Revolutionising Orsted's Offshore Wind Power

Kosciuszko Consulting

Orsted should target Germany and the Netherland whilst differentiating through systems integration

Executive Summary

Question of Case

How can Orsted best reach its 2030 target of 30GW for offshore wind energy?

Issues

Competition
How can Orsted differentiate itself from increasing competition to continue winning auctions?

Financial Viability
Orsted has a limited budget of $200 DKK bn to achieve its ambitious 2030 goals.

Strategy

Eyes on the Prize
Prioritising the largest core markets by GW: Germany and Netherlands

Hydrogen Electrifies
Formalise partnerships with electrolyser OEMs to form a persuasive bidding case – an integrated solution combining offshore wind energy with Power-to-X green hydrogen technology to differentiate from competitors and meet demand in core markets

Impact

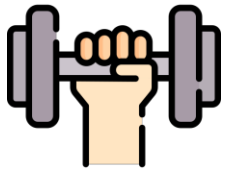
30.24 GW
Installed Renewable Capacity by 2030

$166 DKK bn
In CAPEX and DEVEX Costs, below budget of $200 DKK bn

36 Mt CO_2
In total avoided emissions from wind turbines by 2030

Orsted should move away from price competition and focus on its other differentiation pillars.

Company Analysis



Current Strength

Project deliverability:

30 offshore wind warm installed.

Past project enhances reputation.

Existing initiatives:

Less cement in turbine foundations
Sourcing sustainable steels
Recycling blades
Green procurement activities

Goals & Ambition

Wants to upskill local content and innovation hub.

Wants to become more ecologically friendly. Eg. Artificial reefs (Netherlands).

Improve system integration - Power to X

Cautions

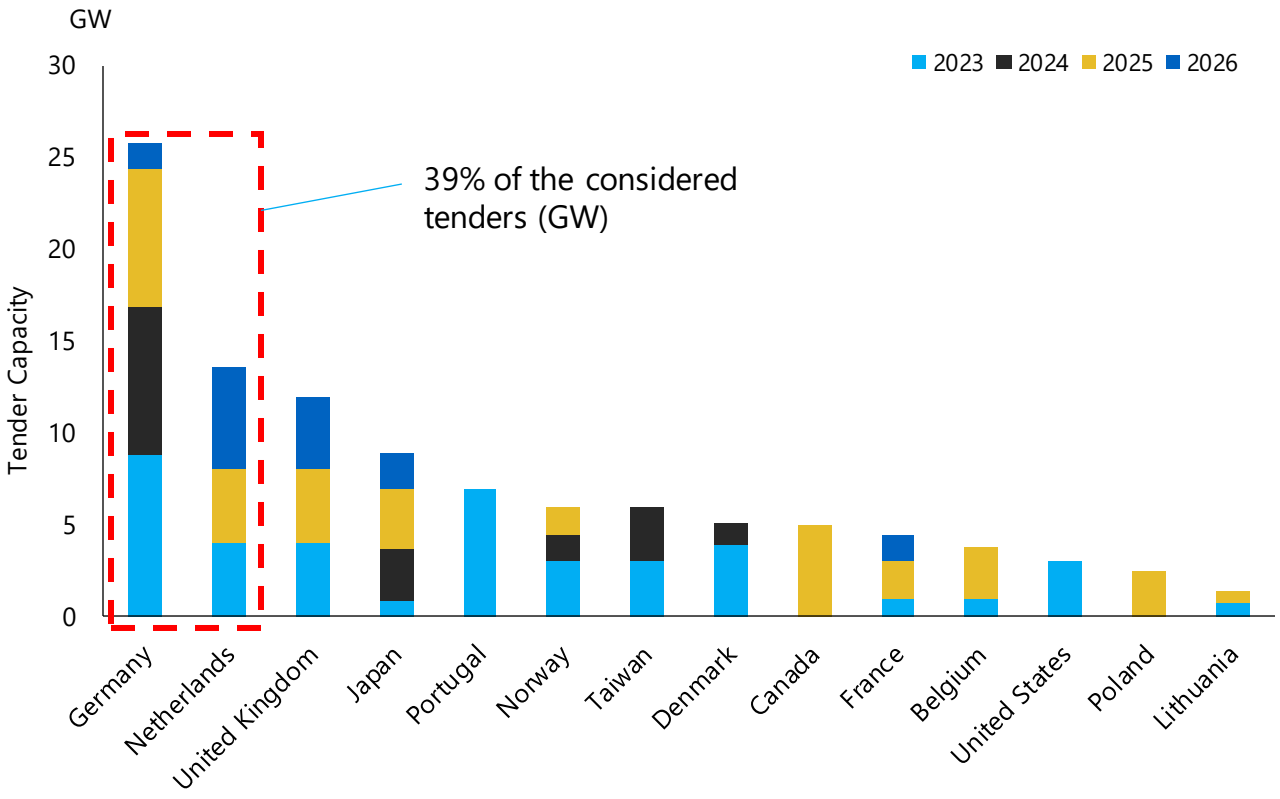
Steer away from **cost** leadership, price reductions

Focus more sustainability initiatives & quality of wind farms.

Orsted should target Germany and the Netherlands which account for 39% of the considered tenders

Market Selection

Off-shore Wind Tender Capacity by Country



Germany and Netherland hold the largest for offshore wind capacity.

Highly Valued Factors

	Germany	Netherlands
Price	🟡	🟡
Local Content	🔴	🔴
System Integration	🟢	🟢
Ecological Mitigation	🟢	🟢
Sustainability	🟢	🔴

Germany and Netherland highly value system integration, ecological mitigation, and sustainability.

