Webinar - Optimising Offshore Wind-to-Hydrogen Production Configurations
OCEAN-H2W™ tool

Presented by

Marie Robert

ORE Research Engineer, PhD

OPHARM2 Scientific Coordinator

Presented by

Nicolas Michelet

Hydrodynamics and Seabed Dynamics Research Engineer, PhD

OCEAN-H2W tool developer

Optimising Offshore Wind-to-Hydrogen Production Configurations

1. Context of the tool development
2. OCEAN-H2W™ tool presentation
3. Example of usage for the tool
4. Services FEM can provide

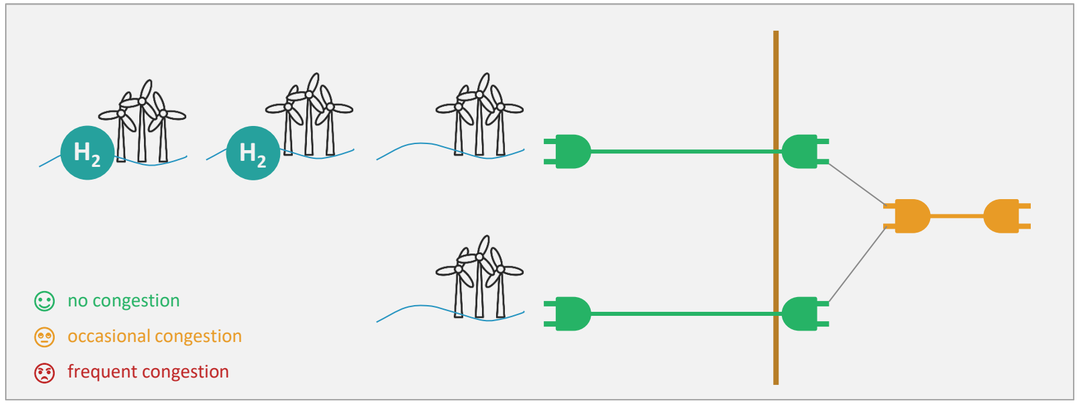
Context of the tool development

Why hydrogen and offshore wind?

FRANCE ENERGIES MARINES

Advantages

- Enhance the energy sovereignty of countries with high offshore wind potential
- Make use of abundant remote offshore energy resources
- Limit grid congestion in the onshore connections of major offshore wind hubs
- Be able to produce hydrogen without drawing on the drinking water supply
- Have space to develop GW-scale electrolysis facilities

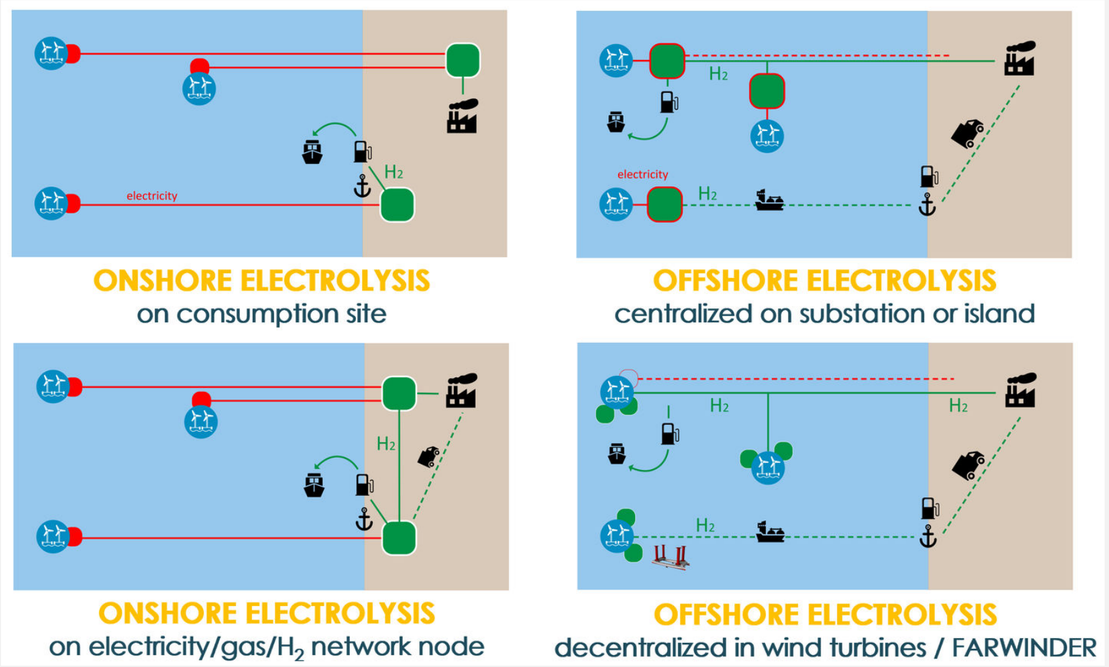


Remaining barriers

- Keep reasonable costs > decide the right OWF-H2 plant layout
  - proper infrastructure sizing
  - manage intermittency, related ageing and O&M
- Potential impacts on offshore ecosystems to be mitigated > anticipation
- Prepare for H2 and electricity market integration

Key questions regarding the architecture of the coupling

- Onshore or offshore electrolysis?
- Ongrid or offgrid electrolysis?
- Production strategy: electricity priority / H2 priority / 100% H2
- Cost estimate for offshore H2 production?
- Sizing of electrolysis power vs OWF power?
- Transport by pipe or by ship?



