PROVARIS

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Independent research reinforce benefits of Provaris' energy efficient regional delivery of green hydrogen

HIGHLIGHTS:

- **Recent independent research studies reinforce the outcomes of Provaris' 2023 Hydrogen Transport Comparison Report announced to the ASX 22 May 2023.**
- **The publications identify global production of Green Hydrogen in 2023 projected to range from EUR 95 to 110/MWh (EUR 3.17 to 3.67/kg) with the most favorable production areas identified as Brazil and Australia.**
- **The addition of conversion, marine transport and reconversion costs required by alternative vectors to deliver green hydrogen to Europe increase the projected a cost range from EUR 6 to 7/kg for Ammonia (NH3), Liquefaction (LH2), and Methanol (MeOH), and EUR 7 to 9/kg for liquid organics.**
- **Costs for green gaseous hydrogen delivered by proposed pipelines from Norway, Iberia, Northern Africa and Eastern Europe delivered into mid-Germany projected at a cost range from EUR 4.8 to 5.8/kg.**
- **Provaris' projected costs for green hydrogen produced from grid connected sites in Norway and transported as compressed gaseous hydrogen into the H2 pipeline grid system in Germany can range from EU 4.90 to 5.90/kg, on a comparative levelized cost of hydrogen basis. This includes renewable PPA, H2 production, compression, shipping, unloading and pipeline fees into Germany.**

Provaris Energy Ltd (ASX: PV1) (Provaris, or the Company) is pleased to advise shareholders of independent research studies on the cost of production and transport of hydrogen from renewable resources into Germany has reinforced the compelling technical and economic outcomes of the Company's 2023 Hydrogen Marine Transport Comparison Report published in May 2023, and supports our focus on the development pf regional hydrogen supply chains in Europe. (A copy of the ASX release and highlights of the study is available here)

Martin Carolan, Provaris Managing Director, and CEO commented: *"Provaris champions the development of regional hydrogen supply chains that prioritize both energy efficiency and robust economic returns. These independent publications serve as a formidable endorsement of our 2023 study's findings and will undoubtedly catalyze the acceptance of our delivery model for gaseous green hydrogen. The overall simplicity, transparency, and cost-competitiveness of compression as a means of transportation make it a persuasive choice for ports, pipelines, and end users alike.*

As we advance toward securing the final class approvals for our H2Neo carrier, Provaris' commitment to bulk-scale storage and transport through compression technology stands as an increasingly lower-risk endeavor. Our strategic focus within the European market has received a substantial boost from the EU Parliament from the Renewable Energy Directive. This directive mandates that by 2030, a substantial 42% of all hydrogen utilized by industry must be from renewable generation."

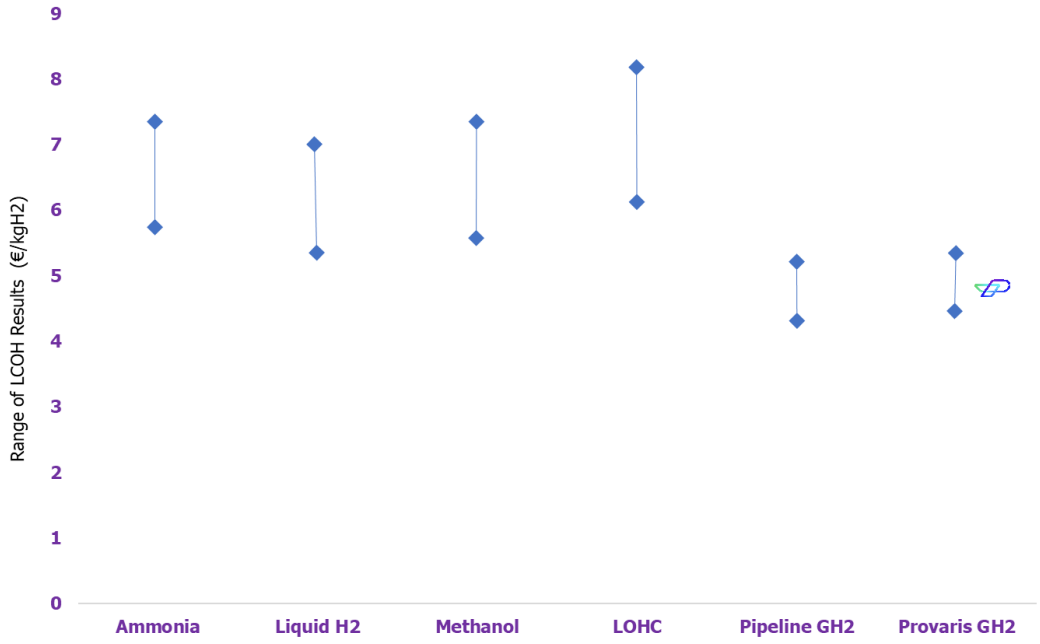
Comprehensive studies supported by German Federal Ministry for Economic Affairs and Climate Action and the Federal Ministry for Economic Cooperation and Development, conducted in collaboration with eminent institutions such as Agora Industry, Hamburg University of Technology[1], and Fraunhofer ISE[2], spotlight the pivotal role of production efficiency and transportation cost when sourcing green hydrogen from the most economically viable regions for renewable energy.

Provaris has taken an innovative approach to this challenge. Through detailed feasibility analysis of grid-connected green hydrogen production sites along the coastal areas of Norway (within a sailing distance of 600-700 nautical miles) translate into a highly competitive delivered cost range of EUR 4.90 to 5.90 per kilogram. This inclusive cost structure encompasses all aspects, including hydrogen pipeline transportation costs into Europe.

