Offshore wind energy value proposition for Estonia

Estonian Wind Power Association

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Estonia must use the full potential of onshore and offshore wind to meet climate protection, energy independence and renewable energy targets

Executive summary (EST)

- Eesti on võtnud eesmärgiks toota aastaks 2030 enda tarbeks elekter taastuvatest allikatest. Eesti aastane tarbimine on täna **9 TWh,** sellest **5 TWh** toodetakse täna fossiilsetest kütustest ja 2,6 on taastuvatest allikatest. Ainult tänase tarbimise katmiseks peaks Eesti aastas tootma lisaks 6,4 TWh taastuvelektrit aastas. Selle numbri sisse ei ole veel arvestatud majanduskasvu ja soojamajanduse üleminekut elektrile.

- Olemasoleva ja kasvava vajaduse katmiseks tuleks rajada **380 MW** maismaa tuule tootmisvõimsust igal aastal kuni 2030. Eestis ei ole piisavalt piirangute vaba maad ega küpseid projekte, et seda eesmärki täita. Parim viis Eesti kasvava energiavajaduse katmiseks on lisaks maismaaparkidele rajada ka meretuuleparke.

- Tuuleenergia arengu kitsaskoht on aeglane menetlusprotsess, mis vaatamata riigi pingutustele seda korrastada võtab aastaid aega. Reeglid on üksteisele vastukäivad ja erisuste lahendamine on jäetud arendajale lahendada. Pea kõik Eesti maismaa ja mere tuule projektid kaasatud kohtumenetlustesse, kus puuduvat või vastukäivat regulatsiooni menetletakse aastaid.

- Võrguga liitumine on tuuleparkidele keeruline. Eesti elektrivõrk on ajalooliselt suundunud Idast-Läände kuid enamus tuuleenergeetika alasid asub Läänes. Võrguga liitumise kulud on arendaja kanda. Läänest-Itta kulgeva võrgu üles ehitamine ainult arendajate kulul ei ole majanduslikult jätkusuutlik.

- Tarneahelate koormatus ja üldine hinnatõus mõjutavad nii maismaa kui mereprojektide majandusliku suutlikust. Ainult turutingimustel on kogu regioonis väga keeruline uusi võimsusi rajada, eriti nii väikese sisetarbimise korral, nagu seda on Eesti.

- Mereparkide rajamisel on edukad riigid kus on pikaajaline plaan ja turutingimustega kooskõlas toetusmeetmed. Enamasti on riigil pakkuda nii võrguühendus, kui CFD või suured elektritarbijad, kellega sõlmida pikaajalised elektrimüügi lepingud(PPAd). Sellega koos on olemas selge seaduslik raamistik, mis annab kindlustunde kõigile osalistele. Mereparkide rajamine on täna Euroopas riiklik huvi, mitte ainult vastu turutingimusi toimuv äri.

- Eestisse tulekut ootab 13 energiamahukat tööstusüksust, mille kogu investeering on 4,898 milionit eurot, millega luuakse 2,890 töökohta. Nende aastane elektrivajadus on 5,8 TWh, mis on 73% Eesti aastasest elektrivajadusest. Need investeeringud tulevad Eestisse, kui neil on tagatud taastuvelektri olemasolu.

- Mereparkide rajamisega luuakse Saaremaale ja Pärnumaale hooldussadamad ja tekivad töökohad kohalikele elanikele. Tallinna Sadama Paldiski Lõunasadamal on suur potentsiaal saada kogu regiooni ehitussadamaks. 1GW meretuulepark loob keskmiselt 150 otsest ja 150 kaudset töökohta.

- Eestis kehtiva seaduse alusel jagavad tuulepargid kasumit kohaliku omavalitsusega. 1GW merepark panustab kohalikku kogukonda tänaste keskmiste elektrihindade juurde **1-1,4 miljonit eurot aastas.**

- Eesti merepargid vajavad riigilt selgelt plaani järgnevaks viieteistkümneks aastaks, nagu seda on teinud UK, Saksamaa, Holland või Poola. Selle juures tuleb silmas pidada, et elektrit ei ole vaja ainult olemasoleva vajaduse katteks vaid ka majanduse kasvamiseks ja fossiilsetest energiaallikatest väljumiseks kogu energiatarbest. Plaani osa on selge seadusandlus, toetusmeetmete ajakava ja võrguühenduste ajakava.

- Võttes arvesse eelmise aasta tundide elektrihinda oleks ühe GW suurusega merepargi CfD tulu olnud riigile järgnev:
  ○ Kui CfD oleks sõlmitud hinnale 75€/MWh oleks riik teeninud 399 miljonit eurot;
  ○ Kui CfD oleks sõlmitud hinnale 80€/MWh oleks riik teeninud 379 miljonit eurot;
  ○ Kui CfD oles sõlmitud hinnale 86,5 €/MWh (MKM analüüsides kasutatud hind) oleks riik teeninud 354 miljonit eurot;
  ○ Kui CfD oleks sõlmitud hinnale 90€/MWh oleks riik teeninud siiski 340 miljonit. eurot.

Executive summary (ENG)

- Estonia has set the target of producing electricity from renewable sources for all its power consumption by 2030. Estonia's annual consumption today is 9 TWh, of which 5 TWh is produced from fossil fuels and 2.6 from renewable sources. The remaining 1.4 TWh are imported. To cover only today's consumption in 2030, Estonia must create an additional capacity for the annual production of 6.4 TWh of renewable electricity, not considering future power demand for industry, heat and transport.

- To meet this need, at least 380 MW of new onshore wind capacity would be needed to be constructed annually until 2030. Estonia lacks unrestricted land or mature projects to meet this goal. The best way to cover Estonia's growing energy needs is to also build offshore wind projects in addition to onshore wind projects.

- The currently most pressing bottleneck in wind energy development is the slow permitting process, which takes years despite the state's efforts to better organize it. Rules are contradictory, and it is left to the developer to resolve the issues. Almost all Estonian onshore and offshore wind projects are challenged in court cases processed for years due to missing or misleading regulations.

