ELY4OFF
PEM ElectroLYsers FOR operation with OFFgrid renewable installations

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Programme Review Days 2019

Brussels, 19-20 November 2019

PROJECT OVERVIEW (JM)

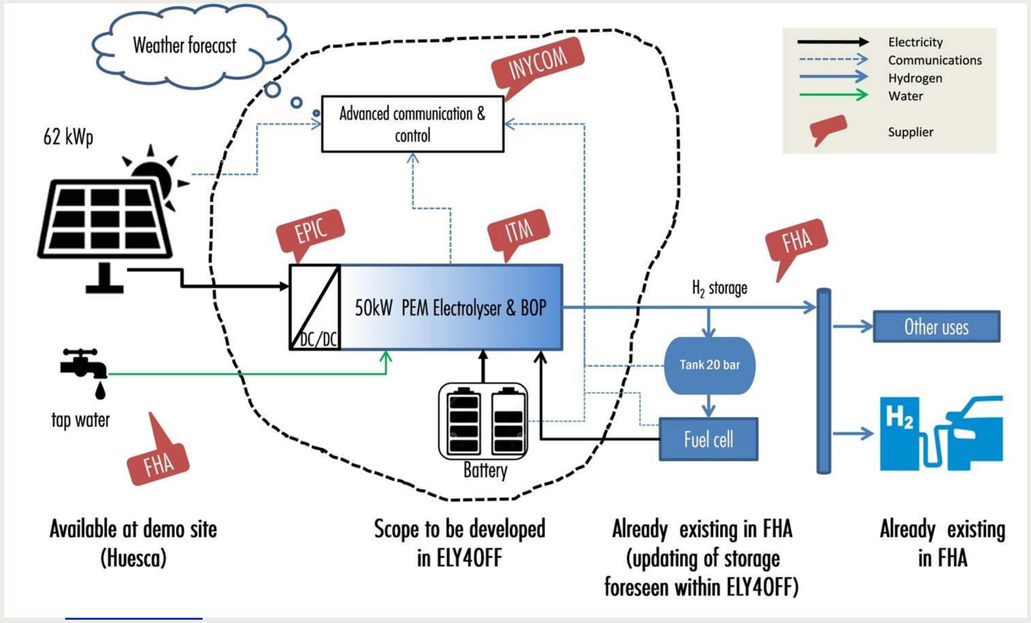
- **Call year:** 2015
- **Call topic:** FCH-02.1-2015 (PEM ElectroLYsers FOR operation with OFFgrid renewable installations)
- **Project dates:** 01/04/2016-30/09/2019
- **% stage of implementation 01/11/2019:** 100%
- **Total project budget:** 2,315,217 €
- **FCH JU max. contribution:** 2,315,217 €
- **Other financial contribution:** 0 €
- **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 ENERGIES ALTERNATIVES **(CEA)**.

PROJECT SUMMARY

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.

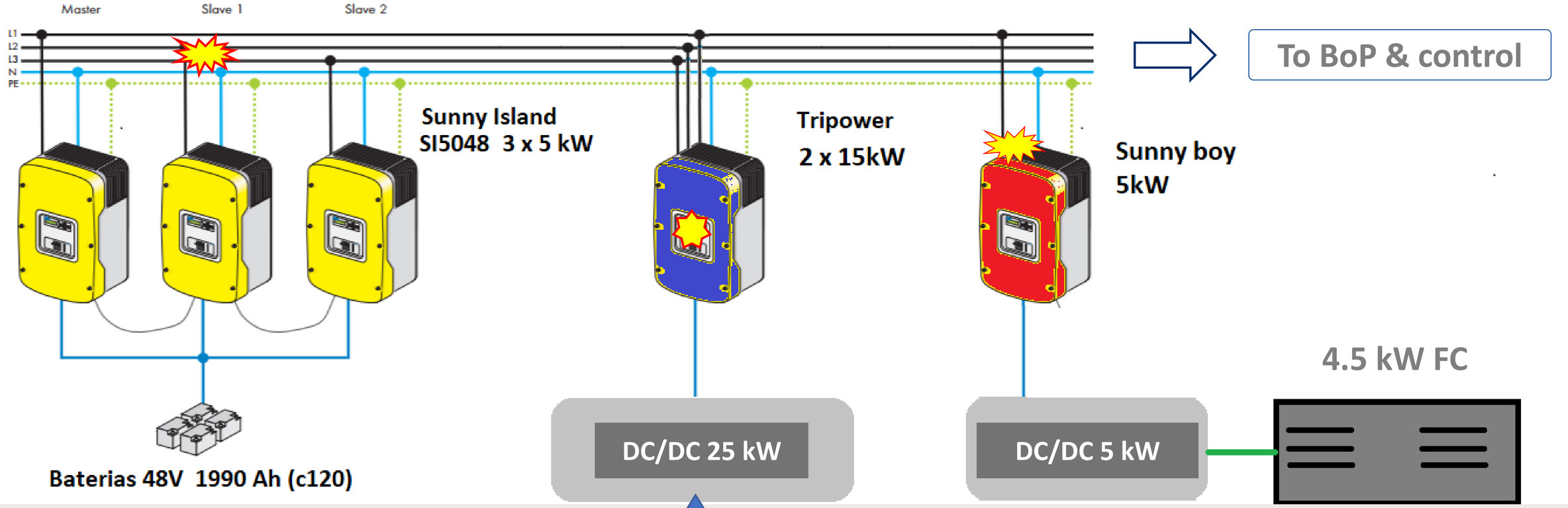


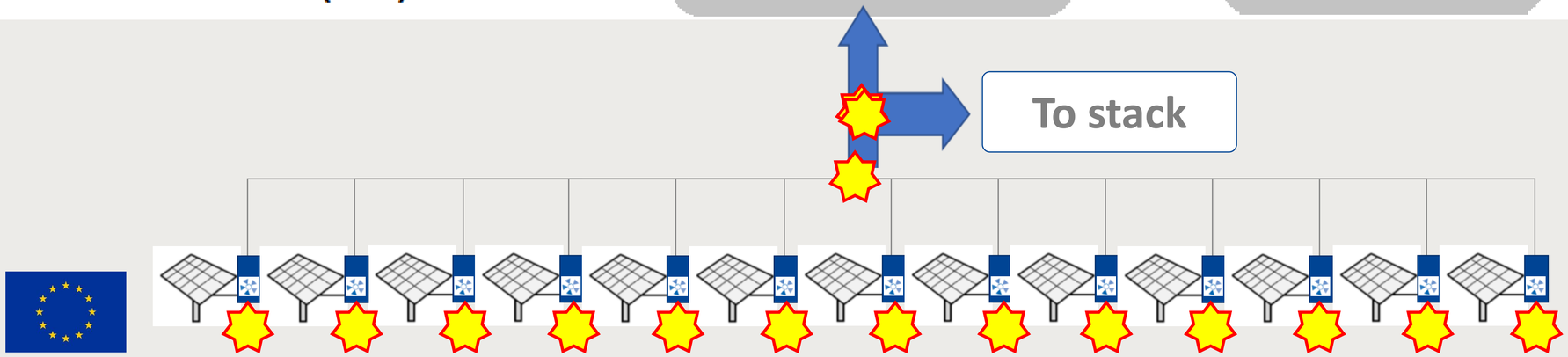
400 kg of green H2 produced during the Final Meeting