Can help making the go / no go decisions

Can help make the right choices in pre-design stages, with LCOH gains up to 30%

The OPHARM and OPHARM2 projects were initiated to answer these questions

OPHARM [2021-2023]
Offshore Production of Hydrogen Analysis and RoadMap

DURATION: 24 mois | **LAUNCH:** 2021 | **BUDGET:** 544 K€

TOPICS

- Market analysis
- Assessment of hydrogen production configurations
- Hydrogen R&D roadmap for the French offshore wind energy sector

PARTNERS

WITH THE SUPPORT OF

OPHARM2 [2023-2026]
Offshore Production of Hydrogen Advanced Analysis

DURATION: 36 mois | **LAUNCH:** 2023 | **BUDGET:** 2 447 K€

TOPICS

- Network integration
- Technology specification, sizing and testing
- Environmental integration

PARTNERS

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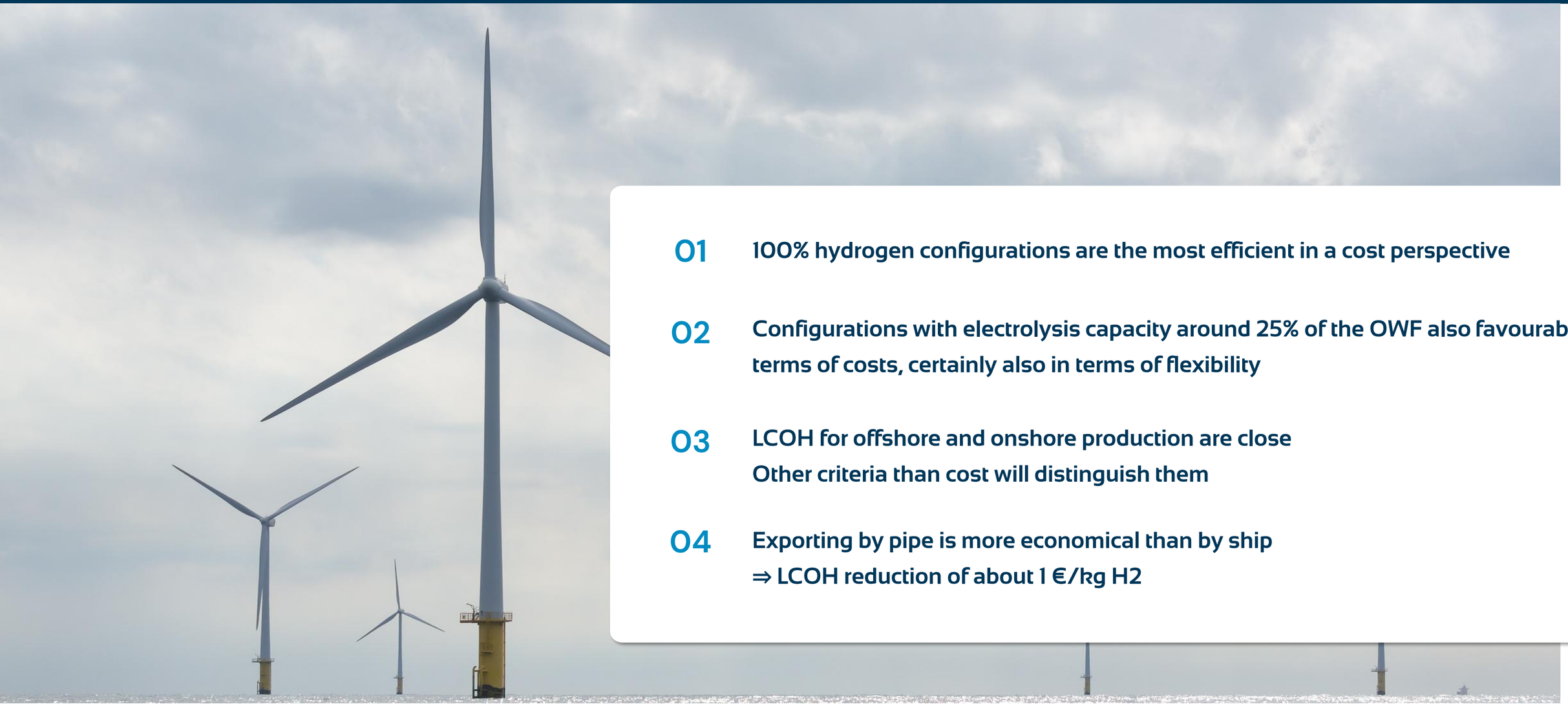
Some findings from the OPHARM project (2023) - Farm scale



01 100% hydrogen configurations are the most efficient in a cost perspective

02 Configurations with electrolysis capacity around 25% of the OWF also favourable in terms of costs, certainly also in terms of flexibility

03 LCOH for offshore and onshore production are close
Other criteria than cost will distinguish them

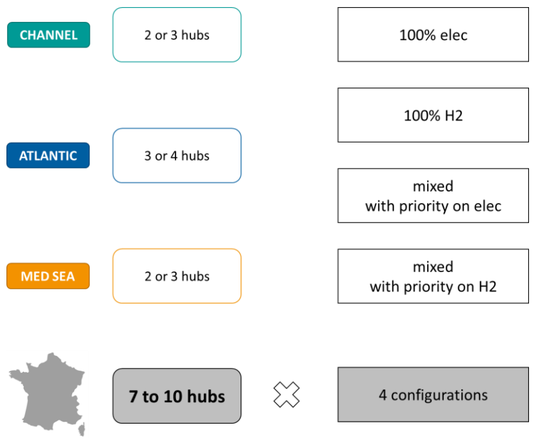
04 Exporting by pipe is more economical than by ship
⇒ LCOH reduction of about 1 €/kg H2

