



# PEMBeyond

**PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications**

**Grant Agreement no: 621218**

## **Deliverable 5.1**

### **Report on decision process between building or acquiring a PSA unit**

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<b>Deliverable title</b>	
Deliverable 5.1 Building or acquiring a PSA unit for hydrogen purification	
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<b>Summary</b>	
<p>The target specifications for the PSA unit were set at the kick-off meeting, held at VTT at M1. According to these specifications it was performed a market survey in order to assess the availability and price of such a PSA unit.</p> <p>Several companies were contacted but only IGS and HyGear presented a suitable PSA unit for the project application. The companies also presented a leasing option for the equipment. At the due date of the deliverable, negotiations between UPorto and HyGear were ongoing.</p> <p>HyGear presented a proposal within a protocol to be established with UPorto, after the end of the project. UPorto will use the PSA unit within the work plan of this project, until its conclusion on April 30, 2017. Possible improvements will be suggested, discussed and implemented within the collaboration with HyGear. At the end of the project the unit will be shipped to HyGear for testing the implemented modifications.</p> <p>The acquisition process takes more time than predicted since many documents needed to be translated and arranged defined in the Portuguese Law.</p> <p>The contract will be signed now.</p>	
<b>Confidentiality</b>	PU

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### 1. PSA specifications

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The PSA target specifications, defined at kick-off meeting of the project, are in the range of:

- Feed composition: 69 % H<sub>2</sub>, 25 % CO<sub>2</sub>, 5 % CH<sub>4</sub>, 1 % CO saturated in water and ethanol at 30 °C and 7 - 10 bar;
- Product flow rate: 1.5 Nm<sup>3</sup>/h, needed to supply a 5kWe PEMFC at 40 % load;
- Required product composition: > 95 % H<sub>2</sub> and < 50 ppm CO;
- Required recovery: > 75 %;
- Power: expected less than 300 W.

### 2. PSA market analysis

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Several companies were contacted and a quotation for a suitable PSA unit was received from two companies, IGS and HyGear. None of them presented an acceptable buying option for a PSA unit under the available budget. Both the companies presented also a leasing option but this solution is not possible, under the project task schedule, considering the UPorto accounting rules.

The quotations are detailed below:

- IGS
  - Buying option: specifications: product flowrate 2.5 Nm<sup>3</sup>/h, 80 % recovery and 98 % H<sub>2</sub> composition;
  - Leasing option: Does not present a financial advantage for UPorto, taking into account the change on the depreciation time from 7 years to 3.
- HyGear
  - Multiple options were discussed, including:
    - Leasing option: Leasing and sharing project results with HyGear
    - Buying option: Purchasing the PSA directly
  - As none of the above fitted the UPorto budget, a third option was proposed:
    - Buying with collaboration: Costs of the unit divided between HyGear and UPorto and in exchange a technical collaboration established between HyGear and UPorto.

The other companies that were contacted and did not send a reply were:

- Linde,
- BOC,
- Oxair and
- GasatSite

The other companies that were contacted and informed that do not have the requested product were:

- Air Products
- AtlasCopco
- Isolcell
- Mahler
- Oxymat
- Parker
- VerdeLCC

### 3. Decision

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This deliverable concerns the decision of acquire or build a PSA unit within the required specifications, based on the availability in the market of a suitable equipment at a reasonable price. Several companies were contacted and invited to present a quotation for the acquisition of such a unit. Despite several companies being contacted, only IGS and HyGear quoted a suitable PSA unit under the project specifications.

IGS referred not having a unit for the specified flow rate, and therefore quoted a unit for 2.5 Nm<sup>3</sup>/h, the minimum size possible. They also presented a leasing option but this option is not appealing in a financial point of view since the PSA must be fully amortized within the project duration, starting the depreciation upon arrival of the equipment at UPorto facilities.

HyGear quoted a PSA unit custom made for this project within 9 months delivery time. Since cost of the buying option is far higher than the available budget, a leasing option was also proposed. However, UPorto has never held a leasing contract before and this option is be very bureaucratic, therefore not possible under the project task schedule.

HyGear also proposed a buying option within a collaboration agreement for sharing the project results and to return the unit at the end of the project to implement the possible improvements. The contract with HyGear, in these conditions, will be signed now.