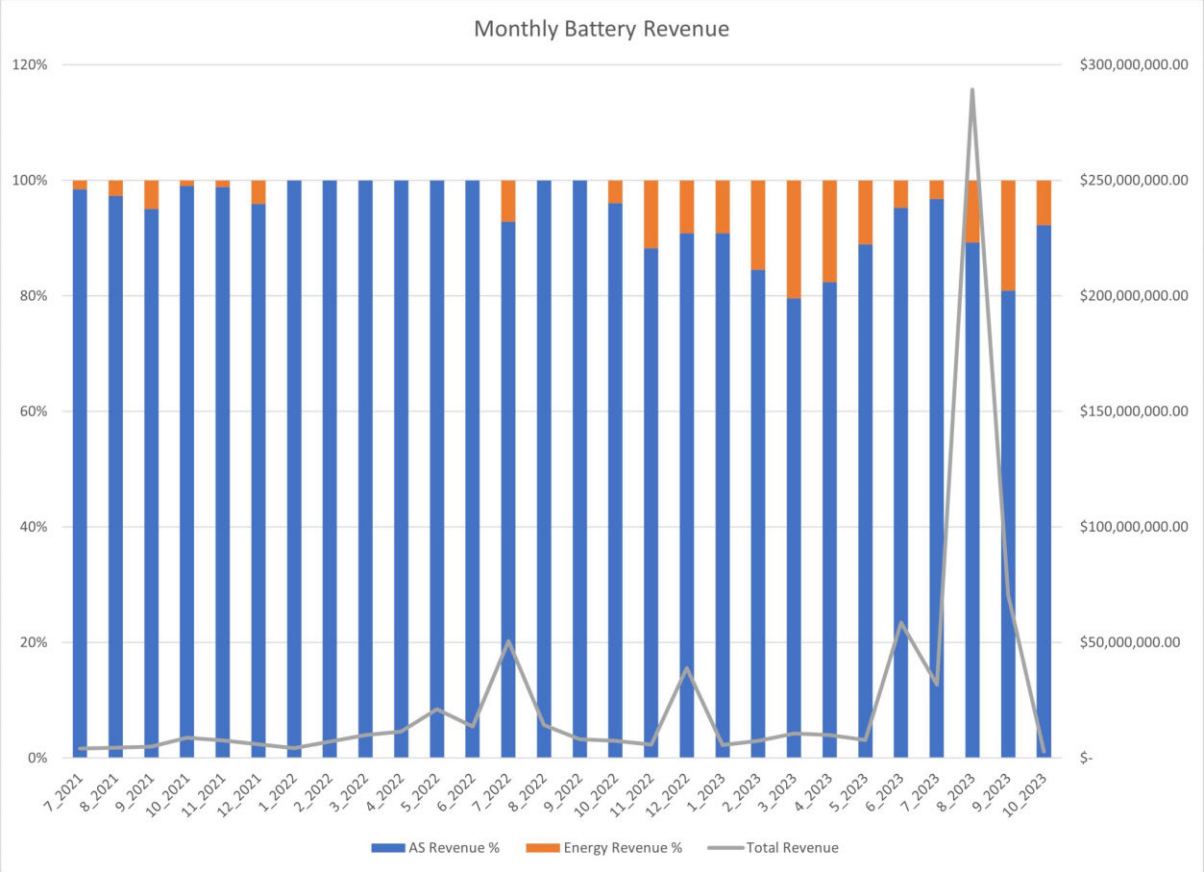

Figure 4: Proportion of revenue derived from Ancillary services and Arbitrage for Battery Operators, Source: CIM View Consulting [4]

In global commodity trade, storage plays this same key role in matching supply and demand. For example certain agricultural commodities are only available at certain harvest periods determined by the seasons. In the absence of storage these commodities would be unavailable to us across the out-of-season periods. In terms of profitability, storage is one of the key contributors to global trading houses profitability. For example, when oil began trading at negative prices, trading houses with storage capabilities made large profits by being paid to take this oil and resell it in future months at large profits. Storage is a key component in global commodity trade and plays an important role in profit generating strategies.

As discussed, I suggest that due to central role storage holds in highly intermittent energy systems, particularly in absence of large scale pumped hydro or nuclear, storage options and research directed towards them needs to be afforded more attention for the reasons discussed. I acknowledge the National Hydrogen strategy mentions storage without going into much detail.