- Connecting to the grid is also still very difficult for wind projects onshore as well as offshore. The Estonian electricity grid has historically been oriented from East to West, but most wind energy areas are in the West. The developer bears the costs of connecting to the network. Building a west-east network only at developers' expense is not economically sustainable.

- The strain on infrastructure, logistics and supply chains due to the general inflationary cost and interest rate increase affect the economic viability of both onshore and offshore projects. It is challenging to build new capacities in the entire region only under market conditions, especially with such low domestic consumption as in Estonia.

- Countries with long-term plans and support measures in line with market conditions successfully establish offshore projects. In most cases, the state can offer network connection and CfDs (Contracts for Difference) or there are large electricity consumers with whom to conclude PPAs (Power Purchase Agreements). Along with this, a clear legal framework provides reassurance to all involved parties. Building offshore wind projects is a National and overarching interest in countries of the European Union and Europe today, not just a business that takes place against market conditions only.

- According to EAS, thirteen energy-intensive industrial units are waiting to come to Estonia, with a total investment of €4,898 million, creating 2,890 jobs. Their annual electricity demand is 5.8 TWh, 73% of Estonia's. These investments will only come to Estonia if the availability of renewable electricity is guaranteed.

- With the establishment of offshore wind projects, maintenance ports will be created in Saaremaa and Pärnu County, creating jobs for residents. A 1GW offshore wind project establishes an average of 150 direct and 150 indirect jobs on site. Paldiski South Harbour has excellent potential to become the offshore construction port for the entire region.

- Based on the current law in Estonia, wind projects share profits with the local municipality. The 1GW offshore wind project will contribute at least €1-1.4 million annually to the local community at today's average electricity prices.

- Estonian offshore wind projects need a plan from the government for the next fifteen years like in the UK, Germany, the Netherlands or Poland. Electricity is required to cover existing needs and the economy's growth and move away from fossil energy sources in all energy consumption.

  The plan must include:
    - Clear legislation.
    - A timetable for support measures.
    - A timeframe for grid connections.

Taking into account last years' hourly electricity prices, the CfD income of one GW offshore park would have been the following for the state:

- If the CfD had been concluded at a price of 75€/MWh, the country would have earned 399 million euros;
- If the CfD had been concluded at a price of 80€/MWh, the country would have earned 379 million euros;
- If the CfD had been concluded for 86.5 €/MWh (the price used in the MKM analyses), the country would have earned 354 million euros;
- If the CfD had been concluded at a price of 90€/MWh, the country would still have earned 340 million euros.

Introduction

The current government coalition agreement states: "The energy crisis, which has substantially impaired the economies of Estonia and Europe more broadly, demands decisive action on the part of the government in establishing new production capacities for renewable energy and boosting security of supply" and "We want Estonia to become a country which exports renewable energy and which is quick to adopt green technologies".

In 2022, Estonia produced 5 TWh of electricity from fossil sources, 2.6 TWh was produced from renewable sources, the largest part of which, i.e. 1.4 TWh, was produced from biomass. Estonia's annual consumption is about 9 TWh. This means that Estonia is an electricity importing country, where not enough is produced to cover domestic consumption. The majority of biomass electricity comes from cogeneration plants. Cogeneration plants produce heat for the local district heating network and electricity. Today, the largest settlements in Estonia are covered by district heating networks, and no large-scale growth in the development of district heating can be foreseen.

Primary energy consumption in 2021 was 116 836 TJ equating to 32.5 TWh. To meet an ever growing share of the energy consumption for the industry for heat and transport with electric power the potential of all renewable energy sources needs to be fully used.

The "Electricity Market Report 2023" of the International Energy Agency says that the European Union needs 39.5 TWh more of green electricity this year than in 2022. In 2024, the need will increase by an additional 37 TWh and in 2025 by 40 TWh. The average price on the Nord Pool electricity exchange remained at an unprecedentedly high level in the second half of 2022, being over 150 EUR/MWh. Low hydro availability in the Nordics and increased cross-zonal demand increased prices by almost 90% year-on-year.

The report articulates the needs: "This decade's fastest changes and largest emissions reductions must come from the electricity sector, and in particular from the rapid expansion of clean electricity generation and consequent reductions in coal emissions. Supply is a critical element in the energy transition, as clean electricity not only reduces energy sector emissions, but contributes to also to reduce emissions in end-use sectors as they increasingly look to electricity to meet demand for energy services. As a result, electricity becomes the "new oil" in terms of its dominant role in final consumption. However, unlike oil, it plays a role in all end-use sectors and significantly improves the overall efficiency of the energy system. By 2050, electricity will provide two-thirds of useful energy for consumers, which is much higher than its share in final consumption (slightly more than half)."

Offshore wind energy, as an advancing sector, holds the potential not only to revolutionize the energy landscape but also to catalyze the emergence of novel industries. One of the most promising avenues is the production of green hydrogen through electrolysis, powered by offshore wind projects. This hydrogen can serve as a clean energy carrier, storage medium, and as a foundational element in various industrial processes. Furthermore, when combined with captured carbon dioxide or bio-based feedstocks, this hydrogen can facilitate the production of sustainable biofuels, creating a synergy between renewable energy and advanced biofuel technologies. The "power-to-x" concept, where the 'x' represents various energy forms like gas, liquids, or chemicals, also gains prominence. By converting the electricity generated from offshore wind into other forms of energy or products, it becomes feasible to integrate these resources into existing infrastructure and markets, ensuring a flexible and resilient energy system. In this integrated framework, the potential to produce advanced biofuels from renewable hydrogen further emphasizes the multifaceted applications of offshore wind, positioning it as a cornerstone for a sustainable, diversified, and integrated future economy.

To meet the future growing needs for electricity and some export capability we are convinced that Estonia needs to also unlock offshore wind potential in the nearest future.

