# ALKAMMONIA
## AMMONIA-FUELLED ALKALINE FUEL CELLS FOR REMOTE POWER APPLICATIONS

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|---|---|
| **Project ID:** | **325343** |
| **Call topic:** | **SP1-JTI-FCH.2012.3.5** – System-level proof-of-concept for stationary power and CHP fuel cell systems at a representative scale |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€2 884 512.59** |
| **FCH JU max. contribution:** | **€1 962 548** |
| **Project start - end:** | 01/05/2013 - 30/06/2018 |
| **Coordinator:** | **AFC ENERGY PLC, UK** |
| **Website:** | **alkammonia.eu/** |

**BENEFICIARIES:** PAUL SCHERRER INSTITUT, UNIVERSITAET DUISBURG-ESSEN, FAST - FEDERAZIONE DELLE ASSOCIAZIONI SCIENTIFICHE E TECNICHE, ACTA SPA, ZENTRUM FUR BRENNSTOFFZELLEN-TECHNIK GMBH, UPS SYSTEMS PLC, FUEL CELL SYSTEMS LTD

### PROJECT AND OBJECTIVES

The ALKAMMONIA project has developed, and is testing, a proof-of-concept system focusing on diesel generator displacement opportunities, to provide power in remote areas. The project integrates three innovative and proven technologies: a highly efficient and low-cost alkaline fuel cell system, plus a novel ammonia fuel system consisting of a fuel delivery and cracker system for generation of hydrogen-rich gas. The project formally ended in 2018, but testing continues on the integrated system. The results will be shared with potential end-users.

### NON-QUANTITATIVE OBJECTIVES

- Partner ZBT proceeded with the more strict and onerous process of TUV certification for the ammonia cracker
- Long-term testing of the integrated system is still in progress at AFCEN, despite the project formally ending. PSI LCA, total system cost and sustainability analyses have been completed and interim data provided.

### PROGRESS AND MAIN ACHIEVEMENTS

- Successful short-term testing of the alkaline fuel cell balance-of-plant and stack
- Successful testing of the ammonia cracker and fuel delivery system
- Successful integration of sub-systems into the ALKAMMONIA system.

### FUTURE STEPS AND PLANS

- Project finished
- Longevity testing of the integrated system, funded commercially
- Scale-up of ALKAMMONIA prototype to address EV charging and other diesel generator displacement opportunities.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? | SOA RESULT ACHIEVED TO DATE (BY OTHERS) | YEAR FOR SOA TARGET |
|---|---|---|---|---|---|---|---|
| Project's own objectives | Cracker efficiency (based on LHV) | % | 80 | 90 | ✓ | N/A | N/A |
| | AFC stack weight | kg/kW | 150 | 28 | ✓ | 200 kg, based on a 5 kWe stack | 2013 |
| | Projected cracker costs | €/kW | 1 000 | 2 183 | ✗ | N/A | N/A |

# CH2P

## COGENERATION OF HYDROGEN AND POWER USING SOLID OXIDE BASED SYSTEM FED BY METHANE RICH GAS

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|---|---|
| **Project ID:** | **735692** |
| **Call topic:** | **FCH-02-4-2016** - Co-generation of Hydrogen and Electricity with High-Temperature Fuel Cells (>50 kW) |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€6 868 158.75** |
| **FCH JU max. contribution:** | **€3 999 896** |
| **Project start - end:** | 01/02/2017 - 31/07/2020 |
| **Coordinator:** | **FONDAZIONE BRUNO KESSLER, IT** |
| **Website:** | **www.ch2p.eu** |


**BENEFICIARIES:** DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, SHELL GLOBAL SOLUTIONS INTERNATIONAL BV, HYGEAR BV, HYGEAR FUEL CELL SYSTEMS BV, SOLIDPOWER SA, SOLIDPOWER SPA, VERTECH GROUP, HYGEAR TECHNOLOGY AND SERVICES BV

### PROJECT AND OBJECTIVES

The CH2P project is developing an innovative technology prototype for hydrogen refuelling stations (HRS). The new system co-generates hydrogen, heat and electricity using solid oxide cell technology fuelled by carbon-lean natural gas (NG) or bio-methane. The CH2P system is a transition technology for an early infrastructure deployment of hydrogen refuelling stations, operating with higher efficiency, lower costs and a reduced environmental footprint compared with conventional technologies. The CH2P system is currently under development and will be finalised by July 2021.

