



Kickstart the EU Market from Norway

H2 Value Chain Conference 2023

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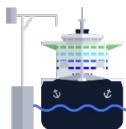
15 November 2023

Seeking to be an integrated developer of the hydrogen value chain

Unique model to capture multiple revenue streams and drive equity value through project development



Production of Hydrogen



Hydrogen Shipping and Storage



Leveraging unique IP

- > **Developer full value-chain for export of hydrogen molecules**
- > Two projects under development, targeting first export in 2027 in Asia and Europe
- > Tiwi H2 (Australia) Norway projects under development
- > Equity ownership in long-term take-or-pay contracts

- > **Infrastructure for loading, storage and shipping of hydrogen**
- > Partner with shipowners and infrastructure funds to own and operate based on long-term charter.
- > Knowledge of the challenges and cost profile across regions

- > **Proprietary development of bulk-scale shipping and storage solution**
- > US Patent & world-first 'Design Approval' for compressed hydrogen carrier & floating storage
- > Development of automated tank production line for static storage tanks

Producing H2 at scale with industrial 20-year offtake at agreed prices enables bankable projects



Provaris is a developer of low-cost, simple, energy-efficient hydrogen supply chains for regional markets

Accelerating innovation to bridge the gap with safe, simple, efficient and economic solutions

Energy Efficiency First Principle



- > Shapes energy policy and investment decisions.
- > Embedded in EU regulation.
 - Energy Union and Climate Action
 - Energy Efficiency Directive
- > Reduce dependence on fossil fuels, security of supply and the use of renewable energy.

Why Compression?

- > **Efficient** regional production & delivery to minimise losses.
- > **Flexible** to 'load follow' variability & volatility in renewable energy.
- > **Simple** process enables low capex design, build and repeat.
- > **Delivers gaseous H₂** required for decarbonisation of industries.
- > **Regional model for green hydrogen production and transport that is 20-25% cheaper than alternative carriers.**

Why Provaris?

- > Ambition to deliver 1Mtpa.
- > Unique IP and approach to developing integrated supply chain
- > Advancing tow production and export supply projects
- > Norway supportive of regional projects for jobs and investment
- > **First mover advantage to capture green premium**

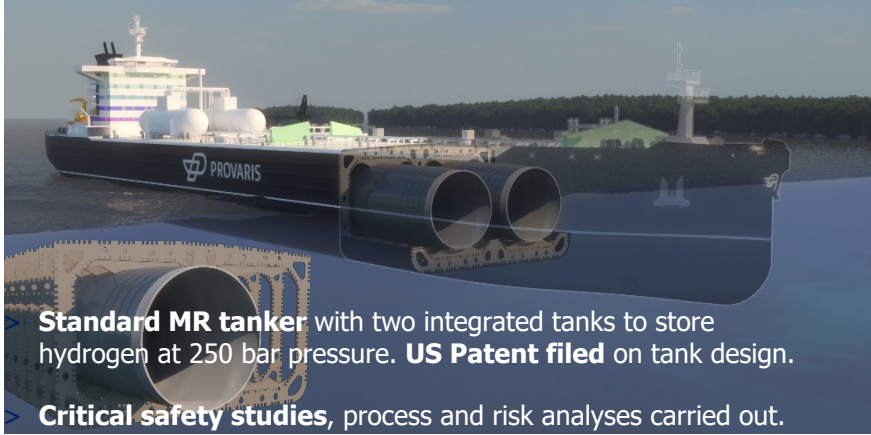
Why Green?

- > EU parliament approval of the Renewable Energy Directive (RED III) requires that **42% of the hydrogen used by industry must be green by 2030** (and reaching 60% in 2035)
- > EU Hydrogen Bank pilot auction dedicated to supporting a green premium (up to 4.50/kg subject to volume)
- > Engagement with German industrials confirm demand for gaseous green supply – market is 3-4mtpa by 2030



World first Design Approval for bulk hydrogen carrier

Low emission shipping through green fuels for power generation, including Fuel Cell and Hybrid integration



- > **'Design Approval' from ABS** based on FEED-level package sufficient for shipyards to quote with confidence
- > **Prototype tank test** to be undertaken in Norway, Q1 2024.
- > Integration with flexible jetty solutions and offshore loading delivers a package to third party feasibility studies.