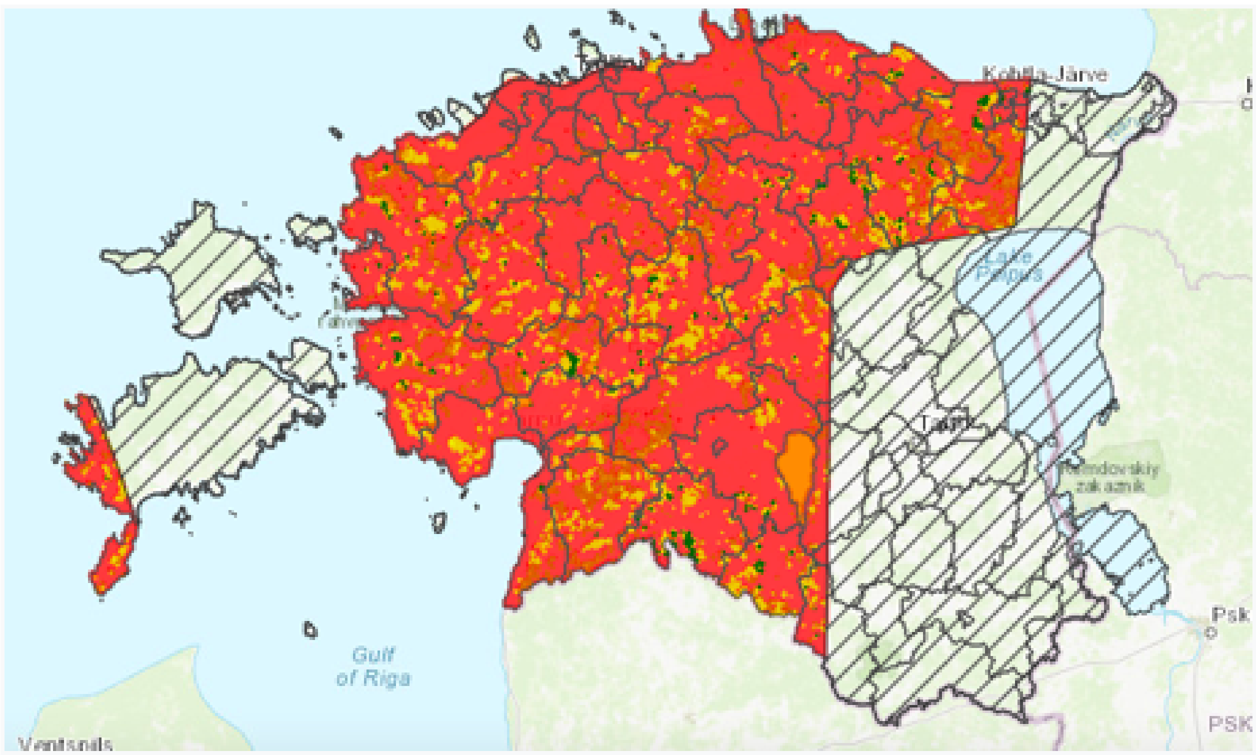
Onshore and offshore wind opportunities for Estonia

Estonia must use the full potential of onshore and offshore wind to meet climate protection, energy independence and renewable energy targets. In terms of efficiency, offshore wind projects typically present a notable advantage, achieving around a capacity factor of 50% compared to the 30% to 35% observed with onshore installations. This efficiency differential means that for a single 18 MW turbine installed offshore, at the end of the decade, one would require nearly four 6 MW turbines onshore to generate comparable power. To put this into perspective, an offshore installation with a total capacity of 1.4 GW, comprising 78 turbines of 18 MW each, would deliver approximately 6.1 TWh. In contrast, achieving this same production onshore would necessitate an installation of 380 turbines, each 6 MW in capacity, amounting to 2.3 GW of installed capacity.

By the end of the current year, Estonia's onshore wind energy capacity is projected to reach 360 MW, with the first wind generator having been installed in 2002. To reach the target of 4.9–6.1 TWh by 2030, as outlined by Timo Tatar at the Estonian Wind Power Association's annual meeting in May, Estonia must commission approximately 2,300 MW in total. This entails the annual addition of 380 MW of onshore wind capacity solely to meet existing demands. Assuming the deployment of 6 MW turbines, there would be a requisite for approximately 380 wind turbine generators (WTGs), demanding an estimated 380 square kilometers of land. While securing such extensive land may pose challenges, a significant portion of the overall renewable energy target will undeniably be realized through onshore and offshore developments.

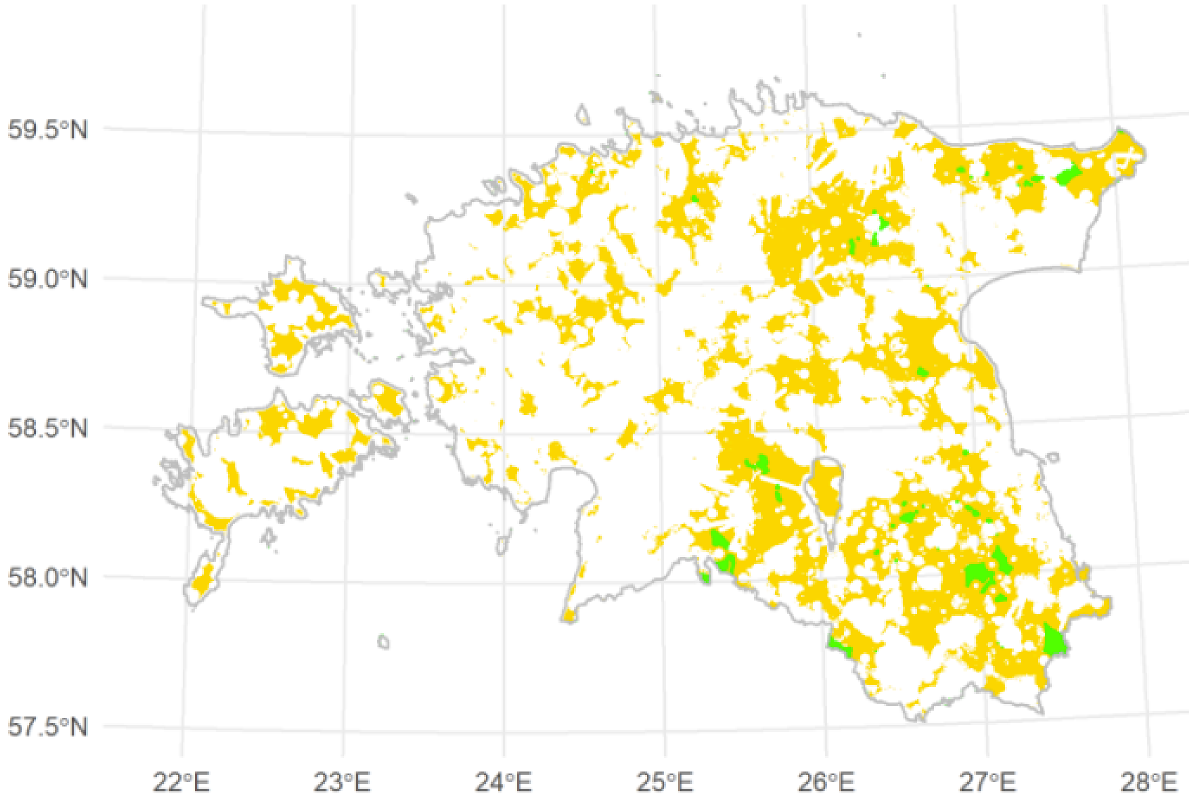
There is not enough land available for onshore developments only