### NON-QUANTITATIVE OBJECTIVES

- Job creation
- By contributing to transition technology for the hydrogen economy, CH2P will help create new employment opportunities in the EU
- Alternative fuels station
- With a single technology, CH2P will deliver natural gas, hydrogen and power, the fuels of European Directive on Alternative fuels Infrastructure
- Cost model
- CH2P will reach hydrogen generation costs far below 4 €/kg of hydrogen
- Use cases
- CH2P can generate hydrogen for six different uses.

### PROGRESS AND MAIN ACHIEVEMENTS

- Successful testing of the large stack module (LSM) of 25 kW
- Hydrogen purity. CH2P system produced 5N purity level, compliant with transport sector use, for on-board PEMFC
- Hydrogen cost estimation of 4.5 €/kg with a novel cost model.

### FUTURE STEPS AND PLANS

- CH2P has been delayed and an amendment submitted to ask for a 12-month extension, ending the project in July 2021
- The full 20 $kgH_2$/day system, the alpha version, will be tested completely by HyGear by December 2020
- The second 40 $kgH_2$/day system will be realised by HyGear as an alpha/gamma version by June 2021
- A 40 $kgH_2$/day CH2P system, combining the alpha and gamma version of 20 $kgH_2$/day each, will be tested by SHELL by June 2021
- Finalisation of the system will foresee adjustments for future integration with a system operating both in SOFC and SOE mode.


## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| AWP 2016 | System size | $kgH_2$/day | 20 | N/A | ✗ |
| | Flexible cogeneration of $H_2$ and power | % | 100 + 100 | 50 + 50 | ✗ |
| | System efficiency | % | 75 | 65 | ✗ |
| Project's own objectives | Power production capacity of the LSM | kW | 25 | 25 | ✓ |

# CLEARGEN DEMO

## THE INTEGRATION AND DEMONSTRATION OF LARGE STATIONARY FUEL CELL SYSTEMS FOR DISTRIBUTED GENERATION

CG Démo

| | |
|---|---|
| **Project ID:** | **303458** |
| **Call topic:** | **SP1-JTI-FCH.2011.3.6** - Field demonstration of large stationary fuel cell systems for distributed generation and other relevant commercial or industrial applications |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€10 343 142.60** |
| **FCH JU max. contribution:** | **€4 590 095** |
| **Project start - end:** | 01/05/2012- 30/09/2020 |
| **Coordinator:** | **BALLARD POWER SYSTEMS EUROPE AS, DK** |
| **Website:** | **www.cleargen.eu** |

**BENEFICIARIES:** AQUIPAC SAS, HYDROGENE DE FRANCE, JEMA ENERGY SA, LINDE GAS MAGYARORSZAG ZARTKORUEN MUKODO RESZVENYTARSASAG, LOGAN ENERGY LIMITED, BALLARD POWER SYSTEMS EUROPE AS, BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM, CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS

### PROJECT AND OBJECTIVES

The main objectives of the CLEARgen Demo project are:

- development and construction of a large-scale fuel cell system, purpose-built for the European market
- validation of the technical and economic readiness of the fuel cell system at megawatt scale, and
- field demonstration and development of the megawatt-scale system at a European chemical production plant.

The demonstration site was chosen for the ability to provide a strong reference case, to convince future operators of the relevance of large-scale stationary fuel cell applications.

### PROGRESS AND MAIN ACHIEVEMENTS

- Delivery of a European-compliant ClearGen™ fuel cell system
- Fuel purification system design produced and installed
- Fuel cell system and components installed and ready for operation.

