

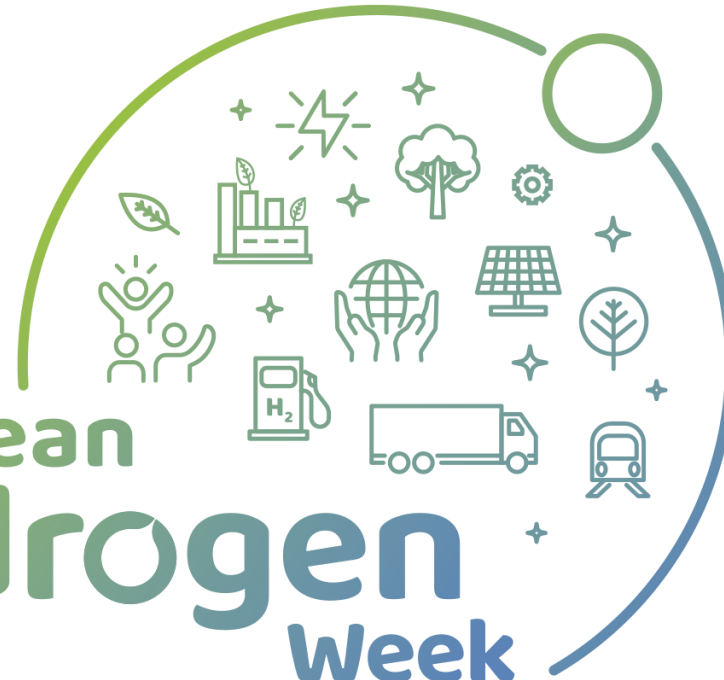
MARANDA

Marine application of a
new fuel cell powertrain
validated in demanding
arctic conditions



MARANDA

European
Hydrogen
Week



Jari Ihonen

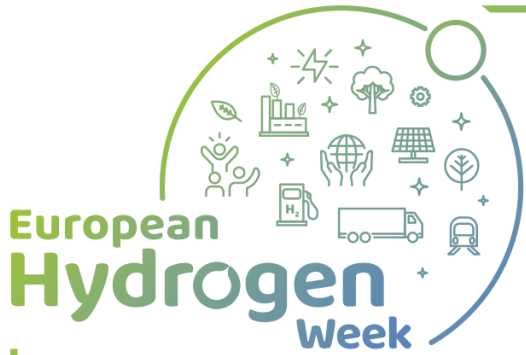
VTT Technical Research Centre of
Finland Ltd

<https://projectsites.vtt.fi/sites/maranda/>

jari.Ihonen@vtt.fi

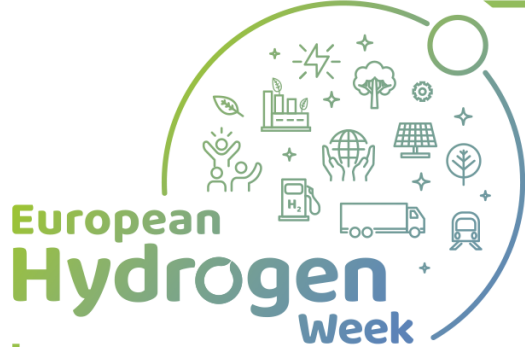
#PRD2020
#CleanHydrogen



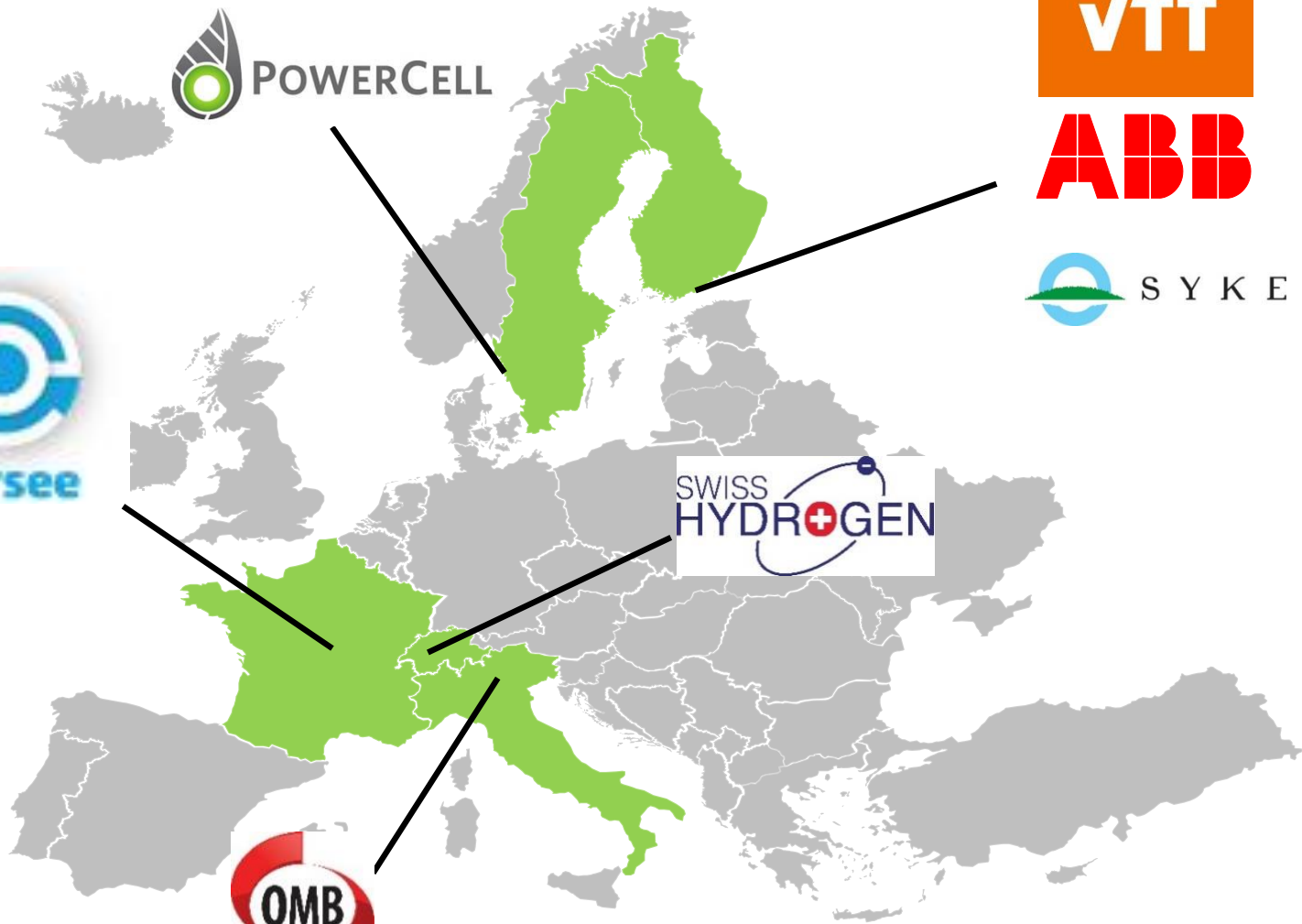


Project Overview

- Call year: 2016
- Call topic: Develop new complementary technologies for achieving competitive solutions for marine applications
- Project dates: 01/03/2017-28/02/2021 (30/11/2021 - 9 month extension under preparation)
- % stage of implementation 01/11/2020: 70 %
- Total project budget: 3 704 758 €
- FCH JU max. contribution: 2 939 358 €
- Other financial contribution: 765 000 € from SERI, State Secretariat for Education, Research and Innovation (in Switzerland)
- Partners: Teknologian tutkimuskeskus VTT Oy, Powercell Sweden AB, ABB Oy, OMB Saleri S.P.A., Persee, Suomen ympäristökeskus SYKE, SwissHydrogen SA