Some findings from the OPHARM2 project (2024)

01 Analysis of the potential for offshore hydrogen production along various French coastlines, whilst ensuring electricity generation is in line with the TSO's roadmap

- **16% of national electricity consumption** would be covered by OWF

  (N2 scenario of « Energy Pathways 2050 » by RTE)
- **France national hydrogen consumption could be addressed**, provided that a sufficient number of OWF hubs are developed
- **50% of the H2 production** would then be covered by generation in the Atlantic area



Some findings from the OPHARM2 project (2024)

01 **Analysis of the potential for offshore hydrogen production along various French coastlines, whilst ensuring electricity generation is in line with the TSO's roadmap**

02 **In a mix between electricity and hydrogen production from different hubs:**

- Electricity is more suited to close to shore sites (cost of electric connections increases significantly with distance)
- Hydrogen is more suited to remote and multi-GW scale sites (taking advantage of pipe max power)

Some findings from the OPHARM2 project (2024)

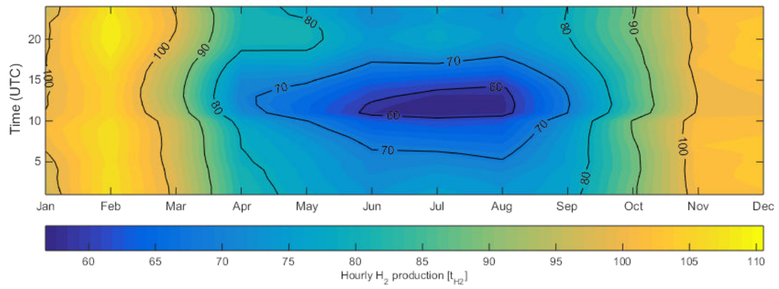
01 **Analysis of the potential for offshore hydrogen production along various French coastlines, whilst ensuring electricity generation is in line with the TSO's roadmap**

02 **In a mix between electricity and hydrogen production from different hubs:**

03 **Analysis of time series**

- Extreme sensitivity of production time series to energy production strategy (100% elec / mixed with elec priority / mixed with H2 priority / 100% H2)
- Strong seasonal signal along the Atlantic, limited along the Mediterranean Sea
- Significant diurnal signal

FRENCH EEZ ATLANTIC AREA



OCEAN-H2W tool presentation

The solution OCEAN-H2W™

ECONOMIC AND ENERGETIC ASPECTS

FARM SCENARIOS

Nominal power, climate & distance to shore

Electrolyser's location

Export product: CGH2

H_2 carrier: pipe, ship

COST DATABASE

Components lifetime

Commissioning / decommissioning

O&M

FARM INDICATORS

kg H_2 / year

€ / kg H_2

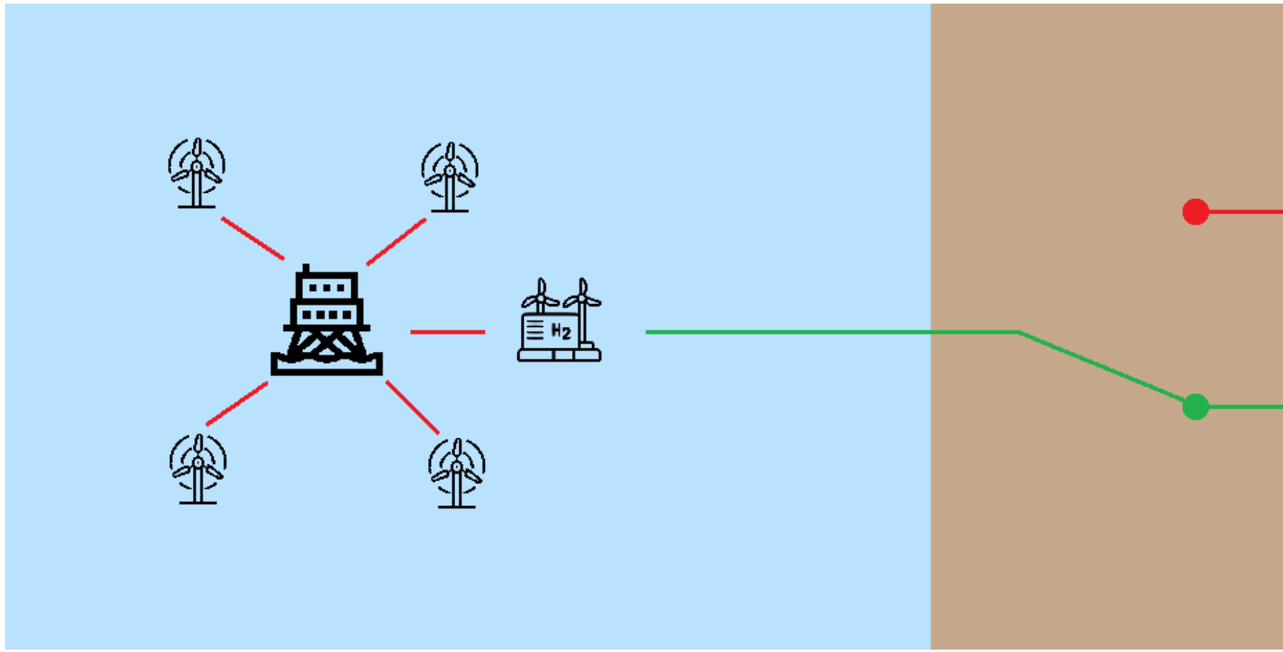
+ time series of dynamic variables

Use case - 100% H_2 Offshore

Is a production offshore more expensive than onshore ?