The available land on Estonia's mainland is constrained by various restrictions. A mere 82 square kilometers is currently primed for immediate development, inclusive of the present 360 MW, as per the 2022 analysis by Keskkonnaagentuur. Illustrated maps depict spatial constraint layers: areas marked in red indicate zones unsuitable for wind energy development, those in yellow require mitigation measures, while green zones are immediately available for development.



Recently, a comprehensive Estonian onshore bird study was disseminated. The findings indicate that 243.5 square kilometers (designated as green areas) are viable for onshore wind park development. Meanwhile, 12,131 square kilometers necessitate supplementary studies, and a vast expanse of 31,246 square kilometers has been deemed unsuitable for any wind park ventures. Subsequent graphs delineate that a majority of these green areas overlap with military restriction zones. Furthermore, the yellow zones, requiring additional studies, align closely with residential areas. Thus, while initial assessments may appear promising, it is foreseeable that detailed examinations concerning onshore developments might unearth additional environmental constraints. **In conclusion, solely from an environmental perspective, the limited availability of suitable land for onshore**

developments already poses a significant challenge to meeting the current electricity demand.



The permitting process is too long for both onshore and offshore

While the state and respective ministries have been proactive, as of today, there has been no relaxation in restrictions or simplification of the planning process. In fact, the scenario has become increasingly intricate. Notably, since the enactment of the new planning legislation in 2015, no wind project has either been constructed or seen the commencement of its construction. The two-phase local spatial plan, originally conceived for wind developments and other substantial industrial projects, has demonstrated to be overly time-consuming and resource-intensive. The innovative legislation intended to streamline the planning process by eliminating the detailed phase remains unutilized. The comprehensive information demanded by the Environmental Bureau during planning stages signifies that there isn't a straightforward path to successful permitting.

Despite a seeming commitment to facilitating the construction of new wind parks, ambiguities persist, notably from the Climate Ministry's interpretation of regulations. For instance, the conventional understanding has been that the blade's aerial projection isn't considered part of the building since it doesn't impede land use beneath the wind turbine.

However, this has been contested by the Climate Ministry's interpretation of the act. Even if the act allows for such an interpretation, it is incumbent upon the ministries to introduce modifications that clarify and expedite the permitting process, rather than introduce hurdles. In the context of offshore developments, there's a prerequisite for water usage, superficies, and building permits – all of which are disparate processes. There is an urgent need for a consolidated permit to expedite the process and conserve valuable time.

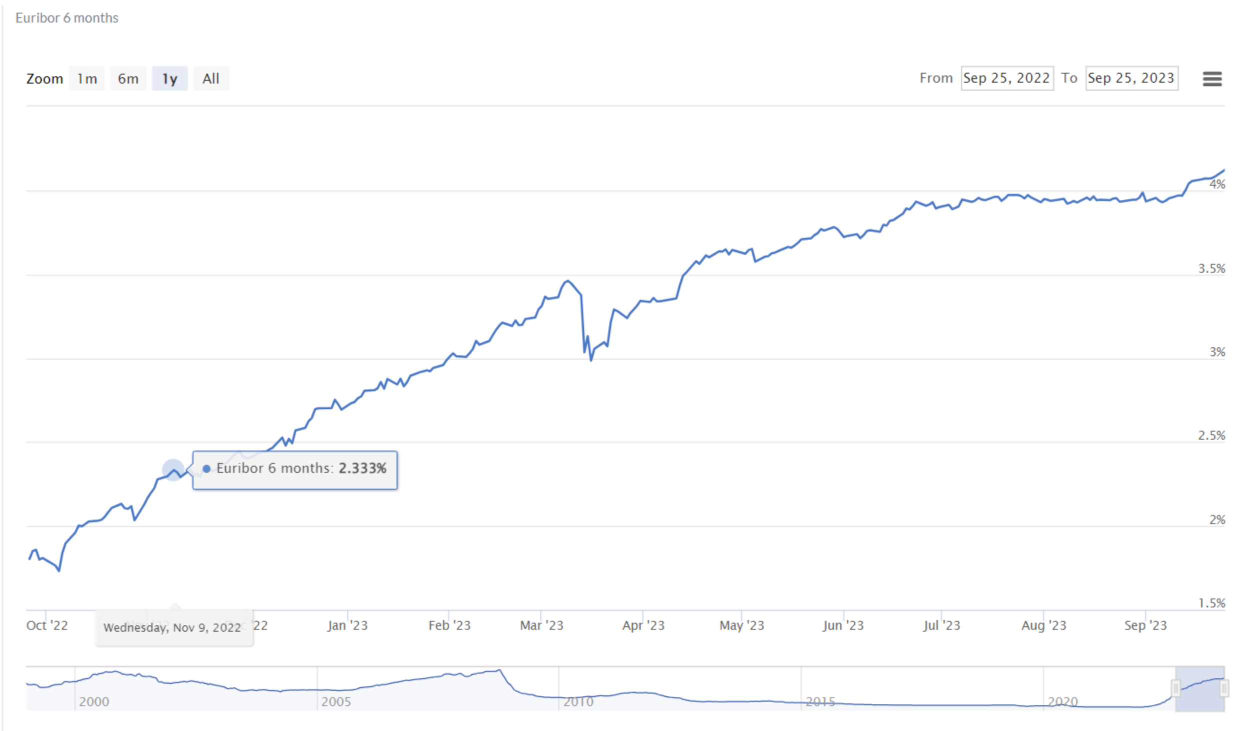
The Grid is a major challenge for onshore and offshore wind

