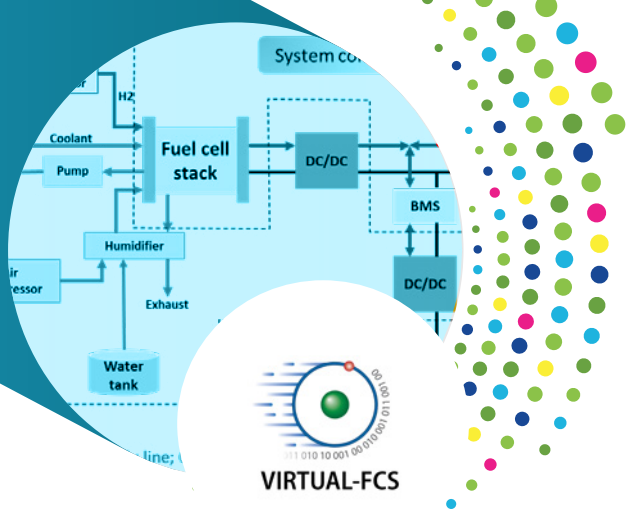
VIRTUAL-FCS

VIRTUAL & PHYSICAL PLATFORM FOR FUEL CELL SYSTEM DEVELOPMENT



Project ID:	**875087**
PRD 2023:	**Panel 3 – H2 end uses – transport**
Call topic:	**FCH-01-3-2019: Cyber-physical platform for hybrid fuel cell systems**
Project total costs:	**EUR 2 349 018.75**
Clean H_2 JU max. contribution:	**EUR 1 897 806.25**
Project period:	**1.1.2020–31.4.2023**
Coordinator:	**Sintef AS, Norway**
Beneficiaries:	Ballard Power Systems Europe AS, Banke APS, Communauté d'universités et d'établissements université Bourgogne-Franche-Comté, École nationale supérieure de mécanique et des microtechniques, SEAM AS, Solaris Bus & Coach sp. z o.o., Université de Franche-Comté, Université de technologie de Belfort-Montbéliard, Vivarail Ltd

https://www.sintef.no/projectweb/virtual-fcs/

PROJECT AND OBJECTIVES

The overall objective of VIRTUAL-FCS is to make the design of hybrid fuel cell and battery systems easier, cheaper and quicker. VIRTUAL-FCS will produce a toolkit combining software and hardware parts for designing and optimising hybrid systems of proton-exchange membrane fuel cells and batteries. The platform will be entirely open source, allowing everyone in both industry and research to benefit from and contribute to the development of the framework. The software tools are being developed in close collaboration with end users and system integrators, securing widespread accessibility.

NON-QUANTITATIVE OBJECTIVES

- VIRTUAL-FCS aims for a significant reduction in development times for new fuel cell and battery hybrid systems. The advanced modelling, simulation and emulation tools developed in the project will enable end users with limited experience of fuel cell systems to design and implement new systems more quickly.
- The project aims to create a development platform for hybrid fuel cell systems with integration capabilities and corresponding simulation models. The real-time software platform combined with a full range of emulated components will enable end users to seamlessly integrate real, simulated and emulated components together in a mixed software–hardware system.
- It aims to create analytical tools and instrumentation to validate the different systems and energy management methodologies developed. VIRTUAL-FCS will validate different energy management systems on the mixed software–hardware system. The characterisation of the systems will be carried out using the standard techniques to validate system performance.
- VIRTUAL-FCS aims to create high-performance, real-time emulators of the dynamic behaviour of real components and subsystems. VIRTUAL-FCS will develop new and improved balance-of-plant and stack models capable of accurate real-time emulation of components' dynamic performance, along with their degradation.
- The project aims to enable the establishment of an EU-based supply industry for hybrid fuel cell system simulation and the experimental tool environment (X-in-the-loop platform) to boost the competitiveness of the EU fuel cell industry. The system simulation tools and methods for setting up and using the experimental platform will be available to the entire European industry free of charge to boost competitiveness.

PROGRESS AND MAIN ACHIEVEMENTS

- VIRTUAL-FCS has demonstrated cyber–physical hardware integration.
- The project has carried out fuel cell electric vehicle simulations.
- It has also carried out real-time system simulation.
- The project has carried out real-time system emulation. The project has demonstrated this capability by emulating a full-stack system with an energy management strategy that can take real-time input from a physical sensor, use this feedback for real-time control of a standard fuel cell stack test bench and simulate various load cycles on the physical stack.
- The project has integrated components from the physical hybrid system into the system simulated in the software tools and into those systems emulated on a controller.
- The project has arranged explanatory webinars and participated in conferences to demonstrate the feasibility of the VIRTUAL-FCS library.
- A simple-fuel cell stack degradation model has been developed.

FUTURE STEPS AND PLANS

- Full validation of the fuel cell stack, battery and balance-of-plant models will be carried out.
- An industrial workshop was arranged for 26 April 2023.

Clean Hydrogen Partnership
Co-funded by the European Union