The final meeting of the FCH JU ELY4OFF (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

PROJECT SUMMARY





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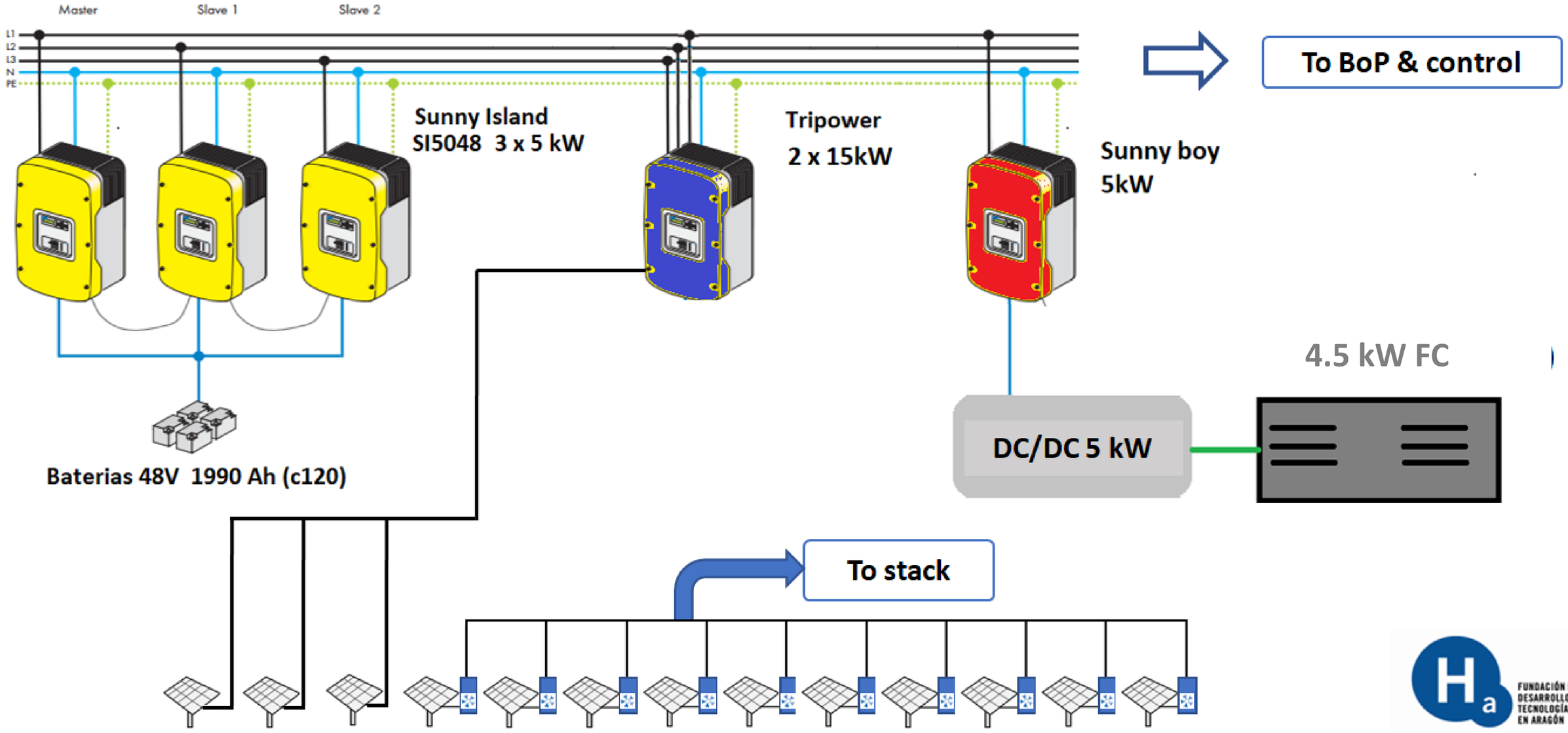

