What Does Your Future Look Like?

SUMMIT CONSULTING

for Vestas

Serena

Claire

Louis

Anish

Executive Summary

Vestas

Mandate

"How can Vestas leverage its position as a global leader in wind power plant solutions to **create new business from Power-to-X**? What should Vestas' strategy be towards 2030?"

Solution

1 Product Development

Developing integrated electrolysis turbines differentiated by cost efficiencies

2 Transformation

Leasing modular electrolysis to customers at scale

3 Expansion

Engaging in regional industry networks for shared resources and expertise

Impact

€82.4B
Increase in revenues by 2030

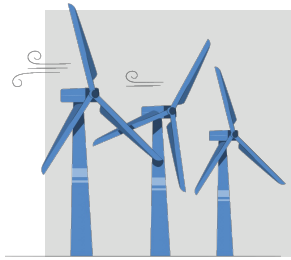
€5.7B
In added value over 6 years

40%
energy waste recaptured

Through cost efficiencies, scalability, and industry, leadership, Vestas will pave the way for wind energy to play a central role in **transforming to truly sustainable energy systems** across the world.

Vestas as the Power-to-X turnkey partner that provides end-to-end project planning, execution and servicing solutions for green hydrogen investors

Vestas Today



The Technological Partner

Planning to offer a **turnkey green hydrogen production solution** that is integrated with its wind power projects to provide customers with a comprehensive solution for sustainable energy production

#1 global leader in onshore wind with 149 GW of installed capacity

Laying the foundation for **scalable Power-to-X** production

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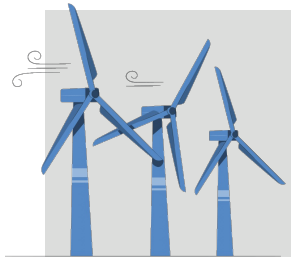

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Innovation

Green Hydrogen Production

Portfolio investment in Hysata's breakthrough hydrogen electrolyzer with a novel cell architecture

Green Ammonia Plant

Partnership that integrates wind, solar, and electrolysis with an ammonia synthesis loop

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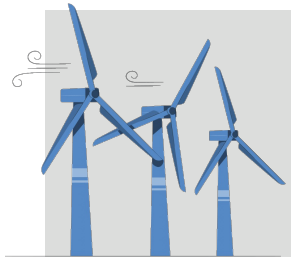

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Core Competencies

Power Plant

Increasing renewable penetration in the energy system

Service

Providing resilience and stability in a fluctuating environment

Development

Accelerating the energy transition by expanding our project pipeline

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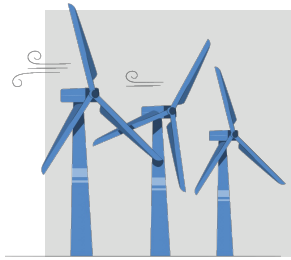

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Goals

Transform the global energy system

Developing and implementing solutions for indirect electrification to power non-electric sectors with green electricity by converting it to green hydrogen via electrolysis

Building a more sustainable planet for future generations

The value of renewables lie in their potential to build resilient, sustainable, and prosperous societies

Vestas pain points translate into actionable goals

3 Major Areas of Focus:

Pain Point	Goal
Economical Viability Production of green sustainable hydrogen is currently double the price of grey traditional hydrogen	**Grey to Green** Make it financially sensible for customer to procure green hydrogen
New Business Uncertainties The new electrolysis market poses new challenges for Vestas, namely which part of the value chain should they focus on	**Successful Penetration** Be able to accurately identify which section of the value chain Vestas is able to better utilize its capabilities
Lack of Demand There is currently limited demand for green hydrogen as it is relatively costly to produce and trade	**Create Demand** Solve for demand mismatch by offering solutions fit for early adopters or apprehensive customers

Opportunity

Henrik Andersen
President and Chief Executive Officer

*"Power-to-X is a long-term strategic enabler to reach our **vision of becoming a global leader in sustainable energy solutions**. However, Vestas has not invested in this industry yet."*

Market trends indicate the different dimensions that the solution should incorporate

Vestas

Market Information

1. Substantial amount of **energy is lost** in the electrolysis process in the form of heat
2. The electrolysis market requires a significant **capital injection**
3. Integrating **electrolysis into wind turbines** can reduce the cost of hydrogen production

Market Data

of the total energy used can be lost in cooling part of the process

~4M€

to install a 10MW industrial-scale electrolysis unit

40%

cost of hydrogen production is reduced by having integrated electrolysis systems

Implications

Vestas has the opportunity to make use of the heat produced by the process and turn it into a **useful energy source** for customers

Making cost-efficient option will guarantee competitive differentiation and **attract apprehensive customers** to the market

Including a cost efficient mechanism into offshore wind turbines will **attract further potential customers**

Market Motions

Wave 1

Refining
Ammonia
Other industrial
Natural gas blending

Wave 2

Heavy duty vehicles
Hydrogen fuel cells
Auxiliary power generation
Hydrogen power & storage units
Local maritime applications
Iron & Steel
Hydrogen for ore reduction

Wave 3

Aviation
Synthetic kerosene, liquefied hydrogen
Maritime
Ammonia, methanol, liquefied hydrogen
Cement
Hydrogen for heat

Sources: International Renewable Energy Agency (IRENA)

What are the different ways Vestas could tackle its pain points and achieve its goals?

Vestas

Value Chain Capabilities	Potential Avenues of Change				
	Value Chain Capabilities	**Competitive Differentiation**	**Cognizant of Market Motions**	**Customer Attraction**	**Feasibility & Cost**
 **Service and Maintenance**					
Leasing and Integrated Systems	●	●	●	◔	◔
Hybrid Solar and Wind Investment	◑	◔	●	◑	◑
 **Design Capabilities**					
Energetic Production Ownership	◑	◔	●	◑	◑
Off-shore Wind Farms Islands	●	◔	◑	◔	◑
 **Development Capabilities**					

Based on our analysis of current operations, future growth strategies, and organizational priorities, the most opportune strategy involves developing a leasing model, integrating electrolysis, and shaping public opinion. This strategic recommendation will incite **competitive differentiation, successful attraction of early adopters and future market players, and mitigate countries regulations risks**.

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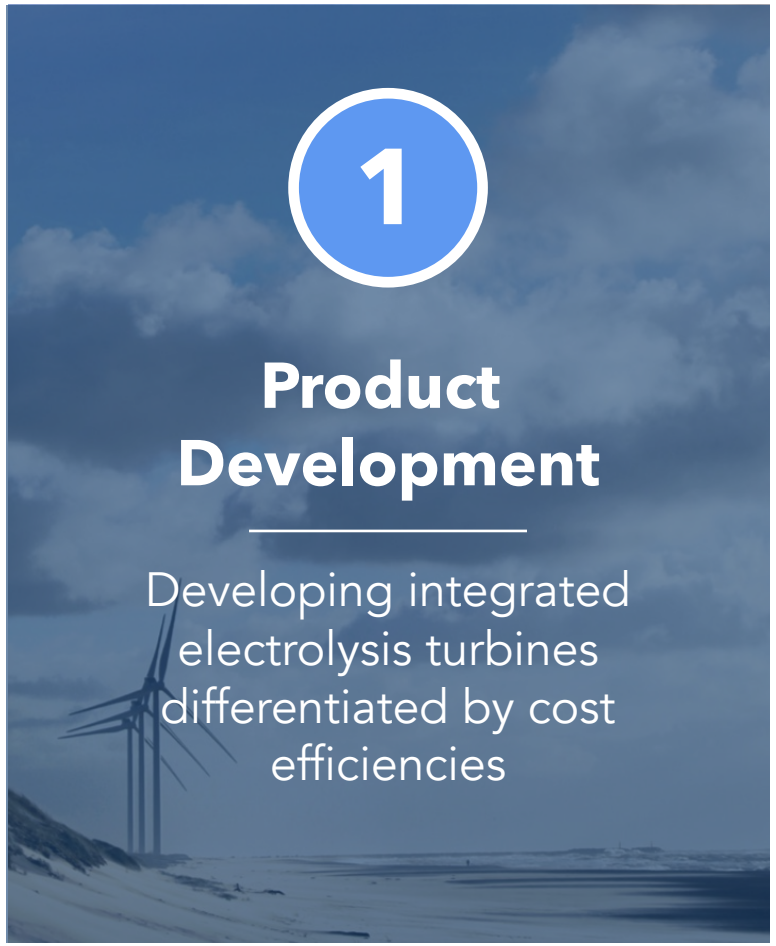
Introducing a three prong solution "P.T.X." to leverage core competencies within wind solutions to create new business from Power-to-X

Vestas

Through leveraging its core capabilities and partnering with key industry players,
Vestas can penetrate the PtX market while maintaining its leading position to change the world.