Partners



#PRD2020
#CleanHydrogen



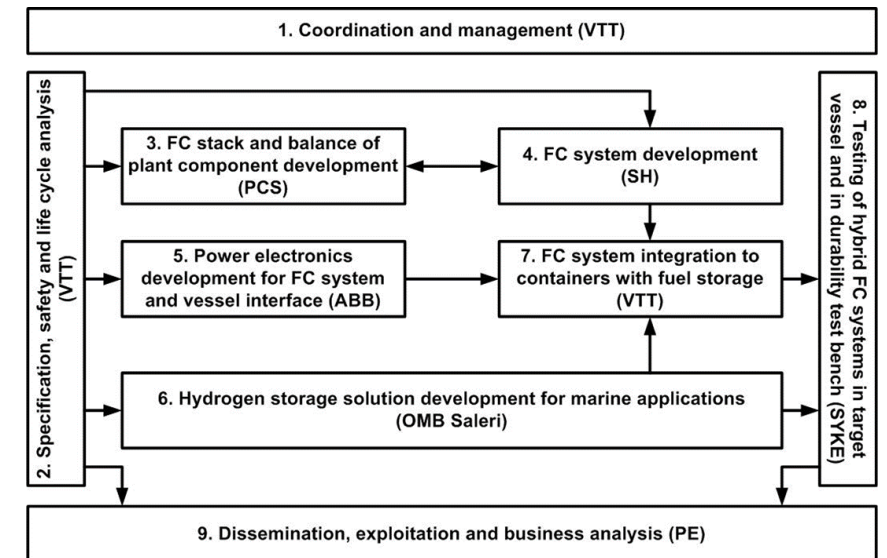
PROJECT SUMMARY for MARANDA

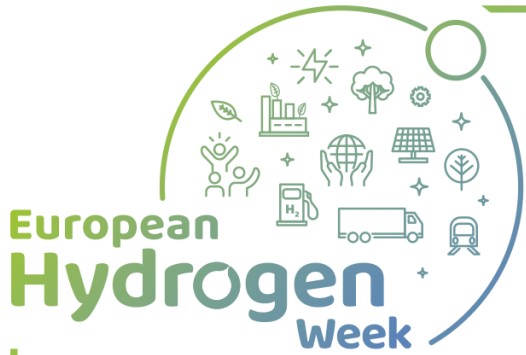
Project main objectives:

- Develop an emission-free hydrogen fuelled PEMFC based hybrid powertrain system for marine applications.
- Validate systems (3 x 82.5 kW) in test benches and on board the research vessel Aranda.

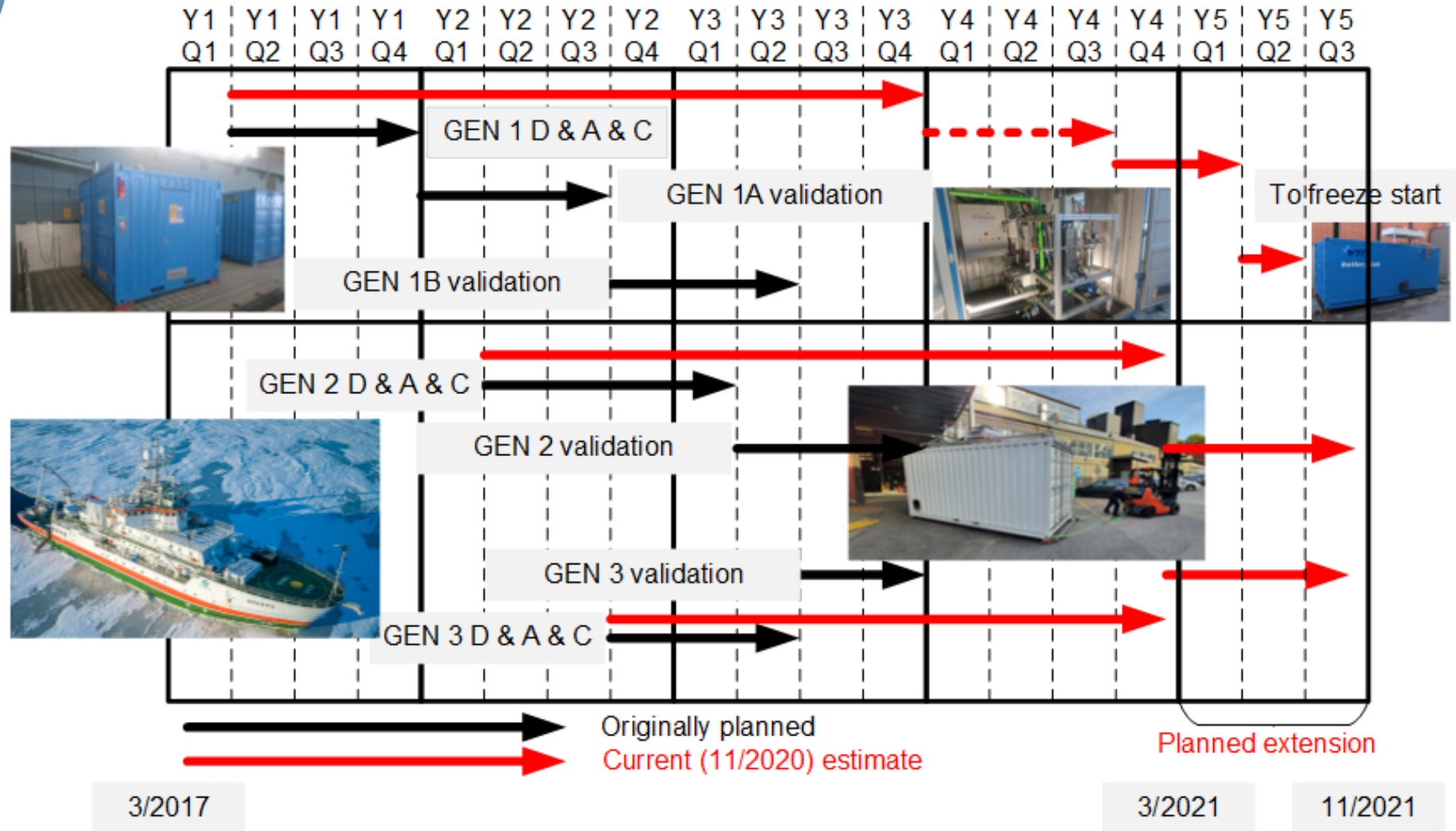
Global positioning vs international state-of the art

- Automotive stacks and systems are used for the first time in marine applications.
- The first marine application in arctic conditions.





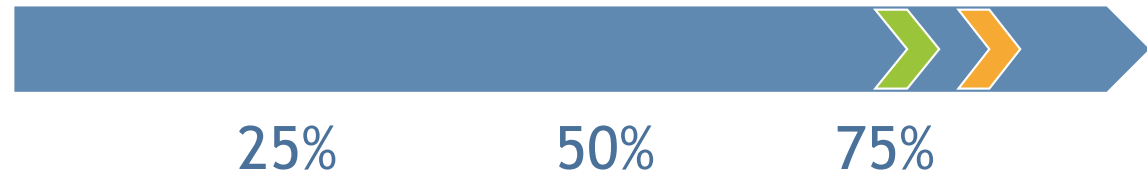
PROJECT SUMMARY - timeline for validation activities



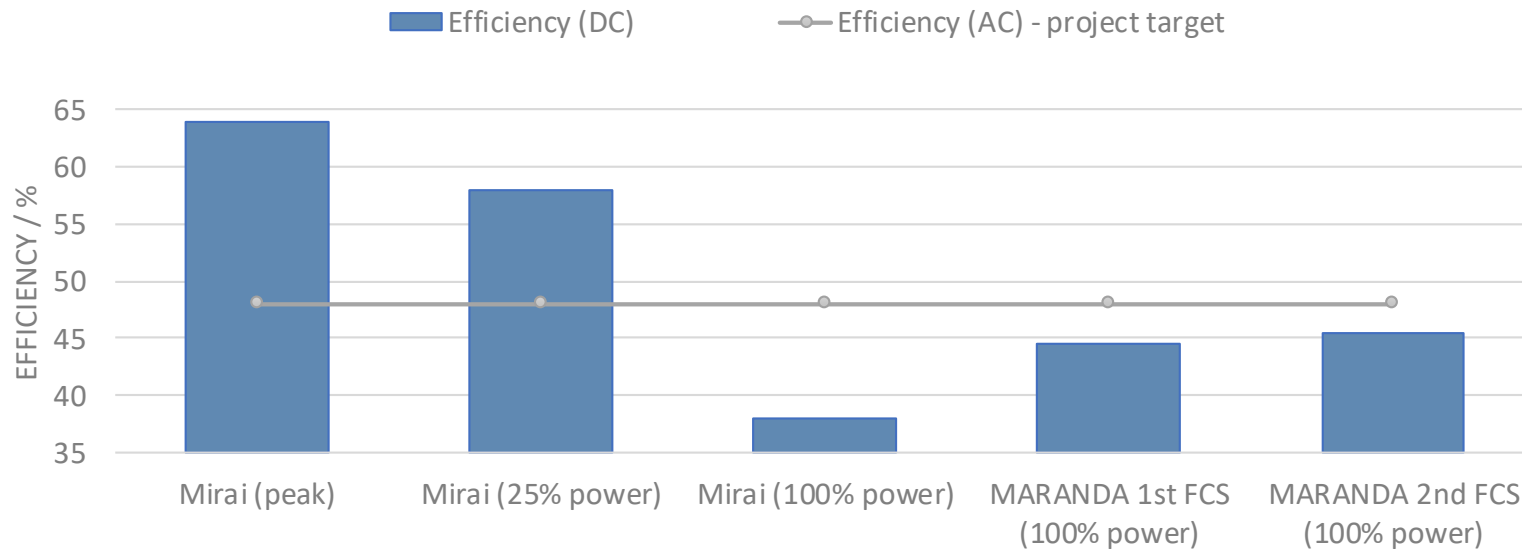
Three 82.5 kW (AC) systems installed, FAT completed and high efficiency (48%) achieved