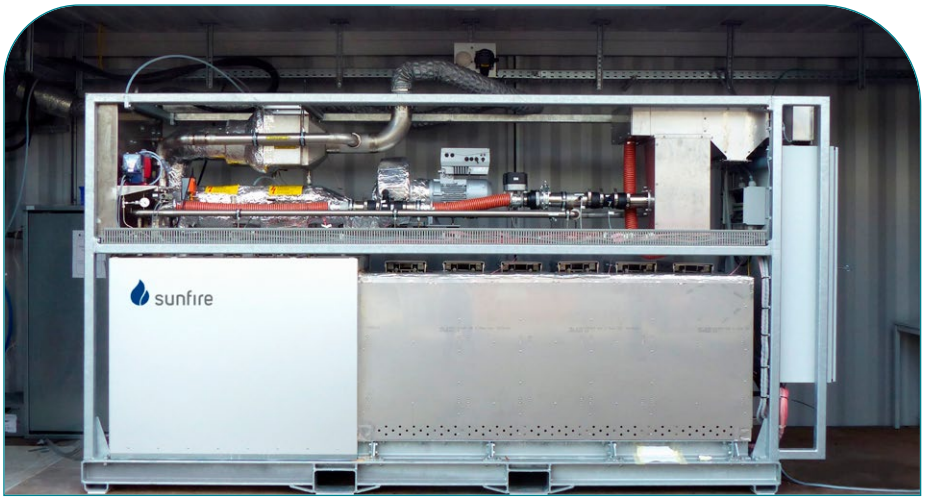
### FUTURE STEPS AND PLANS

- The project has finished.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| AIP 2011 | Lifetime (between FC refurbishment) | Hours | >10 000 | 40 000 | ✓ |
| | Performance loss | % | <3 | 0 | ✓ |
| | Service and maintenance costs | € cents/kW | N/A | 4.5 | ✗ |
| Project's own objectives | Electrical efficiency | % | 50 | 48 | ✗ |
| | Cost | €/MW | <3 000 | 3 000 | ✓ |
| | Availability | N/A | N/A | 90-95 % | ✗ |

# COMSOS
# COMMERCIAL-SCALE SOFC SYSTEMS




| | |
|---|---|
| **Project ID:** | **779481** |
| **Call topic:** | **FCH-02-11-2017** - Validation and demonstration of commercial-scale fuel cell core systems with a power range of 10-100 kW for selected markets/ applications |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€10 277 897.50** |
| **FCH JU max. contribution:** | **€7 486 954.75** |
| **Project start - end:** | 01/01/2018 - 31/08/2022 |
| **Coordinator:** | **TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, FI** |
| **Website:** | **www.comsos.eu/** |

**BENEFICIARIES:** POLITECNICO DI TORINO, SOLIDPOWER SA, SOLIDPOWER SPA, SUNFIRE GMBH, CONVION OY, ENERGY MATTERS BV

## PROJECT AND OBJECTIVES

The key objective of the ComSos project is to validate and demonstrate fuel-cell based combined heat and power solutions in the mid-sized power ranges of 10-12 kW, 20-25 kW, and 50-60 kW (referred to as Mini FC-CHP). The core of the consortium consists of three SOFC system manufacturers aligned with individual strategies along the value chain: SolidPower, Sunfire and Convion.


## PROGRESS AND MAIN ACHIEVEMENTS

- The first ComSos SOFC module, provided by Sunfire GmbH, has been installed in Taiwan
- Business case analysis for the 10-50 kW systems completed
- The first ComSos system has reached efficiency and emission targets (KPIs).

## FUTURE STEPS AND PLANS

- FAT test of the systems designed from all manufacturer finalised
- All systems from SolidPower installed and in operation
- Two systems from Convion installed and in operation
- All systems from Sunfire installed and in operation.


## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| Project's own objectives aligned with AWP 2015/MAWP Addendum (2018-2020) | SME participation | % | 25 | 50 | ✓ |
| | NOx emission | mg/kWh | 40 | <40 | ✓ |
| | Electrical efficiency | % | 42-55 | >50 | ✓ |

# D2SERVICE
## DESIGN OF 2 TECHNOLOGIES AND APPLICATIONS TO SERVICE

| | |
|---|---|
| **Project ID:** | **671473** |
| **Call topic:** | **FCH-02.9-2014** -Significant improvement of installation and service for fuel cell systems by Design-to-Service |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€3 636 797.50** |
| **FCH JU max. contribution:** | **€2 953 790.75** |
| **Project start - end:** | 01/09/2015 - 31/03/2020 |
| **Coordinator:** | **DLR-INSTITUT FUR VERNETZTE ENERGIESYSTEME EV, DE** |
| **Website:** | **www.project-d2service.eu/** |