Similar to storage, transmission systems and grid capacities play an important role in facilitating the transition. All the generation capacity in the world is of no use unless we have the ability to connect it to demand locations and times. Storage will play an important role in linking times of high and low supply while transmission systems will be important in taking advantage of variations in weather by geography and bringing the energy to demand centres. The IEA highlights how queues of renewable projects waiting to get grid connections are already growing, and this issue is likely to be exacerbated over the coming years if grids are not afforded the required attention. Studies have shown that up to 60 billion additional tonnes of CO_2 emission will be emitted due to slower uptake of renewables as a

result of grid issues [5]. Planning and permitting for grid upgrades and expansion are generally accompanied by significant lag times between initial proposals and development often in the magnitude of ten to fifteen years, which is generally longer than the timeframes required to develop renewable projects. This demonstrates the urgency for these projects to begin in the very near future.

Dispatch Down is a term used to describe the amount of renewable energy available but cannot be used by the system due to curtailment or constraint issues. In 2022, this value represented 8.3% of wind generation in Ireland. Figure 6 highlights the levels of Dispatch Down for wind generation in Ireland. It also highlights how wind generation can vary by year with a low wind year occurring in 2021 despite increased capacity. It is important to ensure that this loss does not continue to rise if we are to meet the net zero targets in a timely manner.

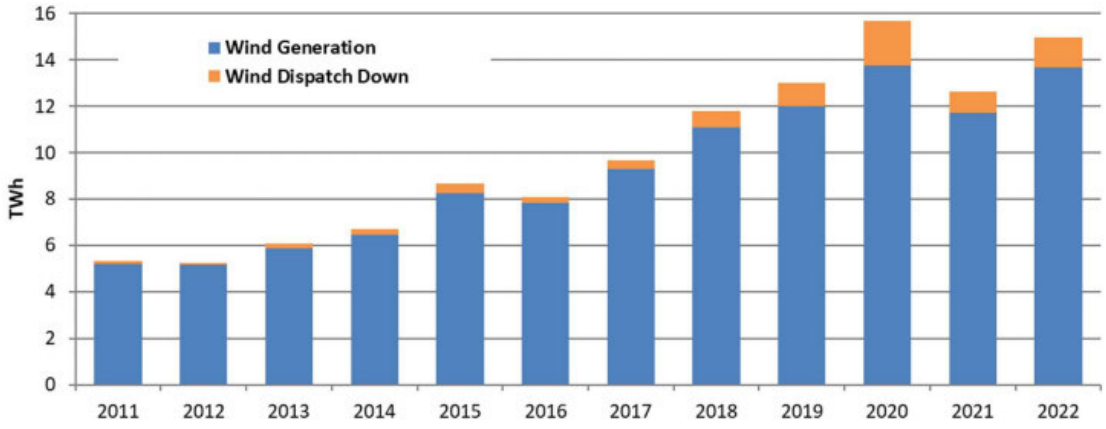

Figure 5: All Island Annual Wind Generation and Dispatch Down Volumes, Source: Eirgrid [6]

It is good to see a number of plans completed and in development at varying levels including the 10 year network development plan and Offshore Transmission Strategy amongst others dealing with this topic. I recognise that there is a degree of dependency on the completion of DMAP but I would like to see more emphasis put on the importance of these infrastructures if we are to achieve our goals and maximise the returns from these technologies being deployed.

A clear prioritisation or ordering of actions across plans is one such way this could be accomplished. Evidently, there is a lot of good work being done in regards planning and strategy but I would like to see more explicit targets, stronger timelines and prioritisation of actions in regards these two critical infrastructures to support the good work being done surrounding the development and implementation of renewable energy technologies. Perhaps these strong timelines will need to be accompanied economic incentives or penalties for industry or relevant stakeholders to meet them.

The addition of DMAP and MARA to the planning and consenting process has clear benefits but I believe efforts are required to ensure this is an efficient and streamlined process and does not increased the significant planning timelines already required. The UK has taken such measures to accelerate their planning, consenting and funding approval processes in their Offshore Wind Net Zero Roadmap and may provide guidance on how to approach such a challenge [7].

Similarly, the Future Framework looks to maximise economic returns of the transition by developing a strong domestic hydrogen demand and export capabilities. I believe this type of ambition is indeed a positive but requires strong incentives, guidelines and leadership if these ambitious goals are to be met including locations of these demand centres. As recognised in the report we are not the only country with aspirations of this nature and I would like to see clear timelines and actions for how these

goals will be achieved to exploit the first mover advantage discussed. Norway is an example of one such country also looking to take advantage of export markets in Western Europe in their Offshore Wind Strategy [8].