2 x FCS delivered
1 x FCS in FAT

Achievement to-date

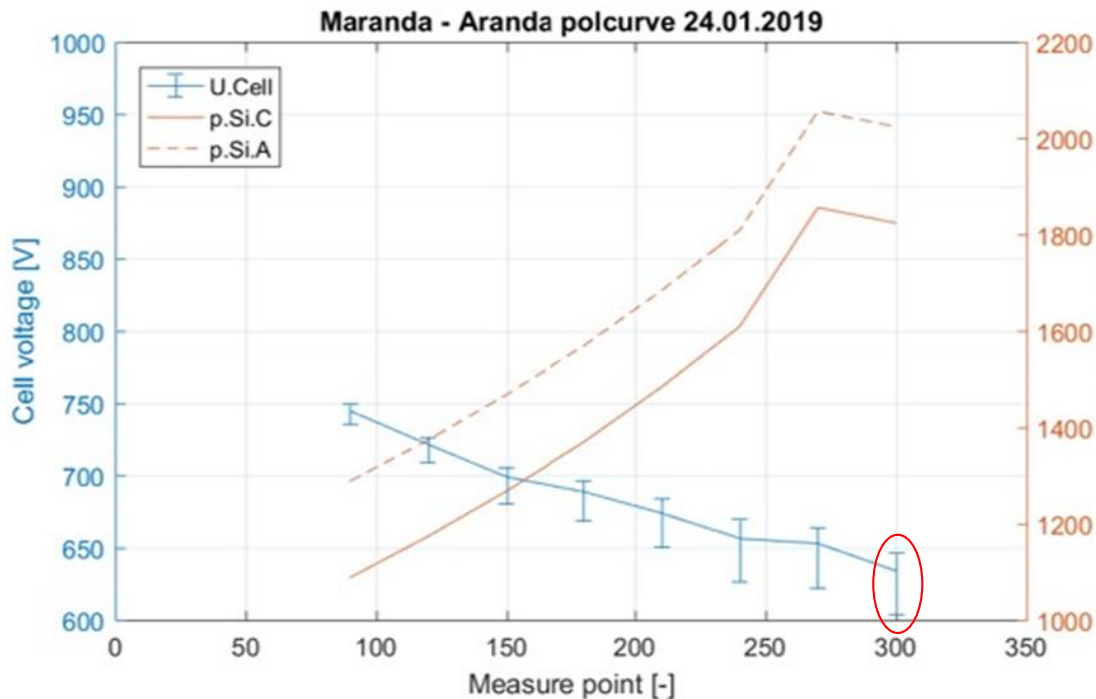


Status at month 44 of a 48 (57) months project at date 01/11/2020

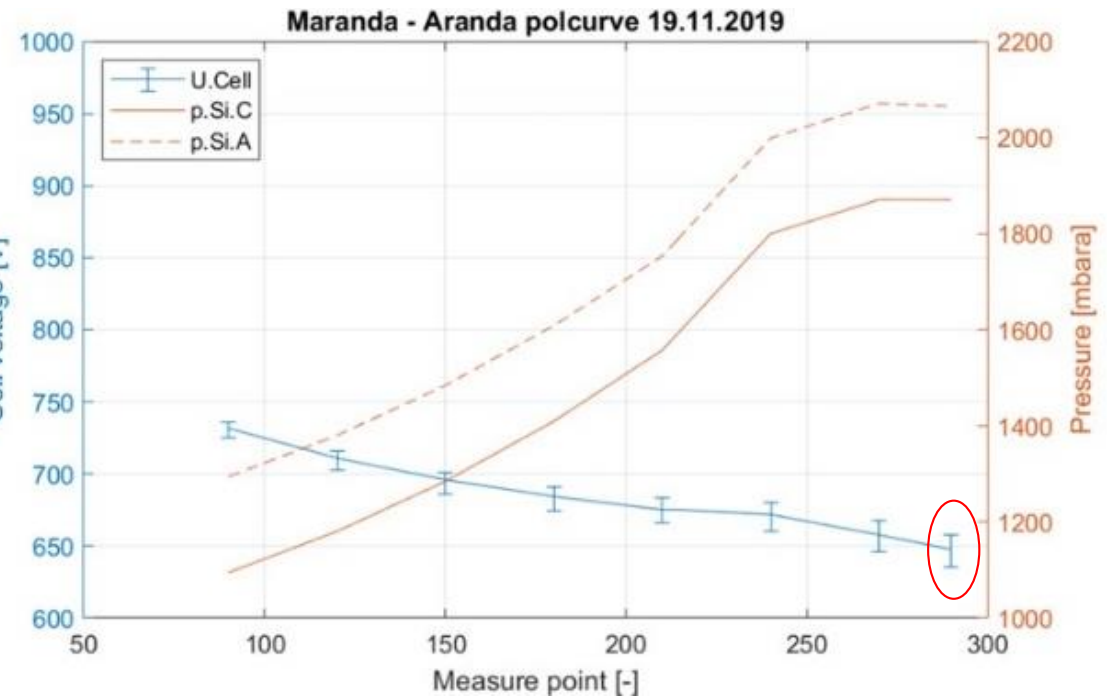


The second Fuel Cell System (FCS) at Swiss Hydrogen's facilities.

Three 82.5 kW (AC) systems installed, FAT completed and high efficiency achieved

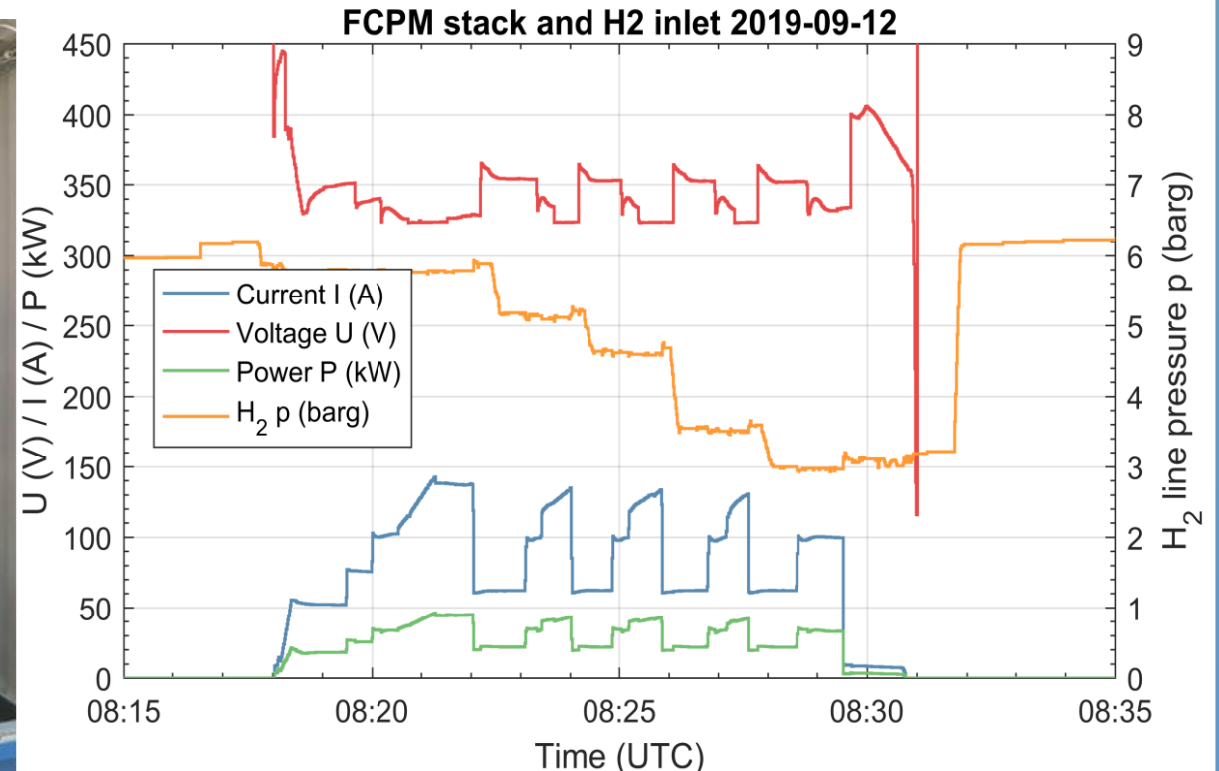


The first Fuel Cell System (FCS) characterization data.