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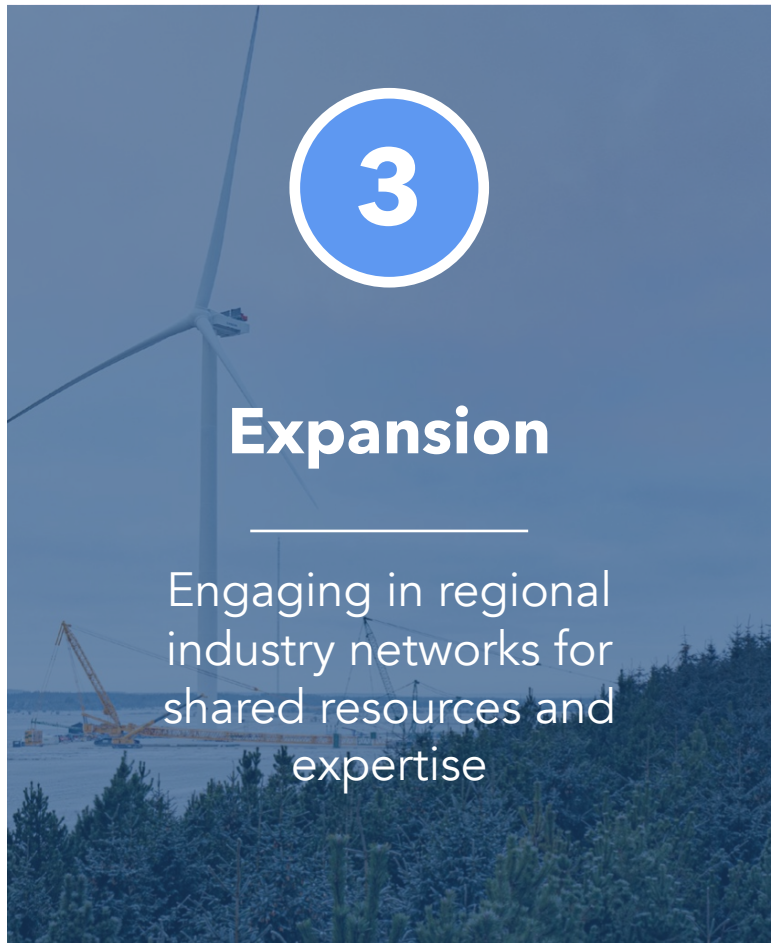

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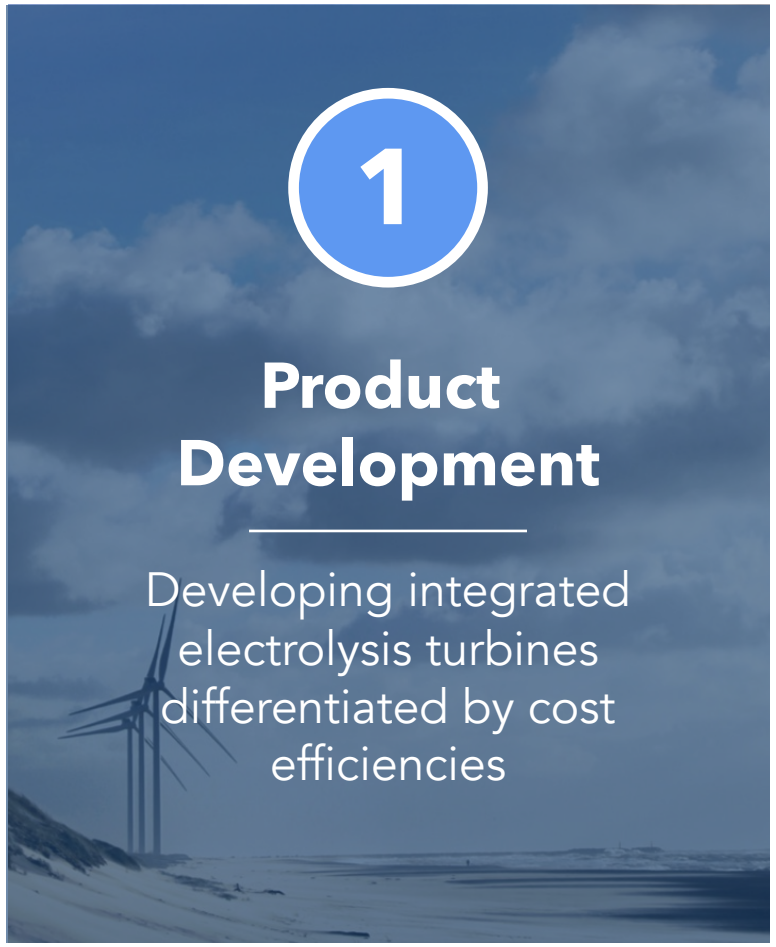

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By producing hydrogen in the wind turbines on site with heat capturing cost efficiencies, Vestas can successfully penetrate the PtX market

Electrolyzing Turbines

Integrating Electrolyzer into Off-Shore Wind Turbines:

- Outsource electrolyzer production from **TOPSOE**
- Develop integrated turbine model with Topsoe, **leveraging existing relationship** with them for customized creation

Sources: Topsoe, Alfa Laval

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Capturing Lost Heat for Cost Efficiencies

Problem: electrolysis is very cost inefficient, losing a significant amount of energy in the process

Solution: capture heat for electrical energy creation and district heating with **waste energy converter**

- **Joint venture** with **Alfa Laval** for development of waste energy converter
- Leverage Alfa Laval's **internal capabilities** from existing *E-PowerPack* heat converters

Producing electrical output at rate of **0.4 KWs** per KW of thermal input

Initial Target Customers: Oil and gas producers, who want to decarbonize operations and break into the PtX market

Target Region: North Africa

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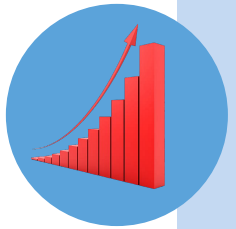

Penetrating PtX Market

Entering the PtX value chain by integrating electrolysis into the turbines facilitates growth into the PtX market

Differentiation

The cost efficiencies produced by the heat conserving solution differentiate Vestas from other hydrogen producers

Develop Capabilities

The dual partnership model will provide Vesta with external expertise and know-how to learn from and apply in other operations

Sources: Topsoe, Alfa Laval

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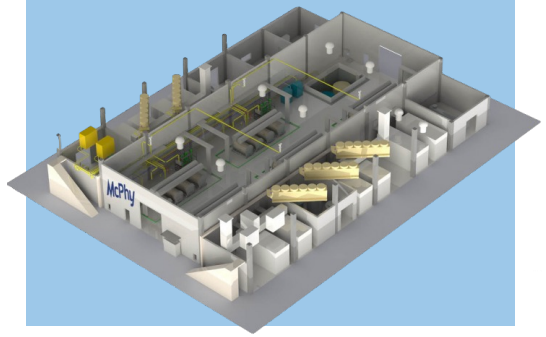
Through a comprehensive leasing model for modular electrolyzer units, Vestas is able to attract and retain customers

