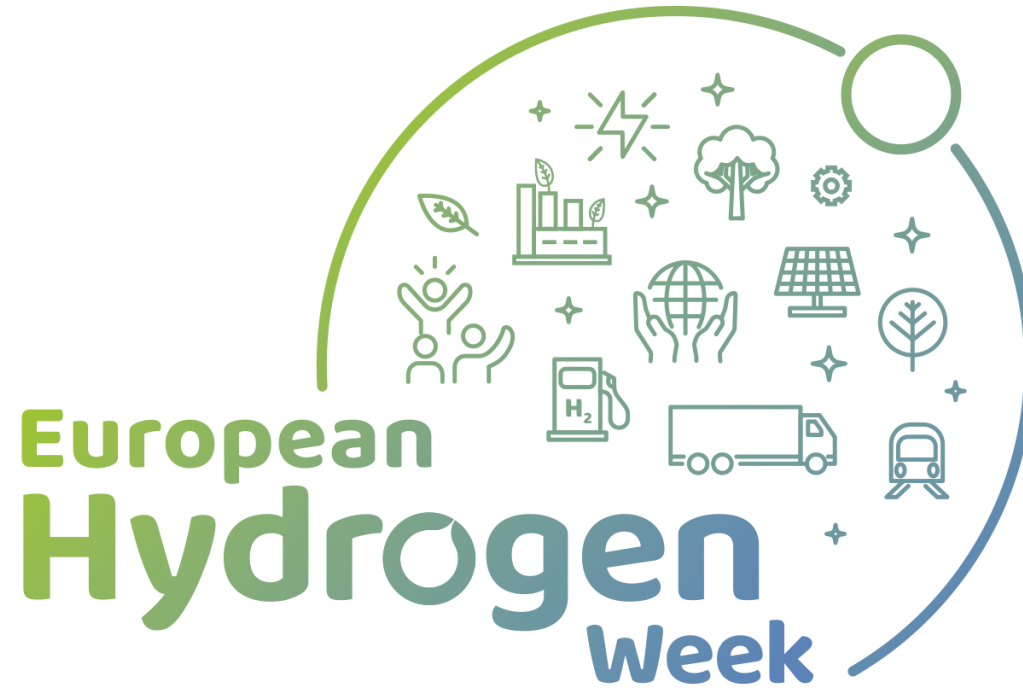


EMPOWER

European methanol powered

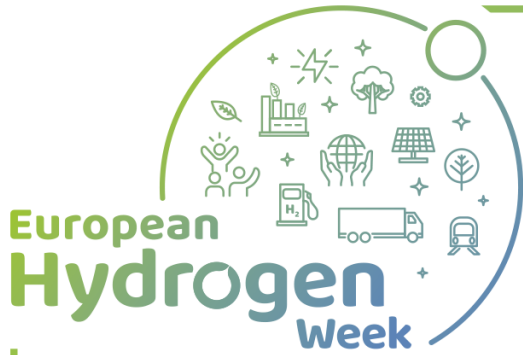
fuel cell CHP



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# Project Overview

**Call year:**  
2019

**Call topic:**  
FCH-02-7-2019 -  
Development of  
highly efficient  
and flexible mini  
CHP fuel cell  
system based on  
HTPEMFCs

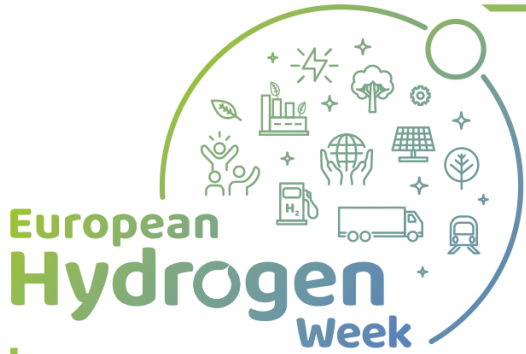
**Project dates:**  
1.1.2020 - 31.12.2022

**Total project budget:**  
1.5 M€

**EMPOWER**

**Stage of implementation**  
01/11/2021: 60%

**FCH JU max. contribution: 1.5 M€**  
**Other financial contribution: 0 €**



# Project Summary

- Target to develop, manufacture and validate a 5 kWe methanol powered mini-CHP (combined heat and power) system based on high temperature PEM fuel cell technology
  - Achieve >50% system efficiency based on novel thermal system integration and improved stack efficiency
  - Improve stack design to increase fuel utilization to >95% and improve stack efficiency to over 55%
- Validation of the system for 2000 hours of operation at end user location
- Plan a scale-up of the system to 50-100 kW and complement with a business analysis of the methanol FC value chain
  - Marine applications
  - Backup power for hospitals, residential and industry areas, hotels, etc