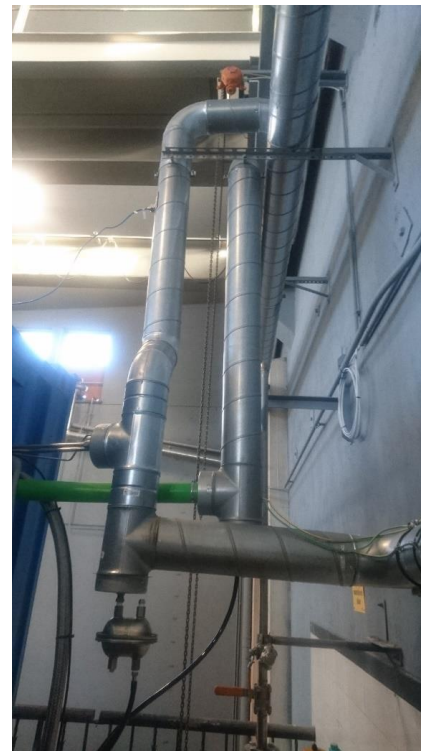
The second Fuel Cell System (FCS) characterization data.

Three 82.5 kW (AC) systems installed, FAT completed and high efficiency achieved



SAT testing and operational data with low H₂ supply pressure.

Three 82.5 kW (AC) systems installed, FAT completed and high efficiency achieved

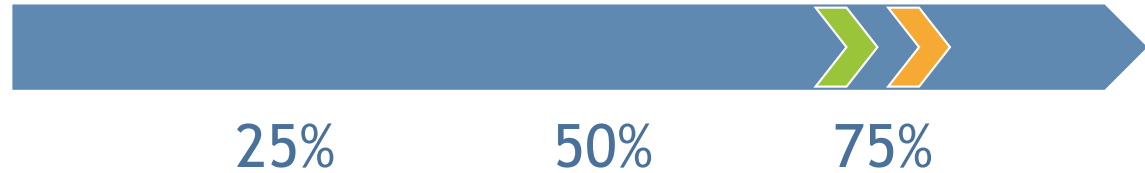


Äetsä durability testing site installations: Container layout & piping interface

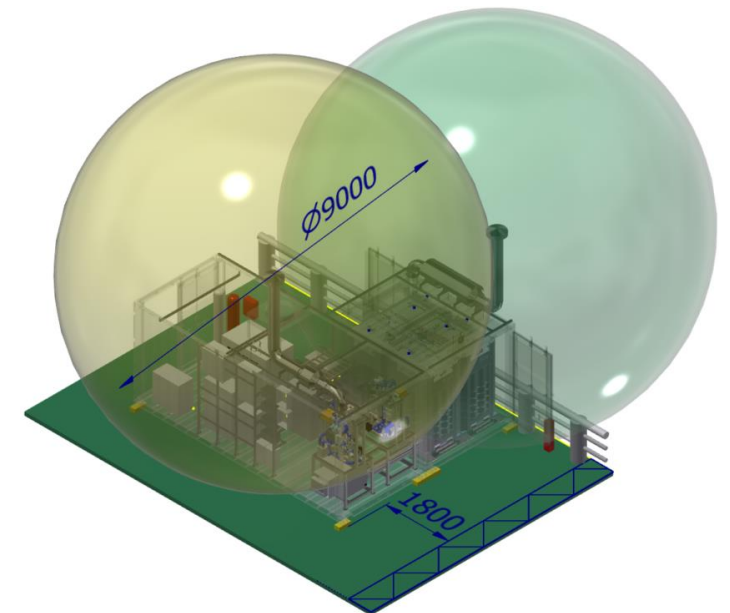
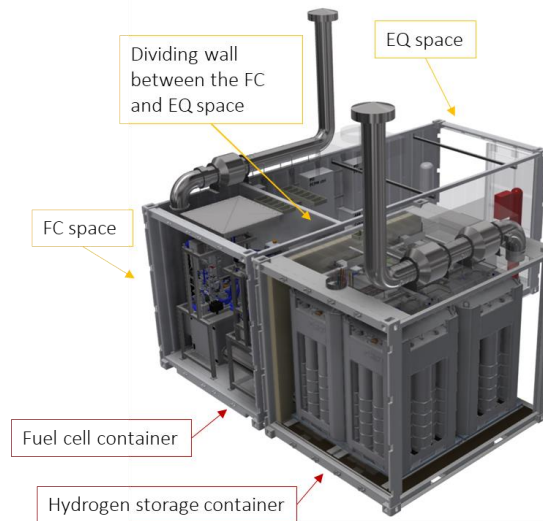
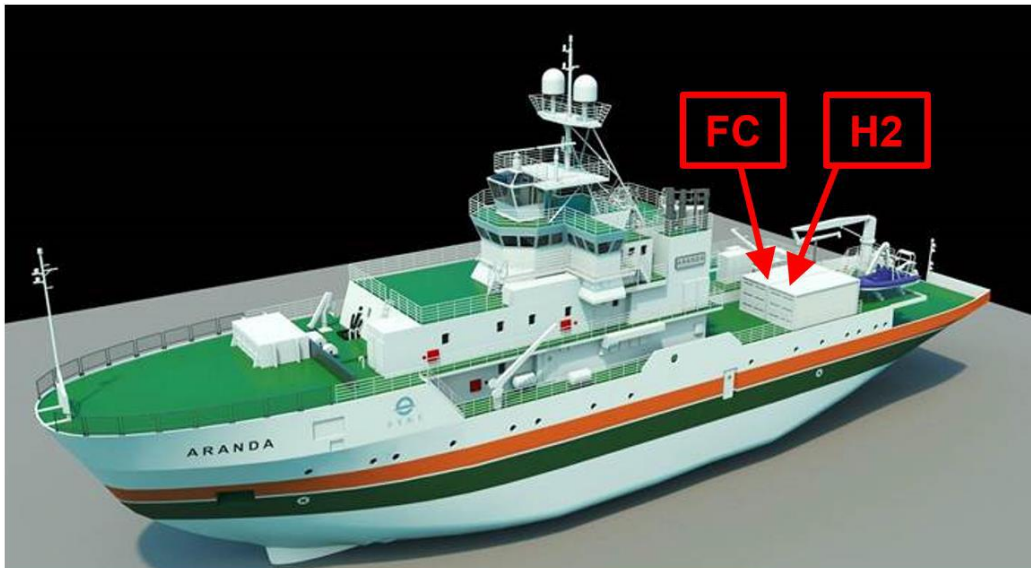
Hydrogen and fuel cell containers completed and accepted by authorities