Modular Electrolyzer Units

Scaled for individual needs and ready for future deployment

Designed to drive progressive decarbonization



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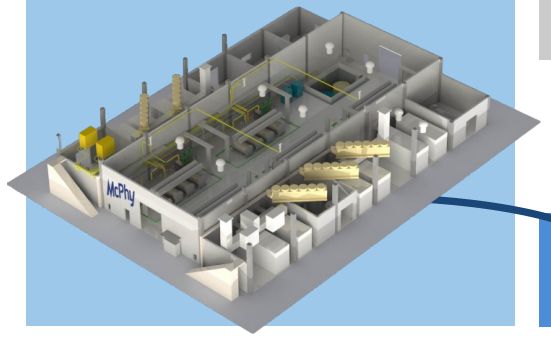

McPhy as a Partner

Cost-competitive low-carbon hydrogen produced on site from alkaline electrolysis

Scalable Solutions

Customizable system set-ups (> 20 MW) for the industrial, mobility, and energy sectors

Stored at McPhy Storage facilities

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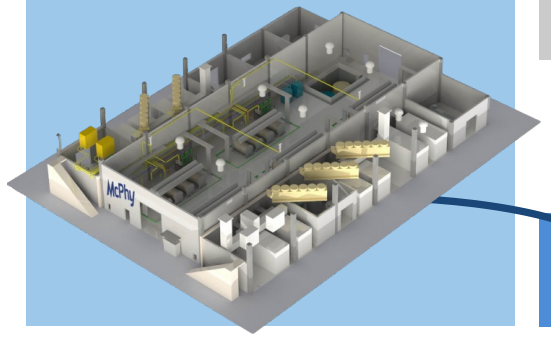

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Why would it work?

By lowering cost barriers, Vestas facilitates the entrance of several players into the green hydrogen market, increasing the green hydrogen supply and acquiring more customers

343,000 €/ year

Utilize Core Capabilities

Control management tools and service expertise

Network of wind turbine customers interested in moving to electrolysis production

De-risking customer's operations

By providing a risk-conscious alternative, Vestas will incentivize further players to jump into the market

Sources: McPhy

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By partnering with regional hubs and universities, Vestas can generate appreciation from the larger society to push governments to action

Leverage Industry Group Positioning

As active members of regional industry groups, Vestas can leverage its leading position to **lobby for effective investment and regulatory environments**

As part of these hubs, Vestas can **gain recognition and approval from the media**

Vesta is currently part of **WindEurope** and **Global Wind Energy Council**

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Key wind and green transition hub

Collaboration, cooperation, access to research and testing facilities

Egyptian Wind Energy Association

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MASEN

Morocco

> “The key to a faster energy transition is to spread awareness and understanding of the benefits of renewables among senior political leaders and the public”
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Thought Leadership

University Research and Event Sponsorship

- Conduct research with universities by providing modular unit for analysis and experimentation

Outcomes

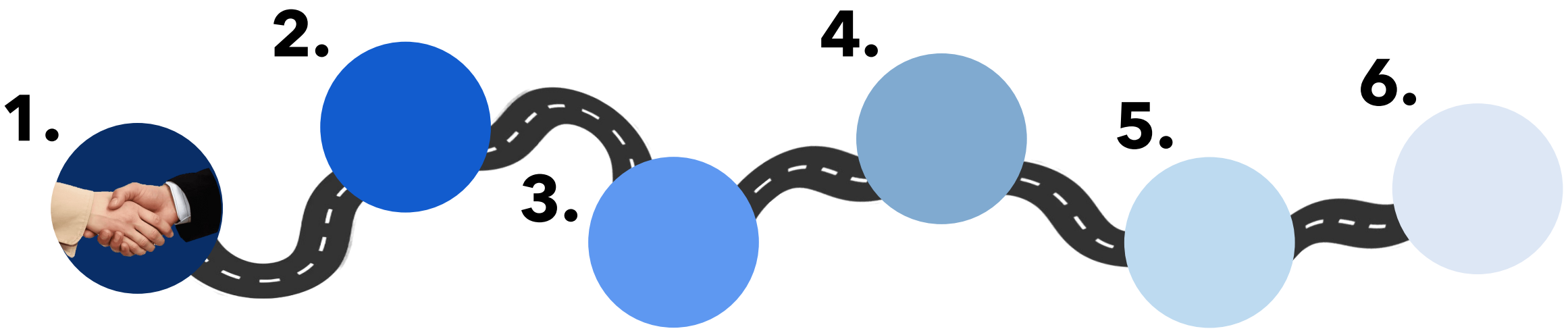
Gain access to new industry development knowledge, research, and more network for collaboration

Governments will be further pushed by their people to provide necessary regulations and investment

Sources: Windpower Monthly

Vestas through the Value Chain

"Some people might call it a turnkey solution, all the way from renewables up to the green hydrogen molecule. That's what we're aiming for and where we have value to add." – **Anders Tuxen**, *Vestas concept lead for hydrogen and Power-to-X*



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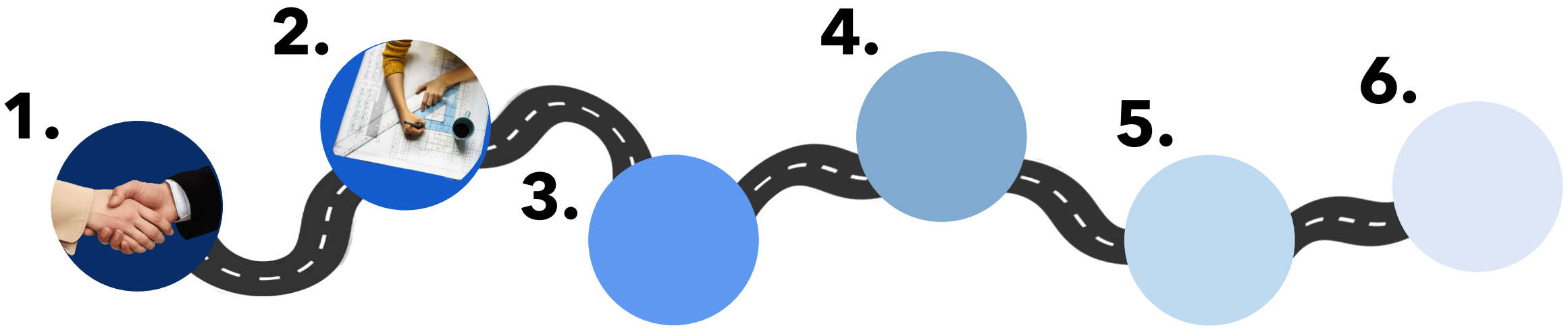

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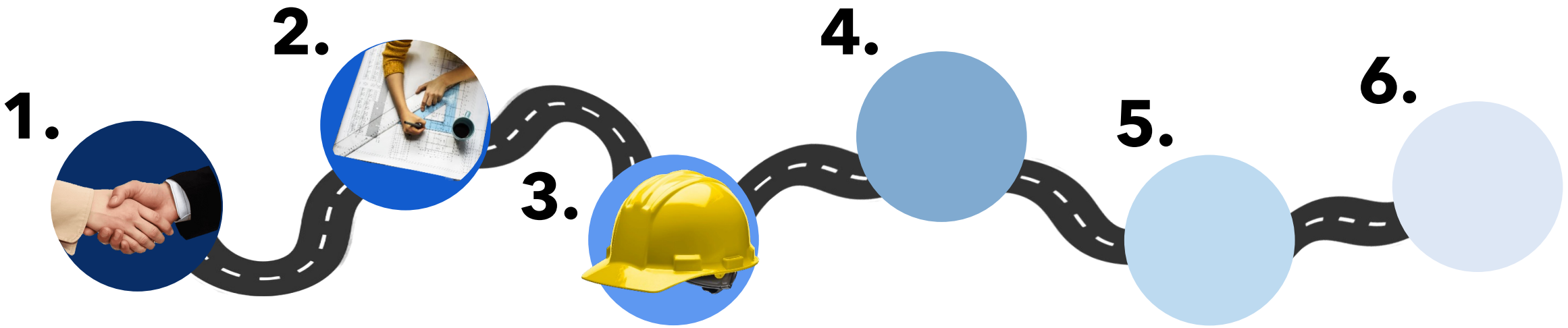