However, it is becoming harder for Orsted to win auctions and differentiate from competition

Auction Criteria

Auction Criteria	Countries / Weightings		Market Players			
	Germany	Netherlands	O'rsted	RWE	Vattenfall	Iberdola
Price Market average of 582DKK/MWh	60%	50%	Hornsea 3 offshore wind farm price at 315 DKK per MWh	17Bn/GW DKK investment ~ 10% less than Hornsea 2	Past bid of 506 DKK per MWh.	23Bn/GW DKK investment ~ 20% more than than Hornsea 2
System Integration Combining offshore wind with other technologies.	20%	25%	**Rockstart** - Innovation Program & Power to X (infancy)	Innovation Competition (2018) & IoT Projects	Integrated real time chatbot Nina	**PRESEO** Venture & Demand side electrification
Ecological Mitigation Limiting environmental impact	20%	25%	Artificial Reefs 3D printed corals	Recyclable blades Marine life research Hybrid electric vehicle	Suction bucket & anchor windfarm to reduce noise	Good workers rights, leader in human rights

To increase win rate, Orsted should differentiate its offerings through improved systems integration.

Strategy

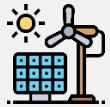
Eyes on the Prize & Hydrogen Electrifies

Ørsted

Kosciuszko Consulting

Green hydrogen stands out as a winner against other strategies in the sub bracket of system integration