Achievement to-date

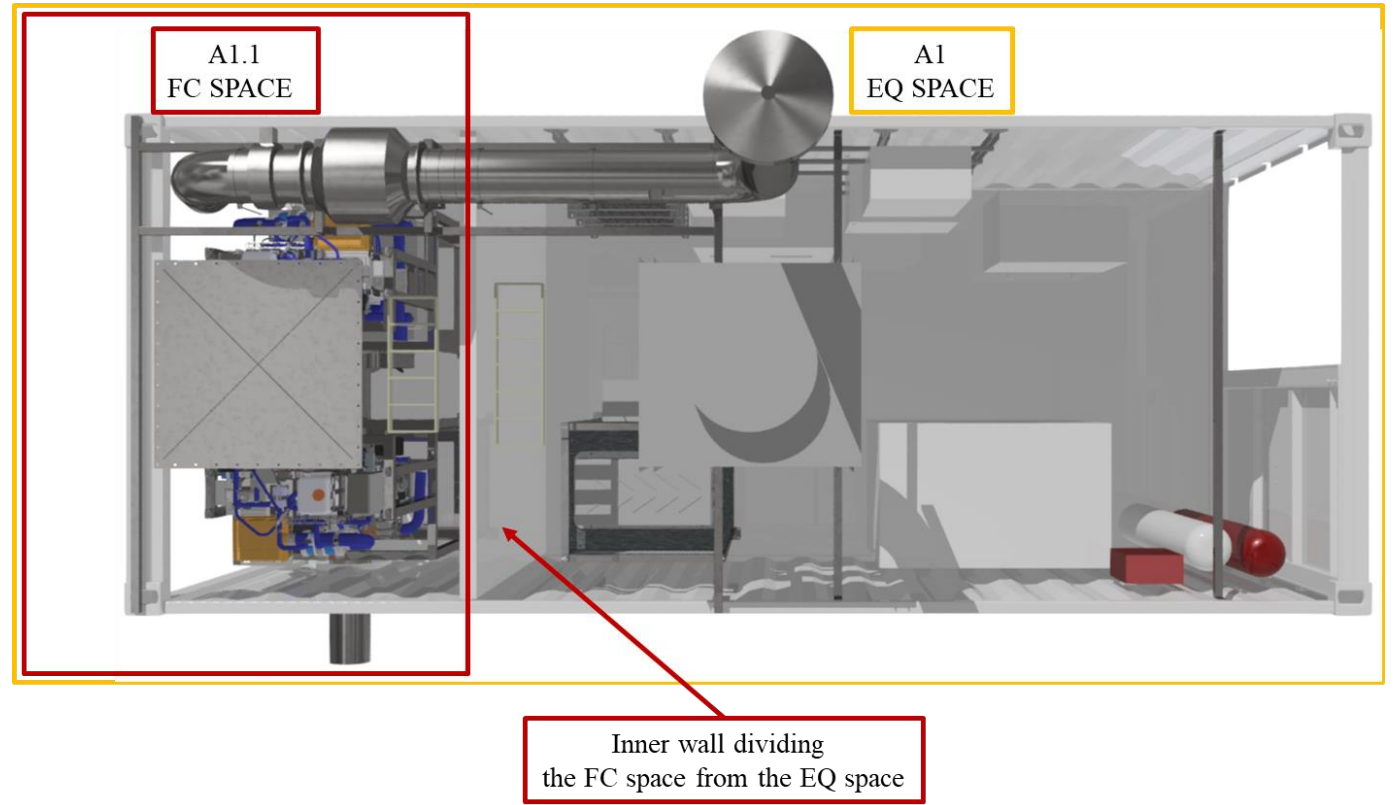
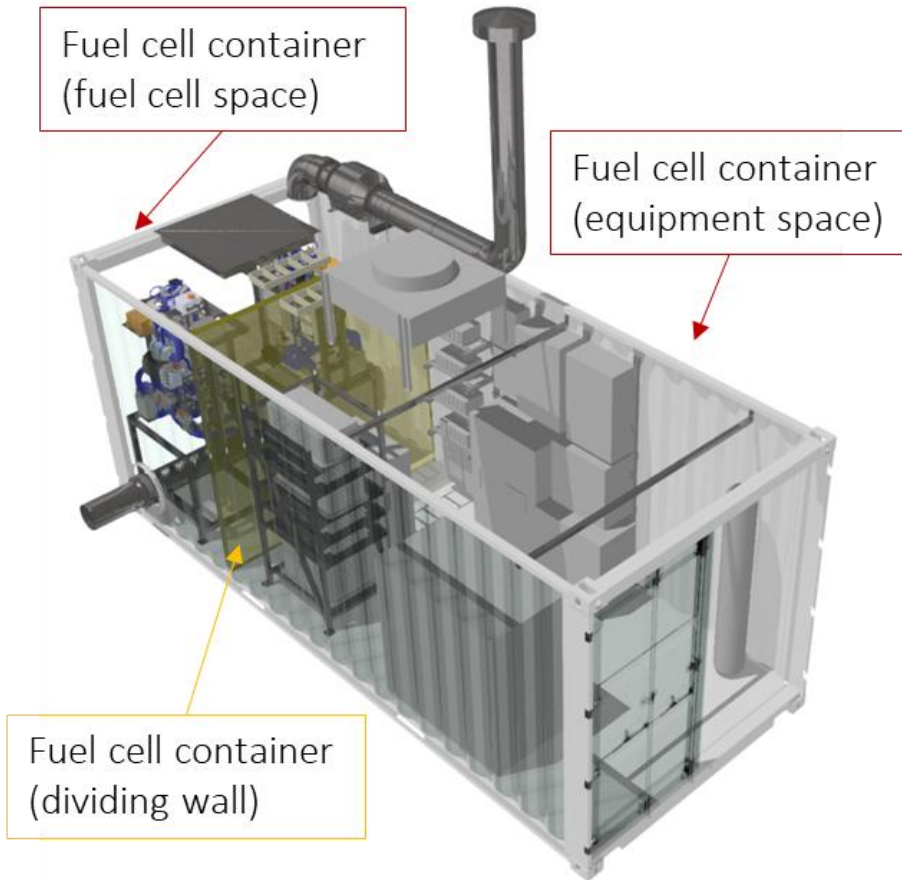
Containers in final assembly and testing



Status at month 44 of a 48 (57) months project at date 01/11/2020



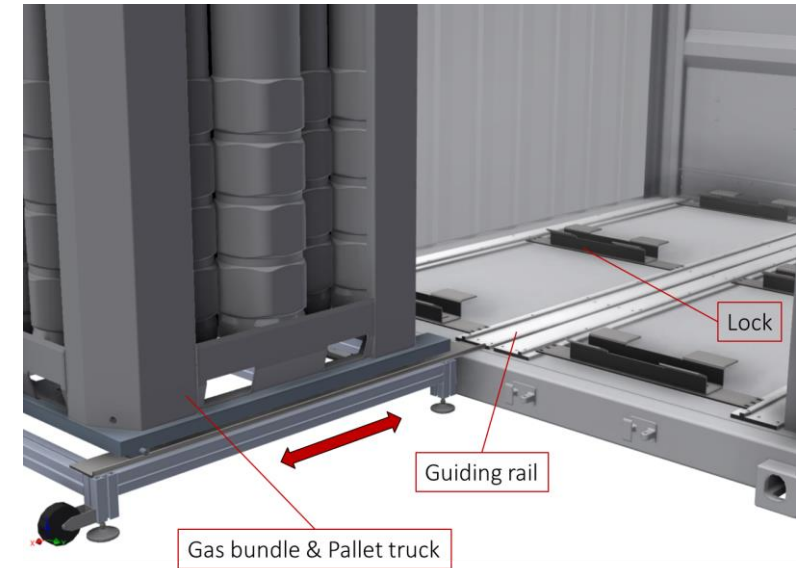
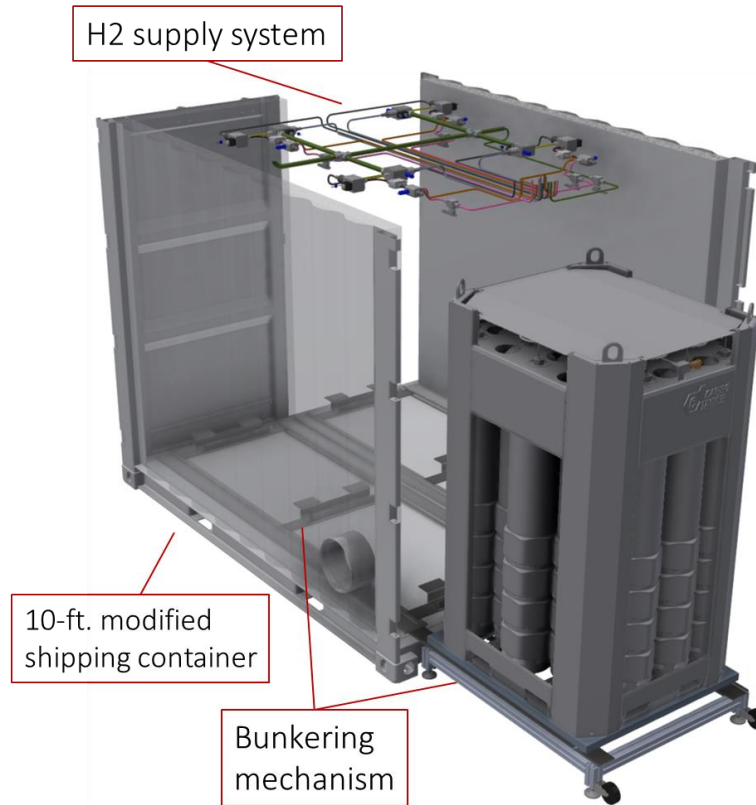
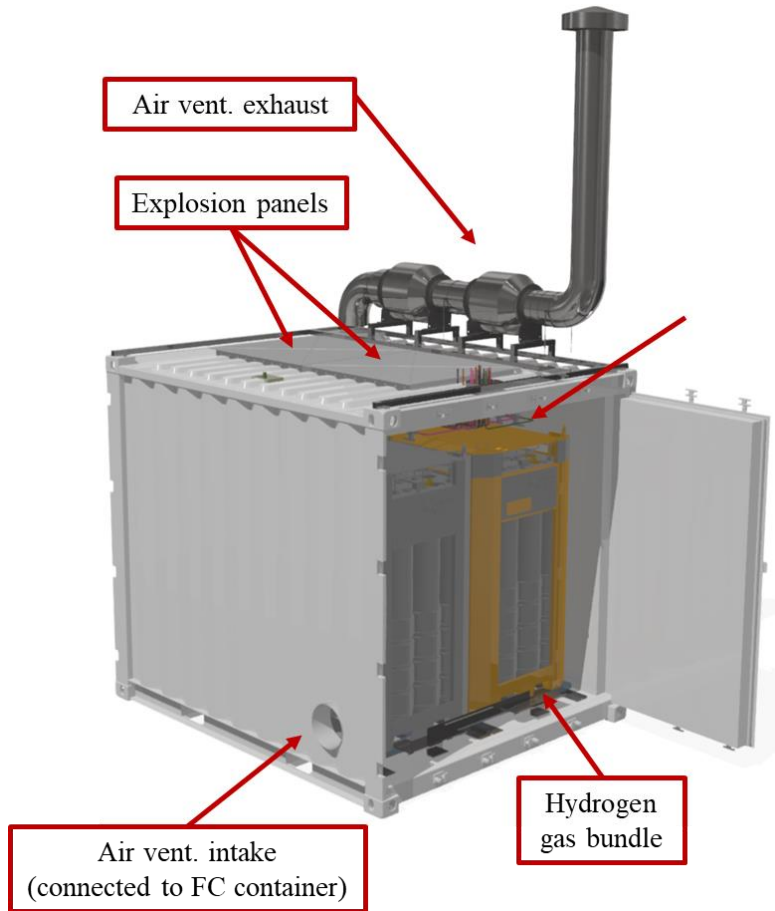
Hydrogen and fuel cell containers completed and accepted by authorities