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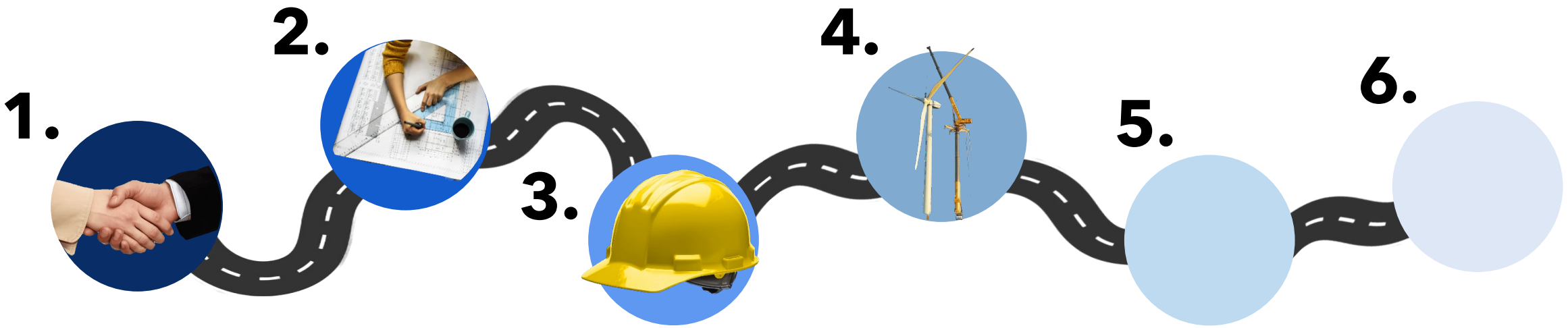

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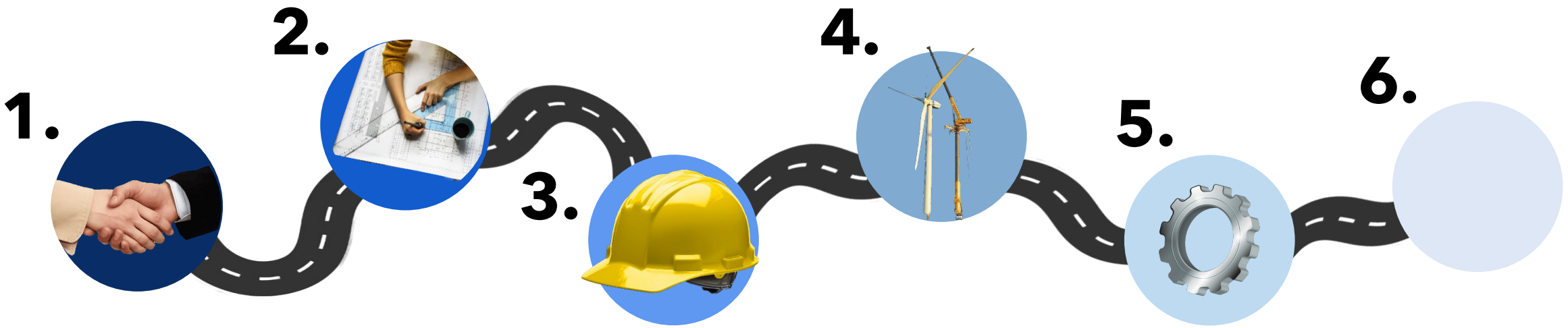

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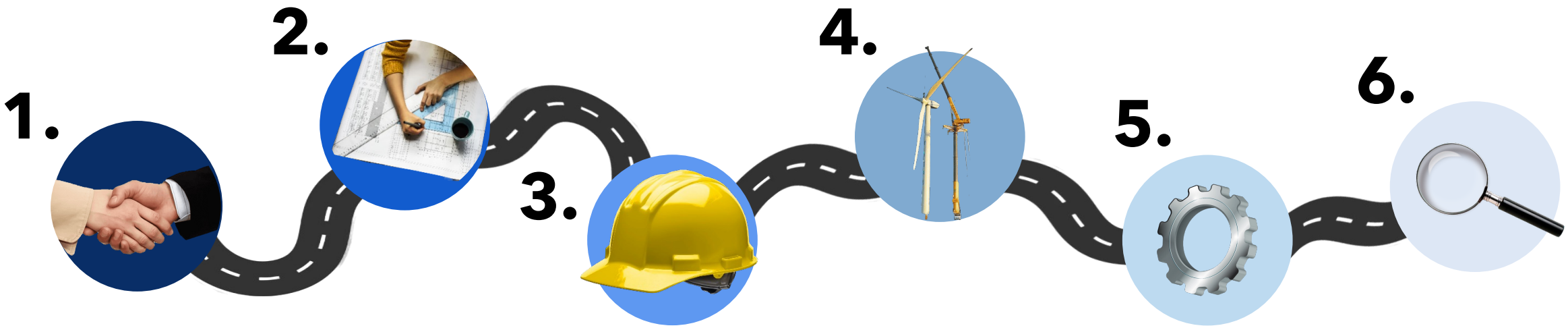

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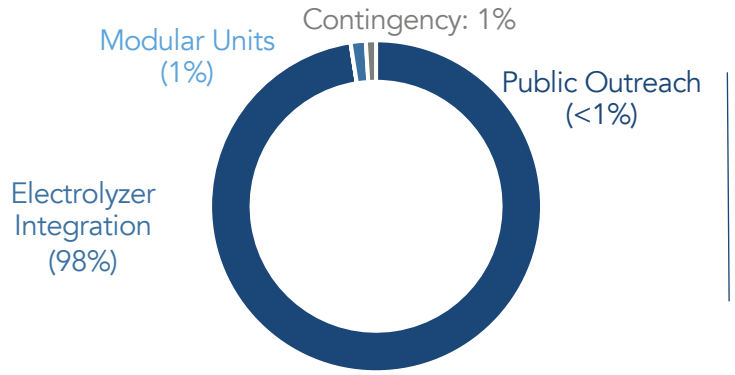
Service:
Monitoring and repairing turbines, modular units, and heat capturing technologies, identifying opportunities to replace old turbines with electrolysis designs

The PTX Strategy achieves key quantitative and qualitative goals aimed for by Vestas

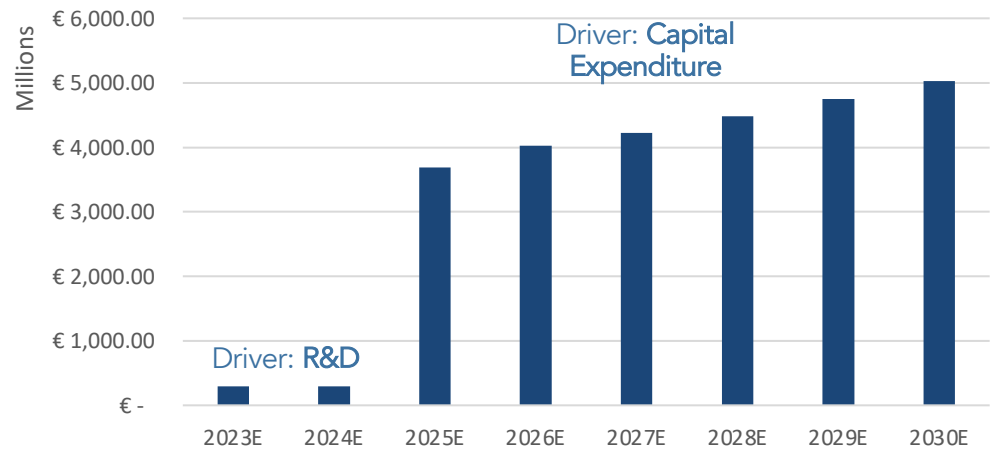
Costs incurred: **16.2B EUR (NPV)** by 2030