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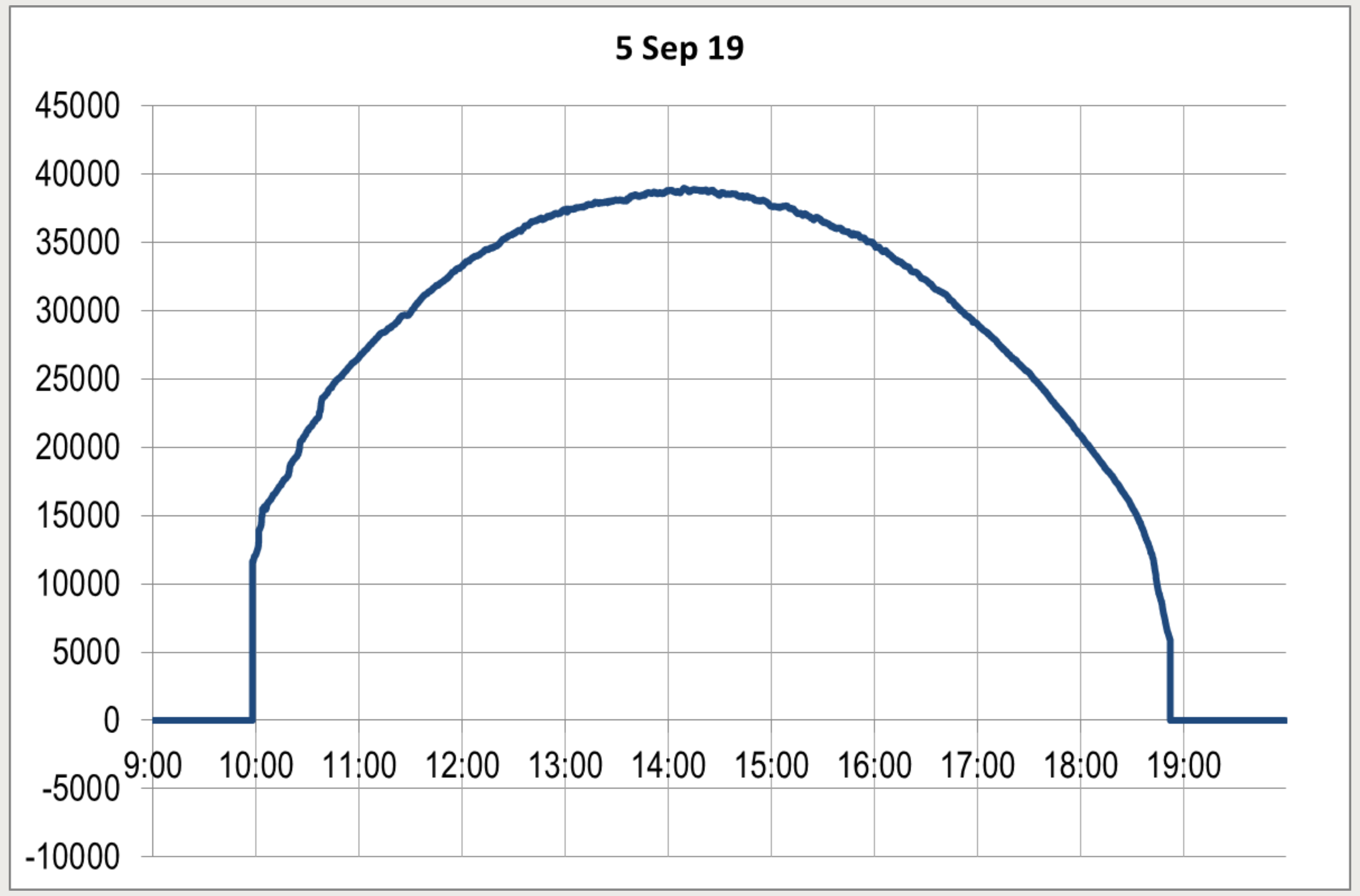
