



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

HAEOLUS

**Hydrogen-Aeolic Energy with
Optimised eLectrolysers Upstream
of Substation**

H₂ A Ξ  L U S

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SINTEF

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Programme Review Days 2019

Brussels, 19-20 November 2019

PROJECT OVERVIEW



- **Call year:** 2017
- **Call topic:** FCH-02-4-2017, Highly flexible electrolysers balancing the energy output inside the fence of a wind park
- **Project dates:** 1 January 2018 – 31 December 2021
- **% stage of implementation 01/11/2019:** 33%
- **Total project budget:** 7 613 404 €
- **FCH JU max. contribution:** 4 997 738 €
- **Other financial contribution:** 0 €
- **Partners:** SINTEF, UBFC, Hydrogenics, Tecnalia, UniSannio, Varanger Kraft, KES
      



PROJECT SUMMARY



- HAEOLUS: *Hydrogen-Aeolic Energy with Optimised eLectrolysers Upstream of Substation*
- Objectives:
 - Enable more wind power in energy grids
 - Test multiple use cases for hydrogen-wind plants
 - Demonstration of 2.5 MW PEM electrolyser, remotely operated
- Haeolus' target: isolated wind resources with weak or no grid (also at sea)
- Comparable projects:
 - HyChico (Argentina), about ¼ capacity of Haeolus, H₂ mixed with NG used in gensets
 - StratosFuel (USA), distribution network of H₂ from "wind farmers"
 - HyBalance (EU), ½ capacity of Haeolus, focus on grid balancing



PROJECT SUMMARY



- Raggovidda wind park (45 MW built out of 200 MW)
- Bottleneck to reach main grid
- Low local consumption
- Hydrogen as solution to export energy
 - Total potential is 2 GW (400 t/d of hydrogen)
- Location in Berlevåg Harbour
 - Still virtually *inside the fence* with dedicated power line
 - Access to road and sea for export
- Start-up next year (April/May)



PROJECT PROGRESS/ACTIONS – Electrolyser Efficiency & Cost



Achievement to date

55 kWh/kg
3,7 M€/(t/d)



25%

50%

75%

52 kWh/kg
3 M€/(t/d)

- Efficiency targets already met by Hydrogenics' latest stack
 - 52 kWh/kg is the MAWP 2020 target
- Cost is also met (according to budget)
 - Will be verified at installation time (spring/summer 2020)
 - MAWP 2020 target is 2 M€/(t/d)

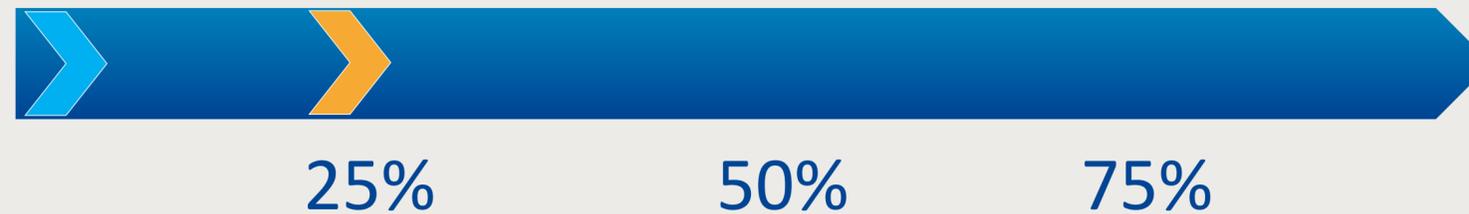


PROJECT PROGRESS/ACTIONS – Electrolyser Performance



Achievement to-date

20 min / 30 s
2 %/year



½ min / 2 s
1.5 %/year

- Cold and hot start: optimisation work to start in January at Hydrogenics
 - Project targets are MAWP 2020's
 - Next year: report on how to reach MAWP 2023 targets by Hydrogenics
- Degradation will be verified during operation
 - Prognostic approach on system level (UFC)
 - 1.5 %/year is MAWP2020 target



PROJECT PROGRESS/ACTIONS – Control & Monitoring System



Achievement to-date

0



25%

50%

75%

3 control cases
Real-time
monitoring

- 3 operation cases being considered
 - Energy storage (and re-electrification)
 - Mini-grid (islanded operation or weak grid)
 - Fuel production
- Achieved:
 - Dynamic model and control algorithm for Energy Storage
 - Control & monitoring infrastructure design