Scenario with an offshore hydrogen production

- 66 x 15 MW wind turbines => 990 MW nominal power
- 842 MW electrolyser positioned over an offshore platform
- Export pipe to connect to the shore

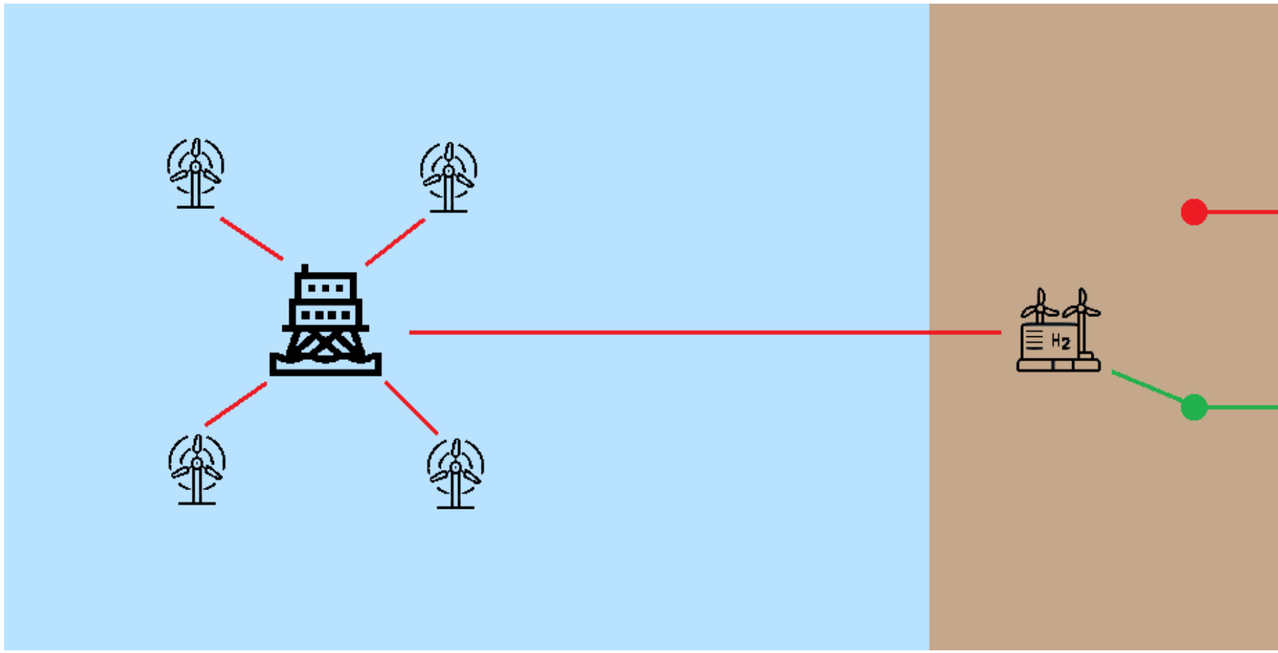


Use case – 100% H_2 Onshore

Is a production offshore more expensive than onshore ?

Scenario with an offshore hydrogen production

- 66 x 15 MW wind turbines => 990 MW nominal power
- Export cables (4x250 MW) to connect to the shore
- 842 MW onshore electrolyser