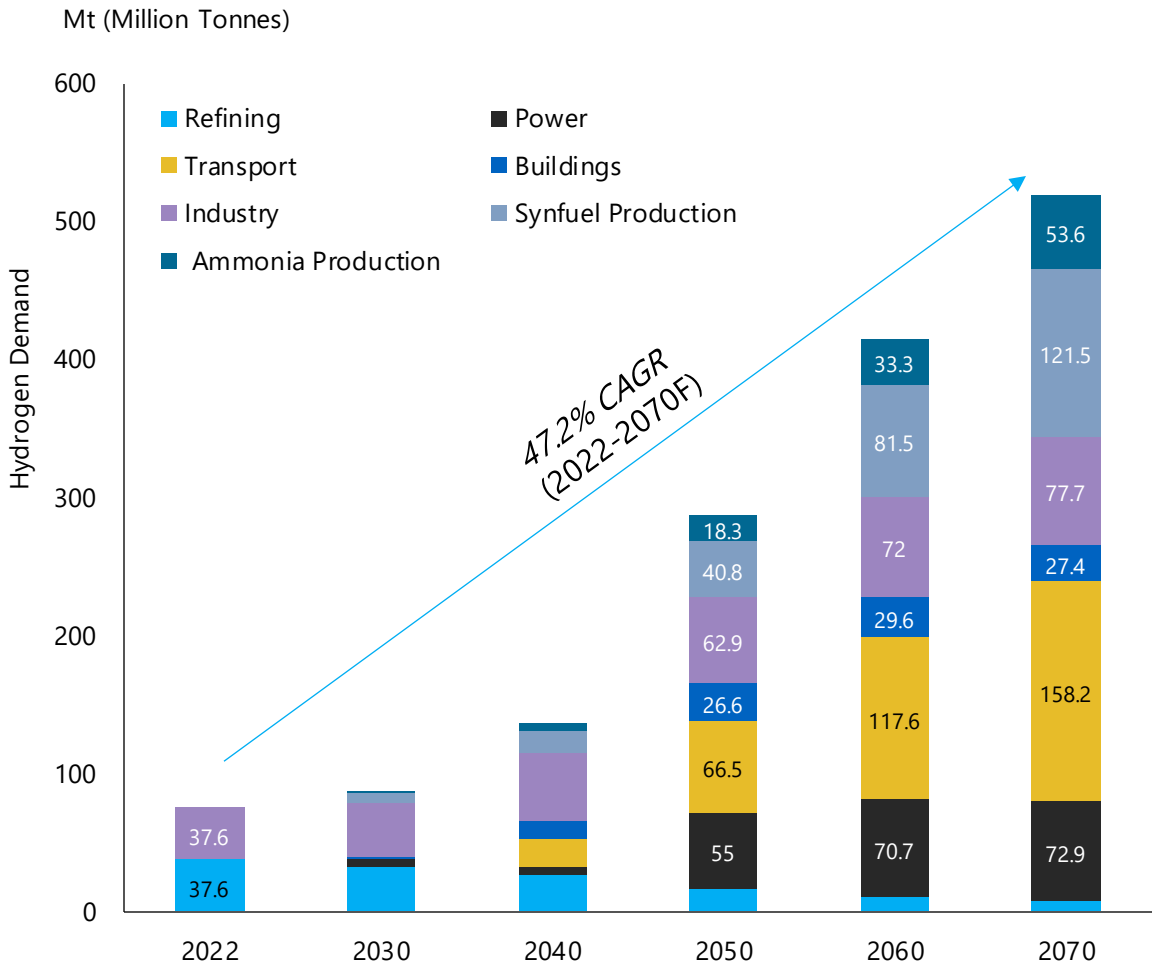
Decision matrix

Alternative Strategies	Advantages	Disadvantages
 Community Microgrid Integration	✓ Decentralized power grids are **isolated** from national **blackouts**	✗ Not very scalable as microgrids must be customized for each local community ✗ Up-front risk of major policy changes
 Decommissioned Platforms Purchase	✓ Oil/gas platforms eligible for decommissioning are repurposed to become offshore wind farms ✓ **Employment opportunities** to redundant oil/gas platform workers ✓ **High availability** of oil rigs eligible for decommissioning - 2021-30 period sees decommissioning of 33% of fixed platforms that are currently in operation (Source: S&P Commodity insights, 2021)	✗ Regulatory barriers regarding the rigging area I.e. If you have a lease to drill, then you only have a lease to drill – may not have a permit for the purpose of wind ✗ Economic infeasibility – decommissioning cost proven to be lower than installation CapEx (Source: J Braga, 2022) ✗ Connecting the offshore wind farms via power cables with the oil platforms may be complex.
 Hybrid Wind & Solar PV Opportunity	✓ Solar generation during the day **complements more intense wind speeds during the night** ✓ Hydro pump acts as a large battery that rebalances the energy output when the wind stops blowing	✗ Only works under specific geographic conditions: turbines must be on a hill and must accommodate for an underwater, man-made lake 600 feet below the wind farm (Source: General Electric, 2016) ✗ Lengthy payback period up to several decades
 Hydrogen Production	✓ **Demand is set to skyrocket** in the next 10 years, underpinned by the process to reach government and corporate sustainability targets ✓ Attractive **substitute for fossil fuel** especially as policies such as Germany's National Hydrogen Strategy (Jun-2020) introduces CO2 pricing for fossil fuels in transport and heating ✓ Orsted can front-run the **commercial use boom** in hydrogen energy	✗ Currently a nascent industry, so industrial use is stymied by the lack of hydrogen energy distribution capability and producers not yet able to capitalize off economies of scale.

Demand for green hydrogen is expected to take off across German and Dutch end-markets

Hydrogen Industry Opportunity

Forecast Global Hydrogen Demand by Sector



Hydrogen in Germany

1. 10GW Hydrogen production capacity target, increased future accessibility as there are plans to develop a national hydrogen energy pipeline in 2027
2. Government subsidies expected to be available for electrolyser plant construction ranging from 20MW-100MW+ capacity
3. Government expected to spend €5B over 2022-24 to decarbonise steel industry, where hydrogen input is necessary

Hydrogen in the Netherlands

1. 4GW Hydrogen production capacity target, HyWay27 expected to be in operation in 2027
2. Total available budget of €800M to subsidise Dutch hydrogen-related projects
3. Government to repurpose natural gas infrastructure to produce world's first national hydrogen network by 2021

An OEM partnership is recommended to supplement a bid with additional hydrogen capabilities

Potential Electrolyser OEM Partners

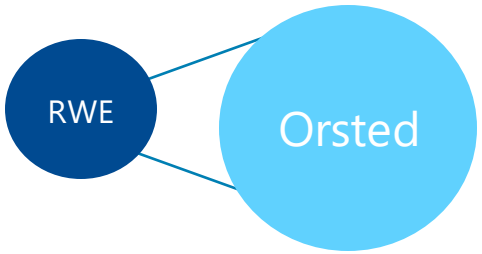
Orsted is recommended to differentiate its bid through implementing hydrogen production and storage in addition to off-shore wind generation

Credibility

- Orsted's strong track record of project deliverability (on time, on budget) can be leveraged
- However, we acknowledge that this is Orsted cannot solely rely on this internal strength

Scale

2.5x larger than the 2nd largest wind player globally

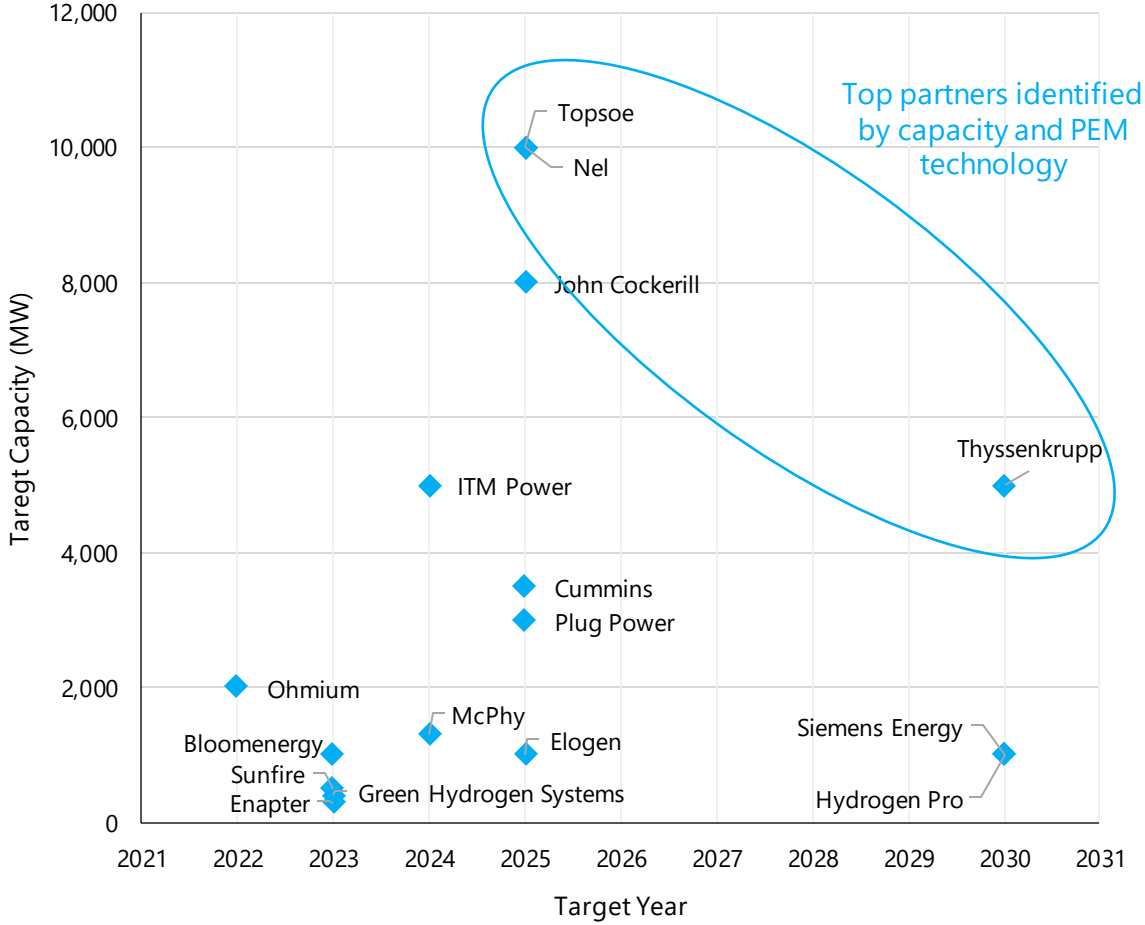


- Orsted's scale presents them as a key enabler for government to reach their renewable energy capacity and decarb targets such as those in the Esbjerg and Marienborg declaration