The development of the DMAP is one of the key actions underlying the processes required to push forward the storage and transmission systems required and as a result I hope it receives the required urgency and attention to achieve the required progress.

In relation to technologies I agree with prioritisation of wind and solar as the most established and proven technologies. Other technologies which may be worth considering are nuclear, floating solar, aqua culture biomass. Personally I would be a proponent of nuclear as part of the countries fuel mix and believe it would ease much of the challenges associated with the transition. As highlighted in an Irish case study [9], no technology currently permitted in Ireland is available at scale to reach the targets as set out in the Paris Agreement but by integrating nuclear energy it is estimated the net zero target could be reached by 2037. I understand however, Nuclear energy remains a topic fraught with debate but I feel it is certainly one solution worthy of further discussion.

A second topic which I believe warrants more consideration is Biodiversity. The health of our oceans are an underappreciated aspect of the natural world with key influences on weather and the circularity of the natural world. I agree offshore wind is important ingredient in transition to net zero but feel health of the ocean should be a core component of planning and decision making process. In our position as stewards of the planet, this transition and wholesale change should be viewed as an opportunity to develop habitats and promote the health of our options rather than be viewed solely as an opportunity to minimise damage or a tick-the-box exercise. The impact of sound pollution from turbines has been studied and demonstrates the importance of each unique site in understanding the impacts [10]. I acknowledge that the enhancing of ecosystems received a brief mention but little detail beyond the collection of data and the conduction of the SEA Screening Report. It is encouraging to see a level of consideration being placed on environmental concerns and ecosystems in the developed of DMAP but I would like to see more efforts directed towards enhancing biodiversity in areas that maybe previously were not suited to it. The revitalising our Fair Seas Report provides good level of detail on the numerous habitat features and associated importance which provides a good starting position for how renewable technologies may be tailored towards providing benefits beyond just the energy they provide [11]. The EU Birds and Habitats directive is another informative resource in this regard [12]. Climate and biodiversity inherently interlinked and I believe we shouldn't address either in isolation. As evident in my upbringing in a small rural farm, a healthy ecosystem reaps benefits beyond the habitats they provide due to the circularity of the natural world and I would like to see more specific actions on how the development of these renewable technologies in offshore locations can be used to enhance the ecosystems and habitats in these locations.

Risk Analysis is an important aspect of all planning processes. Plans are great but things rarely go perfectly smoothly. I'd like to see dedicated risk analysis/scenario analysis for key aspects and parts likely to go wrong to help minimise disruptions. I like the risk analysis presented in WS4 but feel this could be expanded to tiers of specific actions to reduce risks such as supply chain risks, cautious industry and other market risks. Pre-emptive actions or mitigations could also be expanded in such a way with actions organised by levels of difficulty or economic commitments required. I again recognise

this is a strategy framework and is moving towards a specific plan which may compromise of such actions.

Additionally I have a couple of broader points I would like to make. I believe that education of general public should be a core pillar in any strategy of this nature. The information people consume has massive impact on the decisions they make, as has been evident in the success of mass marketing in creating a culture of consumerism over the past number of decades. I believe education has an important role to play in the transition as a whole if the ambitious objectives outlined are expected to be met. I believe it should be a consideration in every policy and framework to achieve the mass awareness levels required to transition in a timely manner. The returns experienced by informational efforts such as these will compound over time and will be key in implementing the substantial changes required in the later part of the transition. I have no doubt the transition will not be without challenges and public buy-in will be important across these challenging periods. Senior executives in Siemens [13] and Total [14] have recently warned governments against selling the transition as a process which will bring us to a utopian destination and highlight the likelihood of higher energy prices. Education and public information campaigns will be needed to help mitigate impacts or slow down the transition. Studies have shown how education influences behaviour [15] and thus can be a key tool for strategy framework such as this. Actions such as this may be identified as specific mitigating actions as part of the increased levels of detail in a risk analysis as suggested. Other actions may include social media campaigns, highlighting the jobs and improved facilities in regional demand centres and promotion of local sports people and artists with genuine connections to the local people. An additional advantage of increased awareness and education of the area will be increased uptake of employment in the sector.