Note: Illustrations are concept designs for unloading at Jurong Island, Singapore



Two Carriers under development

H2Neo

Cargo carrying capacity: 26,000m³ (430t)

Project export capacity¹: 200,000 tpa

Shipping range: Up to 2,000 Nm

- ✓ **AiP Received: 2021**
- ✓ **FEED Approval: 2022**
- Shipbuilding Contract: 2024
- Prototype & Final Approvals: Q1 2024
- **First operations: 2027**

Assumptions:

- Unloading in 18 hours
- Fleet Ships is based on project production rates and distance to market
- Actual importation volumes can be multiples of the above "fleet" production facility capacities.

H2Max

Cargo carrying capacity: 120,000m³ (2,000t)

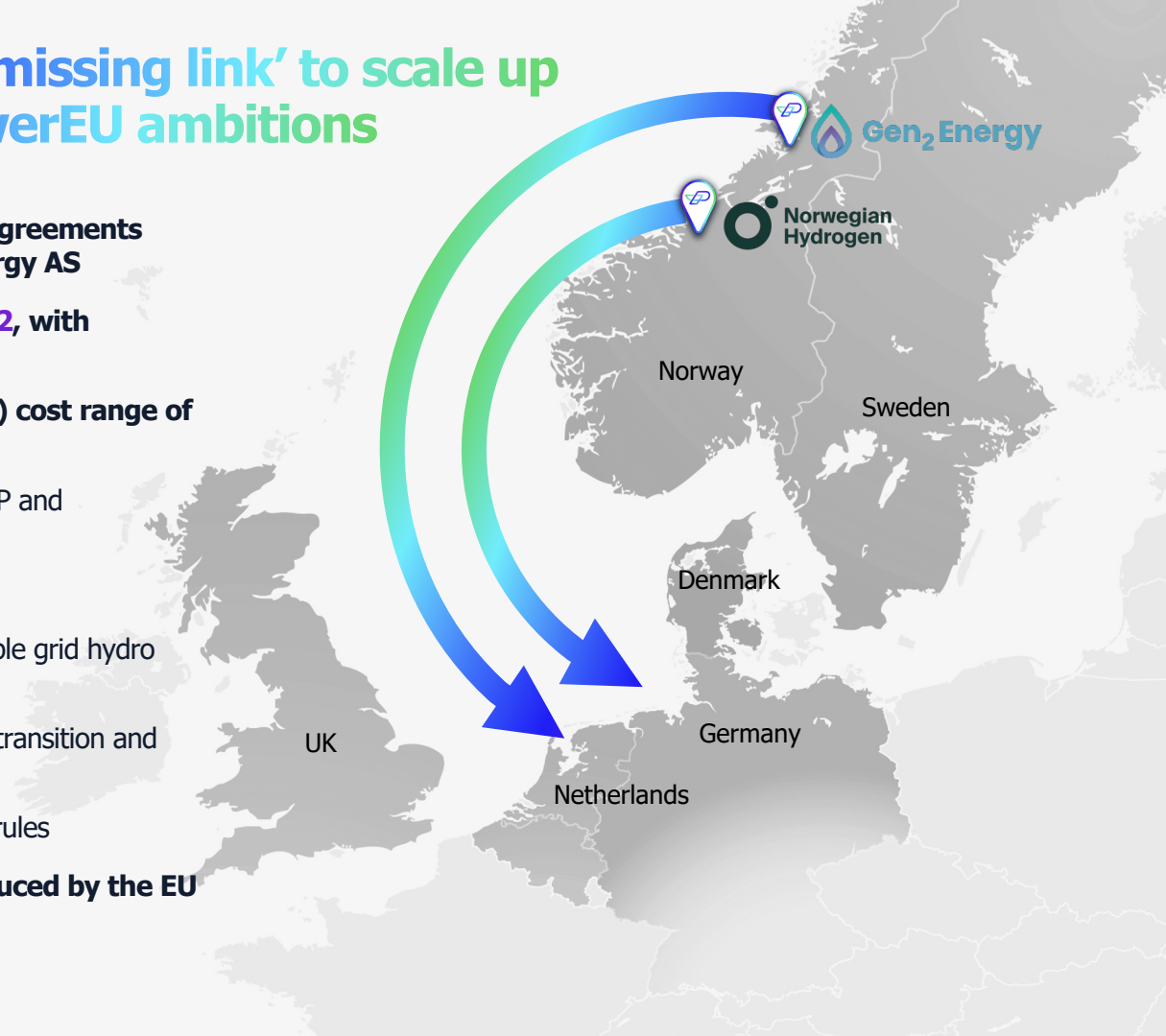
Project export capacity¹: 900,000 tpa

Shipping range: Up to 3,000 Nm

- ✓ **AiP Received: 2021**
- Final Approval - tbc
- Shipbuilding Contract - tbc
- **First operations: Target ~2030**

Provaris identified as the 'missing link' to scale up export and support REPowerEU ambitions

- > Provaris has announced two Collaboration Agreements with Norwegian Hydrogen AS and Gen2 Energy AS
- > Collective project scale +80 ktpa of Green H₂, with additional opportunities under review
- > Delivery (compression and marine transport) cost range of EUR 1.00-1.50/kg
- > First mover advantage utilizing Provaris' shipping IP and development expertise
- > Target first export of hydrogen within 2027
- > Hydrogen production costs competitive using reliable grid hydro power and efficient utilization of electrolyzers
- > EU & Norway "Green Alliance" to focus on energy transition and hydrogen supply
- > Compliance with Delegated Acts and Additionality rules