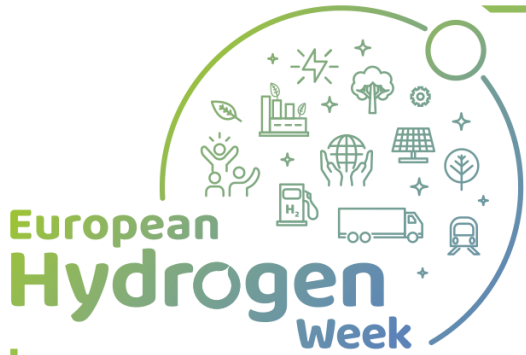


The EMPOWER micro-CHP will be installed into a mobile workspace.

# Project Summary

- Replace diesel generators for power and heat production
  - Back-up power and heat for mobile network system, single houses, renewable energy system
  - Construction sites
  - Field hospitals / hospital tents
  - Raw water test pumping, remote locations, etc.
- CHP system targets
  - High electrical efficiency: > 50% (MeOH LHV)
  - Compact, volume less than 160 liters (30 W / liter)
  - Startup in less than 10 minutes
  - Cost less than 3000 € / kW
  - Mobile and easy to transport





# Partners

Catator AB



THT Control Oy



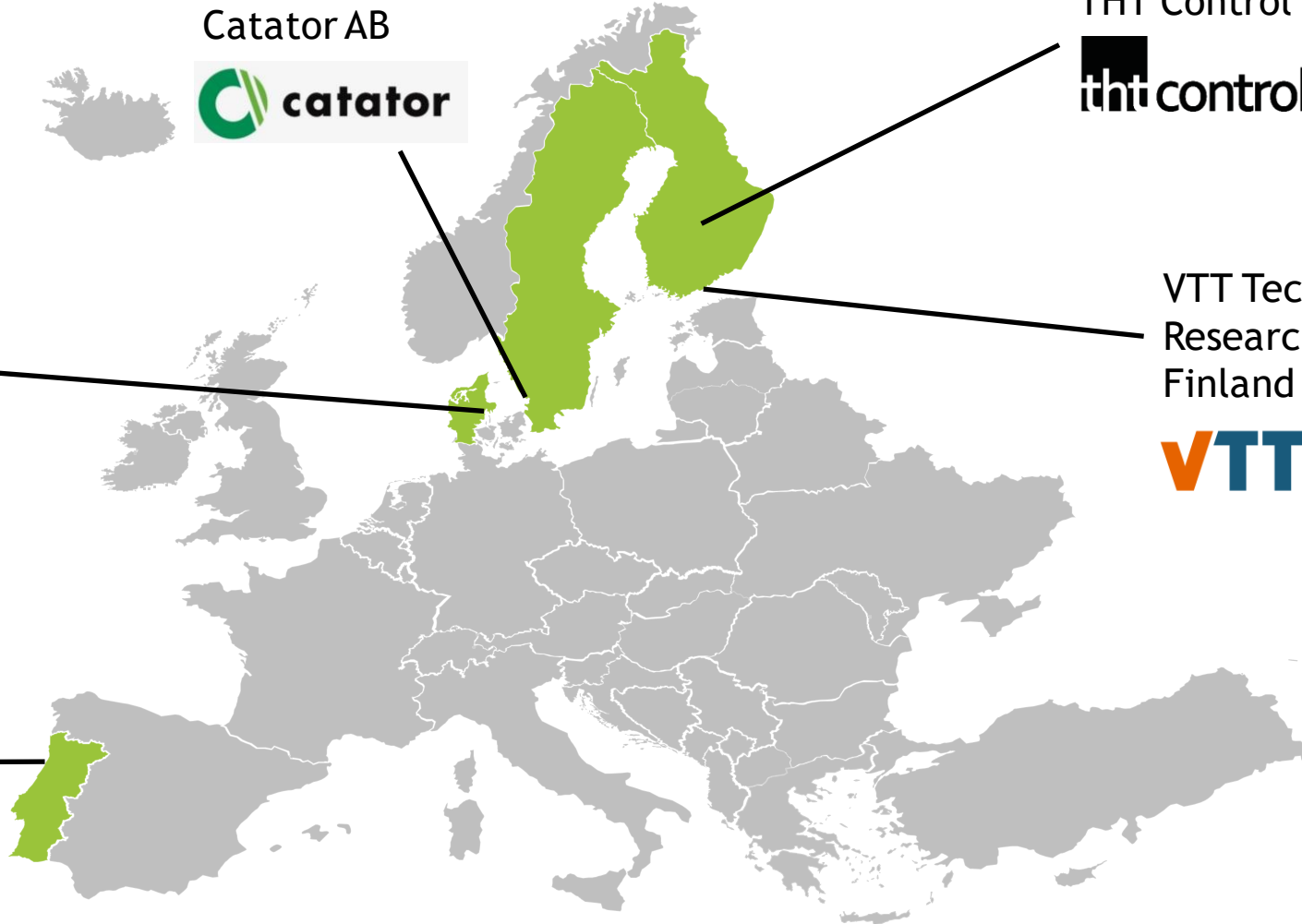
Blue World  
Technologies ApS



VTT Technical  
Research Centre of  
Finland Ltd

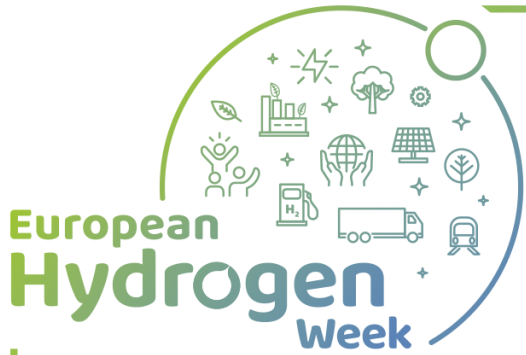


Universidade do Porto,  
Chemical Engineering  
Department

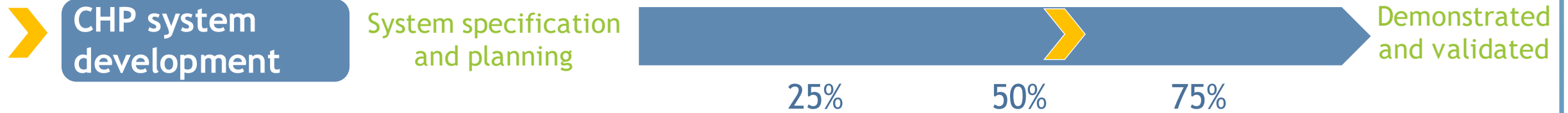


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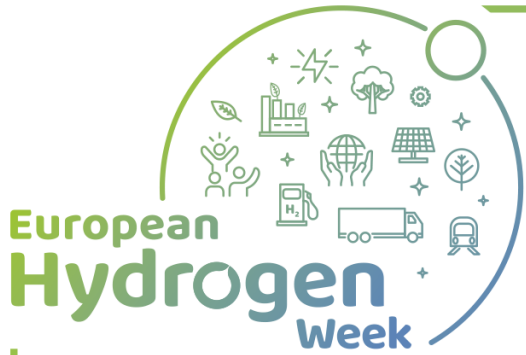


# Project Progress - Overview and selected KPIs



## CHP system development

Expected impact	KPI or other measure	MAWP 2024 target	Current status
<b>Decrease system cost for small-scale CHP unit</b>	CAPEX < 3000 €/kW	5500 €/kW	Achievable with production of 20000 units/year