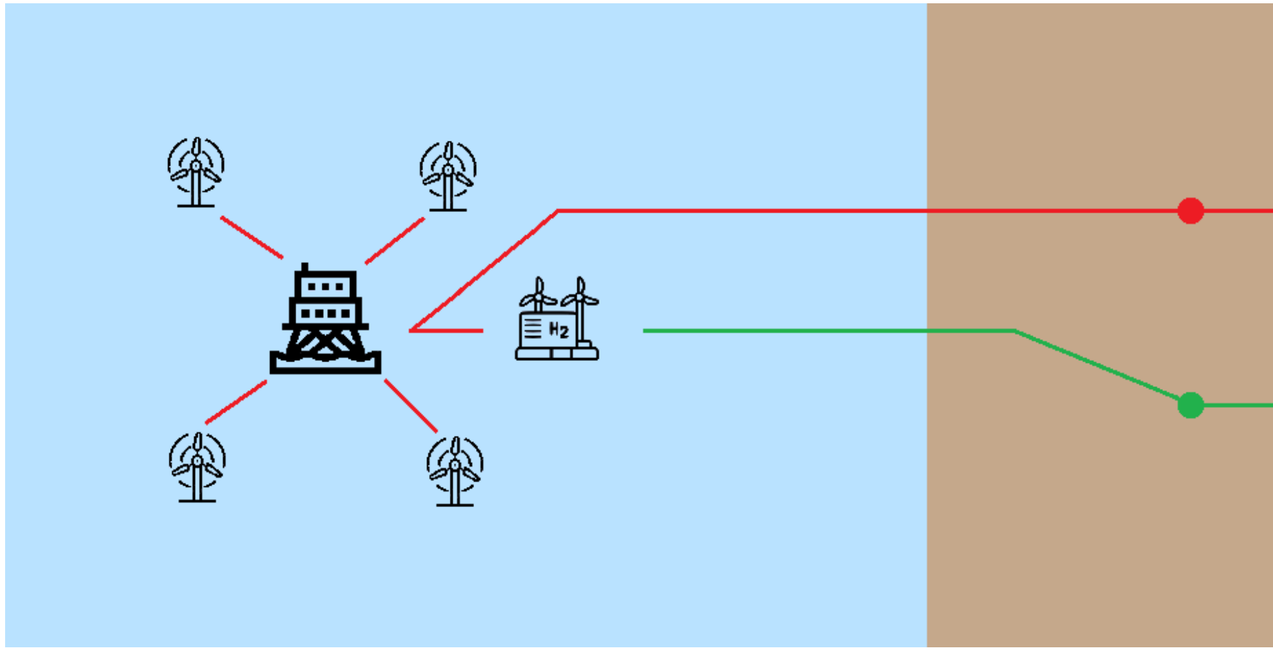


Use case – Mix H_2 + e-

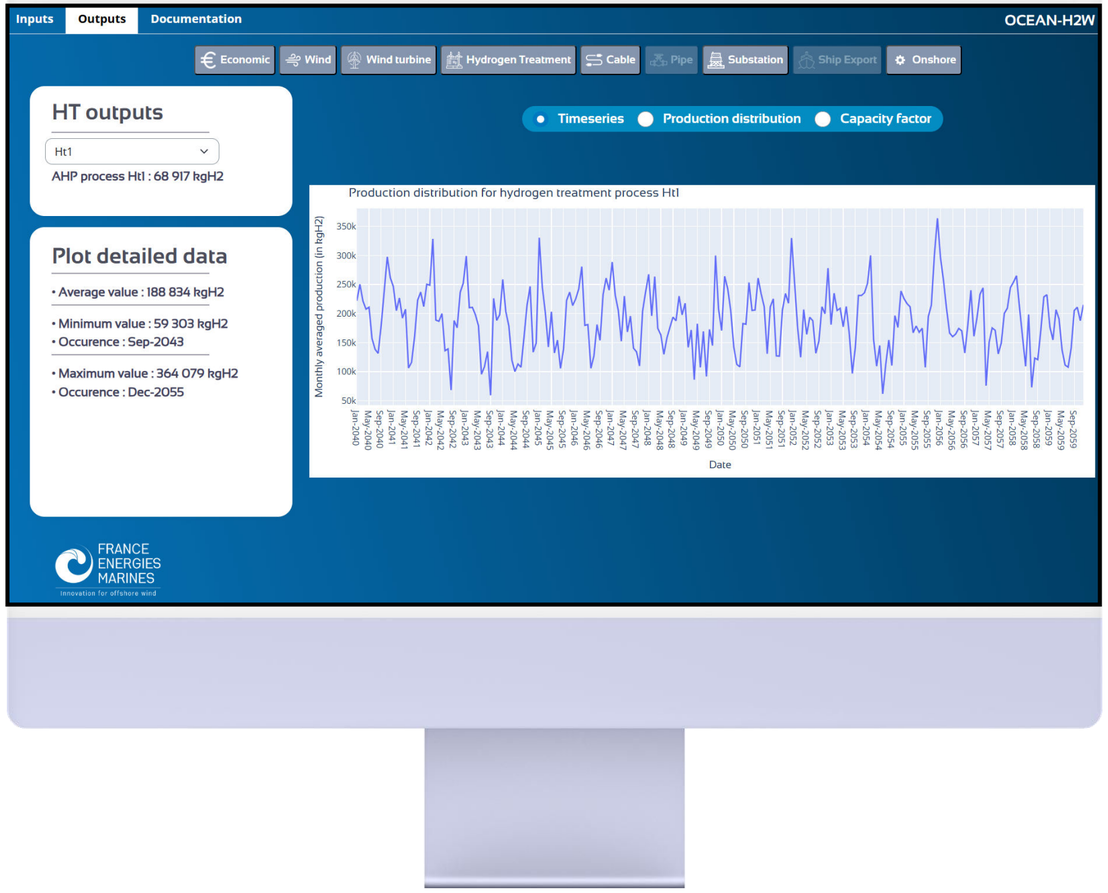
Is it worthwhile to produce hydrogen to smooth out my electricity output?

Scenario with a mix production between hydrogen and electricity

- 66 x 15 MW wind turbines => 990 MW nominal power
- Wind turbine production split
  - Priority on hydrogen production
  - Remains to electricity production
- Export cables (3x250 MW) to connect to the shore
- Offshore electrolyser (250 MW capacity)
- Export pipes to connect to the shore



OCEAN-H2W™ tool presentation



OCEAN-H2W™

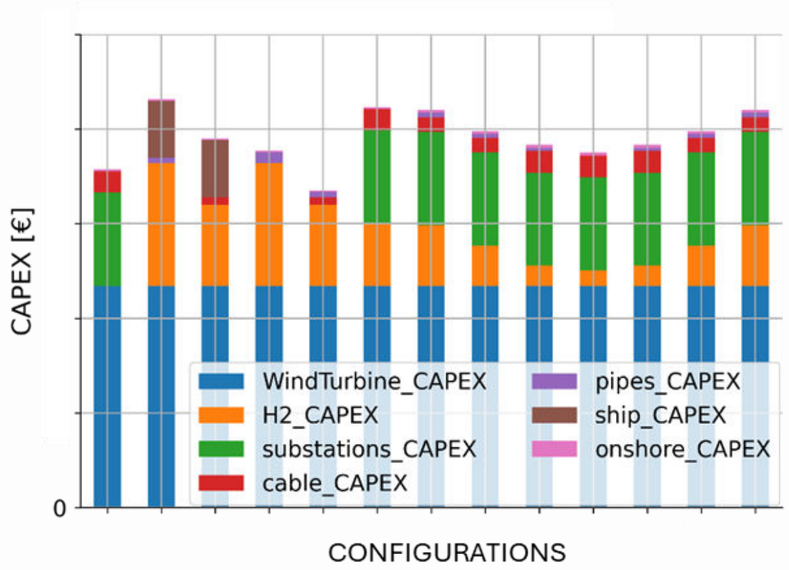
Designed to assess and compare H2 production pathways coupled with offshore wind