The electricity grid is essential for both onshore and offshore developments. Projects cannot come to realization without cost-effective grid connections. While the government introduced legislation to counteract 'phantom connections' (grid connection agreements made to reserve grid capacity for potential future projects, primarily wind), the desired outcome has not materialized. According to data from Elering as of 25th September, grid connection agreements for approximately 900 MW are based solely on storage, with an anticipated solar connection capacity of 1.5 GW and solar with storage at about 250 MW. Wind energy accounts for a mere 260 MW. While freeing up capacity is a positive step, many wind development projects encounter challenges; an area might be suitable for development, but if the necessary infrastructure, like substations or transmission lines, is remote, the project's financial viability is jeopardized. For onshore projects, many potential sites lack available grid connections, an aspect often overlooked in area assessments.

For offshore wind developments, a clear strategy outlining connection points and timelines is imperative. Regrettably, while the west coast of Saaremaa has emerged as a promising area for offshore development, it lacks a grid connection due to historical factors. Plans suggest a potential fourth interconnection to Latvia via Saaremaa, yet considerable ambiguity surrounds its exact implementation. Absent strategic planning, grid development might not proceed in the most socio-economically beneficial manner. Given the substantial investments required, potentially running into hundreds of millions, it's paramount that the economic impact be maximized. For instance, with the Liivi Bay offshore project, society would reap long-term benefits if a new Elering substation were established near Häädemeeste. Such an initiative would trigger a cascading effect, allowing the Distribution System Operator (DSO) to optimize their network and, eventually, offer Rail Baltic the most cost-effective grid connection. **In sum, an effective and strategically planned electricity grid is essential for the success of both onshore and offshore developments, emphasizing the need for forward-thinking approaches to maximize socio-economic benefits.**

Increasing capital costs and revenue security

The escalation in costs for labor, materials, and technology represents only one facet of the broader economic landscape. The wind sector is grappling with a rise in capital costs, predominantly due to a significant uptick in the cost of debt. In investment ventures, a commonly referenced term is the Weighted Average Capital Costs (WACC). This metric amalgamates expected equity returns and the cost of debt, both of which are profoundly influenced by the project's risk. A subsequent graph illustrates the surge in the 6-month Euribor over the past year—a shift that surpasses the project's anticipated risk profile. For lenders, primary concerns stem from revenue security: the ability of the project to service its debt or the looming potential for default. These concerns are equally valid for equity investments.



In the Baltic region, long-term power purchase agreements (PPAs) have traditionally underpinned onshore investments, serving as a safeguard against the looming risk of loan defaults. Elevated market prices in the preceding year fostered an optimistic outlook on future electricity prices from the investor's perspective, creating a boom in developments. However, the Estonian and broader Baltic market's diminutive size means that with an increasing volume of developments, the risk of plummeting or even negative prices amplifies. Due to the inherent market design, each new wind or solar installation accentuates the discount effect, thereby suppressing the electricity market price—a favorable outcome for the general populace and the economy, but one that could soon reach an investor's threshold of viability. For sizable ventures like offshore projects, this threshold might be met with just a single undertaking. Banks, invariably factoring in potential worst-case scenarios, become cautious. It's acknowledged that some financial institutions have refrained from disbursing loans for solar developments unless the revenue is sufficiently safeguarded. Given the surge in solar investments, the valuation of the Solar PPA profile has diminished, inevitably stalling investments in exclusively solar initiatives. A similar fate looms for onshore wind projects, where an inflated risk profile could render the investment nonviable. As such, it seems improbable for Estonia to achieve its 2030 objective relying solely on merchant projects due to the heightened investment risks.

Mitigating revenue risk can be achieved through mechanisms like the renewable auctions, exemplified by the recent Government-led auction for 650 GWh. A mere 1% reduction in WACC can lower the Levelized Cost of Electricity (LCoE) for offshore projects by approximately 7 EUR/MWh and for onshore projects by about 4 EUR/MWh. Any mechanism—be it a security measure, guarantee, or risk mitigation strategy—that influences the project's risk profile can substantially reduce the LCoE, offering the community electricity at the most cost-effective rate.

In conclusion, while the renewable energy landscape in Estonia and the Baltic region offers potential, the interplay of market dynamics, risk profiles, and financial mechanisms necessitates a thoughtful and proactive approach to harness its full benefits.

The local opposition and court cases

The enactment of the local benefit law by the Government has undeniably mitigated some of the resistance typically termed as NIMBY (Not In My Back Yard). However, several projects still grapple with such challenges. A notable example is the Risti project, which has been delayed by the opposition, extending the initial phase of the planning process to four years - a duration initially envisaged for both phases, with a year and a half spent in court proceedings alone. Similarly, opposition in Põhja Pärnumaa has led the local municipality to approach the potential of their zones with caution in the local master plan. Movements in Saaremaa and Häädemeeste opposing offshore developments further complicate matters by disseminating misleading information about the negative impacts of such projects.

Moreover, it's evident that competitors in the onshore sector sometimes struggle to find consensus, potentially leading to legal disputes. Public skepticism has been directed towards certain actions and decisions by TTJA[1], the entity overseeing offshore project determinations. It is anticipated that these decisions might face legal challenges in the future. In summary, while some measures have reduced opposition to wind projects, significant challenges persist, requiring coordinated and transparent efforts for successful realization.