Systemic integration through partnerships

- Orsted must pursue partnerships with electrolyzer OEMs that are large enough to accommodate for their ambitious 8 GW upgrade in offshore wind capacity
- Creating electrolyser technology in-house is not Orsted's specialty and would be exhaustive to their R&D budget.
- Therefore, for a streamlined build-out, it is most beneficial to seek partnerships – Topsoe, Nel and Thyssenkrupp identified as the top potential partners

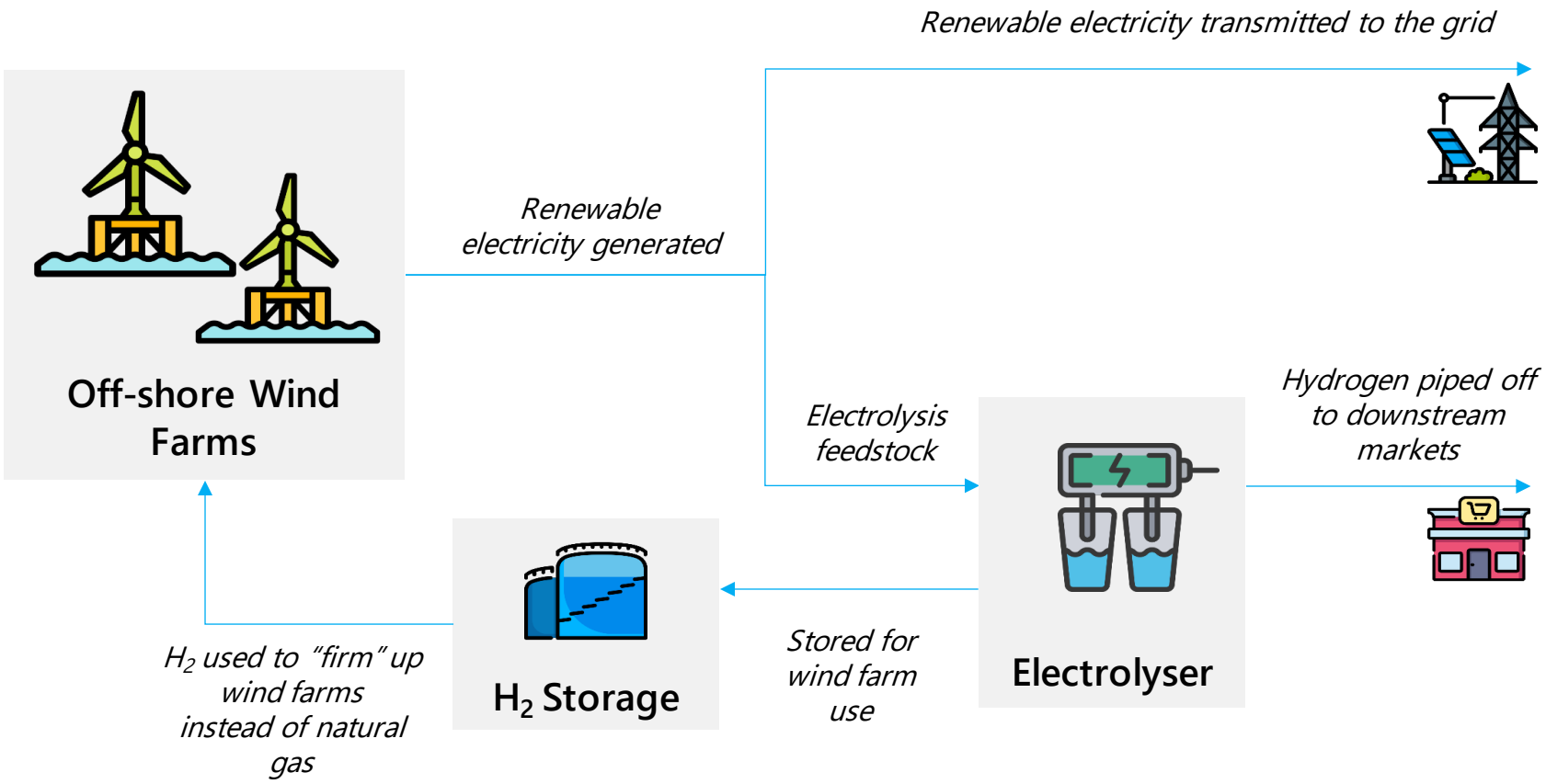
Electrolyser OEM Target Capacity by Year



Note: John Cockerill was excluded as it offers alkaline technology whilst our preference is for PEM technology since it can start faster than alkaline, are therefore is a better complement to intermittent generation

Electrolysers and hydrogen storage can diversify revenue streams and support existing operations

Design Concept



Key Benefits

- Stronger technological integration to win bid
- New revenue stream to enter into growing H_2 market
- Opportunity to firm assets with non-carbon intensive H_2

Downstream Markets

Mobility…	Rail transport, power, fuel cell vehicles
Heat…	Industry, resi and commercial buildings
Feedstock…	Steel-making, gas blending, ammonia fertilizers

Sustainability / Biodiversity Initiatives

To have a positive biodiversity impact, wind farms should be more than just a passive power-generating vehicle: they can be equipped with **IoT technology** to monitor and report temperature and pH of the ocean zone and be designed with **artificial reefs** to host marine life around the foundations of the turbines.