- > **Green Hydrogen Premium likely to be introduced by the EU**



Levelized Costs – Compressed H2 by GH2 Carriers

- > Transport of compressed H2 is more than just the energy content of the carrier:



Minimise (re)conversion losses and capex required for alternative carriers



Does **not require base-load** renewable energy supply to be efficient



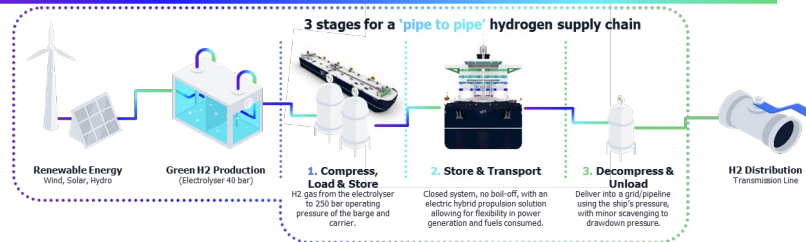
Compression can **100% load-follow** the variable renewable generation profile



Eliminates Batteries, H2 Storage, and/or 'fossil fuel' grid back-up required by other carriers for stable conversion

- > For Norwegian Green H2 Projects at + 40 ktpa, the expected cost of loading ships, transportation to Germany, and discharging into the EU H2 backbones, will be **less than 1.50 EUR/kgH2**.
- > **Loading of GH2 Carrier, via barge, requires 1 kWh/kgH2**, which compares to 8 to 12 kWh/kgH2 for loading a NH3 or LH2 carrier.
- > **Discharge into EU H2 backbone will be ~ 0.2 kWh/kgH2**, which compares to + 10 kWh/kgH2 for reconversion of some of the alternative transportation vectors.
- > **Compressed green H2 from Norway meets the EU Energy Efficiency First Principle**

Simplicity and Energy Efficiency of the Compressed Hydrogen Supply Chain



	Compression	Liquefaction (LH2)	Ammonia (NH3)
'Load Follow' Variable Profile	100%	0%	40-100%
Hourly Change in Process	100%	0%	5%
Conversion Efficiency	1.5 kWh/kg H2	11 kWh/kg H2	9 kWh/kg H2
Boil-off per day	0%	Up to 1%	0%
Reconversion Losses	2.5% (Scavenging)	5% (Regasification)	25-40% (Cracking)
Energy Losses	<20%	+40%	+40%
Purity	✓	✓	?