<b>Support RES system with always available, highly efficient and flexible power source</b>	Start-up < 10 minutes.		Possible according to dynamic simulations
<b>Increase fuel cell stack efficiency</b>	Efficiency 55% LHV		Cell efficiency of >55% at 0.6 bar overpressure demonstrated
<b>Increased system efficiency</b>	System electrical efficiency >50% LHV using methanol	37-60% (LHV)	Ongoing, to be validated in demonstration phase.
<b>Fuel processor efficiency at the Begin of Life</b>	Fuel processor efficiency >85%		Achieved



# Exploitation Plan and Expected Impact

## Exploitation

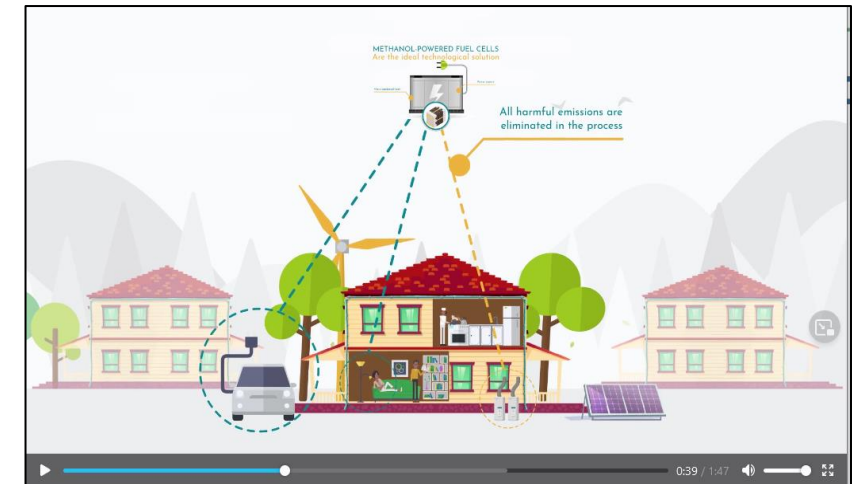
- The project will bring a new product (5 kW CHP system) to the market to end users who have been identified. The product will fill an existing and identified need. It is foreseen that the product can be offered to customers 1-2 years after completion of project.
- Industrial partners develop their fuel cell system and fuel processing offerings and increase their knowhow. The project supports factory ramp-up of BlueWorld Technologies.
- The scale-up study for 50-100 kW systems will look into marine applications, where methanol fuel cells could be of interest