The offshore pace will be challenging as well but there are three projects in an advanced stage of development that aim to be on-line at the end of the twenties[2] and together they could meet the 3 GW installed capacity. These three projects need to develop fast as

[1] Utilitas: Elwindi hoonestusloa taotlus Sõrve meretuuleepargi rajamiseks on õigusvastane (postimees.ee)
[2] depends on grid developments by Elering

unknown circumstances and risks (e.g. local construction geology, permitting, supply chain, grid connection pace etc.) can slow down the projects. Realization is not guaranteed (yet). There are also a second wave of offshore wind projects in Liivi and Saaremaa areas in the counter application stages by the TTJA in 2023, which has the significant additional potential for the renewable energy production after 2030 and energy export opportunities. It must be also noted that the second wave of offshore wind projects successful deployment is based on the stable regulatory framework and risk-mitigating conditions by the state as indicated for the first wave of offshore wind projects.

Looking at the cost, in principle the LCoE for a kWh onshore is lower than the LCoE for a kWh offshore. Having said so, 43% extra installed capacity is required to reach the same output due to the lower capacity factor.

The integration of onshore wind energy with interconnectors from Latvia and Finland has been cited as an economically efficient solution to the electricity crisis. While the competitiveness of onshore wind energy is not in dispute, one must consider the challenges associated with it. Furthermore, it contradicts the goal mentioned at the beginning of this article: to become energy-independent. These challenges include uncertainties in planning, environmental constraints, limitations of the grid infrastructure, increasing capital costs, revenue uncertainty, local opposition (NIMBY), and potential legal disputes with locals or competitors. Given these impediments, it is optimistic to assume that Estonia will achieve its 2030 energy targets. Consequently, it is more likely that Estonia will transition from an energy exporter to an importer, increasing its reliance on neighbouring nations. Furthermore, recent events from the previous year underscored the potential financial repercussions of such dependence.

In Conclusion, onshore wind cannot be the only way forward as it would even be a challenge to meet the internal Estonian goals as well as realize it’s vision of becoming a net energy exporter. Onshore wind can play a limited role as the required installed capacity is rather high due to the lower capacity factor. Offshore wind has the required potential and will be the main source to reach the goals and the vision.

Offshore wind support and the comparison to neighbouring countries

Offshore wind energy development must be seen as a complex solution where government "support" can and does manifest itself in many different circumstances. The economic situation of the countries are also very different, with different framework conditions which unfortunately cannot be applied one-to-one to Estonian conditions. But Estonia can learn from neighbouring countries and establish joint or matching frameworks, to leverage on economies of scale for project development, supply, infrastructure and logistics.

Supporting factors in offshore wind are:

1. Grid connection;
2. Reliable legal framework / Permitting
3. Support, compensation or CFD
4. Offtake opportunities, "the market".
5. Site Data / Information;

Germany / The Netherlands

Germany and the Netherlands didn't compensate for power produced from offshore wind in the most recent auctions and don’t compensate in current auction designs. The countries even receive money based on uncapped high seabed leases in Germany and capped negative bidding in the Netherlands. Project owners don’t have to invest in grid infrastructure outside of the projects and can rely on guaranteed grid connection milestones. Permitting procedures are proven and developers can rely on clear timelines. Tennet, the Dutch and German TSO, ordered offshore substations for 30 billion Euro, next to contracts for installation, cable contracts and onshore infrastructure to cater for dozens of GW's. The majority of the upcoming tenders will include detailed information on the offshore sites as well as the required permits. The industry, for example around the Rotterdam harbor or Porsche, Mercedes, BMW, BASF or Bayer in the south of Germany, requires energy and delivers solid business cases with power purchase agreements (PPAs). 50Hertz, the second German “offshore” TSO, strongly believes that there could be a business case for an interconnector in between Rügen and Saaremaa. The auction framework in Germany is currently discussed between stakeholders and with the government based on massive expense on seabed leases in the latest auctions. The auction framework in the Netherlands is currently discussed and will be amended to learn from auction results and reflect the developments of the offshore wind industry. So focusing only on 0-subsidy or negative bidding would be a misleading simplification. Germany and the Netherlands do invest in offshore wind, with private and public money, information and legislation and the countries are developing offshore wind on a large scale.

Poland

Poland is heading for two-way CFD auctions. That can lead to support from the Polish government, a significant budget is available. The first round in Poland around 6GW of projects received a direct tariff based on the status of the development without an auction (“During the first phase of the scheme, offshore projects will be granted aid using the exception to the auction requirement, due to the existence of a very limited number of projects”, statement of the EU, https://ec.europa.eu/commission/presscorner/detail/en/IP_21_2567). This was approved to kick-start renewable (offshore) energy in Poland. Currently the developers and the Polish government are discussing indexations to cope with the inflation in the supply chain. Next to this the Polish market is in need of (renewable) energy. Thus Poland is supporting offshore wind regulatory and financially and project execution is about to start in the coming years.

Sweden
Sweden is not supporting offshore wind, no compensation , tough regulations, ever changing ideas on grid connection and the lifetime of the nuclear power plants in the south seem to be extended. It shows, even though there are a large number of developments. The last small offshore wind farm, Karehamn (48MW), was installed in 2013. Essentially, no support, no offshore wind.

UK
Launched in 2014, the Contracts for Difference scheme ensures projects receive a guaranteed price from the government for the electricity they will generate – giving companies certainty and confidence to invest in the UK. CfD is a British success story, with the government committed to its ambition of securing 50GW of offshore wind capacity and 5GW of floating offshore wind by 2030. The UK is home to the world's four largest operational wind farms and just last year the UK installed 300 new offshore wind turbines, with Contracts for Difference contributing towards 29GW of total wind capacity and helping power the equivalent of around 24 million homes. Due to a very low CfD level, that did not take high inflation into account (44 GBP/MWh bottom fixed and 114 GBP/MWh floating), not a single offshore wind project participated in the latest offshore wind auction as indicated before by stakeholder, but ignored by the government. Estonia can learn from the UK to better consult with stakeholders.

Estonia
Estonia doesn't have compensation, CfDs or similar measures for offshore wind today. We do not have a grid connection provided by the state today or a clear plan from the TSO when and how the offshore grid connections will be established. Moreover, building a network today is only a cost to the developer. We have an MSP that provides a broad overview of offshore wind areas but needs more information from the point of view of establishing offshore parks. Our legislation is very recent and changing. It has not yet been tested in practice. Estonia's internal consumption is small, and although the potential is excellent, it is not enough to attract investments.