A central electrolyser will be positioned to benefit Orsted's wind farms' clusters

Potential in proximity

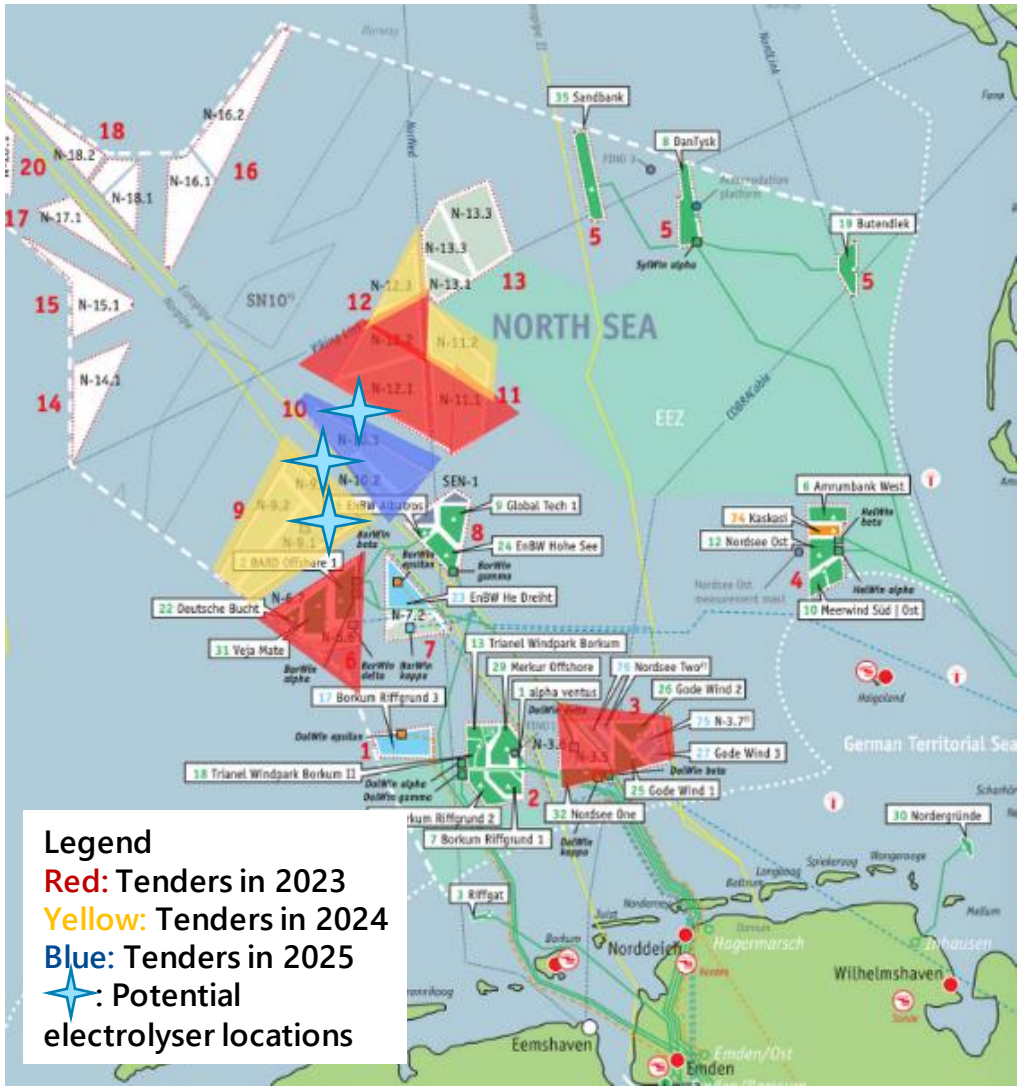
Parallel bidding rationale

1. Establishing parallel tracks of approvals for the auctioned zones can allow Orsted to dominate the key areas such as the North Sea
2. A single offshore electrolyser is more economical than an onshore electrolyser or individual electrolysers attached to each individual turbine
3. Owning wind farms proximal to each other allows Orsted to tap into the scale advantages by building a single or few electrolysers in the centre of the wind farms cluster (especially between zone N-9, N-10, N-6 and N-12)

Priority auction combination of German and Dutch zones:

2023	2024	2025
• IJmuiden Ver I • IJmuiden Ver II • IJmuiden Ver III • IJmuiden Ver IV		• IJmuiden (Noord) Ver V • IJmuiden (Noord) Ver VII • Netherlands Nederwiek South I
• N-11.1 • N-12.1 • N-12.2 • O-2.2 • N-6.6 • N-6.7 • N-3.5 • N-3.6	• N-9.1 • N-9.2 • N-9.3 • N-12.3 • N-11.2	• N-10.2 • N-10.1 • 2025 Auction