Hydrogen and fuel cell containers completed and accepted by authorities



Hydrogen and fuel cell containers completed and accepted by authorities



Hydrogen and fuel cell containers completed and accepted by authorities



Development and validation of new model for hydrogen ejector

➤➤ Achievement to-date

New ejector model developed and validated

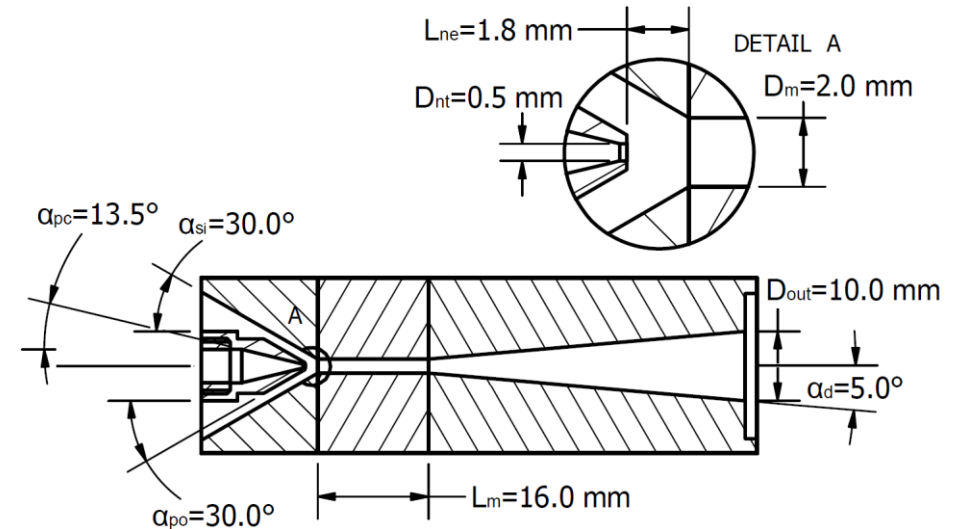
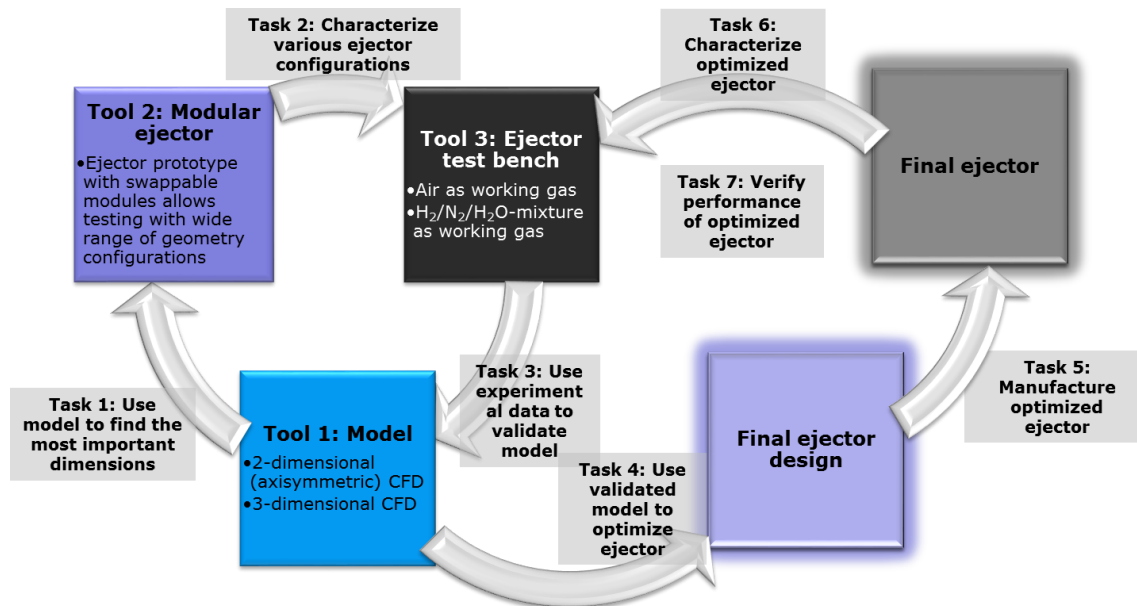