**BENEFICIARIES:** BALLARD POWER SYSTEMS EUROPE AS, BOSAL EMISSION CONTROL SYSTEMS NV, ZENTRUM FUER BRENNSTOFFZELLEN-TECHNIK GMBH, SOLIDPOWER SPA, BRITISH GAS TRADING LIMITED, ENERGY PARTNER SRL

### PROJECT AND OBJECTIVES

The project aimed to simplify fuel cell systems for both residential and commercial applications by making servicing and maintenance easy, fast and safe. The primary objective was to significantly reduce costs and labour for maintenance work, to promote the distribution of energy-efficient fuel-cell-based micro CHP, supplemental power and back-up power technology. Two different fuel cell technologies – PEMFC and SOFC – were employed in different systems that were improved. The project ended in March 2020.

### PROGRESS AND MAIN ACHIEVEMENTS

- System layout improvement and component simplification for easier component exchange, standardisation and better durability
- Remote monitoring system improvement for earlier failure detection and avoidance of expensive service visits
- Elaboration of guidelines for designing easily understandable service manuals to allow non-specialised technicians to perform routine service tasks.

### FUTURE STEPS AND PLANS

Project finished: catalyst investigations and the reactor qualification for lifetime desulphurisation with a possible operating time of 60 000 hours.

## QUANTITATIVE TARGETS AND STATUS

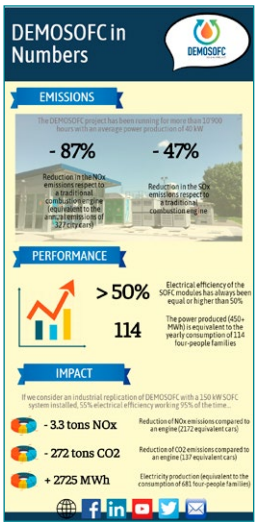
| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| AWP 2014 | Service time /presence time of maintenance technician (SOFC) | Hours | <4 | 4 | ✓ |
| | Total down time for servicing (SOFC) | Hours | <48 | <0.5/<0.5/48* | ✓ |
| | Service interval (SOFC) | 1/a | <1 | 1 | ✓ |
| | Service costs | €/(kW*a) | <600 | 850 | ✗ |

* Cold BoP/annual Service/Stack replacement

# DEMOSOFC
## DEMONSTRATION OF LARGE SOFC SYSTEM FED WITH BIOGAS FROM WWTP

DEMOSOFC
FCH2-JU PROJECT

| | |
|---|---|
| **Project ID:** | **671470** |
| **Call topic:** | **FCH-02.11-2014** – Large-scale fuel cell power plant demonstration in industrial/ commercial market segments |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€5 905 336.25** |
| **FCH JU max. contribution:** | **€4 492 561** |
| **Project start - end:** | 01/09/2015 - 31/08/2020 |
| **Coordinator:** | **POLITECNICO DI TORINO, IT** |
| **Website:** | **www.demosofc.eu/** |




**BENEFICIARIES:** CONVION OY, IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE, RISORSE IDRICHE SPA, SOCIETÀ METROPOLITANA ACQUE TORINO SPA, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY

### PROJECT AND OBJECTIVES

The EU-funded DEMOSOFC project demonstrates the technical and economic feasibility of operating a 174 kWe SOFC system in a wastewater treatment plant. The current plant layout includes only two SOFC modules (1 x 58 kWe and 1 x 44 kWe). The first SOFC module was activated in October 2017 and the second in October 2018. More than 13 600 hours of onsite operation have been reached (SOFC 1, followed by SOFC 2 operation, and finally some months of SOFC 1 and 2 running in parallel).

### NON-QUANTITATIVE OBJECTIVES

- Training end-user (SMAT) technicians on the new fuel cell system. Three training courses have been held
- Visits to the demo sites organised with a standardised format, for people from all over the world
- Technical experience: build technical knowledge, customer and investor confidence. Lessons learnt for replicating detailed engineering, construction, installation and management in the long run
- A complete FMEA of the demo was developed
- Dissemination via press release, social media (Facebook, Twitter, etc), website, workshops at demo site and elsewhere, conferences, public events and technical papers.