## Impact

- Decrease system CAPEX for small-scale CHP units to <3000 e/kW (less than MAWP target for 2024 or 2030)
- Develop an efficient CHP (efficiency >50%) capable of fast startup (<10 min) to support RES systems
- Strengthen EU knowledge on CHP technology and results in synergies and joint ventures

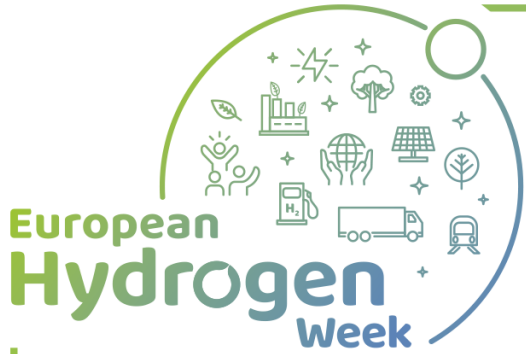
# Communications Activities

- Project website dedicated for general public, providing information about open public events and promoting project results and business opportunities
  - [www.empower-euproject.eu](http://www.empower-euproject.eu)
- Social media presence through project's own [LinkedIn](#) page and visibility at partners' social media channels (Twitter, LinkedIn, etc)
- Regular newsletter and press-releases for relevant achievements
- Videos to promote the methanol and fuel cell applications to public



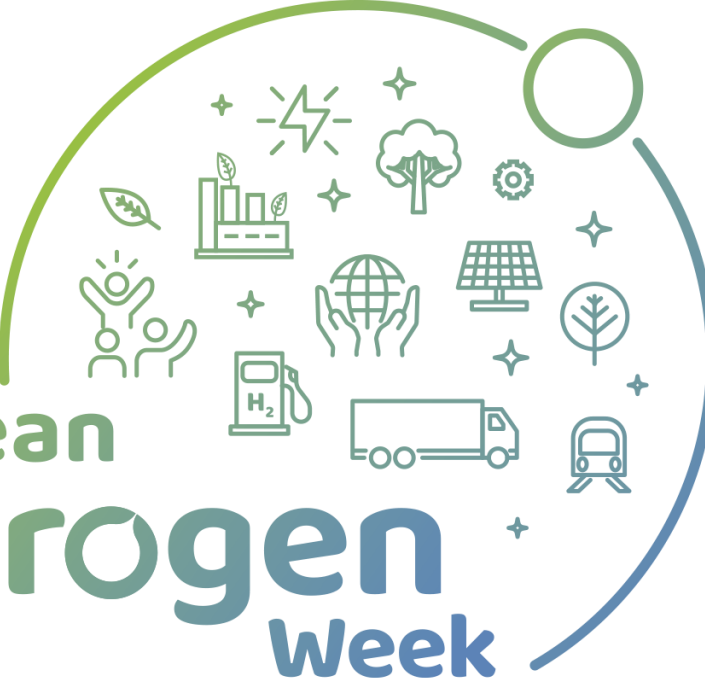
A promotion video of the project focused on methanol and fuel cells applications. Can be seen at project website.





# Dissemination Activities

- One peer-reviewed article published and currently two in the making
  - Lakhtaria P, Ribeirinha P, Huhtinen W *et al.* Hydrogen production via aqueous-phase reforming for high-temperature proton exchange membrane fuel cells - a review [version 2; peer review: 1 approved]. Open Research Europe 2021, 1:81 (<https://doi.org/10.12688/openreseurope.13812.2>)
- Two Master's thesis finished and one PhD thesis in the making
- Webinar on methanol powered fuel cells and the potential of renewable methanol arranged in January 2021
- H2 summer school on hydrogen economy with 93 attendees arranged by University of Porto in September 2021
- Public deliverables shared on project website



**European  
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