25%

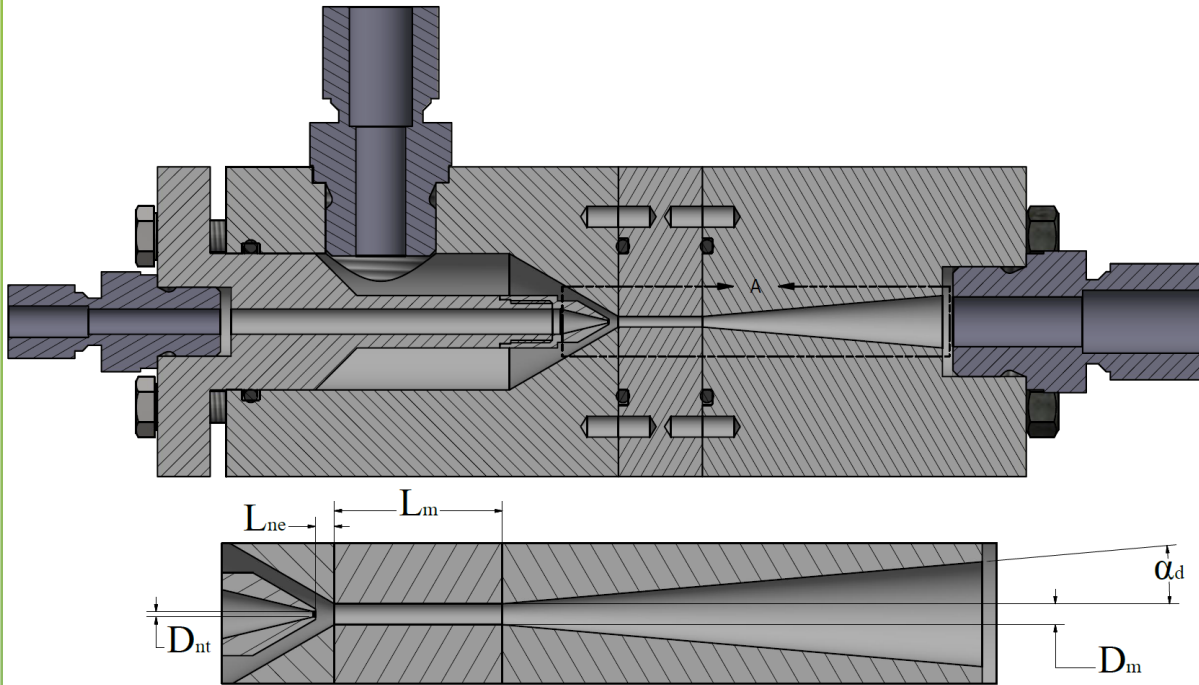
50%

75%

Status at month 44 of a 48 (57) months project at date 01/11/2020



Development and validation of new model for hydrogen ejector

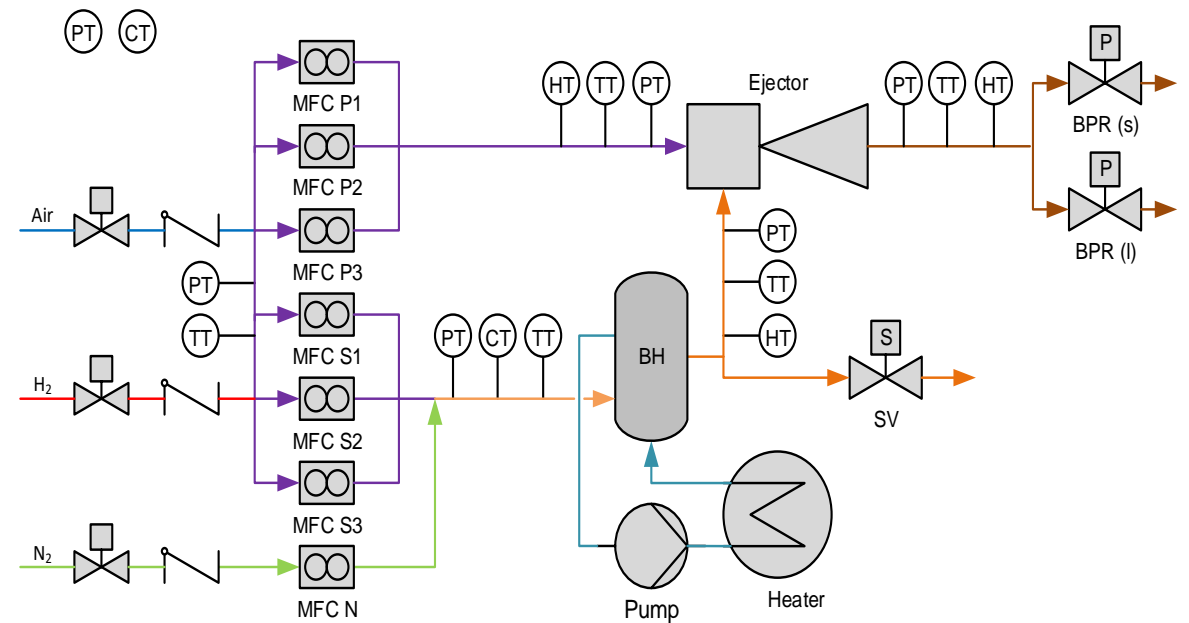
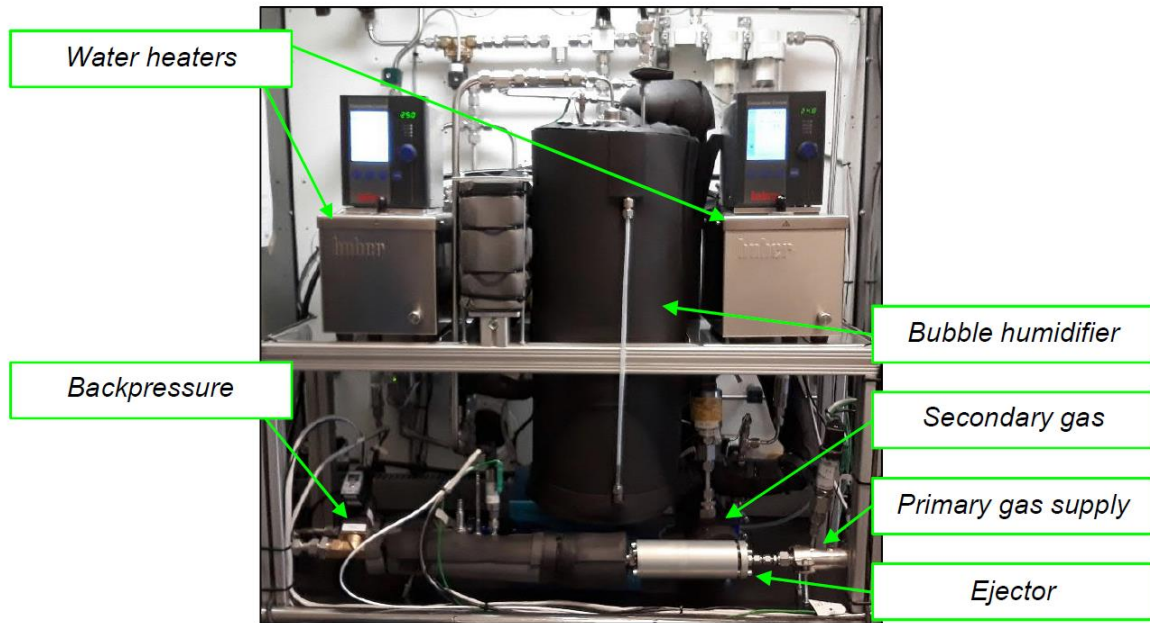


Side-cut view of the modular ejector design.



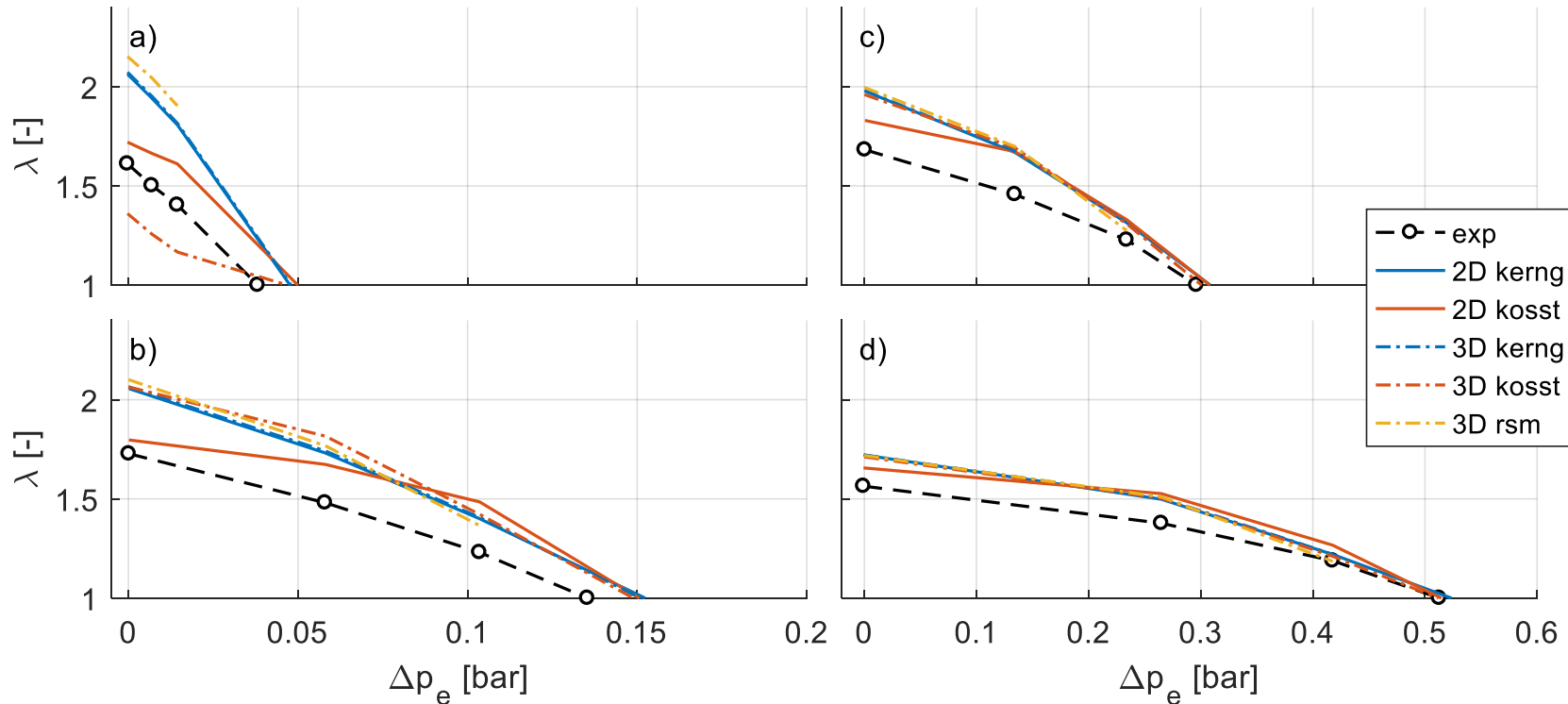
A photo of modular ejector parts.