Another pre-emptive or future focused aspect that may be considered as part of the risk analysis is considering what does this mean for economic growth. This strategy optimises in terms of continuous economic growth, but I would question how coherent is this with the transition over the long term, sustainability and the concept of carbon neutral. It is unclear if consumption needs to continue to grow to facilitate continued economic growth, or if consumption can continue to grow if we are to live in a Net Zero world. This is beyond the scope of this strategy alone but could form an interesting scenario in a risk analysis. A number of studies have been completed on zero growth scenarios [16] [17].

Bibliography

[1] M. R. Shaner, S. J. Davis, N. S. Lewis, and K. Caldeira, “Geophysical constraints on the reliability of solar and wind power in the United States,” *Energy Environ. Sci.*, vol. 11, no. 4, pp. 914–925, 2018, doi: 10.1039/C7EE03029K.

[2] T. Brown and J. Hampp, “Ultra-long-duration energy storage anywhere: Methanol with carbon cycling,” *Joule*, p. S2542435123004075, Oct. 2023, doi: 10.1016/j.joule.2023.10.001.

[3] The Royal Society, “Large-scale electricity storage”, [Online]. Available: https://royalsociety.org/-/media/policy/projects/large-scale-electricity-storage/V1_Large-scale-electricity-storage-report.pdf?la=en-GB&hash=90BC8F8BCBC2A34431B6CF9DD80A8C9D

[4] “CIMView | Home.” Accessed: Feb. 17, 2024. [Online]. Available: https://cimview.com/

[5] “Lack of ambition and attention risks making electricity grids the weak link in clean energy transitions - News,” IEA. Accessed: Nov. 18, 2023. [Online]. Available: https://www.iea.org/news/lack-of-ambition-and-attention-risks-making-electricity-grids-the-weak-link-in-clean-energy-transitions

[6] “Publications.” Accessed: Feb. 17, 2024. [Online]. Available: https://www.eirgrid.ie/publications
[7] “Offshore wind net zero investment roadmap,” GOV.UK. Accessed: Feb. 17, 2024. [Online]. Available: https://www.gov.uk/government/publications/offshore-wind-net-zero-investment-roadmap
[8] O. of the P. Minister, “Ambitious offshore wind initiative,” Government.no. Accessed: Feb. 17, 2024. [Online]. Available: https://www.regjeringen.no/en/aktuelt/ambitious-offshore-wind-power-initiative/id2912297/
[9] Yumpu.com, “atw - International Journal for Nuclear Power | 06.2021,” yumpu.com. Accessed: Jan. 08, 2024. [Online]. Available: https://www.yumpu.com/en/document/read/65949581/atw-international-journal-for-nuclear-power-062021
[10] G. Vella *et al.*, “Assessment of the effects of noise and vibration from offshore wind farms on marine wildlife,” Jul. 2001, Accessed: Feb. 17, 2024. [Online]. Available: https://www.osti.gov/etdeweb/biblio/20262251
[11] “FS_full_report_pages.pdf.” Accessed: Feb. 17, 2024. [Online]. Available: https://fairseas.ie/wp-content/uploads/2022/07/FS_full_report_pages.pdf
[12] “EU Birds Directive | National Parks & Wildlife Service.” Accessed: Feb. 17, 2024. [Online]. Available: https://www.npws.ie/legislation/eu-directives/birds-directive
[13] “Energy bills must rise to pay for net zero, says Siemens Energy boss.” Accessed: Feb. 17, 2024. [Online]. Available: https://www.telegraph.co.uk/business/2024/01/21/energy-bills-must-rise-pay-for-net-zero-siemens/
[14] S. White and T. Wilson, “Total boss warns governments risk mis-selling energy transition.” Accessed: Feb. 17, 2024. [Online]. Available: https://www.ft.com/content/5a76f345-5e28-4f72-9246-6569c4ffe3d9
[15] H. Williams, “Examining the Effects of Recycling Education on the Knowledge, Attitudes, and Behaviors of Elementary School Students”.
[16] “Public policy in a zero-growth scenario,” CEPR. Accessed: Feb. 17, 2024. [Online]. Available: https://cepr.org/voxeu/columns/public-policy-zero-growth-scenario
[17] “Priewe-_The_economics_of_the_Green_Transition_Zero-growth_and_De-growth.pdf.” Accessed: Feb. 17, 2024. [Online]. Available: https://www.ipe-berlin.org/fileadmin/institut-ipe/Dokumente/Veranstaltungen/Priewe-_The_economics_of_the_Green_Transition_Zero-growth_and_De-growth.pdf