Key Findings:

This is an application of the Exfin software to showcase LCOH calculations and potential cost reduction curves:

- Exfin can be used to calculate LCOH with some additional manual processing by applying a conversion rate to the calculated yield (MWh) from wind, or other RES to the LCOH unit in kg/H_2.
- With current estimated costs for the hydrogen conversion units, Alkaline is less expensive than PEM, with the former achieving slightly lower LCOH.
- LCOH is heavily dependent on the LCOE of the renewable energy source.

For more information on Exfin please visit:

exfinsoftware.com

For more information on Dolfines please visit:

www.dolfines.com

Digital rendering of Dolfines floating offshore wind platform with turbines in situ. Image courtesy of Dolfines.

Using Exfin to calculate Levelised cost of hydrogen

Case Study: Dolfines floating structure combined with hydrogen conversion capabilities

Dolfines, a French company, is developing floating offshore wind platforms that will enable hydrogen conversion directly on the platform itself. Through the NWE Interreg project, the Marine Energy Alliance (MEA), Dolfines received both technical and commercial services.

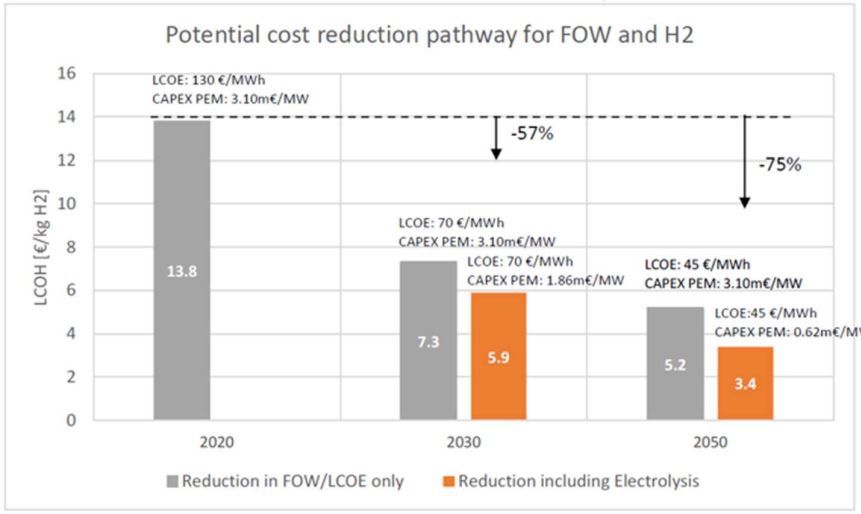
Exceedence Ltd (EXC) provided the commercial service to Dolfines, with one of the tasks investigating what the Levelised Cost of Hydrogen (LCOH) could be if the total amount of produced electricity from the wind turbine were converted to hydrogen.

Using Exfin, a techno-financial software tool, allows the user to quickly and intuitively build, analyse and optimise any type of offshore renewable energy project. Some of the Key performance indicators (KPI) currently calculated are Levelised cost of Energy (LCOE), Internal Rate of Return (IRR) and Net Present Value (NPV).

EXC was asked to build two Baseline projects, one for a 6MW wind turbine and 5MW hydrogen conversion unit, and the other for a 12MW wind turbine with a 10MW hydrogen conversion unit. The wind resource was provided by Centrale Nantes, the wind turbine costs for the 6MW was provided by Dolfines, and the hydrogen unit cost for both PEM and Alkaline was provided by EMEC. EXC sourced the remaining project inputs from publicly available information and industry knowledge.

LCOE and LCOH are both comparative metrics used in the energy industry to assess the relative merits of generation types. LCOE compares different methods of electricity generation on a comparable basis of Cost per MWh, whereas LCOH is compared on a Cost per kg Hydrogen (H_2) basis. Both use the same basic equation:

$$LCOE\ or\ LCOH = \frac{\sum costs\ over\ lifetime}{\sum energy\ produced\ over\ lifetime}$$



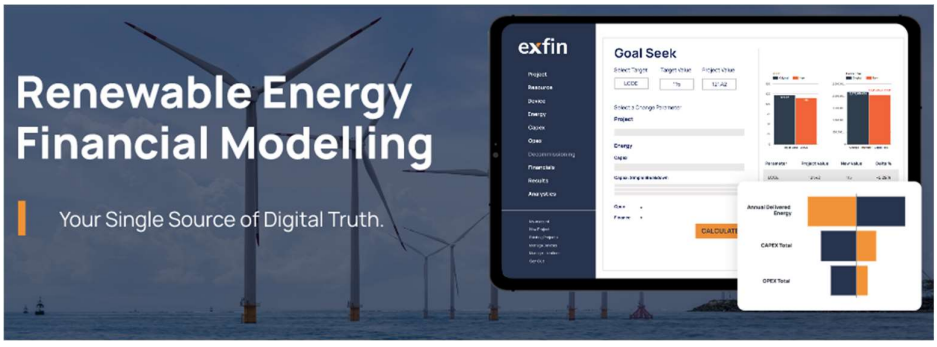
Potential cost reduction pathway for FOW H_2. Image courtesy of Exceedence

To calculate LCOH, the electricity yield needed to be converted from MWh to kg H_2. EMEC and Dolfines suggested a 20% reduction to cover the conversion losses from the hydrogen unit along with other losses. The suggested conversion rate used was thus 55kWh=1kg H_2. Note that, this method does not take into account the time value of selling hydrogen.

LCOH is very dependent on the LCOE of the renewable energy, with the starting LCOE for 2020 estimated to €163 per MWh, bringing the starting LCOH using the PEM hydrogen unit at €13.8 per kg H_2 as shown in the graph above.

Publicly available estimates for the same year is €11.75 per kg H_2, possibly using lower starting LCOE and/or lower H_2 CAPEX.

In 2030, the LCOE for FOW is expected to drop to €70 per MWh and €45 per MWh by 2050. If the cost of PEM stays constant, the LCOH in 2030 and 2050 is estimated to €7.3 and €5.2 per kg H_2 respectively. If similar cost reductions are applied to hydrogen units in offshore applications as onshore (40% by 2030 and 80% by 2050), the estimated LCOH drops to €5.9 and €3.4 per kg H_2 in 2030 and 2050 respectively. Further refinements in assumptions and cost inputs are needed to reach the 2050 target of €2 per kg H_2.



"Exfin enabled us to get to key insights quickly and formed an integral part of our decision making on this subject" – Andreas Emmert, Dolfines

exfin

Key benefits of Exfin:

Accurate financial metrics
Financial projections based on detailed engineering models and real-world wave, tidal or wind resources.

Accelerated project development
Screen out weaker concepts earlier and accelerate the development and refinement of innovative design with genuine prospects.

Design optimisation
Explore potential advances in energy generation and identify opportunities for cost reduction

Design understanding
Key insights into annual energy production, local power fluctuations, loads in structural members and fatigue life expectancy, based on detailed engineering simulation

Clarity
Complete transparency of both financial and engineering design processes

Consistency
Suitable for all stages in the design process, from concept development, to model scale prototypes, and right through to full scale versions

Unlock investment
Increase investor confidence by de-risking projects

Recognised by industry
Validated via industry case studies and technical papers

Environmental and societal benefits
Reduces entry barriers to new developers and facilitates growth of wave energy sector in general