

ELY4OFF PEM ElectroLYsers FOR operation with OFFgrid renewable installations



Programme Review Days 2019 Brussels, 19-20 November 2019



FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

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PROJECT OVERVIEW (JM)

- **Call year: 2015**
- **Project dates: 01/04/2016-30/09/2019**
- % stage of implementation 01/11/2019: 100%
- Total project budget: 2,315,217 €
- FCH JU max. contribution: 2,315,217 €
- **Other financial contribution: 0 €**
- ENERGIES ALTERNATIVES (CEA).





Call topic: FCH-02.1-2015 (PEM ElectroLYsers FOR operation with OFFgrid renewable installations)

Partners: Aragon Hydrogen Foundation (FHa), ITM POWER (TRADING) LIMITED (ITM), Instrumentacion y Componentes S.A. (INYCOM), EPIC POWER CONVERTERS SL (EP), COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX





Purpose: the **development** and **demonstration** of an autonomous off-grid electrolysis system linked to renewable energy sources.

The **PEMWE** industrial prototype (50 kW) will be directly linked to track the solar **photovoltaic** power source cold start and rapid response to changes

The *demonstration* period in a relevant environment (TRL 6) lasted **7 months** and will take place in Huesca, Spain.









The final meeting of the FCH JU ELY40FF (www.ely4off.eu) project has taken place on 26 September 2019 in Huesca in the premises of FHa in Huesca. With the participation of all the stakeholders involved in the project, the final meeting took place to discuss the details of the on-going activities and to qualify the results [...]

Read more

FUNDACIÓN PARA EL **DESARROLLO DE LAS NUEVAS** HIDRÓGENO TECNOLOGÍAS DEL

Positioning vs SoA

PARAMETER	Target	SoA achieved by others	Reference	
Efficiency at system level	50 kWh/kg	48 kWh/kg @ 100 kg/day	NEPTUNE	Max p
Efficiency degradation	2 %/8000h	1.5%	NEPTUNE	Can r
CAPEX	6 M€/(t/d)	3 M€/(t/d) @ 1 MW scale	REFHYNE	Size of
H2 production flexibility	5-150 %	20-300 %	NEPTUNE	Not p
Hot start (min to max power)	2 seconds	1 second	QualiGridS	

Main design parameters: 1 A/cm², 20 bar, 55^oC , stack 50 kW

Application and market area

- Telecoms
- Power to gas, both on-shore and offshore
- Energy systems for isolated areas (e.g. mountains)
- Replacement of diesel engines in offgrid installations
- Off-grid HRS to supply to FCEVs
- Fertiliser production

Comments

power reached during demo was 82 %

n't be measured until stack returns to lab conditions

unit influenced dramatically the cost

possible to demonstrate onsite as PSU is limited

PROJECT ACTIONS– Efficiency of the PSU (DC/DC)

Achievement to-date

Project start < **92%**

Current technology: rectifier (90-96%) & inverter (90-96%)

Achieved: 97.4%

25%

50%

75%

PROJECT ACTIONS- Ramp up (sec to full load)

Achievement to-date

Project start <2 seconds

4th October 2019

PROJECT ACTIONS – Availability

Achievement to-date

Project start:

Main causes of unavailability

- Immaturity of control system \bullet
- Some components in manual ${\color{black}\bullet}$ operation
- Inaccurate start-up estimation
- Alarms due to off-grid control lacksquaredifferent from on-grid
- Others (maintenance, tests, ...)

Risks and Challenges

Insufficient durability of thin membrane \rightarrow thicker commercial was selected

- 50 μm MEA and tested at 1 A/cm², 54^oC and 20 bar: 88,1% eff achieved but short circuits during tests after • 765 h
- Commercial thicker membrane: 86% eff, degradation under 10 μ V/hr and reversible

Fabrication & assembly delays \rightarrow Demo period re-scheduled (extension)

- 1. Modifications in ely due to off-grid conditions
- 2. Presence of field engineers during commissioning (summer)
- 3. High interdependence of subsystems (DC/DC converters, electrolyser, control)

Energy management configuration \rightarrow the intended one could not be tested DC, 3P AC, and 1P AC: the optimal solution is full conversion of PV to DC and then split \bullet

- Problems with commercial DC(low)/DC(high): finally 3 strings dedicated to BoP & storage \bullet

Demo period covered Spring & Summer \rightarrow desirable extreme weather

- The rest of the year is required to stress the system performance
- Fuel cell has not entered into operation during demo

Communications Activities

ely40ff

Press releases

Communication and Dissemination

1

Public Workshops organized

21 Public deliverables 71 Publications Scientific (4) Divulgative (67)

Open Access Article

Use of Hydrogen in Off-Grid L Techno-Economic Assessme

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EXPLOITATION PLAN/EXPECTED IMPACT

Exploitation

Service offered by EC: **Business Plan Development** (BDP) provided in Nov 2017

Unique selling points:

- **Dynamic and fast** answer H2 production
- Excellent H2 **purity** for any purpose
- **Self-sufficient** system up to several days
- Scalable up to 10 MW

Strategy Plan:

- 6 exploitable results (ITM: 3, EPIC: 1, INYCOM: 1, FHa: 1)
- 3 business cases elaborated: off-grid installation, PtG, and mobility.
- 8 target markets identified: Telecoms, PtG, isolated areas, back-up systems in weak grids, HRS, fertiliser production,

Impact

- Partners agree to continue the testing **post-project**
- Strict off-grid conditions lead to significantly higher **LCoE**: necessary to consider RES potential
- Off-grid elys can hardly compete economically at kW scale -> **R&D at MW** scale should be undertaken
- Better **combine** wind and solar
- Predicted costs of merely H2 production are not too high -> **R&D on down-stream components** is required
- Do not forget to consider the avoided cost of connecting to grid and grid fees.
- Since the project started there are new **positions on** green H2 at massive scale in Australia, Nord Sea region, Saudi Arabia

Question for the audience

Achievements from ELY4OFF

Take your smartphone; go to <u>www.sli.do</u> and insert the code **#PRD19**

Was the ELY4OFF system tested in any weather condition?

- 1. Yes, and its performance was satisfactory
- 2. No, extreme weather conditions could not be tested and will not be in the future
- 3. No, extreme weather conditions could not be tested but they will be as the demonstration continues after the end of the project

FHa team in PRD2019

DR. FERNANDO PALACÍN **Managing Director**

MR. PEDRO CASERO Head of Innovation Dept.

FUNDACIÓN PARA EL DESARROLLO DE LAS NUEVAS

MR. GUILLERMO FIGUERUELO

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