Notably, the long-distance conversion, transportation to Germany, and subsequent reconversion to gaseous form for pipeline distribution can lead to considerably higher costs, ranging from EUR 6 to 7 per kilogram for Ammonia (NH3), Liquefaction (LH2), and Methanol (MeOH), with an even more substantial EUR 7 to 9 per kilogram for liquid organic alternatives.

A concise summary of the comparative results is presented in Figure 1, providing an illuminating perspective on why Provaris' emphasis on collaborative ventures in Norwegian sites has the potential to establish highly efficient green hydrogen supply chains without any adverse impact on local grid operations. Furthermore, this strategic choice positions us as pioneers, poised to capitalize on the ambitious REPowerEU agenda, which aims to import 10 million tons per annum (Mtpa) by 2030.

Figure 1: Summary of LCOH Results by Fraunhofer and Agora publications (250ktpa production scale)



Sources: Agora Industrie and TU Hamburg (2023); Fraunhofer ISE (2023); Provaris Energy. Provaris GH2 assumes grid connected production site delivered from Norway to Germany using a fleet of H2Neo compressed hdyrogen carriers.

These in-depth studies also highlight promising market demand and the cost-competitiveness of exporting green, compressed hydrogen from Norway to the EU. It is noteworthy that the EU's Renewable Energy Directive explicitly necessitates that 42% of industrial hydrogen must be green by 2030, with a goal of reaching 60% by 2035. Additionally, the directive underscores that 1% of all fuels used in 2030 must be Renewable Fuels of Non-Biological Origin.

[1] Agora Industrie and TU Hamburg (2023), supported by the Federal Ministry for Economic Affairs and Climate Action

[2] Fraunhofer Institute for Solar Energy Systems ISE on behalf of the H2Global Foundation in cooperation with Gesellschaft fur international Zusammenarbeit (GIZ), supported by the Federal Ministry for Economic Cooperation and Development.

The demand for our unique approach remains robust, extending to locations in the North Sea and Baltic regions which enjoy a shorter proximity to the ports of the Netherlands and Germany. Provaris is poised to be a key player in meeting the burgeoning demand for green hydrogen in these pivotal regions.

The Agora Industrie and TU Hamburg (2023) study was supported by the Federal Ministry for Economic Affairs and Climate Action. The study presents the full value chain costs for delivery of green hydrogen (in gaseous form) into the hydrogen backbone in Wilhelmshaven, Germany. The study has evaluated commonly recognised maritime transport vectors from a fixed sailing distance to cover what can be considered as favorable green hydrogen producton sites (e.g. Brazil and the Middle East). The study covers CAPEX and OPEX for all indivual components of the value chain, as well as energy supply costs and other costs (such as port fees). The supply chain is ex-electrolyser (at production side), and thus no variability in H2 production costs by region, through to injection into hydrogen pipeline in Wilhelmshaven. It further considers gaseous hydrogen supply via pipeline from Norway.

Key findings include:

- Liquid Hydrogen (LH2) transport costs approximately EUR 6/kg H2, affected by LH2 carrier investments and liquefaction expenses.
- Methanol transport costs slightly more at EUR 6.2/kg H2, increasing to around EUR 7/kg H2 for CO2 Direct Air Capture projects.
- Ammonia transport costs around EUR 7/kg H2, incurring higher losses in conversion and re-conversion stages.
- Gaseous H2 from Norway costs EUR 4.8 to 5.7/kg H2 for short pipeline distances.

A link to the full report is provided below.

The Fraunhofer ISE study "Power-to-X Country Analyses" is a cost analysis study on behalf of H2Global | Fraunhofer ISE | August 2023. The report covers pipeline options from a number of regional and favorable green H2 production sources, including Iberia, Eastern Europe (Ukraine) and Northen Africa. Longer term, with full implementation of a EU hydrogen backbone pipeline network, this study estimates pipeline supply option costs in the same range as that of the Agora study.

The Fraunhofer study set out to identify the cheapest production regions (based on renewable energy potentials) and the impact of transportation (by volume and distance) to Germany.

Key findings include:

- Brazil and Australia are identified as the most cost-effective production regions, with estimated costs of EUR 3.17 to 3.67 per kilogram of H2.
- The study omits re-conversion costs to gaseous H2 in pipeline at German ports but offers valuable cost insights compared to the Agora study.
- Supply costs for Ammonia from Brazil and Australia range from EUR 6 to 6.4 per kilogram of H2 before re-conversion, slightly higher than Agora's estimate.
- Significant cost variations exist within and between regions, accounting for factors like renewable energy

potentials and economies of scale.

- Green Ammonia from Northern Africa can cost between EUR 6.3 and 8.2 per kilogram of H2 before cracking at the receiving port.

A link to the full report is provided below.

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About Provaris Energy

For more information: www.provaris.energy

Provaris Energy Ltd (ASX: PV1) is an Australian public company developing a portfolio of integrated green hydrogen projects for the regional trade of Asia and Europe, leveraging our innovative compressed hydrogen bulk storage and carrier. Our focus on value creation through innovative development that aligns with our business model of simple and efficiency hydrogen production and transport can establish an early-mover advantage for regional maritime trade of hydrogen and unlock a world of potential. In August 2022 Provaris Norway AS was established to advance the development of hydrogen export projects from Norway and other European locations.