Examples of using the tool’s functionalities

Examples of Using the Tool's Functionalities

Assess different configurations for a given wind farm or hub

- On AEP / cost / LCOH / production profile criteria



OPHARM plot

ATLANTIC EEZ France

Bottom-fixed wind farm

Examples of Using the Tool's Functionalities

Derive hourly production profiles

- At the scale of one wind farm or one hub
- At the scale of a maritime façade

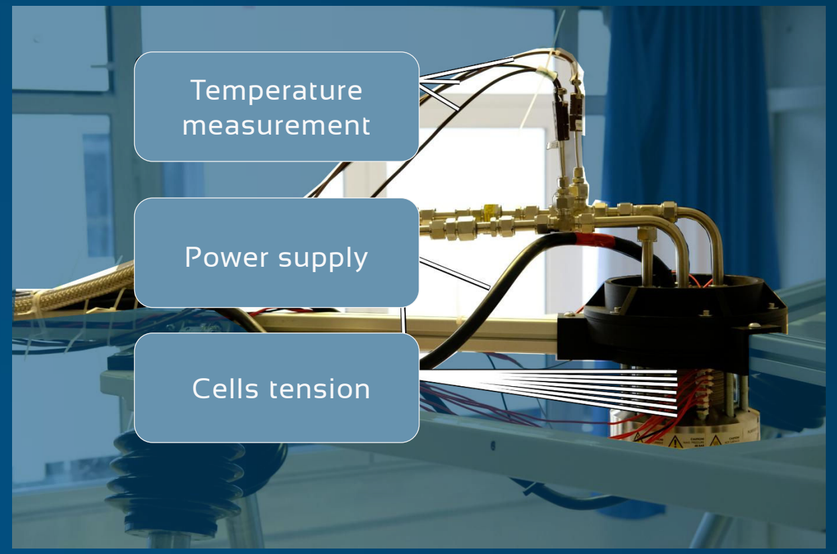
- With the possibility to represent mixed configurations involving electricity and hydrogen production

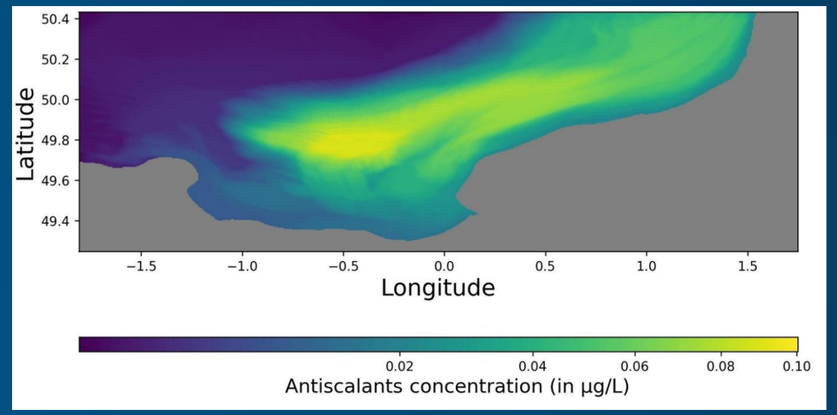
Examples of Using the Tool's Functionalities

Feed realistic technological or environmental studies

- **Technological**
  - Electricity production rhythms for durability studies
  - For coupling with experimental studies

- **Environment > use hourly production profile to derive**
  - Water consumption
  - Produced water discharge
  - Hydrogen production profiles
  - For coupling with other numerical modelling