1 Cost Breakdown



Modular Units Breakeven:
1.5 Years

2 Costs Over Time

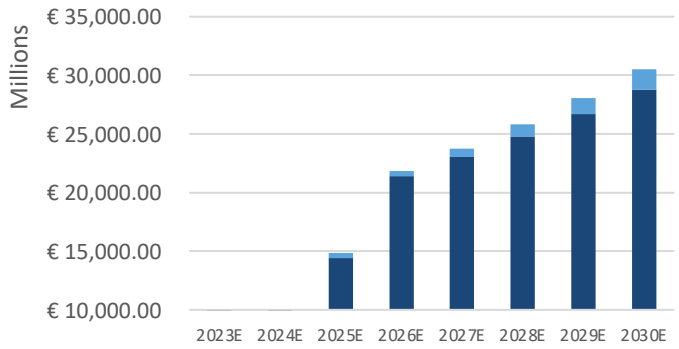


Revenues: **82.4B EUR (NPV)** by 2030

3 Revenue Growth

$5.7B additional value

EBIT Margin 2030:
11.3%



4 Energy Capture

Operated at 60 degrees

Electricity input: 49.8 kWh/kg

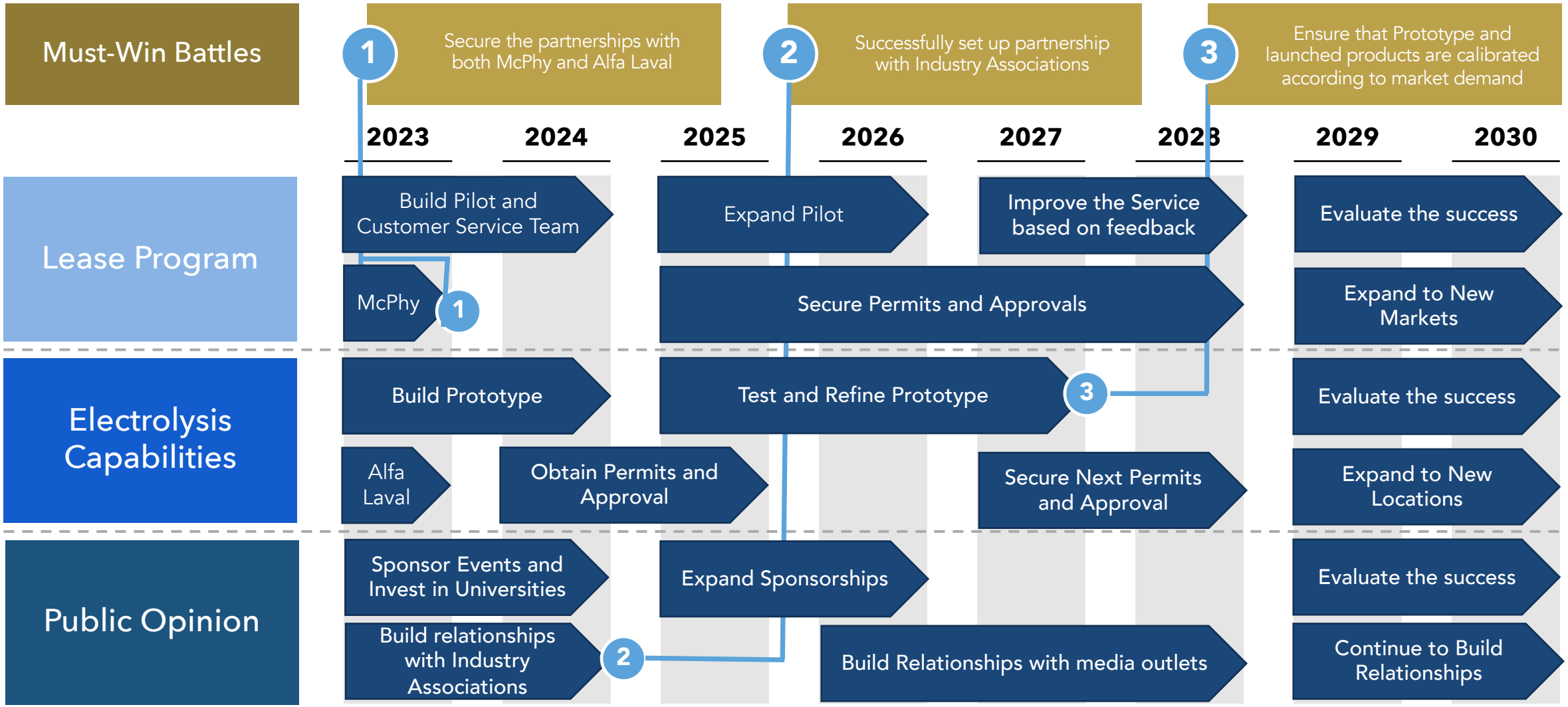
80% efficiency

Minimum loss: 9.96 kWh

Minimum captured: 2.0 kWh

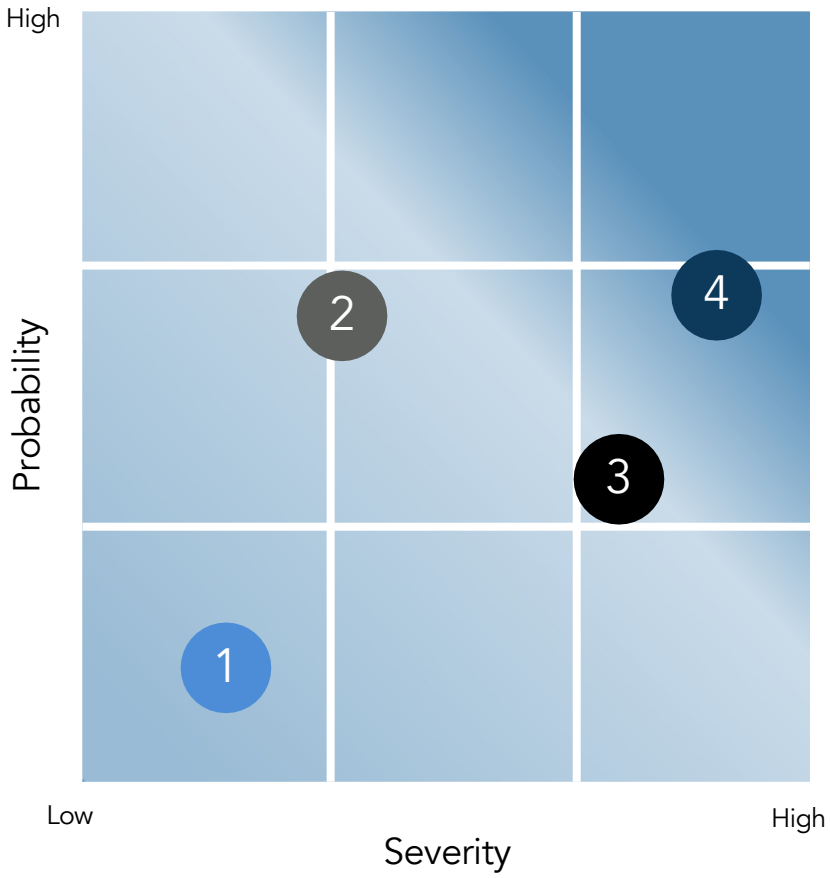
Captured, at minimum, 20% of lost energy in electrolysis

The proposed strategy requires implementation support over the course of three years



The PTX solution is subject to important risks which can be addressed with proper mitigation plans

Risk Assessment Matrix



	Risk	Mitigation	Case Proof
1	Alpha Laval and/or McPhy decide to not partner	Contact back-up partnering companies TESVOLT and Evident Thermoelectrics, as well as ITM Power	UNDERGROUND
2	Environmental permits and local administration authorizations can create significant delays	Leverage network within industry associations to accelerate administrative processes	TESLA
3	Safety risks related transferring the heat instead of cooling the electrolysis units	Establishing safety protocols and testing out the final product through multiple safety hazards situations	SAMSUNG
4	Demand for rental electrolysis does not materialize	Vestas could focus on leasing to pilot projects which can help control risks involved in it	Vestas

Vestas' leadership in sustainable solutions positions the firm to pave the way for wind energy in the transformation of the global energy system

Through implementing the PtX Solution, Vestas will achieve:

Success across the value chain, creating differentiated value in cost efficiency

An increase of €82.4 billion by 2030

Industry leadership in Power-to-X solutions within high activity markets

SUMMIT CONSULTING for Vestas

Thank you!