### PROGRESS AND MAIN ACHIEVEMENTS

- High electrical efficiency, always in excess of 50 %, with peaks at 56 %
- Zero emissions to atmosphere, NOx, SOx, VOC and PM below detection limits
- >13 500 hours of operation on site (4 600 + for SOFC 1 and 9 700+ for SOFC 2).

### FUTURE STEPS AND PLANS

- Overall performance analysis
- Create a summary of results and data to use as a guideline for future replication of the biogas-SOFC concept
- Finalise the exploitation plans of all the partners to maximise the project's impact
- Perform the second emissions analysis, with 2 SOFC modules running in parallel
- Dissemination: thematic webinars offered to an international audience and a thematic event for public administrations.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| MAWP 2014-2020 | Electrical efficiency | % LHV | 42-60 | 50-56 | ✓ |
| | NOx emissions | mg/kWh | <40 | <160 | ✗ |
| | Availability of the plant | % | 97 | 70 | ✗ |
| | Thermal efficiency | % LHV | 24-42 | 30-35 | ✓ |
| | Lifetime | Years of plant operation | 8-20 | 2.5 | ✗ |

# EVERYWH2ERE

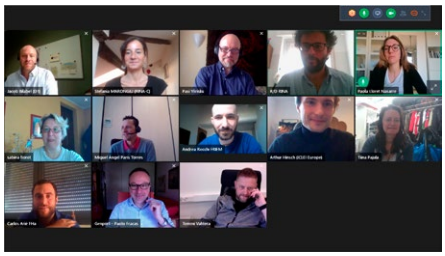
## MAKING HYDROGEN AFFORDABLE TO SUSTAINABLY OPERATE EVERYWHERE IN EUROPEAN CITIES


| | |
|---|---|
| **Project ID:** | **779606** |
| **Call topic:** | **FCH-02-10-2017**: Transportable FC gensets for temporary power supply in urban applications |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€6 762 324.46** |
| **FCH JU max. contribution:** | **€4 999 945.76** |
| **Project start - end:** | 01/02/2018 - 31/01/2023 |
| **Coordinator:** | **RINA CONSULTING SPA, IT** |
| **Website:** | **www.everywh2ere.eu/** |

**BENEFICIARIES:** FRIEM SPA, LINDE GAS ITALIA SRL, DELTA1 GUG (HAFTUNGSBESCHRAENKT), SWISS HYDROGEN SA, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, MAHYTEC SARL, IREN SMART SOLUTIONS SPA, IREN ENERGIA SPA, IREN SPA, GENPORT SRL - SPIN OFF DEL POLITECNICO DI MILANO, THT CONTROL OY, POWERCELL SWEDEN AB, FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDROGENO EN ARAGON, ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH), PARCO SCIENTIFICO TECNOLOGICO PER L'AMBIENTE ENVIRONMENT PARK TORINO SPA, ACCIONA CONSTRUCCION SA

### PROJECT AND OBJECTIVES

The goal of the project is to realise and demonstrate the operation of eight fuel-cell-based power gensets (4 x 25 kW – 4 x 100 kW) fuelled by compressed hydrogen for use in temporary applications like events, music festivals, construction sites, etc. In addition, the project will study their impact on European society from a logistic, environmental and business perspective. Specific analyses will be conducted in this regard. The consortium is currently finalising the first two gensets (1 x 25 kW, 1x100 kW) and has performed some preliminary LCA and market analysis.



### NON-QUANTITATIVE OBJECTIVES

- Higher social acceptance of FCH technology
- Demonstrating fuel-cell-based gensets at events, festivals etc. to give strong visibility to FCH technologies
- Easier permitting
- Development of an HSE guideline (with a mini-HAzop) to facilitate permitting and maybe a future-dedicated regulation/technical norms.

### PROGRESS AND MAIN ACHIEVEMENTS

- First fuel cell SuSy and container realised and sent to Italy for final integration
- First market assessment (future potential price) and logistic analysis based on hydrogen mapping
- First environmental analysis and health and safety assessment for operation and future marketability.