International competition

A competition is taking place, a competition between countries to attract offshore investments, offshore developers and the offshore supply chain. On a global scale, Europe vs America vs Asia compete also for infrastructure and logistics. In Europe competition is between a large number of countries. Many of the major developers are not actively pursuing offshore wind projects in Baltic Countries anymore. RWE, Total Energies and Orsted have recently left the Estonian market. Also, only two companies were active in the first Lithuanian auction due to a lack of transparency, the auction framework and late publication.

What’s in it for Estonia?

Next to becoming energy exporter, energy independent and complying with (inter)national goals and agreements Estonia is in a position to become the first and largest offshore wind energy hub in the middle / northern part of the Baltic Sea.

The EAS analysis shows that 13 significant energy-intensive investments are willing to come (if conditions allow) to Estonia in the near future. The total volume of investments is 4,898 million euros. Of these, eight projects will create 2,890 jobs, which is 0.4% of all employment in Estonia.

The annual energy demand of these eight projects is 6.8 TWh, which is 19% of Estonia's annual energy demand. The electricity demand of these projects is 5.8 TWh, which is 73% of Estonia's yearly electricity consumption.

Within Estonia, three developers are proceeding, taking risks and investing significant amounts of money, two large areas (Saaremaa and Gulf of Riga/Liivi) are defined for large scale offshore wind development. The Second wave projects’ auctions are being prepared where several offshore wind farms’ developers will compete to pay money for the right to investigate and develop marine areas. There is a real interest to connect Saaremaa to Rügen (Germany) with a high voltage interconnector. The current investment potential looks promising. However, it needs to be enabled by the next steps defined in the “Solutions for Estonia” paragraph.

The development of offshore wind will next to the above major goals for example give an opportunity for the establishments of long term O&M harbors, chances for supply chain (secondary steel (Marketex)), CTV vessels (Baltic Workboats), etc.) and becoming first mover in Power2X. Saaremaa could become an energy hub in line with the plans on and around Bornholm which could lead to industrial (Power2X) activity (and related infrastructure).

In the analysis "Wind energy and economic recovery in Europe" published by Wind Europe, points out: 1 GW of wind power creates 1,133 jobs over the entire life cycle, of which 453 are indirect and 680 are direct jobs. The same analysis suggests that about 1/3 of direct jobs are related to park operation and maintenance. The summed European experience is that 1 GW creates an average of 226 maintenance-related jobs, with the volume of wind turbine maintenance technicians being higher in onshore wind farms and lower in offshore farms with a higher proportion of other direct jobs. International experience says that 1GW offshore wind brings 100 maintenance technician jobs and 50 maintenance-related jobs. The forecast for Estonian offshore parks (3GW) will bring us 450 maintenance technician jobs by 2030 and as many related jobs.

Kuressaare Vocational School submitted a project application of EUR 1.98 million to the business development measure for the establishment of a training base for wind turbine technicians to support the achievement of the goals set in the development strategy of Saare County.

The local benefit law for offshore wind energy states that all municipalities within 20 km from the closest offshore wind turbine receive income from 0.5% of the energy produced. The payment is calculated using the quarter's electricity production and the average day-ahead spot market electricity price. The law sets a minimum capacity factor for payment calculation at 32%. The direct local benefit payment is divided proportionally between municipalities according to distances to shore.

In the example of 1 GW offshore wind park:
The local benefit if the average power price is 75 €/MWh equates to at leas**t 1.05 Meur** per year.
The local benefit if the average power price is 100 €/MWh equates to at least **1.4 Meur** per year.

During the Paldiski conference we heard the ministry of climate raising the question why Estonia should export energy to other countries while its citizens had to bear the environmental impact of offshore windfarms. We would like to raise the counter question why Estonian citizens should pay Finnish utilities to provide their electricity – generating tax income in neighboring countries and thereby contributing to prosperity and social welfare on the other side of the gulf?

It is absolutely understandable that the Estonian government is seeking for the best possible solution to provide affordable electricity to their citizens. But we strongly advise that short-term low costs should not be the only criterion. The advantage of stable prices over long periods of time due to full control over our own production capacity should be weighed against it as well.

Solutions for Estonia

As extensively shown above offshore wind is essential to reach the Estonian goals. Further on solid long term commitments from the government are needed to develop towards an optimized energy mix which can secure Estonia's needs in 2030 and far beyond. Next to offshore wind, onshore wind turbines are a primary need to ensure energy security though unfortunately there is not enough land to cover all the growing needs. Solar farms cannot produce the required energy and nuclear electricity is not suitable yet for large scale implementation. In line with the above to secure the future energy mix and the investments needed to develop this energy mix Estonia needs to agree on a renewable energy roadmap for 2030 and beyond. The current approach is mainly a step by step approach, focussing on short term solutions only. The roadmap needs to provide solutions promoting and combining all available renewable energy sources. Estonia will need all of them.

Focusing on the offshore wind development the next steps needed are :

- **The government needs to develop a renewable energy Roadmap 2038 based on a strong offshore wind basis.**
    - This roadmap must outline the major steps for the upcoming 15 years, up to 2038. As the development of large energy production plants (including offshore wind) will take time, a point on the horizon is needed as companies need a reliable route to realization. The first round of offshore wind farms need this to invest in the realization of their projects before 2030. The second round of offshore wind farms (current auctions) need a stable outlook as they are considering investing now to be able to build projects after 2030 and large scale Power2X developers need to invest in their pilot projects now to harvest in the mid thirties. Investment security is needed;
    - The roadmap must not only look at the Estonian consumption in 2030 but must give guidance to developments after 2030, in and outside Estonia, and give Estonia the opportunity to become the Baltic Sea energy hub connected to all surrounding countries and those further south;
    - The roadmap must incorporate the envisaged goals and practical steps on, amongst others, accelerating the permitting process, the connections to the national and international grid and the security of the revenue streams for the projects. These practical steps need to be aligned.
    - The Roadmap needs to include improvement and acceleration of the permitting procedures. Acceleration of permitting procedures for all upcoming offshore wind projects is already on the agenda though the real effect is not visible yet. Next to the timely availability of the superficies license and the building permits, the grid connection permit (land-use planning for grid) is the main trigger for reaching the Final Investment Decision. Combining and accelerating procedures is needed to fulfill the 2030 goals and ambitions beyond;
    - It is essential for any upcoming auction, for exclusivity or for a CfD, that developers can rely on a reliable and fast permitting process.
    - Acceleration of the development of onshore projects is needed as well and also these permitting procedures need to be optimized. New additional requirements should be limited.
- The Roadmap needs to outline the grid developments
    - Next to the grid connection permitting process it is of utmost importance that the future grid plans will be based on the goals of the roadmap and the on-going and upcoming offshore wind developments. Developers will not take a risk to develop, and invest in, a project without knowing when grid capacity and a grid connection is available.
    - The grid over Saaremaa and international connections (LV, FIN, GER) strengthen the entire Estonian electricity system and thereby create better opportunities for connecting offshore wind farms to the grid and for exporting energy surplus.