Tak!

Serena

Claire

Louis

Anish

Appendix

Earnings

Issue	Earnings	Unit	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Electrolyzer Integration		EUR	€ -	€ -	€ 14.402.357.280,00	€ 21.387.500.560,80	€ 23.006.106.603,24	€ 24.748.805.319,34	€ 26.625.209.007,69	€ 28.645.680.548,06
	Market Growth of Turbines	#	3.126,00	3.339,54	3.567,66	3.811,37	4.071,72	4.349,86	4.647,00	4.964,44
	Improved Turbine Growth	#	3.126,00	3.376,08	3.646,17	3.937,86	4.252,89	4.593,12	4.960,57	5.357,41
	Turbine Sale Price	EUR	€ 4.000.000,00	€ 4.000.000,00	€ 5.500.000,00	€ 5.500.000,00	€ 5.478.000,00	€ 5.456.440,00	€ 5.435.311,20	€ 5.414.604,98
Modular Units		EUR	€ -	€ -	€ 34.333.332,00	€ 34.333.332,00	€ 45.319.998,24	€ 60.083.331,00	€ 79.653.330,24	€ 105.403.329,24
	Number Leased	#	€ -	€ -	€ 100,00	€ 100,00	€ 132,00	€ 175,00	€ 232,00	€ 307,00
	Lease per Month	EUR	€ -	€ -	€ 28.611,11	€ 28.611,11	€ 28.611,11	€ 28.611,11	€ 28.611,11	€ 28.611,11
	Lease Per Year	EUR			€ 343.333,32	€ 343.333,32	€ 343.333,32	€ 343.333,32	€ 343.333,32	€ 343.333,32
Total Earnings			€ -	€ -	€ 14.402.357.380,00	€ 21.421.833.892,80	€ 23.051.426.601,48	€ 24.808.888.650,34	€ 26.704.862.337,93	€ 28.751.083.877,30
Industry WACC			9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%
NPV of Earnings			€ -	€ -	€ 10.928.455.267,74	€ 14.825.985.634,01	€ 14.551.456.571,69	€ 14.284.258.507,57	€ 14.024.341.120,21	€ 13.771.716.590,69
			€ -	€ -	€ 424.979.469,58	€ 424.979.469,58	€ 701.214.120,61	€ 1.014.049.214,20	€ 1.367.317.861,29	€ 1.765.218.244,73

Capital Expenditure and Operational Expenditures

Issue	CapEx	Unit	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Electrolyzer Integration		EUR	€ -	€ -	€ 3.555.581.953,50	€ 3.840.028.509,78	€ 4.064.286.174,75	€ 4.301.640.487,36	€ 4.552.856.291,82	€ 4.818.743.099,26
	Electrolyzer Price	EUR	€ -	€ -	€ 1.000.000,00	€ 1.000.000,00	€ 980.000,00	€ 960.400,00	€ 941.192,00	€ 922.368,16
	Number of Turbines	#	3.126,00	3.333,88	3.555,58	3.840,03	4.147,23	4.479,01	4.837,33	5.224,32
	Cost of Turbine Manufacturing		€ -	€ -	€ 3.555.581.953,50	€ 3.840.028.509,78	€ 4.064.286.174,75	€ 4.301.640.487,36	€ 4.552.856.291,82	€ 4.818.743.099,26
Modular Units		EUR	€ -	€ -	€ 50.000.000,00	€ 16.000.000,00	€ 21.500.000,00	€ 28.500.000,00	€ 37.500.000,00	€ 49.500.000,00
	Number Leased	#	-	-	100,00	132,00	175,00	232,00	307,00	406,00
	Cost per Unit	EUR	-	-	€ 500.000,00	€ 500.000,00	€ 500.000,00	€ 500.000,00	€ 500.000,00	€ 500.000,00
Contingency		EUR	€ -	€ -	€ 36.055.819,54	€ 38.560.285,10	€ 40.857.861,75	€ 43.301.404,87	€ 45.903.562,92	€ 48.682.430,99
Total CapEx			€ -	€ -	€ 3.641.637.773,04	€ 3.894.588.794,88	€ 4.126.644.036,50	€ 4.373.441.892,23	€ 4.636.259.854,74	€ 4.916.925.530,25
Industry WACC			9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%
NPV of CapEx			€ -	€ -	€ 2.763.261.211,61	€ 2.695.432.977,97	€ 2.604.987.644,46	€ 2.518.104.516,37	€ 2.434.780.936,22	€ 2.355.198.335,80
Issue	OpEx	Unit	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Electrolyzer Integration		EUR	€ 176.470.588,24	€ 176.470.588,24	€ 3.646.266.400,00	€ 3.937.959.712,00	€ 4.167.930.719,18	€ 4.411.332.033,18	€ 4.668.947.983,92	€ 4.941.608.706,18
	R&D	EUR	€ 176.470.588,24	€ 176.470.588,24	€ -	€ -	€ -	€ -	€ -	€ -
	Electrolyzer Price	EUR	€ -	€ -	€ 1.000.000,00	€ 1.000.000,00	€ 980.000,00	€ 960.400,00	€ 941.192,00	€ 922.368,16
	Number of Turbines	#	€ 3.126,00	€ 3.376,08	€ 3.646,17	€ 3.937,86	€ 4.252,89	€ 4.593,12	€ 4.960,57	€ 5.357,41
	Cost of Turbine Manufacturing		€ -	€ -	€ 3.646.166.400,00	€ 3.937.859.712,00	€ 4.167.830.719,18	€ 4.411.232.033,18	€ 4.668.847.983,92	€ 4.941.508.706,18
	Training	EUR	€ -	€ -	€ 100.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00
Public Outreach		EUR	€ 76.008,00	€ 76.008,00	€ 76.008,00	€ 76.008,00	€ 76.008,00	€ 76.008,00	€ 76.008,00	€ 76.008,00
	Event Sponsorship	EUR	€ 50.000,00	€ 50.000,00	€ 50.000,00	€ 50.000,00	€ 50.000,00	€ 50.000,00	€ 50.000,00	€ 50.000,00
	Hub Membership	EUR	€ 1.008,00	€ 1.008,00	€ 1.008,00	€ 1.008,00	€ 1.008,00	€ 1.008,00	€ 1.008,00	€ 1.008,00
	Research Budget	EUR	€ 25.000,00	€ 25.000,00	€ 25.000,00	€ 25.000,00	€ 25.000,00	€ 25.000,00	€ 25.000,00	€ 25.000,00
Modular Units		EUR	€ 117.647.058,82	€ 117.647.058,82	€ 117.647.058,82	€ -	€ -	€ -	€ -	€ -
	R&D	EUR	€ 117.647.058,82	€ 117.647.058,82	€ 117.647.058,82	€ -	€ -	€ -	€ -	€ -
Contingency		EUR	€ 2.941.936,55	€ 2.941.936,55	€ 37.639.894,67	€ 39.380.357,20	€ 41.680.067,27	€ 44.114.080,41	€ 46.690.239,92	€ 49.416.847,14
Total OpEx			€ 297.135.591,61	€ 297.135.591,61	€ 3.801.629.361,49	€ 3.977.416.077,20	€ 4.209.686.794,45	€ 4.455.522.121,59	€ 4.715.714.231,84	€ 4.991.101.561,32
Industry WACC			9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%	9,64%
NPV of OpEx			€ 271.016.921,40	€ 247.194.122,01	€ 2.884.662.234,48	€ 2.752.757.486,41	€ 2.657.409.262,73	€ 2.565.363.997,88	€ 2.476.507.243,36	€ 2.390.728.519,01

