Development of innovative 50 kW SOFC system and related value chain

Reporting

Project Information

INNO-SOFC

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Project website

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Project closed

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€ 3 998 081,25

Coordinated by
TEKNOLOGIAN TUTKIMUSKESKUS VTT OY
Finland

Periodic Reporting for period 3 - INNO-SOFC (Development of innovative 50 kW SOFC system and related value chain)

Reporting period: 2019-05-01 to 2019-10-31

Summary of the context and overall objectives of the project

The INNO-SOFC project is focusing on development of an innovative 50 kW SOFC system and related value chain from interconnects and stacks to end-users and application analysis. The project is based on the products of industrial partners and motivated by their interest to further improve their products and consolidate an efficient value chain by collaboration. Industrial partners are operating at different phases of the value chain and are not therefore competing against each other, The project aims to improve beneficiaries' products and consolidate an efficient value chain by a close collaboration. Research centres support these companies to develop, experimentally validate and demonstrate their products.

The main objective of this project is to design, assemble and demonstrate a novel 50 kW SOFC power plant with significant cost reductions, improved efficiency and longer lifetime compared to current state of the art SOFC systems. The quantitative objectives of the project are 60% electrical and 85% total efficiency. In addition, at least 30% reduction in system cost, below 4000 €/kW is targeted. Cost target for stacks is 2000 €/kW. Life-time target for the system is 30000 hours. Stack life-time will be validated in 10000 hour test. Other objectives of the project are to identify most promising applications and boost the market penetration of stationary fuel cell products and services.

Process calculations indicate that the chosen concept will meet the technical requirements. System calculations indicate that targeted performance of 50 kW output power, 60% electrical efficiency and 85% total efficiency will be reached. INNO-SOFC system will be demonstrated in Lempäälä (Finland) as a part industrial distict's smart grid system. Exploitation of INNO-SOFC technology and value chains has started effectively as Convion has sold two C50 fuel cell systems to this smart grid system. This Lempäälä project is earmarked by the Finnish government as a key project in helping the country to achieve its national energy targets for decarbonisation. Under the agreement, the two fuel cell co-generation systems built by Convion will be integrated into the smart grid in the district. At the heart of the combined heat and power (CHP) systems with a total electrical output of 116kW are the next generation of solid oxide fuel cell (SOFC) stacks, from leading fuel cell manufacturer Elcogen.

In general, it seems that efficiency and cost targets will be achieved with the INNO-SOFC system with improved stacks. INNO-SOFC system has been transported to Lempäälä smart grid and customer will start operation by the end of April 2020. Stack long-term testing has lasted 12000 hours and degradation rate has been <0.4% fulfilling project targets. A public modeling tool was created to analyze different business cases. The tool gives comprehensive insights for manufacturers and business developers in potential applications at different conditions (cost of electricity and gas, subsidies, etc.). The model can be found on the website of BlueTerra (ex.EnergyMatters): https://blueterra.nl/en/project/inno-sofc/

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The project improved beneficiaries' products and consolidated an efficient value chain by a close collaboration.

Energy Matters has led end-user and application analysis to find most promising markets for stationary SOFC systems. The analysis showed that with current prices, three niche markets are potential, small server rooms, smart grid CHP, and bio-CHP. These markets will serve as a route to series production, which will lead to drastic cost reductions and consequently opens up other markets. This analysis also highlighted the importance of system cost reduction to reach mass markets. Our stack degradation and end-of-life analysis indicates that with current stack technology, the linear degradation is low enough to ensure economic operation during the full technical lifetime of the SOFC in premium markets. Degradation will become more important when moving to main stream markets. A public analysis tool can be found from https://blueterra.nl/en/project/inno-sofc/

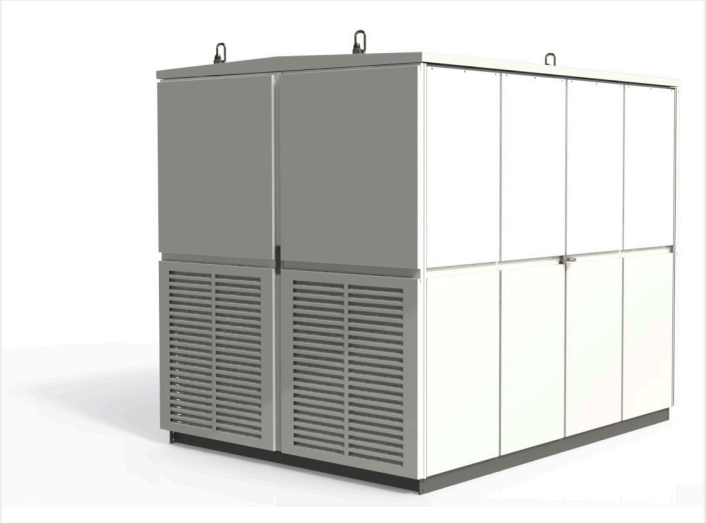
Convion has led system design process. Input from techno-economic analysis carried out in WP2 highlighted the importance of meeting the cost targets already in small series production. Increased emphasis on cost reduction has enforced redesigns of originally planned design solutions. Through multiple design iterations, structures have been considerably simplified and made more tolerance-friendly and now enable to meet cost targets even in small series production. For example in the system frame, the old welded steel pipe structure has been replaced with self-standing sheet metal structure, bringing down the system weight, assembly costs and material costs. System calculations indicate that targeted performance of 50 kW output power, 60% electrical efficiency and 85% total efficiency are achievable. INNO-SOFC system has been transported to Lempäälä smart grid and customer will start operation by the end of April 2020.

Elcogen has optimized their open cathode fuel cell stack design and related interconnect plates to enable both easy integration into fuel cell system and to lower the costs of manufacturing processes. ElringKlinger and Elcogen have optimized the interconnect manufacturing to gain energy and cost efficient processes. Elcogen has designed and deployed a new stack conditioning system consisting of specific setup for open air flow stacks. Elcogen has also optimized its protective coating solution for the interconnect structure and has implemented into use a new production method for applying coating on interconnect plates. Stack long-term testing has lasted 12000 hours and degradation rate has been <0.4% fulfilling project targets.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Within this project 60% electrical and 85% total energy efficiency will be demonstrated at system level. The electrical efficiency of a SOFC system is affected by stack voltages, system fuel utilization and auxiliary (parasitic) power consumption, including power conversion losses. INNO-SOFC project provided improvements to all of these factors. The use of Elcogen's high performance stacks at low temperatures will provide an improved Nernst voltage combined with reduced Ohmic losses, resulting in a higher cell voltage than conventional SOFC cells at nominal conditions throughout the lifetime. High performance stacks combined with several improvements in system architecture led into beyond state of the art system efficiency. INNO-SOFC system has been transported to Lempäälä smart grid

and customer will start operation by the end of April 2020. The project improved beneficiaries' products and consolidated an efficient value chain by a close collaboration.



Convion C60 SOFC system

Last update: 20 June 2020

Permalink: https://cordis.europa.eu/project/id/671403/reporting