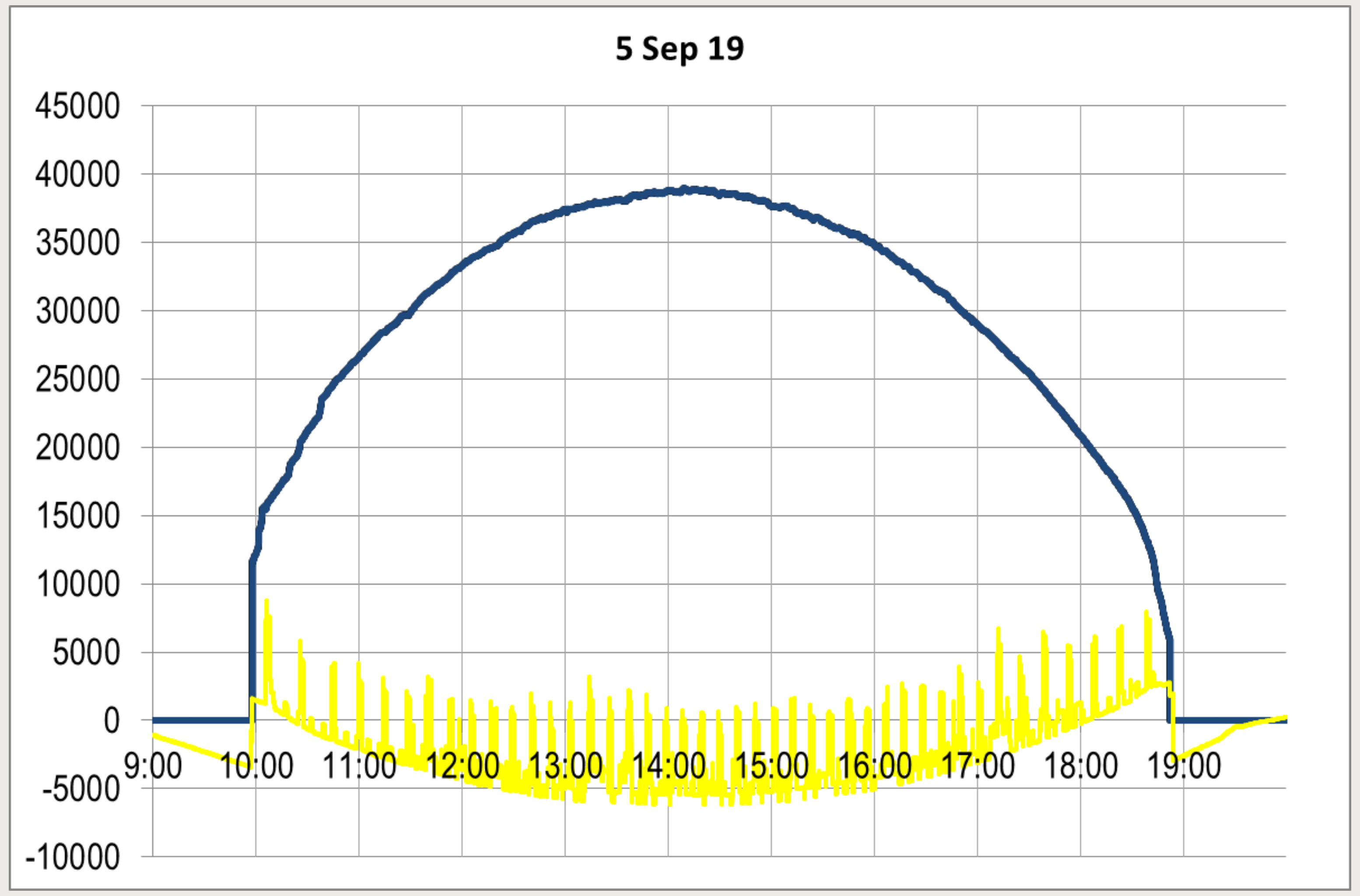
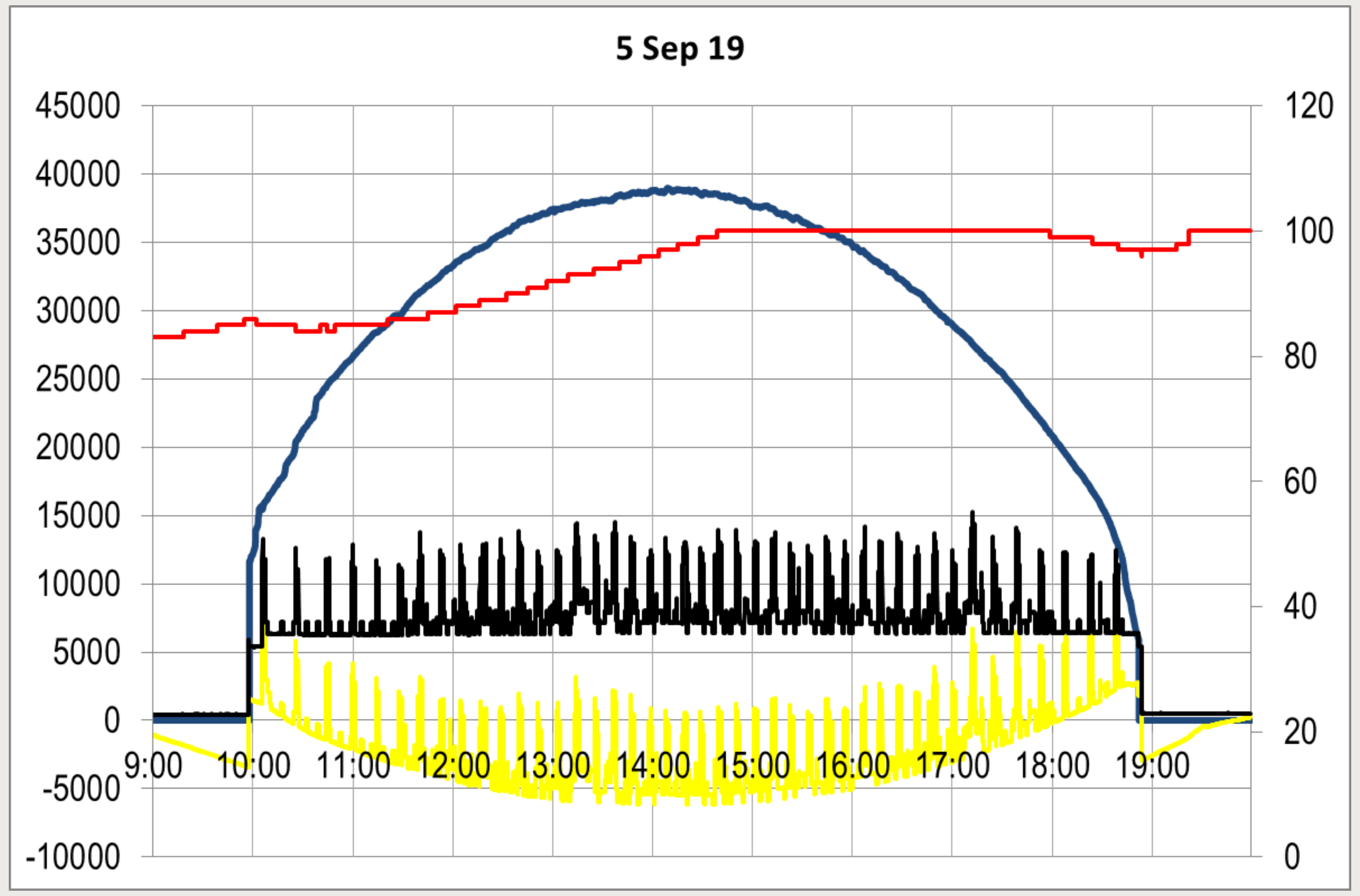
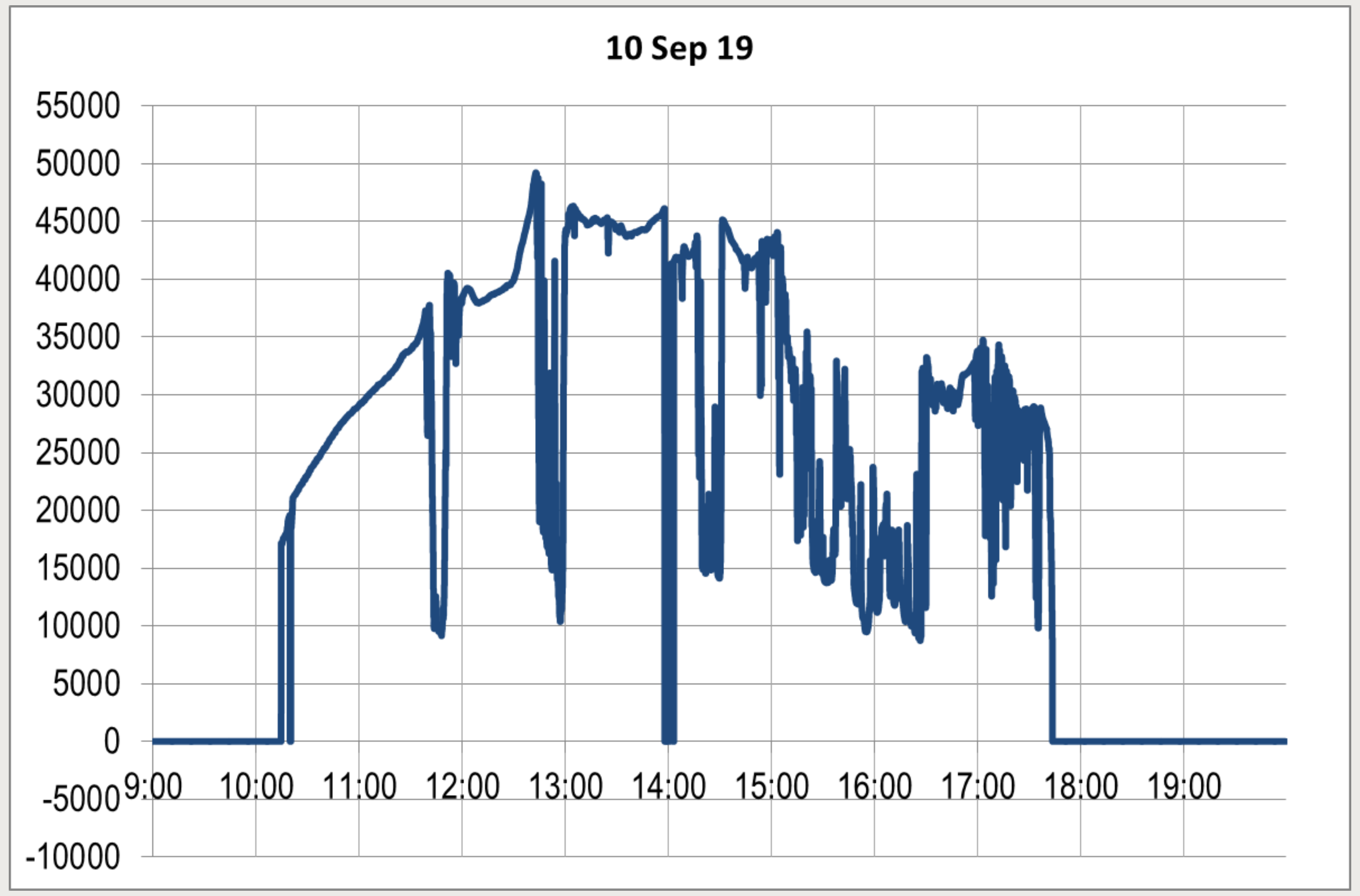