Expenses

Issue	Expense	Unit	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Electrolyzer Integration		EUR	€ 176,470,588.24	€ 176,470,588.24	€ 3,646,266,400.00	€ 3,937,959,712.00	€ 4,167,930,719.18	€ 4,411,332,033.18	€ 4,668,947,983.92	€ 4,941,608,706.18
	R&D	EUR	€ 176,470,588.24	€ 176,470,588.24	€ -	€ -	€ -	€ -	€ -	€ -
	Electrolyzer Price	EUR	€ -	€ -	€ 1,000,000.00	€ 1,000,000.00	€ 980,000.00	€ 960,400.00	€ 941,192.00	€ 922,368.16
	Number of Turbines	#	3,126.00	3,376.08	3,646.17	3,937.86	4,252.89	4,593.12	4,960.57	5,357.41
	Cost of Turbine Manufacturing		€ -	€ -	€ 3,646,166,400.00	€ 3,937,859,712.00	€ 4,167,830,719.18	€ 4,411,232,033.18	€ 4,668,847,983.92	€ 4,941,508,706.18
	Training	EUR	€ -	€ -	€ 100,000.00	€ 100,000.00	€ 100,000.00	€ 100,000.00	€ 100,000.00	€ 100,000.00
Public Outreach		EUR	€ 76,008.00	€ 76,008.00	€ 76,008.00	€ 76,008.00	€ 76,008.00	€ 76,008.00	€ 76,008.00	€ 76,008.00
	Event Sponsorship	EUR	€ 50,000.00	€ 50,000.00	€ 50,000.00	€ 50,000.00	€ 50,000.00	€ 50,000.00	€ 50,000.00	€ 50,000.00
	Hub Membership	EUR	€ 1,008.00	€ 1,008.00	€ 1,008.00	€ 1,008.00	€ 1,008.00	€ 1,008.00	€ 1,008.00	€ 1,008.00
	Research Budget	EUR	€ 25,000.00	€ 25,000.00	€ 25,000.00	€ 25,000.00	€ 25,000.00	€ 25,000.00	€ 25,000.00	€ 25,000.00
Modular Units		EUR	€ 117,647,058.82	€ 117,647,058.82	€ 515,100.00	€ 51,500,000.00	€ 16,480,000.00	€ 22,145,000.00	€ 29,355,000.00	€ 38,625,000.00
	R&D	EUR	€ 117,647,058.82	€ 117,647,058.82		€ -	€ -	€ -	€ -	€ -
	Number Leased	#	-	-	100.00	100.00	132.00	175.00	232.00	307.00
	Cost per Unit	EUR	-	-	€ 500,000.00	€ 500,000.00	€ 500,000.00	€ 500,000.00	€ 500,000.00	€ 500,000.00
	Maintenance	EUR	€ -	€ -	€ 15,000.00	€ 15,000.00	€ 15,000.00	€ 15,000.00	€ 15,000.00	€ 15,000.00
Contingency		EUR	€ 2,941,936.55	€ 2,941,936.55	€ 36,468,575.08	€ 39,895,357.20	€ 41,844,867.27	€ 44,335,530.41	€ 46,983,789.92	€ 49,803,097.14
Total Expenses			€ 297,135,591.61	€ 297,135,591.61	€ 3,683,326,083.08	€ 4,029,431,077.20	€ 4,226,331,594.45	€ 4,477,888,571.59	€ 4,745,362,781.84	€ 5,030,112,811.32
Industry WACC			9.64%	9.64%	9.64%	9.64%	9.64%	9.64%	9.64%	9.64%
NPV of Expenses			€ 271,016,921.40	€ 247,194,122.01	€ 2,794,894,146.38	€ 2,788,756,908.62	€ 2,667,916,468.57	€ 2,578,241,969.09	€ 2,492,077,493.21	€ 2,409,414,836.41

EBIT Calculation

mEUR	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Partial Income Statement								
Revenue	15.936.965.039	17.533.263.472	19.289.452.366	21.221.546.872	23.347.166.269	25.685.694.643	28.258.457.651	31.088.916.998
Strategy Revenue	-	-	424.979.470	424.979.470	701.214.121	1.014.049.214	1.367.317.861	1.765.218.245
Total Revenue	15.936.965.039	17.533.263.472	19.714.431.836	21.646.526.341	24.048.380.390	26.699.743.857	29.625.775.512	32.854.135.243
EBITDA	2.071.805.455	2.279.324.251	2.562.876.139	2.814.048.424	3.126.289.451	3.470.966.701	3.851.350.817	4.271.037.582
Amortization	555.000.000	555.000.000	556.666.667	557.200.000	557.916.667	558.866.667	560.116.667	561.766.667
EBIT	1.222.687.808	1.430.206.604	1.888.562.413	2.256.848.424	2.568.372.784	2.912.100.035	3.291.234.150	3.709.270.915
Assumptions								
Organic Growth	10%	10%	10%	10%	10%	10%	10%	10%
EBITDA Margin	13%	13%	13%	13%	13%	13%	13%	13%
EBIT Margin	8%	8%	10%	10%	11%	11%	11%	11%

How has the solution answered the asks from Vestas?

	Asks from Vestas	Proposed Solution
1	In what part(s) of the Power-to-X value chain should Vestas play a primary role, and why?	Development, Design, and Service are the main parts of the value chain where we see Vestas succeeding the most based on its core capabilities
2	Further, what should the value propositions of Vestas be under the various possible configurations?	Vestas is offering a cost-effective solution onshore, with its innovative lease program, and offshore, with integrated electrolytes in their wind turbines. Further, the ability to capture the heat on both solutions will increase efficiency of the energy creation process
3	How can Vestas leverage its internal capabilities and partnerships to win in Power-to-X?	Vestas is leveraging its internal capabilities and filling gaps with partnerships in order to create the proposed solutions explained herein
4	Which steps should Vestas take in order to develop capabilities within green hydrogen while being cognisant of the various stages the market will go through?	The Lease Program can capitalize on the first phase of the market by providing a cheaper alternative for new players to jump in. Further, by introducing Vestas into new markets, the company is effectively securing its place in the markets of tomorrow

Partner Company: Alfa Laval

Leading global provider of first-rate products in the areas of heat transfer, separation and fluid handling.

<u>Relevant Experience and Competencies:</u>

The E-Power Pack

The Alfa Laval E-PowerPack converts waste heat directly into clean electrical power, giving a plug-and-play efficiency upgrade for meeting sustainability requirements. Based on Organic Rankine Cycle (ORC) technology, this compact and easily installed module can make use of a wide variety of gas and liquid heat sources. It thus provides an all-in-one solution that lowers fuel costs, reduces emissions and shrinks carbon footprint.
Designed for on the water, but the core technology is transferable.