### FUTURE STEPS AND PLANS

- Demonstration of gensets
- Enhancement of LCA and LCC analysis
- Refinement of the gensets' executive design
- Testing of ejector solutions
- Finalisation of a road-to-market strategy.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT |
|---|---|---|---|---|
| Project's own objectives | Lifetime | Hours | 20 000 | |
| | Efficiency of the genset | % | 50 | |
| | CAPEX | €/kW | 5 500 | |

# PACE
## PATHWAY TO A COMPETITIVE EUROPEAN FC MCHP MARKET

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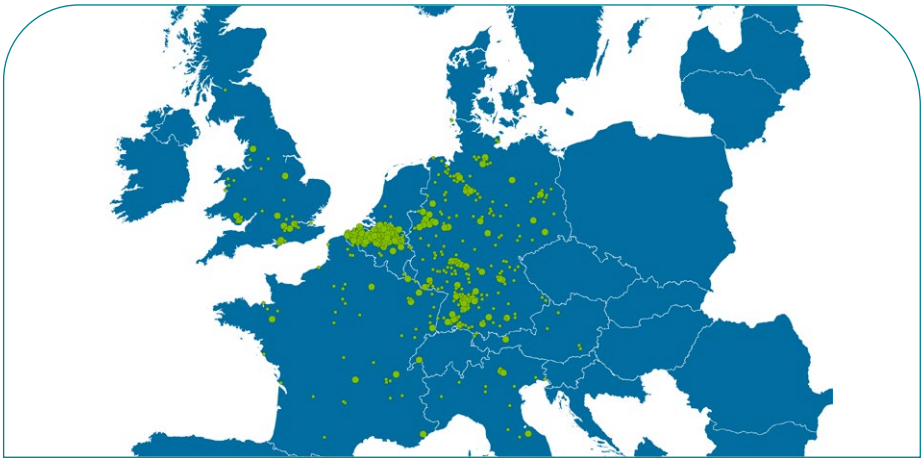
|---|---|
| **Project ID:** | **700339** |
| **Call topic:** | **FCH-02.9-2015** - Large scale demonstration µCHP fuel cells |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€84 376 433.29** |
| **FCH JU max. contribution:** | **€33 932 752.75** |
| **Project start - end:** | 01/06/2016 - 30/06/2022 |
| **Coordinator:** | **THE EUROPEAN ASSOCIATION FOR THE PROMOTION OF COGENERATION VZW, BE** |
| **Website:** | **www.pace-energy.eu** |



**BENEFICIARIES:** REMEHA GMBH, REMEHA NV, VIESSMANN ELEKTRONIK GMBH, VIESSMANN WERKE ALLENDORF GMBH, BDR THERMEA GROUP BV, SOLIDPOWER GMBH, SUNFIRE FUEL CELLS GMBH, REMEHA BV, VIESSMANN WERKE GMBH & CO KG, SUNFIRE GMBH, BAXI INNOTECH GMBH, BOSCH THERMOTECHNIK GMBH, SOLIDPOWER SPA, SENERTEC KRAFT-WARME ENERGIESYSTEME GMBH, EWE AKTIENGESELLSCHAFT, VAILLANT GMBH, ELEMENT ENERGY LIMITED, HEXIS AG, FACHHOCHSCHULE ZENTRALSCHWEIZ - HOCHSCHULE LUZERN, DANMARKS TEKNISKE UNIVERSITET

### PROJECT AND OBJECTIVES

PACE unlocks the large-scale European deployment of the state-of-the-art smart energy solution for private homes: fuel cell micro-cogeneration. PACE will see up to 2 800 householders across Europe reaping the benefits of this home energy system. The project enables manufacturers to move towards product industrialisation and fosters market development at national level by working with building professionals and the wider energy community. The project uses modern fuel cell technology to produce efficient heat and electricity at home, empowering consumers in their energy choices.

### NON-QUANTITATIVE OBJECTIVES

- Field demonstration of about 2 800 units
- 1 168 units commissioned to date and 2800 planned by the end of the project
- Increased system lifetime to more than 15 years and longer maintenance interval due to new/improved components
- System (excluding stack) lifetimes of 10 years at the start of project, increasing to a minimum of 15 years by the end of the project
- All partners will eliminate the need for stack replacement during a customer's 10-year service plan, by the end of the project (worst case scenario is 7 years at the project start).