^All auction formats: Central, all technology: Fixed



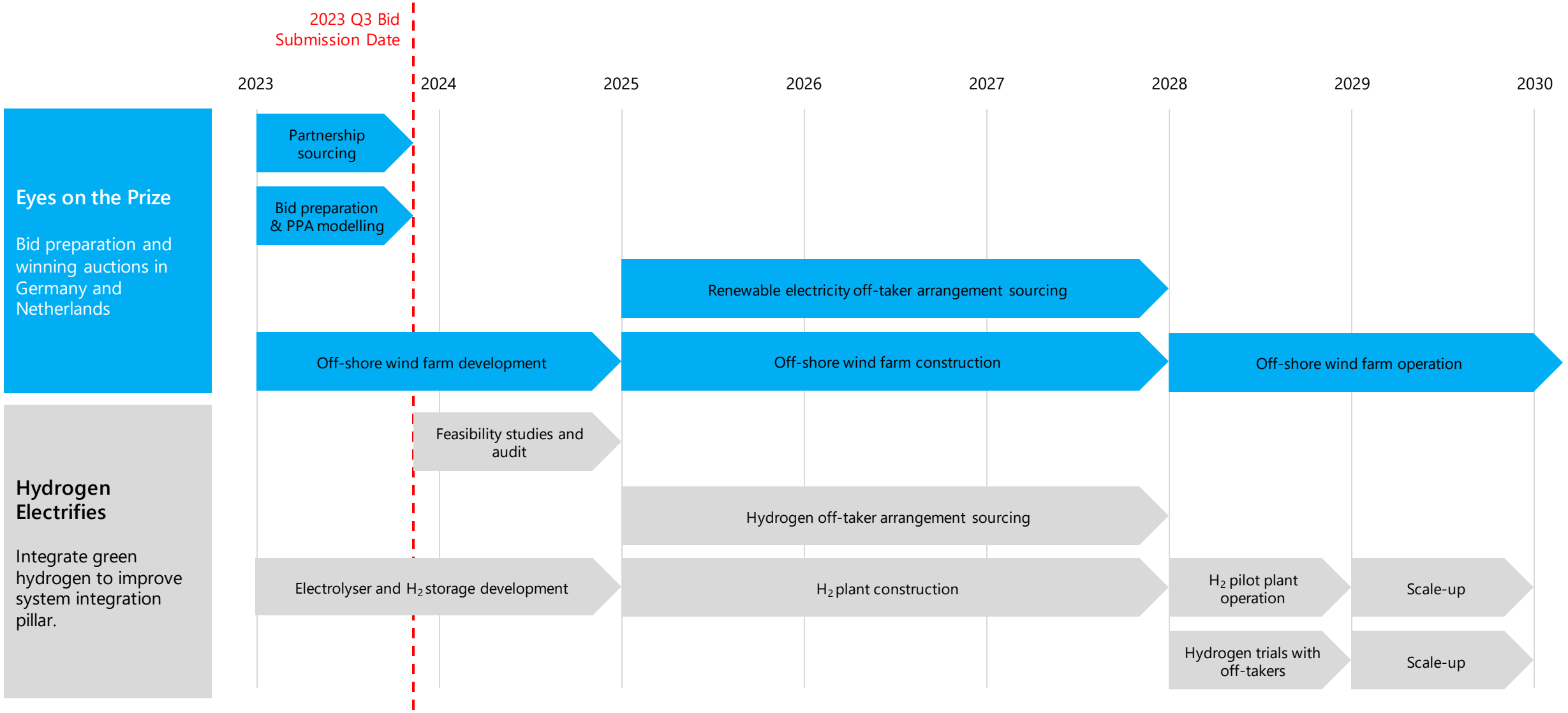
Implementation & Financials

Ørsted

Kosciuszko Consulting

Orsted should focus on the 2023 bids in the short-term and contract partners for the long-term