    - To unlock part of Estonian offshore potential it is necessary to work on an Electricity interconnector with an electricity demanding market such as Germany. At least 2 GW capacity interconnector could be financed by EU, Elering's congestion income and private investors in such a way avoiding transmission tariff increase. Regulation should be in place to allow private investors (like for example Neuconnect (German – UK interconnector)) to invest and develop the infrastructure.
- The Roadmap needs to create a reasonable revenue outlook
    - Unfortunately the Estonian energy landscape at this time cannot provide PPA's that would give sufficient comfort to invest in the realization of large energy production plants like offshore wind farms. Based on the Roadmap this can change in the future due to interconnectors and Power2X developments;
    - A commitment is needed that the government will roll-out CfD programs in a way which maximizes the value of the provided support for Estonia. This is done by having most possible competition in the CfD auctions. As the first wave projects have been established on an open-door basis without any assumed support (and hence also without any state payment) these projects should be less sensitive in requiring a CfD. Consequently, it could make sense that the CfD auctions are structured in way where first and second wave projects are able to compete equally (entry requirement for the CfD auction could e.g. be site exclusivity) in a first CfD auction and then later CfD auction to include later waves (and earlier waves if not successful in earlier CfD auctions).
    - Following this commitment the government can use 1 to 1,5 year to define and discuss the conditions for the CfD auction rounds.;
    - The roadmap should outline the development of interconnectors and Power2X opportunities which would broaden the Estonian energy **landscape and lead to developments that will need less governmental support.**

CfD and electricity price calculations

Contracts for Difference (CfD) present a strategic advantage for governments in the facilitation and promotion of offshore wind projects. Through the CfD mechanism, governments can assure long-term price stability for energy producers by guaranteeing a fixed remuneration rate for the electricity produced. This in turn reduces exposure to market volatility, fostering an environment conducive to sustained investment by mitigating associated financial risks and ensuring predictable revenue streams. Additionally, the structure of the CfD ensures fiscal prudence; in instances where the prevailing market price surpasses the agreed CfD strike price, developers are obligated to refund the excess, safeguarding the state from potential overexpenditure and simultaneously benefiting consumers during periods of elevated market rates. Moreover, as the offshore wind sector evolves and attains economies of scale, the competitive nature of the CfD auction system further catalyzes cost reductions. This not only ensures value optimization for taxpayers but also reinforces the government's commitment to renewable energy targets.

CfD calculations have been made with a monthly power price resolution for a 1000 MW offshore wind farm with a net capacity factor of 45% based on historic hourly market price data.
Calculations highlight that the renewable energy sector would be supported during times of low energy costs resulting in a prospering economy and strong tax revenues. During times of high energy costs, renewable energy producers contribute significantly to the state's budget, which can be used to ease economic hardship.

Year/ price	**75 €/MWh**	**80 €/MWh**	**86.5 €/MWh** (MKM analysis strike price)	**90 €/MWh**
2019	116 594 779	136 304 779	161 927 779	175 724 779
2020	165 573 938	185 283 938	210 906 938	224 703 938
2021	-60 472 926	-40 762 926	-15 139 926	-1 342 926
2022	-399 103 829	-379 393 829	-353 770 829	-339 973 829
SUM	-177 408 038	-98 568 038	3 923 962	59 111 962

*negative sums represent payments from the electricity producer to the state.

Summary

It is in the national interest of Estonia to become energy independent and to have full control over its own generating capacity. This will grant stable energy prices for decades. It won't come for free, but the socio-economic benefits outweigh the short term advantages of alternative solutions, like e.g. to enter into new dependencies with neighbouring countries.

According to WindEurope, every GW installed capacity off-shore will create about 150 direct jobs and further 150 indirect jobs for the operation and maintenance. Local companies like BLRT Marketex, Baltic Workboats, Port of Tallinn would gain directly. But what counts much more is a recent analysis of EAS, which concludes that Estonia could gain the chance to attract a number of energy-intensive investments to the country, which would have the potential to significantly impact Estonia's economy by creating up to 2,890 jobs. This includes the investment in new technologies, like Power2X. But the energy demand of these investments is significant and far beyond today's energy production in Estonia.

A view on neighbouring markets show that offshore wind only can be attracted if the government provides an attractive framework. This primarily comprises secure timelines for grid availability, reliable permitting processes and an economic framework that grants long-term security for investors. One approach for the economic framework could be the introduction of Contracts for Difference (CfD), which act like a kind of insurance: In times, when electricity prices are low, the government stabilises the cash-flow of the renewable energy producers. And in bad times, when energy prices are high, the investors pay the difference to the market price back to the government. Local municipalities will benefit even more through the guaranteed sharing of 0,5% of the gross sales.

There is a common belief that Estonia can achieve its 100% renewable energy goal by 2030 through investment in onshore wind alone. But onshore wind simply cannot grow that fast due to a number of constraints (grid, conflicting interests, availability of areas), and the final capacity is limited due to the lack of space.

To meet the growing electricity demand and to enable some export capability, Estonia should develop own renewable energy generation, and offshore wind emerges as the most scalable solution for this.