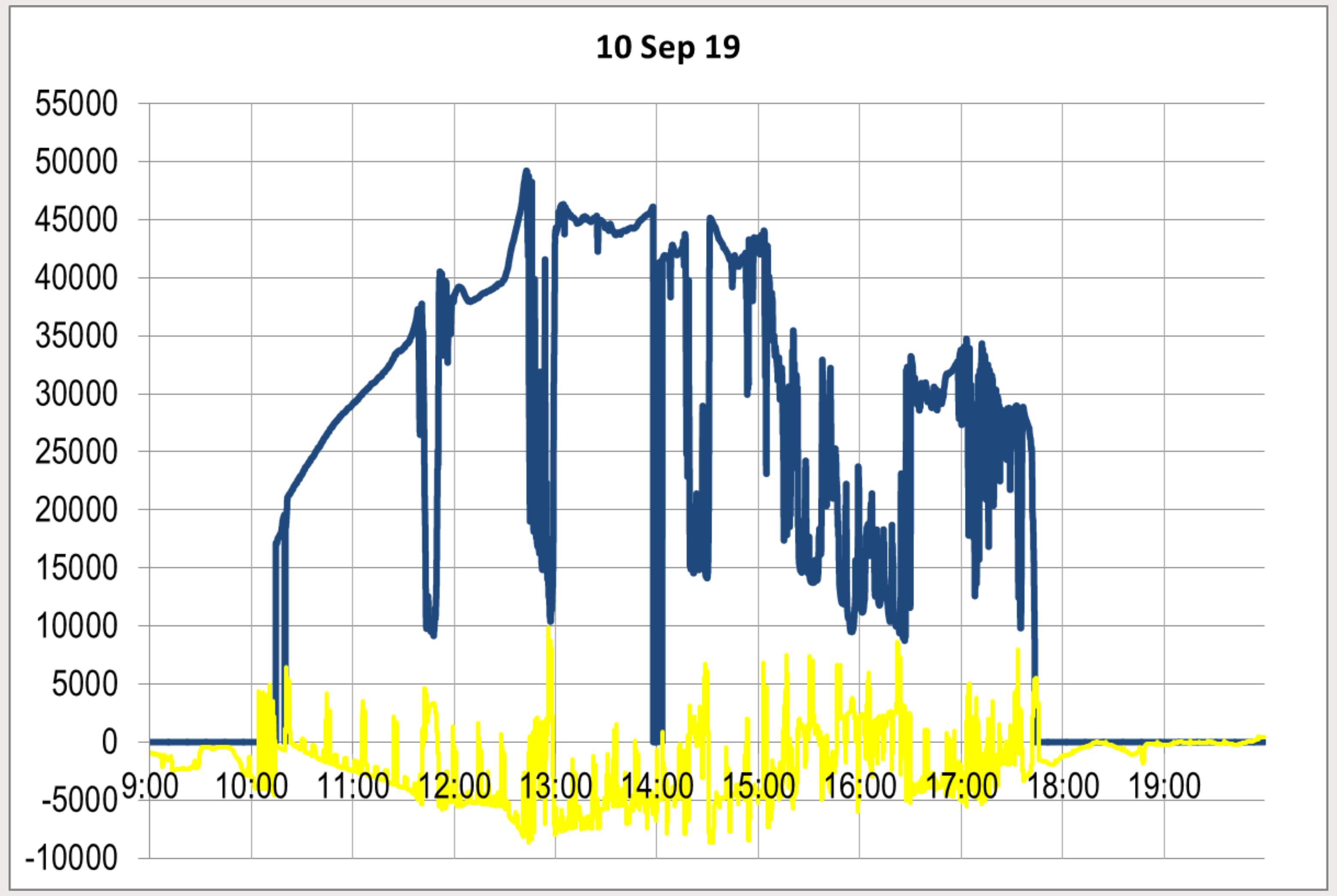
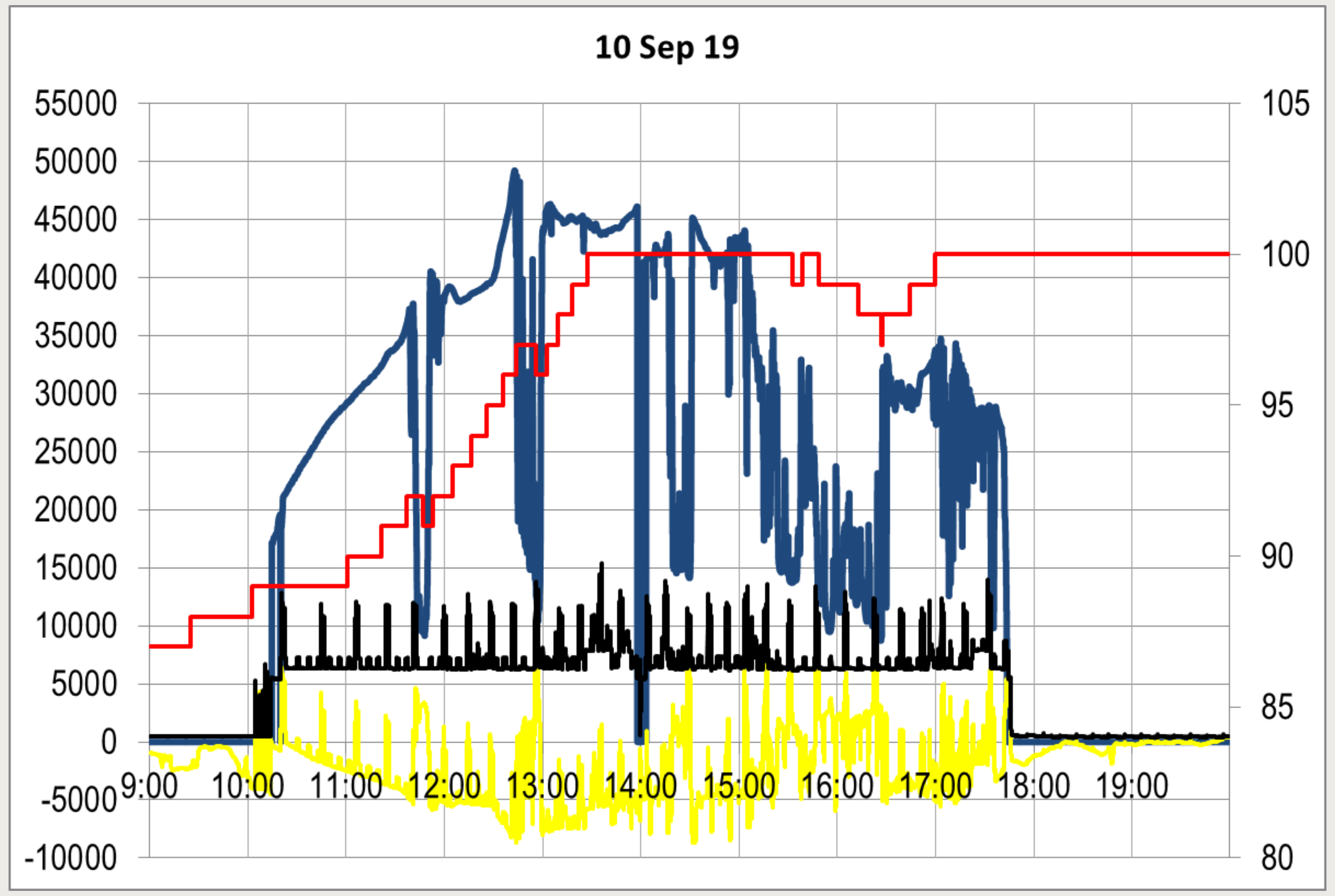