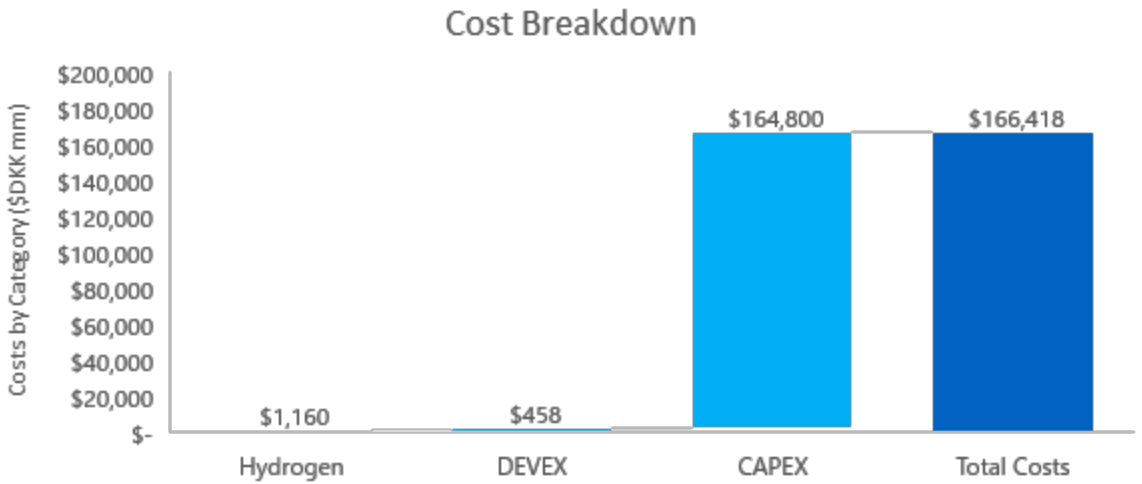
Implementation Timeline



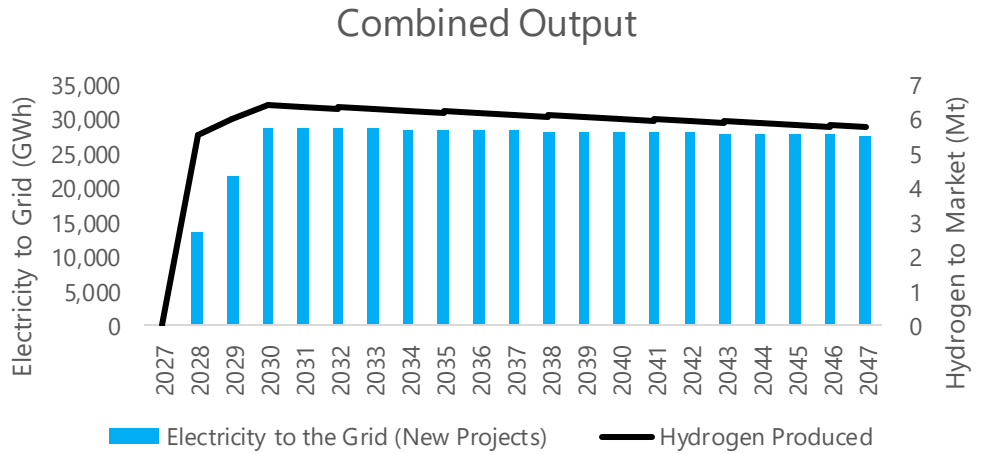
Orsted can achieve its 2030 objectives whilst remaining under the budget of $200DKKmm

Financials

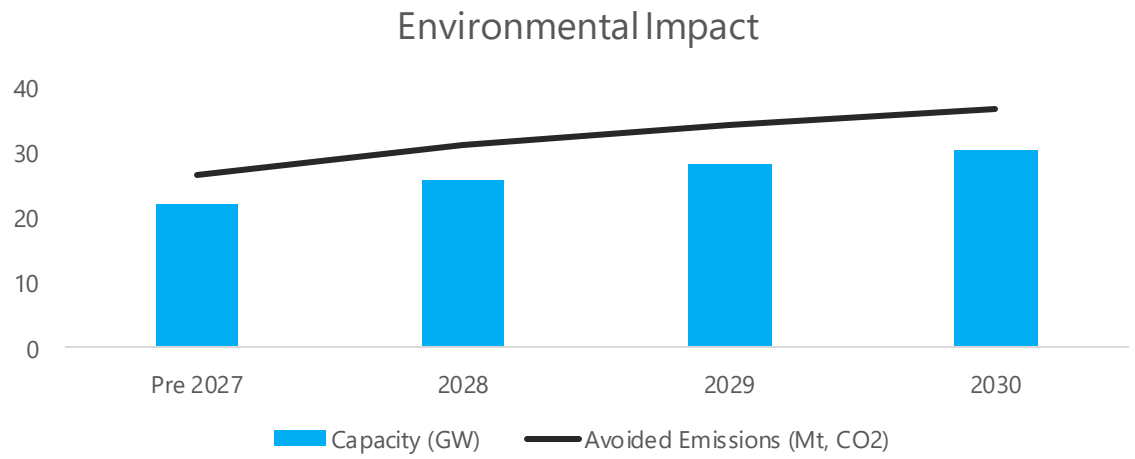
Cost comprises mostly from CAPEX, totaling $166 DKK bn



8GW translates to 28,000 GWh and 6 Mt of Hydrogen



Accomplishing 2023 targets and avoiding emissions



Key Assumptions:

- Tender win rate increased from 30% pre-2025 to 45% post-2025 (when hydrogen plants are operational)
- Degradation of 5% p.a. applied to new turbines
- Wind turbines emit 6g of CO2 / kWh compared to 900g from coal-based power plants
- Hydrogen electrolyser CAPEX of $30 DKK mm / MW, with OPEX at 1.5% of CAPEX

Appendices

Ørsted

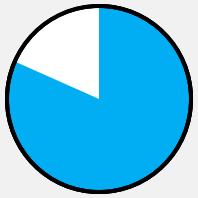
Kosciuszko Consulting

Green hydrogen use cases in the Netherlands and Germany

Appendix

Transport

- Industrial ports opportune for hydrogen-powered transport
- Greening the maritime sector is a trend seen with the Netherlands starting to retrofit coastal shipping with hydrogen
- Diesel trains to be replaced by hydrogen models in the next 10-15 years as hydrogen offers the compact propulsion system, with rapid refueling times and a long travel range

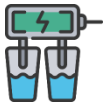


It is estimated that 20% of all German utility vehicles will be hydrogen powered by 2035

Gas blending

- Local chemical plants can employ green hydrogen to create low-emissions heat and power
- Appeals to governments since CO2 reduction targets in transport, heat supply and industry can only be achieved if progress is made in the large-scale use of zero-emissions energy sources like hydrogen
- The ecological mitigation advantages from this industrial gas blending use case of green hydrogen is clear in the recent case of RWE's Eemshydrogen which demonstrates:

160MW wind farm



50 MW electrolyser capacity

Industrial use leads to 250,000 tons of CO2 savings

Steel-making

- The Salzgitter 2022 partnership highlighted the potential for circularity partnership where green hydrogen-powered steelmaking is used to: 1) produce new turbine components, or 2) recycle scrap from decommissioned wind turbines
- Orsted could maintain this momentum from by reaching out to new partners like ArcelorMittal and Thyssenkrupp for circular green steel-making
- Thiis would present an industry-leading sustainability initiative since steel alone makes up half of the total climate footprint of offshore wind farm project