### PROGRESS AND MAIN ACHIEVEMENTS

- Winner of the 2018 FCH JU Award for Best Success Story
- 1 877 units sold as of the end of April 2020
- Joint Declaration on Stationary Fuel Cells for Green Buildings signed by associations, authorities, industry, research institutes and consultancies.

### FUTURE STEPS AND PLANS

- All 2 800 units to be deployed in the project will be installed
- Continue data collection and analysis to provide fact-based understanding of the technology's performance and benefits
- Identify ongoing regulatory barriers to the deployment of fuel cell mCHP units across Europe and collaborate with industry and policymakers to remove these barriers
- Develop use cases for fuel cell mCHP units beyond the project's end. This includes an assessment of the economic potential of FC mCHP units in grid service markets.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? | SOA RESULT ACHIEVED TO DATE (BY OTHERS) |
|---|---|---|---|---|---|---|
| Project's own objectives | Sold units | N/A | 2 800 | 1 877 | ✗ | 1 046 |
| | Manufacturing capacity (average company level) | Units/year | 1 000 systems/year per OEM by end of 2020 | 2 300 | ✓ | 1 500 |
| | Time before stack replacement | Years | 15 years system lifetime with >50 % reduction in stack replacement or no stack replacement | >6, based on operational period possible | ✗ | N/A |

# REMOTE

## REMOTE AREA ENERGY SUPPLY WITH MULTIPLE OPTIONS FOR INTEGRATED HYDROGEN-BASED TECHNOLOGIES

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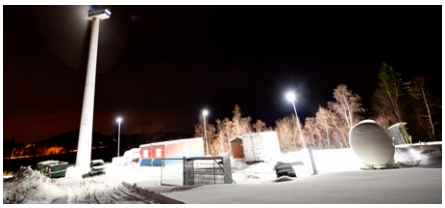
|---|---|
| **Project ID:** | **779541** |
| **Call topic:** | **FCH-02-12-2017**: Demonstration of fuel-cell-based energy storage solutions for isolated micro-grid or off-grid remote areas |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€6 753 851.25** |
| **FCH JU max. contribution:** | **€4 995 950.25** |
| **Project start - end:** | 01/01/2018 - 31/12/2021 |
| **Coordinator:** | **POLITECNICO DI TORINO, IT** |
| **Website:** | **www.remote-euproject.eu/** |

**BENEFICIARIES:** SINTEF AS, EPS ELVI ENERGY SRL, TRONDERENERGI AS, ORIZWN ANONYMH TECHNIKI ETAIREIA, POWIDIAN, IRIS SRL, HYDROGENICS EUROPE NV, ENEL GREEN POWER SPA, BALLARD POWER SYSTEMS EUROPE AS, ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS, STIFTELSEN SINTEF

### PROJECT AND OBJECTIVES

REMOTE will demonstrate the technical and economic feasibility of two fuel-cell-based H2 energy storage solutions (integrated P2P, non-integrated P2G + G2P systems), deployed in four demos, based on renewables (solar, wind, biomass, hydro), in isolated micro-grid or off-grid remote areas. By year 2.5 of the project (May 2020), the analysis of the technical, economic and regulatory framework for the demos was performed. The design, engineering, operations and maintenance plan and permitting procedures have been assessed for all the demos. Two demos have been built and their installation is almost complete.



### NON-QUANTITATIVE OBJECTIVES

- Gain experience of P2P systems throughout the value chain
- Validate real demonstration units in representative applications of isolated micro-grid or off-grid areas, to enable suppliers, users and other stakeholders to gain wide experience for the future deployment of these energy solutions
- Identify gaps in regulations
- The lessons learnt from the demo plants' design, installation and operation will help identify gaps in regulations, to allow for full-scale exploitation of $H_2$-based energy storage in the energy market (not only for islands or remote areas)
- Creation of know-how for next-generation P2P
- Through the demo's design, installation and operation, REMOTE will create fundamental know-how for the next generation of fully integrated P2P chains based on fuel cells and $H_2$ technologies adapted to market and society's needs, and contribute to scientific advances in the management of off-grid and isolated micro-grids.