PROJECT PROGRESS/ACTIONS – Wind-Hydrogen Integration



Achievement to-date



7 main reports

- 7 public reports on various aspects of hydrogen-wind energy
 - Raggovidda energy analysis (hydrogen cost 4-5 €/kg) ✓
 - Valorisation plan for produced hydrogen ✓
 - Techno-economic analysis for multiple sites (due 2019)
 - Impact of wind-hydrogen on energy systems & RCS (due 2019)
 - Environmental performance analysis (due 2020)
 - Roadmap to 2023 MAWP targets for electrolysers (due 2020)
 - Business case for wind-hydrogen in Europe (due 2020)



Risks and Challenges

- Choice of electrolyser site
 - Raggovidda (wind park) of Berlevåg harbour (easier access)
 - Solution: Berlevåg with dedicated power line
- Tight construction window due to winter conditions
 - Rough start, missed 2018 window for experimental hall
 - Building now mostly complete, ready for electrolyser
- Accidents during operation
 - More attention after Oslo explosion
 - Thorough safety protocols
 - Site far from residential areas



Communications Activities



- Presented at 3 conferences and several smaller seminars
- 1 presentation at Oil & Energy ministry of Norway
- 1 workshop and 1 seminar organised by project
- 1 journal paper
- Presentations at IEA-HIA Task 38 (Power-to-H₂)
- Web site: <http://www.haeolus.eu>
- Social media:    
- Planned:
 - Real-time demonstration data on Web site
 - Plant visit for external observers
 - 2 more academic seminars

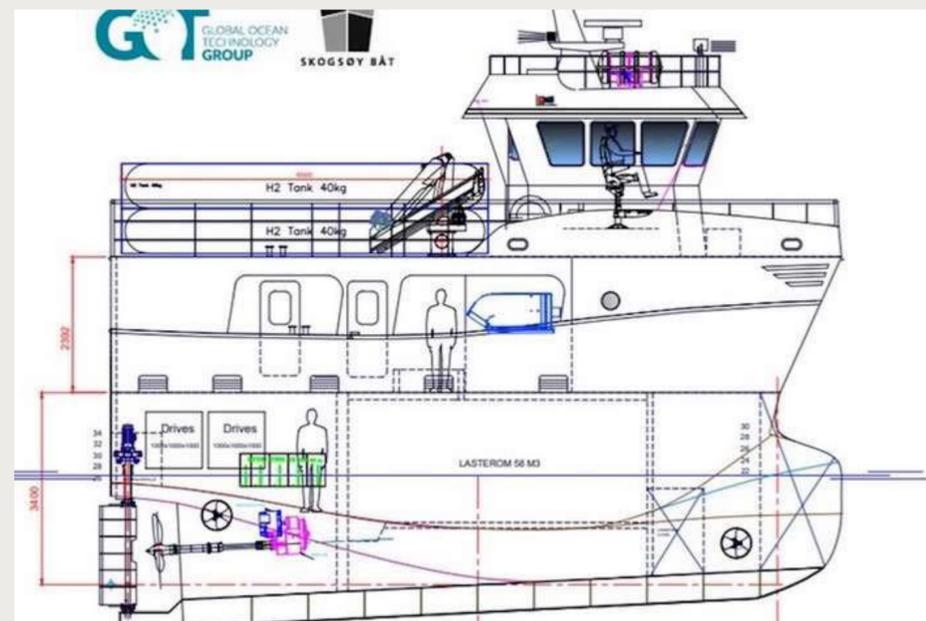


EXPLOITATION PLAN/EXPECTED IMPACT

Exploitation

Local valorisation of produced hydrogen:

- Maritime: fishing boats, fast passenger boats, aquaculture (also by-product oxygen)
- Land: cars (taxis), buses, snowmobiles
- Air: replacement of Dash 8 in local transport
- Export: Svalbard decarbonization (7 t/d)



Impact

Strong involvement of local community

- Both county and municipal governments
- Positive influence from local businesses
- Multiple potential users are preparing for hydrogen



Workshop on hydrogen organised by Finnmark County Council for local stakeholders



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