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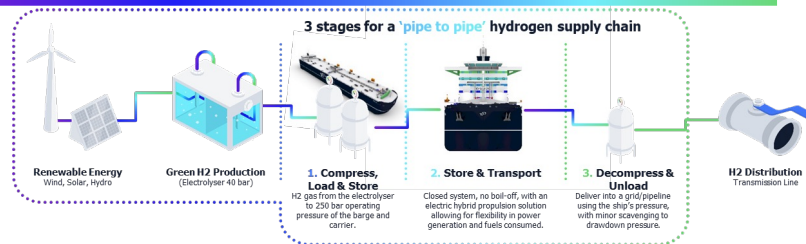
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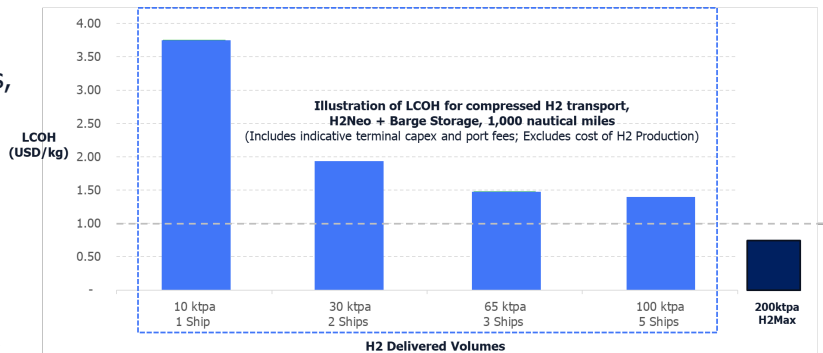
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Simplicity and Energy Efficiency of the Compressed Hydrogen Supply Chain



Energy efficiency and levelised cost evaluated across the full supply chain



Development of 270 MW green hydrogen plant, Ålesund, Norway

Collaboration with Norwegian Hydrogen AS, located at Ørskog in Ålesund municipality



- › **Pre-feasibility completed March 2023 for 270 MW production capacity with export volume 40,000 tpa**
- › Competitive LCOH based on current electricity prices
- › **Marine transport cost range of EUR 1.00-1.50/kg**
- › 20 MW capacity already granted for regional supply to industry
- › Integration with Provaris solution for storage and marine transport to Europe (~600 Nm sailing distance to e.g. Wilhelmshaven)
- › Compression enables plant design with high degree of flexibility for usage of the power grid to balance against high demand periods
- › Reduces CO2 emissions by 500,000 tonnes annually
- › Significant regional value created with +50 jobs and district supply of heat and oxygen
- › **Target FID late-2024 and First Export late-2027**



Innovative hydrogen tank prototype and automated production line for tank construction in Norway

Use of proven robotics and laser-welding will 'crack the code' on cost-effective storage and transport IP

> **Prodtex AS** to construct and test a prototype scaled tank, alongside SINTEF, DNV and ABS for fatigue testing and final approvals (Q1 2024)

> **Proven application of robotic-laser welding**

📈 Increased productivity (~20x)

🔥 Reduced heat & energy costs

🏆 100% quality assurance (NDT)

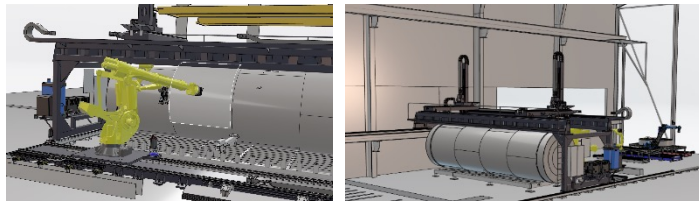
🌿 Reduction in CO2 footprint

🏠 Reduction in construction costs

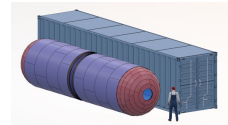
🔍 Extends IP to new applications



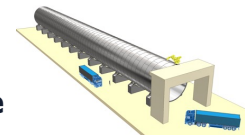
Q1, 2024: Prototype Tank construction & Fatigue Test complete & final class approval



2024: Sale of 1 to 10 tonne tanks from existing Prodtex facility.