### PROGRESS AND MAIN ACHIEVEMENTS

- Fuel cell, battery and control modules of demo 4 (Norway) have been installed on-site. The site is ready for the installation of the electrolyser
- Demo 2 (Greece): all the modules have been shipped and placed on-site. The plant is ready for commissioning
- The parameters for the evaluation of techno-economic KPIs have been defined.

### FUTURE STEPS AND PLANS

- Demo 4 finalisation of installation, commissioning and start of operation
- Demo 2 commissioning and start of operation
- Demo 1: implementation of new technological design, realisation and installation
- Demo 3: identification of a new site compliant with project requirements
- Demo 3: implementation of new technological design, realisation and installation.

## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? | SOA RESULT ACHIEVED TO DATE (BY OTHERS) | YEAR FOR SOA TARGET |
|---|---|---|---|---|---|---|---|
| MAWP addendum 2018-2020 (Target year 2020) | Rated efficiency electrolyser (PEM) | kWh/kg | 55 | 50.5 (rated value, to be measured on demo) | ✓ | 50 | 2020 |
| | Lifetime | Years of plant operation | 8 – 20 | 15 (fuel cell) - 20 (surrounding equipment), estimated | | N/A | N/A |
| | Electrolyser footprint (PEM) | $m^2$/MW | 100 | 273 | ✗ | 10 | 2018-2020 |
| | Rated efficiency electrolyser (alkaline) | kWh/kg | 50 | 50.6 (rated value, to be measured on demo) | ✓ | N/A | N/A |
| | Rated efficiency fuel cell (PEM) | %LHV | 42-60 | 45 | | 51 | 2018 |

# REPOWER
## ROBUST AND REMOTE POWER SUPPLY

RoRe Power
ROBUST & REMOTE

| | |
|---|---|
| **Project ID:** | **824953** |
| **Call topic:** | **FCH-02-3-2018:** Robust, efficient long term remote power supply |
| **PRD 2020 Panel:** | 3 - Trials and Deployment of Fuel Cell Applications - Energy |
| **Project total costs:** | **€4 039 705** |
| **FCH JU max. contribution:** | **€2 999 190.26** |
| **Project start - end:** | 01/01/2019 - 31/12/2022 |
| **Coordinator:** | **TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, FI** |
| **Website:** | **rorepower.com** |


**BENEFICIARIES:** 3E ENERGY OY, SUNFIRE FUEL CELLS GMBH, SUNFIRE GMBH, SOLIDPOWER SPA, EUROPEAN FUEL CELL FORUM AG

### PROJECT AND OBJECTIVES

The overall objective of this project is to further develop and demonstrate solid oxide fuel cell (SOFC) systems for off-grid power generation in markets such as gas and oil infrastructure in remote regions with harsh climates (from -40 °C to +50 °C), and to supply power to telecommunication towers (e.g. telecom base stations or microwave transceivers), especially in emerging countries.

### NON-QUANTITATIVE OBJECTIVES

- Product-specific installation and integration training for customers
- Product-specific installation and training sessions for Sunfire-Remote integration were held with partners in Canada, the UK and the Netherlands.

### PROGRESS AND MAIN ACHIEVEMENTS

- The first RoRePower unit was installed in a telecom application in Alaska
- Sunfire Remote 400 prototype has run 7 700 hours with a degradation of 0.63 %/1 000 h and 85 cycles of operation
- An approach for long-term desulphurisation >15 months was developed and is ready for selected installations.

### FUTURE STEPS AND PLANS

- Identify all customer sites
- More than 20 RoRePower units have been installed on customers' sites
- Service contract concept created for end customer
- Long-term validation and demonstration, over more than one year in the relevant environments, has produced reliable field data.


## QUANTITATIVE TARGETS AND STATUS

| TARGET SOURCE | PARAMETER | UNIT | TARGET | ACHIEVED TO DATE BY THE PROJECT | TARGET ACHIEVED? |
|---|---|---|---|---|---|
| AWP 2019 | Electrical efficiency | % | >35 | >35 | ✓ |
| | Start-up for propane | °C | -20 | -30 | |
| | Long-term desulphurisation | Months | 15 | 15 | |