PROJECT SUMMARY

Positioning vs SoA

PARAMETER	Target	SoA achieved by others	Reference	Comments
Efficiency at system level	**50 kWh/kg**	48 kWh/kg @ 100 kg/day	NEPTUNE	Max power reached during demo was 82 %
Efficiency degradation	**2 %/8000h**	1.5%	NEPTUNE	Can't be measured until stack returns to lab conditions
CAPEX	**6 M€/(t/d)**	3 M€/(t/d) @ 1 MW scale	REFHYNE	Size of unit influenced dramatically the cost
H2 production flexibility	**5-150 %**	20-300 %	NEPTUNE	Not possible to demonstrate on-site as PSU is limited
Hot start (min to max power)	**2 seconds**	1 second	QualiGridS	

Main design parameters: 1 A/cm^2, 20 bar, 55ºC , stack 50 kW

Application and market area

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

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

Achievement to-date

Project start
< 92%

Achieved: 97.4%

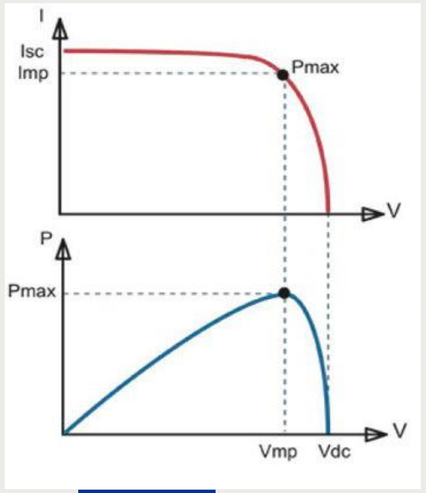
25% 50% 75%

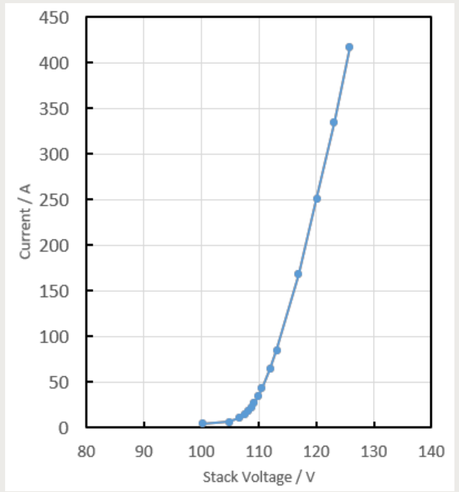
TARGET
>96 %

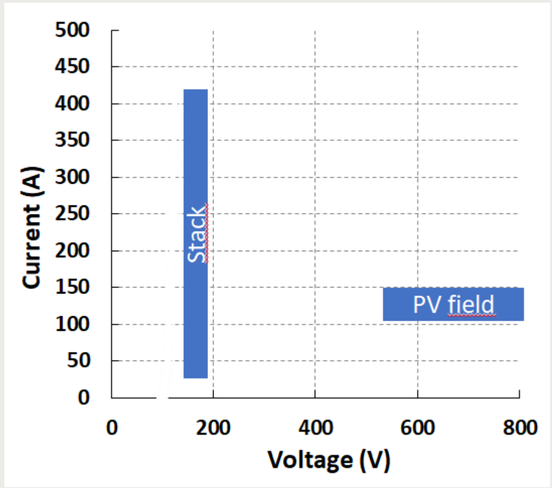
Current technology: rectifier (90-96%) & inverter (90-96%)

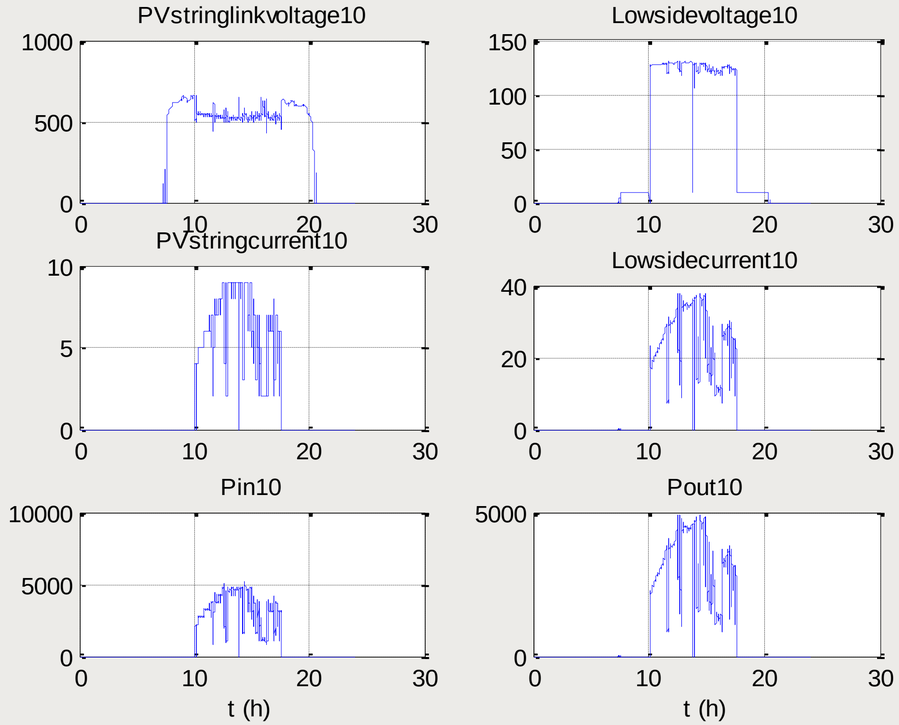
PV output: 450 – 800 V

Stack reqs.: 110 – 160 V









PROJECT ACTIONS– Ramp up (sec to full load)