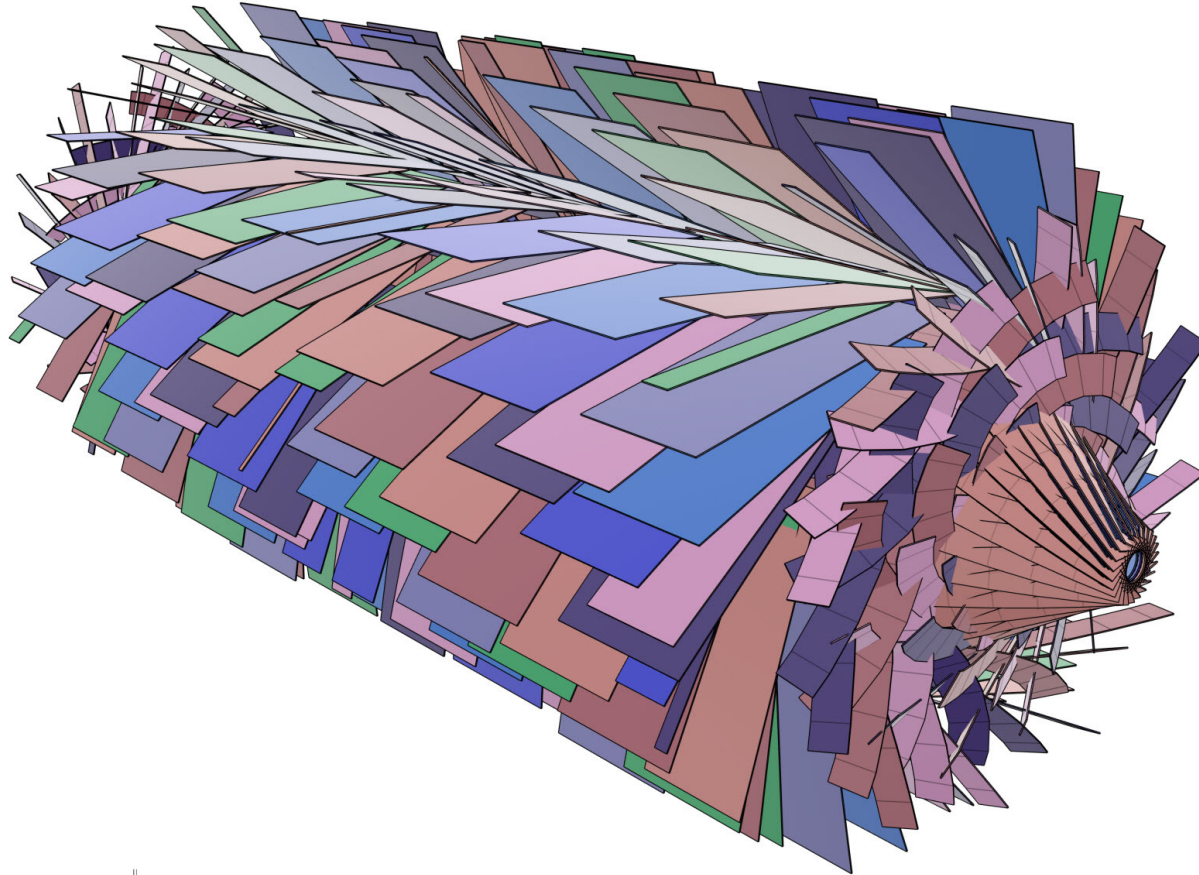
2025: Develop new large scale Production Line to produce tanks for bulk-scale shipping and storage