Development and validation of new model for hydrogen ejector



Test-bench schematic and photo

Development and validation of new model for hydrogen ejector

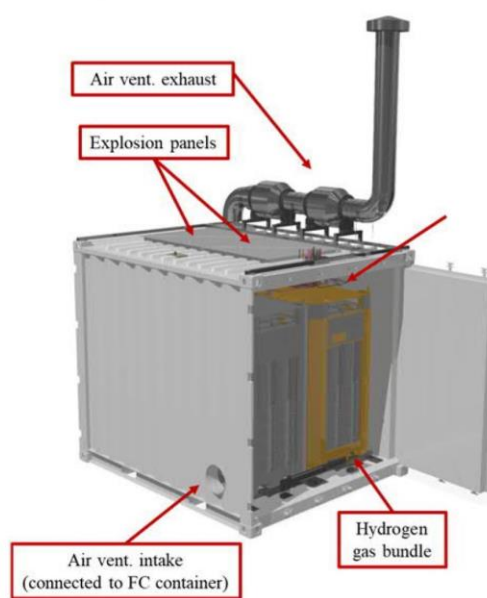
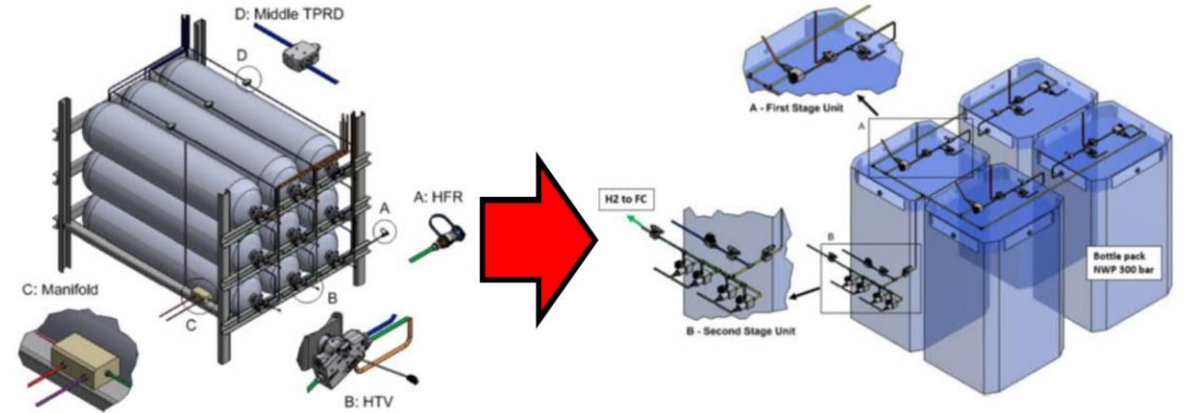


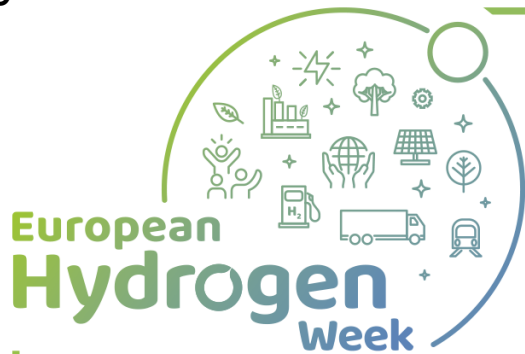
Comparison of experimental and modelling results for ejector #1

Further reading: D3.3 Hydrogen ejector development report in <https://projectsites.vtt.fi/sites/maranda/>

Risks, Challenges and Lessons Learned

Description of risk	Risk-mitigation measures
Both FCS and hydrogen storage containers need to be realised so that class approval could be possible (DNV GL-classed)	Resources are transferred from other tasks and work packages if needed.
Road transport of the closed sea container with full hydrogen bottles is not possible.	A change of the hydrogen storage container to TPED certified composite bottle bundles.
Poor availability of 300 bar TPED certified composite bottle bundles.	The work is started with fully compatible 200 bar TPED certified composite bottle bundles financed outside of the project.





Communications activities

MARANDA project, together with FLAGSHIPS project had an own booth were presented in own booth in Electric & Hybrid Marine World Expo 2019.

A fuel cell system (2nd MARANDA system) from Swiss Hydrogen as well and hydrogen supply solution hardware was displayed at the fair. The presentation of the 100 kW fuel cell system was a great success and the stand was one of the busiest in the fair.

Project results have been communicated and disseminated in over 20 events (conferences, workshops, trade fairs, etc.)

electric
& hybrid marine
WORLD EXPO 2019

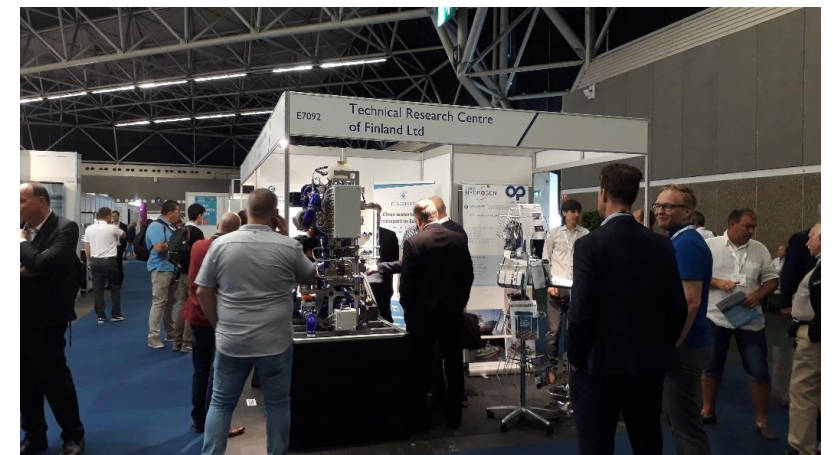
Stand n:o
E7092

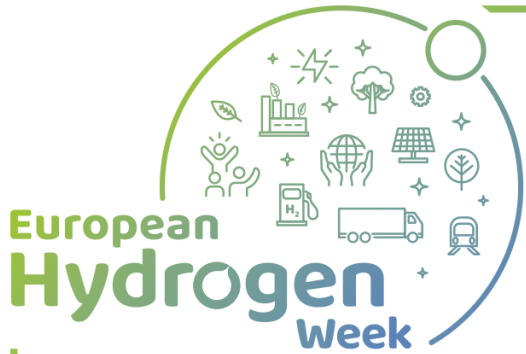


MARANDA



FLAGSHIPS





Exploitation Plan/Expected Impact

Exploitation

Direct exploitation of the project results will be done by the project partners:

VTT: Ejector model and experimental characterisation in ejector test-bench.

OMB: Design, manufacturing and testing hydrogen storage at system level.

Persee: HFC Vessel analysis tool

PCS: Stack durability test results

ABB: HES880 drive operating at 690 V(AC)

SH: Cost reduction of fuel cell system

Impact

VTT: Research services for fuel cell companies

OMB: a wider and more complex range of products.

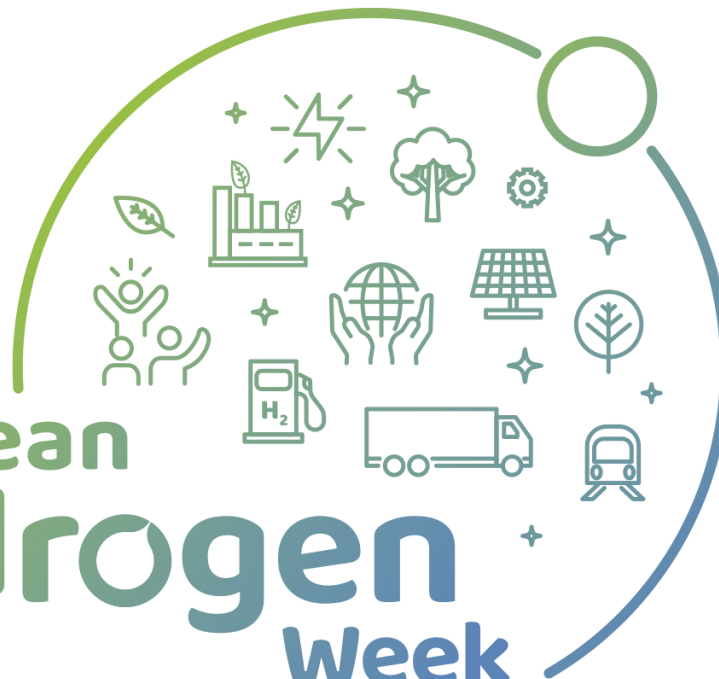
Persee: The vessel tool is expected to be used by all project partners during dissemination events.

PCS: Enables application of PowerCell S3 stack in more heavy-duty applications demanding long lifetime

ABB: New markets and applications for HES880

SH: Enlarge the market for Swiss Hydrogen

European Hydrogen Week



#PRD2020
#CleanHydrogen