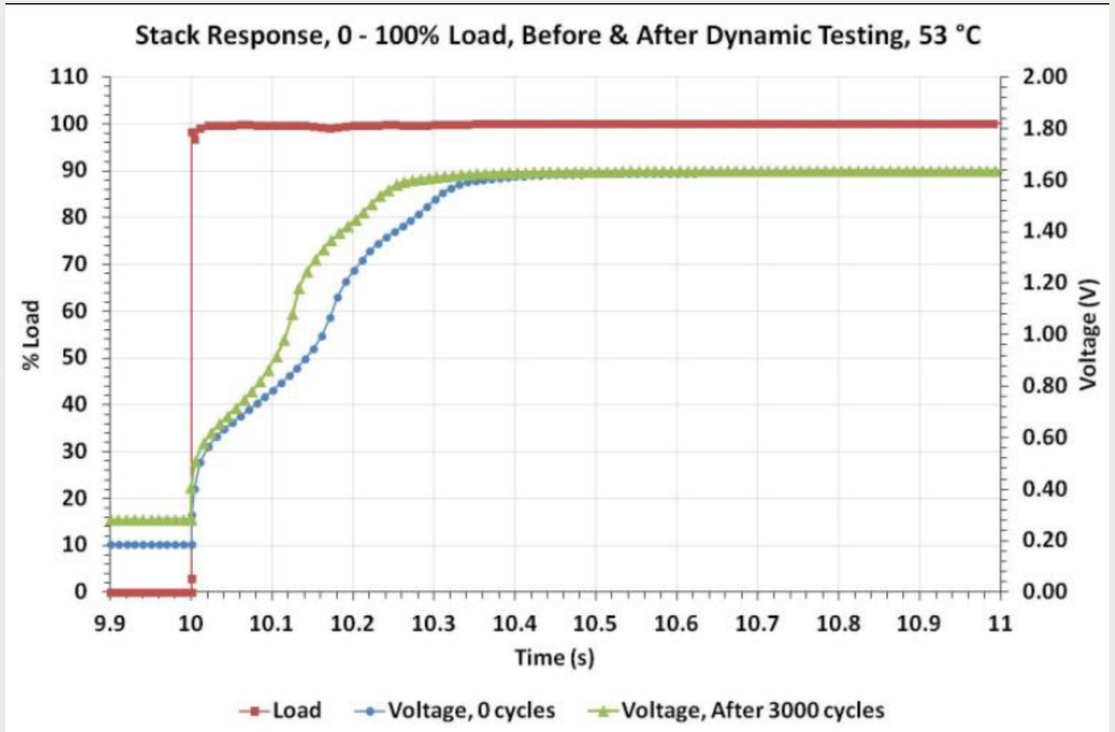
Achievement to-date

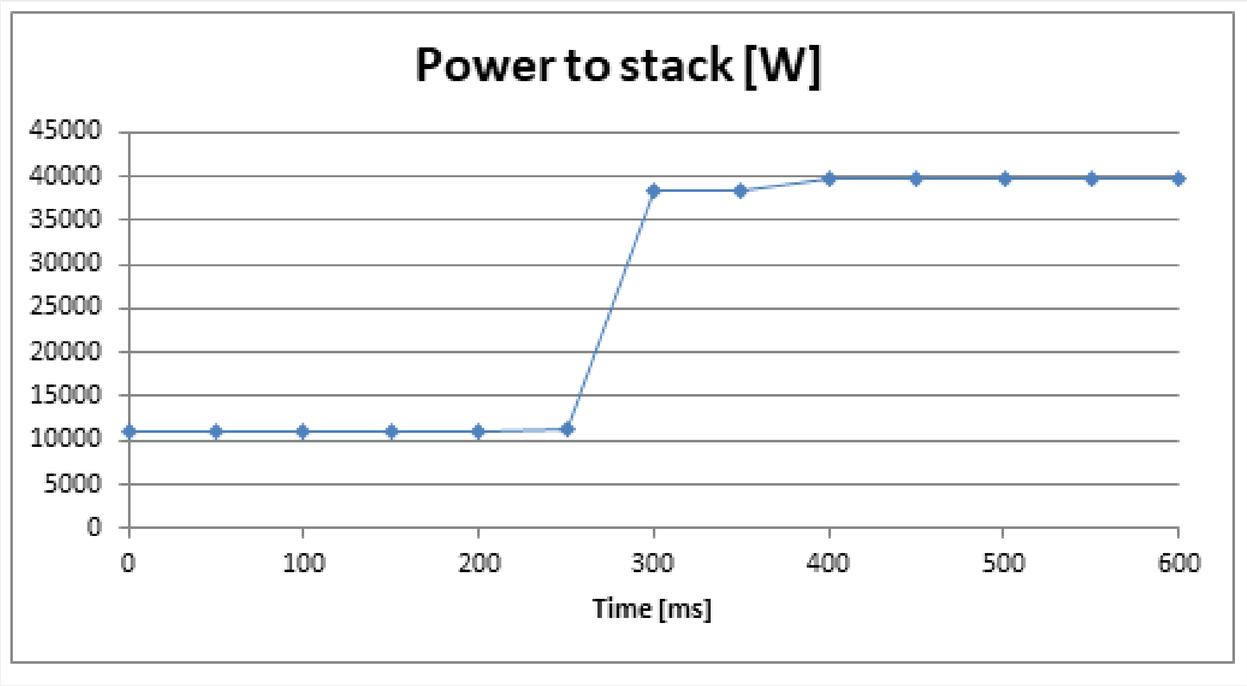
Project start
<2 seconds

Achieved: <100 ms

TARGET
2 seconds

25% 50% 75%





PROJECT ACTIONS – Availability

Achievement to-date

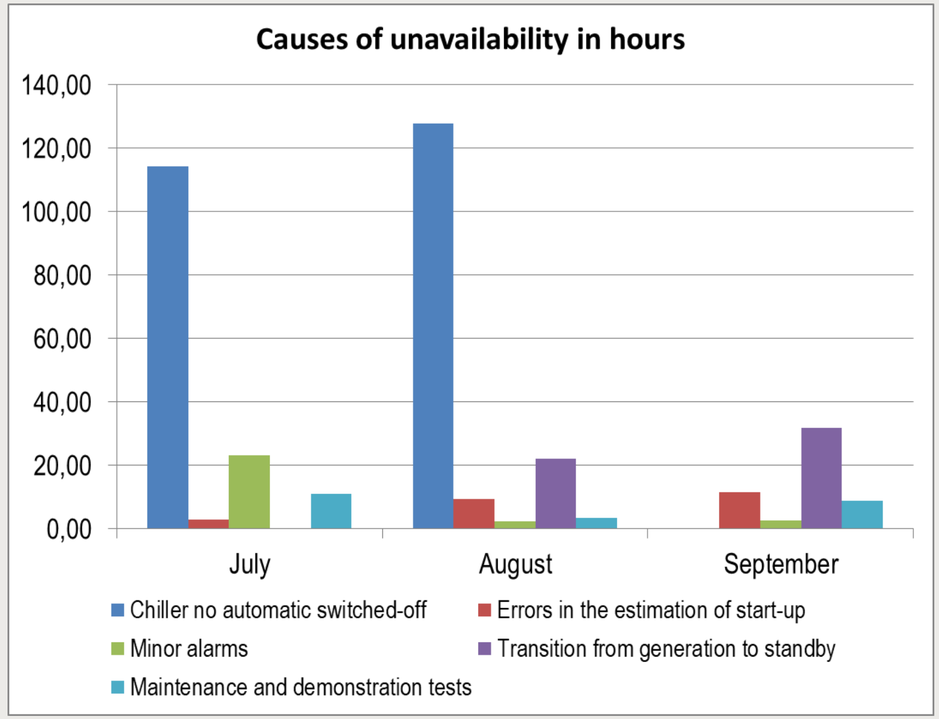
Project start: --

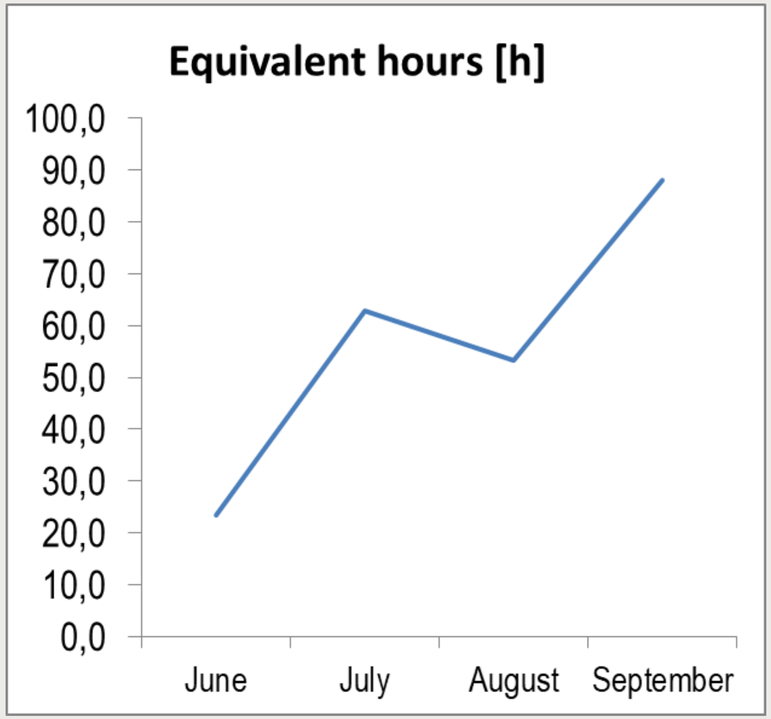
25% 50% 75%

Target: --

Main causes of unavailability

- Immaturity of control system
- Some components in manual operation
- Inaccurate start-up estimation
- Alarms due to off-grid control different from on-grid
- Others (maintenance, tests, …)





Risks and Challenges

Insufficient durability of thin membrane → thicker commercial was selected

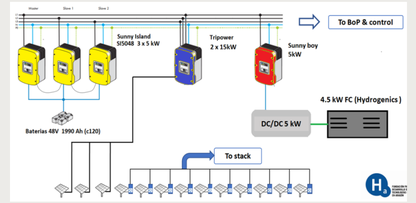
- 50 µm MEA and tested at 1 A/cm^2, 54ºC and 20 bar: 88,1% eff achieved but short circuits during tests after 765 h
- Commercial thicker membrane: 86% eff, degradation under 10 µV/hr and reversible

Fabrication & assembly delays → 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 → the intended one could not be tested

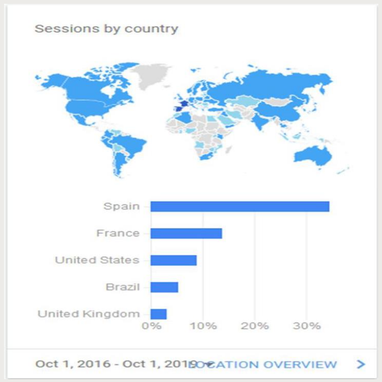