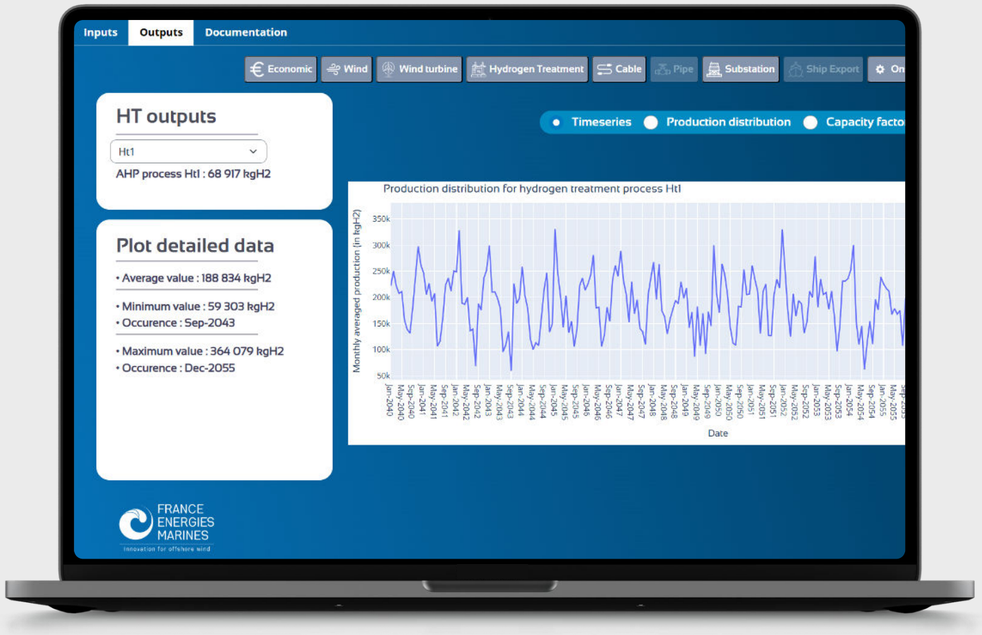


Practical access to the tool

Practical access to the tool

Software as a service, with included training in the first year

Cost of the licence will depend on your status, get in touch with us

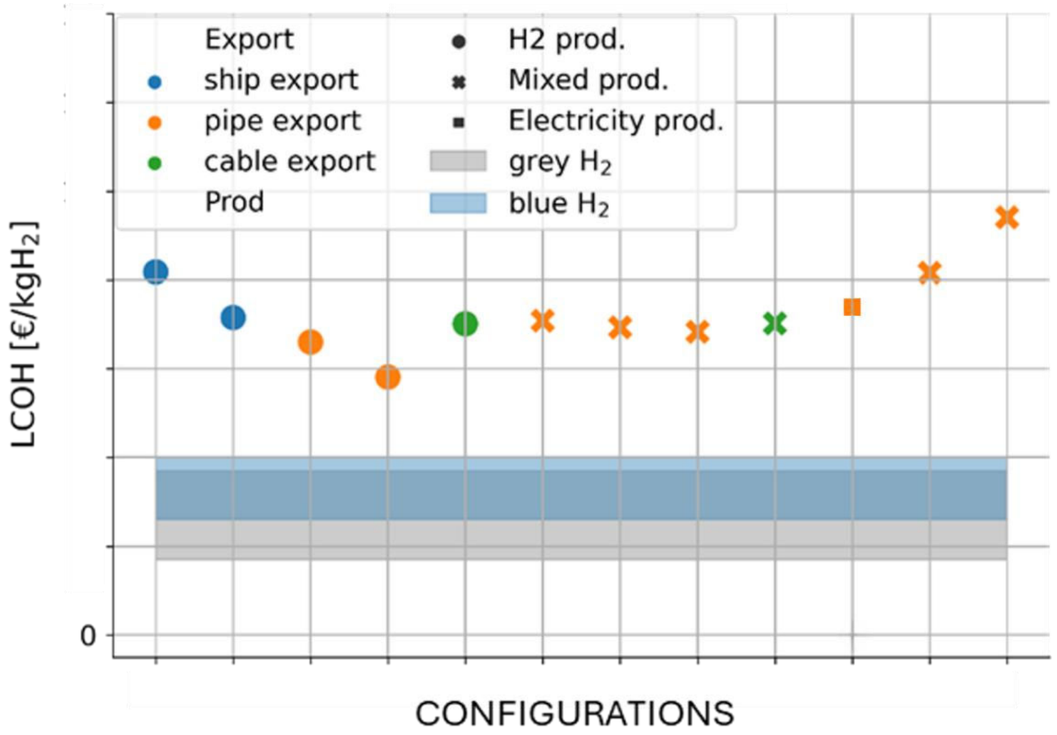


On-demand expert support for case design, launch, and analysis

Available in **September 2026**

Related services FEM can provide

Optimisation study of one wind farm configuration



- With the expertise developed over research cases
- Ability to launch many cases with small variations of inputs
- Ability to analyse the results of an important number of cases
- Criteria for optimisation may include: AEP / LCOH / storage size

For whom?

OWF developers, potential PPA clients, decision-maker on tenders

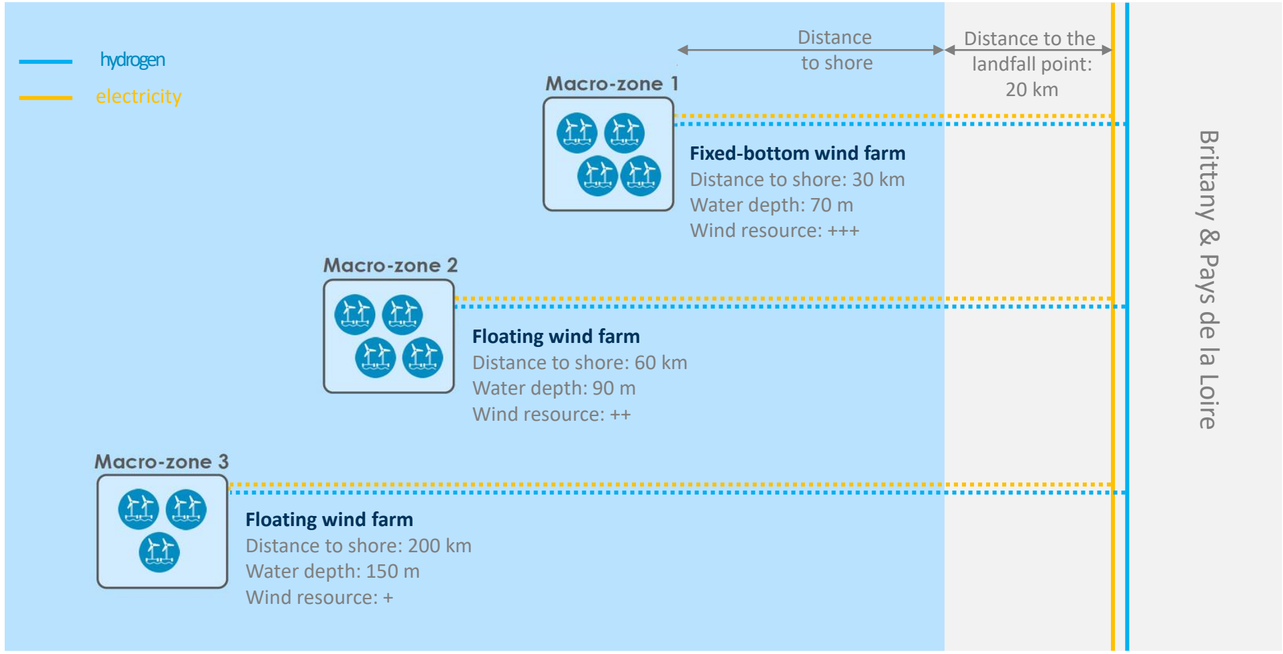
Assessment of the offshore H2 production potential at the scale of a sea basin