Agriculture

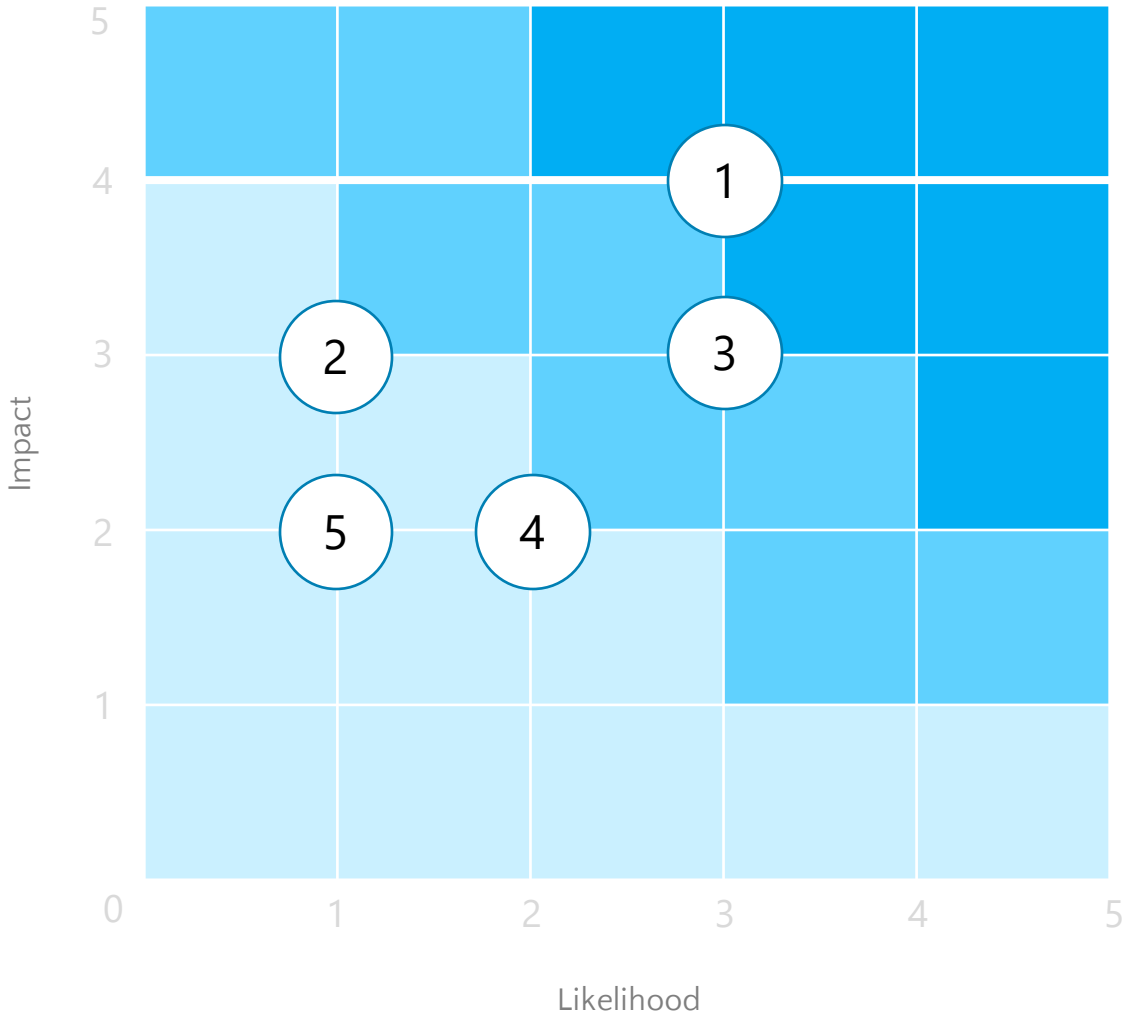
- In 2021, Ørsted and Yara have developed a green ammonia project in the Netherlands – a scalable and sustainable initiative
- As Germany is the 3rd largest exporter of agricultural products, there is naturally a significant use for ammonia/fertiliser - Orsted

Long-Term corporate, infra, & political tailwinds

- Future corporate ESG targets drives increased industrial demand for green hydrogen. For example, German's largest steelmaker thyssenkrupp aims for climate-neutral steel production by 2050.
- Improved accessibility to hydrogen energy from government-funded national networks in Germany and the Netherlands (both expected to be in operation in 2027) which should incentivize both supply and demand
- Germany's National Hydrogen Strategy (Jun-2020) makes hydrogen an attractive replacement fossil fuels with the introduction of CO2 pricing for fossil fuels in transport/heating

Several risks and mitigation strategies have been taken into account.

Risk and Mitigation



	Risk	Mitigation
1	Failing to win a bid, actual win rate less than expected.	Fall back on other core European economies that values sustainability. Eg. France
2	Hydrogen and wind farm cost exceeds budget due to supply chain disruptions.	The current cost is $40 DKK Bn less than the given budget.
3	Lack of support from electrolysis partners.	Explore the option of developing hydrogen technology in house.
4	Hostile competitive response through imitating hydrogen technology.	First mover advantage protects us due to the limited amount of hydrogen suppliers and the complexity of technology.
5	Safety risk related to the construction of the plant.	Comply with engineering standards to reduce risk.

Sensitivity analysis suggests that this strategy is prone to variance in win rates

Sensitivity Analysis

Base Win Rate

Win Rate Post-2025	20%	25%	30%	35%	40%
55%	10.49	11.53	12.57	13.61	14.65
50%	9.91	10.95	11.99	13.03	14.07
45%	9.34	10.38	11.42	12.46	13.50
40%	8.76	9.80	10.84	11.88	12.92
35%	8.19	9.23	10.27	11.31	12.35

Base CAPEX ($DKKmm/GW)

$ 16,000	$ 18,000	$ 20,000	$ 22,000	$ 24,000
$ 133,448	$ 149,978	$ 166,508	$ 183,038	$ 199,568

Likelihood

Key Takeaways

- In the base case with 30% base win rate, Orsted may choose between the several tenders in 2025, with an expect 11.42 GW if all tenders were contested for.
- In the worst case, with 20% win rate pre-hydrogen and 35% win rate post-hydrogen, the expected capacity won still meets Orsted's 2030 goals.

- The most significant cost associated with this strategy is CAPEX.
- However, even with Base CAPEX costs increased by 20%, Orsted is still under the budget of $200 DKK bn.