Source: Alfa Laval

TOPSOE

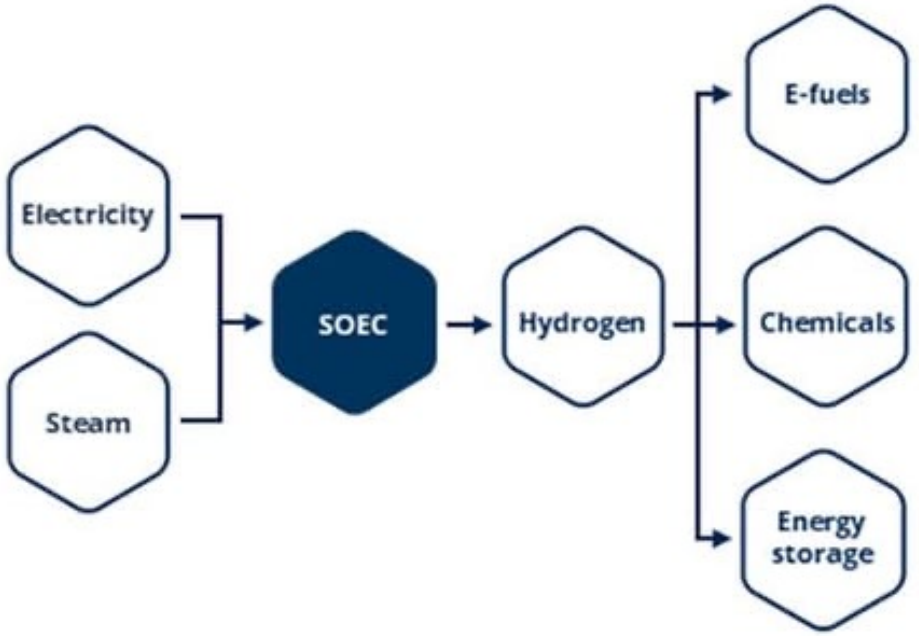
Topsoe is a leading global developer and supplier of decarbonization technology, catalysts, and services for the energy transition.

Relevant Experience and Competencies:

High Temperature Electrolysis

"High-temperature electrolysis, made possible by the power of Topsoe's proprietary solid-oxide electrolysis cell (SOEC), empowers producers in hard-to-abate sectors to generate carbon-free hydrogen or carbon monoxide using renewable electricity. The unmatched efficiency and industrial scalability of SOEC technology position it as an ideal means to an ideal end: satisfying the world's energy demands with zero negative environmental impact."

Existing relationship with Topsoe for green ammonia plant



Source: Topsoe

Green Ammonia Power-to-X Partnership 2023

Vestas partnership with other Danish companies Topsoe and Skovgaard Energy to create plant to produce green ammonia based on renewable power and electrolysis of water, expected to be operational by 2023.

Location: Ramme near Lemvig, Western Jutland, Denmark.

Output: More than 5,000 ton green ammonia annually from renewable power. This production will prevent 8,200 tons of CO_2 from being emitted into the atmosphere every year.

Power supplied from renewable sources: 50 MW new solar panels and 12 MW existing V80-2.0 MW Vestas wind turbines.

Ole Kiil Nielsen, Head of Power-to-X Solutions at Vestas:
"As pioneers of renewable energy, Vestas is committed to expand its potential, also beyond the power sector. Vestas is uniquely positioned together with our partners to integrate and optimize renewable energy with other technologies to develop Power-to-X cost-effectively and at scale. This project displays how it can be done and builds critical experience for the partners. Vestas is firmly committed to lead development of this fast-evolving industry."

Source: Topsoe.com/press-releases

Detailed Implementation Plan

Task	2023		2024		2025		2026		2027		2028		2029		2030	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Leasing Program																
Identify potential customers and locations																
Build a pilot project																
Establish customer service and maintenance team																
Expand the pilot project																
Secure necessary permits and approvals for installation																
Scale up the program																
Improve the supply chain to ensure timely delivery																
Expand the program in new markets																
Evaluate the success of the program																
New Electrolysis Capabilities																
Build a prototype																
Obtain necessary approvals and permits																
Test the prototype																
Refine based on feedback from prototype testing and demand																
Secure necessary permits and approvals																
Expand the program in new locations																
Evaluate the success																
Public Opinion																
Begin sponsoring events and attending conferences																
Invest in research and development at universities																
Build partnerships with industry associations																
Expand sponsorship and attendance at events																
Build relationships with key journalists and media outlets																
Leverage industry association to support policy initiatives																
Continue to build relationships																
Evaluate the success																

London Underground Case Proof

- In the early 1990s, London Underground began construction on a new extension to the Jubilee Line. The project was being carried out by a consortium of companies known as the Jubilee Line Extension Project (JLEP)
- 1997, the rail engineering company pulled out of the project due to financial difficulties, leaving the JLEP without a critical partner. London Underground had to quickly find a replacement partner to keep the project on track and avoid costly delays.
- London Underground ultimately turned to another rail engineering company, which was able to take over the work that the original partner had been responsible for. The new partner was able to work closely with the existing partners to complete the project on time and within budget.

Tesla Case Proof

- In 2017, Tesla began construction of a Gigafactory in the state of Nevada, with the goal of producing batteries for its electric vehicles. However, the company faced significant delays with the permitting process from local administration.
- According to a report from the Reno Gazette-Journal, Tesla had applied for permits to install manufacturing equipment at the Gigafactory in November 2016. However, the local authorities did not approve the permits until February 2017, causing a delay in the construction timeline.
- Despite the delays, Tesla was ultimately able to complete construction of the Gigafactory and begin production of batteries.

Shaping Public Opinion

> The key to a faster energy transition is to spread awareness and understanding of the benefits of renewables among senior political leaders and the public.

Clive Turton, President & CEO, Asia Pacific, Vestas

Port of Aalborg: Production and knowledge hub for wind and green transition

- The Port of Aalborg founded Aalborg Renewables as a community of businesses in various renewable sectors in the greater Aalborg area, including onshore and offshore wind. Members include Siemens Gamesa, Bladt Industries, testing facility owner, BLAEST, and the University of Aalborg, as well as start-ups focused on adjacent industries.
- A key focus of the hub is to increase its presence and scope by recruiting more members, whilst gathering the competencies needed for wind, the wider green transition, as well as the whole value chain, to deliver such projects. A new community – Aalborg Fuels and Carbon Capture – is therefore now emerging to support this strong focus on green transition.

Samsung Case Proof

- In 2016, Samsung launched the Galaxy Note 7. However, shortly after the launch, reports began to surface of the phone catching fire or exploding, leading to safety concerns and calls for a recall.
- Samsung initially tried to address the issue by issuing software updates that would limit the phone's battery charge, but this proved ineffective. The company eventually issued a full recall of the Galaxy Note 7, with the estimated cost of the recall and lost sales reaching billions of dollars.
- An investigation into the cause of the safety issues found that the battery design was to blame, Samsung ultimately had to redesign the battery and conduct **extensive testing** to ensure that the issue was resolved before relaunching the product.
- The Galaxy Note 7 safety issues had significant impacts but the company was ultimately able to recover by improving its product safety processes.

Vestas Case Proof

- In the early 2000s, Vestas was facing a challenging market for wind turbines, with low demand and intense competition making it difficult to succeed. The company had invested heavily in developing its technology and had become a leader in the industry, but a lack of demand for wind power meant that its turbines were not selling as well as expected.
- To address this challenge, Vestas focused on expanding its global footprint and building relationships with key customers. The company began to develop new products and services to meet the needs of its customers, including new wind turbines that were designed for use in low-wind conditions
- Vestas also invested heavily in research and development, working to improve the efficiency and performance of its wind turbines. The company's efforts paid off, with increased demand for wind power and a growing interest in renewable energy driving sales of its turbines.

McPhy for Modular Electrolysis Units

Vestas

McPhy

Driving clean energy forward

- Electrolysis: McPhy has expertise in the design and production of advanced electrolysis systems that use renewable energy sources to produce hydrogen. The company's electrolysis systems are highly efficient and can produce high-purity hydrogen that is suitable for a wide range of applications.

MODULARIZED & SCALABLE SYSTEMS