- DC, 3P AC, and 1P AC: the optimal solution is full conversion of PV to DC and then split
- Problems with commercial DC(low)/DC(high): finally 3 strings dedicated to BoP & storage



Demo period covered Spring & Summer → desirable extreme weather

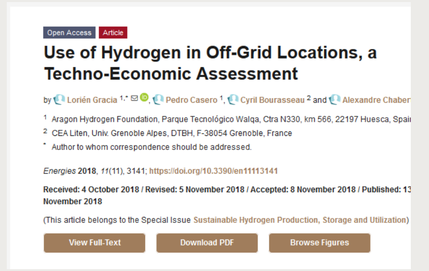
- The rest of the year is required to stress the system performance
- Fuel cell has not entered into operation during demo

Communications Activities



Communication and Dissemination

- **Participation to a Conference** — 13
- **Website** — 1
- **Press releases** — 21
- **Public Workshops organized** — 1
- **Graphic material** — 1
- **1** (YouTube)
- **Public deliverables** — 21
- **Publications** — 71
  - Scientific (4)
  - Divulgative (67)



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

FHa team in PRD2019

FUNDACIÓN PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGÍAS DEL HIDRÓGENO EN ARAGÓN

15 ANIVERSARIO FUNDACIÓN PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGÍAS DEL HIDRÓGENO EN ARAGÓN

100 CENTENARIO PARQUE NACIONAL DE ORDESA Y MONTE PERDIDO

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