- Definition of hypothesis and scenarios with the client
- Modularity of the representation by hub
- Hourly time series

> production profiles at different time scales

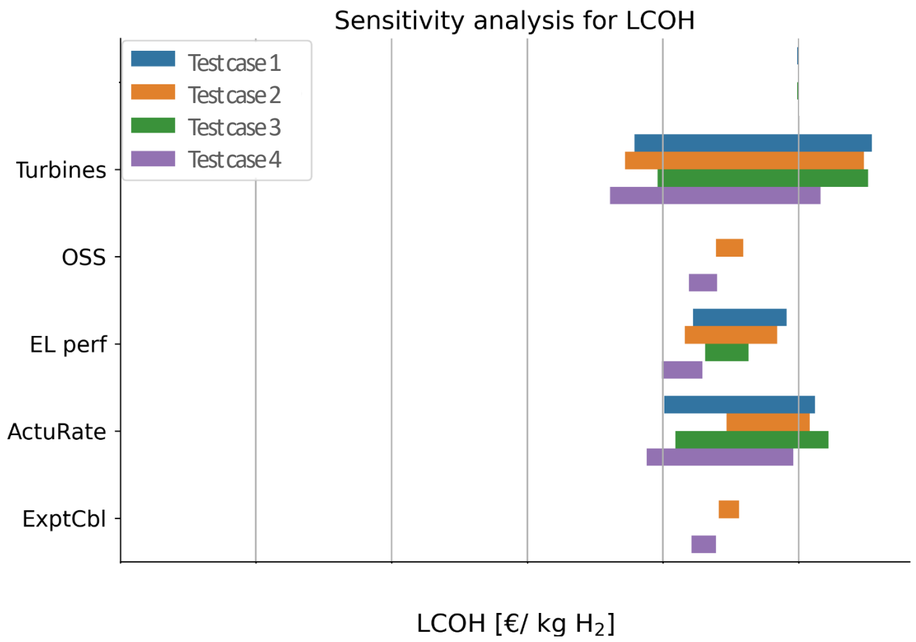
For whom?

Regions, states, electricity and gas network operators, decision-maker on tenders, consultancies



Related services FEM can provide

Sensitivity studies



- Assess the impact of uncertainties or improvement of pre-identified inputs
- To better understand the uncertainties associated with LCOH calculation and build robust business models
- To orientate research effort on the right pathways

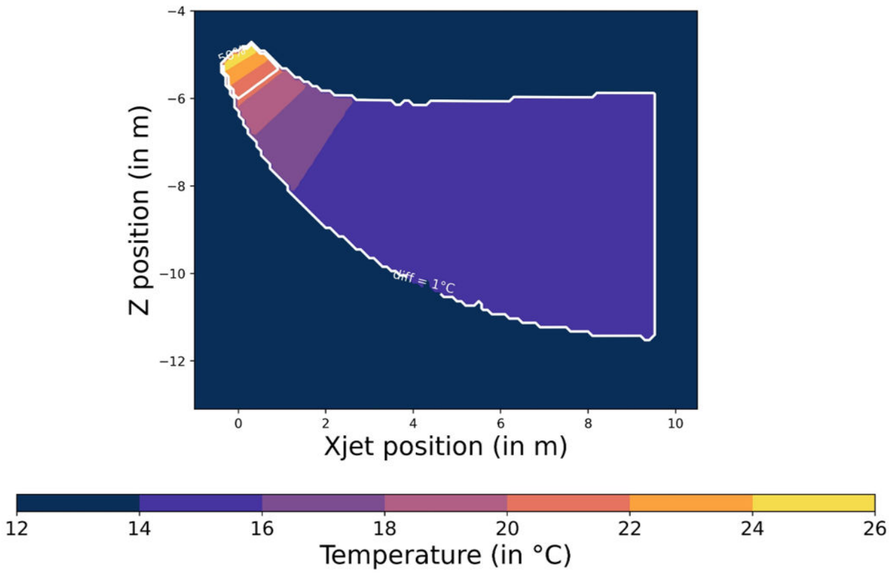
For whom?

Regions, states, H2 project developer, consultancies, R&D program managers

Related services FEM can provide

Coupling with other modelling

Model PLUME2.0



- **Experimental**
  - Technology e.g. durability tests, impact of intermittency
  - Environment e.g. impact of produced water discharge
- **Numerical**
  - Environment e.g. impact of produced water discharge
  - Economics e.g. SPOT market time series
  - Climate change estimate hydrogen production in future climate projections

For whom?

H2 technology developers (electrolysis, compression), laboratories, NGO, TSO, …

Evolution of the tool according to your needs

Development of specific modules
Sun, tide or wave?
Hydrogen derivatives

Connection to
in-house tool of yours

Address
new questions

Conclusion

Available for you in September 2026
as a Software As A Service

5 years

of tool development and usage for R&D topics

An intuitive tool with rapid onboarding and optimised execution times

Applicable anywhere in the world

Support at every stage of your project through a tailored service offering

Conclusion

FEM team available to answer your questions

Marie ROBERT

Scientific Coordinator

Nicolas MICHELET

OCEAN-H2W™ tool developer

Lénaïg MELLAZA

Project manager

Contact

commercial@france-energies-marines.org

FRANCE ENERGIES MARINES

Thank you for your time and attention