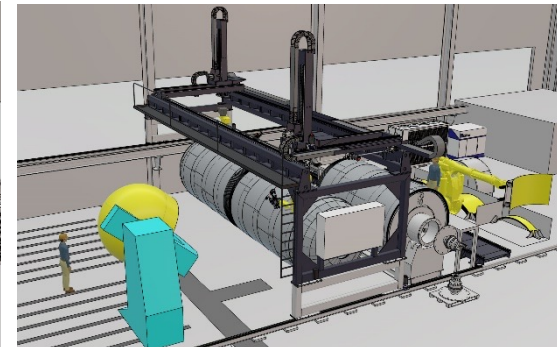
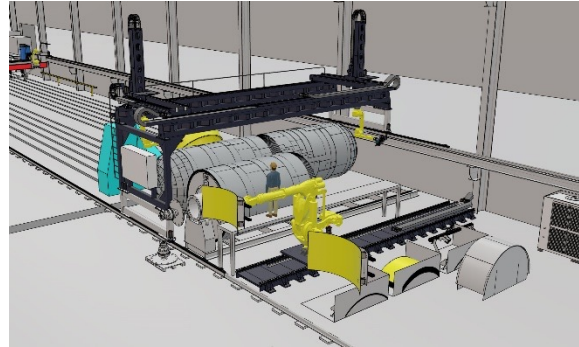
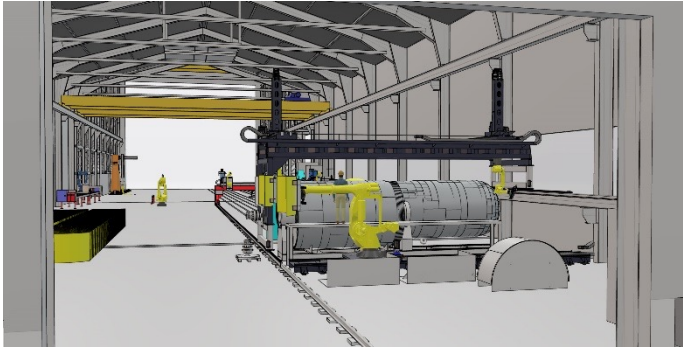
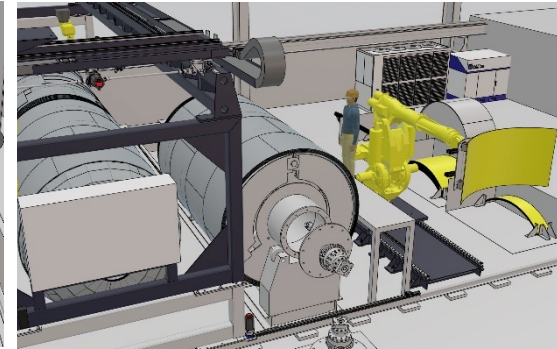
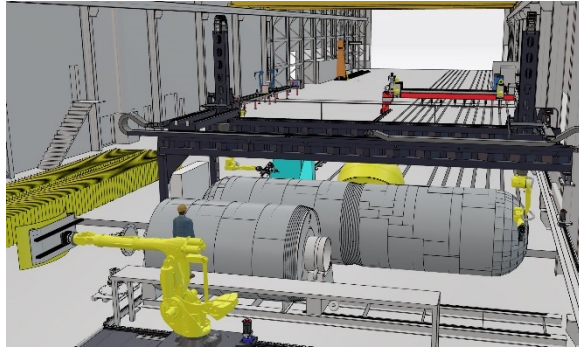
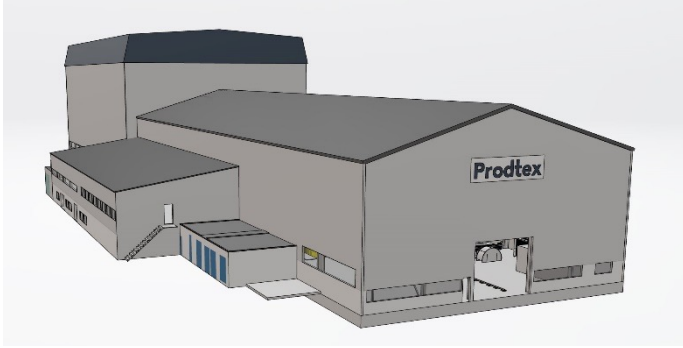
Supported by collaboration partners:



Innovative hydrogen tank prototype and automated production line for tank construction in Norway



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